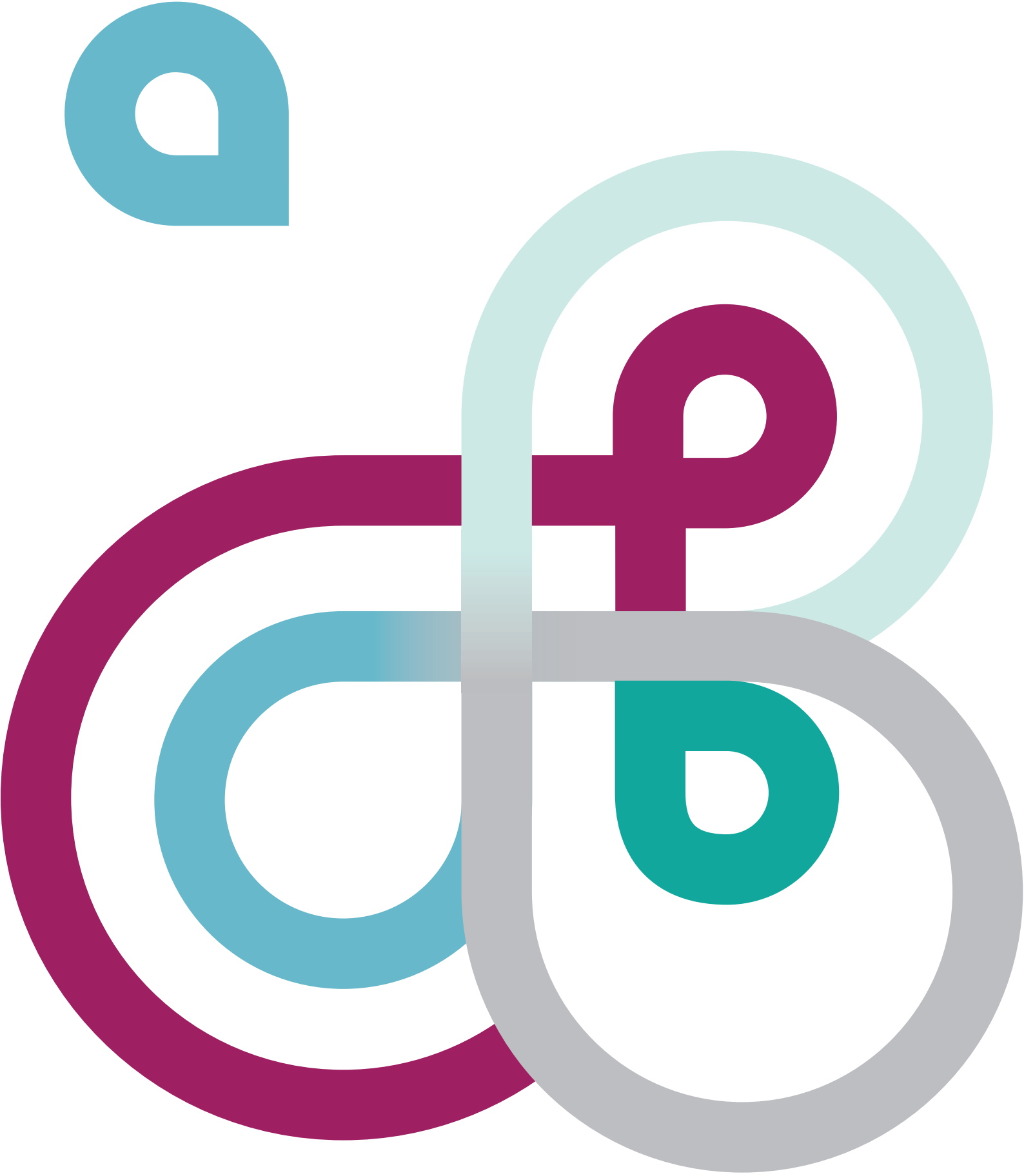

Advocacy and action in public health:
Lessons from Australia, 1901>2006

Australian Government
Department of Health and Ageing

PHIDU

THE UNIVERSITY OF ADELAIDE
AUSTRALIA

Advocacy and action in public health: lessons from Australia over the twentieth century

Su Gruszin
Diana Hetzel
John Glover

December 2012

Promoting a Healthy Australia

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Foreword

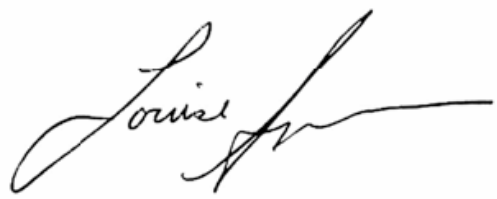
This review showcases Australia's achievements in public health over the last century. It was commissioned by the Australian Government Department of Health and Ageing in preparation for the challenges of the 21st century, particularly for expanded efforts in the field of preventive health in Australia.

Promoting a Healthy Australia is the first national agency solely focused on prevention, providing an increase in Australia's capacity for disease prevention and health promotion. The Agency is focused on the challenges associated with preventable chronic disease and is playing a key role in tackling risk factors and behaviours. Health Ministers have requested the Agency to focus initially on obesity, smoking and harmful alcohol consumption.

The health many of us enjoy today owes much to the successes of the past one hundred years: controlling communicable disease, assuring the safety of food and water, curbing risk behaviours like smoking and drink-driving – just some of the achievements highlighted in this review. However, the challenges to improving the population's health remain. The burden of disease posed by the health risks of obesity, harmful alcohol consumption, smoking, and social disadvantage, and the diseases of ageing are among those that contemporary public health must address. Yet the lessons of the past century can inform how we tackle existing and emerging problems. In particular, we have learnt that successful efforts have called for, and productively harnessed, the collaboration of quite diverse sections of government and community, working together with energy, imagination and commitment.

As highlighted throughout this report, effective preventive health interventions can save lives and prevent suffering and disability. Such interventions also limit demand on health services so these can be better focused on diseases that are not preventable. As our population ages and we focus on the increasing dominance of chronic disease, prevention has also become a first-order issue in preserving the economic potential of our workforce, and improving the quality of life of all members of our society, particularly Aboriginal peoples and Torres Strait Islanders, and others who are socially and economically disadvantaged.

We congratulate the Public Health Information Development Unit at The University of Adelaide for producing *Advocacy and action in public health* and commend the review to all who have an interest in learning how Australia manages the great challenge of public health. Promoting a Healthy Australia is pleased to publish this report as a reference and planning resource for the broader public health community.



LOUISE SYLVAN

CEO, Promoting a Healthy Australia

December 2012

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Preface

This project was funded under a grant from the Australian Government Department of Health and Ageing.

The report was commissioned by the Population Health Division of the Department, and auspiced by the National Public Health Information Working Group (subsequently the Population Health Information Development Group). An advisory group provided expert opinion to support the direction of the project (see Appendix A).

The aim was to publish a report on the successes of public health action, that is, those measures that contributed to improvements in the health of Australians over the twentieth century. The intention was to improve our understanding of what constitutes 'public health', to highlight its capabilities and to provide convincing evidence of the value of investing in public health.

Many areas where public health strategies have been successful were identified. It was only possible, however, to include an overview of a selection of topics in this report. The reviewed literature was broad and included relevant historical documents. However, it revealed few published evaluations that objectively measured the relative performance of successful public health interventions. Thus, in order to support the inclusion of certain topics, we asked public health experts across Australia for their views of the most successful public health interventions since 1901 (the experts are listed in Appendix B, the survey results in Appendix C and the survey questionnaire in Appendix D).

For some topics, there was so much information that only a fraction of it could be included; for other topics, there were gaps in, for example, historical time trend data, national data analyses or evidence of cost-effectiveness. For other strategies, it was apparent that the benefits had been limited, or effective for only some sections of the community.

This report, therefore, represents merely a 'snapshot' of the public health successes in Australia over the last century. It serves, however, to remind us of how far we have come, how such progress was achieved, and exactly what 'public health' represents, namely, the 'organised response by society to protect and promote health and to prevent illness, injury and disability'[1], in partnership with local communities and organisations.

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[1] National Public Health Partnership (NPHP), *Public health in Australia: the public health landscape: person, society, environment,* NPHP, Melbourne, 1998.

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The authors wish to thank the following people*:

- Members of the Project Advisory Group for their assistance and advice (Appendix A).
- Participants in the Public Health Successes Survey (Appendix B), many of whom made detailed comments and provided additional evidence of public health successes, and in particular, Coeli Geefhuysen for her editorial insight and assistance.
- Departmental officers in many areas of the Australian Government Department of Health and Ageing for their close review of earlier drafts, and especially Joy Eshpeter for initiating and Cora Shiroyama, Carolyn Dunn, Lucinda Glover, Michael Kortt, Diane du Toit and Meaghan O'Shannassy of the Population Health Division of the Department for supporting the project; and the Portfolio Strategies Division of the Department for a meticulous review of the data and data graphics.
- Numerous individuals in the following organisations for reviewing pertinent material: the Australian Breastfeeding Association; the Australian Bureau of Statistics; the Australian Institute of Health and Welfare; the Australian Safety and Compensation Council; the Cancer Council Australia, the Cancer Council Victoria, and SunSmart Victoria; the ETS and Children Project, NSW; the Family Planning Association NSW; Food Standards Australia New Zealand; the Heart Foundation; the National Coroners' Information System; the National Joint Replacement Registry; the National Stroke Foundation; QUIT WA and the WA Department of Health, and other people who preferred to remain anonymous.
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- Judith Raftery for her editorial review of the final draft of the report.

The following organisations are gratefully acknowledged for granting permission to use or reproduce their copyrighted data and/or charts:

- Australian Bureau of Statistics for permission to use ABS data from many different publications, as acknowledged in the source notes below the figures and tables;
- Australian Institute of Health and Welfare for making available many of the charts from their review: *Mortality over the twentieth century in Australia: trends and patterns in major causes of death* (AIHW, Canberra, 2006); others from diverse individual publications, as well as those of the National Injury Surveillance Unit. Source notes below the figures and tables reference the individual publications and data books;
- Australian Centre For Health Research;
- Australian Water Safety Council;
- Professor Margaret Burgess and the *NSW Public Health Bulletin*;
- Dr James Leigh and Assoc. Professor Tim Driscoll and the *International Journal of Occupational and Environmental Health*;
- Medicare Australia;
- National Institute of Clinical Studies;
- National Centre in HIV Epidemiology and Clinical Research;

- New South Wales Roads and Traffic Authority; and
- Queensland Injury Surveillance Unit.

The authors thank the many other people and organisations who have allowed the use of their previously published graphs, tables or other data in this report. In a number of cases, these were re-formatted to a common style for the purpose of publication, while retaining as much of the initial detail and style as possible.

The following individuals and organisations are also gratefully acknowledged for their permission to use copyrighted graphics:

- Noel Butlin Archives Centre at the Australian National University: 'Grim Reaper (AIDS) - Grey and white portrait'.
- National Prescribing Service Limited: 'Common colds need common sense not antibiotics' colour graphic.
- The ETS and Children Project: 'Car and home smoke free zone' colour graphic.
- Collection: Powerhouse Museum, Sydney: 'Sex in Life: Young Women' colour booklet cover.
- Australian Breastfeeding Association: 'Breastfeeding welcome here' colour graphic.
- Department of Agriculture, Fisheries and Forestry, 2006: 'Mixed fruit' colour photograph.
- State of Western Australia through its Department of Health: Go for 2 & 5® 'Pop a few extra fruit and vegies in your trolley' colour graphic; and 'Only dags need fags' colour graphic.
- Maggie Brady: 'The Grog Book' colour book cover.
- The Cancer Council Victoria: 'Slip! Slop! Slap! Sid the Seagull' colour graphic.

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Su Gruszin, Diana Hetzel and John Glover

*People have been identified by the titles and positions they held at the time of their contribution.

Overview

In 1910, Dr JHL (Howard) Cumpston, the first Commonwealth Director-General of Health, raised the 'rapidly developing science of public health' as a 'significant source of the power of the modern state' and identified 'the statesman's first duty as the promotion of the health of the people'.[5] He recognised that a healthier population can contribute much more to the wealth, productivity and welfare of a nation. Australia has become a first world country with a healthy population, enjoying long life expectancies and a generally good quality of life because important public health problems were successfully addressed over the course of the twentieth century. Many of these public health successes are celebrated in this report.

The 20th century was a period of great social, economic and scientific development in Australia. In the early part of the century, public health measures were largely environmentally focused, producing major reforms in sanitation, such as the installation of sewerage and safe drinking water systems, which led to marked declines in waterborne disease by the 1930s. The year 1908 saw the first federal public health legislation in Australia, the Commonwealth *Quarantine Act*, which played an early role in preventing the arrival and transmission of infectious diseases from other countries. Local, state, and federal government efforts reinforced a concept of collective 'public health' action. Improvements in general living conditions (e.g., less overcrowded housing and better nutrition) and in hygiene (e.g., public education about food handling and hand washing) also helped reduce the spread of infectious diseases.

Science and emerging technologies, such as the development of antimicrobial drugs and the timely implementation of mass immunisation programs, drove the second wave of improvements in public health. For example, a national program of diphtheria vaccinations for children was introduced in 1932, and penicillin was developed by Australian researcher, Howard Florey and his team in 1941. Many other improvements in medical treatment were made, and additional widespread immunisation programs introduced in the second half of the century.

These and other advances resulted in dramatic declines in newborn deaths and in deaths from infectious diseases, so that, by the end of the century, death rates were less than one third of what they had been in the early 1900s. As a result, life expectancy at birth for most citizens increased by more than 20 years, although not for Australia's Indigenous peoples – the broader determinants of their wellbeing still need to be effectively addressed.

Australia was an early adopter of innovative technologies, which made food safer and extended the supply of fresh food, among other improvements. Refrigeration was first used in Australian ships exporting fresh meat in 1897, and rapidly became widespread throughout the food industry and the community after World War II. Other new technologies, such as lead-free canning, reduced various hazards in preserving food. By the 1950s, state and local health departments had made substantial progress in foodborne disease prevention through food safety regulation and inspection. Pasteurisation of milk successfully prevented the spread of bovine tuberculosis. Food fortification technology was used from the 1960s when salt was first fortified with iodine, and subsequent measures, including bread flour fortification with thiamine from 1991 and folic acid fortifications of various foods from 1996, reduced preventable deficiency diseases and certain congenital malformations.

Better control and reduction of environmental poisons was achieved through the implementation of broad public health strategies, such as the removal of lead from petrol and paint, the closure of asbestos mines and nation-wide banning of asbestos and asbestos products. Urban air quality improved after the first *Clean Air Acts* in 1967. Fluoride in drinking water, which protects against dental disease, especially for children, was first introduced in Beaconsfield, Tasmania in 1953, and the water supplies of seven capital cities were fluoridated between 1964 and 1977.[234] Improvements in health and housing infrastructure in Indigenous communities halved the incidence of skin and eye infections as demonstrated by Nganampa Health Council's 'Healthy Living Practices' developed in 1987.[161]

Mothers and their infants were another early focus for public health activity in Australia. Large improvements in the safety of birthing and aftercare resulted from the prevention of sepsis and better training of birth attendants. Antenatal and postnatal care, family planning, parental education (especially of mothers), higher rates of breastfeeding initiation after mid-century lows, and the development of universal primary health services all contributed to improvements in the survival rates of infants and children. Australian public health researchers identified infant sleeping position as a preventable risk factor for Sudden Infant Death Syndrome, and strategies to reduce it were implemented using public education campaigns from 1990 onwards.

During the second half of the century, cardiovascular diseases and cancer became more prominent, due in part to the large reductions in infectious diseases. There was a rise, followed by a partial fall in two major afflictions: coronary heart disease and lung cancer. Behavioural risk factors associated with chronic diseases were identified, and concerted public health campaigns led to reductions in tobacco smoking and changes in social attitudes about smoking. Population screening for risk factors proved to be a successful approach to case-finding for certain cancers, offering opportunities for earlier clinical intervention and treatment. Cervical and breast cancer screening programs commenced in 1991, and screening for bowel cancer in 2006. Sun safety measures, refined in the years after the first sun protection campaign in 1981, proved their worth by reducing skin cancer.

Over the century, there were improvements in the working conditions of employees across a wide range of industries and occupations as the fields of occupational health and safety developed. The emphasis at the beginning of the century was on providing basic public health amenities such as toilets, ventilation and fire escapes in workplaces; and on placing limits to the hours and ages of employment of women and children. By the end of the century, workplaces were increasingly used as locations for public health programs to improve health, such as hearing screening, blood pressure monitoring, and screening for preventable genetic conditions. Although workplace hazards and injuries remain potentially significant causes of disability and related health problems, preventable exposures and injuries have been addressed in a number of areas.

Road safety interventions put in place from the 1970s, including national speed limits, mandatory seat belts, blood alcohol limits and breathalyser testing, led to reductions in the rate of motor vehicle fatalities that had been rising steeply, along with the popularity of motoring, since the 1950s. A barbiturate poisoning epidemic was arrested through the implementation of greater restrictions on the prescription and dispensing of barbiturates and other drugs in the 1960s. Other public health measures to reduce preventable injuries included improvements in domestic swimming pool fencing to prevent toddler drownings; in product safety (e.g., nursery furniture, playground equipment); and in information systems, such as that enabling coroners to identify national trends and help eliminate preventable hazards in the community. National gun law reforms, together with the firearms buyback of 1996, contributed to reductions in firearm deaths. National strategies were also developed to reduce the impact of suicide, HIV/AIDS and hepatitis C, and their associated risk factors.

During the 1980s, Australia endorsed the World Health Organization's Alma Ata principles, which emphasised the importance of primary health care, participative approaches to health promotion and illness prevention, and the appropriate use of technology.[6] Health policies were explicitly reshaped to focus on health promotion and the prevention of disease, disability and injury.

Towards the end of the century, there was greater community awareness of the state of the environment, shown in activities such as rubbish recycling schemes, the annual 'Clean up Australia' day and other community-led projects, with the public health sector playing an active role. The future health consequences of global climate change, however, required further effort from environmental and public health practitioners, as impacts in Australia were likely to include increases in heat- and flood-related deaths and injuries and the expansion of geographic areas susceptible to the transmission of tropical infections, such as dengue fever and malaria. Public health science will undoubtedly contribute to the development of knowledge about how best to address these changes as they emerge.

Over the 20th century in Australia, the role of the public health workforce widened considerably, from early action to improve sanitation and the control of infectious diseases such as typhus and plague, to highly sophisticated, multi-faceted programs to limit tobacco smoking within the population. Later, public health programs developed a social contract function, emphasising education and engagement with the community. Under this approach, a government's role was to monitor and warn the population through surveillance; to help prevent health problems through the search for underlying causes and remediating actions; and to minimise the harm and maximise the good arising from the management of health issues. Over time, this led to a sharper focus on equity issues in order to close the gap between the health of the most and least disadvantaged groups in the population. Governments were also concerned to balance the rights of the individual in relation to the state against situations where the rights of the community overrode those of an individual.

By the end of the 20th century, there was wider recognition of the importance of the period of early childhood for human development and health, with evidence from public health research emphasising the critical periods of infancy and early childhood in establishing a basis for health, learning and behaviour throughout life.[228] The cost-effectiveness of public health interventions during the first years of life had been demonstrated by evaluations of programs such as intensive, targeted home visiting and early childhood education. Despite this, more effort was needed to ensure that every child in Australia had the 'best start in life', especially those who were of Aboriginal and Torres Strait Islander origin.

At the start of the 21st century, Australia had a world-class system of health care financing and provision, whereby people were able to access publicly subsidised health care services, pharmaceuticals, and medical technologies, through a range of service and funding arrangements. These included government funding of public hospital and medical services; subsidised pharmaceutical products delivered through the Pharmaceutical Benefits Scheme; and medical devices (e.g., cardiac pacemakers, artificial hip joints) made available in hospitals following approval by the Medical Services Advisory Committee.

The public health practice of 'an organised response' to the protection and promotion of health and the prevention of illness, injury and disability in the population undoubtedly saved many lives during the 20th century. Development of a specialised public health workforce, conduct of public health research, and monitoring and surveying the population's health were essential elements. The establishment of an Aboriginal Community-Controlled Health sector, and an Indigenous public health workforce, developed over more than thirty years from 1971, meant that some of the fundamentals necessary to effect improvements in the health and wellbeing of Indigenous Australians were in place at the start of the 21st century.[656] However, much faster progress was needed.

Improvements in public health over the century lifted educational and labour force participation, especially for older workers; increased overall wellbeing, quality and enjoyment of life; and increased the numbers of people in education, the labour force, volunteering and grand-parenting by reducing the impacts of preventable illness, disability and injury.

Current public health activities draw upon a wide range of methods applied across many different settings including schools, homes, roads, workplaces and health care. In partnership with public health authorities, investment and activity by non-government organisations (NGOs), businesses and communities, and government sectors responsible for education, environment and housing among others, all contribute to improving the health of Australia's population. Modern public health, as recently described by Powles, has come to be 'science plus civic engagement'.[2]

This report aims to raise awareness of some of the successful public health programs that were implemented from 1901 to 2006 in Australia for the benefit of its population. The selection was informed by an extensive literature review, a survey of health experts, and other public health research. The programs that were chosen addressed significant health problems with identifiable improvement in the population's health. They were implemented on a national or universal scale and functioned at that scale for at least five years, and their impact was largely attributable to public health effort rather than to general rises in the prevailing social and economic conditions.

The continuing challenge of remedying inequalities in health across the population

Although there have been many achievements in improving public health in Australia over the last century, the problem of inequalities in health across the population continues to be a challenge. Premature mortality and rising levels of illness remain disproportionately concentrated among the most socioeconomically disadvantaged groups in our society, primarily Aboriginal and Torres Strait Islander Australians, especially those living in remote communities.

In reviewing improvements in health over the 20th century, the Australian Institute of Health and Welfare concluded that benefits had not been shared equally. Despite the large increases in Australian life expectancy by the year 2000, the life expectancies of Aboriginal and Torres Strait Islander peoples was at levels not experienced by the rest of the population since 1900.[3] Reducing these and other inequalities needs to be a priority for the 21st century, and public health programs that offer improvements in the health of Aboriginal and Torres Strait Islander peoples need to be consolidated and extended. The wider social and economic determinants of health also need to be better integrated into cost-effective public health programs.

Conclusion

The 20th century public health successes addressed problems that had a significant impact on the population's health. Public health interventions used a range of methods and many of the most successful were complex, multi-faceted and extensive, instituting concurrent public health action across different areas - for example, in legislation, fiscal incentives, social marketing, health promotion, and provision of public health services. This was as true of some earlier public health successes, such as tuberculosis control from the late 1940s, as of later examples, such as tobacco control from the 1970s.

In 1997, a National Health and Medical Research Council (NHMRC) review of infrastructure for promoting the health of Australians identified that the key elements of successful approaches were:

- strategic direction;
- technical expertise (including surveillance, research and evaluation);
- supportive structures for implementation; and
- sustained investment.[4]

The NHMRC review identified that the greatest improvements in health had been achieved with a sustained response that engaged many components of the health sector (e.g., hospitals, NGOs, universities and public health practitioners), non-health sectors, and, most importantly, the community.[4] While more remains to be done, much has been learned over the last century that can be applied by those charged with achieving public health successes in the hundred years to come.

A wealth of information is presented in this report with the aim of raising awareness of the many successful programs and strategies that made a measurable impact on the health of the Australian population over the period, 1901 to 2006. This report highlights the successful interventions that the public health sector has contributed to Australia's development as a nation since Federation, and offers a valuable resource to people tackling current and future public health challenges. The achievements of public health should be celebrated and stand as models for action to address population health challenges in the future.

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Introduction

'The health status of the Australian people has improved markedly over the last 150 years, the period in which modern public health was transplanted to, and matured, in that country.' – MJ Lewis, 2003.[1]

The 20th century was a period of great social, economic and scientific development in Australia. For the population's health, these developments brought better nutrition and living conditions from the start of the century, widespread immunisation and improvements in medical treatment in the second half, and a growing awareness in more recent times of the effect of socioeconomic and behavioural factors on health. A dramatic decline in perinatal mortality (newborn deaths) and deaths from infectious diseases resulted, with death rates less than one third of what they were in the early years of the century, and an improvement in life expectancy at birth of over 20 years. However, there was also a greater prominence of the chronic diseases (e.g., cardiovascular diseases and cancer). Furthermore, despite improvements in living conditions and in life expectancy for most people after 1901, some groups did not receive the full health benefit, especially Aboriginal and Torres Strait Islander populations, and other socioeconomically disadvantaged groups. This reinforces the fundamental importance of societal inequalities in relation to inequalities in the health of populations, and the continuing challenge in the 21st century to remedy such injustices.

'If you had been born in 1900, you could expect to live until the age of 52 if you were a man, 55 if you were a woman. But you could have died from diarrhoea or enteritis before you were five; one in 10 children did. You may never have known your mother – six women died in every one thousand live births. By the 1990s, it was 11 in every 100,000 confinements. If your father had not been killed in a work accident, or caught tuberculosis or pneumonia, he may have died from a heart attack. Today he is still likely to die of cardiovascular disease or cancer, especially if he was a smoker, but not until the age of 70. In the early 1900s, your brother might have died in a horse accident. By the 1970s, he was more likely to be killed in a car crash, and by the end of the century, it was suicide that was claiming many young male lives.'

– F Beddie, 2001.[318]

The contribution of public health interventions and actions to improving the population's health is apparent throughout this review, although their impacts are not always easily proven or attributable as such. This is partly because data have not survived or formal evaluations were never undertaken, especially for early public health programs. It is also because many of the factors that determine the health of a population lie outside the immediate control of the public health sector, and encompass factors such as socioeconomic status, genetic inheritance, culture, and one's level of education. These external factors impinge on many of the interventions examined in this report, and where possible, limitations in the success of public health programs have been identified.

Defining 'Public health'

'Public health' has been defined in many ways over the past one hundred years. In 1910, the first Commonwealth Director-General of Health, Dr JHL (Howard) Cumpston, raised the 'rapidly developing science of public health' as a 'significant source of the power of the modern state' and identified 'the statesman's first duty as the promotion of the health of the people'.[5]

As the public health historian Lewis observed in 2003, 'public health' can refer to both:

(1) the 'professional knowledge and practices, social institutions, and public policy devoted to the advancement of the collective health'; and

(2) the 'actual state of health of the people', or the 'health status of the population as a whole'.[1]

Over the century, many government-led programs and practitioner and citizen-based movements were initiated to promote health and to prevent disease at a population level in Australia. These progressed at the same time as many international programs, such as food assistance, agricultural

development, malaria eradication and so forth, were set up to improve the health of people in other countries.

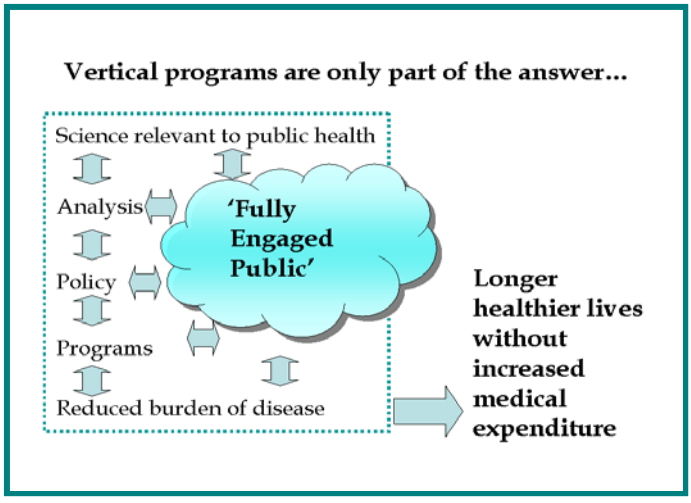
Under the aegis of the World Health Organization (WHO), a number of significant public health charters set the direction for efforts to improve the population's health:

- the *Declaration of Alma Ata* (1978), which emphasised the importance of primary health care, participative approaches to health promotion and illness prevention, and the appropriate use of technology;
- *Health for All*, which set ambitious targets to achieve 'Health for All by the Year 2000' (1981); and
- the *Ottawa Charter for Health Promotion* (1986), which identified the principal health promotion activities and delineated five action areas for governments – building healthy public policy; creating supportive environments; strengthening community action; developing personal skills; and reorienting health services towards health promotion.[6,7,8]

> ***Primary health care:***
>
> *... includes at least: education concerning prevailing health problems and the methods of preventing and controlling them; promotion of food supply and proper nutrition; an adequate supply of safe water and basic sanitation; maternal and child health care, including family planning; immunization against the major infectious diseases; prevention and control of locally endemic diseases; appropriate treatment of common diseases and injuries; and provision of essential drugs;*
>
> *involves, in addition to the health sector, all related sectors and aspects of national and community development, in particular agriculture, animal husbandry, food, industry, education, housing, public works, communications and other sectors; and demands the coordinated efforts of all those sectors …*
>
> – *Declaration of Alma-Ata*, 1978 [part only].

During the 1980s, Australia endorsed the *Alma Ata* principles, and restructured a number of its health policies towards health promotion and the prevention of disease, disability and injury. Other parts of the health sector were also influenced: the safety and quality movement in acute care; population-focused investment and policy initiatives; the 'health outcomes' methodology; and a population approach to the 'care continuum' including prevention. Research and evidence-based practice contributed to public health analysis. Later, the emphasis shifted towards the ideal of an active partnership with all citizens, with engagement, participation and persuasion used far more widely than the strategies of legal coercion and regulation.[5] This is reflected in the description of modern public health as 'science plus civic engagement' (depicted in Figure 1).[2]

Figure 1: Public engagement and public health



Source: Powles, *Public engagement and public health*, 2003.

In this report, the National Public Health Partnership's definition of 'public health' has been used:

'the organised response by society to protect and promote health and to prevent illness, injury and disability; the starting point for identifying public health issues, problems and priorities, and for designing and implementing interventions, is the population as a whole, or population sub-groups.'[9]

Principles and methods of public health

'Public health' is a public or common good, and its execution rests on a set of principles that inform and guide public health action. Visions or long-term goals are commonly framed as 'Better health for all through effective public health action to maintain, protect and promote health'.[10]

A set of principles of public health is shown in Box 1.[11] The first principle, of 'population focus', sets out the aim of improving the overall health of the whole community. It is sometimes described as 'the principle of the aggregate' because public health activity is directed towards the population, or a specific population subgroup, rather than the health of an individual.[12] A focus on the population is warranted, as the entire community benefits from clean water and air, safe food, immunisation, drug regulation, and the health of individuals remains at risk if those factors impinging on populations are left unattended.

The principle of 'prevention, promotion and early intervention' describes a key difference between public health and clinical medicine. Clinical medicine is aimed primarily at the treatment of individuals. Although prevention is part of many clinicians' activities, the major focus of public health is on the prevention of disease, disability and injury before there is a need for clinical intervention. 'Early intervention' describes public health activities aimed at deferring the onset of a disease or condition, its progression or complications, as well as screening activities that enable early diagnosis and intervention (e.g., organised cancer screening).

Box 1 Five principles of public health

Population focus

■ Aims to improve the overall health of the community.

Focus on prevention, promotion, and early intervention

■ Tackles the things that can add years to life and quality life to years.

Work in partnership

■ Works with local communities, sharing information and acknowledging their concerns; and

■ Works with other agencies to influence the things that affect health but are not strictly 'core business' for the health sector (for example, collaborations with the police on anti-violence programs).

Reduce health inequalities

■ Works to reduce the differences in health between sections of the community.

Effective and sustainable action

■ Uses the best scientific information about approaches – what works and what doesn't; and

■ Uses the best mix of approaches to get the best value for investment.

– NPHP, 2002; citing NSW Health, *Healthy People 2005: new directions for public health in NSW*, 2000.[11]

The public health principle of operating in partnership with communities, and with a wide range of agencies that include government departments (in addition to health), such as transport (for road safety), urban planning (for healthy environments), education (for health literacy in schools), is important. Local government also has carriage of many public health monitoring activities, from inspection of food premises to immunisation. There are numerous non-government organisations (NGOs), such as the Heart Foundation, the National Stroke Foundation, and the Cancer Council Australia, and health foundations (e.g., the Victorian Health Promotion Foundation) that are active partners in public health practice. In fact, without these partnerships, the achievements in public health over the last century would not have been possible.

The principle of 'reducing health inequalities' describes public health work in ameliorating the preventable differences in health between groups in society. These may relate to differences in the distribution of resources, for example, or in access to health care or in the determinants of health. Some variations in the health of communities are unavoidable and arise from differences in genetic inheritance, age, sex and so on. Others, however, can be avoided or minimised through action to address the underlying causes or risks.

Lastly, the principle of 'taking effective and sustainable action' relies on good science, accurate information, and evidence of what works, and uses a mix of approaches to get the best value for any investment made. Hence, many public health programs are complex and multi-faceted, as they aim to address issues on a number of fronts simultaneously. Examples include:

- social marketing to raise awareness and inform the community (e.g., media messages regarding sun protection);
- legislation to enable public health practitioners to act (e.g., quarantine) or to regulate public behaviour (e.g., drink driving laws);
- encouraging participation in health-promoting activities (e.g., city fun runs);
- education to improve population health literacy (e.g., in schools and in the media); and
- the subsidising of products and services (e.g., many pharmaceuticals, immunisation).

In the early part of the 20th century, public health measures in Australia were mainly environmentally focused, and produced major reforms in areas such as sewerage and safe drinking water systems. Later, public health programs developed a social contract function, emphasising education and engagement with the community, with government's role being to monitor and warn (surveillance), to prevent (search for underlying causes), to minimise harm, and to maximise good. By the end of the century, there was a sharper focus on equity issues (closing the gap between the health of the most and least disadvantaged groups in the population) and on balancing rights (the rights of the individual in relation to the state, and the situations when the rights of the community must override those of an individual).

By the start of the 21st century, public health activities drew upon a wide range of methods applied across different settings (such as schools, homes, workplaces, the media and health care). Activities and investments by the non-health sectors of government (such as education, housing and transport), NGOs and communities, all contributed to the improvement of the population's health, in partnership with public health authorities (Figure 2).[13]

Figure 2: Public health methods

Advocacy and lobbying	Immunisation	Research and evaluation
Communicable disease control	Infection control	Road safety
Community action	Legislation and regulation	Screening to detect disease/risk factors
Community development	Lifestyle advice	Social action
Counselling	Management of biological risk	Social marketing
Diagnosis	Monitoring and surveillance	Training and workforce development
Directed investment	Occupational health and safety assessment	Treatment
Environmental monitoring	Personal skills development	Urban planning
Epidemiologic methods	Political action	Vector control
Exercise of capabilities	Public policy development	Waste management
Food safety	Radiation safety	Other methods of intervention
Health education	Remediation of environment	
Health impact assessment		

Source: Gruszin et al., *Public Health Classifications Project, Phase one: final report*, 2006.

Determining the proportion of improved life expectancy and health attributable to successful public health action

Increasingly, research shows that health is the product of many different factors.[14] Those that have the most important effects are known as 'the key determinants of health'; and include individual characteristics, such as the genes that we inherit from our parents, and aspects of our own beliefs, behaviours and coping abilities. Other significant influences operate in families, neighbourhoods, communities, culture or kinship groups, and across society as a whole. As many of the health determinants overlap, it can be difficult to ascertain the exact contribution of each factor, and the ways in which they influence our health as a population. Thus, while the health of the population

improved significantly over the 20th century, it is difficult to assess how much of that improvement was due solely to public health knowledge and practices, rather than to concurrent changes in living conditions and in the wider determinants of health.[15]

Most researchers, however, credit public health improvements in lifespan to the success of the following elements: improved nutrition; safe, clean water and adequate sanitation; control of infections through vaccination, safer food, and hygiene practices; and other broad public health developments.[16] In Australia, those groups in our population that did not enjoy these public health amenities did not increase their life expectancy to the same degree – for example, Aboriginal and Torres Strait Islander peoples.

Over the century, there were other significant changes in society that, although not the direct result of public health interventions, had beneficial effects on the population's health. These included:

- modernisation, the establishment of a basic wage and welfare safety nets, and a rise in living standards with increasing prosperity;
- controlled fertility and smaller family size;
- changes in agricultural practices and transport leading to better quality food and wider distribution of perishables;
- higher education levels and rising health literacy; and
- access to improved medical treatments and health care services for individuals.

Furthermore, from the time of Federation in 1901, the influence of democratic government for the growing population and the enfranchising, as citizens, of groups such as women, migrants, and the Indigenous population, were all steps towards a healthier population. In the latter third of the century, the negative impacts of social exclusion and racism on health were acknowledged, and further measures put in place to reduce discrimination and increase opportunity for disadvantaged groups within Australia.[17-19]

The relative economic security and stability that Australia enjoyed over the century also had a positive effect on health.[20,21] Education and the involvement of the scientifically informed media produced a more health literate population. The role of general education and the consequent rise in health knowledge of mothers had a profound impact on child nutrition, and was credited as the most significant factor in improving infant and child health.[22] With the emergence of the 'wellness revolution', there was a stronger move towards preserving health and preventing illness.[23] Advances in public health knowledge, practices, institutions and policies, and changes in the socioeconomic determinants of health also contributed to the achievements over the 20th century.

The National Health Performance Framework

In measuring the success of public health programs nationally, the National Health Performance Framework is a useful reference point (Figure 3).[24] The framework is a nationally agreed structure for reporting on the performance of all levels of the health system, including the area of public health, and consists of three tiers. The first, **Health status and outcomes**, has four dimensions: health conditions, human function, life expectancy, and deaths. Many public health successes can be measured directly by these outcomes.

The second tier, **Determinants of health**, has five dimensions: environmental factors, socioeconomic factors, community capacity, health behaviours, and person-related factors. Numerous public health interventions over the last hundred years are also represented within this tier.

Figure 3: The National Health Performance Framework

Health status and outcomes		
Health conditions	*Life expectancy and wellbeing*	
Human function	*Deaths*	
Determinants of health		
Environmental factors	*Health behaviours*	
Socioeconomic factors	*Person-related factors*	
Community capacity		
Health system performance		
Effective	*Appropriate*	*Efficient*
Responsive	*Accessible*	*Safe*
Continuous	*Capable*	*Sustainable*

Source: National Health Performance Committee, *National health performance framework report*, 2001.

The third tier, **Health system performance**, is grouped into nine attributes: effective, appropriate, efficient, responsive, accessible, safe, continuous, capable and sustainable. These are useful when considering the 'organised' system of public health and its effects on other systems more widely.

Throughout this report, the domains of the National Health Performance Framework serve as a reminder of the significant public health contribution to the improvement in the health of Australians over the 20th century. Within each major chapter, there are a number of specific examples of programs which highlight the scope of public health intervention. The list only represents programs that were underpinned by relatively robust evidence of their success, as well as those cited most often by surveyed experts.

The chapter titles are:

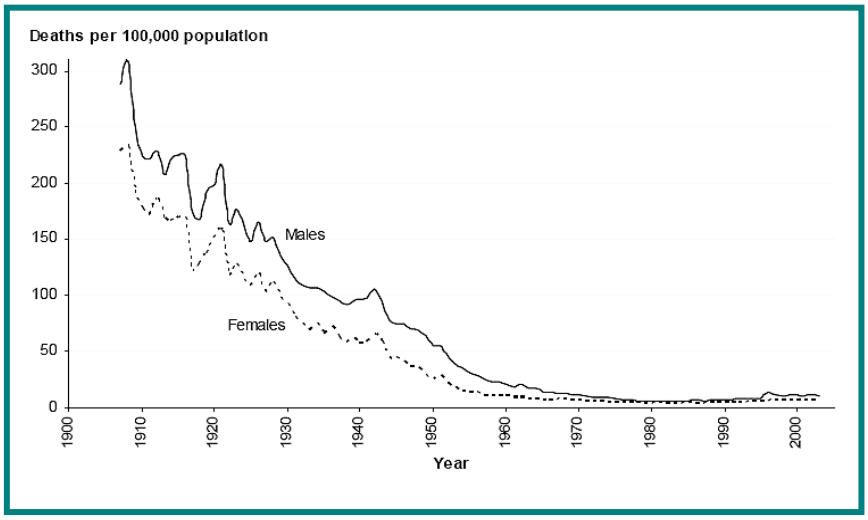
1. Control of infectious diseases;
2. Maintaining a safe environment;
3. Improved maternal, infant and child health;
4. Better food and nutrition;
5. Preventing injury;
6. Reducing risk factors and chronic diseases;
7. Improving health and safety at work;
8. Universal access to health care, pharmaceuticals and technology; and
9. Improving public health practice.

The report provides an historical overview of the public health actions taken to address the many population health issues that arose over the last century. These successful interventions also led to a more integrated and collaborative 'modern public health' approach taken by the numerous stakeholders and partners who continue to work in public health arenas today.

1 Control of Infectious diseases: 1901 onwards

The decline in deaths from infectious diseases in Australia over the 20th century was substantial – and was reflected in the sharp drop in infant and child mortality and a more than twenty-year increase in life expectancy at birth.[3,25] Public health practices and policies did much to contribute to this achievement. In the early 1900s, infectious diseases were a major cause of death, with tuberculosis and sexually transmissible diseases being the commonest causes.[26] One in ten children died from diarrhoeal disease, or enteritis, before they were five years old. However, from 1907 to 1980, the annual death rate for all ages from infectious diseases fell from about 250 per 100,000 population, to about 5 per 100,000 population. The rate then rose slightly, to around 9 per 100,000 in the year 2000, with increases in deaths from septicaemia, HIV/AIDS and hepatitis.[25] The falls in these death rates for males and females are shown below (Figure 1.1).

Figure 1.1: Dramatic decline in death rates for infectious diseases, 1907-2003



Source: AIHW, *Mortality over the twentieth century in Australia,* 2006, p. 36.

Influenza was also responsible for many deaths during the 20th century, with the greatest number occurring during the 1918-19 pandemic, when approximately 12,000 Australians died in less than a year, from a population of 4.9 million (Box 1.1).[3]

During the 1970s and 1980s, new viral infections were described, including hepatitis B and C and the human papilloma viruses. HIV infection, first identified in 1981, caused a global pandemic, resulting in millions of deaths worldwide over the subsequent two decades.

In the early years of the 21st century, the appearance of 'avian flu' and SARS (Severe Acute Respiratory Syndrome) attracted worldwide attention, with the fear that some viruses might mutate to allow human-to-human transmission. These episodes illustrated the unpredictability of disease outbreaks and new infective agents. They also underscored the importance of disease prevention and ongoing monitoring of the factors that facilitated the emergence or re-emergence of infectious diseases.[27]

Box 1.1 Influenza, from 1918-19

The arrival of the great influenza pandemic in Australia was delayed until early 1919, because strict quarantine measures were adopted, despite some controversy over their appropriateness. A late epidemic occurred with a less virulent organism, but the pandemic still caused many deaths. Its impact is clearly evident in the 'spike' of deaths in Figure 1.1.

There were other significant influenza epidemics, such as the one that occurred in 1956-57.

Influenza pandemics and epidemics were controlled by a range of measures, including quarantine and population movement restrictions; public health campaigns against transmission by coughing and sneezing; and vaccination programs to curtail or constrain influenza in vulnerable populations (Sub-section 1.3.2).

Public health practices

In the 20th century, public health actions to control 'contagion' were underpinned by the earlier discovery in the 19th century of micro-organisms as the cause of many infectious diseases (e.g., cholera and tuberculosis). Success in controlling infectious diseases resulted from improvements in:

- sanitation, hygiene and general living conditions (including less overcrowded housing and better nutrition) (Section 1.1);
- specific communicable disease control and surveillance measures (Section 1.2);
- the implementation of mass immunisation programs, starting with smallpox (Section 1.3); and
- improved clinical procedures (such as operative sterilisation techniques) which reduced the transmission between individuals, and antimicrobial drugs (Section 1.4).

Scientific and technologic advances played a major role in each of these areas and became the foundation for modern public health disease surveillance and control. Monitoring of notified infectious diseases allowed their spread to be tracked and responses initiated to contain them.

Successful public health measures to control infectious diseases used both universal approaches and the targeting of high-risk population sub-groups. Over the century, strategies became progressively more national in focus and in implementation, and were assisted by advocates and strong leadership, national policies and plans and enabling legislation (see below).

Table 1.1: Historic highlights of successful infectious disease control

1908	Commonwealth *Quarantine Act* passed – the first federal public health legislation.
1930s-40s	Marked declines in waterborne disease as a result of improvements in sanitation and drinking water treatment.
1932	Diphtheria vaccinations for children introduced as a national program.
1941	Penicillin developed by Australian researcher, Howard Florey and his team in the UK.
1942	Mass vaccination with pertussis vaccine commenced.
1947	Discovery of streptomycin as an effective treatment for tuberculosis.
1948-	Tuberculosis Screening and Treatment Program initiated and conducted until 1975.
1951	Australian WHO Collaborating Centre for Reference and Research on Influenza established at the (then) Commonwealth Serum Laboratories.
1956	Mass vaccination with inactivated polio vaccine commenced.
1963	WHO guidelines on drinking water quality released.
1966	Oral poliomyelitis vaccine became freely available.
1970-71	Measles vaccine became freely available, and School-girl rubella vaccination program started.
1972	National Health and Medical Research Council (NHMRC) issued guidelines on drinking water quality in Australian capital cities, based on WHO guidelines.
1980	Global eradication of smallpox as a result of pioneering work by Australian microbiologist, Frank Fenner.
1982	First Australian case of HIV/AIDS diagnosed.
1983	Australia certified malaria-free by the WHO.
1987	'Grim Reaper' HIV/AIDS media campaign launched.
1989	First National HIV/AIDS Strategy published. Communicable Diseases Control Network established (became the Communicable Diseases Network Australia [CDNA] in 2001). MMR (Measles-Mumps-Rubella) vaccine released for all infants at 12 months.
1992	National Water Quality Management Strategy launched.
1993	NHMRC recommended a National Immunisation Strategy. National Hib vaccination program initiated.
1995	Outbreak of *E. coli* associated with contaminated mettwurst consumption in SA – the national food authority asked to reform existing food hygiene standards. The Cooperative Research Centre for Water Quality and Treatment (CRCWQ&T) established.
1996	Australian Childhood Immunisation Register (ACIR) established.
1999	National Influenza Vaccine Program for Older Australians commenced (publicly-funded vaccine).
2000	Australia declared polio-free. Hepatitis B universal infant vaccine became available. National food safety standards developed. Establishment of OzFoodNet to ensure national collaboration with state and territory health authorities investigating foodborne disease.
2003	High-risk food industry sectors required to implement food safety programs based on Hazard Analysis and Critical Control Point methods.
2004	Further NHMRC *Australian drinking water guidelines* issued, incorporating a framework for the management of drinking water quality.
2005	National Pneumococcal Vaccination Program for Older Australians commenced. Varicella vaccine became available for children. NHMRC guidelines for managing recreational water released.
2006	*National guidelines for water recycling* (1st phase) issued – focus on treated sewage & greywater.

1.1 Sanitation and hygiene

During the 19th century, the growth in population that followed industrialisation and immigration led to urban overcrowding, with poor quality housing serviced by inadequate water supplies and waste-disposal systems. This resulted in repeated outbreaks of cholera, dysentery, tuberculosis, typhoid fever, influenza, plague and smallpox in many of Australia's capital cities.[3]

However, the incidence of these diseases began to decline with the introduction of public health measures, such as publicly-financed water and sewerage schemes, improved sanitation and better housing; and these improvements continued well into the 20th century.[3,28] Local, state, and federal government efforts reinforced the concept of collective 'public health' action. Control of animals and other pests also contributed to reductions in infectious diseases.

Quarantine played an early role in preventing the arrival and transmission of human infectious diseases. In 1900, an outbreak of bubonic plague in Sydney was the trigger for the first federal quarantine activity. An Australian medical researcher, Ashburton Thompson, was in charge of the measures taken to combat it, and became the first person to establish the connection between rats, fleas and the spread of plague to humans.[29]

By the end of the century, quarantine remained important in preventing the transmission of diseases, which might have had detrimental effects on the Australian economy. Control through quarantine at the point of entry to Australia was effected under the Commonwealth *Quarantine Act 1908* and covered animals, plants and humans. It was administered by the Australian Quarantine and Inspection Service, which had the emergency power to override any state-specific quarantine controls.[30]

> ***Survey respondent:*** *'Safe drinking water and improved sanitation in the early decades of the 20th century [were public health successes], especially for their impact on infant mortality… the evidence shows that infant mortality fell drastically during the early decades of the century and that this was substantially due to the more sanitary living conditions that mothers and babies experienced. This impact on infant health and infectious disease was greater than any subsequent public health measures including various medical interventions (vaccination, antibiotics) available later in the century. This also related to urban planning which in the early decades of the century placed importance on good ventilation, space, reducing overcrowding etc. and more orderly growth of towns, planning which also had implications for better sanitation and water supply infrastructure.'*

From the 1930s to the 1950s, state and local health departments made substantial progress in disease prevention activities, including sewage disposal, water treatment, food safety (Sub-section 1.1.2), and public education about hygienic practices (e.g., food handling and hand washing).

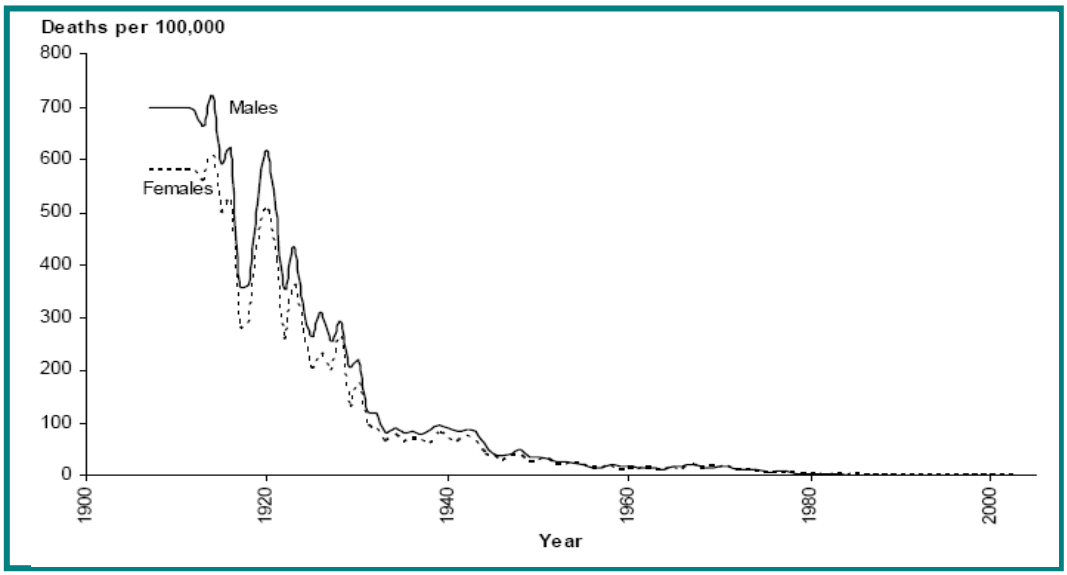
1.1.1 Clean water

1901 onwards

> *'The treatment and disinfection of drinking water has dramatically lowered the incidence of waterborne disease outbreaks since the early part of this century.' – Productivity Commission, 2000.*[32]

The provision of safe drinking and recreational water was a significant public health achievement in the 20th century. As improvements in drinking water treatment and sanitation were implemented, major reductions in waterborne diseases occurred, and deaths from diarrhoeal diseases declined rapidly over the first half of the century, especially in children aged 0-4 years (Figure 1.2).

Figure 1.2: Decline in death rates from diarrhoea, males and females, 0-4 years, 1907-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 48.

In 1907, diarrhoeal disease was the third leading cause of death for both males and females, and was responsible for more than seven per cent of all deaths.[13] The impact on young children was particularly severe, with diarrhoea the cause of around one quarter of all deaths of infants aged under 12 months.[25] By the year 2000, diarrhoeal deaths were less than one per 100,000 children, a very substantial fall from a rate of more than 600 deaths per 100,000 children in 1907 (Figure 1.2).[13]

The first colonial Act in Australia was passed in 1850 in Sydney, with the aim of 'sewerage, cleansing, and draining… to promote the health of the inhabitants'.[5] In 1875, the Sydney Sewerage Board reported that 4,700 of the city's 5,400 'water closets' (toilets) were polluting the drinking water mains with sewage. Protection of water supplies from sewage pollution was one of Australia's earliest public health measures, and an underground sewerage system for Sydney was completed in 1889. Similar construction in other Australian cities followed.

> *'By the early twentieth century, better protection of water supplies from sewage pollution and simple but effective methods of water treatment (chlorination, sand filtration) had greatly reduced rates of waterborne disease... Since then, scientists and engineers have been developing ways of processing water more quickly, more effectively, in a more controlled way and at lower cost.'*
> *– Cooperative Research Centre for Water Quality and Treatment, 2003.*[31]

Chlorination was introduced in the 1930s and 1940s throughout the developed world, when it became evident that filtration and disinfection with chlorine were key factors in preventing outbreaks of cholera and typhoid fever.[31] From then on, a range of water treatment methods was developed and implemented. Coagulation, flocculation, sedimentation and filtration together or in combination, were the most widely used technologies from early in the 20th century.[31] Coagulants (such as alum) helped particles separate out as sediment, effectively removing almost all the bacteria and viruses from water supplies. Filtration removed smaller particles, using sand, gravel or charcoal filters or newer synthetic materials, and later, microfiltration using membranes was used.[31]

By the end of the century, the public health system that provided clean, safe drinking water to the population comprised many different elements. The delivery of safe drinking water was the responsibility of state and territory governments. Government health and water resource departments were authorised to regulate and monitor standards for drinking water quality, although responsibility for other components of the system rested with water corporations, storage facilities, water catchment and environmental protection agencies, and others. While national guidelines for water quality standards had been developed, differences in standard setting, regulation and quality of water delivered were still apparent across the country in 2000.[32]

The first World Health Organization (WHO) *Guidelines on drinking water quality* were released in 1963. In 1972, a set of guidelines for drinking water quality in Australian capital cities was issued in line with the WHO *Guidelines*.[32] Quality standards for drinking water were then regularly updated. The 1980 revision of the guidelines (published jointly by the NHMRC and the Australian Water Resources Council) was considered a landmark in water quality management, as it was the first time that the various water supply and health authorities had worked together to produce a single guideline document for Australia.[33] There were subsequent revisions of the national *Australian drinking water guidelines* (in 1987, 1996 and 2004) for water supply 'from catchment to tap'.[34]

> *'A major contributing factor to the high standard of living across most of urban Australia [was] the quality of town water supplies.'*
>
> – W Maher et al., *Drinking water quality*, 1997.[745]

A National Water Quality Management Strategy (NWQMS) was launched in 1992 to coordinate the management of water resources as part of sustainable development,[35] and was included in the Council of Australian Governments (COAG) Water Reform Framework from 1994.[36] The Cooperative Research Centre for Water Quality and Treatment (CRCWQ&T) was established in 1995 as the principal research and development agency for drinking water quality in Australia.

In 1998, there were a number of *Cryptosporidium* water contamination incidents in Sydney, although people did not fall ill as a result (Box 1.2). While the contamination was at levels below the standard for drinking water, these incidents nevertheless raised public concern.[37] A water sector study by the Productivity Commission in 2000 compared regulatory processes for the development and enforcement of drinking water quality standards against accepted best practice, and found a 'diversity of approaches to developing, promulgating and enforcing standards' with considerable scope for improvement.[32]

Box 1.2 Water quality and *Cryptosporidium*

In July 1998, routine water testing identified *Cryptosporidium* oocysts and *Giardia* cysts at high levels in treated Sydney drinking water. In the absence of evidence-based guidelines for public health action, and in light of overseas reports of major outbreaks of disease linked with contaminated municipal water systems, NSW Health responded by issuing a series of 'boil-water' alerts. These lasted intermittently until mid-September of that year.

Sydney residents had opportunities for exposure to *Cryptosporidium* and *Giardia* in drinking water before the boil-water alerts were issued, and compliance with the alerts was far from complete. However, enhanced surveillance through laboratories, general practitioners, emergency departments, pharmacies and nursing homes, as well as the usual notification system, did not reveal any increases in diarrhoeal illness in the Sydney area.

Laboratory reports of giardiasis increased slightly, as did isolation of other gastrointestinal pathogens that were unrelated to drinking water. This suggested that the results were probably due to increased testing, and identification of background cases unrelated to Sydney water. Positive outcomes of the crisis included the development of protocols for the issuing of future boil-water alerts and information to consumers, health care facilities, manufacturers and others on reducing the risk of cryptosporidiosis.

However, many questions remained unanswered about factors affecting the viability, infectivity and pathogenicity of *Cryptosporidium* and *Giardia* in water, and additional research was needed.

Source: Public Health Division, *The health of the people of New South Wales – Report of the Chief Health Officer*, NSW Department of Health, Sydney, 2002 [adapted].

For example, cost-benefit analysis was rarely used in the development of standards, and there was an 'absence of rigorous regulatory assessment' and a lack of information on drinking water quality and accompanying risk levels across Australia.[32] There were also divided responsibilities for water regulation, and limited transparency and accountability. The review was timely, as many urban water sectors in Australia were facing potentially large investments in treatment technologies in order to meet increasingly stringent water quality standards.

By 2000, an estimated $400 million a year was being spent on water treatment and it was acknowledged that higher standards of water safety would increase treatment costs.[32] Comparison with other countries suggested that insufficient resources were being dedicated to drinking water standards' activity in Australia, and changes to institutional structures and regulatory processes were necessary.[32]

Public health regulators then worked with industry to develop a risk management framework for managing safe drinking water supplies. This was the principal focus of the *Australian Drinking Water Guidelines* released in 2004.[33] That year, as part of the National Water Initiative, a process for public consultation to finalise the draft NWQMS guidelines on water recycling was also agreed. Two draft documents were available for comment in 2006, and the Phase One guidelines were endorsed by the Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the Australian Health Ministers' Conference.[38] The guidelines provided a national reference for the supply, use and regulation of recycled water schemes with a focus on treated sewage effluent and greywater.[39] Phase Two of the guideline development focused on stormwater reuse, managed aquifer recharge and recycled water for drinking.

The quality of recreational water was regulated by state, territory and local governments, safeguarding water for activities such as swimming, surfing and boating. This was to prevent gastroenteritis, respiratory illness, and eye, ear-nose-throat and skin infections, which were associated with recreational exposure to contaminated beach water.[40] In 2005, the NHMRC issued *Guidelines for managing risks in recreational water*, which revised existing guidelines to aid the development of standards and legislation to manage safe, recreational water environments.[41]

Public health practices

The major reductions in waterborne diseases, which occurred from the early 1900s as improvements in drinking water treatment and sanitation were implemented, illustrated the potential for universal public health measures to make a major contribution to the population's health. By the end of the century, the public health standard was for safe drinking water to be delivered into the home for most people in the majority of communities in Australia.

A preventive approach was essential to assure the quality of drinking water. Drinking water had to meet appropriate standards for microbiological, chemical and radiological contaminants, and for physical characteristics (e.g., odour, taste and clarity) as determined by the NMHRC guidelines. These incorporated world standards set by the WHO. Water quality was monitored and tested to ensure compliance and that measures were in place to contain any breakdown in quality that might emerge.

In Australia, as in other developed countries, the scope and precision of drinking water guidelines and standards became more comprehensive as public health knowledge, community awareness and the demand for high quality water increased.[32] Standards for recreational water were also developed. The public health principle of prevention was systematised through the incorporation of a risk management approach, a useful preliminary for cost-benefit analyses of further public health investments in water treatment.

Factors critical to success

Successful public health measures to control infectious waterborne diseases were based on universal approaches, such as separating all sewage from drinking water and sewering all urban developments. Public health analyses of risk and of the level of precautions that should be communicated to the population after events when the risk of infection had been increased temporarily, were tailored to address those groups most at-risk.[42] Over the century, the public health strategies and guidelines that were developed became progressively more national in focus, while their implementation remained at the level of government closest to the local population. State, territory and local government legislation and regulation also contributed to the success of clean water initiatives.

Safe drinking water strategies successfully established standards, guidelines and model provisions for the diverse agencies that were responsible for providing drinking water to the population. Their contribution to public health should not be under-estimated. Goslin, for instance, noted the 'invisibility of public health' when it was working well – in relation to safe water, food and products – as one explanation for why public health interventions were 'politically and publicly under-appreciated'.[43]

The provision of safe drinking water and of methods to ensure safe recreational water, made a measurable improvement in the health of the population. Water is essential for life and ensuring its safety for drinking and recreation remained a significant focus for public health activity.

Future challenges

By the end of the 20th century, the delivery of quality-assured, safe drinking water to all Australian communities was still to be achieved. For communities not connected to mains water supply, some provision for the supply of safe drinking water was essential. This could be groundwater, stored rainwater or a combination of both. For many small communities in remote parts of Australia, however, the provision of an adequate supply of water was an ongoing challenge. Many of these were Indigenous communities. Information from the 2001 Community Housing and Infrastructure Needs Survey (CHINS) revealed that nearly half (98 of the 213 Indigenous communities with a population of 50 or more) were not connected to a town water supply, and water quality had failed testing or was not tested in the year previous to the survey.[44]

Future strategies generally included the delivery of recycled water that was safe for drinking. Growing populations and greater urban density were also increasing the risk of exposure to pharmaceuticals in drinking water. Both surface and ground waters can be contaminated by effluent discharge; and stable compounds are not affected by advanced filtration technologies and can re-appear in drinking water. Environmental monitoring and toxicological testing for the commoner pharmaceuticals were suggested as priorities.[45] Other chemicals remained a problem, including pesticides, but there were methods to remove these. Evaluating the likely public health benefits and capital costs of investments to upgrade water protection and treatment systems to meet the requirements of more stringent drinking water guidelines and standards remained an issue.[32]

> ***Survey respondent:*** *'The majority of Australians have access to drinkable water however some of the highest risk groups (e.g., remote Indigenous groups) still don't have this.'*

As well as the priority of delivering safe, clean drinking water to all Australian communities, other challenges included:

- establishing standards for water recycling - becoming increasingly important as a result of population growth and long-term changes in climate;
- maintaining the protection of existing water supplies and catchment areas to human and environmental health; and
- introducing water fluoridation in Queensland and to additional, mostly larger regional communities (Box 3.1).[46]

1.1.2 Food safety

1901 onwards

At the beginning of the 20th century, food was a common route for the transmission of infectious diseases. Foodborne diseases occurred as a result of bacteria (e.g., *Salmonella*, *Campylobacter*), parasites (e.g., *Cryptosporidium)*, toxins (e.g., from *Staphylococcus aureus*), and viruses (e.g., noroviruses, hepatitis A), with bacterial causes being the commonest.[47,48] Foodborne disease outbreaks were more likely to

originate in the home and to be limited in scope. Typical sources included family meals and home-preserved goods. Towards the end of the century, foodborne diseases were more likely to be contracted outside the home (as more people bought pre-prepared food and ate out more often), or as a result of travelling to another country. By then, most foodborne infections were of relatively short duration, although some occasionally led to more serious, even chronic consequences, as well as death.

Much foodborne disease was avoidable. Early public health legislation, such as the *Victorian Public Health Act 1854*, provided for Local Boards of Health to inspect places used for the 'sale of butchers' meat, poultry or fish, or as a slaughter house', and to seize and destroy any food that was unfit for human consumption.[5] Initially, control of food under Health Acts focused on issues of cleanliness (e.g., in slaughterhouses and the disposal of putrefying food) and adulteration (e.g., the watering down of milk), with a later emphasis on the purity of food, to ensure that consumers received full value for their money.

By the 1950s, state and local health departments had made substantial progress in foodborne disease prevention, including food safety inspection and public education about hygienic food storage and handling practices. The advent of refrigeration and its gradual spread throughout the food industry and the community, improved food safety and the ability to store nutritious foods, such as milk and meat for longer periods (see Sub-section 4.1 and Box 4). Pasteurisation of milk successfully prevented the spread of bovine tuberculosis (TB).

A major reform of food safety in Australia followed a high-profile outbreak of foodborne illness in South Australia in 1995, caused by the contamination of mettwurst with *Escherichia coli* (*E. coli* O111). One child died, 23 children were hospitalised with Haemolytic Uraemic Syndrome (HUS) (five suffered ongoing illness), and a further 150 people developed other health-related conditions.[49] The outbreak highlighted a number of risks in the manufacture and regulation of certain meat products.

In July 1995, Health Ministers asked the (then) Australia New Zealand Food Authority (ANZFA) to reform existing State and Territory food hygiene standards which had become out-dated and inconsistent.[50] As a result, Australia had uniform national food safety standards from 2000. Further reform occurred in 2003, when the Australia and New Zealand Food Standards' Council agreed that four high-risk food industry sectors should be required to implement Food Safety Programs based on the principles of HACCP (Hazard Analysis and Critical Control Points).[51] This was a systematic preventive approach to food safety, to identify potential food safety hazards so that key actions (known as Critical Control Points) could be taken to reduce or eliminate them.

Both food codes and standards changed as a direct result of the contaminated mettwurst outbreak in SA. Scientific testing methods and food safety monitoring systems also improved. The meat industry invested significantly in quality assurance and HACCP programs to ensure the safety of their food products and regain customer confidence after a number of food contamination incidents.[49]

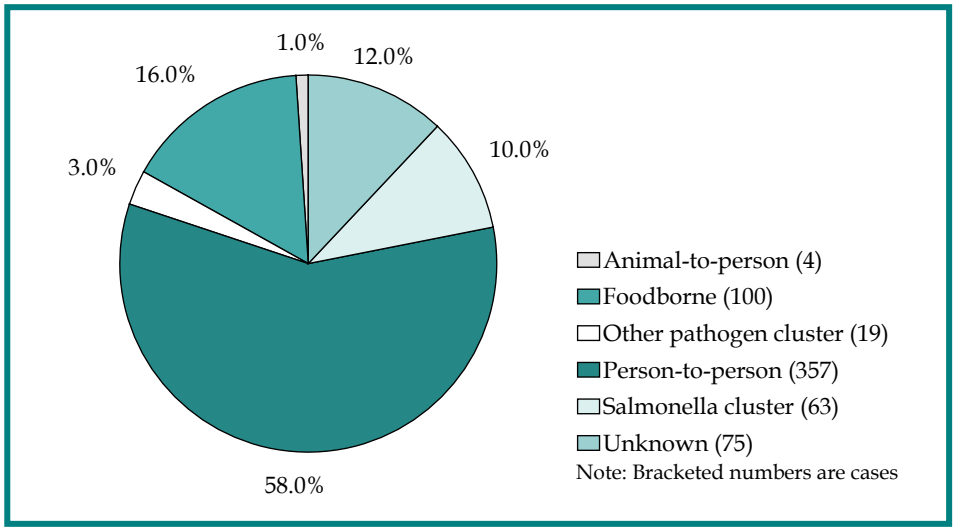
Surveillance at selected monitoring sites, established in 2000 by the Australian Government, identified 624 outbreaks of gastrointestinal illness affecting 10,865 persons during 2005 (Figure 1.3).[52,53] Consumption of contaminated food and/or water was the suspected cause of 102 of these outbreaks (giving an overall rate of 5.0 foodborne outbreaks per 1,000,000 population). The 102 outbreaks affected 1,975 people. Four of these people died and 166 were hospitalised. Restaurants, domestic kitchens, professionally catered events, and aged care homes were the usual settings involved in outbreaks, with *Salmonella* the most common agent of foodborne infection.[54]

Much illness caused by foodborne disease went unreported, and the total health impact was therefore difficult to calculate. Data from the National Gastroenteritis Survey 2001-02 were used to estimate that at least 5.4 million cases of gastroenteritis in Australia each year originated from contaminated food (32% of the estimated total of 17.2 million gastroenteritis cases in Australia annually, and an incidence of 0.29 cases per person per year, or one episode per person every three to four years).[55]

Foodborne gastroenteritis was estimated to result annually in approximately:

- 1.2 million doctor visits;
- 300,000 antibiotic prescriptions;
- 15,000 hospitalisations; and
- 2.1 million lost work-days.

Figure 1.3: Suspected mode of transmission of gastroenteritis outbreaks, 2005 (624 outbreaks)



Source: OzFoodNet Working Group, *Communicable Diseases Intelligence,* vol. 30, 2006, p. 287.

Furthermore, there were an estimated 42,000 subsequent episodes of conditions resulting from acute gastroenteritis (including 21,000 episodes of reactive arthritis, and 20,200 episodes of irritable bowel syndrome). Containing foodborne diseases and ensuring food safety remained important public health activities.

Public health practices

National, state, territory and local governments, and the food industry, all had responsibilities for maintaining and improving the safety of food in Australia, and for ensuring the effectiveness of food regulation. With the focus on prevention, public health professionals played important roles in preventing foodborne disease (e.g., through local government public health inspection of restaurants and other places where food was prepared and sold) and in investigating and responding to foodborne disease outbreaks when they occurred (Box 1.3).[56]

Diseases that were potentially foodborne (such as campylobacteriosis, HUS, cryptosporidiosis, hepatitis A, listeriosis, salmonellosis, shigellosis, and typhoid) were required by law to be notified by doctors and pathology laboratories to state and territory health authorities, which reported them to the National Notifiable Diseases Surveillance System. Government public health units initiated investigations in order to contain outbreaks quickly, prevent further spread, and monitor interventions.

The OzFoodNet network was established in 2000 by the Australian government to ensure national collaboration and coordination with state and territory health authorities in the investigation of foodborne disease, and to improve the understanding and evidence base of causes in the community in order to reduce food poisoning.[52] OzFoodNet monitoring sites reported regularly on outbreaks of gastrointestinal and other foodborne illness, people affected (including deaths and hospitalisations), suspected modes of transmission, common settings and infectious agents (e.g., *Salmonella*).[53]

A review of foodborne disease outbreaks from 1995 to 2000 supported the direction of public health activities in moving to risk-based food safety interventions, focusing on mass catering, hospitals, and aged-care facilities.[57] It found that outbreaks in aged-care and hospital facilities were associated with 35% of the 20 deaths attributed to foodborne illness during the period. These data showed the importance of continuing to improve public health measures to ensure food safety and contain foodborne disease especially among vulnerable population groups, such as the elderly and the chronically ill.

Box 1.3 Outbreak response case study: an outbreak of Hepatitis A

By June 30 [1997], 23 cases of hepatitis A linked to attendance at a popular restaurant (Restaurant A) had been notified to [a regional] Public Health Unit [PHU]. Of the cases, 11 (48%) were females with ages ranging from seven to 48 years. All cases reported the onset of jaundice from June 2. Nineteen cases reported eating at the restaurant on Mother's Day (May 11), and four reported eating there on the following Sunday. PHU staff inspected restaurant A on June 12. Blood was taken from all 20 food handler employees identified by the proprietor as working on Mother's Day, and all tested negative for recent hepatitis A infection.

On June 18, the Health Department issued a warning through the media advising that patrons who had attended the restaurant since May 1 may be at risk of hepatitis A, and those patrons who developed any symptoms of illness should contact their medical practitioner. The restaurant voluntarily closed until the source of infection was identified.

A case-control study was conducted [on] 22 cases and 72 diners who had eaten at the restaurant on Mother's Day identified from Restaurant A's reservation list. Preliminary analysis showed that all cases, but only 53 (74%) controls, reported eating prawns at the restaurant. Cases reported consumption of no other common food items.

The prawns served at Restaurant A in June were traced to a batch of imported frozen fresh-water prawns. In response to the epidemiological and food inspection findings, the importer voluntarily recalled the remaining prawns from the distributors and Restaurant A was allowed to reopen for business.

Source: 'Hepatitis A outbreak linked to a Sydney restaurant', *NSW Public Health Bulletin* 1997, vol. 8, no. 6-7, p. 51 [adapted].

Factors critical to success

Successful public health measures to control foodborne diseases and improve food safety used universal preventive approaches across the population. Early in the century, critical action was taken in regard to issues of cleanliness and hygiene, eliminating, where possible, the disease pathways as they were identified (e.g., pasteurising milk to prevent the spread of TB). Public education, from early hygiene classes taught at schools to health promotion activities such as pre-Christmas radio warnings about how to cook turkeys safely, also played a part. The Australian community as a whole became better informed about safe food preparation and handling practices by the end of the 20th century, although there was room for further improvement.

Over the century, strategies were progressively more national in focus and in implementation, assisted by national legislation and regulation systems, in combination with surveillance and monitoring. The development of local public health units into a sophisticated rapid response system that reported, shared and responded to critical information to contain outbreaks when they occurred, also contributed to success in this area.

After the contaminated mettwurst outbreak in SA in 1995, food codes, standards, scientific testing methods and food safety monitoring systems were improved and became more effective.[58] Development of robust monitoring and reporting mechanisms was increasingly applied nationally (e.g., OzFoodNet) as well as the requirement to notify cases of foodborne diseases. There was ongoing work on information systems to: support the practical application of HACCP; improve rapid

dissemination of information on foodborne disease outbreaks using websites and commentary from multiple sources; build active surveillance networks that could share, for instance, molecular information between public health agencies; and provide online educational packages to food industry personnel.[59,60]

The food safety system that developed was national in scope, with participation from all states and territories, as well as from stakeholders from government (e.g., public health units, pathology reference laboratories, and local government inspectorates), private industry (e.g., food manufacturers, restaurants) and the agricultural sector. Developments in food science, microbiology and epidemiology also contributed to improvements in food safety, as well as guidelines to assist high risk businesses implement comprehensive food safety programs. There was success in eliminating a number of avenues of infection, although food safety remained a matter for public health vigilance and action.

Cost-effectiveness

Although much foodborne disease went unreported, foodborne disease was reported to cost as much as $1.25 billion annually in Australia.[61] Productivity and lifestyle costs were estimated at $772 million (62% of the total), followed by the cost of premature mortality ($232 million).[61] Health care service costs were quantified at $222 million, with the majority being attributed to emergency care, general practitioner and specialist services. Gastroenteritis accounted for an estimated $811 million annually (81% of the productivity, lifestyle and premature mortality costs) while another seven foodborne illnesses were prominent cost contributors, including listeriosis and reactive arthritis.

There was evidence that the benefit to the community of the food safety system that was in place outweighed the cost of foodborne disease prevention, surveillance, and outbreak responses. Large, uncontained outbreaks had the potential to be expensive to control and to lead to significant business losses through reduced consumer confidence (e.g., compared to the economic costs to the beef industries in various overseas countries arising from 'Mad Cow Disease'[62]). In Australia, the actual direct cost (to health authorities and industry) of the contaminated mettwurst outbreak in SA in 1995 was estimated at $20 million (in 2000) and continuing to rise. ANZFA calculated a $400 million cost to Australian industry from the decline in trade attributable to the 1995 mettwurst outbreak, together with a subsequent *Salmonella* outbreak in 1997.[50]

The National Risk Validation Project identified high-risk food businesses that were consistently associated with foodborne disease outbreaks, and analysed the benefits and costs of implementing HACCP food safety programs in these sectors. Food businesses or sectors ranked as high-risk are shown in Table 1.2, together with the per meal costs of illnesses caused by foodborne diseases, and the benefits from implementing food safety programs, thereby preventing food-related disease.[49]

The Project found that the aggregated costs associated with foodborne illness in Australia were in excess of $1.67 billion a year. Costs per industry ranged from $75 million to $540 million per year, but it was the cost of foodborne illness per meal consumed that highlighted the very high costs associated with raw, ready-to-eat seafood (at $4.87 per meal compared to $0.49 for general catering). The most conservative benefit to cost ratios were assessed as ranging from 6.5 to 115.9 for the four highest risk sectors: seafood, catering, processed meat, and food service to vulnerable populations such as those in hospitals and aged-care facilities. The findings demonstrated that the benefits of implementing and operating food safety programs far outweighed the costs of doing so for most high-risk food industries, and reinforced the conclusion that 'the community would be better off as a result of mandatory food safety programs'.[63]

Table 1.2: Costs of foodborne illness and benefit-cost ratios for high-risk food industries

High-risk food industries	Cost of foodborne illness per meal ($)	Benefit-cost ratios	
		Class 1 outbreaks	Class 1 & 2 outbreaks
1. Food service for sensitive populations	0.21	6.5	6.8
2. Producers, harvesters, processors and vendors of raw ready-to-eat seafood	4.87	25.8	25.8
3. Catering operations serving food to the general population	0.49	9.9	10.4
4. Eating establishments	0.06	0.8	0.9
5. Producers of manufactured and fermented meats	0.39	115.9	165.6

Note: Class 1 outbreaks assume that the cause of illness would have been detected and remedied by measures put in place under a food safety program; Class 2 outbreaks assume there is insufficient information to estimate likely effectiveness.

Source: Food Science Australia & Minter Ellison Consulting, *The National Risk Validation Project*, 2002, p. 8.

Future challenges

By the end of the century, three areas of food safety that required further attention were:

- the impact of global climate change;
- improving food safety and quality in remote Indigenous communities and for other vulnerable populations; and
- the impact of population ageing.

As the incidence of bacterial foodborne diseases increased during summer months, and was greater in the warmer northern regions of Australia, the expectation that average temperatures would continue to rise as a consequence of global warming meant that it was likely that rates of foodborne diseases would also rise.[55,64-66] In addition, infectious diseases (e.g., salmonellosis, cholera, and giardiasis) were known to thrive in the after-effects of environmental disasters. As extreme weather events (e.g., floods, storms, cyclones) were expected to become more frequent as a result of climate change, an increase in waterborne diseases was also identified as a potential threat, 'especially in impoverished areas'.[67]

A lack of infrastructure such as all-weather roads and reliable electricity supply in many remote communities meant that the transport, storage, refrigeration, and preparation of the fresh foods that were essential for good health could be compromised. These factors directly affected the health and wellbeing of those who lived in these areas of Australia, most of whom were Aboriginal and Torres Strait Islander peoples; and were reflected in the very high rates of severe gastroenteritis and malnourishment seen in children from these communities.[68,69] The challenge was to provide all Australian communities with the infrastructure to support the provision of safe, nutritious food.

Australia's population was ageing and foodborne disease was known to affect vulnerable populations, including the elderly, more severely than others. Thus, the effects of foodborne illness were likely to be more widely distributed in the future.

1.2 Screening and infectious disease surveillance

1901 onwards

The 20th century saw the development of a wide range of technological advances in detecting and monitoring infectious diseases, which contributed to the achievements of public health in controlling them. Towards the middle of the century, the incidence of tuberculosis (TB) declined as improvements in housing continued to reduce crowding, and the national tuberculosis control program of free chest x-ray screening was initiated in 1948 in an effort to find cases early and treat them (Sub-section 1.2.1).

Public health strategies to detect and manage sexually transmissible infections included confidential clinics, notifiability and contact tracing, and were extended to education campaigns in schools and social marketing about safe sexual practices. As a result, there were reductions in syphilis and other sexually transmissible infections (e.g., gonococcal infections). Congenital syphilis was almost eradicated.

There were major improvements in both state-based and national surveillance of infectious diseases through mandatory notification and other alert and control systems, and advance planning for epidemics, such as avian (bird) flu. The control of epidemics was the role of state and territory communicable disease control units, which undertook contract tracing and outbreak investigation. Control of animal sources of infection (e.g., bovine tuberculosis, brucellosis in domestic animals) was also an important preventive activity. Screening of blood donations removed a potential cause of inadvertent human-to-human transmission of many infectious bloodborne agents.

Some diseases, such as leprosy, malaria and dengue, were far more prevalent in northern parts of Australia, and their control and treatment remained a challenge. Sanatorium treatment, essentially isolation of infectious cases, remained a possible public health intervention for the treatment and containment of drug-resistant strains of diseases (e.g., multi-drug-resistant tuberculosis). Diseases that arose over the 20th century, such as HIV/AIDS, presented new challenges in their prevention, treatment and control (Sub-section 1.2.2). Screening and treatment for *Chlamydia* infection in young women gained in significance, and it was the most frequently notified infectious disease in 2004 (there were 41,311 diagnoses in 2005, a four-fold increase over the previous ten years), with untreated *Chlamydia* becoming a significant cause of infertility.[70] *Chlamydia*, gonorrhoea, syphilis and hepatitis C were all commoner in Aboriginal and Torres Strait Islander peoples, and the incidence rates of *Chlamydia* and gonorrhoea increased considerably between 1994 and 2004 in these groups.

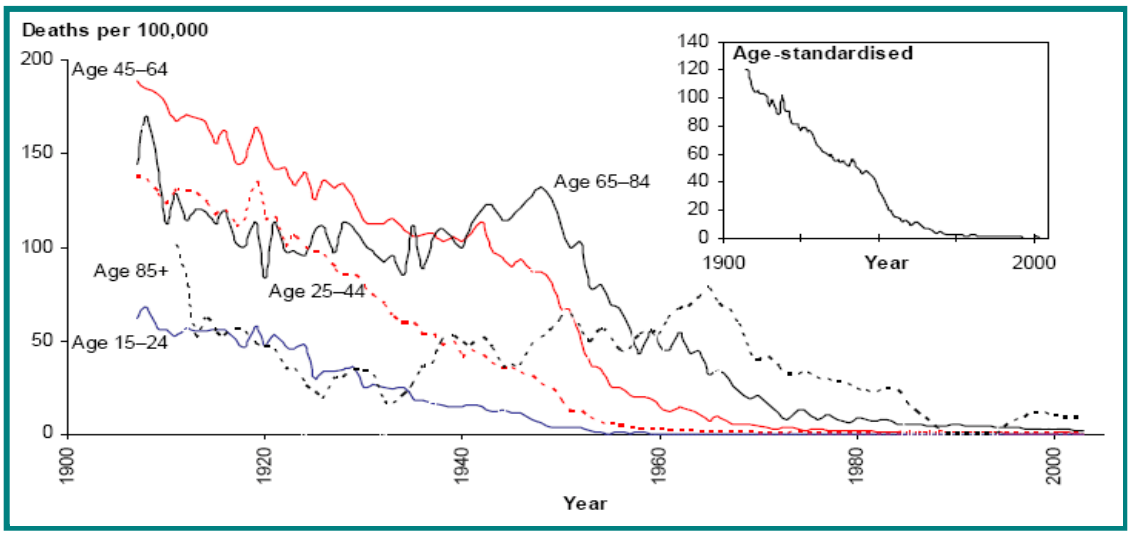
The following sub-sections focus on two successful public health activities, Tuberculosis control (Sub-section 1.2.1) and the HIV/AIDS Strategy (Sub-section 1.2.2).

1.2.1 Tuberculosis control

1948 onwards

At the beginning of the 20th century, tuberculosis (TB) was the leading cause of death among females, and the second largest cause of death among males. In 1907, death rates were 121.0 per 100,000 population for males (Figure 1.4), and 93.0 per 100,000 population for females (Figure 1.5).

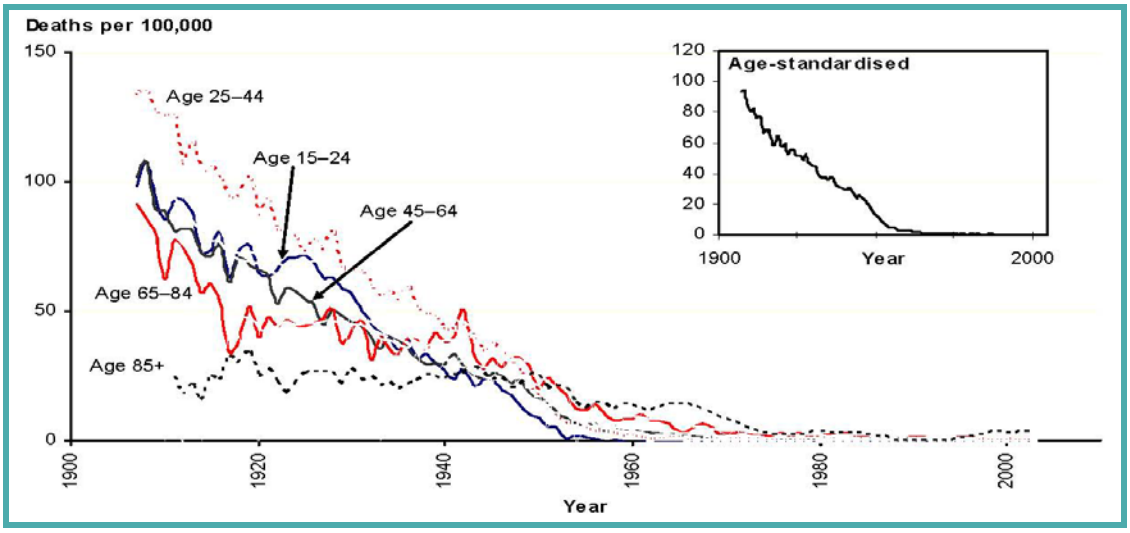
Figure 1.4: Age-specific and age-standardised death rates for TB, males, 1907-2003



Note: The rates shown for the 85 year or over age group are five-year moving averages; thus, this smoothing process is unlikely to show the correct rate for any particular year.

Source: AIHW, *Mortality over the twentieth century in Australia,* 2006, p. 52; data: AIHW GRIM Books.

Figure 1.5: Age-specific and age-standardised death rates for TB, females, 1907-2003



Note: The rates shown for the 85 year or over age group are five-year moving averages; thus, this smoothing process is unlikely to show the correct rate for any particular year.

Source: AIHW, *Mortality over the twentieth century in Australia,* 2006, p. 52; data: AIHW, GRIM Books.

Among those aged 45-64 years, TB was responsible for almost 180 deaths per 100,000 males and 89 deaths per 100,000 females. For males in the 64-84 year age group, the death rate in 1910 was 112 per 100,000 population and for females, the rate was 62 per 100,000. The death rate for males and females aged 25-44 was around 125 per 100,000 population. By the 1980s, deaths from TB had been 'virtually eliminated' in Australia, and by 2000, there was less than one death per 100,000 population.[25] At the end of the century, Australia had one of the lowest rates of TB infection in the world. The substantial decline in the death rate from TB was attributed to improved socioeconomic circumstances; better living conditions, especially less overcrowding; TB sanatoria (establishments for the isolation, treatment and convalescence of people with TB); effective treatment with antibiotics; and the success of the post-World War II National TB Campaign that included immunisation and mass chest X-ray screening.[25]

TB was a disease that was stigmatising and much feared by the population. The discovery of streptomycin in 1944 meant that an effective treatment was available from about 1947 onwards, and allowed a program of population screening and treatment to begin. It included the establishment of mass chest X-ray screening using miniature radiography, effective containment and treatment of active cases in sanatoria, and the implementation of a universal BCG (bacillus Calmette-Guérin) tuberculosis vaccination strategy.

By the end of the century, states and territories were responsible for providing and managing TB services in Australia and for continuing the close working relationship between public health units, laboratories (including TB reference laboratories), clinicians and TB treatment services.[71] The federal government monitored the incidence and prevalence of TB nationally using information from state and territory health authorities and laboratory services.[71]

Public health practices

The public health principles that were applied to the control of TB included a focus on the whole population, and a strategy that was multi-faceted with prevention, diagnosis and treatment elements. The universal approach worked to reduce differences in health between segments of society, although there were some areas that required further attention. The actions were effective, based on scientific evidence and skilled logistical support, and used a mix of approaches to address all areas of risk.

From 1991, the National Notifiable Diseases Surveillance System (NNDSS) collated national data on notified cases of TB reported to State and Territory public health authorities. The Australian Tuberculosis Reporting Scheme, run by the Australian Mycobacterium Reference Laboratory Network,

reported cases of bacteriologically confirmed TB and drug resistance from 1994. Reports on TB notifications were published annually in Australia's *Communicable Diseases Intelligence*.[72] Australia implemented the WHO recommended five-point strategy (1993) known as Directly Observed Treatments – Short Course (DOTS) for TB control, with appropriate modifications for a low incidence, industrialised country.

In 1999, the Communicable Diseases Network Australia (CDNA), concerned about difficulties that had arisen in TB control in other industrialised nations, and a perceived decline in TB expertise within Australia, formed the National Tuberculosis Advisory Committee (NTAC) with representation from the Commonwealth, and all state and territory governments:

- to provide strategic, expert advice to CDNA on a coordinated, national and international approach to TB control; and
- to develop and review nationally agreed plans for the control of TB in Australia.[71]

The resulting National Tuberculosis Control Program required all levels of government to work together to ensure that Australia continued to enjoy one of the lowest rates of TB infection in the world. Key strategies of the Program included:

- active and passive case finding for early diagnosis of TB through clinical and laboratory services;
- prompt, effective free treatment of people with active TB in supervised programs; and
- timely surveillance and national reporting of TB incidence, drug resistance, and treatment outcomes to inform program evaluation.

BCG vaccination, which reduced invasive TB and death by about 70%, was indicated in high-risk groups, including newborn Aboriginal and Torres Strait Islander babies in areas where TB was prevalent, and neonates and children who were likely to travel to or live in countries where TB was common.[73] The low rate of infection in Australia was maintained during periods of large-scale migration from countries with much higher TB prevalence rates, by using effective pre-migration screening and specialised, multi-disciplinary TB services in the states and territories.[71] Globally, TB remained a major health problem, especially in the WHO regions of South East Asia, and the Western Pacific (in which Australia is located) which had a reported notification rate in 2003 of 57 cases per 100,000 population.[74]

Factors critical to success

The death rate from TB fell rapidly with the improvements in sanitation, living standards and housing from the start of the century, emphasising again the importance of these interventions to the public's health. With the introduction of the National TB Campaign after World War II, the annual rate of TB declined from 48 cases per 100,000 population in the late 1940s to around five cases per 100,000 population per year by the end of the century.[75] The campaign was cited as the 'archetypal mass screening program'.[76] The implementation was led by ex-military doctors who were 'systematic, disciplined, and logistically skilled'[76] and this played a large part in its success as it was rolled out across the country.

Other factors included community acquiescence with screening radiography and the removal to sanatoria of infected individuals.[76] Compliance with treatment was facilitated by the payment of a pension while people were undergoing treatment, which generally resulted in removal from family for lengthy periods of time, and subsequent loss of employment.

The National TB Campaign and subsequent activities had a measurable impact on the health of the population (Figures 1.4 and 1.5, and Figure 1.6). The Campaign addressed a significant public health problem, as TB was one of the three leading causes of death at the beginning of the century. It was ambitious in scope, functioned nation-wide as a universal program for over thirty years, and employed cost-effective strategies, given its scale.

Surveillance and monitoring of TB cases continued to play an important preventive role in Australia at the start of the 21st century. From 2000 to 2006, the annual rate of TB remained relatively stable at around five cases per 100,000 population, despite Australia's continued intake of migrants from areas of high TB prevalence.[76]

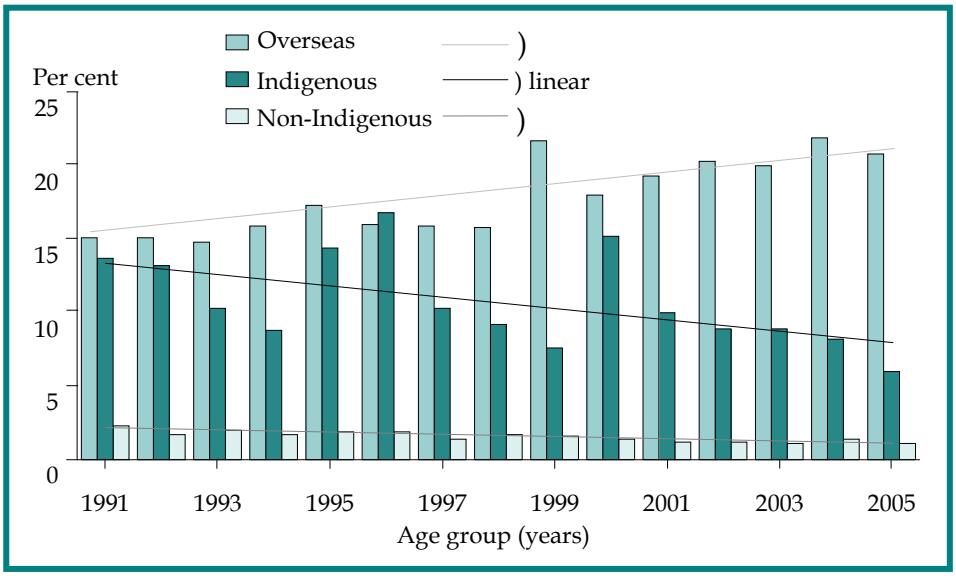
Future challenges

Screening, early intervention and treatment of TB almost eliminated the disease, except in refugee, homeless and Aboriginal and Torres Strait Islander populations, and in those migrating from overseas countries with high rates of TB (Figure 1.6). TB and HIV co-infection emerged as a major global public health issue. While co-infection was rare in Australia, HIV testing of TB patients was complete in only about one third of Australian cases.

Fortunately, multi-drug resistant TB (MDRTB) was uncommon in Australia, and remained at less than two per cent of new cases annually; however, the risk of MDRTB persisted, as most notified cases were of people from countries with high rates of drug resistant TB.[76]

In 2005, the rate of TB infection in the non-Indigenous Australian-born population was 0.8 cases per 100,000 population compared to 20.6 cases per 100,000 population in those born overseas. The rate of TB infection in Indigenous Australians was 5.9 cases per 100,000 population, seven times greater than that for non-Indigenous Australians.[77]

Figure 1.6: TB incidence rates by Indigenous status and country of birth, Australia, 1991-2005



Source: Roche et al., *Communicable Diseases Intelligence*, 2007, vol. 31, p. 74.

The Indigenous population had higher rates of infection, active disease, hospitalisation and death from TB than the non-Indigenous Australian-born population, and the disparity changed little over the last decade of the century, despite TB control programs being in place (although NTAC noted that careful interpretation of data was needed as numbers were small, Indigenous status reporting was not complete, and geographic variability was significant).[78] Contributing factors included socioeconomic disadvantage, the presence of co-morbidities (e.g., diabetes and renal disease), smoking, alcohol abuse, poor nutrition, overcrowding and poor living conditions, and social and geographical isolation.[79]

By the end of the century, the following remained challenges in applying more successful interventions in populations who were most at risk of TB:

- addressing 'upstream' contributors to the increased risk of TB in Indigenous Australians, such as socioeconomic disadvantage, poor nutrition and overcrowded living conditions;
- extending effective TB control programs and identifying measures likely to be more successful in controlling TB in Indigenous communities;

- supporting pre-migration TB screening and post-migration treatment programs for migrants to Australia;
- maintaining access to cost-free TB treatment programs and diligent contact tracing, enlisting the support of community peers, and providing essential health information in appropriate community languages for overseas-born Australians; and
- remaining alert to the global TB situation, and contributing to control efforts in the WHO regions of South East Asia and the Western Pacific.

1.2.2 HIV/AIDS Strategy

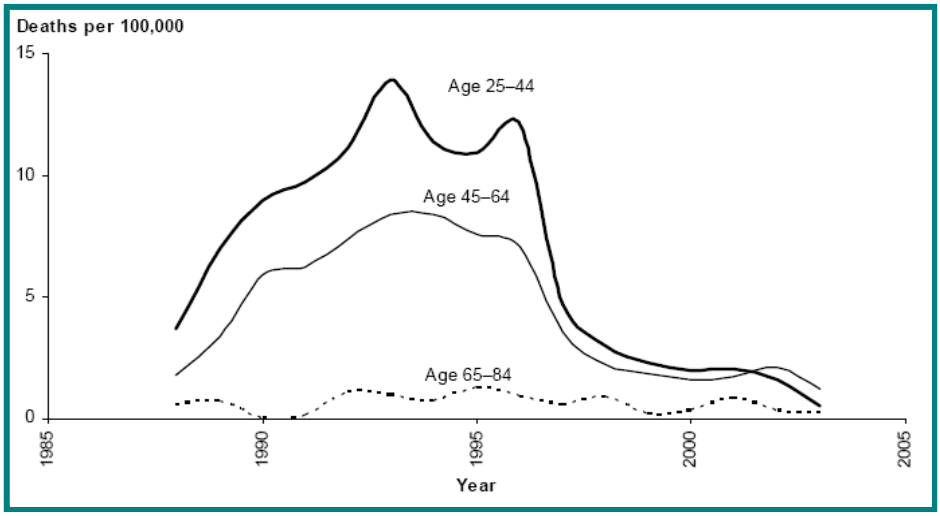
1985 onwards

'HIV/AIDS is a bloodborne viral disease of the late twentieth century that has become a worldwide threat.' – AIHW, 2006.[25]

Human Immunodeficiency Virus (HIV) is the virus that causes the Acquired Immune Deficiency Syndrome (AIDS). First identified in 1981, HIV resulted in a worldwide epidemic.[80] HIV impairs a person's immune capacity, making them susceptible to a range of other infections. In Australia, the majority of HIV cases were diagnosed in gay and other homosexually active men, with much smaller numbers in people using injecting drugs, infected by contaminated blood or needle stick injury, or exposed through heterosexual contact.[25]

The HIV/AIDS epidemic in Australia was controlled early by public health intervention and effective community action. Rates of infection significantly slowed after 1994, although they began rising again around the year 2000. By 2005, death rates from HIV/AIDS had fallen to one death per 100,000 population for males (from the peak of 6.4 deaths per 100,000 males in 1993) and 0.1 deaths per 100,000 population for females (from 0.3 deaths per 100,000 females in 1995). These falls are evident across the age groups shown in Figure 1.7.[81]

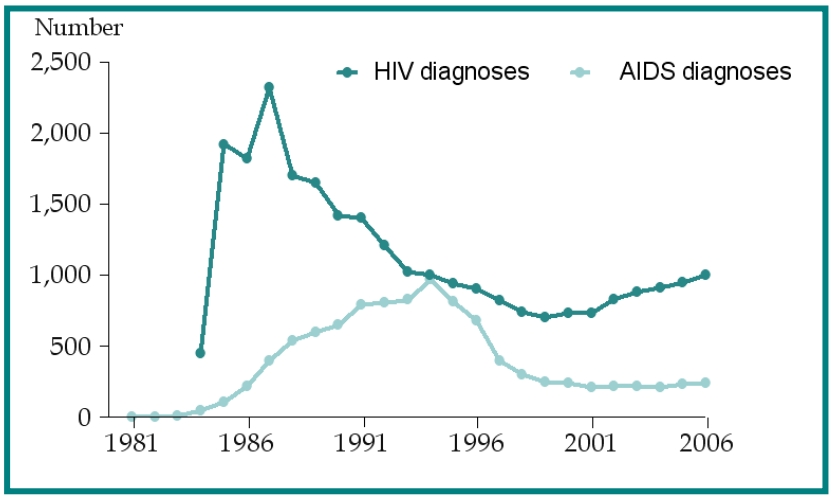
Figure 1.7: HIV/AIDS – age-specific death rates, males, 1988-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 77; data: AIHW, GRIM Books.

The number of people diagnosed with AIDS in Australia declined from 817 in 1995 to 213 in 2001, and was stable at around 240 diagnoses per year over the five years to 2006 (Figure 1.8).[82] This decline was attributed to reducing HIV incidence from 1986 onwards and to the wide availability of effective antiretroviral treatments from 1996.[82]

Figure 1.8: Number of diagnoses of HIV infection and AIDS, 1984-2006



Source: National Centre in HIV Epidemiology and Clinical Research, *HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia: Annual Surveillance report 2007*, 2007, p. 9.

Surveillance data (which adjusted AIDS diagnoses for reporting delays and HIV diagnoses for multiple reporting) showed that the annual number of new HIV diagnoses increased after a 15-year decline, rising from 763 cases in 2000, to 998 in 2006.[82] A growing number of these diagnoses were for HIV infections acquired in the previous year ('newly acquired HIV' means that evidence from blood tests suggests that the infection has been acquired in the year in question) (Figure 1.8).

Public health practices

The spread of HIV/AIDS was controlled by a relatively rapid public health intervention, and, although 6,723 people had died in Australia from AIDS by the end of 2006, the rate of infection slowed substantially from 1994. Safe sex and safer injecting campaigns, blood supply screening, infection-control guidelines and the introduction of new treatments contributed to the decline in HIV/AIDS mortality.[3]

In 1985, Australian governments committed to a harm minimisation approach to address the HIV epidemic.[83] The first *National HIV/AIDS Strategy*[84] in 1989 set out specific anti-HIV measures, which included:

- blood bank screening (Box 1.4);
- needle exchange programs; and
- sexual health education in schools and for 'at risk' communities.[86]

The commitment to a harm minimisation approach enabled difficult topics to be addressed early. The *National HIV/AIDS Strategy: revitalising Australia's response 2005-2008* was the fifth version of the strategy.[85]

> ***Survey respondents:*** *'The approach to HIV/AIDS was exemplary and Australia in my view did as well as any country in the world.'*
>
> *'In May 1985, Australia was the first country to introduce HIV screening in blood banks when Dr Neal Blewett brought the testing kits to Australia from the USA in May 1985. This, combined with needle exchange programs and extensive sexual health education for young people and people in at risk groups, limited to some extent the epidemic that was so catastrophic in other countries where these measures were not implemented.'*

'AIDS first appeared in the media as a deadly disease spread primarily among homosexual men who were perceived as having infected the blood supply. The shape and extent of the threat to "the general public" was unknown. Announcements of the first identification of an AIDS "case" in Australia, then of HIV transmission through the blood supply and the death of three Queensland infants with HIV from blood transfusions each raised media panic. The response on the part of gay communities in Australian cities from mid-1983 was to develop education and care programs, which effectively changed behaviour before governments became active. The response on the part of the

federal government… was exceptionally proactive, putting Australia well in advance of other countries.' – J Ballard, 2005.[85]

The lack of a curative medical response to AIDS meant that there was ample scope for public health intervention, such as health education and promotion of behavioural change, to contain the spread of the disease. AIDS Councils established early by gay communities rapidly promoted safe sex awareness messages, and are thought to have been responsible for the early decline in HIV transmission, well before government-funded education programs were initiated.[85] The partnership approach taken by the Australian government involved affected communities, all levels of government, service providers and researchers.[86] This allowed for a high level of consultation and collaboration to prevent, manage and treat HIV/AIDS in the community.[86]

Factors critical to success

The prevention and control of HIV/AIDS in Australia was successful because, with strong national leadership, the need for preventive measures in sub-populations such as those using injecting drugs and sex workers, was acknowledged and tackled early. The approach adopted by the national government was described as 'an internationally heralded feature of the Australian response'.[85]

The early preparation and ongoing revitalisation of the national strategy, as well as a policy commitment to using a harm minimisation approach, also contributed to success in this area. Forging a dedicated AIDS medical community across specialties to work collaboratively with NGOs involved with affected people, was another arm of Australia's effective response.[86] National monitoring systems which guaranteed confidentiality, and research into risk factors, patterns of transmission and treatment options also strengthened the public health system response.

Innovative social marketing (e.g., the 'Grim Reaper' HIV/AIDS media campaign launched in 1987) was used successfully to raise awareness in the population about safe sexual practices and other risk reduction measures. Inadvertent infection was addressed by the implementation of donor screening and blood testing to ensure the safety of the blood supply.

These factors had a significant impact in containing the transmission of HIV and improving the lives of those already infected. Later increases in the rate of HIV infection in Australia, however, confirmed that it was necessary to continue these and other strategies.

Grim Reaper (AIDS)

Source: Noel Butlin Archives Centre, Australian National University: National AIDS Archive Collection.

Cost-effectiveness

In 2003, Abelson and colleagues estimated that the cost of programs to reduce HIV/AIDS from 1984 to 2010 was $607 million.[87] These included education and prevention programs from 1984, which targeted both high-risk and general population groups. A reduction of 25% in the HIV/AIDS transmission rate was accredited to the costed programs, which were fully attributable to public health effort. The net benefit was estimated at $2.54 billion.

Future challenges

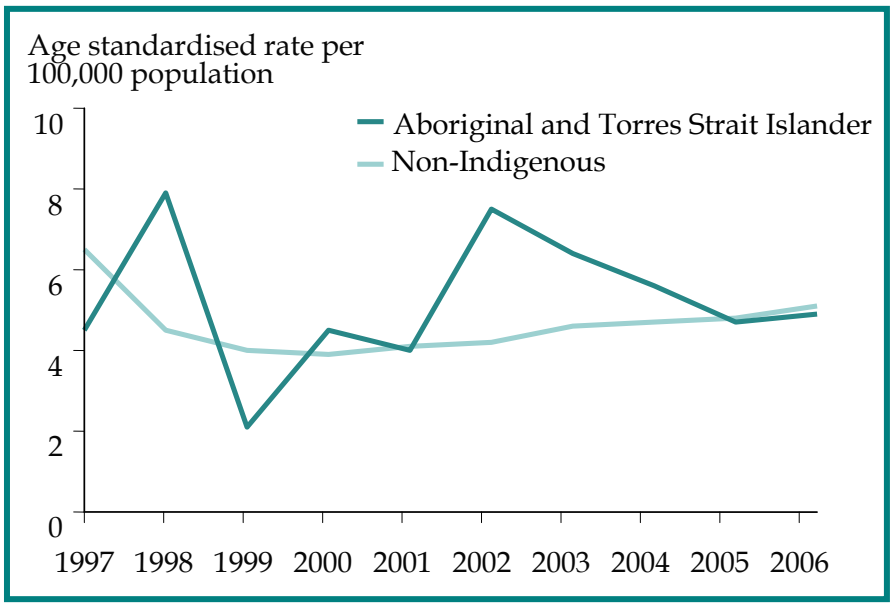
The need for a continued effective response was underlined by the increase in the annual number of new HIV diagnoses and changes in the pattern of transmission. Although the majority of new HIV infections arose in men with a history of homosexual contact, the proportion attributed to heterosexual contact increased from 7% before 1996, to 24.5% in newly diagnosed HIV cases in 2006.[82] These issues

required a revitalising of prevention and education efforts focusing on key objectives, including prevention of the spread of sexually transmissible infections (STIs) and HIV/AIDS, and maximising the quality of life for those living with HIV/AIDS.[86]

Aboriginal and Torres Strait Islander peoples were regarded as priority population groups for prevention and health promotion activities under the national strategy.[86] Rates of HIV diagnoses were approximately the same for the Aboriginal and Torres Strait Islander and the non-Indigenous populations in the five years 1996-2000, with both rates declining over this period (Figure 1.9). Previous analyses of case data (1992-1998) suggested that Indigenous Australians had not experienced the decrease in HIV that occurred in the non-Indigenous population.[88] A study (1983-2002) in WA demonstrated that this population was at greater risk of HIV transmission than had been previously thought.[89] Subsequent national data , however, revealed that, while the HIV rate had increased in 2002 to 7.5 per 100,000 population, it declined to 4.9 per 100,000 population in 2006 (while increasing in the non-Indigenous population to 5.1 per 100,000 population in 2006) (Figure 1.9).[82]

> *'Groups such as people who inject drugs, young people, people in custodial settings and Aboriginal and Torres Strait Islander people may be at risk of HIV, STIs and hepatitis C. Interventions aimed at these groups must account for this multiple risk and offer prevention, testing, treatment and support services that recognise and address the possibility of co-infection with other conditions.'*
>
> – Foreword to the *National HIV/AIDS Strategy: revitalising Australia's response 2005-2008* by the Hon. T Abbott, MP, The Minister for Health and Ageing.[86]

Figure 1.9: Newly diagnosed HIV infection by Indigenous status and year, 1997-2006



Source: National Centre in HIV Epidemiology and Clinical Research, *HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report, 2007*, 2007, p. 19.

It is important to note that Indigenous rates were calculated on small numbers of cases. The data did, however, indicate relatively high rates of infection from heterosexual contact and injecting drug use, which differed from the pattern of transmission in the non-Indigenous population, suggesting that different prevention strategies were needed.[82] The complementary *National Aboriginal and Torres Strait Islander sexual health and bloodborne virus strategy* outlined a national approach to preventing the spread of hepatitis C, HIV/AIDS and other sexually transmissible infections in Aboriginal and Torres Strait Islander communities.[86]

Box 1.4 Safety of the blood supply, 1985-

Recognition that bloodborne viruses such as HIV had the capacity to infect recipients of blood products (e.g., people with haemophilia) and that the government was responsible for the blood supply, led to measures to improve the safety of the blood supply. Before testing for HIV became possible, there were over 500 cases (up to 1998) of HIV transmission as a result of transfusion of infected blood or blood products and almost everyone who received HIV-contaminated products became infected. [90,91]

Diagnostic tests for HIV were developed soon after the virus was isolated in the USA in April 1984. In Australia, the ability to test for HIV was used to alert the public to the risk of blood contamination and became a focus for early government action.[92] Screening of blood donations for HIV was implemented in 1985.[93]

Standard precautions for the care and treatment of patients, including the handling of blood to prevent the transmission of infection were drawn up by the NHMRC in 1996 and implemented in health care settings.[94] Blood, blood components and plasma derivatives were regulated under the *Therapeutic Goods Act 1989*.[95]

1.3 Organised mass immunisation

1932 onwards

Vaccines against smallpox and typhoid were available in Australia from the early 1800s.[96] The first vaccine material arrived in Sydney in 1804 and was used to start a local, voluntary smallpox vaccination program. Vaccination was identified as 'the first modern public health activity undertaken by the state'[5], and Australia earned a respected record in the development of vaccines and vaccination programs over the 20th century.

Professor Sir Gustav Nossal, outlining the history of vaccine development from World War I onwards in Australia, described the important advances in vaccine technology and delivery made by many scientists working at notable Australian institutions (e.g., Commonwealth Serum Laboratories [CSL] and the Walter and Eliza Hall Institute).[97] The CSL were in charge of vaccine production for the nation from the middle of the 20th century. These included the Salk vaccine (inactivated polio vaccine) and a live-attenuated, intranasal influenza vaccine given to 20,000 army recruits during World War II. Advances in the development of human vaccines by Australian scientists (including Sir Frank Macfarlane Burnett) produced vaccines for cholera, tuberculosis, Q fever, and the human papilloma virus. Other Australian researchers undertook pioneering work on *Helicobacter pylori* and malaria.

By the end of the century, public health and clinical research into vaccine-preventable diseases and vaccines was undertaken in a number of centres throughout Australia. These included the Collaborative Research Centre for Vaccine Technology (established in 1993), and the National Centre for Immunisation Research and Surveillance of Vaccine-preventable Diseases (established in 1997), which strengthened and integrated surveillance, research and evaluation of these diseases and measures to prevent them.[98]

The process that delivered vaccination in an organised and cost-effective way to the populations in need was equally important, and essential to achieve the required level of 'herd immunity' against the infectious diseases. As a result of immunisation strategies conducted through the century, Australia was declared polio-free in 2000, with measles, rubella and *Haemophilus influenzae* type b infection (Hib) close to being eliminated.[99,100]

The following Sub-sections focus on organised immunisation for whole populations – for both children (1.3.1) and adults (1.3.2).

1.3.1 Organised childhood immunisation

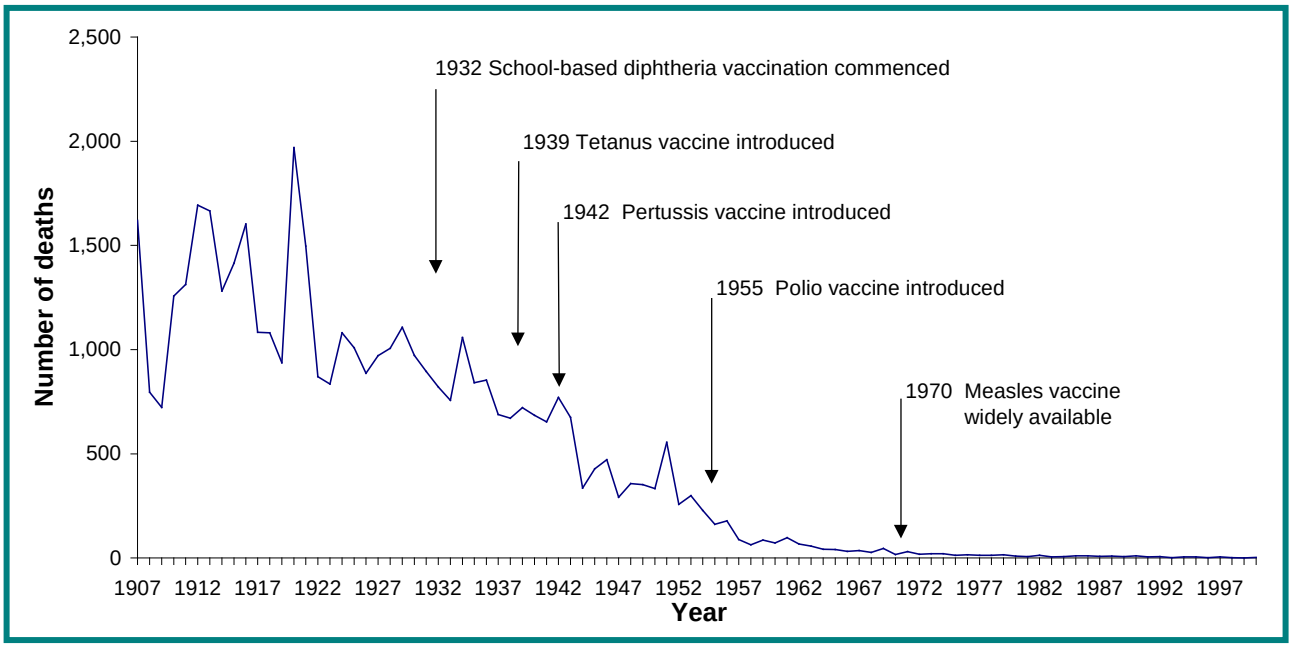
1932 onwards

> *'Immunisation is a simple, safe and effective way of protecting children against certain diseases. The risks of these diseases are far greater than the very small risks of immunisation.' – Immunise Australia Program, 2006.*[101]

In 1932, diphtheria vaccination was introduced nationally for children. With the subsequent use of vaccines against tetanus (1939), whooping cough (pertussis) (1942), and poliomyelitis (1955), and against measles, mumps and rubella from the 1960s, deaths from vaccine-preventable diseases decreased by more than 99%, despite significant growth in the population.[98]

This dramatic decline was the result of specific vaccination programs (Figure 1.10). In 2001, it was estimated that at least 78,000 Australian lives had been saved, and substantial illness prevented, through vaccinations for diphtheria, whooping cough, tetanus, measles and poliomyelitis (Box 1.1).[98] Prevention was vital because many of these diseases, especially those caused by viruses (e.g., poliomyelitis, measles, and hepatitis A), had no specific treatments or had drug-resistant strains.[98]

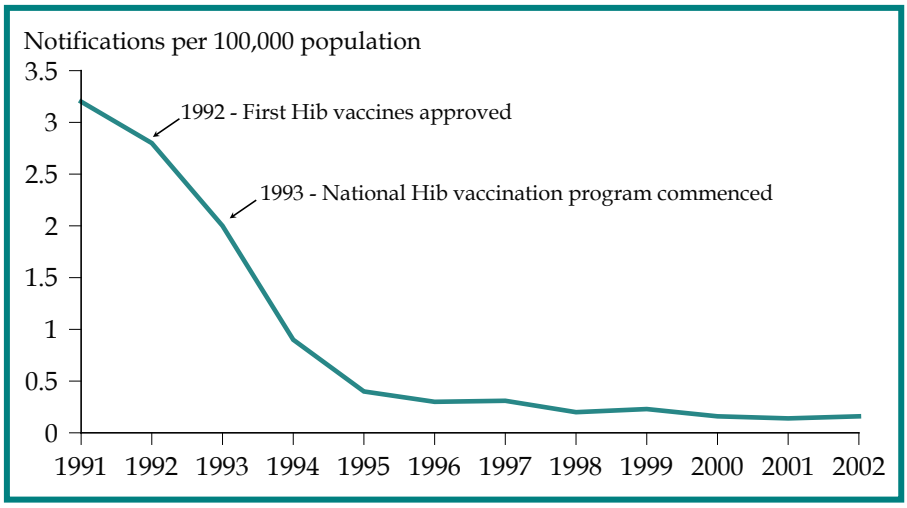
Figure 1.10: Deaths from selected vaccine-preventable diseases (measles, pertussis, diphtheria, tetanus and polio), 1907-2000



Source: Burgess, *NSW Public Health Bulletin*, 2003; citing AIHW, *Australian long-term trends in mortality*, AIHW, Canberra, 2002.

Vaccination against other infections (such as *Haemophilus influenzae* type b infection [Hib], hepatitis B, invasive pneumococcal disease and meningococcal disease type c) effectively extended protection. For example, after 1993, with the introduction of the Hib vaccine, the incidence of the disease fell immediately (Figure 1.11), and, by the year 2000, more than an estimated 100 deaths in children under the age of five had been prevented.[102] Vaccination was also targeted specifically at high-risk population groups (e.g., hepatitis A and pneumococcal immunisation for Indigenous children).[103]

Figure 1.11: *Haemophilus influenzae* type b disease notification rate, 1991-2002



Source: Brotherton et al., *Communicable Diseases Intelligence,* vol. 8, 2004, p. S95.

The case of measles indicated a continuing need for vigilance, proactive public health surveillance, and the implementation of refinements in immunisation techniques and programs. Although a vaccine for measles was included in childhood vaccination schedules in 1971, the immunised population (coverage) remained too low to confer herd immunity. It stayed low even after the first national measles campaign in 1988 (with major measles outbreaks in 1993-1994), and after changes in the immunisation schedule, which introduced a second dose of MMR (measles, mumps, rubella vaccine) in 1994.[104]

The national Measles Control Campaign, conducted by the Australian government in conjunction with all state and territory governments in 1998, included the administration of a mass 'catch up' dose of the vaccination to all primary school-aged children, and lowered the recommended age for the second dose of MMR in 1999.[104] It was estimated that 96% of children aged five to 12 years (1.7 million children) had received the recommended two doses of MMR vaccine after the 1998 Measles Control Campaign[105]; and significant increases in the level of protection against measles among preschool and primary school age children, to 89% and 94% (from 84% before the campaign) respectively, were demonstrated in analyses of post-campaign sera.[106]

The ultimate aim was to interrupt native measles' transmission, as had been achieved in other countries (e.g., the UK, the USA and Finland).[104] Although coverage in children in Australia was high, a group of young adults who missed out on earlier measures to extend coverage remained susceptible to the disease, and a young adult MMR vaccination campaign was conducted during 2001 to reach this group.[102] Later outbreaks of measles involved people who were infected with the disease overseas. To sustain control of measles over time, greater effort in young adults and continuing high coverage in children were required.[102] In addition, young adults planning overseas travel to areas where measles was currently endemic were encouraged to confirm their measles immunity or have a second dose of MMR. High uniform vaccination coverage against measles was needed to prevent its reintroduction until global eradication could be achieved, and it was expected that WHO would set a target date for full measles' elimination in the Western Pacific Region, including Australia.[102,107]

There was a reduction of 99% in measles' notifications from 1994 (when 4,792 cases were notified) to 2004 (when only 45 cases were notified).[13] In the first decade of the 20th century for which there were reliable deaths' data (1907-1916), there were 2,143 deaths from measles, but only a single death during the period 1997 to 2004.[13]

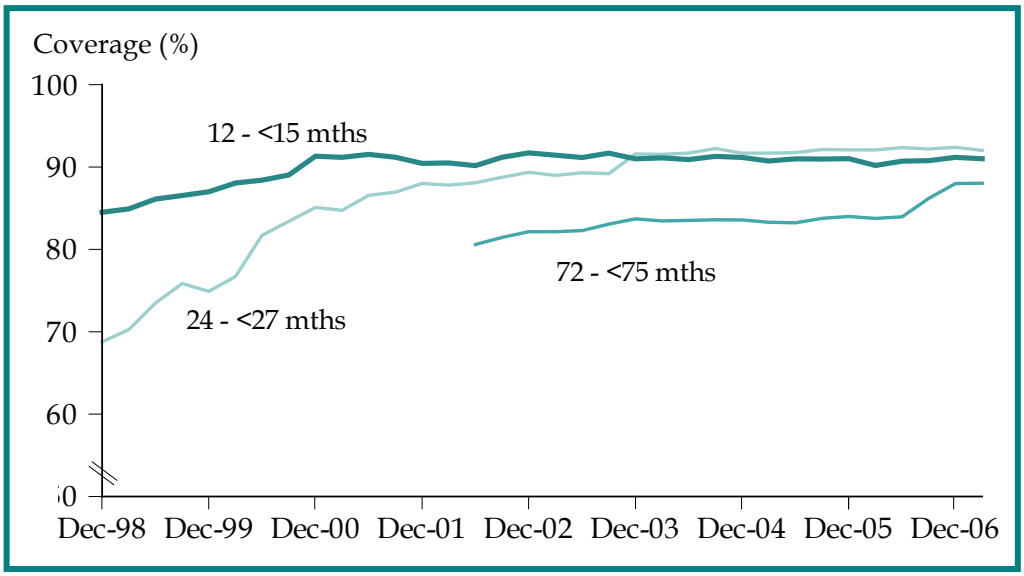
Public health practices

By the end of the 20th century, the public health approach was one of a government-funded, universal childhood immunisation program to protect against 12 vaccine-preventable diseases, supported by

immunisation registers and vaccine research.[108] The national immunisation schedule included diphtheria, mumps, pertussis, rubella, tetanus, Hib, hepatitis B, meningococcal type c infection, and chicken pox.[109] Data from the Australian Childhood Immunisation Register (ACIR), which operated by Medicare Australia from 1996, showed the increasing proportion of children fully vaccinated at key ages (Figure 1.12).[110]

Immunisation was supported by nation-wide monitoring of incidence and outbreaks of vaccine-preventable diseases, and active countermeasures (e.g., community education campaigns) to increase immunisation coverage when it fell below acceptable rates. Notifications and contact tracing of cases of vaccine-preventable diseases and other control measures were carried out by public health units in all states and territories.

Figure 1.12: Childhood immunisation standard coverage by age groups, December 1998-March 2007



Source: Medicare Australia, *Australian Childhood Immunisation Register statistics: immunisation coverage graphs - March 2007*, 2007.

Factors critical to success

For many years, Australian immunisation measures did not reach the required level to prevent outbreaks of whooping cough and measles. It was only after the creation of a national register (the ACIR) that country-wide coverage rates could be monitored and the childhood immunisation program considered a success. The leadership of the National Immunisation Program (NIP) (a joint initiative of Australian, State and Territory governments), public funding of vaccines and efficient vaccination delivery systems (e.g., via general practitioners, local government, Aboriginal Medical Services) were critical factors in ensuring the high coverage rates that conferred herd immunity and limited the number of cases of infectious disease.[111]

The ACIR enabled parents to track their child's vaccination status, and coverage rates to be monitored. The *Immunise Australia* program, launched in 1997, included educational activities for parents and providers to raise community knowledge and awareness, and to create a more supportive climate for childhood immunisation.

Vaccine funding was approved by the Federal Minister for Health and Ageing under the *National Health Act 1953*.[100] State and Territory legislation enabled the collection and reporting of communicable disease information. National legislation provided for some parental payments to be tied to the immunisation status of their children[112], with model provisions for the certification of children's immunisation status on school and child care entry developed by the National Public Health Partnership.[113]

The childhood vaccination program had a measurable impact on children's health, as well as the general population. It addressed a significant health problem, was ambitious in scope, functioned nationally as a universal program for over five years, used integrated vaccines (judged to be cost-effective) at the scale required to provide adequate coverage, and was cost-effective. To remain successful, herd immunity across the adult population needed to be maintained.

Cost-effectiveness

Vaccine expenditure under the NIP in 2004-05 was estimated at $285 million (a large increase on the $13 million in 1996). Some of the benefits and costs of universal childhood immunisation follow.[87]

- Measles – cost of immunisation programs during 1970 to 2003 estimated at $52 million:
  - saved an estimated 95 lives over the same period and averted around four million cases. Measles' notifications fell from around 100,000 to under 2,000 cases a year;
  - savings to government included $8.5 billion, mainly in health care expenditure;
  - net benefit estimated at over $9.1 billion.
- Hib – cost of immunisation programs during 1991-2003 estimated at $165 million:
  - saved an estimated 78 lives over the same period and averted around 3,600 cases from 1993 to 2003. An estimated 350 cases were averted annually during the 1990s;
  - net benefit estimated at $10 million.

Future challenges

In March 2006, 90% of one year old and 92% of two year old children were fully immunised.[116] Participation in vaccination programs had to be maintained at high rates to ensure herd immunity, and to eliminate further vaccine-preventable diseases.[98] Furthermore, despite low or absent disease incidence in Australia, the Western Pacific region and the rest of the world were not disease-free, and the threat of disease rose when immunisation coverage dropped. It was important to maintain immunity in adults, via adult maintenance immunisation, for the 'childhood diseases' of whooping cough, diphtheria and tetanus.

Box 1.5 Poliomyelitis eradication: the Polio plus campaign, 1980-2000

Poliomyelitis ('polio') or infantile paralysis is a viral paralytic disease caused by the poliovirus. From the 1940s through the 1950s and into the early 1960s, Australia had epidemics of polio every second or third summer, according to Professor Sir Gustav Nossal. He has been an immunologist for over 40 years, and spent 25 years with the WHO, most recently as the Chairman of its Global Program for Vaccination. He remembers those times when 'my mother wouldn't allow us to go to the movies of a Saturday afternoon because that would be a crowded place in which we'd be sure to catch polio'.[114] Wards in hospitals were filled with people on respirators (the so-called 'iron lungs') because their breathing muscles had become paralysed.[115]

Australia played a part in the global eradication of polio, and, in 2000, Australia, and its region of the Pacific, were declared polio-free.

The Polio plus campaign, a partnership between WHO and Rotary International, developed into one of the largest public health initiatives.[115] When Polio plus began, polio was circulating in 125 countries, and the reported incidence (of 350,000 cases per year) was almost certainly an underestimate. The eradication campaign used four linked strategies: high routine infant immunisation rates; National Immunisation Days to mobilise community effort, when all children under five years were immunised on a given day (regardless of their previous immunisation status) with the aid of 'an army of volunteers'; good surveillance of all cases of paralysis; and lastly, as eradication campaigns approach completion, 'mop-up' campaigns to track down the last cases of wild polio in the communities, 'breaking the last few chains of transmission.'[115]

Additional measures were required to ensure better recruitment of 'hard to reach' children from those population groups who were often under-immunised (e.g., those from socioeconomically disadvantaged families, recently arrived migrants, those who were non-English speaking). Greater efforts were also needed to increase immunisation rates for very young Aboriginal and Torres Strait Islander children, especially for the pneumococcal vaccine. A 2004 study estimated that, although the

uptake of the pneumococcal conjugate vaccine for this group had increased in most jurisdictions from 2001, coverage was less than 50% in all jurisdictions except the NT, WA and Queensland.[117]

1.3.2 Organised adult immunisation

1999 onwards

> *'… administration of … influenza vaccine to individuals at risk of complications of infection is the single most important measure in preventing … influenza infection and … mortality.' – National Health and Medical Research Council, 2003.*[118]

Influenza or 'flu' is a highly contagious viral infection that is transmitted by sneezing and coughing, and causes illness lasting for more than a week. In adults, symptoms are fatigue, fever, chills, loss of appetite, headache and muscle pain and for some, cough and nasal discharge. Influenza can be fatal and deaths attributed to the disease are thought to be substantially under-reported; it was estimated that the true death rate from influenza was up to eight times higher than that reported.[119] Vaccination against influenza effectively reduces the risk of being infected with the disease (by up to 70% in people aged over 65 years).[118] People aged 65 years and older (50 years and over for Aboriginal and Torres Strait Islander peoples) are at higher risk of serious illness, complications and death from influenza (although these may also occur in younger people).[120]

A common complication of both influenza and pneumococcal disease is pneumonia, an inflammation of the lung tissues. Pneumococcal pneumonia is the commonest form of serious pneumococcal disease in adults.[121] Other complications are septicaemia (blood infection) and meningitis (inflammation of the tissue covering the brain). Both pneumococcal disease and influenza have similar impacts, especially on older people, and vaccination programs are aimed at reducing the impact of both diseases.[121]

Influenza death rates showed a steady decline from 1997-1998 (Table 1.2). Although hospitalisation rates for influenza increased (after the lowest recorded rate of 9.4 hospitalisations per 100,000 population for 2001-2002), they were still well below those of 1997-1998 when adult vaccination programs were in their infancy.

Table 1.3: Trends in hospital separation and death rates for influenza and pneumonia, 1997-2004

Year	Hospital separation rates		Year	Death rates	
	Influenza	Pneumonia		Influenza	Pneumonia
			1997	1.3	12.4
1997-1998	21.2	354.3	1998	0.7	11.2
1998-1999	15.5	338.9	1999	0.4	10.3
1999-2000	13.6	319.9	2000	0.4	15.4
2000-2001	12.4	305.9	2001	0.2	13.8
2001-2002	9.4	311.7	2002	0.3	15.0
2002-2003	11.3	321.9	2003	0.3	16.8
2003-2004	13.8	324.8	2004	0.2	15.6

Source: AIHW, *Australia's health 2006*, 2006, p. 110.

After large declines earlier in the century, followed by a decade of relative stability, later pneumonia death rates appeared to increase (although this might have partly reflected changes to automated cause of death coding).[13] As with influenza, later hospitalisation rates for pneumonia remained below those of the period, 1997 to 1998.

Public health practices

Unlike immunisation against other diseases, influenza vaccination is required annually to account for changes in the influenza virus itself. Therefore, the prevalence of different influenza strains was monitored, and annual vaccines tailored to provide the best protection against the specific influenza viruses likely to threaten our geographical region.[119] The cost of providing sufficient vaccines for the immunisation target group (about 2.1 million people were vaccinated against influenza in 2004) was met by the Australian government through payments to the states and territories, while jurisdictional health departments met other costs and organised vaccine distribution to immunisation providers (e.g., general practitioners).[121] Vaccine recipients made their usual arrangements (e.g., bulk-billing or co-payment) when they visited their doctor or other provider to receive their vaccination. Laboratory-confirmed influenza became a nationally notifiable disease in 2001 and all jurisdictions implemented and/or contributed to influenza notification.[122]

In 2004, the Australian government initiated a tender process to streamline influenza vaccine purchasing arrangements (previously, each jurisdiction had negotiated separately with the vaccine suppliers).[123] The national tender process resulted in agreements with two companies to provide vaccine for three influenza seasons, thus enabling substantial savings and access to vaccine supply in the event of an influenza pandemic.[124]

Under the National Influenza Vaccine Program for Older Australians, influenza vaccination was funded by the Australian government for:

- all Australians aged 65 years and older;
- Aboriginal and Torres Strait Islanders aged 50 years and older;
- Aboriginal and Torres Strait Islanders aged 15-49 years where indicated (i.e., for those who were considered to be at high risk of complications and death from the disease); and
- younger people with underlying chronic illnesses (such as heart disease, respiratory disease and diabetes), which were likely to increase their vulnerability to influenza infection and its complications.[120,118]

The National Pneumococcal Vaccination Program for Older Australians, which commenced in 2005, provided free pneumococcal vaccine for:

- all Australians aged 65 years and older;
- Aboriginal and Torres Strait Islanders aged 50 years and older; and
- Aboriginal and Torres Strait Islanders aged 15-49 years considered to be at high risk of complications and death from pneumococcal disease.

These vaccination programs were also administered by general practitioners. The Adult Vaccination Survey, the fifth in a national series, was extended to assess pneumococcal, as well as influenza, vaccinations for the first time in 2004.[123]

A national surveillance system monitored seasonal influenza epidemics. Components included medical consultations for influenza-like illnesses from sentinel general practices across Australia, and laboratory-confirmed cases of influenza notified by the states and territories.[122] The design of annual influenza vaccines (based on monitored changes in the virus) and the determination of the need for any additional public health measures (depending on the epidemic and/or pandemic nature of seasonal influenza) were based on this surveillance information.[125]

The federal budget (2006-07) included funding of $1.2 million to examine ways in which to redevelop the ACIR as a whole-of-life register. This was to extend the Register to include adult immunisations, such as those for tetanus, influenza and pneumococcal disease, and self-funded (as well as government-funded) vaccines, and new vaccines, thereby potentially improving health and reducing wastage of expensive vaccines.[122]

Factors critical to success

The National Influenza Vaccine Program for Older Australians started in 1999, and an estimated 2.1 million vaccinations were undertaken in 2004. Its effectiveness was assessed by surveying the target populations, with program coverage increasing from 69% in 1999 to 79% in 2004.[121] International collaboration was another factor critical to success. Australian public health reference laboratories provided data to the WHO on local influenza strains as part of its global influenza monitoring program, in order to determine the appropriate influenza strains for the Australian vaccine each year. The national vaccination program against influenza for people most at risk was assessed as effective by the National Institute of Clinical Studies, which recommended coverage be extended.[126]

Similarly, the National Pneumococcal Vaccination Program for Older Australians was targeted to those who were most at risk. In 2004, before the program commenced, the vaccinated proportion of the target population was estimated to be only 51%. This was 1.3 million people out of about 2.6 million in the target group, and indicated the scale of the program that was required.[121]

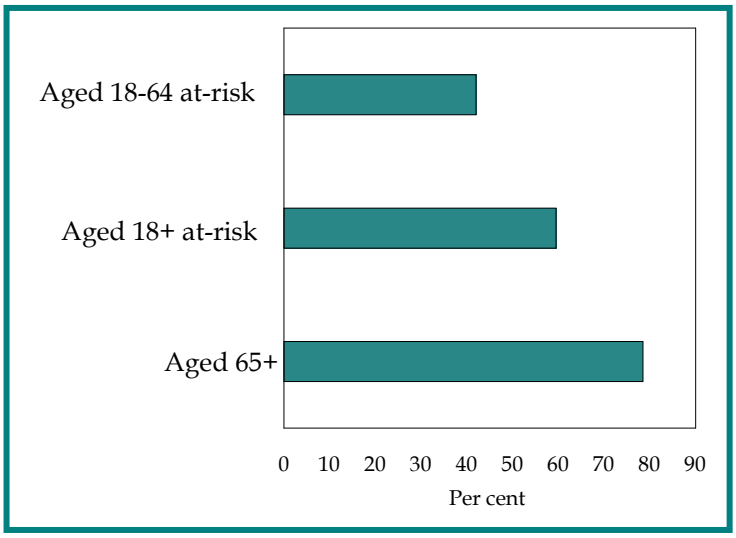
Cost-effectiveness

In 1996, it was estimated that influenza was responsible for one million medical consultations, between 20,000 and 40,000 hospitalisations, 1,500 deaths and 1.5 million days off work each year, at a total economic cost of about $600 million annually in Australia.[127] Influenza and pneumococcal vaccines were assessed as cost-effective for people aged 65 years and older.[128] The effectiveness of the influenza vaccine in any given year varied, depending on the age and immune response of those who were vaccinated and the closeness of the 'match' between the virus strains in the vaccine and those prevailing in the community. Reviews showed that well-matched influenza vaccine was effective in preventing significant proportions of hospital admissions for influenza and pneumonia and deaths from all causes.[129]

Future challenges

Although the *2004 Adult Vaccination Survey* indicated that 79% of people aged 65 years and over were vaccinated against influenza, only 42% of those younger than 65 years with high-risk conditions were vaccinated (Figure 1.13), and this group contributed significantly to hospitalisations for influenza.[121]

Figure 1.13: Influenza vaccination rates by age groups, 2004



Source: National Institute of Clinical Studies, *Evidence–practice gaps report,* vol. 2, 2005, p. 27.

The National Institute of Clinical Studies identified the need to increase influenza vaccine coverage in people aged less than 65 years who were at risk due to pre-existing chronic health conditions, and this was also supported by the Influenza Specialist Group.[120]

The expansion of universal vaccination to younger groups of Indigenous people was also suggested as a measure that would significantly improve the health of this vulnerable population group.[130]

1.4 Aseptic procedures and antimicrobial medicines

1901 onwards

The recognition by Ignaz Semmelweis in 1847 that the incidence of postnatal infection of women could be drastically cut through the use of hand-washing in obstetric clinics, was an important precursor to the later development of germ theory and surgical instrument sterilisation.[131] In 1870, British surgeon Joseph Lister introduced aseptic surgical techniques, which reduced infection and opened the door to modern medical and surgical practices. Strict adherence to aseptic techniques and hand-washing remained the cornerstone of infection prevention.

The development of antibiotics and other antimicrobial medicines played a further role in the decline of infectious diseases. Penicillin was developed for medical use in the early 1940s by the Australian researcher, Howard Florey, and his team, and was first produced in substantial quantities to treat sick and wounded soldiers.[132] It became a widely available medical product for the treatment of previously incurable bacterial illnesses, with fewer side effects than the sulphonamide (sulpha) drugs, which had been in use from the 1930s.

The development of antimicrobial medicines, including antibiotics, saved the lives of many people with streptococcal or staphylococcal infections, gonorrhoea, syphilis, tuberculosis or other infections. Drugs were also developed to treat certain viral diseases (e.g., herpes, HIV and HCV infections), fungal diseases (e.g., candidiasis and histoplasmosis), and parasitic diseases (e.g., malaria). However, the rise of drug-resistant strains of some infectious agents causing these diseases was concerning and underscored the importance of disease prevention.

Antibiotics were used not only to treat and prevent infectious diseases in humans, but also to promote growth and to improve feed efficiency in intensively reared animals (e.g., poultry, pigs and feedlot cattle) and fish for human consumption. Such uses contributed to the development of antibiotic resistance, which became an international issue as resistance spread.

> *'The increasing prevalence of antibiotic-resistant bacteria is a public health issue of major concern. Essential, life-saving antibiotics are becoming less effective and there are fewer alternatives available for treatment.' – JETACAR, 1999.*[133]

In 1998, the Australian Government Ministers for Health and Aged Care, and Agriculture, Fisheries and Forestry established a Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR) to examine this issue. JETACAR produced a report in 1999 which made recommendations on the future management of antibiotic use in food-producing animals.[133] A joint response by the two departments supported the recommendation for a national antibiotic resistance management program of regulatory controls, monitoring and surveillance, infection prevention, education and research.[134]

Source: National Prescribing Service Limited (NPS), 'What you need to know about common colds' [website], NPS, Sydney, 2006.

A Commonwealth Interdepartmental JETACAR Implementation Group was established to manage the Australian Government's response to the problem, and the first National Summit on Antibiotic Resistance was held in 2001. This achieved broad commitment to develop a national antibiotic resistance management program.[135] In 2001, the NHMRC established the Expert Advisory Group on Antimicrobial Resistance, whose role was to advise regulatory agencies, monitor antibiotic use and antibiotic resistance, and investigate the impact of antibiotic use on human health.[136]

The national *Strategy for Antimicrobial Resistance (AMR) surveillance in Australia* outlined a framework to address the recommendations made by JETACAR.[137] The Australian Council for Safety and Quality in Health Care developed a National strategy to address health care-associated infections (2000-2005),[138] which was continued by its successor, the Australian Commission for Safety and Quality in Health Care from 2006. While infection control measures in hospitals contributed significantly to reducing maternal and other deaths, drug resistance in many organisms remained a serious challenge (e.g., septic infection rates were increasing for older people in hospital).[13]

Future challenges

There was a need to reduce the rate of health care-associated infections (which were difficult and expensive to treat) through the linking of surveillance and intervention strategies. For instance, the activities of the South Australian Infection Control Service (established in 2001 as a voluntary network of infection control practitioners) had halved the rates of Methicillin-resistant *Staphylococcus aureus* (MRSA) infections in hospitals over two years, with a consequent reduction in hospital treatment costs.[139] This improvement was attributed to regular feedback of data, and new hand washing techniques. Older, well-proven methods to contain infectious diseases, such as isolation and strict quarantine, also reduced MRSA spread in hospitals.

A surgeon reported: 'Within our own institution [The Queen Elizabeth Hospital] we experienced an unrelenting increase in wound infections in orthopaedic, vascular and transplantation surgery. Expensive options involving new air conditioning systems, more infection control nurses and even ceasing some types of surgery were seriously mooted. Instead, it was decided to pursue an education project regarding the merits of hand washing, which was suggested and policed by nurses and consultant surgeons. Within months, incidence of new infections dropped dramatically to below benchmark levels where it has remained for more than 18 months.'

– GJ Maddern, *ANZ Journal of Surgery,* 2004.[746]

The rise of antibiotic-resistant bacteria was an increasing challenge for health care providers. Antibiotic-resistant bacteria first appeared in the 1950s, as a likely result of the widespread, indiscriminate use of antibiotics in human and animal populations. MRSA was only one of more than thirty species of resistant bacteria found in hospitals across Australia; and community-acquired cases began appearing, some with life-threatening consequences.

By the end of the 20th century, bloodstream infection due to *Staphylococcus aureus* was still not a nationally notifiable disease. Thus, data were not routinely collated at state and national levels, foregoing an estimation of disease burden and the monitoring of trends across Australia. Notifiability would also have provided a basis for investigating apparent sustained increases in incidence, and for evaluating the effectiveness of preventive and therapeutic interventions.[140]

Box 1.6 Control of hydatid disease in Tasmania, 1960s-

Zoonoses – infectious diseases occurring naturally in animals that can be potentially transmitted to humans – include various strains of influenza (e.g., 'bird flu'), brucellosis, echinococcosis, listeriosis, Q fever and salmonellosis, among others. Echinococcosis or hydatid disease is a potentially fatal parasitic disease, common to humans and some animals, caused by infection with tapeworm larvae of the genus *Echinococcus granulosus*. In Australia, it was transmitted by wildlife in a prey-predator life cycle, with dogs and foxes as definitive hosts and herbivorous animals (e.g., sheep, kangaroos) as intermediate hosts. Although human hydatid disease occurred in almost all rural communities and grazing lands of the world, it carried 'the added stigma that it was preventable'.[141,142]

The highest prevalence of human hydatid disease in the English-speaking world was recorded in Tasmania in the 1960s.[143] The disease was also found in other areas of Australia, with a mean annual prevalence of 2.6 infections (ranging from 0.3 to 25.5) per 100,000 rural population; and a number of cases from urban areas found in NSW/ACT hospital studies (the latest of which studied cases from 1987-1992).[144] At the launch of 'The Travelling Parasite', a public health educational video on the prevention of hydatid infection in 1996, it was described as occurring mostly in eastern NSW along the Great Dividing Range, with one person a day on average treated for it in Australia (although accurate data were not available).[145] Despite being a notifiable disease, human hydatidosis was widely under-reported. Later information indicated that the disease was common in sheep-farming areas in NSW, ACT, Victoria, southwest WA and eastern Qld, and probably in SA. It was also found in cattle in the Kimberley region of WA, in northern Qld and near Darwin in the NT.[146]

A major contributing factor to the higher incidence in Tasmania - where the disease was common in sheep (with 60% carrying cysts) and rural dogs (12% carried the tapeworm) - was the habit of feeding sheep offal to working dogs.[147,148] A large number of human infections resulted, some of which were fatal. A 1960 survey reported 92.5 human infections per 100,000 population.

Tasmania began a control program in 1962 to stop transmission of hydatid disease to humans. Public meetings were held and committees formed to raise awareness of the considerable health risk of hydatids. The Tasmanian program was aimed at stopping the hydatid life cycle by denying dogs access to offal from sheep, cattle, goats and pigs. It included regular testing of dogs for tapeworm infection, together with an educational program emphasising prevention. Abattoir monitoring of sheep enabled rural properties with infected dogs to be traced. With community support, the voluntary program became compulsory in 1966. The number of new human infections per year fell from 18 in 1966 to four in 1983, with equally striking falls in the prevalence of tapeworm in dogs and hydatid cysts in sheep (to less than 1%).

In 1996, Tasmania was declared 'provisionally free' of hydatid disease, as there had been no new infections in humans, dogs or commercial livestock for several years.[149] Around 400,000 sheep and 60,000 cattle were inspected for hydatid cysts in abattoirs each year in Tasmania and, if found, further action (e.g., quarantine, slaughter of flock) was taken at the property of origin. It continued to be illegal to allow dogs access to livestock offal in Tasmania, and dogs entering the island had to have been previously treated for tapeworm.

Control of human hydatid disease in Tasmania was recognised worldwide as a most successful public health campaign and a model for hydatid control programs. It achieved success as a public health measure because of its emphasis on public participation, community education, and united action by many agencies including agriculture and health departments, underpinned by sound epidemiological principles.[150] Hydatid disease ceased to be a notifiable disease in the year 2000.[151]

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2 Maintaining a safe environment: 1901 onwards

'Australians are entitled to live in a safe and healthy environment.'
– The National Environmental Health Strategy, 2000.[152]

At the beginning of the 20th century, the focus of environmental health activity was on public engineering and sanitation, in order to provide safe drinking water and remove waste (e.g., 'nightsoil' or sewage, and industrial waste), and the elimination of housing slums. Later, the large-scale implementation of sanitation prevented the spread of infectious diseases and safeguarded the environment. The application of housing standards, building codes, and land use planning resulted in better housing and less overcrowding.[153]

By the end of the 20th century, a high standard of environmental health was the norm for most people in Australia. The housing and environmental health of many Aboriginal and Torres Strait Islander communities, however, fell far short of that enjoyed by other Australians.[154] Results from the *2001 Community Housing and Infrastructure Needs Survey* for Indigenous communities indicated that around one in four permanent dwellings 'were in poor condition, needing major repair or replacement' (27%, down slightly from 29% in 1999).[155]

There were some improvements: a reduced proportion of the population living in temporary dwellings; a larger proportion of permanent dwellings connected to water, power and sewerage systems; and fewer communities with more than 50 people experiencing sewerage system overflows and leakages (48%, down from 59% in 1999). A range of further measures was put in place to address the poorer environmental health of many remote and rural Indigenous communities (e.g., training and employment of Environmental Health Workers, remedial housing health hardware programs).[156]

The 2005 Productivity Commission report, *Overcoming Indigenous disadvantage*, identified 'effective environmental health systems' as an area for action:

- to reduce rates of water and foodborne diseases, trachoma, tuberculosis and rheumatic heart disease (diseases associated with poor environmental health);
- to improve access to clean water and working sewerage systems; and
- to reduce overcrowding in housing.[157]

Environmental health and housing in remote Indigenous communities remained areas of public health concern, as they are critical determinants of health and wellbeing for Aboriginal and Torres Strait Islander peoples. The development of an Indigenous environmental health workforce, a long-term strategy to improve housing and health infrastructure in remote communities, and growing community awareness of the importance of environmental health, were steps towards improving the health of these Australians (Box 2.1).[158]

Across Australia, other initiatives included better control and reduction of environmental poisons (e.g., lead and asbestos) through the implementation of broad strategies such as the removal of lead from petrol and paint, the closure of asbestos mines and nation-wide banning of asbestos and products containing asbestos (Sections 2.1 and 2.2). However, human exposure to many chemicals remained a concern.

Urban air quality improved after the first *Clean Air Acts* in 1967, and there was continuous monitoring of certain pollutants, as well as the setting of national ambient air quality standards (Box 2.2). Levels of passive tobacco smoking were reduced by laws to make workplaces and public spaces smoke-free, and by media awareness campaigns to reduce children's exposure to tobacco smoke in homes and cars (Section 1.1). However, general indoor air quality required coordinated attention, as Australians as a whole spent up to 90% of their time indoors.[159]

Box 2.1 Housing for Health, 1985-

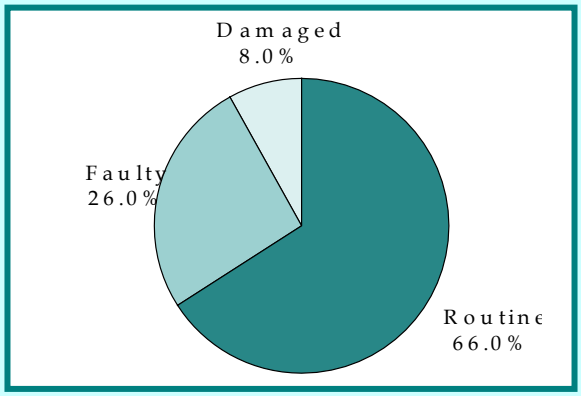
Indigenous community and state-based Housing for Health (HfH) projects operated from 1985.[160] In 1987, Nganampa Health Council developed 'Healthy Living Practices' and demonstrated that improvements in the health hardware of housing in Indigenous communities halved the incidence of skin and eye infections.[161] (Health hardware refers to those items in a house that assist in maintaining the health of the occupants). In methodology developed by the Council, nine essential healthy living practices were developed: washing people; washing clothes/bedding; waste removal; nutrition; reduced crowding; separation of dogs and children; dust control; temperature control; and reduced trauma.

Fixing Houses for Better Health (FHBH) began in 1999 as a collaborative program between Healthabitat, ATSIC, state/territory Aboriginal and Torres Strait Islander housing agencies and health departments in NSW, Qld, SA, WA and NT, using the HfH approach to make urgent safety and health hardware repairs to existing housing and living areas.[162]

In 2001, Australian Housing Ministers announced a ten-year plan for new directions in Indigenous housing and environmental health.[163] The (then) Department of Family and Community Services (FaCS) allocated $9m for FHBH projects over four years, to survey and fix 1,500 houses in remote Indigenous communities. The success of HfH and FHBH projects relied on immediate action and the principle of 'no survey without service' (framed by the late Dr Fred Hollows).[164] FHBH projects were evaluated as successful in fixing critical health hardware deficiencies of houses in participating communities, the delivery method was endorsed, and further funds were allocated in 2005 to extend FHBH projects and associated research and development.[165]

Accurate data from the projects enabled the debunking of the myth that 'housing was poor because it was damaged by community members'.[166] As indicated in Figure 2.1, faulty work and (unmet) need for routine maintenance were the more significant reasons.

Figure 2.1: Reason fix required, national fix work data as recorded by licensed trades, 1999-2005



Source: McPeake & Pholeros, *National Housing Conference 2005*, 2005, p. 5.

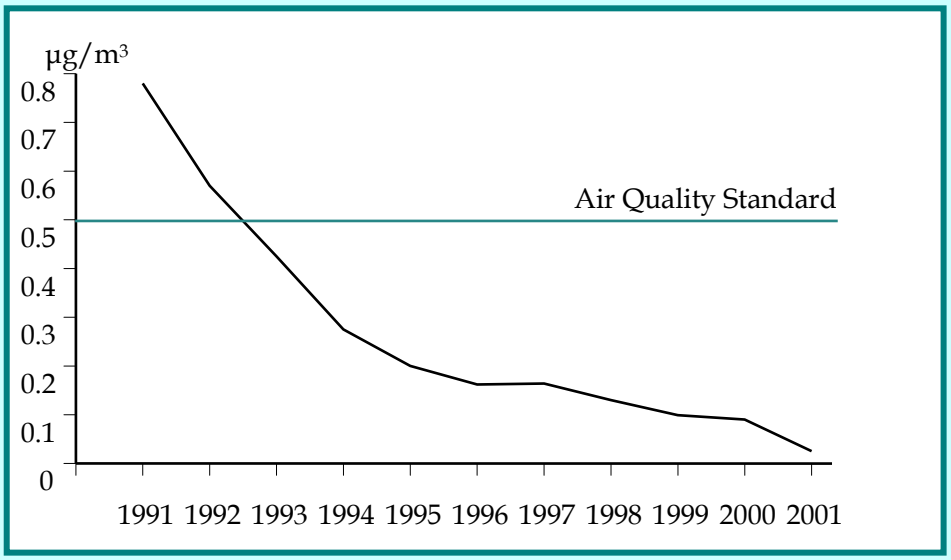
Nationally, there was greater community awareness of the state of the environment, demonstrated by activities such as rubbish recycling schemes, the annual 'Clean up Australia' day and other community-led projects. In many of these, the public health sector played an active role.

The future health consequences of global climate change, however, required further effort from environmental health and public health practitioners. Impacts in Australia were likely to include increases in heat- and flood-related deaths and injuries, and the expansion of geographic areas susceptible to the transmission of tropical infections such as dengue fever and malaria. More research would be needed to identify the best ways in which humans could adapt to these changes. Some individuals and communities lacked the resources required to respond adequately, and remote Aboriginal communities, people on low incomes and elderly people were particularly vulnerable.[167]

Box 2.2 Improvements in urban air quality, 1967-

Reductions in air pollution delivered long-term benefits to the health of the population, and there were major improvements in urban air quality with the Clean Air Acts in the 1960s. Monitored airborne lead levels showed a decrease following the introduction of lead-free petrol in 1985. On 15 March 2000, the Australian government announced a phase-out of leaded petrol under the *National Fuel Quality Standards Act 2000* (Figure 2.2).[168] On 1 January 2002, the phase-out was completed. The *State of the Environment Report* (2006) described airborne lead concentrations as no longer of concern in urban areas.[169] Major urban centres also reported levels well below national standards for carbon monoxide, sulphur dioxide, and nitrogen dioxide.[170]

Figure 2.2: Trend in average annual airborne lead levels, 1991-2001



Note: µg/m^3 = micrograms per cubic metre; graph based on national averages calculated from site-specific data.

Source: Department of Environment and Heritage, *State of the air: community summary 1991-2001*, 2004, p. 6.

Air quality improvements were also attributed to national controls on motor vehicle emissions, better motor vehicle design (especially in emissions' control technologies such as catalytic converters), and new fuel standards.[152,171] Stringent new vehicle emissions' standards for diesel and petrol vehicles, and changes to Australian Design Rules were implemented from 2002 to 2007 as part of the Australian government's 1999 *Measures for a Better Environment* tax package. Despite these improvements, motor vehicle-related ambient air pollution in 2000 was still estimated to cost approximately $2.7 billion annually. The economic benefits of reducing air pollution included productivity gains (e.g., employees needing fewer sick days) and savings in health expenditure (e.g., fewer cardio-respiratory deaths and illnesses requiring treatment in hospital).[172] Other air pollutants, particularly ozone and particle levels, were high relative to air quality standards.[152]

Public health principles and practices

The *Australian Charter for Environmental Health* contained a set of nine principles: human health protection; interrelationships between economics, health and environment; sustainable development; local and global interface; partnership and cooperation; risk-based assessment and management; evidence-based decisions; efficiency; and equity.[173] Public health practitioners helped to develop a suite of protective responses to environmental health risks. Safeguarding environmental health continued to develop as a successful instrument against a range of potentially hazardous exposures. Two major challenges to attaining equitable environmental health management still existed:

- ensuring access to safe and healthy environments for rural and remote Indigenous Australian communities; and
- safeguarding the quality of environments for the health of future generations.[174]

These two challenges formed the environmental health justice component of the *National Environmental Health Strategy implementation plan*.

Table 2.1: Historic highlights of successful environmental health strategies

Asbestos	
1937-1966	Asbestos mining commenced at Wittenoom, WA until shut down in 1966.
1955	Asbestos identified as a cause of lung cancer.
1962	First reported case of mesothelioma; in retrospect, 658 cases in Australia from 1945-1979.
1970s	Peak of asbestos product manufacturing and consumption.
Late 1970s-early 1980s	A series of regulations adopted by the states imposed asbestos exposure limits.
1980	Australian Mesothelioma Surveillance Program commenced (later, the Australian Mesothelioma Register).
1983	Asbestos mining ceased in Australia with the closure of the Woods Reef mine in NSW.
1999	Risks of Chrysotile asbestos published.
2001	Workplace Relations Ministers' Council agreed to phase out all new chrysotile asbestos use by 2003.
2004	Asbestos and all products containing asbestos banned Australia-wide.
Lead	
1925	SA Royal Commission examined high numbers of lead-affected Port Pirie workers; research into lead effects on the local environment.
1969	NHMRC amended the Uniform Paint Standard to reduce the amount of lead in domestic paint to 1.0%.
1979	SA Port Pirie Cohort Study examined the effect of lead on the neurological development of children.
1984	SA Government set up Port Pirie Lead Implementation Program and remedial interventions commenced.
1993	NHMRC revised 1987 guidelines for lead in blood and ambient air.
1994	National Occupational Health and Safety Commission declared the National Standard for the Control of Inorganic Lead at Work and the National Code of Practice for the Control and Safe Use of Inorganic Lead at Work.
2001	Major urban centres reported airborne lead levels well below national standards.
2004	Continued funding of the SA Lead Program and a further review of the Program's goals and focus.
2006	National Industrial Chemicals Notification and Assessment Scheme (NICNAS) declared lead compounds in industrial surface coatings and inks as priority existing chemicals for health risk assessment with a view to eliminating their use.
Clean Air	
1960s	First Clean Air Acts introduced, e.g., the *NSW Clean Air Act 1961*.
1985-2002	Leaded petrol phased out.
1998	Ambient air quality standards and goals for six pollutants set.
2001	Major urban centres reported levels well below national standards for airborne lead, carbon monoxide, sulphur dioxide, and nitrogen dioxide.
2002-2007	Stringent new vehicle emission standards for diesel and petrol vehicles, and changes to Australian Design Rules (new vehicle emission standards and fuel standards) implemented.
2003	Air quality standards strengthened to address the adverse health impacts of small particle pollution.
Smoke-free premises	
1986	NHMRC reviewed the evidence on effects of passive smoking on health.
1987	Australian domestic airlines smoke free. Victoria – *Tobacco Act 1987* regulates smoking in public areas.
1988	All Australian government and Telecom offices made smoke free. State governments followed suit.
1997	Second NHMRC report on passive smoking produced and national response to passive smoking agreed.
1999	The *National Tobacco Strategy 1999 to 2002-03* endorsed.
2000	Australian Health Ministers' Advisory Council endorsed the national response to passive smoking in enclosed public places and workplaces.

2.1 Environmental lead reduction

1979 onwards

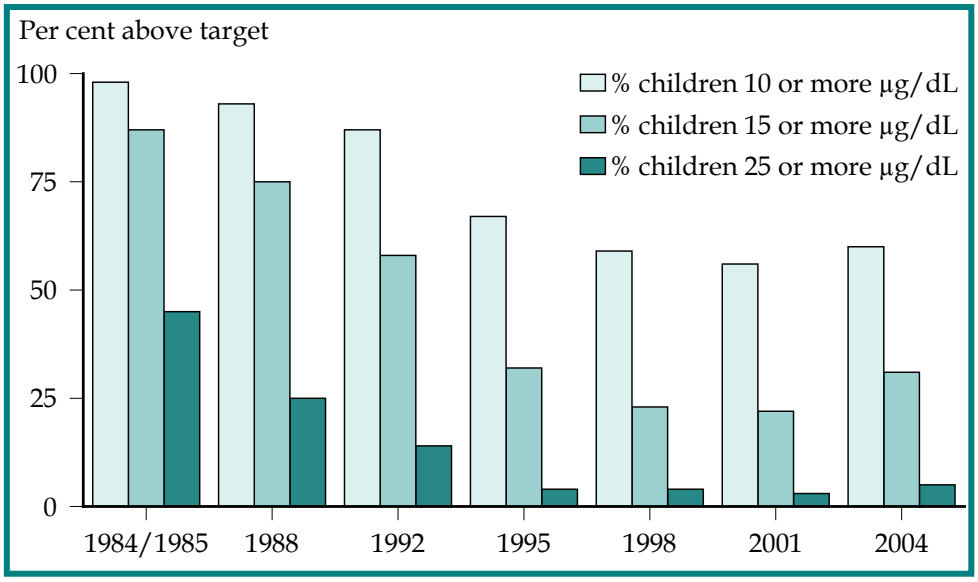
'There are no benefits of human exposure to lead and all demonstrated effects of such exposure are adverse' – National Health and Medical Research Council, 1993.[173]

Lead accumulates in the body, and even small amounts of dust containing lead pose a health risk.[174] At the levels of lead exposure experienced by communities located near lead mines or smelters, there were significant neuro-behavioural effects on children's health and development, especially on their cognitive performance.[175] The youngest children were at greatest risk because of lead-ingesting behaviours (e.g., putting things in their mouths), increased ability to absorb lead and the susceptibility of their rapidly developing central nervous systems.[175,176] Evidence suggested that the intelligence quotients (IQ) of children could be reduced by up to five points for each 10µg/dL (micrograms per decilitre) increase in blood lead level within the range 10-25µg/dL.[175]

Public health research showed that there were measures that could be taken to reduce the impact of lead in the communities that were most affected (the 'point source communities'). Such sites included Port Pirie in South Australia; Broken Hill and Boolaroo in New South Wales; Mt Isa in Queensland; and other places in Australia where mining, transport, processing and shipping of lead had taken place.[177,178,179]

In 1925 in South Australia, a Royal Commission first investigated the high numbers of lead-affected Port Pirie workers. In 1979, the Port Pirie Cohort Study, funded by the SA Health Commission, began to examine the effects of lead on the neurological development of children. The Port Pirie Lead Implementation Program was established in 1984 in response to the environmental contamination that had accompanied a century of smelting, and a range of interventions followed. Over the 20 years of the program, dramatic reductions in blood lead occurred in Port Pirie. In 1984, 98% of young children exceeded the later NHMRC goal of 10µg/dL. This significantly improved with a fall to 55% by 2001. These reductions, however, reached a plateau and started to rise somewhat after 2001, serving as a timely reminder that Port Pirie was still the most contaminated area in Australia and much still remained to be done.[175]

Figure 2.3: Percentage of Port Pirie children aged 1-4 years with blood lead levels above target values, 1984-2004



Source: Maynard et al., *The Port Pirie Lead Implementation Program*, 2006, p. 25.

This example of a lead remediation program in a heavily polluted location showed that mitigating the effects of accumulated environmental lead on a community was a long-term project, requiring a sustained public health effort.

In 1993, the NHMRC revised the 1987 guidelines, and recommended a specific goal, 'to achieve for all Australians a blood lead level of less than 10 µg/dL (micrograms/decilitre or 0.49 µmol/L), of particular urgency for children aged one to four because of the known adverse effects of lead exposure on intellectual development'.[173] The aim was to achieve this in 90% of all children aged one to four years, by the end of 1998. The goal was achieved - the National Survey of Lead in Children in 1995 showing that 93% of the age group had blood lead levels below the NHMRC target. Seven per cent, or around 75,500 children, had blood lead levels above the target, and 2% (17,500 children) had blood levels that were notifiable (blood levels greater than 15 µg/dL). Mean blood lead levels were higher in those from socioeconomically disadvantaged households, in Indigenous children, in families with cars using leaded petrol, and in older homes that had paintwork in poor condition. The lowest levels were in children in the ACT, where there was a relative absence of heavy industry, and many of the surveyed children lived in houses built after the 1970s.[180]

There was also a reduction in lead levels in the air because of the progressive reduction of lead in fuels. Lead-free petrol became available across the country from 2002, and reduced population lead exposure was demonstrated by monitoring airborne lead levels (Box 2.3).

Over the decade to the year 2000, a decrease in the mean blood lead concentration in adults (mainly female) was observed, from 4.7 to 2.3 µg/dL, a decrease of about 5% per year (and comparable to that observed in other countries).[181] National air quality standards set out maximum allowances and specified measurement and sampling requirements, and there were also standards for drinking water, and occupational exposures.[182]

Public health principles and practices

Public health practice focused on populations at two levels: the overall population and the groups within it that were most affected and therefore at greatest risk. Standards and guideline setting, regulating, and monitoring all played a role. There were achievements in long-term public health programs to remediate lead-toxic environments, as demonstrated by the reduced blood lead levels of those living in affected communities such as Port Pirie. Other programs were less successful (e.g., in Broken Hill, drought and wind stirred up lead-laden dusts and exposure levels, which had decreased, rose again).[183]

Remediation approaches that integrated a range of activities into a multi-focused strategy, included:

- population monitoring and active case finding;
- case management of identified cases;
- public education and health promotion;
- remediation of public land, and, in some cases, of private land and housing; and
- ongoing evaluation, research and development.[175]

There were also environmental controls on the disposal of lead-contaminated waste, and public guidance was widely available.[174]

In the occupational health area, the *National Standard for the Control of Inorganic Lead at Work* and the *National Code of Practice for the Control and Safe Use of Inorganic Lead at Work* were released in 1994, and aimed to 'progressively reduce lead exposure and blood lead levels to convert existing lead-risk jobs to no lead-risk jobs'.[184] There was routine monitoring of blood lead levels in people who were at high risk of occupational exposure (e.g., heavy industry and lead mine workers).

More generally, there was ongoing public health activity in setting and testing hazardous and risky lead exposure level standards, in researching how to best mitigate its effects, and in preparing educational material to warn of its hazards (e.g., warnings regarding domestic removal of lead paint).

The *National Pollutant Inventory* came into effect in 1998 after a three-year period of development, and held increasingly better data on sources of lead and compound emissions in Australia.[185]

Factors critical to success

Successful public health measures to counter environmental lead included:

> ***Survey respondent:*** *[Successful public health interventions have been] 'large scale and over time - all mining communities cleared out (asbestos), lead – removal from petrol, and abatement in communities.'*

- the introduction of lead-free petrol from 1985;
- the use of tarpaulins and other measures to limit lead dust escaping into the environment by covering lead loads transported from mines, often across long distances, to processing or shipping facilities;
- the removal of lead from paint: the Uniform Paint Standard was amended in 1969 to reduce the amount of lead in domestic paint to 1% (with States altering their relevant legislation soon after, e.g., amendments to the *NSW Poisons Act 1966* in 1972); and, from 1997, the limit was further reduced to 0.1%, well down from the 50% that was common for lead in paint in the 1950s (care had still to be exercised in relation to renovating or removing older paints);
- bans on lead shot in the duck season and over wetlands (from 1998 in the NT and SA; from 2001 in Victoria); and
- the increasing availability of lead-free products: by 2002, there were lead-free 'fishing sinkers, shot, bullets, flashing, PVC cable sheathing, PVC plastic products, mirror-backings, line-marking paints, solder, collectors' metal miniatures, chess pieces, artists' paints, industrial paints, and wicks for candles'.[186-189]

These programs all contributed to a healthier population by reducing environmental lead exposure.

In communities affected by environmental hazards such as lead, the interventions focused upon the whole community, especially children, who were most at risk. Programs represented sustained efforts over a long period of time, supported by substantial government investment. The most successful programs engaged the affected communities, conducted regular independent reviews of the effectiveness of program activities, disseminated findings widely, and had collective community agreement about necessary action.

The removal of lead from widely used products (e.g., petrol and paint) was achieved over a relatively short time, by balancing commercial interests and the public's health. Awareness of the dangers of lead exposure was raised in lead-affected communities, and more generally. Lead emissions and other sources of lead pollution were routinely monitored, as were human exposures to lead.

Future challenges

> *'As environmental exposure to lead declines for the whole population, continued specific attention is needed for children living in industrial areas.'*
>
> – NR Wigg, *Journal of Paediatric Child Health,* 2001.[190]

The *State of the Environment report* (2006) found that, while urban air quality had continued to improve and lead concentrations were no longer of concern in urban areas, lead emissions in specific localities (e.g., Port Pirie, SA; Broken Hill, NSW; Mount Isa, Qld) remained problematic.[169] Exposure of lead-affected communities required ongoing attention, and more needed to be done to improve lead abatement at its source (e.g., reducing industrial emissions) and in transit (e.g., covering loads and stockpiles at ports).[186] The challenge was to work more closely with lead polluters to improve abatement and remediation measures, and investigate more effective preventive measures, especially for those young children most at risk.[191] Lead dust is an important source of dietary

contamination as it does not degrade, and better secondary processing to remove it from the soil system was required to limit contamination of the air, food and water.[181]

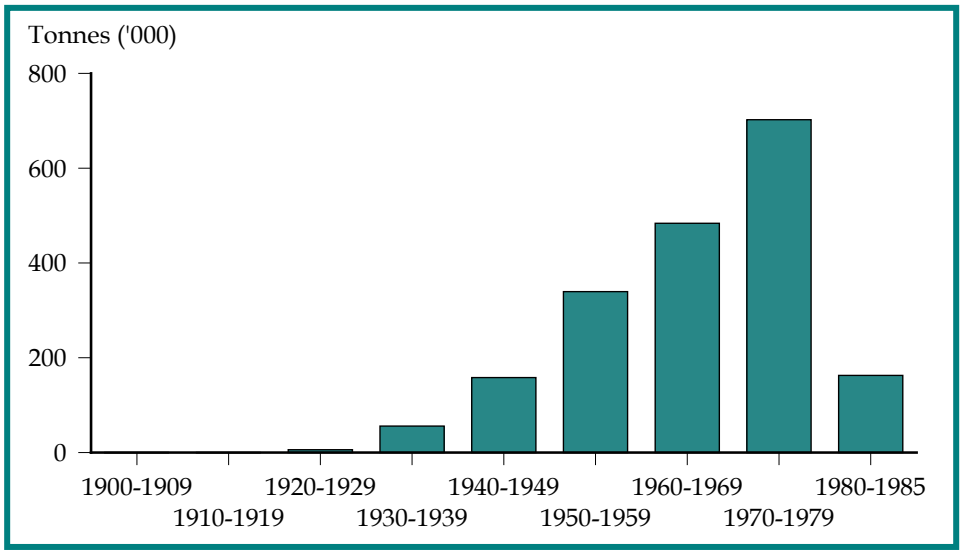
Evidence-based responses to environmental hazards tended to be slow, with lag times of sometimes more than 30 years before effective action was taken. A further public health challenge was to shorten the response interval in initiating preventive action.

2.2 Reduced exposure to environmental asbestos

1960s onwards

The mineral, asbestos, was widely used in many industries throughout Australia over the 20th century because of its strength, flexibility, and durability and its resistance to heat, acids and alkalis. The majority of asbestos used was incorporated into 'fibro' cement, i.e., cement reinforced with asbestos fibres, and formed into building materials, and pressure and sewerage pipes. By the 1950s, it was found in most homes, cars and workplaces. Australia was both an importer and exporter of asbestos, and a substantial local mining industry existed, exposing thousands of workers and their families to asbestos dust. In addition to mining and production, the export process (e.g., bagging, transport and wharf labour) also exposed many others to its hazards. By 1954, Australia was the fourth largest gross consumer of asbestos cement products in the world and the first on a per-capita basis.[192] A crude estimate of Australia's overall exposure, 'apparent consumption of asbestos' (the difference between amount produced and imported, and amount exported), is shown in Figure 2.4.

Figure 2.4: Apparent asbestos consumption, 1900-1985 (tonnes)



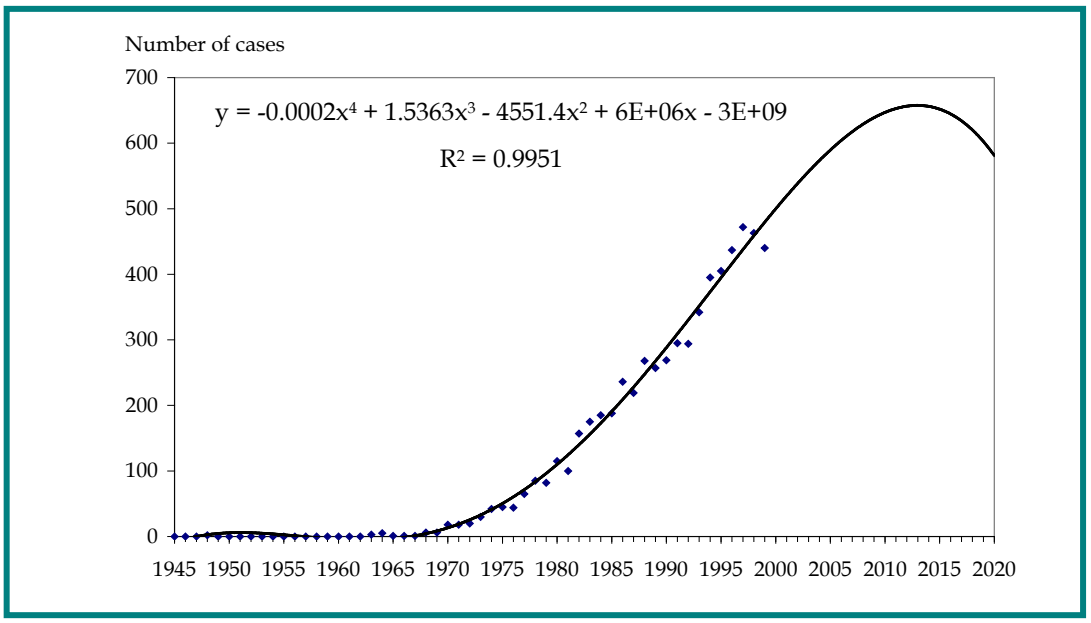
Source: Leigh & Driscoll, *International Journal of Occupational and Environmental Health*, vol. 9, 2003, p. 208.

By the end of the 20th century, asbestos was no longer 'mined, milled or manufactured' in Australia because of the known health risks.[193] However, much of the industry's output was still in use (e.g., in 'fibro' houses, power stations and in water and sewerage piping), and the risk of exposure remained high in certain industries and occupations.[192] There was relatively early recognition in Australia of the health risks associated with asbestos exposure and, in 1955, it was demonstrated that asbestos caused lung cancer.[3] Occupational exposures were estimated to be responsible for 15% of lung cancers in males, with air pollution possibly contributing a further 5% of cases.[194]

The first case of mesothelioma (a rare lung cancer that develops decades after asbestos exposure) was reported in 1962 in Wittenoom in Western Australia and, by 1969, another fourteen cases had been reported in Victoria and Queensland.[192,195] Research then demonstrated that nearly all human mesothelioma cases resulted from asbestos (or erionite) exposure, which could be very small. While there was a dose-response relationship with asbestos exposure, a threshold level was not identified

(studies showed that it was less than 0.15 fibre year/mL).[192] As Leigh and Driscoll commented, 'With this background, it was almost certain that Australia would suffer a severe mesothelioma epidemic' (Figure 2.5).[192]

Figure 2.5: Incident cases of malignant mesothelioma, 1945-1999, and extrapolated to 2020



Source: Leigh & Driscoll, *International Journal of Occupational and Environmental Health*, vol. 9, 2003, p. 214.

In 2001, the number of mesothelioma cases notified to the Australian Mesothelioma Program and Register from 1945 onwards totalled 7,027 (a further 488 notifications added to mid-2003 probably under-estimated the actual number of diagnosed new cases).[192] Notifications showed a continuing upward trend in both males and females, and Australia had the highest reported incidence of malignant mesothelioma in the world during the last two decades of the 20th century. Incident cases were not expected to peak until 2014, forty years after the maximum asbestos exposure period of the 1970s.

Public health principles and practices

The initial recognition of the link between respiratory exposure to asbestos and asbestosis, lung cancer and mesothelioma led to public health measures to reduce environmental asbestos as a hazard.[196] Asbestos was no longer mined in Australia, and at least one mine closure was related to its inability to meet occupational dust control regulations (although the international market for asbestos had also weakened). The asbestos mine at Wittenoom closed in 1966, and all asbestos mining ceased in Australia when the last mine (Woods Reef, NSW) ceased production in 1983.[197]

It was public health research that identified the problem from the 1950s, continuing into the 1960s and 1970s and led to action to prevent further exposure. Asbestos exposure was significantly reduced by closing asbestos mines and their proximate townships, and by asbestos fibre control (from the 1980s). The Australian Mesothelioma Surveillance Program (later known as the Australian Mesothelioma Register) began in 1980.[198] Using its data, occupational and industrial links were established and lifetime risks of mesothelioma were calculated for a range of occupations.[199]

From the late 1970s to the early 1980s, a series of regulations were adopted by individual jurisdictions to impose limitations on asbestos exposure. Asbestos use in motor vehicle parts such as brake linings and clutch plates was phased out, but products used in the construction industry remained in many older buildings. The Workplace Relations Ministers' Council agreed to support the phasing out of all new chrysotile products (a form of asbestos) by 2003, and, from 31 December 2003, asbestos and products containing asbestos were banned and could not be imported, stored, supplied, sold, installed, used or re-used in Australia.

Strict precautions also governed the removal and disposal of asbestos and asbestos-containing materials.[193] For instance, occupational health and safety regulations stipulated that asbestos-containing material could only be removed by licensed removalists; and the transport and disposal of asbestos waste was regulated by the Environment Protection Authority, which specified safe handling and disposal methods through special licensing.

Factors critical to success

Large-scale interventions, such as the closure of mines and townships, had a relatively quick impact on reducing associated exposures to asbestos. Control measures were put in place to limit the risks of domestic, occupational and industrial exposures, and to manage asbestos risk reduction and removal.[197]

> ***Survey respondent:*** *'Asbestos fibre control [has been a public health success] - while we are still seeing a terrible toll in terms of mortality (mesothelioma and lung cancer) and to a lesser extent morbidity (asbestosis) from this today, it would have been orders of magnitude worse without prompt action to reduce exposure during the 1980s.'*

The Mesothelioma Register played an important role in focusing attention on the health problems posed by asbestos; and there was ongoing monitoring of the health of those affected by asbestos exposure. By the end of the century, there was state and national government support for appropriate compensation for those affected by asbestos exposure. In 2006, The Asbestos Diseases Research Centre at the University of Western Australia was set up to research mesothelioma and new methods of treatment.

Future challenges

Ongoing challenges included the risks to communities that were still being exposed to asbestos environmentally (i.e., naturally, or through windblown tailings) and domestically (e.g., through use of asbestos in older buildings). There were significant numbers of people who had already been exposed, or might yet be exposed in older domestic settings, and whose health needs would lead to future costs for the health care system. It was estimated that the number of mesothelioma cases would grow to around 18,000 cases by 2020, with the additional case load for asbestos-related lung cancer expected to be around 30,000-40,000 cases (two cases of asbestos-related lung cancer for every one case of mesothelioma).[192] About 11,000 of the expected mesothelioma cases were still to appear, creating a substantial future demand for clinical management, and for compensation.[192,200,201]

As with lead, the challenge was to manage the tension between economic benefit and the risk to public health, to speed up effective responses to environmental threats, and to reduce the liability caused by external costs imposed on the wider community (and hence, borne by governments and citizens rather than the polluter).[168]

2.3 Reducing the health effects of passive smoking

1995 onwards

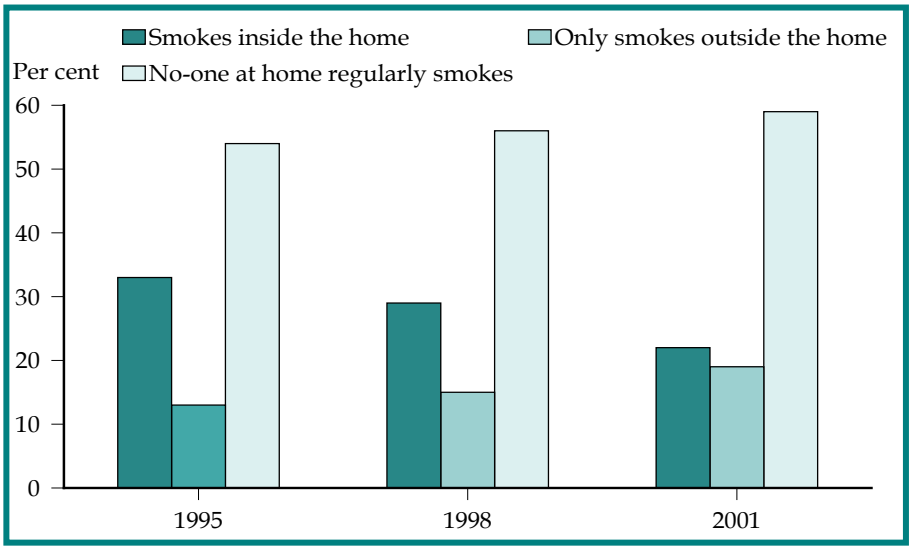
Public health studies demonstrating the adverse health effects of passive smoking in adult non-smokers first appeared in the early 1980s, and, by 1995, over 600 published medical studies linked exposure to environmental tobacco smoke (ETS) with lung cancer and other respiratory diseases.[203] In 1987, the NHMRC review on the evidence of health effects of passive smoking concluded that it was a cause of respiratory illness and contributed to the symptoms of asthma in children.[218] Then, research showed that passive smoking contributed to Sudden Infant Death Syndrome (SIDS) and developmental delay in children.[204,205] Furthermore, the risk of heart attack or death from coronary heart disease was estimated to be 24% higher in non-smokers who lived with a smoker.[218]

Legislation, regulation and other initiatives to highlight public awareness of the dangers of passive smoking (inhalation of ETS) resulted in large increases in the number of premises that were tobacco smoke-free. These included workplaces (where some of the first bans on smoking inside were put in place), public spaces and commercial buildings. By 2000, many jurisdictions had controlled exposure to ETS by regulating against smoking in public buildings, and smoking had been banned on all forms of public transport, in cinemas, theatres and concert halls, and increasingly in shopping centres and restaurants.[206,152]

Both smokers and non-smokers benefited from smoke-free premises. In a review of studies on the impact of smoke-free workplaces, Chapman and colleagues found a reduction in the number of cigarettes consumed (i.e., smokers smoked less) and in the prevalence of smoking (i.e., some people quit smoking when their workplaces became smoke-free).[206] They estimated that around 22% of the 2.7 billion cigarette decrease in cigarette consumption from 1988 to 1995 was attributable to smoke-free workplaces. A longitudinal study that sampled a cohort of workers in 1993 and 2001 confirmed that smoke-free workplaces were a significant factor in increasing the proportion of workers who reduced their cigarette consumption, and of those who stopped smoking altogether. [207]

Most importantly, results from population surveys demonstrated a reduction in the proportion of people smoking inside homes with young children (Figure 2.6).[208] This reflected a significant change in community behaviour and attitudes.

Figure 2.6: Proportion of population smoking in homes with young children, 1995, 1998 and 2001



Source: National Health Performance Committee, *National report on health sector performance indicators 2003*, 2004, p. 41.

When smoke-free premises' legislation was first mooted, many industry groups argued that the legislation would result in 'economic ruin' because of a loss of customers and that it was unnecessary

and unworkable.[209] However, these predictions did not eventuate.[210,211] Laws that initially restricted and then eliminated smoking in public premises limited opportunities for smoking, and reduced the social acceptability of smoking in enclosed spaces.[209]

For example, a survey of adult South Australians conducted in 2005, examined the effect of phasing in smoke-free laws and found that there was high community awareness of, and support for, smoke-free premises' laws, and the laws had not reduced the patronage of licensed premises.[209]

This legislation was an effective public health measure because the behaviour modelled in social settings such as licensed premises (e.g., bars and clubs) potentially affected social norms.[212] It was also likely that, as children's main exposure to ETS occurred in family homes and cars, the adoption by adults of voluntary smoking restrictions would substantially reduce children's exposure.[213]

> *'Smoke-free restaurants do not require "smoking police" to enforce bans, present few ongoing difficulties for staff, attract many more favourable than unfavourable comments from patrons, and do not adversely affect trade.'*
>
> – S Chapman et al., *Medical Journal of Australia* 2001.[211]

Public health principles and practices

Smoke-free premises' legislation took both a population and an environmental health approach to decreasing levels of passive smoking. The Australian government led by example, implementing smoke-free workplaces and public spaces in areas under its jurisdiction. It also played a role in providing evidence on the harmful effects of ETS through the NHMRC reports, and in encouraging state and territory governments to make the necessary legislative and regulatory changes.

Australian government smoking bans were introduced in all federal government and Telecom buildings in 1988, as well as in aircraft, buses and coaches that were registered under the Federal Interstate Registration scheme, and in domestic aircraft and airports operated by the Federal Airports Corporation.[214] The state governments followed soon after - in Western Australia for example, the public service became a smoke-free workplace in 1989, and smoke-free areas were extended through the *Health Act 1911*, the *Tobacco Control Act 1990* and *Occupational Health and Safety Regulations 1996*.

After the release of the NHMRC's scientific information paper on passive smoking in 1997, the Australian government determined that, as a major public health issue, passive smoking warranted a national response.[4,215] By the time of the first *National Tobacco Strategy* in 1999, it was considered that extending smoke-free workplaces and public places could not be achieved by 'education, information, common courtesy, voluntary codes and other forms of self-regulation' alone, and that 'legislation would be the most effective strategy for significantly reducing exposure' to ETS.[216]

The Legislative Reform Working Group of the NPHP, working in consultation with state and territory government tobacco control policy officers, developed the *National response to passive smoking in enclosed public places and workplaces* to assist these governments to review existing, and enact new legislation on passive smoking.[215] The national response was also intended to assist jurisdictions take action on one of the six key objectives of the *National Tobacco Strategy 1999 to 2002–03*: reducing exposure to tobacco smoke through, for example, the 'establishment of smoke-free environments (both private and public) as the norm'.[216] It included guiding principles (Box 2.3) as well as model legislation, and was endorsed by the Australian Health Ministers' Advisory Council in 2000.[217]

Box 2.3 Smoke-free public places' and workplaces' legislation: Guiding principles

1. People have a right to participate in the life of the community without risks to their health from environmental tobacco smoke exposure. This right can be most effectively safeguarded in enclosed and in confined public places, where non-smoking is the normal practice.

2. There is no 'right to smoke' in an enclosed public place or workplace.

3. Non-smoking requirements should be designed to apply equally to all premises within a given industry sector in order to facilitate equal treatment of premises, and to promote community awareness, understanding and compliance.

4. A successful transition to 'non-smoking as the norm' may involve phasing-in arrangements for some types of premises.

5. Compliance systems should be based primarily on awareness, education and community support.

Two additional principles for legislative approaches to smoke-free workplaces specified that:

1. Public areas of workplaces should be non-smoking.

2. A non-smoking work environment should be regarded as the norm.

Source: National Public Health Partnership (NPHP), *National response to passive smoking in enclosed public places and workplaces – guiding principles for smoke-free public places and workplaces legislation*, NPHP, Melbourne, 2000, pp. 2-4.

The Australian government then encouraged state and territory governments to take further action to limit the ETS exposure of children in cars. Tasmania and South Australia were first to ban smoking in cars when children were present. The involvement of public health practitioners in encouraging parents to reduce ETS exposure in the home and car and, ideally, to opt for smoke-free environments, was an important public health approach to reducing ETS-related morbidity.[218] For example, the NSW Environmental Tobacco Smoke and Children community education project, which aimed to raise awareness of the risks associated with passive smoking, and provide parents and carers with ways to minimise children's exposure, surveyed adults in NSW where there was a smoker and young children in the household and found that:

The ETS and Children Project

- smoke-free homes increased from 47% in 2002 at the start of the campaign, to 73% in 2005;
- smoke-free cars had a similar increase – from 43% in 2002 to 61% in 2005; and
- there were significant changes in attitudes and knowledge, with people surveyed after the campaign more likely to agree that exposing children to ETS in the home and car would affect children's health.[219]

Research revealed that objective measures of ETS exposure (e.g., bio-markers such as urinary cotinine) were, to some extent, higher that those based on self-report.[220] However, these survey responses demonstrated what could be achieved by increasing public awareness and access to information resources for parents and carers, early childhood education and health practitioners, and policy makers.

Factors critical to success

The leadership of the public health practitioners and researchers who first advocated reducing the harms arising from ETS exposures was vital to the success of subsequent interventions. The Australian government played a significant role in reducing ETS exposure through the introduction of smoke-free premises in the late 1980s, and through its encouragement of the jurisdictions to take similar action.

Another factor was the willingness of local, state and territory governments to regulate and legislate for the introduction of smoke-free workplaces and premises.

Community support for, and compliance with the introduced restrictions was also an important factor behind the increasing public health success of smoke-free premises, with early compliance by patrons.[211] Perhaps the greatest contributor to the success of smoke-free premises was the gradual nature of the changes that were introduced (although some public health commentators described the thirty-year period taken to ban smoking in enclosed spaces, as change 'moving at glacial pace'). Nevertheless, the fact that these initiatives were also accompanied by public health information, health promotion, and community awareness-raising resulted in a major shift in public attitudes towards the social unacceptability of smoking. Legislative change proceeded in partnership with social change.

> ***Survey respondent:*** *'Smoke-free premises and the control of air pollution in or caused by industry have reduced the burden of chronic respiratory disease and can be expected to reduce it further.'*

Cost-effectiveness

Abelson and colleagues estimated that, over the thirty years from 1970 to 2010, government investment in programs to reduce tobacco consumption *per se* produced a saving of about $2 for every $1 of expenditure, with 17,400 premature deaths averted.[221] Further benefits could be accessed if exposures of children to ETS in early life were reduced, as they resulted in developmental delay as well as childhood asthma and an increased risk of cancer.[221]

In terms of benefits to business (excluding the tobacco industry), although there were fears that smoke-free premises' legislation would be costly, most businesses reported the opposite. Early changes were to a large extent 'self-policing' with businesses (in this case, 82% of surveyed restaurateurs) reporting that implementation of the law required little effort and no expenditure on their part.[220]

Future challenges

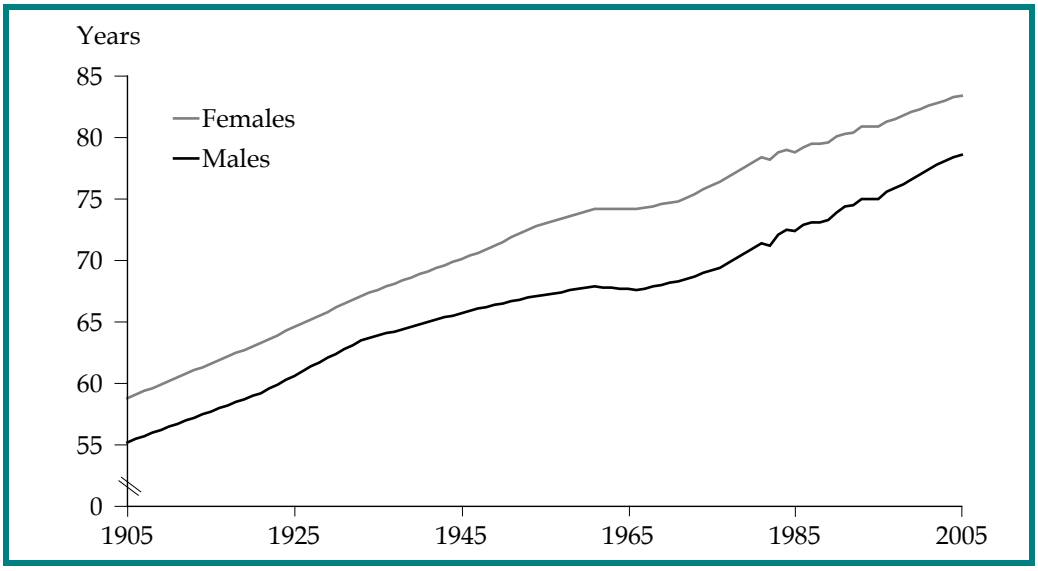
Future challenges lay in further reducing passive smoking in all states and territories, and in maintaining community compliance and cooperation. The reduction (followed by elimination) of children's exposure to ETS needed to be a national priority. Research conducted for the *National Drug Strategy* in 1995 estimated that around 1.7 million children were potentially exposed to tobacco smoke in Australian homes, with the largest proportion (41.7%) being those aged up to five years old, when the impact of ETS was greatest and developmental delay most likely to occur.[220,218]

Although evidence indicated that socioeconomically disadvantaged areas and households (including those of Indigenous Australians) had higher rates of smoking and of children's exposure to ETS (in homes and cars), the NSW Population Health Survey quantified this difference. It showed that, while 89% of households with children 0-8 years were smoke-free overall in 2003-2004, this varied from 82% of the one fifth of households that were most disadvantaged, to 95% of the one fifth of households that were least disadvantaged.[222] Other factors that made a difference were the age of the mother and whether she had tertiary educational qualifications. In order to achieve equity in terms of giving every child the best chance to grow up in a smoke-free environment, effective public health action to reduce ETS exposures of children in the most disadvantaged households across Australia was necessary.

3 Improved maternal, infant and child health: 1901 onwards

The spectacular improvement in the life expectancy and health of Australian mothers, infants and children over the 20th century was one of the most successful areas of public health effort. Advances in sanitation and hygiene, living and birthing conditions, antenatal and postnatal care, parental education (especially of mothers) and better nutrition, contributed to the substantial reductions in the mortality and morbidity of mothers, infants and children.[223] Early in the century, the large declines in infant and child death rates resulted in increasing life expectancies, while reductions in deaths at older ages contributed later in the century (Figure 3.1).[13]

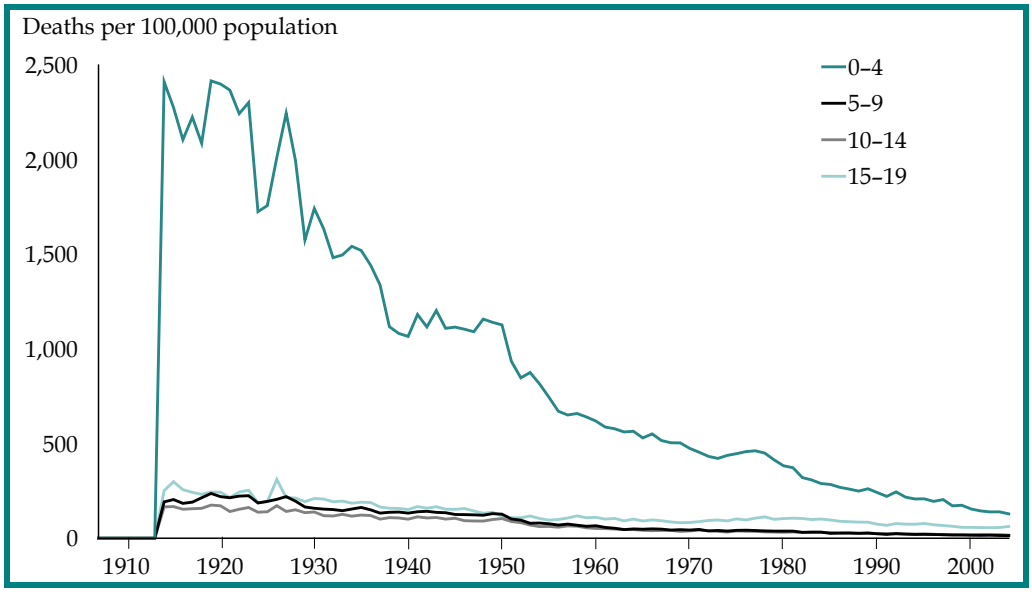
Figure 3.1: Trends in life expectancy at birth, 1905-2005



Source: ABS, *Australian Historical Population Statistics*, 2006.

Over the century, the decline in all-cause death rates of children aged under 5 years was dramatic (Figure 3.2). By 2004, the age-standardised death rate was just under 5% of the 1907 rate.

Figure 3.2: Deaths of children and young people (0 to 19 years), by age group, 1907-2004



Source: AIHW, GRIM Books, 2005.

Rates for other young age groups were also significantly lower in 2004, at 5.5% of the 1907 rate for those aged 5 to 9 years, 7.4% for those aged 10 to 14 years and 15.5% for those aged 14 to 19 years. At the end of the 20th century, however, Indigenous infants still had far lower life expectancies than non-Indigenous infants.[3] While a non-Indigenous baby had an average life expectancy of around 80 years (78.5 years for males and 83.3 years for females), an Aboriginal or Torres Strait Islander infant could expect to live only 59.4 years for a male and 64.8 years for a female.[25,224]

A wide range of measures was responsible for the reductions in infant, child and maternal death rates. These included:

- better health and nutritional status, and economic and living conditions;
- rising levels of education generally, and of parents, particularly mothers;
- improvements in medical knowledge, treatment and procedures, health care delivery systems including emergency care, the availability of antibiotics and vaccines, and the continued development of safe contraceptives; and
- shifts in social and legislative attitudes that broadened women's roles, skills and responsibilities beyond their reproductive lives.[225-227,266]

By the end of the 20th century, infants and children had become a recognised focus of public health effort, deserving special attention from health policymakers and practitioners alike. There was also acknowledgment of the importance of the period of early childhood for human development and health. Evidence from public health research, as well as from many other disciplines, emphasised the significance of early brain development and the critical influences of a nurturing environment and secure relationships in infancy and early childhood, which set a base for health, learning and behaviour throughout life.[228] Other perinatal and early childhood factors, especially nutrition and growth, were shown to have lifelong impacts on adult health, in areas such as the cardiovascular and endocrine systems.

The cost-effectiveness of public health intervention during the first years of life was demonstrated by evaluating programs such as intensive, targeted home visiting and early childhood education. Some of these initiatives in other countries returned benefits that exceeded program costs in the areas of higher employment and skill levels in mothers, reduced welfare expenditure, improved school performance, and reduced criminal activity of parents and children, and led to fewer health care costs.[229]

To this end, a draft framework for a *National Agenda for Early Childhood* (2004) proposed specific areas to which the Australian, state and territory governments might commit in order to improve outcomes for young children and their families.[230] The *Stronger Families and Communities Strategy*, initiated in 2000, was later guided by the *National Agenda* in order to provide a greater focus on early childhood initiatives.[231]

> *'Early childhood is widely acknowledged as a crucial period of physical, emotional, intellectual and social growth. How we as a society respond to the needs of young children can have a profound impact on their development and life pathways. This, in turn, has consequences for the economic and social growth of Australia as a whole.'*
>
> *– The National Agenda for Early Childhood: a draft framework, 2004.*[230]

In July 2006, the Council of Australian Governments (COAG) agreed to a suite of indicative high-level outcomes as a framework for the *Human Capital Agenda* (to improve participation and productivity), which included an outcome to 'significantly improve the proportion of children that are born healthy', and a subsidiary one, 'that the gap between Indigenous and non-Indigenous children is closed'.[232]

By the start of the 21st century, there was a greater recognition of the importance of early public health programs for infants and children. However, more effort was needed to ensure that every child in Australia had the 'best start in life', especially those who were of Aboriginal and Torres Strait Islander origin.

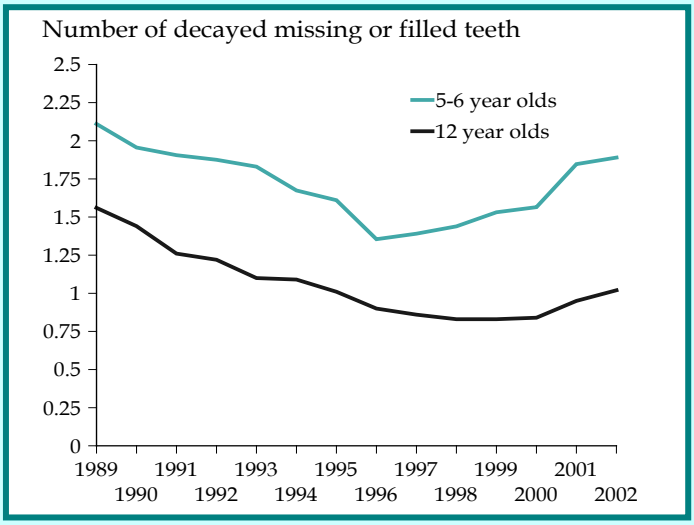
Box 3.1 Water fluoridation, 1960s-

Fluoride in drinking water protects against dental disease, especially in children, and may also have an indirect effect on reducing coronary heart disease risk by reducing the incidence of periodontal disease.[233]

The addition of fluoride to drinking water to prevent dental caries ensured that this public health measure was available to all in the fluoridated areas. In Australia, drinking water was first fluoridated in Beaconsfield, Tasmania in 1953, and then in six capital cities between 1964 and 1971, with Melbourne fluoridated in 1977.[234] Brisbane remained the only non-fluoridating capital city. In 2001-02, just over 69% of Australians (67.5% of 0-14 year olds) had access to optimal levels of fluoridated water supply.[234] Although many regional and rural communities did not have access, some commenced water fluoridation, or planned to do so.[234] The cost of adding fluoride to drinking water supplies was modest and it was estimated that each dollar invested in water fluoridation returned savings ranging from $12.60 to $80 in dental treatment costs alone, with those who were most disadvantaged gaining the greatest benefit. The goal of the *National Oral Health Plan 2004-2013* was to extend water fluoridation to all Australian communities with populations greater than 1,000 people.[235]

The Australian beverage industry applied to FSANZ to add fluoride voluntarily to bottled water to address concerns about increased consumption of bottled water and sub-optimal fluoride levels for the prevention of dental caries, but, by the end of 2006, this had not been agreed.[236]

Figure 3.3: Dental caries experience of children aged 5-6 years and 12 years, 1989-2002



Source: Australian Research Centre for Population Oral Health, *Child Dental Health Surveys* (various years), The University of Adelaide.

Tooth decay in the deciduous teeth of 5-6 year old children was lower at the end of the 1990s than in 1990 (Figure 3.3). However, and contrary to over two decades of recorded declines in decay experience, the end of the 1990s saw a period of increasing decay scores – most evident for 5 year olds who, between 1996 and 1999, experienced a 21.7% increase in recorded decay. Tooth decay in the permanent teeth of 12 year old children (recorded as the mean number of decayed, missing and filled teeth: DMFT) had reduced by 83%, from 4.79 in 1977 to 0.9 in 1996 (Figure 3.3). From then, the trend was stable, with a mean DMFT score of 0.83 in 1999, 0.84 in 2000, and a rise to 1.02 in 2002.[13,237,238]

In 2002, across the age range 5-15 years, children from areas with higher concentrations of fluoride in drinking water had fewer decayed, missing and filled teeth, on average, than children from areas with relatively low concentrations of fluoride in drinking water. Relative differences ranged from 6.9% to 65.3% in the deciduous teeth and from 12.7% to 50.6% in the permanent teeth.[234]

Public health practices

Mothers and their infants were an early focus for public health activity. The 20th century witnessed large improvements in the safety of birthing and aftercare (e.g., the prevention of sepsis), and the gradual development of primary health services for infants and children, which offered care and support to parents.

Public health measures included:

- improved sanitation, clean and fluoridated drinking water (Box 3.1), and generally better standards of hygiene;
- changes in traditional and cultural practices through health promotion and community education campaigns;
- universal maternal, infant and child health services providing a high standard of health care and information to parents and their children, including antenatal and postnatal screening;
- organised family planning services that offered effective contraception, and later expanded their focus to sexual health more broadly;
- breastfeeding support, education and promotion that encouraged women to breastfeed and resulted in high breastfeeding initiation rates;
- targeted services and programs to improve outcomes for Indigenous mothers and infants; and
- monitoring and research into preventing health problems, such as neural tube defects and SIDS, that identified a number of effective strategies to reduce these major causes of infant disability and death.

The establishment of universal health services for mothers and babies contributed to the success of the public health measures described above. Universal services aimed to provide access for all mothers and babies, improve their health, and that of the population overall. However, services were less accessible for those in remote areas, and under-utilised by some families who were socially marginalised or living in very stressful circumstances. Targeted services and programs to improve the birthweight and health of Indigenous infants and mothers had some success from the 1980s onwards, but more still needed to be achieved.

The education of parents, and particularly of mothers, was also crucial, and was often delivered in the home by infant health nurses, community midwives and other public health practitioners.[239] Advice about breastfeeding, infant sleeping position and behaviour, and home safety aimed to address risky practices. Some commentators accredited the larger share of the gains in population health to improved economic conditions which led to better nutrition.[240]

The principle of intervening early to prevent disease by attempting to remedy the environmental conditions that bred disease was another public health contribution in this area. The public health practices of sanitation and hygiene generally, as well as specifically in birthing and in the home, introduced a set of basic measures that became universally effective.

Future challenges

Further challenges in improving maternal, infant and child health remained – the mental health of mothers and children, childhood overweight and obesity, tobacco smoking rates in pregnancy, and the need to increase iodine in maternal and children's diets.

However, the greatest challenge was to ensure that the dramatic population health gains made during the century were fully extended to all Australians, especially Aboriginal and Torres Strait Islander mothers and babies.

Professor Fiona Stanley concluded her Centenary article, *Child health since Federation,* thus:

'Issues in relation to poverty and child health have not left Australia's shores in the century either, in spite of us being one of the most developed countries in the world. Many Indigenous families with children are living in conditions of real deprivation, not unlike those in the 19th and beginning of the 20th century. Their rates of death and illness are higher than those of non-Indigenous children, although there have been improvements recently… And we are faced with more children of all kinds living in relative poverty, with observable disparities in health status between the 'haves' and the 'have-nots'. This is a common problem in wealthier countries all over the world… Today's social and environmental influences, as with those 100 years ago, are far more powerful in child health and disease than are the drugs or medical care facilities we have at our disposal to treat them. Are we going to respond to change our social, emotional and economic environments to improve child health as effectively as did our forebears in the years after Federation?'

Source: F Stanley, 'Centenary article – Child health since Federation' in ABS (eds.), *Year Book Australia 2001*, ABS, 2001, pp. 368-400.

Table 3.1: Historic highlights of improved maternal, infant and child health

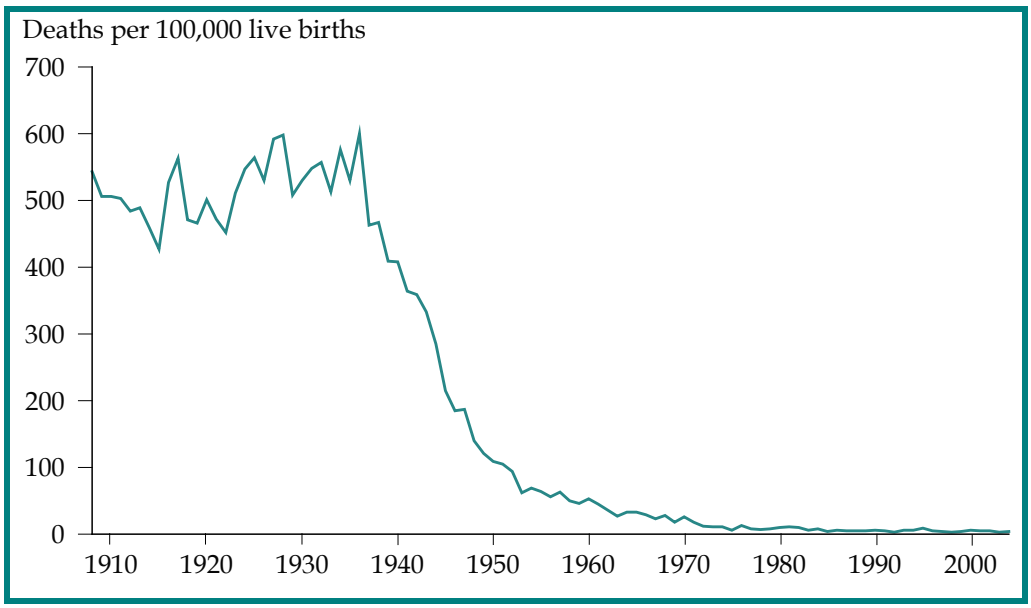
1907	Basic wage determined.
1909	Mothers' and infants' welfare centres (medical in nature but promoting general health) first established in Adelaide.
1912	Maternity benefit introduced. Statutory regulation of midwives in Queensland.
1920s-30s	Growth of maternal and infant health programs.
1926	The (then) Racial Hygiene Association (RHA) of NSW founded to promote sex education, prevention and eradication of venereal disease and education of the public in eugenics.
1933	The first birth-control clinic, although only for married women, established by the RHA.
1937	Dramatic decline in maternal mortality following the use of antibacterial drugs.
1960s	Universal screening of newborns to detect rare congenital metabolic conditions.
1964	The Nursing Mothers' Association (now the Australian Breastfeeding Association) founded. Information on maternal deaths reported nationally from 1964.
1970s	Family planning programs established, including for single women. Only an estimated 40-45% of women breastfeeding their infants on discharge from hospital.
1973	Opening of many women's and community health centres under the Community Health Program.
1981	Australia signed the WHO *International code of marketing of breast-milk substitutes*.
1982	Breastfeeding first included in *Dietary Guidelines for Australians*.
1987	Better Health Commission set targets to increase the proportion of women breastfeeding on hospital discharge to 95% and still breastfeeding at three months to 80%, to increase rates in at-risk groups, and lengthen the average period of breastfeeding by the year 2000.
1988	Tasmanian Infant Health Survey began collecting data for a prospective study on Sudden Infant Death Syndrome (SIDS).
1991	'Reducing the Risk' campaign by SIDS organisations and Red Nose Day funds, launched nationally.
1992	The SIDS death rate fell after the national campaign on infant sleeping position.
1995	The first comprehensive national health policy framework for Australian children and young people aged 0-24 years.
1996-2001	National Breastfeeding Strategy (nine projects over four years).
2003	NHMRC *Dietary Guidelines for Children and Adolescents in Australia* incorporated *Infant Feeding Guidelines for Health Workers*. Treasury became the first federal agency accredited as a 'Breastfeeding-Friendly Workplace'.
2004	*National agenda for early childhood* draft framework - areas in which the Australian, state and territory governments could achieve better outcomes for children, their families and communities. Renewal of the national *Stronger Families and Communities Strategy* (2004-2009).
2006	Council of Australian Governments (COAG) agreed to a framework for the *Human Capital Agenda*, including 'significantly improving the proportion of children that are born healthy, with the subsidiary outcome that the gap between Indigenous and non-Indigenous children is closed'.

3.1 Safer birthing practices

1901 onwards

There was an impressive reduction in the rates of women dying from childbirth over the 20th century. In the early 1900s, childbirth was responsible for the deaths of around 600 women during pregnancy, childbirth and the puerperium (the period after childbirth) in every 100,000 live births.[5] The rate declined rapidly from the mid-1930s, to levels of around 11 deaths per 100,000 live births in the early years of the 21st century (Figure 3.4).

Figure 3.4: Maternal deaths in pregnancy, childbirth and the puerperium, Australia, 1908-2004



Source: ABS, *Causes of death,* and historical *Demography bulletins.*

By this time, maternal deaths were very uncommon, and over the three years from 2003 to 2005, 65 deaths were classified as directly or indirectly relating to the pregnancy or its management, with all deaths occurring while the women were pregnant, or within 42 days of termination of pregnancy.[241] During this triennium, one woman died for every 11,896 women giving birth, giving a maternal death ratio of 8.4 per 100,000 of women giving birth. This compared favourably with the reported Maternal Mortality Rates (MMR) in other developed countries.[242]

The AIHW National Perinatal Statistics Unit and other commentators attributed the sustained progressive overall decrease in the rate of maternal deaths in Australia to:

- improved general health status including much better nutrition,
- improved reproductive patterns, including a decrease in the number, and better spacing of pregnancies;
- effective contraception and family planning;
- access to appropriate general and specialised health care;
- the introduction of medical interventions (e.g., aseptic procedures, use of antibacterial drugs and antibiotics, blood transfusions); and
- professional training of birth attendants.[243-245]

By the late 1990s, maternal death rates had fallen substantially in Australia and remained among the world's best.[242] The Organisation for Economic Co-operation and Development (OECD) reported that, in 2003, Australia had the sixth lowest maternal mortality ratio of the 29 OECD countries for which data were available.[246]

In 2000, the WHO calculated that a woman's estimated lifetime risk of maternal death in Australia was 1 in 5,800.[242] Lifetime risk in the UK was calculated at 1 in 3,800, in the US one in 2,500; and in New Zealand, 1 in 6,000. By contrast, for the whole of the WHO Western Pacific region in which Australia is located, the lifetime risk of maternal death was dramatically higher at 1 in 540.

Maternal mortality rates for Aboriginal and Torres Strait Islander women, however, were more than two and a half times as high as for other Australian women. In 2003-2005, there were 21.5 deaths per 100,000 women giving birth, compared with 7.9 per 100,000 for non-Indigenous women.[241] This high rate and a lack of improvement indicated that further measures were needed to improve pregnancy outcomes for Aboriginal and Torres Strait Islander women.

Survey respondents: *'Deaths of women in childbirth or due to induced abortion were not uncommon in the first part of the century. Improvements in later years were due to better antenatal and obstetric care, ready access to reliable contraception for fertility control (child spacing and reduction of overall family size), and access to safe legal abortion in the last 30 years… the availability of contraception and legal abortion were important public health measures.'*

'Birth control, including availability of contraceptives and contraceptive advice, wider availability of legal abortion, [and] the contraceptive pill had profound effects on the health and well-being of women and their children.

'Poor maternal and child health early in the century had its origins in too many unwanted pregnancies in deprived conditions. For example, postpartum haemorrhage and maternal death in childbirth, and other debilitating obstetric problems were related to excessive numbers of pregnancies, exhaustion and inadequate maternal nourishment. This also impacted in a pervasive way on the health and well-being of Australian women, whose life destiny was dictated by pregnancy, not by ability.'

Public health practices

Early in the 20th century, the Federal Health Council (an early cooperative arrangement for public health between federal and state governments) drew up a national scheme to coordinate maternal welfare activities, including a model maternity centre in each capital city, a consultant service, public antenatal clinics, rural maternity facilities, and a system to collect vital statistics. The federal government was also to subsidise university research, fund chairs of obstetrics and model maternity units, and convene an annual conference on maternal health.[5] As Lewis noted, 'the reality never approached the blueprint', but this was the beginning of the development of a professional public health approach to maternal health, which included a population focus on prevention and early intervention, as well as partnership approaches to providing services.[5]

Social and cultural changes over the 20th century led to a reduction in overall family size, meaning fewer pregnancies per mother, and greater spacing between pregnancies.[247] A number of safe and reliable contraceptive methods and advice on fertility control and family planning became available to prospective parents. Access to safe, legal abortion also greatly reduced related illness, injury and death.[248] The availability and accessibility of professional pregnancy counselling for women, especially those living in rural and remote areas was improved with the introduction of a new Medicare payment in 2006 for non-directive pregnancy support counselling (provided by eligible GPs, and psychologists, social workers and mental health nurses on referral from a GP).

By the start of the 21st century, a high standard of antenatal and obstetric care was available for pregnant women. One principle of antenatal care was the screening and early detection of problems, so that potentially adverse consequences to the mother and fetus could be minimised or avoided. Pregnant women were screened for a range of conditions including hepatitis B and C, rubella, gestational diabetes mellitus, and Rhesus incompatibility (providing antiD for the active immunisation of Rhesus-negative women was one of the many contributions of the Commonwealth Serum Laboratories), and other conditions that might affect their health in pregnancy or that of their unborn child.[249,250] The baby was usually examined *in utero* by ultrasound to ensure position and appropriate development, and might be genetically screened for Down Syndrome and other chromosomal abnormalities.

Giving birth became safer as the result of a range of clinical improvements including highly skilled birth attendants. While puerperal fever (or postpartum infection) was the cause of around one third of early maternal deaths at the beginning of the century, these deaths were extraordinarily rare a century later.[245] Doctors in the 1920s attributed the high maternal death rate largely to poor standards of obstetric care, especially unnecessary and poorly performed Caesarean sections.[251] High levels of interference in labour and delivery (e.g., forceps deliveries), lacerations, blood loss and exhaustion from prolonged labour all increased the possibility of postpartum infection.[245] 'Untrained' midwives were also identified by the medical profession, leading to their formal training and registration, which was largely achieved by the 1930s. Maternal death rates, however, remained high until after 1937, when there was a sudden decline following the introduction of antibacterial drugs (Figure 3.4).[25] Many mothers and their infants were also saved by the early recognition of risk during pregnancy and appropriate emergency care in the case of complications.

Box 3.2 Changes in social and medical attitudes towards child-bearing

'The late nineteenth and early twentieth centuries saw profound changes in social and medical attitudes towards maternity. Nowhere is this more apparent than in the rise of antenatal care, a system of monitoring the health and wellbeing of the unborn child through the surveillance of the pregnant woman. The emergence of such a system of surveillance in Australia occurred around the time of the First World War. In essence, the development of an antenatal regime was stimulated by fears over the declining population, and concerns over the high rate of maternal mortality during reproduction. The rise of antenatal care, however, is notable for more than being an extension of medical services to mothers. The interest in the fetus marks a significant shift in understandings about mothers and children. Based on the perceived need for population, the fetus was considered less a part of the mother, and more an independent potential person. At the same time, the development of an antenatal regime justified enormous intervention into the lives of women and mothers, extending medicalisation throughout the pregnancy and beyond.'

– L Featherstone, *Limina,* 2004.[747]

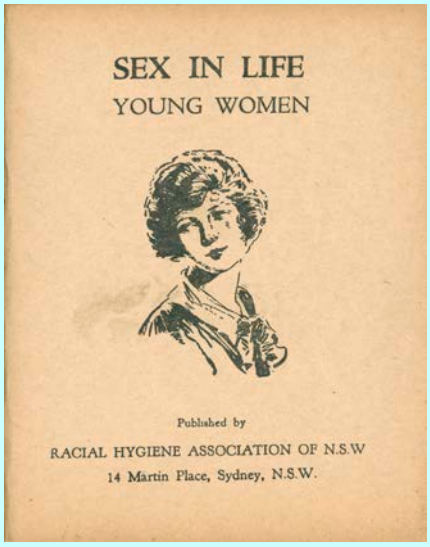
The 'medicalisation' of birth, however, tended to diminish women's satisfaction with the experience of childbirth (Box 3.2).[252] Planned homebirth was a preferred option for a few women who were at low risk of complications, were tended by qualified midwives and had appropriate access to a hospital for transferral if the need arose.[253] Most (67.6%) of the relatively small number (589) of planned homebirths that were reported nationally in 2004 (0.2% of all births; 0.8% of all births to Aboriginal and Torres Strait Islander mothers) occurred in major cities, with all infants being live born and few low birthweight or preterm babies (1.5% were of low birthweight, and 0.3% were preterm).[243] The introduction of hospital-based birthing centres and culturally appropriate Indigenous birthing centres also partly addressed women's desire for less medical intervention in childbirth.

Mothers were generally better educated than they were at the beginning of the 20th century when literacy rates and educational levels were far lower. There was greater public child health support for both parents in their role; and public health research continued to identify ways to improve the experience of pregnancy, childbirth and parenthood.

Public health also played an important role in gathering and analysing data related to pregnancy and birth. The maternal death rate is regarded as a leading or headline indicator of a nation's overall population health and development status. Maternal deaths were reported nationally from 1964. Information was collated and published by the AIHW's National Perinatal Statistics Unit with the objective of monitoring and interpreting national data on reproductive and perinatal illness and deaths.[254] Maternal deaths in hospital were key sentinel events, regularly scrutinised by the Australian Commission on Safety and Quality in Health Care as part of the national commitment to improve the quality and safety of maternal care in Australia.[241]

Box 3.3 Family planning, 1926-

Family planning services provided reproductive and sexual health services, contributing to the reduction of high parity and high risk for mothers and associated infant morbidity and mortality.



Collection: Powerhouse Museum, Sydney.[255]

Dr Marie Stopes was a family planning pioneer in Europe at the turn of the 20th century. She fought enormous prejudice to establish the first family planning clinic in London in 1915, believing strongly that, until women could determine the numbers of children they had, they would never be able to escape poverty and ill health.

Founded in 1926 by feminists Ruby Rich and Lillie Goodisson, the Racial Hygiene Association of NSW (its name was changed to the Family Planning Association (FPA) of NSW in 1960) had as its objectives 'the teaching of sex education; the eradication and prevention of venereal diseases; and the education of the community along eugenic lines'.[256] In Australia, as in other countries at this time, a 'loosely-defined collection of eugenics-related goals for increasing the nation's fitness' was the norm, and its aims - considered 'scientific, worthwhile and achievable' - left a legacy in various disciplines, such as family planning and public health.[257] It was supported by many leading feminists of the day, including Jessie Street who was the inaugural vice president.[258]

In 1933, the Association established the first birth-control clinic in Sydney, although this was for married women only (those with 'hereditary, economic or health problems').[259] Judicious birth control was to 'eradicate inheritable disease, diminish maternal mortality (by discouraging abortion) and result in an increased and healthier population'. At that time, when Australia's population was seven million and there was a 'populate or perish' mentality, the concept of women having control over their reproduction was 'akin to treason'.[259]

In 1971, the FPA officially resolved to provide birth control to single people as well as to married people. National family planning programs were established in the 1970s across Australia. Family planning clinics offered a wide range of services, and the FPA's focus was on training GPs, nurses and other health workers in education, advocacy and research (e.g., testing of new contraceptives), and young people as peer educators.

Factors critical to success

Chief among the contributors to the success of public health measures to ensure safe motherhood and reduce deaths related to pregnancy and childbirth, was the universal availability of maternal health care of a high quality. These services extended from antenatal care through to safe birthing conditions provided by well-trained staff with the availability of emergency medical responses when required, and postnatal care. The provision and professionalisation of maternal care services had a measurable impact on the health of pregnant women and their survival during and after childbirth.

Another contributor was the range of public health initiatives, frequently led by NGOs and other agencies that brought sexuality and fertility 'into the light' (Box 3.3). These movements started early in the century and expanded to the provision of sexual health education, family planning, safe contraception and pregnancy alternatives, and pregnancy counselling and support. The social and cultural shifts that accompanied these changes meant, for example, that 'backyard abortions', which had killed many women, ceased and a range of safe, reliable fertility-control methods was available to women.

Through their universal reach, strategies to improve maternal care were ambitious in scope and operated Australia-wide. The reduction in maternal deaths by the end of the century addressed what had been a significant public health problem at its start.

Future challenges

By the end of the century, however, the need to improve outcomes for Indigenous mothers and their babies was still critical. Mortality rates of Aboriginal and Torres Strait Islander women remained unacceptably high, at more than five times that of non-Indigenous women (45.9 per 100,000 women who gave birth compared to 8.7 per 100,000 in 2000-2002).[241] Age-specific death rates for Aboriginal and Torres Strait Islander women of reproductive age were also on average three to five times as high as those for non-Indigenous women.[241]

Although some targeted services and programs had been developed from the 1980s to improve birth weight and health in Indigenous mothers and babies (Box 3.6), more work was needed to ensure the sustainability of successful programs, with priority given to appropriate primary health care initiatives.[260,261] The socioeconomic determinants of health which so adversely affected this population group also needed to be urgently addressed if health benefits were to be realised.

Socioeconomic disparities also existed for other disadvantaged groups: in infant mortality, low birthweight, perinatal risk, and in smoking and drinking alcohol during pregnancy. These required a more targeted approach to improve the health of those most disadvantaged in Australian society.

In keeping with the guidelines of the Royal Australian and New Zealand College of Obstetricians and Gynaecologists, the *2006 National HIV testing policy* (a revision of the *1998 HIV Testing Policy*), universalised HIV testing as part of antenatal care for pregnant women, recommending that HIV testing be routinely offered to all women.[250,262] Testing was only to be performed with the informed consent of the woman. This approach of assessing HIV status during pregnancy allowed appropriate interventions to be targeted early to improve the health of pregnant women and to decrease the incidence of mother-to-child HIV transmission.

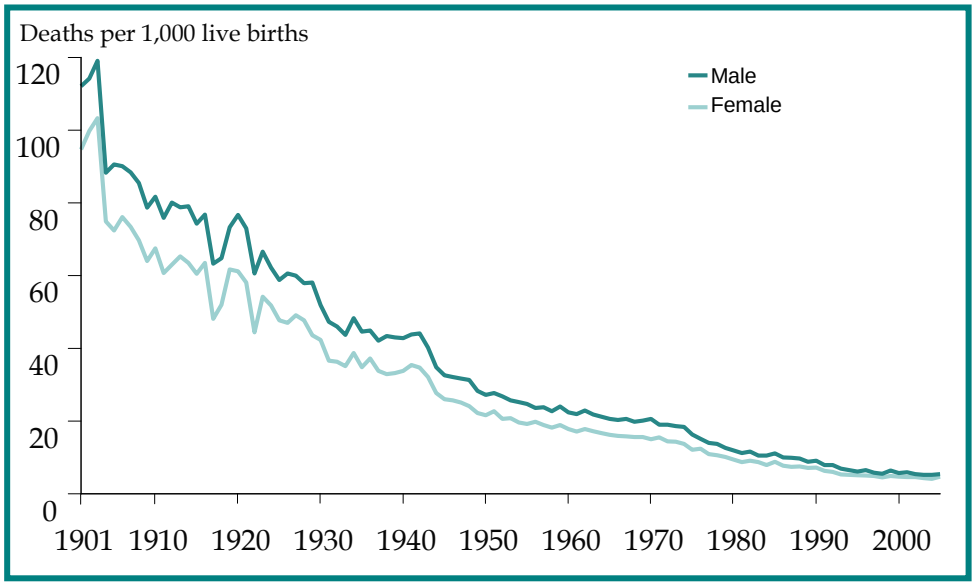
Although delivery at home was a preferred birthing option for a very small number of women, it was viewed with considerable caution by many medical specialists, even where transport and hospital facilities were available nearby. This delivery option, however, remained a challenge for those in remote areas. The 'tyranny of distance' was also problematic for very small, premature or unwell newborn infants.

3.2 Improved survival and health of infants

1901 onwards

Rates of infant deaths – the deaths of children aged less than one year – fell substantially over the 20th century.[25] The decline in the infant mortality rate (IMR: infant deaths per 1,000 live births) from 1901 to 2005 is shown in Figure 3.5. For reasons that are not well understood, female infant death rates were consistently lower than male rates. The IMR fell from 112 (males) and 95 (females) per 1,000 live births in 1901, to below 70 in the mid-1920s. Both male and female rates remained below ten deaths per 1,000 live births from 1986, and the overall rate remained at or under five deaths per 1,000 live births from 2002.[263] In 2005, the infant mortality rate was 5.0 infant deaths per 1,000 live births, slightly above the rate of 4.7 in 2004, but 50% lower than the 1985 rate of 9.9 per 1,000 live births.[224]

Figure 3.5: Infant mortality rate, 1901-2005



Source: Portfolio Statistics & Standards Section, Economic & Statistical Analysis Branch, Portfolio Strategies Division, DoHA; data: ABS, *Deaths Australia*, and historical *Demography* bulletins from 1908 to 2006.

Best estimates of Indigenous infant mortality rates (which were only available from the 1970s) were of the order of around 70 to 80 deaths per 1,000 live births in the 1970s, falling to around 25 deaths per 1,000 live births in the 1980s.[264] In 1994-96, the rate of 18.6 deaths per 1,000 live births was still decreasing, but remained far higher than the rate for non-Indigenous infants.

> *'Towards the end of the twentieth century, the Indigenous infant mortality rates were about three times as high as those of other Australian infants' – AIHW, 2006.*[154]

In 2005, ABS data for Queensland, South Australia, Western Australia and the Northern Territory combined (likely to be an under-estimate, although these areas were considered to have the best ascertainment of Indigenous status) estimated the infant mortality rate for Aboriginal and Torres Strait Islander infants at 15.0 for males (more than three times the rate for non-Indigenous males) and 10.4 for females (more than two and a half times the rate for non-Indigenous females).[224]

> *'The fascinating question is that the real gains in child health were made before antibiotics and widespread immunisation against the classic infectious diseases of childhood. The bio-social change that closely correlated with the sharp fall in infant mortality between the late 1880s and the 1920s was the fertility rate: as families shrank in overall size, and spaced their children more strategically, new babies, infants and young children all improved their survival chances. Therefore, if women's health benefited from a release from the relentless cycle of pregnancy and birth, children's wellbeing benefited immensely also.'*
>
> – JS McCalman, 2005.[247]

Overall, the large falls in infant and child death rates over the century (from 1907 to 2000) were attributed to fewer deaths from:

- diarrhoea – decreased from 700 (male) and 579 (female) deaths to less than one death, per 100,000 population;
- other infectious diseases – decreased from around 315 (male) and 494 (female) deaths to less than three deaths, per 100,000 population; and
- conditions originating in the perinatal period – decreased from 700 (male) and 596 (female) deaths to 55 and 45 deaths, per 100,000 population respectively.[25,13]

There was compelling evidence that adverse experiences during infancy (such as being of low birthweight, chronically ill, or having been abused and/or neglected) could have a negative impact upon later physical and mental health and social disadvantage in adulthood.[265]

Public health practices

Early in the 20th century, the emphasis in public health was on the provision of safe, aseptic birthing conditions with well-trained birth attendants. Registration and training of midwives and better training of doctors focused attention upon the need for sterile techniques and more hygienic birthing practices.

For babies, infant health services developed with the first service established in 1909 in Adelaide by Dr Helen Mayo. At the end of 1915 in NSW, for instance, there were nine baby health clinics (mainly in areas of high infant mortality) and by 1919, there were fifteen.[266] In Queensland, where the State (rather than NGOs and benevolent associations) took the initiative, there were four clinics in Brisbane in 1918.

The spread and universal reach of mothercraft and infant health services meant that, by the end of the 20th century, they were available to all but the most remote mothers and babies. Infant health nurses provided essential services, from monitoring the health and growth of infants and assisting mothers, to encouraging breastfeeding, and providing information and education on safety in the home, safe sleeping position, and other matters pertaining to the development of infants.

The introduction and growth of universal screening of newborns in order to detect a range of rare congenital metabolic conditions also contributed to improvements in the health of infants (Box 3.4).

Box 3.4 Screening of newborns, 1960s-

Universal screening of newborns to detect rare congenital metabolic conditions was established in the late 1960s. Early detection allowed early treatment of conditions that caused severe disability or death. Testing expanded from the first programs for phenylketonuria, to include programs to detect hypothyroidism, cystic fibrosis, and a number of other conditions.[267] Equally as important, a mechanism was in place to expand routine screening to further conditions as they too became preventable.

The public health practices of screening and early detection were extended to the state-based screening of newborns for hearing deficits (Box 3.5) and these programs were to be made available Australia-wide.

Box 3.5 Extending newborn hearing screening, 2000-

Much of the disability associated with hearing loss could be averted through the early screening of hearing in newborns, and this was becoming universal in Australia.[268] One example was the NSW Statewide Infant Screening Hearing Program (SWISH), which included screening, diagnostic assessment, early intervention and parent support. After three years, the program found that:

- 3.8% of infants screened did not pass the hearing test bilaterally (with both ears); almost all of these (97.2%) attended diagnostic audiology;
- about 45% of those with bilateral hearing impairment had *no risk factors*; and
- about 20% of those with unilateral hearing loss had developed bilateral hearing loss by the time they were assessed.

Overall, 1.2 in 1,000 babies had a degree of permanent bilateral hearing impairment. The average age for fitting hearing aids was two months. Parental satisfaction with the program was very high: 99% of parents reported that they would recommend screening to other parents. SWISH Coordinators were proactive with follow-up, and the NSW Blue Book provided a safety net, as baby health nurses checked that the SWISH page had been completed.[269]

The main factor attributed to the success of the program was the tenaciousness and persistence of the SWISH Coordinators in getting babies to diagnostic testing and follow-up if needed; and, as a result of their efforts, coverage in 2005 was estimated at 98%. The program drove demand in other programs, as hearing aids fitted on much younger children had to be replaced more often to keep up with their rate of growth and development.[270]

The general rise in the level of education, and specifically the education of mothers in mothercraft, also contributed to improving the health of infants (Box 3.6). By the start of the 21st century, universally available services delivered a high standard of postnatal and early childhood care. Breastfeeding improved infant immunity and health. Childhood immunisation, which commenced in infancy, contributed to the decline in infant deaths. Finally, a range of common – but preventable – causes of infant injury in the home and elsewhere (e.g., swimming pools, cars) was identified, and measures to prevent or minimise their impact implemented. The success of public health measures to ensure safer infancy and fewer infant deaths rested on the increased availability of standard care of a high quality, from aseptic birthing conditions provided by well-trained staff through to infant health services delivered in clinics and in homes by infant health nurses and other community-based practitioners. Services also included screening for preventable or treatable conditions, in order to reduce avoidable death and disability.

Box 3.6 'Lifting the weight' and programs for health gain for Aboriginal and Torres Strait Islander babies, 1984-

The Australian Medical Association's 2005 Indigenous Report Card, *Lifting the weight – low birth weight babies,* detailed some targeted programs that demonstrated improvements in birthweight and health in Aboriginal babies:

- Nganampa Health, Antenatal Care Program, Anangu Pitjantjatjara Lands, SA (1984-);
- Congress Alukura Women's Health Program, NT (1986-);
- Mums and Babies Program, Townsville Aboriginal and Islander Health Service, Qld (2000-);
- *Strong Women Strong Babies Strong Culture* Program, NT (1993-), WA (2003-).[260]

The limited evidence available suggested, however, that a main driver behind the improvement in infant mortality was semi-coercive programs to have women from remote areas deliver their babies in large centres, a long way from their homes. There was insufficient attention paid to programs to improve birthweight, and the birthweight distribution for Aboriginal and Torres Strait Islander children in Queensland, for example, hardly shifted over the previous 16 years.[261] Coory and Johnston (2005) reported that

> *'the main reason Indigenous babies have a high risk of death is because they are born too early and too small'.*[261]

To reduce the relative excess of deaths among Indigenous babies, priority needed to be given to primary health care initiatives aimed at reducing the prevalence of low birthweight and preterm birth.[261]

Factors critical to success

The success of public health measures to ensure safer infancy and fewer infant deaths rested on the increased availability of standard care of a high quality, from aseptic birthing conditions provided by well-trained staff through to infant health services delivered in clinics and in homes by infant health nurses and other community-based practitioners. Services also included screening for preventable or treatable conditions, in order to reduce avoidable death and disability.

Future challenges

At the start of the 21st century, the public health challenges included improving outcomes for Indigenous babies, and those of mothers in other socioeconomically disadvantaged groups, whose babies were more at risk of low birthweight or of dying before the age of 12 months, and of other adverse health outcomes.[261] Child death reviews were being undertaken in most States and Territories to examine preventable causes of death in infants and children, although there was no national data collection and no consistent approach taken to reviewing.

Targeted services and programs that had had some success in improving birth weight and health gain in Aboriginal and Torres Strait Islander babies (from the 1980s) needed to be consolidated to ensure their longer term success, and priority given to primary health care initiatives to reduce the prevalence of low birthweight and preterm birth (Box 3.6).[260]

Similarly, there were some successful early intervention programs to improve the health of babies in lower socioeconomic situations, but more needed to be done to broaden the reach of the best programs, and to apply the universal principle of early intervention to those most in need.

Other challenges were:

- encouraging peri-conceptional use of folic acid supplements (including consideration of the mandatory fortification of a staple food, such as flour) to prevent neural tube defects;
- reducing exposure to environmental tobacco smoke – a cause of SIDS and of significant developmental delay in children;
- ensuring that iodine deficiency in pregnant women and infants was identified and remedied to prevent iodine deficiency disorders; and
- addressing childhood overweight and obesity.[271,126,272]

3.3 Promotion of breastfeeding

1964 onwards

> *'Breastfeeding is the normal and most appropriate method for feeding infants and is closely related to immediate and long-term health outcomes.' —National Health & Medical Research Council 2003.*[273]

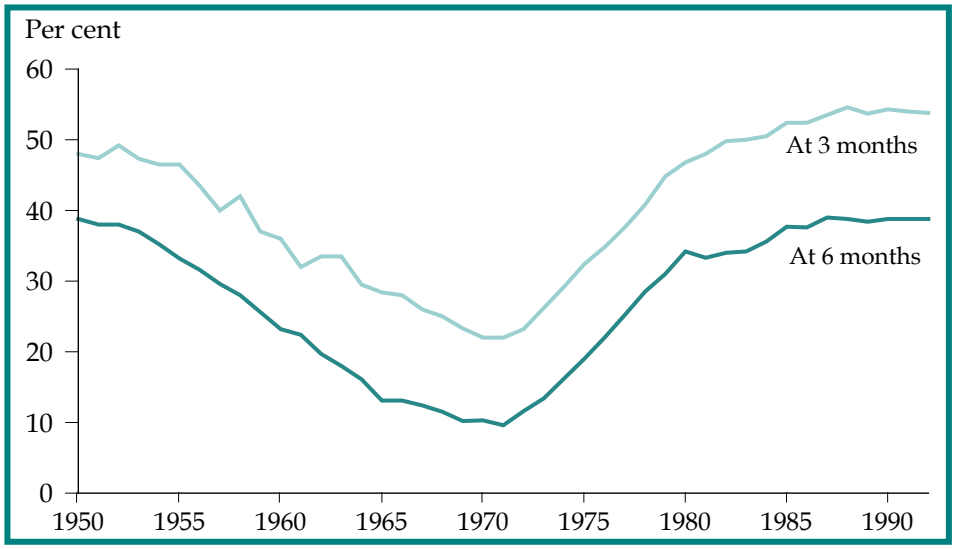
There were many benefits to be gained from breastfeeding – for infants, mothers and the community. For infants, breastfeeding protected against respiratory, ear and gastrointestinal infections; and exclusive breastfeeding for at least four months reduced the prevalence of asthma and cows' milk allergy.[273] Breastfeeding was associated with good developmental outcomes in children such as improved visual acuity, psychomotor development, and jaw formation, and higher IQ scores. For mothers, breastfeeding promoted recovery after childbirth and reduced the risk of post-delivery haemorrhage; and it also enhanced infant-mother attachment and protected against negative moods and stress, and reduced the risk of pre-menopausal breast cancer.[274,275] For the community, there were significant social and economic benefits that resulted from breastfeeding.

Breastfeeding rates in Australia waxed and waned quite substantially. At the beginning of the 20th century, Australia had relatively high breastfeeding rates, and public health campaigns such as '*Don't kill your baby, never wean in summer*' directly communicated the risks of not continuing to breastfeed.[276] A link between bottle feeding and gastrointestinal illness in infants was identified.[273] This feeding method increased the risk of infection through contamination of the feeding equipment, and bottle-fed infants missed out on the protection against infection afforded by breastfeeding.[277]

In the following decades, the influence of scientific mothercraft and the Truby King-associated infant health clinic movement had differing effects on breastfeeding.[278] Some of the recommended breastfeeding practices (e.g., scheduled feeding where 'timetabling took on a clocklike regularity with a moral significance', test weighing, and a general 'preoccupation with graphs, charts, and standardised measurement' which ignored babies' individual requirements) resulted in a decline in breastfeeding rates.[278]

By the 1950s and 1960s, the promotion of artificial infant formulas had a devastating effect on breastfeeding rates of infants at three and six months (Figure 3.6).[279,280] By the early 1970s, it was estimated that only 40-45% of women were breastfeeding their infants on discharge from hospital.[281] This trend was eventually reversed through the sustained efforts of community-based breastfeeding support groups, which began in the early 1960s with the establishment of the Nursing Mothers' Association (NMA, now the Australian Breastfeeding Association [ABA]). At the time that the NMA was founded (1964), the use of artificial formulas was favoured and little breastfeeding support was available to mothers or to health professionals.

Figure 3.6: Mothers exclusively breastfeeding infants at three and six months, Victoria, 1950-1992

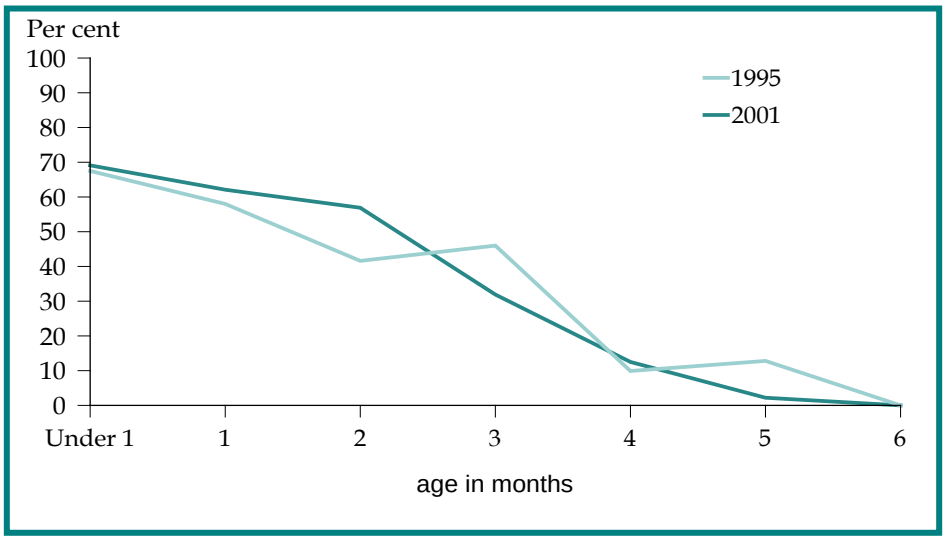


Source: IH Lester, *Australia's food and nutrition*, 1994, p. 194; indicator compiled by the Nursing Mothers Association of Australia, 1993.

In 1974, the 27th World Health Assembly noted an overall decrease in breastfeeding rates in many parts of the world, and attributed some of the decline to 'the promotion of manufactured breast-milk substitutes'.[282] Australia supported the World Health Assembly's adoption of the *WHO International code of marketing of breast-milk substitutes* in 1981, agreeing to protect and promote breastfeeding and to ensure appropriate marketing of substitutes. In response, the requirement for a breastfeeding statement on infant formula labels was incorporated in the *Australia New Zealand Food Standards Code* and an industry self-regulatory arrangement was established in 1992. However, no such requirement was applied to the labelling of feeding bottles and teats.

By 1987, the Nutrition Taskforce of the Better Health Commission had established targets aimed at increasing the proportion of mothers who were breastfeeding on discharge from hospital to 95%, and the proportion still breastfeeding at three months to 80%, by the year 2000.[273] By 1995, it was estimated that 82% of all children up to the age of three were breastfed on leaving hospital (83% in 2001), but this proportion decreased substantially in the two months following discharge.[283] The decline in the proportion of infants who were exclusively breastfed at various ages up to six months, in 1995 and 2001, is shown in Figure 3.7.

Figure 3.7: Proportion of fully breastfed infants, newborn to 6 months of age, 1995 and 2001



Source: ABS, *Breastfeeding in Australia, 2001,* 2003.

In 1982, Australia was one of the first countries to adopt dietary guidelines which encouraged breastfeeding.[273] The NHMRC produced *Infant feeding guidelines for health workers* in 1996, to support health workers to promote breastfeeding as 'a primary aim of nutrition and better health programs'.[284] Revised guidelines were incorporated into the *Dietary guidelines for children and adolescents in Australia* in 2003.[273] The 2003 NHMRC dietary guidelines recommended that infants up to the age of six months only consume breast milk. Therefore, remedying this downward trend in rates of exclusive breastfeeding of young infants still remained a substantial challenge by the start of the 21st century.[126]

Breastfeeding support groups were partially successful in advocating for the implementation of the WHO *International code of marketing of breast-milk substitutes*.[282] Furthermore, the possible long-term adverse effects of breast milk substitutes (e.g., on the development of metabolic-related diseases such as diabetes and cardiovascular disease) were becoming evident from public health research and clinical trials.[285]

Accreditation of 'baby-friendly' places (e.g., health services, workplaces, cafes and restaurants) encouraged the promotion of breastfeeding by providing supportive environments for mothers. The *Baby Friendly Health Initiative* (BFHI), a program developed by WHO and UNICEF, was facilitated in Australia by the Australian College of Midwives Inc. from 1995. 'Baby friendly' maternity sites had to demonstrate their compliance with the 'Ten steps to successful breastfeeding' – a series of best practice standards for a pattern of care in which practices 'harmful to breastfeeding' were replaced by ones proven to promote breastfeeding.[286,287] By late 2006, the BFHI had accredited over 50 Baby Friendly hospitals and health services across Australia (more than twice the 24 that were accredited in mid-2001).[288]

The Australian Government established the *National Breastfeeding Strategy 1996-2001* with the aim of encouraging breastfeeding awareness and raising Australian mothers' breastfeeding rates.[289] As women's participation in the labour force increased, many women returned to work relatively soon after their babies were born. For instance, information from the first wave of the *Longitudinal Survey of Australia's Children* indicated that one in five mothers was in the paid workforce by the time their child was six months old, with a significant proportion returning to or commencing work before their child was three months old.[290] Among other approaches, the National Breastfeeding Strategy included the development of workplace resource materials to support breastfeeding mothers returning to work and to educate both employers and employees.

In 2003, the Treasury was the first federal agency to be accredited as a 'Breastfeeding Friendly Workplace', providing breastfeeding breaks and flexible work options. Other Australian government agencies in Canberra and elsewhere became accredited, with the Australian government Departments of Health and Ageing (DoHA) and Family and Community Services (DFaCS) achieving national accreditation for all their offices across Australia.

> *'Employers who are "breastfeeding-friendly" save on recruitment costs as valuable skilled employees are more likely to return after having their baby if the workplace supports their plans to breastfeed. Parents are also less likely to need time off to care for a sick baby, keeping employers' costs down'.*
>
> – Dr Julie Smith, Australian Breastfeeding Association.

Other workplaces became 'baby friendly' premises as a result and this move was enhanced by the ABA's production of a 'Breastfeeding Welcome Here' kit, to accredit and promote breastfeeding-friendly businesses.[291] While breastfeeding in public was once unthinkable, modern attitudes became more accepting, and a mother's right to breastfeed was protected under the Commonwealth *Sex Discrimination Act 1984*.[292] The Australian government continued to provide funding in support of breastfeeding and for research into breastfeeding and other infant feeding practices.

Public health practices

Breastfeeding support, education and promotion were undertaken by non-government and community organisations, supported by health departments in the states and territories, and the Australian government. This demonstrated the public health principles of promoting and protecting the health of the community, by focusing on its youngest members and their mothers, in partnership with a wide range of agencies. As a result, there was a range of promotional and educational materials available to assist mothers to choose to breastfeed and a variety of services to help them maintain breastfeeding.

Source: Australian Breastfeeding Association

Factors critical to success

From the 1970s, the activities and community advocacy of NGOs contributed to the resurgence of breastfeeding as a public health measure. Government support for these activities was also important. The 1995 *National Health Survey* had a special focus on breastfeeding and subsequent surveys monitored breastfeeding rates at a population level and provided information on critical issues (such as reasons for discontinuing breastfeeding), to direct public health research towards addressing barriers to breastfeeding.

Public health research also continued to quantify the societal value of breastfeeding, and to generate evidence about the benefits in terms of improved health, reduced illness, and consequent decreased demand for hospital and health services.

Successful public health measures to promote breastfeeding initially used universal approaches to focus on all mothers, and increasingly tailored their interventions to reach particular groups (e.g., partners of breastfeeding mothers, and Aboriginal and Torres Strait Islander mothers).

> ***Survey respondent:*** *'The public health success [in increasing breastfeeding], as in tobacco, originated in women/community based action and advocacy, which prevented the near "extinction" of breastfeeding in Australia, unlike in the UK or US.'*

Cost-effectiveness

A study quantified some of the benefits of extending exclusive breastfeeding in Australia to six months, by estimating that the hospitalisation costs for the treatment of five infant and childhood illnesses attributable to early weaning from breast milk (including gastrointestinal illness, respiratory illness and otitis media) were around $1-2 million a year in the ACT alone.[293] Extrapolated nationally, hospitalisation costs associated with premature weaning were of the order of $60-100 million per year, and excluded costs associated with other illnesses and out-of-hospital health care costs related to early weaning.[294] Although breastfeeding initiation rates were relatively high at 92%, fewer than one in ten ACT infants were exclusively breastfed for the recommended six months (ABS data suggested that a similar situation existed nationally).[283] The study concluded that 'interventions to protect and support breastfeeding were likely to be cost-effective for the public health system'.[293] While further gains were required, increasing the proportion of breastfed Australian infants was economically advantageous, in addition to being a public health goal.

Future challenges

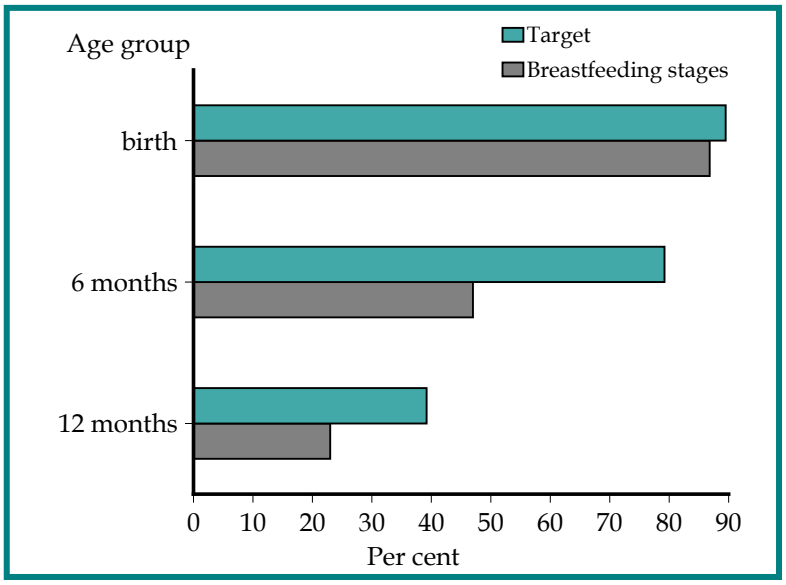
From a public health perspective, at the start of the 21st century, there was 'room for improvement in both the rates and the duration of breastfeeding in Australia'.[273] As achievable objectives for Australia, the NHMRC recommended:

- a breastfeeding initiation rate in excess of 90%;
- 80% of infants still breastfed at the age of six months;

- mothers continuing exclusive breastfeeding for about six months; and
- 40% of mothers still breastfeeding their infants at 12 months.

The latest estimates showed that, while breastfeeding was initiated for 87% of newborns, less than half of Australian infants at six months of age (48%) were still receiving some breast milk, and less than 1% of those were fully breastfed (Figure 3.8).[295] In addition, a far higher proportion of infants aged three months or less was regularly given solids and breast milk substitutes in 2001 than in 1995. These data appeared to indicate that breastfeeding rates were still declining, with decreasing rates of exclusive breastfeeding, and more infants being given breast milk substitutes before six months of age.

Figure 3.8: Prevalence of breastfeeding, infant age 0-12 months, 2001



Source: National Institute of Clinical Studies, *Evidence–practice gaps report* 2005, vol. 2, p. 7.

The proportion of infants being breastfed in 2001 was higher among older mothers and those with a tertiary education.[283] Women from the more advantaged socioeconomic groups also tended to breastfeed their infants for longer periods.[273]

The National Institute of Clinical Studies (NICS) indicated that future effort should focus on increasing the duration of exclusive breastfeeding. To this end, NICS suggested better management of the difficulties and barriers that breastfeeding mothers faced.[126] Although these directly affected mothers, health savings from breastfeeding and the possible health risks of breast milk substitutes impacted directly on government budgets, and therefore also had implications for the wider community.[294]

The best available evidence suggested that long-term intensive promotion of breastfeeding was most successful when it spanned the pre- and post-natal periods, and involved multiple contacts with a peer counsellor or professional breastfeeding promoter.[126] Improved contact with postnatal services was needed, especially for high-need women (such as those who were Indigenous and those who were socioeconomically disadvantaged). Information offered to women about breastfeeding had to be consistent, easy to access and reflect the standard in the NHMRC guidelines.[126]

Finally, other interventions that were likely to improve breastfeeding duration (drawn from the *Australian Breastfeeding Leadership Plan*) included:

- improving workplace conditions for breastfeeding;
- piloting a human milk bank in a maternity hospital, and evidence-based guidelines for its use;
- promoting the acceptability of breastfeeding in public;
- educating women's partners and enlisting their support for breastfeeding; and

- improving the knowledge of peers and health professionals (e.g., general practitioners and pharmacists) who were likely to provide informal and formal breastfeeding support to mothers once they had left hospital.[296]

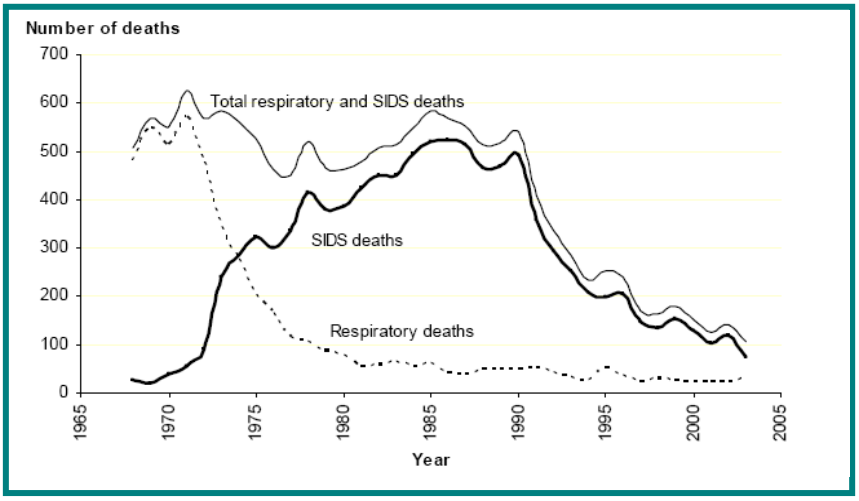
3.4 Preventing infant deaths from Sudden Infant Death Syndrome

1991 onwards

From the first registration of 26 infant deaths from Sudden Infant Death Syndrome (SIDS) in 1968, the number rose to a peak of 525 deaths in 1986 (Figure 3.9). The number then fell sharply from 1986 onwards, and by 2003, the number of SIDS deaths was 73.[25] There was a corresponding decrease in deaths attributed to a range of respiratory diseases among those aged less than 1 year, notably the 'unspecified' types of pneumonias.[25] It is therefore possible that the apparent emergence of SIDS could be due to a change or a refinement of deaths classification. Whatever the explanation for SIDS' apparent emergence, the resulting public health intervention and research in Australia are credited with major falls in the rates.

Although SIDS was the leading cause of death in 1997-2001 for both Indigenous and non-Indigenous infants, a higher proportion of Indigenous infants died from this cause (16.6% compared to 9.3% for non-Indigenous infants).[297]

Figure 3.9: Deaths from SIDS and respiratory causes, infants under one year of age, 1968-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 76.

In 2005, Gilbert and colleagues reported that the advice given to mothers for nearly a half century (to put infants to sleep face downwards) was contrary to the evidence available from 1970 onwards, that this was likely to be harmful.[298] They suggested that a systematic review of preventable risk factors for SIDS from 1970 and earlier recognition of the risks of infants sleeping face downwards could have prevented 60,000 deaths in the UK, Europe, the US, and Australasia from this cause.

The eventual fall in SIDS deaths in Australia was credited to public health research which identified that the sleeping position of infants was a preventable risk factor for this type of death. This finding enabled public awareness and education campaigns to be mounted.[204] The large reduction in the death rate from SIDS was attributed almost entirely to the change in the prevalence of placing infants in the prone position to sleep.[299] By 2001, SIDS was no longer the overall leading cause of death for infants (deaths from SIDS decreased from 11.4% in 1997 to 7.5% in 2001), but it remained the leading cause of post-neonatal deaths (infants aged 28 days to 1 year).[204]

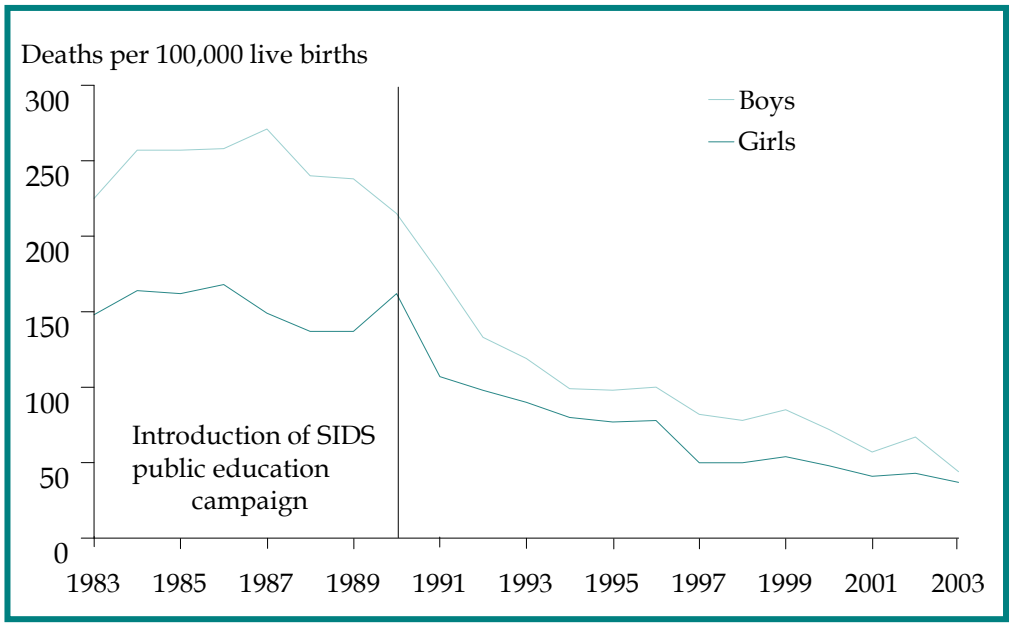
It was likely that the change in sleeping position reflected a 'healthy adopter' phenomenon, in that families at lower risk of SIDS were more likely to adhere to the prevailing health advice.[204] Despite

research, the causes of SIDS were still largely unknown; however, maternal smoking and infant exposure to environmental tobacco smoke (Section 2.3) were known preventable risk factors for SIDS that needed further intervention.[204]

Public health practices

Australian public health researchers first identified infant sleeping position as a preventable risk factor for SIDS, and suggested strategies to reduce it. The pioneers were Terry Dwyer and Anne-Louise Ponsonby at the Menzies Centre for Population Health Research in Tasmania, who conducted a Rotary funded, world-first study that collected and analysed details about the health and environmental circumstances of more than 10,000 apparently well babies.[300] The *Tasmanian Infant Health Survey* began collecting data for this prospective study on SIDS in 1988.[301] Findings from the study contributed to the public education campaign targeted at parents of newborn infants which encouraged them to adopt a number of changes, including the sleeping position of infants. The first 'Reduce the Risks' campaign began in July 1990 in Victoria. A national campaign, driven by SIDS organisations and supported by Red Nose Day funds, was launched in 1991 and their impact was evident in the declining SIDS death rate (Figure 3.10).

Figure 3.10: Infant deaths from SIDS, 1983-2003



Source: AIHW, *A picture of Australia's children*, 2005, p. 18.

The campaigns promoted infants sleeping on their backs from birth with their heads and faces uncovered and free from exposure to environmental tobacco smoke.[302] Population-wide behavioural changes arising from public awareness and education campaigns resulted in fewer infant deaths. However, more needed to be done for Indigenous babies, whose death rates from SIDS remained higher. Over the period 1991-2000 for South Australia, Western Australia and the Northern Territory combined, the ABS estimated that the Indigenous SIDS death rate was 4.49 per 1,000 live births, compared to the non-Indigenous rate of 0.73 per 1,000.

The prevention of as many premature deaths as possible remained a major public health objective. By the start of the 21st century, public health researchers continued to monitor and research SIDS deaths to identify other preventable risk factors and strategies that could be promulgated to the community, through health promotion activities, in order to lessen the number of infants still dying from this cause.

Factors critical to success

The prospective study which identified the major risk factors shared by babies who suffered SIDS deaths was frequently cited as a classic example of public health research and was often listed by respondents to the Public Health Successes Survey.[303] The identification of the problem, the well-designed research of its causes and the adoption of preventable measures demonstrated the contribution that public health research could make in the field of preventable deaths.

The ability of public health practitioners to roll out community education campaigns to inform parents of the changes that were necessary to reduce the risks of a SIDS death was a critical element in the success of these measures. An estimated 4,084 babies' lives were saved in Australia after the SIDS risk reduction campaigns began.[303] These approaches, however, failed to reach all segments of Australian society.

Future challenges

The National Institute of Clinical Studies identified placing infants to sleep on their backs to reduce the risk of SIDS as an evidence-practice gap, which formed part of the challenge of improving infant health at a population level.[126]

While the SIDS death rate decreased overall in Australia, it remained significantly higher in the Northern Territory and amongst Indigenous communities elsewhere, where similar reductions were not evident.[304] There was also an increased risk in families that were socioeconomically disadvantaged. A systematic review reported a significant association of socioeconomic status with SIDS, with the risk of infant death increasing markedly with greater exposure to adverse social circumstances.[305,306] Other studies supported these findings and affirmed that adverse social circumstances played a significant role in pathways to sudden unexpected deaths in infancy. A detailed study of infants born in Western Australia during the period from 1980 to 2001 found that, not only did Indigenous infants have more potentially preventable deaths than non-Indigenous infants, but disparities between Indigenous and non-Indigenous infants for all major causes of deaths including SIDS had also increased.[307]

Families at low risk of SIDS were more likely to adhere to prevailing health advice and, while significant improvements had been made, families most at risk of SIDS had not benefited to the same extent.[307] Further public health research was needed to target SIDS risk reduction activity more appropriately. Programs aimed at reducing SIDS, decreasing serious infections, and improving antenatal care to reduce low birthweight and preterm births were likely to be more cost-effective than further improvements to neonatal intensive-care facilities, perinatal transport and increased hospital births for Indigenous mothers.[307]

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4 Food and nutrition: 1901 onwards

From 1901 onwards, improvements in food quality, food safety and nutrition contributed to the health and increased longevity enjoyed by most Australians at the start of the 21st century, as evidenced by:

- declines in death rates generally, through improved nutrition and correspondingly better health, and
- declines in death rates specifically, through
    - decreases in foodborne infectious diseases, as the result of a range of food safety measures;
    - an 85% reduction in stomach cancer over the period 1925-2000, largely credited to the introduction of refrigeration and changes in meat-curing practices (Box 4.1); and
    - reductions in some chronic diseases, such as coronary heart disease, partially attributed to dietary changes from the 1970s.

From early in the 20th century, public health practitioners marketed the advantages of particular foods in order to improve the nutritional status of the population. Later in the century, nutritional campaigns and public concerns about food tended to be more critical, even as food availability, affordability and quality increased.[308]

Over the century, it was recognised that food had the capacity to both cause and protect against disease.[309] For example, the rapid rise and subsequent decline in the rate of sudden deaths from coronary heart disease was mirrored by the dietary intake of saturated fats and later, of polyunsaturated margarine from the 1970s.[310,311] By the end of the century, there were concerns about over-nutrition, 'empty nutrition' (high caloric foods which lacked nutrients), and energy-dense foods and drinks; the role of poverty in nutritionally poor diets that led to overweight and obesity; the claims made about the health benefits of some foods; and the community's need to interpret conflicting advice and 'science' about food and healthy food behaviours.[312-315]

> ***Survey respondent:*** *'Life expectancy was impacted by lack of nutrition knowledge and poor food security. Whilst not all segments of society are equally advantaged, under-nutrition is less widespread than was the case prior to the baby boom era (from the late 1940s when food rationing no longer occurred).'*

Health, growth and nutrition are interrelated, and average population height has been used to reflect the nutritional status, health and life expectancy of a population.[239] As nutrition improves with general improvements in socioeconomic conditions over the century, average population height also increases. Long-term changes in height slowed over the last two decades of the century, although body weight increases began occurring, raising concerns about population levels of overweight and obesity.

Food production also underwent significant transformation during the 20th century, in areas such as animal husbandry, agricultural production, and food harvesting, processing and storage technologies. Standard setting and the regulation of standards for food production ensured that Australia's food supply was one of the safest in the world.[316] Changes in food regulation (such as the adoption of a whole-of-food-chain approach) were designed to adapt and respond, in order to protect consumers from unpredictable risks in the food supply chain.

At the end of the 20th century, the cheaper manufacturing and growth in sales of energy dense foods and the affordability of fresh foods emerged as important issues, with fresh foods affected by increases in the price and availability of land, water and transport, and subject to drought, crop disease and sudden disaster (e.g., the effect of Cyclone Larry in decimating Australian banana production in 2006).[317]

Public health practices

Public health approaches were exemplified by a focus on prevention, promotion and early intervention in partnership with the community and other agencies, to influence population nutrition and improve food quality. The supply of safe, affordable and nutritious food was an important public health goal, and principles were applied:

- to guarantee the safety of food and the food supply;
- to set standards for safe food production and supply, and enforce and monitor them;
- to inform and educate the community about food, nutrition and healthy food practices;
- to operate a response system to contain, treat those affected by, and prevent the further spread of, outbreaks of foodborne disease; and
- to reduce preventable nutrient-related deficiency diseases and conditions.

By the end of 2002, food was required to be labelled with information related to seven nutrients (including sodium and saturated fats), so that consumers had access to information to assist healthy food selection.

From its relatively early days, Australia was a supplier of food to other countries, and a keen user of innovative technologies, many of which improved and extended the ability to supply fresh food to distant markets (e.g., the use of refrigeration on ships to export fresh meat), and reduced various hazards in preserving food (e.g., lead-free food canning). The technology of food fortification was used from the 1960s when salt was first fortified with iodine. Subsequently, flour for bread was fortified with thiamine (from 1991), and various foods were voluntarily fortified with folic acid (from 1996). These public health measures were aimed at reducing a number of preventable deficiency diseases and certain congenital malformations.

The early establishment of dietary standards, including those for breastfeeding and later of nutrition policies, provided guidelines, educational material for health workers and other instruments to support the national effort to improve public nutrition. Health promotion practitioners worked to educate the Australian community in 'food literacy', healthy food behaviours, and hygienic food handling practices, from school onwards. Apparent increases in the consumption of fresh fruit and vegetables were attributed to public health's educational efforts; however, more remained to be done to tackle the unintended effects of cheaper, energy dense and processed foods on the population.

Table 4.1: Historic highlights of better food and nutrition

1901	Federation - under Section 51 of the Australian Constitution, food controlled by state and territory legislation.
1905	The Victorian *Pure Food Act* enacted – the first overall food act in Australia.
1907	Federal Council of Chambers of Manufacturers lobbied commonwealth and state governments for a uniform system of food laws.
1908	Commonwealth *Quarantine Act 1908* passed, covering imported foods. Uniform food standards promised by the Prime Minister Deakin.
1912	The first refrigerators for domestic use appeared.
1914	Australia likely the first country in the world to enact pure food laws and standards.
1922	Victorian *Milk Supply Act* passed after concerns about the quality of Melbourne's milk supply. Australian Dairy Council established – enforced the pasteurisation of milk and undertook research, advertising and marketing.
1926	Free School Milk program began in Australian primary schools.
1936	A Commonwealth Inquiry into Nutrition concluded that Australians were generally well-fed, but there was much ignorance about diet. National Health and Medical Research Council (NHMRC) set up.
1939-45	World War II food rationing, and exportation of food to England to serve the war effort. Public health information on feeding a family was couched in patriotic terms.
1940s	Major improvements in many food technologies, standards and regulation following World War II.
1961	The international Food and Agriculture Organisation established the Codex Alimentarius Commission, to further both consumer health and fair trade practices. Australia was a member from the outset.
1968-72	Fast food chains established.
1970s	Crisis of heart disease, stroke, hypertension & diabetes. Public discussion of the role of diet.
1973	Food packaging scare (relating to polyvinyl chloride (PVC) food and beverage containers) led to public health measures to establish standards for plastics that come into contact with food.
1974	Free School Milk Program ended after evidence suggested that children's protein and calcium levels were adequate. Decline in calcium intake followed.
1975	Conference of Commonwealth and State Health Ministers agreed to a joint working party to draft a Model Food Act to achieve national uniform food legislation.
1981-89	States and territories implemented uniform food legislation based on the 'Model Food Act' developed in 1980.
1982	First *Dietary Guidelines for Australians* published.
1986	The Better Health Commission recommended a strategic focus on nutrition.[318]
1991	The *National Food Authority Act* passed, the first federal legislation enacted to unify food standards in Australia, and the National Food Authority (NFA) created.
1992	Imported food regulated specifically by the Commonwealth *Imported Food Control Act 1992*.
1994	NFA proposed national food safety programs using Hazard Analysis and Critical Control Points (HACCP) methods.
1995	First National Nutrition Survey conducted by the ABS (in association with the National Health Survey). Death of a child from Haemolytic Uraemic Syndrome and hospitalisation of 23 others in SA after eating contaminated mettwurst led to strengthened national food regulation for fermented meat products.
1996	Trans-Tasman Mutual Recognition Arrangement signed, permitting goods, including foodstuffs, to be freely traded between Australia and NZ.
1998	Food regulation review (Blair report) *Food: a growth industry* released. National Office of Food Safety created. *Australian guide to healthy eating* released.
1999	National Aboriginal and Torres Strait Islander Nutrition Working Party established. *Dietary guidelines for older Australians* published (NHMRC).
2000	Draft Model Food Bill released. New joint *Australia New Zealand Food Standards Code* adopted after a six-year review of existing food standards – the first joint food code between Australia and NZ. The National Biotechnology Strategy launched.
2001	Food Standards Australia New Zealand (FSANZ) created (replaced ANZFA, which was established in 1996).
2003	*Dietary guidelines for children and adolescents in Australia* published (NHMRC). National Biotechnology Strategy extended to 2008, after 2003 evaluation.
2004	Government ministers asked to consider compulsory iodine and folic acid fortification of certain food following the re-emergence of iodine deficiency in Australia and NZ.
2006	Review of food and agricultural policy, *Creating our future: agriculture and food policy for the next generation*. New *Nutrient Reference Values for Australia and NZ* including *Recommended Dietary Intakes* prepared by the NHMRC released.

4.1 Food technology development

1901 onwards

Modern food technologies date back to the introduction of heat processing in the 1780s.[319] In the 19th century, there were many essential developments in the storage and transport of food. An over-production of lean meat in Australia in the 1840s stimulated the development of a meat export industry to Britain. From 1840 to 1940, food technology became firmly established, and Australia was, and remained, a significant net exporter of food.[320]

Technological changes included meat canning and refrigeration. The refrigeration and pasteurisation of milk conferred protection against bovine tuberculosis (TB) and other milkborne diseases. The introduction of refrigeration reduced the need for harmful food preservatives, leading to substantial reductions in stomach cancer, increased dietary protein intake, and directly contributed to the modern rise in adult height.[321]

Meat canning expanded in the 1870s, and accelerated in the last twenty years of the 19th century. During that time, substantial advances in the milling, dairy, brewing and sugar industries and in refrigeration were introduced.[319]

> *'Science began to be applied to food; new methods and efficiency lent new authority to analytical chemistry, which quite rapidly led to the control of food technology through food regulations, and science was also applied in the brewing and sugar industries and to cereals.' – Australian Academy of Technological Sciences and Engineering, 2000.*[319]

Up to the beginning of World War II, modern can-making and canning techniques replaced older hand fabrication and sealing methods. A variety of food companies was established, the processing of fruit and vegetables (by canning, freezing and dehydration) was refined, research and development emerged in government and industry laboratories, and ancillary or service companies arose.

World War II provided a major impetus to the development of food technology in Australia. New products, methods, packaging materials and techniques were introduced. Better regulation of foods led to important changes in the control of food additives and contaminants, and in packaging (e.g., the introduction of lead-free, welded cans replaced those with lead solder-sealed side seams). The period after World War II was a time of technological expansion, with the application of food science. Public health practices expanded in concert with these technologies.

Plastic food packaging suffered a setback in 1973 when a number of cases of a rare angiosarcoma (a malignant vascular tumour, which can arise from prolonged exposure to vinyl chloride monomers) were found in workers involved in the manufacture of polyvinyl chloride (PVC), and traces of vinyl chloride monomer were detected in some foods and beverages packaged in PVC containers. Immediate action was taken to establish standards for plastics that were in contact with food, and food containers were made according to stringent regulations and standards.

By the end of the century, there were further advances in food science and technology leading to potential changes to foods. These included developments in modern biotechnology (e.g., recombinant DNA technology, molecular and cellular biology, biochemistry and immunology) to produce genetically modified crops, animals and foods. Managing change in existing and future food technologies and the associated risks to public health was challenging.

Other changes in food regulation – adopting a whole-of-chain approach to food safety and re-structuring the regulatory system around the identification, assessment and management of risk – had a flow-on effect, improving management technologies for primary producers (e.g., in information systems for traceability). Australia became an exporter of food standards and regulatory systems, as well as an exporter of food.[322]

Factors critical to success

The almost universal application of food technologies across the population was critical to the successful public health actions taken in this area. Refrigeration, for example, was a remarkable invention both domestically and commercially; and refrigerated containers allowed fresh food to be supplied to distant markets. Improvements and innovation in food packaging and storage technologies were introduced industry-wide, contributing further to Australia's reputation as a country with a safe food supply, and, therefore, a supplier of safe food.

Many new food technologies were introduced relatively quickly after their benefits had been identified (e.g., pasteurisation of milk against TB), thus substantially improved public health and safety, efficiently and at low cost. Good science and improving cost-benefit risk assessments also guided food technology developments, such as the introduction of Hazard Analysis and Critical Control Point (HACCP) methods.

Future challenges

Challenges included finding better ways to manage the introduction and risks associated with changes in food technologies, represented by advancements in biotechnology such as genetically modified crops, animals and food.

> *'Biotechnology holds the promise of improved health and welfare for all Australians through better understanding of disease, improved diagnosis, and treatment with more specific biopharmaceutical products. Biotechnology, including the genetic modification of agricultural and food products also has the potential to deliver productivity, competitiveness and sustainability benefits to Australia. The technology offers improved resistance to insects and disease, and new uses for agricultural products, improved food qualities, reduced environmental impact and bioremediation are all possible.' – Ministerial foreword,* Australian biotechnology: a national strategy, *2000.*[323]

The Australian government's National Biotechnology Strategy (NBS) identified the importance of capturing the benefits of biotechnology, while safeguarding community and environmental health.[323] Genetically modified (GM) foods were likely to become more common globally, as food producers used biotechnology to control 'input traits' (such as herbicides, drought and salt tolerance), insect and virus resistance, and 'output traits' (such as improved food characteristics e.g., rice containing Vitamin A, oilseeds with increased levels of omega-3 fatty acids).[324] The possible long-term health effects of these modifications were undetermined, and difficult to anticipate.[325]

In response, Australian governments established a strong regulatory framework for gene technology. For example, FSANZ's food safety assurance program assessed whether food contained any additional allergens or toxins resulting from the GM process; the Gene Technology Regulator assessed GM plants for potential environmental impacts; and GM plants were subject to regulatory safeguards before being licensed for release.[326]

> *'Safety issues surrounding foods derived from GM [genetically modified] plants are central to their acceptance into the food chain. Consumers seek reassurance about the safety of the food they eat, in terms of both its immediate and long-term health effects. Rigorous scientific assessment of GM food safety is therefore essential to provide a sound scientific basis for future regulation.'*
>
> – Huppatz & Fitzgerald, *Medical Journal of Australia,* 2000.[326]

Other public health safety approaches to GM food interventions involved:

- developing monitoring systems for adverse events in those eating GM foods and for ecological impact when effects might not become apparent for years, or possibly decades (e.g., if the latency period between the impact of the food and related illness is long, as with Mad Cow disease);
- governments, industry and researchers working together to achieve nationally consistent traceability and tolerance protocols; and

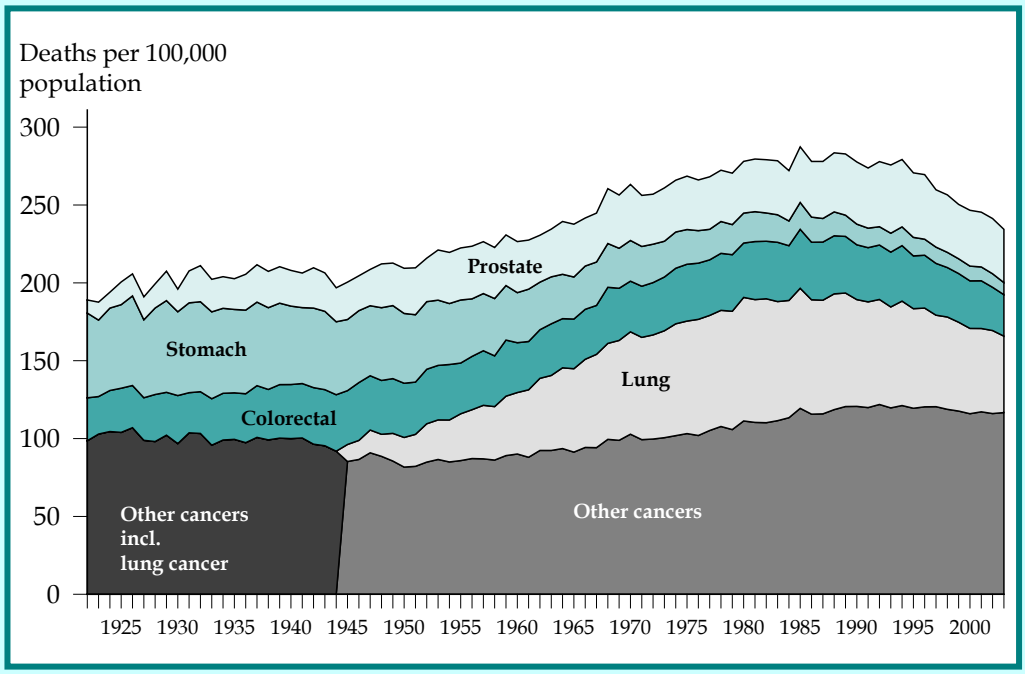
- regulatory systems to build community trust and confidence that the operational checks and balances would ensure that food derived from new technologies was safe and beneficial.[324-326]

Box 4.1 The health impact of refrigeration, and reductions in cases of stomach cancer, 1900-

In 1897, refrigeration was first used in ships to transport fresh meat, thereby reducing wastage and improving nutrition in the 'old world' (the UK). The decline in the prevalence of stomach cancer was associated with the increased consumption of fresh fruit and vegetables, and the advent of widespread refrigeration after World War II.[327]

Refrigeration replaced the need for harmful food preservatives (e.g., nitrates) that caused stomach cancer. The fall in the death rate of 85% (1925 to 2000) for stomach cancers was applauded as one of the 'notable success stories relating to trends in mortality'.[25] Stomach cancer rates fell from 54 deaths per 100,000 males and 32 deaths per 100,000 females in 1925, to ten and four deaths per 100,000 males and females, respectively, in 2000 (Figure 4.1).

Figure 4.1: Decline in stomach cancer rate, males, 1922-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, AIHW, 2006, p. 28.

Refrigeration was strongly linked to improved nutrition: it was estimated that the adoption of refrigeration increased dairy consumption by 1.7% and overall protein intake by 1.25% annually after the 1890s; and directly contributed at least 5.1% of the increase in adult stature of post-refrigeration cohorts (see Section 4.3).[328]

Refrigeration enabled the storage and transport not only of fresh food, but also of medicines and vaccines. The related technology of air conditioning was expected to play an increasing part in preventing heat stress deaths in the hotter areas of Australia, as the climate warmed.

The need to improve mechanisms for public information and consultation about significant technology issues in the community and politically was supported by public views of biotechnology developments.[329] Strategies identified in the *National Biotechnology Strategy* (NBS) to increase community awareness and informed debate included action:

- to engage the community in discussion of regulatory processes, including testing and labelling of GM foods, and assessing and managing risks to human health and the environment;
- to build community confidence in biotechnology, its regulation, the industry, and the way risks are assessed and managed;
- to inform consumer discussions and listen to community concerns; and
- to encourage public contribution to policy decisions.[323]

The 2003 evaluation of the NBS affirmed a continuing need for 'generic information on risks and assessment methodology to underpin future risk assessment' and suggested that more information on the role of each of the various regulatory agencies could increase public confidence in the safeguards already in place.[727]

4.2 Food regulation

1905 onwards

Historically in Australia, food regulation intersected the areas of public health and safety, consumer protection, and business regulation.[30] Food regulation was defined as:

> *'Actions by government which affect the safety or quality of, or the information available in relation to food; encompassing all types of government regulation-making, industry self-regulation, compliance and enforcement activities; and covering relevant activities of all businesses in the supply chain' – Food Regulation Review Committee ['The Blair Review'], 1998.*[330]

Food regulation involved the development and enforcement of food standards that took into account possible regulatory impacts, yet ensured the highest possible level of consumer protection.

Food and drug legislation expanded in Australia in the early 20th century, as standards for foodstuffs were developed, and it became an offence to sell food that did not comply with the detailed specifications applying to it. The *Victorian Pure Food Act 1905* was the first over-arching food act developed in Australia. In 1908, the *NSW Pure Food Act* was passed, with other states following soon after. Despite the fact that a conference of state premiers in 1908 decided that uniform legislation to standardise manufactured food was desirable, it was not until 1975 that federal and state Health Ministers agreed to draft a Model Food Act.[35] Its purpose was to meet the need for complementary national regulations for food standards, hygiene, labelling and packaging.[331]

The Model Food Act developed in 1980 as a blueprint for the development of jurisdictional legislation was described (in 1995) as 'the most important recent development in food law in Australia'.[30] The *Queensland Food Act 1981* was the first state legislation to implement the model legislation. Other states and territories legislated soon after, with Victoria, SA, NT, NSW and ACT creating *Food Acts* in 1984, 1985, 1986, 1989 and 1992 respectively; and Tasmania and WA amending their *Public Health Acts* in 1984 and 1985.[331]

The *National Food Authority Act*, passed in 1991, was the first federal legislation to unify food standards across Australia. The legislation implemented a number of commonwealth/state/territory agreements, including that of the Australian Health Ministers in 1990 to a national method of setting food standards. It established a National Food Authority to develop food standards and, in cooperation with the states, to educate the community. In 1996, the Commonwealth passed amending legislation to transform the National Food Authority into the Australia New Zealand Food Authority (ANZFA) and establish a joint food standards-setting system for Australia and New Zealand.[332]

Imported food was regulated by the Commonwealth under the *Imported Food Control Act 1992,* so such foods had to conform to domestic Australian laws.

A review of food industry regulation conducted by Dr Bill Blair sought ways to reduce the regulatory burden of Australia's food regulation regime, while maintaining public health and safety.

> *'Never before in the history of food consumption have people been so conscious of the safety of their food – and so dependent on others for protection, both within and outside the food supply chain.'*
>
> – G Peachey, *National standards for food safety*, 2005.[316]

The Blair Review reported in 1998 that the food regulatory system in Australia was 'complex, fragmented, inconsistent and wasteful', and recommended that governments:

- aim for an integrated, streamlined and cost-effective co-regulatory system to protect public health and safety effectively across the whole food supply chain;
- develop effective working relations and partnerships between food regulation agencies, the agrifood industry, statutory authorities and consumers;
- centralise responsibility for developing domestic food regulations and standards in a national agency that operated as a partnership between the Commonwealth, states and territories, and recommended resulting regulations and standards to Ministers for national agreement and uniform adoption, enforced and administered by state/territory regulatory agencies;
- ensure a single Commonwealth/state/territory and New Zealand Food Regulation Ministerial Council responsible for developing all food regulations in Australia; and
- streamline standard-setting processes.[333,330]

The main proposal was for a co-regulatory approach to food regulation based upon government, industry and consumers working together.[334] Under the Food Regulation Agreement (FRA) signed in 2000, the Commonwealth, states and territories agreed to implement a cooperative national system of food regulation. A draft Model Food Bill was released, with Annex A to be uniformly applied when states and territories passed Model Food Bill legislation, and Annex B varying between jurisdictions. The *Australia New Zealand Food Standards Code* was adopted after a six-year review of existing food standards – the first joint food code for Australia and New Zealand.

A new statutory authority, Food Standards Australia New Zealand (FSANZ), replaced ANZFA in 2001.[333] FSANZ reported to the Australia New Zealand Food Regulation Ministerial Council, which was composed of Australian and New Zealand government representatives from both health and agricultural portfolios.[324] The Ministerial Council endorsed principles and protocols for the development of food regulation policy guidelines in 2005 (Box 4.2).

FSANZ' role was to develop and regulate food standards in Australia and NZ. It did so with advice from other government agencies (e.g., the Therapeutic Goods Administration), input from consumer and industry groups, and consideration of food regulation policies endorsed by the Ministerial Council. In the process, FSANZ was required to consider the many public health issues that fall within the spectrum of food regulation. These included labelling, mandatory fortification of foodstuffs, health claims, additives and nutritional supplements.[335,313]

Food standards then covered the entire food supply chain – from primary production to

Box 4.2 Principles for development of food regulation policy guidelines

The Australia and New Zealand Food Regulation Ministerial Council (2005) endorsed principles and protocols for the development of food regulation policy guidelines. The guidelines should:

- be consistent with the *FSANZ Act*;
- reflect the application of the *Australia New Zealand Food Standards Code* to the whole food supply chain (Australia only);
- take into consideration existing legislation;
- prioritise policy principles, where appropriate;
- be clear, concise and unambiguous;
- be evidence based wherever possible;
- be developed in a level of detail commensurate with the complexity and sensitivity of the policy issue;
- take into consideration any relevant social or cultural impacts; and
- take into consideration the potential regulatory impact of the policy.

Source: Australia and New Zealand Food Regulation Ministerial Council, *Principles and protocols for the development of food regulation policy guidelines*, 2005, p. 9.

manufactured food and retail outlets – and all food sold in Australia (i.e., both domestically produced and imported food), had to comply with the relevant standards.[335] Implementation, monitoring, and enforcement of food standards was, however, carried out by state and territory, and in some cases, local governments – introducing the potential for inconsistent and burdensome regulation for food suppliers who operated across several jurisdictions.

A review of food and agricultural policy in 2006 concluded that 'despite Australia's high food safety standards, there [was] considerable room for improvement in their governance and implementation'.[324] The review noted that regulation-imposed business costs were ultimately paid by consumers, and that, while reforms were to have reduced the compliance burden on the food sector, they had not achieved their aims. Other problems included inconsistent implementation of food regulation, regulatory processes, and a lack of alignment of domestic food standards with international standards under Codex. The review concluded that food regulation governance arrangements needed to be revised urgently to meet national policy objectives.[324]

Public health practices

The supply of safe, affordable and nutritious food was an important public health goal. As such, food regulation in Australia was strongly focused on the protection of public health and safety through the development and enforcement of nationally uniform food standards.

Food regulation had three objectives:

- protection of public health and safety;
- provision of adequate information relating to food to enable consumers to make informed choices; and
- prevention of misleading and deceptive conduct.

Responsibility for the regulation of food in Australia was shared between the Commonwealth and state and territory (and in some cases, local) governments, and relied upon the effective cooperation between the parties to the Food Regulation Agreement.

By the end of the 20th century, food hygiene practices provided protection from foodborne diseases in the growing, processing, preparation and handling of food. Good agricultural practice (GAP) and good manufacturing practice (GMP), helped to avoid, for example, the introduction of viruses onto raw foodstuffs and into the food manufacturing environment. HACCP controlled viruses that might be present during the manufacturing process.[336] Food premises in Australia were regulated and routinely inspected. These public health practices in agriculture, manufacturing, processing, and food service, together with the protection afforded consumers by the Commonwealth *Trade Practices Act*, the *Food Acts* of states and territories and non-mandatory codes of practice for specific foods and food processing industries, all contributed to a food supply that was reported to be one of the cleanest and safest in the world.[316]

At a national level, several additional government agencies were involved in the regulation and supply of safe food. The Australian Quarantine and Inspection Service (AQIS), for example, performed a vital role in monitoring imported foodstuffs and minimising the risk of diseases such as 'mad cow disease' and aflatoxins (fungal toxins) entering the local food supply.[331] Likewise, the Department of Agriculture, Forestry and Fisheries monitored new agricultural methods, such as genetic modification of crops, processing techniques and chemical or microbiological contamination risks.[337]

As manufacturing processes became more sophisticated and consumer demand expanded accordingly, products such as 'nutriceuticals' (functional foods), medicinal foods, and performance-enhancing foods (sports foods) necessitated increased scrutiny by regulators. The development of new or strengthened food standards followed, along with further food packaging and labelling standards. Improved nutritional and ingredient-derived labelling was, in part, a reflection of the desire of consumers to achieve dietary goals through the ability to make informed choices.

Factors critical to success

The modern ability of Australian governments to regulate food standards and processes across the food supply chain was critical to the development and continuation of a safe food supply. Domestic food regulation and standards were operationalised in a complex partnership between the Commonwealth, state and territory, and local governments. Effective cooperation was enhanced through the agreement between these parties to a national method of setting food standards, and the enactment of legislation to implement unified food standards. Strengths were getting these and other partners across the federal system to act in a nationally consistent way, while weaknesses related to the inevitable inconsistencies and the somewhat cumbersome processes that were developed.[324]

FSANZ, the independent statutory agency with responsibility for standard-setting, worked with industry, consumers and state and territory jurisdictions, and considered that 'consultation [had been] replaced with engagement', believing that 'engagement leads to convergence'.[316] The time taken to achieve a standard was critical to remove ambiguities and align all partners to a common approach.

The 'whole-of-supply-chain' approach to regulating the food supply, adopted by Australia and NZ in 2002, was another successful factor in transforming food regulation. It identified potential hazards and applied risk management control at key points along the chain.[316]

Cost-effectiveness

Overall, improvements in food safety regulation over the century resulted in benefits to society – in terms of reduced health risk (e.g., less illness, death, and loss of productive capacity due to failures in food safety) over and above the costs of introducing and maintaining improvements. It was, however, a complex area and difficult to 'prove' this likely outcome over the whole of the century with the knowledge and analytic tools available to date.

The Blair Review (1998) reported that most agrifood businesses employed practices and equipment that matched or exceeded the standards required by law.[334] Indicative costs of food-related regulatory compliance per firm represented around 0.3% of average annual turnover. ANZFA assessed the proposed improvements to food safety standards as a tangible way to achieve 'highly significant savings' of benefit to the entire Australian community. An immediate reduction in the incidence of foodborne illness was not expected; however, as food industry compliance with new standards was achieved, a potential 20% reduction in the incidence of foodborne illness could realise an annual saving of over $500 million.[50] The cost of foodborne disease to the community was estimated at more than $2.6 billion each year. The cost to government of implementing food safety reforms was expected to be an increase of $22.9 million on the (then) current annual cost of $47.7 million. For small retail businesses, compliance costs were estimated at $1,071 each year, partly replacing existing annual food regulation compliance costs of $1,640.

Analyses of rates of salmonellosis, before (1993/1994) and after (2000/2001) changes in food standards and the regulation of meat and poultry hygiene in Australia, concluded that improvements in the microbiological quality of red meat and poultry were evident over the same timeframe as the regulatory changes.[338] The fact that improvements did not appear to reduce case-rates for salmonellosis was attributed to lack of control over other sectors (e.g., the food service and domestic sectors), and the difficulties inherent in quantifying the public health outcomes of changes to food hygiene regulation (e.g., impossible to estimate what the case rates might have been without the changes).

Food markets were becoming global, and trade in food products was increasing, especially for minimally processed foods (e.g., seafood).[339] About 10% of food consumed by Australians originated overseas, and was regulated by the *Imported Food Control Act 1992*. A review of its operation, including barrier inspection and end-point testing by the AQIS Imported Food Inspection Program (IFIP), concluded that the benefits were substantial. The scheme was estimated to have potentially saved Australians at least $21 million in medical expenses and lost production in 1997, based on only three bacterial contaminants in imported food detected by IFIP in that year.[340] The costs (largely borne by

food importers and consumers) were estimated at around $9 million per year, or about 0.25% of the value of imported food.

Finally, a review of the economics of HACCP, undertaken shortly after it was introduced in the food legislative system in New Zealand, concluded that HACCP brought benefits to society by reducing costs associated with food safety risks, but that it also imposed additional costs on the food industry.[341] A full cost-benefit analysis of the food legislation system was required, which would include not only benefits (reductions in health risks) and costs, but also issues such as effects on productive efficiency, export values and market share, and producers (e.g., on firm sizes and market structure).

Future challenges

Future challenges in food regulation included ongoing public engagement in regulatory and standard-setting processes, which recognised the unequal resources of the food industry compared with the general public. The regulatory system needed to be accessible to all stakeholders, have clear objectives, and be open and transparent in its operation, in order to gain and retain the confidence of the community.[342] There needed to be a greater commitment overall – by government and industry – to consumer engagement in food standards and policy development.

In light of recent events in biosecurity and biothreats, potential gaps and vulnerabilities in agriculture and food chain safety and security had to be identified and addressed, to ensure the integrity of food and minimise the potential for destructive interference.[343-345] Finally, regulators had to ensure that there were appropriate regulatory approaches to manage new foods and food technologies.

4.3 Improved nutrition

1901 onwards

Improvements in nutrition impact positively on long-term trends in health, life expectancy, labour productivity, and the economic growth of nations.[239,346] Historical bio-demographic analyses showed that poor nutrition increased vulnerability to diseases, both infectious and chronic diseases.[239]

The average height of a population reflected its nutritional status, health (including the prevalence of chronic diseases) and life expectancy.[239,347] Over the 20th century in Australia, nutrition – the right food in adequate quantities – improved with better socioeconomic conditions, and was reflected in an increase in average population height. The rate varied between 0.4 and 2.1 cm/decade in males and between 0.01 and 1.6 cm/decade in females.[348] The increase slowed during the last two decades of the century.

The strongest increase in stature coincided with major improvements in the socioeconomic conditions of the population, with a corresponding shift towards earlier maturation. Australian men were estimated to be around 5 cm taller in 2003 than those of 80 years before, while women's height increases were somewhat smaller, at around 1.5 cm from the 1920s.[349] The improved availability of nutritious food was the likely reason for these height increases, although quantity rather than quality may have been a key factor.

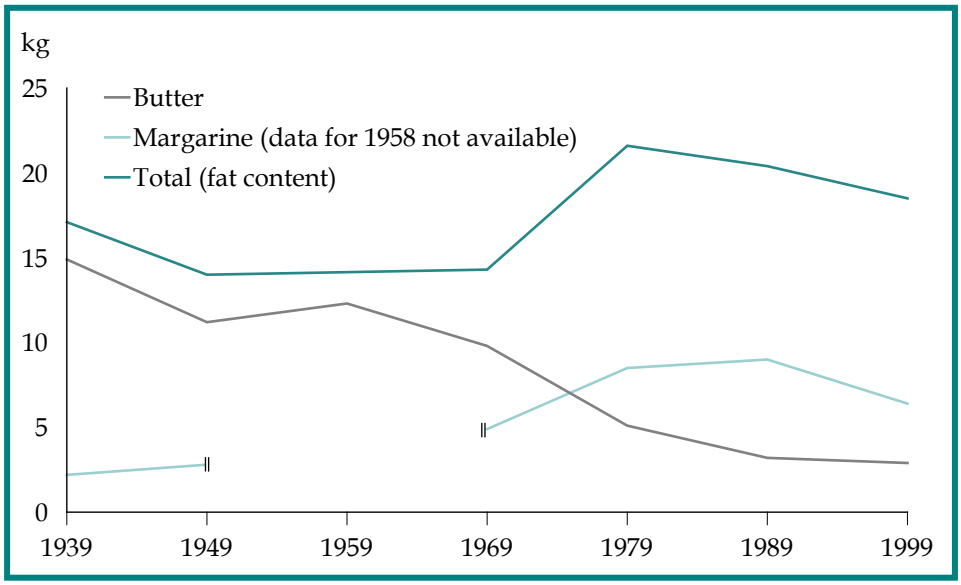
After World War I, nutrition emerged as a public health issue, when a larger than expected proportion of the young male population who enlisted were found to be unfit. The School Milk Program, which subsidised the provision of milk to school children, started in 1926 in response to observed protein and calcium deficiencies in their diets. The program continued until 1974, and the success of this policy was evident when calcium deficiencies were again observed in children after it ceased.[308] In 1936, a Commonwealth Inquiry into Nutrition concluded that 'Australians were generally well-fed, but there was much ignorance about diet' - for example, inspection of schoolboys' lunches at the time revealed that the most popular sandwich spread was tomato sauce.[318]

The traditional public health approach to nutrition also focused on educating the population, by providing advice and information to encourage healthy eating – one such example was the second edition of *Diet and nutrition for the Australian people* (which originated from the 1936 Advisory Council on Nutrition). Published in 1943, it was partly rewritten to take account of the changes that war had brought in the variety, quantity, and cost of available foodstuffs. *Dietary guidelines for Australians* (first published in 1982) were extensively used for nutrition education by groups with interests in the public's health, including NGOs such as the National Heart Foundation.[35] These were later revised and updated by the NHMRC.

The important place of nutrition in influencing the incidence and prevalence of many chronic diseases, through a causative or a protective role, was evident.[350] The later 'nutrition transition' in Australia was the shift to greater dietary intakes of animal and partially hydrogenated fats and lower intakes of fibre.[351, 352] This was reflected in higher rates of chronic conditions (such as obesity, Type 2 diabetes, cardiovascular disease and high blood pressure), which were previously associated with middle age, and of risk factors, such as sedentary lifestyle, poor diet and lack of exercise.[353]

The transition was driven by urbanisation and technological change, and the increasing supply of ready-to-eat, highly processed and energy-dense foods. The first self-service supermarkets opened in Australia in 1950, and, by 1994, four major chains held 95% of the retail market in packaged foods.[35] There was also expansion in the sectors where food was prepared or eaten away from the home. Dietary changes, such as that from butter to margarine and oils (from saturated to unsaturated fats) in the 1960s and 1970s (Figure 4.2), less use of salt in cooking and in food preparation, and increases in the consumption of fresh fruits and vegetables, had a positive impact on the prevalence of some chronic diseases (Section 6.2).[310]

Figure 4.2: Selected oils and fats consumption (per capita, based on proxy data), 1939-1999



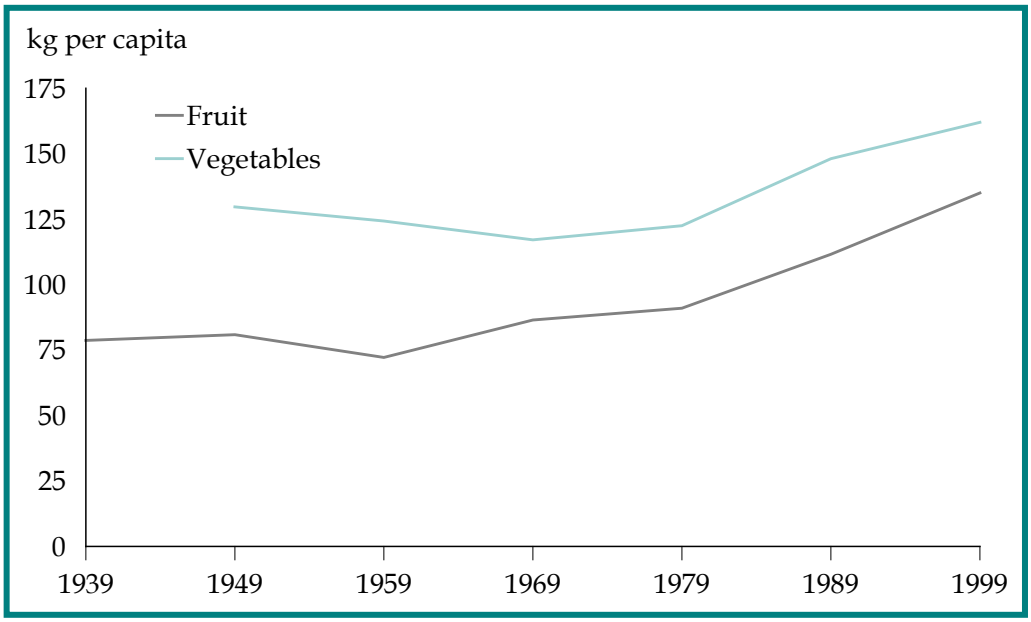
Source: ABS, *Apparent consumption of foodstuffs, Australia, 1997-98 and 1998-99*, 2000.

In 1986, the Australian Better Health Commission inquired 'into the current health status of the Australian population and [recommended] national health goals, priorities and programs to achieve significant improvements in illness prevention and health awareness'.[318] It proposed a strategic focus on nutrition as one of three priority areas for prevention activity.[318]

Analyses of household expenditure on food between 1988-89 and 2003-04 showed that consumption increased most significantly for poultry, seafood and fresh fruit and vegetables, and decreased for meat, eggs, grains and sugar. Longer term trends suggested that, from 1948-49 onwards, the population as a whole had consumed larger proportions of high-value foodstuffs, such as seafood, and less meat, eggs, grains, and sugar.[354]

Increases in the apparent consumption of fruit and vegetables for the period from 1939 to 1999 are shown in Figure 4.3. Although the highest proportions of people usually eating the daily recommended number of serves of fruit and vegetables were reported by the 55-64 year and older age groups, other evidence indicated that young people had also increased their consumption of fresh fruit and vegetables.[355,356]

Figure 4.3: Apparent fruit and vegetable consumption (per capita, based on proxy data), 1939-1999



Source: ABS, *Australian social trends 2002*, 2002, p. 84; data: ABS, *Apparent consumption of foodstuffs, Australia, 1997-98 and 1998-99*, 2000.

Nevertheless, a lack of fruit and vegetable intake was identified (with other risk factors such as smoking, physical inactivity, and obesity) as having a quantifiable role in the population's burden of disease.[357] The national nutrition plan for 2000-10, *Eat Well Australia*, and the related *National Aboriginal and Torres Strait Islander Nutrition Strategy*, identified the following priorities: increasing vegetable and fruit consumption; overweight and obesity as major health issues; and the nutrition of vulnerable groups, especially Indigenous peoples.[358,346]

The *National Chronic Disease Strategy* (2006) regarded poor diet and nutrition as one of a cluster of preventable risk factors for chronic diseases that could be addressed by interventions that took a whole-of-life approach, and started early in life.[359] The Strategy also called for the evidence base for prevention to be improved – through monitoring and surveillance of population trends, particularly in the chronic disease-related risk factors of diet and nutrition, and physical activity.

Mixed fruit

Source: Australian Government Department of Agriculture, Fisheries and Forestry, 2006.

In the latter part of the 20th century, there was rising concern about over-consumption of food and the rapid increase in overweight and obesity among the population. It was estimated that the proportion of overweight or obese adult females (aged 18 years and over) increased from 32% in 1995 to 40% in 2005, while the proportion of overweight or obese adult males rose from 49% in 1995 to 58% in 2005.[360]

Similar increases were observed for children. The *NSW Schools Physical Activity and Nutrition Survey* (SPANS), which weighed and measured 5,500 children aged five to 16 years across a range of schools, found that the prevalence of overweight and obesity had increased markedly in school-aged children over the 20 years from 1985.[361] The proportion of boys who were overweight or obese increased from 11% in 1985 to 25% in 2004 (across all school years), and the proportion of girls rose from 12% in 1985 to 23% in 2004. Overall, around a quarter off NSW school students were estimated to be overweight or obese in 2004, many more than in previous comparable surveys (in 1985 and 1997). It also appeared

that, for boys, the rate of increase in those overweight was escalating, while for girls, it was steady or slowing. Many consumed foods and drinks that were high in calories and low in nutritional value.[361]

While inadequate nutrition was a substantial problem at the start of the 20th century, this had been replaced by overweight and over-nutrition at the start of the 21st century.

Other public health nutrition issues included:

> *'Inequitable food pricing is an issue for all remote communities.'*
>
> – K Webb & S Leeder, *Medical Journal of Australia*, 2007.[364]

- improving access to fresh foods including fruit and vegetables in less populated rural and remote areas;
- the role of 'empty nutrition' in health – the concern that some overweight children could also be malnourished, with 'empty calories' from energy dense nutrient-poor foods and high sugar content drinks;
- poverty, food insecurity, and unhealthy eating practices also leading to obesity and other chronic diseases; and
- under-nutrition (e.g., among remote Indigenous children and youth, elderly people at home and in nursing homes, and people living in poverty).[315,362,363]

Public health practices

Over the century, there were many public health programs initiated by governments, schools, health-related NGOs and others to improve the diet and nutrition of specific populations. Examples included:

- the School Milk Program (1926-1974);
- school nutrition education programs, including the Health-Promoting Schools Programs (from 1994); and
- public education campaigns, such as the Victorian '2 Fruit 'n' 5 Veg every day', based on a campaign strategy developed by the Health Department of WA in 1990 (the first of its kind in Australia); and the national 'Go for 2 & 5®' campaign under the *Building a Healthy and Active Australia Initiative*, also based on effective Health Department of WA nutrition campaigns (2002-2005). The national 'Go for 2 & 5®' campaign encouraged Australian children and families to increase their daily intake of fruit and vegetables to the levels recommended in the Australian dietary guidelines: for adults two pieces of fruit and five servings of vegetables, and for children of the following ages:

  4-7 years: 1 serve of fruit and 2 serves of vegetables;

  8-11 years: 1 serve of fruit and 3 serves of vegetables;

  12-18 years: 3 serves of fruit and 4 serves of vegetables;

'Go for 2 & 5®'

while recognising the reality that the amount a child ate at any one time depended on age, appetite, activity levels, and cultural and family factors.[308,365-369]

Within all levels of government, together with NGOs such as the Heart Foundation, schools and community groups, there were many programs aimed at improving public health nutrition by encouraging the community to have healthier food behaviours, only some of which are detailed here.

Developments over the century such as water fluoridation and improvements in food standards, standard setting, food legislation and regulation were public health measures that aimed for universal application across the population, as the most cost-effective way to deliver maximum benefit. For

example, both food fortification and water fluoridation were applied universally (providing protection against disease for almost an entire population) at minimal cost, using existing distribution systems.

Nationally recommended daily dietary requirements set standards that allowed population dietary behaviours to be assessed against an ideal.[370] The role of fruit and vegetables in the prevention of chronic diseases was quantified and codified in dietary guidelines, and their consumption monitored by population health surveys at the national and jurisdictional levels. Population nutritional status was extensively recorded in the *National Nutrition Survey* in 1995, but a further national nutrition survey had not been repeated by 2006. In 2001, state and territory population health surveys agreed to use a set of standard questions to gather data on the consumption of fruit, vegetables and type of milk.[371]

FSANZ' ultimate goal was 'a safe food supply and well-informed consumers'.[372] It conducted surveillance and monitoring of the food supply by regular sampling of a basket of foods – the 21st *Australian Total Diet Study* was published in 2005 - and modelling the impact of cumulative and 'all-diet' (i.e., including nutritional supplements, vitamins and minerals) exposure to certain variables in foods (e.g., micronutrients, additives, and pesticides), amongst its other activities.[373]

The National Nutrition Action Plan for 2000 to 2010, *Eat Well Australia* and the related *National Aboriginal and Torres Strait Islander nutrition strategy* focused on a partnership model to address areas where the greatest impact could be achieved, with priorities being:

- a major health focus: overweight and obesity;
- a critical food group: vegetables and fruit;
- strategic population/target groups: women, infants and children (including school canteen policies);
- the nutrition of vulnerable groups, especially Indigenous peoples; and
- capacity building to strengthen the infrastructure required for effective action, including strategic management, funding and resources, research and development, workforce development, communication, monitoring and evaluation.[346,358]

Despite these strategies, however, it remained very difficult to change the population's eating habits, especially while powerful commercial interests maintained activities that militated against good nutritional practice and healthy food affordability. Some researchers called for governments to tax processed foods containing high sugar and saturated fat, and reinvest the monies collected to fund effective measures to increase the intake of fruit, vegetables, and other low fat foods.[374] Thus, 'success' in changing the population's food consumption behaviours continued to be difficult to achieve.

Factors critical to success

Better economic circumstances and developments in agriculture and in food treatment, processing, packaging and storage technologies contributed to improvements in the population's nutritional status over the 20th century. Uniform food legislation created a national focus for public health issues to do with food, although the competing interests of the food industry and consumers had to be balanced. Regulatory regimes, based on risk assessment and improved compliance with food standards and regulations, had the effect, over time, of significantly raising food safety and quality.

Strategies to provide standardised information to consumers, and public health education on good eating habits and the nutritional value of foods successfully increased health literacy in relation to food for some, though not all, members of the community, as health literacy continues to be largely determined by socioeconomic status. However, the Australian community expected government to play an active role in improving population nutrition. For example, a community survey about the so-called 'obesity epidemic' revealed that 83% of respondents believed government 'should go beyond regulating food advertising to kids and also require manufacturers to make children's food healthier'.[375]

Cost-effectiveness

The *National Chronic Disease Strategy* reported that increasing fruit and vegetable consumption by just one serve a day would save the Australian health care system $157 million annually, by preventing heart disease, and lessening the prevalence of osteoporosis.[359] Public policies to promote healthy eating and dietary change were among the most cost-effective methods to prevent cardiovascular disease at a population level.[376] Published studies of the primary and secondary prevention of cardiovascular disease were reviewed to determine the cost-effectiveness of dietary change strategies compared to other measures. Although evidence was limited, strategies promoting healthy eating appeared more likely to be cost-effective than those relying on modern cholesterol-lowering drugs, or primary care screening and dietary advice; and comparable to, or less costly per year of life saved, than anti-smoking strategies.[376] The beneficial impact of consuming a 'Mediterranean diet' after suffering a heart attack was also assessed as a cost-effective strategy at the population level.[377]

Future challenges

Differential improvements in population nutrition, and access to fresh and affordable food remained substantial challenges for Australia. Lack of access to food was one of the factors that contributed to the higher death rates of Australians from socioeconomically disadvantaged and remote areas.[378,379] Studies in Queensland, WA, SA, Tasmania and the NT found the costs of food were higher in rural and remote areas than in capital cities and large rural centres, and that the quality of fruit and vegetables was poorer, and they were more expensive and less varied.[380] In SA, the cost of a basket of healthy food was highest in population centres of fewer than 400 people (cost ranged from $274 in the capital to $389 in towns of less than 400 people); and in remote and socioeconomically disadvantaged towns, where it ranged up to 175% of the cost in the capital.[380]

Comparison of a basket of healthy food items in Queensland over the period 1998-2004 found the cost of healthy foods rose more than that of less nutritious foods, making healthy foods (especially fresh fruit) relatively less affordable.[379] The provision of fresh nutritious food, including fruit and vegetables, at affordable prices to all Australian communities – especially for Indigenous communities and others in remote areas – continued to be a major challenge.[381]

Other challenges included:

- changing food behaviours and achieving better compliance with recommended dietary intakes (e.g., of fresh fruit and vegetables) at a population level;
- continuing and increasing levels of overweight and obesity, especially at younger ages;
- increasing access to fluoridated drinking water across the whole population;
- the advertising, pricing (relative to fresh food), nutritional value and energy density of processed foods;
- the need to ensure the reliability and consistency of public health nutritional messages - with some food producers, for instance, advertising their products as 'low fat' but neglecting to mention accompanying high sugar or salt levels; and
- the wider issues related to control over the food supply, the food chain, and influences on the food choices of individuals and communities.[317,382,383]

In relation to food fortification, folic acid fortification was identified as an evidence-practice gap by the National Institute of Clinical Studies (2005), which recommended encouraging periconceptional use of folic acid supplements and consideration of the mandatory fortification of a commonly eaten food (Box 4.3).[126] FSANZ was also considering the mandatory replacement of non-iodised salt with iodised salt in breads, breakfast cereals and biscuits, to reduce the rising prevalence of iodine deficiency in some population groups.[384,385]

Box 4.3 Food fortification, 1960s-

Food fortification for public health reasons was undertaken from the 1960s with the fortification of salt with iodine, bread-making flour with thiamine (1991), and various foods with folic acid (voluntarily, from 1996). The goal of food fortification was to reduce nutritional deficiencies, related diseases and congenital malformations. For example, after the detection of iodine deficiency in Tasmania in the 1960s, subsequent iodine fortification had a large impact on reducing the incidence of goitre.[386]

Iodine fortification, 1960s-

Without adequate iodine, infants can suffer from mild intellectual disability to cretinism. Iodine deficiency is 'the single most important cause of preventable intellectual deficit in the world.'[387] In adults, iodine deficiency leads to hypothyroidism, poor mental performance and goitre, a condition where the thyroid gland expands massively in response to low iodine levels.

Iodine fortification of salt led to reductions in a range of iodine deficiency disorders.[388] The re-emergence of iodine deficiency in some population groups is a repetition of a previous public health problem, as Australian soils were iodine-deficient, especially in the mountainous areas of northern and eastern Tasmania, the Atherton Tablelands (north Qld), the Great Dividing Range (NSW), the plains surrounding Canberra, the eastern region of Victoria and the Adelaide Hills.[385,389] FSANZ considered mandatory replacement of non-iodised salt with iodised salt in bread to reduce the prevalence of iodine deficiency, along with folic acid fortification.[384] Tasmania had a voluntary iodine fortification program using iodised salt in bread from 2001.[390]

Thiamine fortification, 1991-

Fortification of flour with thiamine led to reductions in Wernicke-Korsakoff Syndrome (WKS).[391] WKS is a neurological disorder – potentially fatal – caused by thiamine (vitamin B1) deficiency. It is easily treated by thiamine supplementation, and most people so treated show good clinical improvement.[392] Although the occurrence of WKS was reduced by the fortification of bread-making flour with thiamine, it was not eliminated. As most cases were found in heavy alcohol drinkers with a preference for beer, it was suggested that beer would be a more appropriate medium for thiamine fortification, and more cost-effective than the fortification of bread-making flour.[393]

Voluntary folic acid fortification, 1996-

Voluntary folic acid supplementation of foods led to a reduction in babies born with congenital neural tube defects (NTDs); however, the National Institute of Clinical Studies recommended increased periconceptional use of folic acid supplements, and consideration of the mandatory fortification of a food staple.[126, 394] The NHMRC *Recommended Dietary Intakes (RDIs)* were reviewed, and recommended consumption of an additional 400µg/day of folic acid through a supplement or fortified foods, for women planning to become pregnant, for at least one month before and three months after conception (in addition to consuming dietary folate) to reduce the likelihood of NTDs in the baby.[370,395,396] After extensive consultation, FSANZ determined that mandatory fortification of wheat flour for bread-making purposes in Australia with folic acid was the preferred approach.[397]

Food fortification policy

Food fortification for preventable deficiency diseases provides a 'generic solution which does not require daily decisions by every individual'.[398] Food fortification policy must, however, 'be driven by a demonstrated health need rather than by competition within the food industry'; fortified foods should be limited to those consumed by the target population and be consistent with nutritional rationale; and fortification should not exceed safe upper limits.[399] Mandatory fortification of foods with iodine, for example, is considered to fulfil the public health criteria (derived from interventions to increase nutrient intakes) of 'effectiveness, equity, efficiency, certainty, feasibility and sustainability'.[384]

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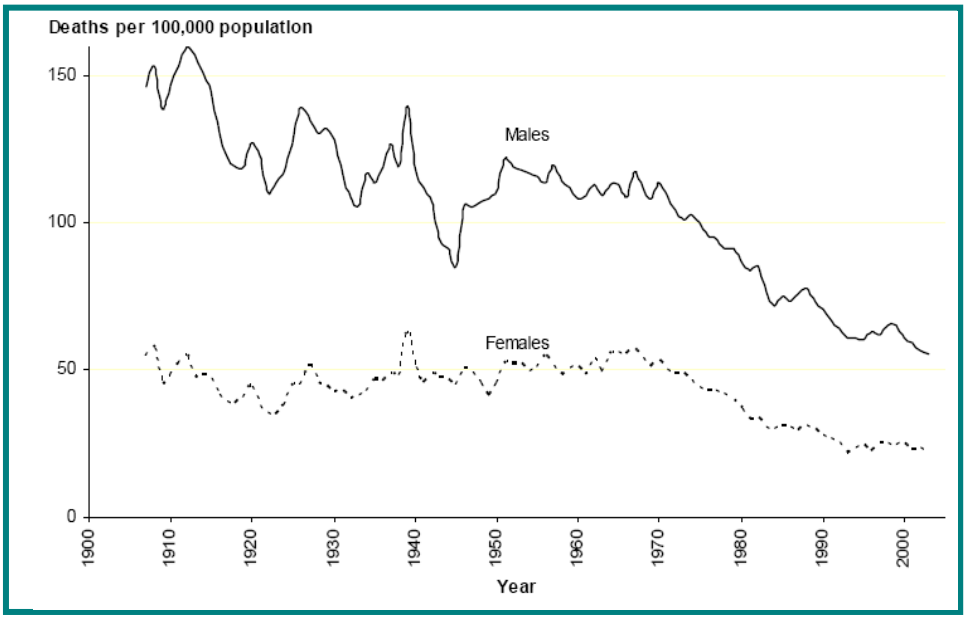
5 Preventing injury: 1970s onwards

Over the 20th century, injury was the cause of many deaths and physical, cognitive and psychological disabilities that seriously affected the quality of life of injured individuals and their families.[400] It was a primary cause of death in people under 45 years of age, and a leading cause of death, illness and permanent disability in older age groups. It was also a major source of health care costs.

Many injuries are preventable, and there were substantial opportunities to reduce the incidence, impact and burden of injury on health, using effective and innovative strategies. Injury prevention and control was included as a National Health Priority Area (NHPA) at the start of the NHPA initiative in 1986.

From 1907 to 2003, there were major reductions in the rate of injury deaths (Figure 5.1). The death rate from injury and poisoning for males fell from 147 per 100,000 population in 1907, to 61 per 100,000 population in 2000.[25] This figure excluded deaths from Australia's engagement in wars. The rate for females also decreased, from 55 per 100,000 population in 1907, to 25 per 100,000 in 2000.[25]

Figure 5.1: Death rates for injury and poisoning, 1907-2003

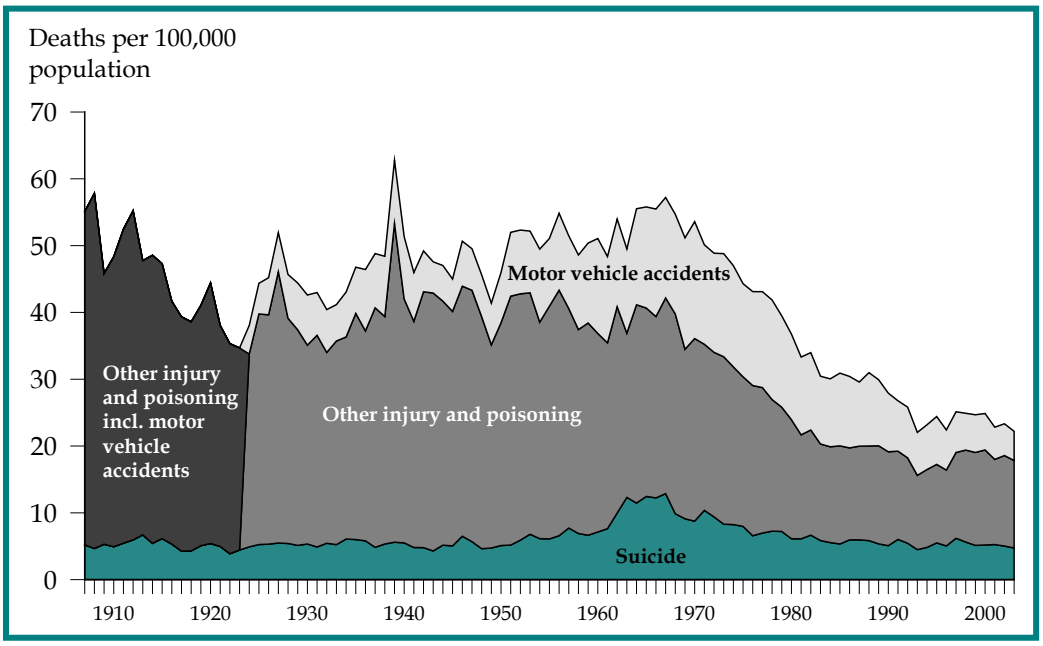


Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 33.

However, as there were comparable falls in the rates of death from other causes, this cause still accounted for about the same proportion of all deaths in 2003 (6.0%), as it had in 1907 (4.9%). Many more people survived and were hospitalised as a result of their injury, or suffered some form of disability.[25] Injury and poisoning accounted for just under 441,000 hospitalisations, slightly less than seven per cent of all hospital admissions in 2002-03.[25]

Figure 5.2 shows the increase in motor vehicle fatalities from the 1950s, which increased steeply following the rise in motoring after World War II. Road traffic fatality was the leading cause of injury mortality, peaking in 1970, when the motor vehicle death rate for males was 49 per 100,000 population (18 per 100,000 for females). By 2000, it had dropped to 14 per 100,000 population for males and 6 per 100,000 population for females.[25] A range of interventions, such as the introduction of national speed limits, mandatory seat belts, alcohol limits and breathalyser testing, were put in place from the 1970s, and while motoring in terms of average distances driven continued to rise, mortality risk fell substantially.

Figure 5.2: Death rates for injury and poisoning, showing the impact of motor vehicle accidents and suicide, males, 1907-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 35.

While there were reductions in suicide from specific causal agents, suicide and violence were ongoing challenges, as were the higher injury rates in some sub-populations, such as young males, Indigenous Australians and others who were exposed to alcohol-related harm and other injury risks. Some successful initiatives to reduce suicides are discussed in Section 5.3.

Public health practices

Various measures to reduce preventable injuries were identified and addressed during the latter part of the 20th century, especially in Australian homes (e.g., child-proof lids for poisons and medications, smoke alarms, fencing for domestic swimming pools) through legislation, regulation, standard setting, and public education (Box 5.1). Standards enshrined the safety requirements for numerous products, and were the mechanism for implementing those requirements. Coroners in some States accentuated their role in identifying preventable injuries (e.g., such as those from certain baby baths and cots) by highlighting potential remedies (Coroners' roles in identifying unsafe products are described in Box 5.2).

From the 1970s, public health successes included road traffic safety and the impact of related measures, such as the mandatory wearing of seatbelts, and cultural changes, such as those that occurred in relation to drink driving. The prevention of injuries in the home was another successful area, and there were numerous public health programs using measures such as product redesign, risk reduction and behavioural change (see Section 5.2).

The development of national suicide prevention strategies, including a national youth suicide

Box 5.1 The role of public health in injury prevention

The role of public health is to identify, research, monitor and act in effective ways to prevent injuries. Methods used included:

- problem identification, description and investigation including the use of epidemiological studies to quantify the scope of problems and likely solutions;
- community education campaigns;
- social marketing of behavioural changes;
- influencing of standard setting for product safety and other public safety concerns;
- legislation to enact and regulate mandatory safety requirements; and
- product safety design and redesign to rectify unsafe products and settings.

prevention plan, contributed to reducing rates of youth suicide. Restricting the availability of potentially dangerous medications also prevented deaths (Sub-section 5.3.1). Box 5.5 describes the limiting of a potentially harmful drug, which was a preventable cause of analgesic nephropathy. The impact of gun control and the associated reduction in gun-related deaths (both intentional and accidental) was a later success (Section 5.4).

The National Health Priority Areas' (NHPA) report on injury prevention and control identified the following effective strategies:

- smoke detectors;
- sports' policies regarding effective protective gear;
- playground equipment safety standards and regulations;
- speed and red light cameras;
- interlock devices for vehicles of drink-driving offenders;
- mandatory standards for nursery furniture; and
- legislation to ensure a maximum bathroom delivery water temperature of 50°C for all new hot water heaters.[401]

At the start of the 21st century, important public health injury issues included preventing violence, addressing the role of alcohol as a risk factor for violent behaviour including suicide, and reducing the higher rates of injury and violence in Aboriginal and Torres Strait Islander communities.

The Australian government's National Injury Prevention Program was guided by three national plans:

- the *National Injury Prevention and Safety Promotion Plan: 2004-2014*;
- the *National Falls Prevention for Older People Plan: 2004 Onward*; and
- the *National Aboriginal and Torres Strait Islander Safety Promotion Strategy*.

States and territories and many communities tailored their own injury prevention plans to local conditions. Some emerging public health issues included the prevention of sports injuries and recreational water traffic accidents (associated with increases in boat ownership and use), and the need for a proactive role in product design and faulty product recall (e.g., of baby walkers and other infant care equipment).

Cost-effectiveness

The AIHW estimated the direct costs of injuries in Australia at $4,061 million annually in 2000-01.[400] A review of the injury prevention and control area found that information on the relative cost-effectiveness of different injury programs was not available.[401] The authors noted that there was little 'sound evidence of effective counter-measures' with certain limited exceptions (e.g., road trauma and work-related injuries), but that the absence of evidence reflected a lack of funded research. Work on the comparative cost-benefits of various potential measures was 'at a formative stage', while that in other areas was far behind. In a later article, Moller noted that basic 'information requirements for cost-benefit and cost-effectiveness measures [could still] not be met'.[402]

Table 5.1: Historic highlights of successful injury prevention

1924	First recording of motor vehicle accident deaths.
1929	The Standards Association of Australia established to prepare standards for all types of goods and services.
1959	Australian Consumers' Association established.
1965	Seat belt legislation introduced in Victoria.
1967	Stringent restrictions placed on the prescription of barbiturates and other drugs available through the PBS, with the almost immediate effect of reducing 'drug suicides'.
1970s	Mandatory fitting of seat belts in new passenger vehicles (from 1 January 1970).
1973	Legislation in all Australian states and territories for the compulsory wearing of seat belts in motor vehicles, and protective helmets by motor cycle riders and pillion passengers.
1979	First Australian standard on fences and gates for private swimming pools published. Legislation banning the sale of 'over the counter' compound analgesics reduced the incidence of analgesic-induced kidney disease.
1976-1988	Introduction of random breath testing (RBT) in Victoria in 1976 (NT: 1980, SA: 1981, NSW and the ACT: 1982, Tasmania: 1983, Qld and WA: 1988).
1987	The National Committee on Violence recommended uniform national firearm laws after the Hoddle and Queen Street massacres in Melbourne caused the deaths of 15 people in 1987.
1988	Standards Australia established (formerly, the Standards Association of Australia).
Late 1980s	Speed cameras introduced, first in Victoria and later in other jurisdictions, with other speed measuring devices and red light cameras.
1990-1992	Victoria enacted legislation that made wearing of bicycle helmets compulsory and other jurisdictions followed in 1991 and 1992.
1992	National maximum speed limit of 110 km/hour in all States, blood alcohol limit of 0.05% (0.05gms alcohol per 100mls blood).
1993	An interim Australian Standard in relation to swimming pool safety published on the location of fencing for private swimming pools (made final in 1994).
1995	*National Youth Suicide Prevention Strategy 1995-1999* published.
1996	Reform of gun laws in all states and territories after the Port Arthur Massacre in April. Injury prevention and control became a National Health Priority Area. First *National Road Safety Strategy and Action Plan* published.
1997	National Injury Prevention Advisory Council established. All states adhere to the *Standard for the Uniform Scheduling of Drugs and Poisons*.
1998	*National Water Safety Plan* introduced.
2000	National Coroners' Information System established – the world's first national collection of coronial information. The *National Road Safety Strategy 2001-2010* launched. *Living Is For Everyone (LIFE): a framework for prevention of suicide and self-harm in Australia* released.
2001	*National Injury Prevention Plan Priorities for 2001-2003* and the implementation plan published.
2003	State and territory governments agree on National Handgun Control after a multiple person shooting at Monash University in Victoria in 2002.
2004	The *Water Safety Plan 2004-07* launched; ultimate goal: 'zero drowning deaths and the establishment of a culture of water safety in Australia'.
2005	The *National Injury Prevention and Safety Promotion Plan: 2004-2014* launched.

5.1 Road traffic safety

1970s onwards

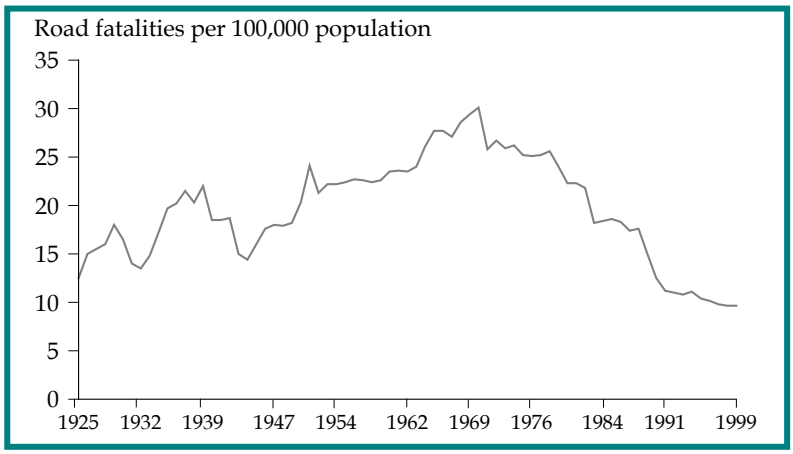
> *'From the first recording of deaths due to motor vehicle accidents in 1924, the rates were substantial for both sexes throughout the twentieth century, especially in the second half. In 1970, deaths from motor vehicle accidents peaked at 49 deaths for males per 100,000 population and 18 for females, then fell to 14 and 6 respectively by 2000'. – AIHW, 2006.*[25]

At the start of the 20th century, the advent of motor vehicles brought the advantages of more rapid transport and the ability to travel longer distances, but also resulted in a substantial burden of death and disability for the population. Road deaths were responsible for a significant proportion of injury deaths for much of the century, and fatality rates rose steeply in the 1950s and 1960s, peaking in 1970.[25]

A feature of deaths due to road accidents was their greater impact on younger people and on those in the most economically productive age groups.[403] While road accidents in Australia caused just over two per cent of deaths around 1991, it was estimated that they made up almost seven per cent of years of life lost through all causes of death.[403]

From a peak in 1970, road accident death rates then decreased substantially (Figure 5.3). In 2000, the rates were 14 (male) and 6 (female) deaths per 100,000 population.[25] In 1970, this equated to a per vehicle rate of eight road accident deaths per 10,000 registered vehicles; but, by 1999, this reduced to a rate of 1.4 deaths per 10,000 registered vehicles.[404] This improvement was attributed to a number of interventions, including better design of vehicles, roads and traffic flow; compulsory use of seat belts, child restraints and helmets for cyclists and motorcyclists; lower speed limits; restrictions on the use of alcohol and other drugs while driving; and public education campaigns.[3]

Figure 5.3: Road fatalities per 100,000 population, 1925-1999



Source: ATSB & ABS, *Year Book Australia 2001,* 2001.

In 2000, the *National Road Safety Strategy 2001-2010* set the ambitious goal of reducing the number of road fatalities by 40%, to no more than 5.6 per 100,000 population by the year 2010.[405] The 2005 progress report identified a road fatality rate of 8.0 deaths per 100,000 population in the twelve months to September 2005, which was close to the pro rata rate required to meet the goal.[406]

Public health practices

Contributions to the dramatic decline in road fatalities and injuries included:

- the enactment of key pieces of road safety legislation;
- improvements to roads and vehicles;
- improved emergency medical retrieval, care and treatment;
- intensive public education campaigns, leading to behavioural change; and
- enhanced police enforcement technology and strategies.[406]

Public health measures were largely undertaken through intersectoral partnering outside government health departments (e.g., with road transport authorities and police). Some campaigns were led by medical practitioners, such as neurologists and neurosurgeons who advocated the compulsory use of helmets to reduce brain injury. Road safety initiatives were primarily driven by state, territory and local governments, which developed their own policies and plans tailored to their conditions, in tandem with national strategies. There was also significant input into preventive public health interventions from motoring and pedestrian organisations and a range of other stakeholders. The Australian government's role was to initiate national policy and strategy, providing incentives to jurisdictions, funding some programs and research, and road building programs (e.g., those targeting accident 'black spots').

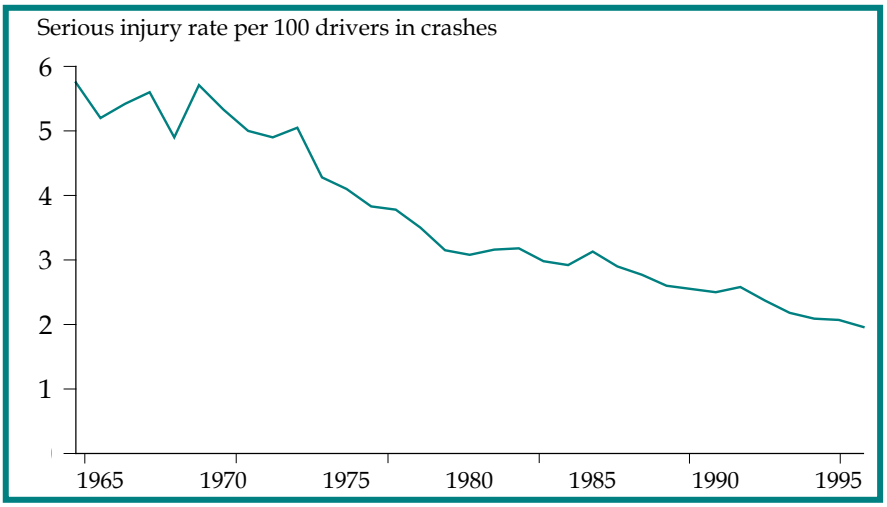
Successful public health measures included:

- compulsory seat belts from the 1970s, with enforced mandatory wearing of seat belts;
- mandatory wearing of motorcycle helmets (from 1973 for motorcycle drivers and their passengers), and of bike helmets (nationally from 1992);
- baby capsules and improved occupant restraints in motor vehicles;
- reductions in road speed limits, reduced speed zones (e.g., near schools), and traffic zones shared by motorists, cyclists and pedestrians;
- setting and monitoring blood alcohol limits (e.g., random breath testing, penalties and fines for drivers);
- driver education and testing; and
- road safety campaigns in schools and the mass media.

Random breath testing (RBT) was first introduced in Victoria in 1976, and, between 1980 and 1988, it was progressively implemented by other states and territories. From its inception, the use of RBT was intensified and refined (e.g., through the inclusion of 'booze buses' and mobile testing units) and the program was 'one of the most extensive programs for mass breath testing of drivers worldwide'.[404] A number of states and territories (SA was the first in 1973) also legislated for compulsory blood testing of people involved in accidents who attended hospital.[404] In 1992, the Australian government offered funding to the states (noting that the NT had not complied) if they implemented the mandatory wearing of bicycle helmets, a maximum speed limit of 110km/hour, and a maximum blood alcohol limit of 0.05%. Road deaths continued to fall across the nation from that time.

Measures to improve roads and road use included the federal funding of the National Highway around Australia, the Black Spot Program that funded improvements to known accident 'black spots', and the Roads to Recovery Program that funded local councils to improve the roads. In suburban areas, the introduction of techniques designed to lessen the impact of motor vehicle traffic by slowing it down ('traffic calming'), and other traffic management innovations also contributed. Better structural design of vehicles, improved seats, more advanced seatbelts and airbags all reduced the risk of occupants being seriously or fatally injured in a crash.[408] Modern vehicles were safer than those in use 30 years earlier; and there was also a substantial reduction in serious injuries (Figure 5.4).

Figure 5.4: Trend in serious injury rate of drivers in vehicle accidents, 1964–1996



Source: NSW RTA, *Road Safety 2010,* 2002, p. 11; citing AAA, *Newer cars benefit everyone - Discussion paper*, 1998.

Vehicle safety enhancements from 1970 identified by the Australian Transport Safety Bureau (ATSB) included:

- mandatory fitting of seat belts in new passenger vehicles;
- progressive extension of seat belts to other motor vehicles and the use of retractable belts;

- anchorages for child restraints;
- improved vehicle brakes, tyres, lights, indicators and glazing, head restraints and impact resistance;
- increased roll-over strength and occupant protection in buses;
- speed limiters on heavy vehicles; and
- airbags for drivers and passengers as standard elements in newer cars.[404]

The introduction of laminated, and the withdrawal of toughened, glass windscreens reduced the risk of facial injury and eye damage.[409] *Australian Design Rules for Motor Vehicle Safety* were developed as the mechanism for implementing mandatory safety requirements as they were identified.[405]

Other successful measures were the implementation of nationally consistent 0.05% blood alcohol limits for drivers, zero blood alcohol limits for special driver groups, structured penalties, and mass public education and media campaigns – many with high 'shock value' to catch the attention of targeted groups (such as young drivers).[404] The standard of road traffic safety was the result of more than fifty years of development and investment in motor vehicle design, roads and facilities, and responsible, trained drivers, the majority of whom complied with safety requirements.

> *'People have heeded the call to drive more responsibly'* – National Road Safety Strategy 2001-2010*, 2000.*[406]

Factors critical to success

Public health programs to increase road traffic safety were successful because of the strong policy leadership shown at all levels of Australian, state and territory governments. As road safety initiatives were adopted and proven in one jurisdiction, they were successfully extended to other states and territories (e.g., RBT, speed cameras).

> *'The turnaround that has been achieved in Australia's road safety performance since 1970 has highlighted the effectiveness of a resolute, coordinated approach by government.' – ATSB, 2001.*[404]

Legislation, such as that requiring the wearing of seatbelts, enabling RBT and the enforcement of speed and alcohol restrictions for drivers, had one of the strongest effects on road safety. The campaign, which culminated in legislation in all states and territories for the compulsory wearing of seat belts in motor vehicles, was led by surgeons concerned with the high numbers of preventable traumatic injuries. The progressive extension of seat belt rules, and other occupant-restraining devices such as baby capsules, and the improved engineering and installation of such devices continued to reduce trauma from road accidents. The WA Office of Road Safety's campaign on 'Restraints' identified that drivers and passengers travelling unrestrained in a car were ten times more likely to be killed in a road crash than those wearing a seatbelt, based on analyses of road crash statistics from 1990 to 1999.[410]

The efficacy of many of the measures described above was dependent on large-scale cultural change. For example, RBT from 1976 in Victoria, encouraged Australian men to say 'No' to 'one more for the road', by providing them with a valid reason to curtail their alcohol intake.[76] The greatest success was the attitudinal shift from a high tolerance of drink driving to its perception as a 'social crime', and acceptance by the population of a range of measures (e.g., designated driver programs) that ensured drivers were not over the alcohol limit. As a result of the many public health programs that reduced road trauma, communities had a heightened awareness of road safety, which was not a consideration in the early days of motor transport.[404]

After the Australian government offered additional funding to the states and territories in 1992 to implement a suite of measures across the country (including a maximum speed limit and a lower blood alcohol limit for drivers), a national approach was more evident and meant that a clear and consistent message was delivered across Australia. This reinforced the cultural shifts required to instil behavioural change (such as not drinking and driving).

National road safety policies after 1996 (the latest was the *National Road Safety Strategy 2001-2010*) set out frameworks that recognised the roles of the many other organisations that contributed to road safety, but encouraged individual governments to develop and implement road safety strategies, consistent with the national strategy but also reflecting local conditions.

Cost-effectiveness

In 2003, Abelson and colleagues costed a range of programs that addressed road trauma over the period 1970-2010, including the mandatory fitting of seat belts, campaigns against drinking and driving, reduced vehicle speed limits, enforced speed restrictions, accident black spot programs, and improved traffic management. They attributed 50% of the reduction in road accidents to these public health measures (with the remaining 50% attributed to better roads and vehicles). The benefits arising from public health programs were estimated at $2.7 billion per annum in the late 1990s, with 1,000 lives saved and 5,000 hospital cases averted each year (there were also savings in property damages). The programs were estimated at $600 million a year. Although the 'net present value' to government of road safety programs was estimated as negative (i.e., expenditure was greater than savings), the authors noted that this was sensitive to the definition of programs, and that the social benefits outweighed the savings to government.[87]

In 2000, the Bureau of Transport Economics estimated the cost of all road accidents at around $15 billion per year in 1996 dollars. At the time, this was an amount equivalent to Australia's total annual defence budget, and translated to over $750 per year for every person in Australia. More than half the total costs of road accidents (56%) were directly related to victims, including costs from lost output, long-term care, rehabilitation and lost quality of life. Road accidents cost the Australian community over $41 million daily, of which $23 million were expenses directly related to accident victims. The study estimated the average cost of a road accident death at $1.5 million (in 1996 dollars), while the cost of a seriously injured person was estimated at $325,000 and a minor injury at $12,000.[403]

A Victorian study found that programs that enforced driver alcohol and speeding limits, and were supported by publicity, were effective and cost-beneficial.[407] For instance, an economic analysis that examined the impact of speed cameras, RBT, and associated publicity in the mass media in that state over four years (1990 to 1993), estimated that 10,800 'serious casualty crashes' had been averted and the social cost savings were more than twenty times the program costs.[407]

The *National Road Safety Strategy 2001-2010* reported that many known road safety measures had 'not yet reached the limit of their cost-effective potential for all groups and areas' and set a target for the wider implementation of measures which retained additional potential.[404]

Future challenges

Future challenges included the reduction of road fatalities by 40% to no more than 5.6 per 100,000 population by the year 2010 – the target of the *National Road Safety Strategy 2001-2010*.[404] Strategic objectives included:

- improving road user behaviour;
- improving the safety of roads;
- improving vehicle compatibility and occupant protection;
- using new technology to reduce human error;
- improving equity among road users;
- improving trauma, medical and retrieval services;
- improving road safety policy and programs through research of safety outcomes; and
- encouraging alternatives to motor vehicle use.[404]

Targeted age- and sex-related (especially young, male) research and intervention programs to address the over-involvement of young drivers in casualty crashes were other challenges. For example, in NSW, although 17 to 25 year old drivers held only 16% of licences, they accounted for 26% of drivers involved in crashes in which there was a fatality or an injury.[408] NSW strategies to address this included ways of improving the knowledge and ability of younger drivers, and a graduated licensing scheme requiring a progressive improvement in skills.[409] Decreasing the age of Australia's vehicle fleet was also likely to deliver reductions in road trauma injuries, as modern cars were significantly safer and offered greater protection for occupants.

5.2 Preventing injuries in the home: childhood drowning

1986 onwards

Patterns of injury varied with age, and many accidents occurred in settings in and around the home.[411] Near-drowning and drowning were major causes of injury and death in early childhood when children were unable to swim or to recognise the dangers of water. At the start of the 21st century, more toddlers drowned in swimming pools than died from any other cause in Australia.[412] There was a substantial rise in drowning in children under five years of age – already a significant problem – as the popularity of home pools increased from the late 1960s.[413] In 1960, although drowning occurred at a rate of 5.3 per 100,000 children under 15 years of age, the rate in children under five years was 7.4 per 100,000 children.[412] By 1973, this rate had jumped to 10.8 per 100,000 children under five years overall, while in the warmer state of Queensland, it had risen to 16.0 per 100,000 children by 1973.[412]

Public health analyses of the problem were reported from the mid-1970s. A 1976 study using coroners' reports and hospital records showed that the child immersion rate (of drownings and hospitalised near-drownings) in Brisbane doubled between 1971 and 1976, and the toddler immersion rate was 50 per 100,000 children.[414] Half the incidents occurred in the family pool, which, in most cases (75%), had no barrier to keep children away from the water.[415] Other studies showed that nine out of ten incidents of pool drowning involved children under five years, and in two out of three cases, the pool in which the child drowned was located at their own home.[416]

By 1977, public health officials, researchers and organisations (e.g., the Australian Consumers' Association) were concerned about pool safety and advocated for pool fencing.[417] The Standards Association produced a guideline to advise householders (and others) of the measures required for pools to be safe.[418] Design guidelines were sufficiently advanced by 1979 for a published Australian standard on fences and gates for private swimming pools that included a minimum fence height (1.2m), a gap between horizontal elements (90cm), and child-resistant guarding on gate latches.[419] By 1985, self-closure and self-latching were also recommended as part of the standard. It did not however, address the biggest failure: the location of the fence. Only in 1993, after major objections from child and safety advocates and years of struggle within the Standards Committee, was a draft standard published, indicating the differences in the degree of safety offered by different fencing configurations.[413]

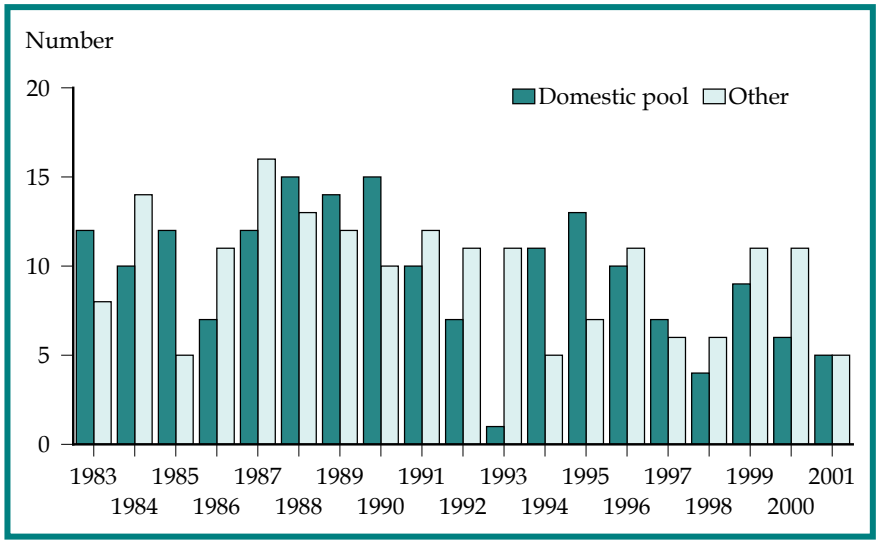
A Brisbane City Council ordinance requiring the fencing of both new and existing pools was introduced in 1977, but was struck down in 1978 by the Queensland Parliament. State legislation requiring pools to be fenced was not effected until 14 years later (in 1992). In 1990 in NSW, after a Minister's child nearly drowned, an *Act* was passed requiring all domestic swimming pools to be fenced to the Australian Standard, with the fence separating the pool from the house (not then required by the Standard). New pools had to meet the provisions immediately and existing pool owners had more time to comply; however, before the compliance date, the *Act* was over-ridden (in 1992), and NSW reverted to less effective requirements.

Objections to regulation for pool fencing came from individual householders, organised anti-fencing groups and the pool construction industry. Views included doubts about the severity of the drowning problem, objections on the basis of cost, aesthetic arguments, the unfairness of additional requirements

once pools had been built, and parental responsibility for supervision. The pool industry, concerned about sales, voiced most arguments, and their representatives on the standard-setting committee opposed the development of an effective standard. It took nearly four years to develop a 'consensus' standard, which was well below the level of protection achievable by implementing the findings from research. The process illustrated some fundamental problems in setting safety provisions in standards that had no performance monitoring criteria (e.g., protection of 75% of children at risk).

By the 1990s, Australians owned more than 625,000 pools, with 20,000 new pools being built each year.[413] Much of the existing regulation was ineffective as only the property – rather than the pool itself – needed to be fenced. Council registration of pools did not include inspecting the effectiveness of pool enclosures, nor were regulations monitored for their correct application. Hence, toddlers still drowned at an alarming rate (Figure 5.5 shows the situation for Queensland, where state legislation requiring pools to be fenced came into effect in 1992).

Figure 5.5: Queensland drowning deaths by year of immersion, children 0-4 years, 1983-2001



Source: Cunningham et al., 'Ten years on: toddler drowning in Qld 1992-2001', *Injury Bulletin*, no. 75, 2002, p. 2.

There was a decreasing trend (between 1983 and 1998) in drownings of children aged from zero to four years for Australia, with the exception of the NT. In the NT, where pool fencing legislation was not introduced until 2004, the long-term trend indicated an increase in drownings of children aged up to four years, in contrast to the decreasing rate for the rest of Australia.[420] By that time, all jurisdictions in Australia had some form of regulatory requirement for fencing domestic swimming pools. Not all offered the same level of protection for the at-risk group, however, and the practice of requiring that there be no direct access from the house to the pool was not yet universal.[420] WA also implemented an organised inspection program.

Childhood drowning and near-drowning continued to be major public health issues, especially for the under five year age group.[421] Drowning prevention remained a national health priority, and water-safety organisations worked with all levels of government to develop a *National Water Safety Plan*. Its ultimate goal was 'zero drowning deaths and the establishment of a culture of water safety in Australia', and the objective was for a continued reduction in the number of drowning deaths, to 200 deaths by 2007.[422]

A comparison of data for 2003 with a benchmark (taken as the average of the five years, 1994-1998) shows that a 17% reduction from 300 to 250 drowning deaths was achieved, with a reduction from 58 to 35 deaths in children aged from birth to four years (Table 5.2).[422]

Table 5.2: Drowning deaths, Australia, 1994-98 and 2003

Variable	1994-98*	2003
All ages		
Drowning deaths in Australia	300	250
Ranking of cause of accidental death	3rd	4th
0-4 year old children		
Drowning deaths	58	35
Ranking of cause of accidental death	1st	2nd
*Benchmark, based on five-year average, 1994 to 1998		

Source: Australian Water Safety Council, *National Water Safety Plan 2004-07*, 2004, p. 8.

The *National Drowning Report 2005* from the Royal Life Saving Society Australia (RLSSA) cited 259 drowning deaths, a large decrease from the five year average (1998-2002) of 290.[423] The largest decline was in the under-five year age group, in which there were 28 drowning fatalities, many fewer than the five-year average of 51.[423] Serious near drownings, however, occurred at three to four times the rate of fatal drownings, and between 5% and 20% of children who experienced serious near drownings suffered some degree of permanent brain damage.[424]

Public health practices

Key public health practices included water safety education and research; standards and legislation pertaining to 'aquatic locations' (e.g., pools); and the targeting of high-risk groups, with the primary focus on children under five years of age.[422] At the start of the 21st century, each state and territory had a *Water Safety Plan*, adapted for local conditions, and drawn up with the contributions of water safety stakeholders (e.g., Water Safety Councils, RLSSA, and state Departments of Sport and Recreation).

By 2005, pool-fencing legislation had been introduced in all jurisdictions, and, in most situations, pool fencing was legally required. After Queensland and NSW introduced their pool-fencing legislation in the early 1990s, the pool drowning rate fell to less than half the pre-fencing rate (despite little enforcement of the legislation, and a doubling in the number of pools built after the legislation was introduced).[425]

- In Queensland, 157 children under five years drowned from 1992 to 2002. Almost half of these deaths occurred in domestic pools.
- Pool fencing saved the lives of over 70 toddlers in Queensland in the ten years to 2002.
- The toddler pool drowning rate could be reduced further by full implementation of pool fencing with regular inspections focusing on improving compliance of gates and doors.

– K Cunningham et al., *Injury Bulletin*, 2002.[748]

National water safety education campaigns received government and corporate support. The *National Water Safety Plan* identified a range of best practice programs that included:

- the Keep Watch program – an integrated public awareness and education program, developed by the RLSSA in 1996;
- a voucher system providing five free water safety lessons for 0 to 4 year olds, developed by the NT Government in 2004;
- the Home Pool Inspection service, developed by the RLSSA WA in 1999;
- in-servicing of Community Health Workers in the Keep Watch program and the provision of resources, developed by the NSW Water Safety Taskforce and the RLSSA in NSW and WA in 2003; and
- the *Child Safe Play Areas on Farms* promotion developed by Farmsafe Australia and the Australian Government Department of Health and Ageing in 2002-03.[422]

The *National Injury Prevention and Safety Promotion Plan: 2004-2014* built on previous injury prevention strategies to guide research, programs and policies, to help prevent injuries, under an injury prevention and safety promotion framework, and guide the activities of the many partners: government agencies, local government, private sector organisations, NGOs, communities and individuals.[426]

Factors critical to success

The relative success in preventing childhood drowning was based on public health measures that included the early identification of the problem and reasonably effective interventions that were demonstrated to work. However, there was failure to the extent that interventions, once they were shown to be effective, were not introduced early or widely enough.[426]

> ***Survey respondent:*** *'It was public health pioneers such as John Pearn and Jim Nixon who first warned of the rising death rate from drowning in the mid-1970s. They also developed a standard based on good basic research to establish the most appropriate height of fencing, and drafted effective Council regulations for Brisbane which were then overturned by the state government'.*

A critical factor was the public health principle that injuries generally, and childhood drowning in particular, could be prevented. Public health research focused attention on identifying and monitoring clusters of injuries, and ways to prevent them. Action was taken by governments at all levels, but particularly by state, territory and local governments, to amend legislation, improve regulation and monitoring, and provide community education to reduce childhood drowning.

Nationally, the coordination of state and territory efforts, together with those of other key stakeholders such as NGOs involved in particular areas (e.g., water safety, consumer safety), was achieved through the promulgation of national strategies such as the *National Injury Prevention and Safety Promotion Plan: 2004-2014* and its predecessor. As injuries were preventable, there were a range of actions to be taken; and public health monitoring and evaluation of national and jurisdictional strategies helped identify those that represented best practice.

Ongoing identification of 'clusters' of fatalities, made possible through the National Coroners' Information System (Box 5.2), also assisted injury prevention efforts, and allowed monitoring to show whether coroners' recommendations had been implemented and remained effective.

Future challenges

The regulatory environment needed to be tightened to ensure pool fencing complied with the law and with Australian safety standards. For instance, WA legislation required mandatory local council inspections of pool fences every four years, resulting in increased compliance with standards. An audit of pool fencing inspection records (from a random sample of WA local councils) showed an average compliance level of 71% by the third inspection – well up from 45% at the first inspection.[426]

The Australian consumer organisation, *Choice,* nominated the following for urgent implementation in relation to childhood drowning:

- state and federal governments together to develop a mandatory product safety scheme to ensure all pool fences meet the requirements of the Australian standard (18 out of 31 pool fences assessed did not meet a key safety aspect of the Australian standard; results suggested non-standard pool fencing was still widely available);
- four-sided pool fencing be made mandatory across Australia, as it was clearly safer than fencing that allowed access to the pool from the house;
- mandatory council inspections be adopted across Australia, on a four-yearly basis at least, to help save more children's lives.

The *National Injury Prevention and Safety Promotion Plan: 2004-2014* identified safe play areas on rural properties and restricting access to hazards, including dams and rivers; safer products and environments for children that were appropriate to their age-specific development; and safe design awareness, by designers, manufacturers, retailers and consumers.[426] Finally, there was also a need to make greater use of coronial findings and recommendations as they related to specific preventable injuries (Box 5.2).[427]

Box 5.2 Role of the coroner in identifying unsafe products and practices

In Australia, almost all injury deaths are reported to and investigated by a state or territory coroner. Coroners served as advocates for injury prevention and as agents of change in identifying more effective injury prevention strategies.[427]

The National Coroners' Information System (NCIS) was a database for use by researchers to identify patterns and trends in fatalities reported to a coroner; and the world's first national database of coronial information.[428,429] Around 7,500 of the 18,000 deaths reported annually to coronial offices were due to unnatural causes (e.g., workplace, road, and other accidents; and suicides), many of which were potentially preventable.

From its establishment in 2000, many practices and products relevant to public health and safety were identified using the NCIS, including:

- blind cord strangulation of young children – identification of such deaths led to discussion by the Blind Manufacturers' Association of Australia regarding re-design, and a national campaign aimed at raising parents' awareness of the risk;
- all-terrain vehicle deaths – identification of the total number of fatalities involving this type of vehicle led to joint inquests, coronial recommendations, industry training programs for the agricultural sector and a review of injury rates;
- working under vehicles – the number of deaths of 'home mechanics' crushed while working under jacked-up vehicles led to a national targeted campaign for young to middle-aged males;
- cigarette-related fires – data about the number of house fire deaths caused by lit cigarettes led to a national manufacturing standard to produce 'self-extinguishing' cigarettes; and
- regional suicide rates – Australian government funding was provided for mental health services in remote South Australia, influenced by data which demonstrated that suicide rates were relatively higher there than in other South Australian regions.[429]

The NCIS held information on every death reported to a coroner in Australia from July 2000 (January 2001 for Queensland). Developed as a 'death investigation and research tool' by Monash University in 1998, it was managed by the Victorian Institute of Forensic Medicine. It provided the means to 'systematically identify and retrieve clusters of similar cases' from coronial offices around Australia, enabling coroners to identify national trends and assist in the elimination of preventable hazards in the community.[428]

5.3 Preventing suicide

1907 onwards

At the start of the 21st century, deaths from suicide were one of the ten leading causes of death for males in Australia.[25] Over the century, the overall suicide rate remained relatively stable, fluctuating within a range of between 10-14 deaths per 100,000 population.[430] The highest rates were recorded during the Great Depression years of the 1930s, in the 1960s and into the 1990s.[431] There was no reliable population screening tool for suicidal intention or risk.[432]

In 1907, age-standardised suicide rates were 27 per 100,000 population for males and five per 100,000 population for females (Figure 5.6 and Figure 5.7, respectively, in Box 5.3). The lowest rate for male

suicides was 12 per 100,000 during World War II. In the latter half of the century, there were around 20 suicides per 100,000 population for males.

For females, the rate remained relatively even (at around five suicides per 100,000 population) until it rose dramatically in the 1960s, to a peak of around 13 suicides per 100,000 population. The rate returned to around five suicides per 100,000 population by the 1980s (Figure 5.7). The rise in the female suicide rate was attributed to the increased availability of barbiturates, and the subsequent fall in the rate to restrictions on their availability, which were put in place as a public health response (Sub-section 5.3.1).[25]

The overall suicide rates discussed above do not reveal the substantial variations in rates for different age groups. For instance, suicide rates among 15 to 24 year olds increased from six male and four female suicides per 100,000 population in 1907, to around 30 male and seven female suicides in the 1990s, before falling to 20 and six per 100,000 population in 2000.

The rates in younger males, which remained higher than at the beginning of the 20th century, were an ongoing public health concern.[432] In 2004, suicide deaths made up more than 20% of deaths for males aged 20-39 years; and a year later, this high proportion had expanded to the older age groups, up to 54 years for males.[433] The age-standardised suicide death rate for males was about four times higher than the corresponding rate for females (Figures 5.6 and 5.7).

Box 5.3 Suicide rates, 1907-2003

For most of the 20th century, suicide rates (deaths per 100,000 population) were relatively constant, with male rates exceeding those of females by a ratio of four to one (note the different scales used in the figures below).[25]

Figure 5.6: Male suicide rates, 1907-2003

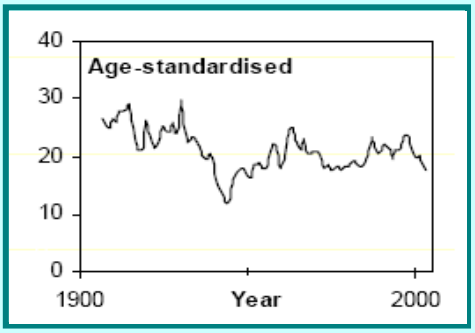
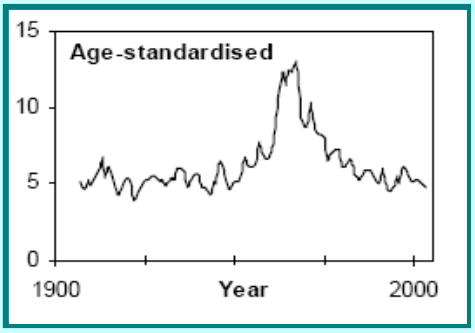


Figure 5.7: Female suicide rates, 1907-2003



Deaths per 100,000 population

Source: AIHW, *Mortality over the twentieth century in Australia,* 2006, p. 74.

Background issues that contributed to suicide included individual causes (e.g., genetic predisposition to depression, personality, and sexual orientation), exposure to trauma, family-related factors, life stressors, poor social support, and wider socioeconomic, cultural and social factors.[434] There were clear and demonstrated associations between suicide and unemployment, low socioeconomic status and low occupational prestige.[430] Evidence also suggested that many of those attempting or completing suicide had a recognisable mental health problem, and contextual factors contributed to suicidal behaviour by influencing individual vulnerability to mental health problems and conditions (e.g., mood disorders, substance abuse, anxiety disorders and antisocial and offending behaviours).[430]

Two important contextual factors that affected rates of suicide were the availability of methods of suicide (e.g., guns, barbiturates), discussed below, and the treatment of suicide by the media.[430]

Public health practices

The *National Suicide Prevention Strategy* commenced in 1999 and built on the former *National Youth Suicide Prevention Strategy* (from 1995). *Living is for everyone: a framework for prevention of suicide and self-harm in Australia* (the LIFE Framework) was developed by the National Advisory Council on Youth Suicide Prevention (Box 5.4). It was informed by evidence that suicide prevention required a multi-faceted approach and collaboration between all levels of government and the community.[435] The Australian government funded the development of national and community-based models of suicide prevention.

An important public health principle for preventing suicide was to limit the availability of the means to suicide.[435] A systematic review of suicide prevention strategies, drawing on Australian and international experience, concluded that there was good evidence that restricting population access to lethal methods could reduce suicide rates by the method in question, and at times, the total suicide rate.[434,436] One of the review's authors concluded that this was an often under-valued approach.[434]

The findings covered a range of means, including:

- detoxification of domestic gas and of carbon monoxide emissions from vehicle exhausts;
- legislative restriction on ownership of, and access to, firearms;
- restrictions on the pack size of over-the-counter analgesics;
- installation of barriers at sites for jumping, and at subways to prevent people leaping in front of trains; and
- use of clinically safer drugs, and restricting access to highly toxic drugs, gases and pesticides that could be lethal in overdose.[434,437]

Although restricting access to potentially lethal means of suicide did not address the problems or distress of any individual, it had the potential to reduce the proportion of suicide attempts that were made impulsively or in extreme situations of anguish and anger, thus allowing time for help to be provided. The public health successes reported below used this approach to reduce suicides, by limiting the availability of pharmaceutical drugs and of guns.

Box 5.4 *LIFE Framework:* Guiding principles

- 'Suicide prevention is a shared responsibility across the community, professional groups, non-government agencies and the government sectors.
- It requires a diversity of approach, targeting the whole population, specific population subgroups and individuals at risk.
- It must be evidence-based and outcome-focused.
- It must incorporate community and carer involvement and expert input.
- Activities must be accessible to those who need them, and appropriate and responsive to the social and cultural needs of the groups or populations they serve.
- They must be sustainable, to ensure continuity and consistency of service for communities, and evaluation must be an integral part.

It is crucial that activities do no harm. Some activities that aim to protect against suicide have the potential to increase suicide among vulnerable groups. Well-meant messages may cause harm because they may be interpreted differently by different groups. Awareness of this potential is of particular importance in programs that involve schools, the media or raising awareness of suicide. All approaches need to be market-tested and carefully evaluated for negative as well as positive outcomes. Suicide risk may also be inadvertently increased by programs outside the ambit of suicide prevention, which address broad social issues.

The LIFE Framework recognises the considerable contribution to prevention of suicide achieved by people helping each other at an informal level, particularly families and friends, especially in supporting those affected by suicide and self-harming behaviours. It also recognises the importance of action and advocacy by consumer groups in enhancing service delivery systems and good practice, in ways that take into account feedback from consumers.'

Source: DoHA, *LIFE – Living Is For Everyone: a framework for prevention of suicide and self-harm in Australia – areas for action*, 2000, p. 17.

Cost-effectiveness

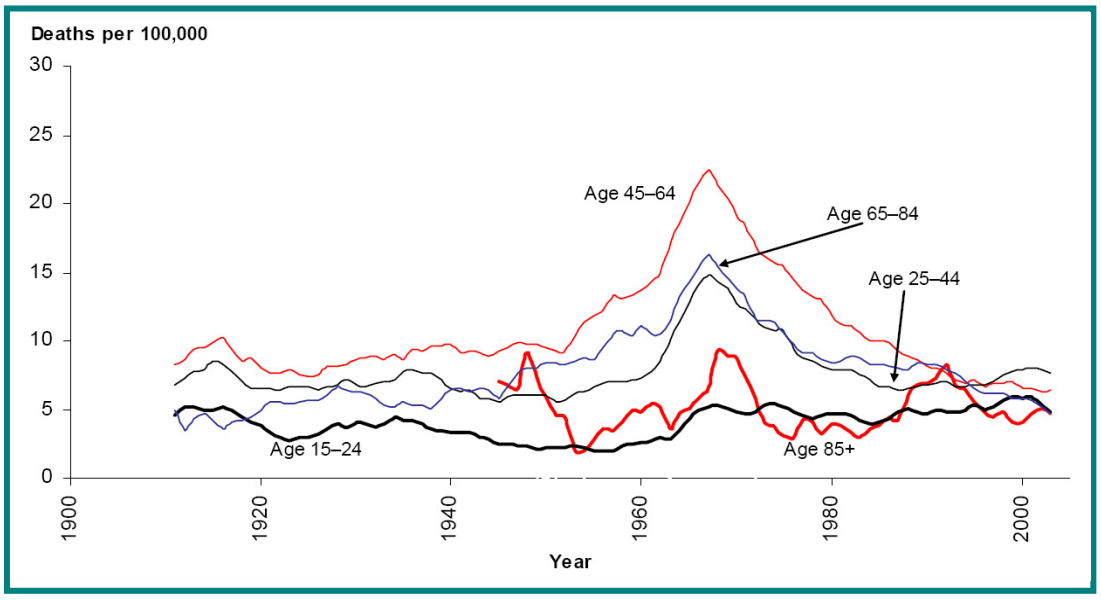
In 2006, Beautrais observed that the development of national suicide prevention plans and strategies was too recent for many of them to have been evaluated, and therefore, they had generated little information to guide their optimal use. She found that national suicide prevention strategies had proceeded largely independently, in the absence of international guidelines (although some did exist), without inter-country comparison or clear evidence of their efficacy or cost-effectiveness.[434,438] There was evidence, however, that restricting people's access to lethal methods could reduce suicide rates. A multi-country systematic review of prevention strategies reported that there was evidence that physician education in depression recognition and treatment could also be beneficial.[436] It concluded that more evidence of the efficacy of other intervention and program components was needed, so that the use of the limited resources dedicated to suicide prevention programs could be optimised.

5.3.1 Restricting the availability of potentially dangerous drugs

1960s onwards

In the early 1960s, suicide rates, particularly those for women and people in older age groups, accelerated in association with a high number of barbiturate poisonings.[439] The female suicide rate, which had been fairly even at around five deaths per 100,000 population until the 1960s, rose sharply to a peak of about 13 deaths per 100,000 population (Figure 5.7 in Box 5.3).[25] This dramatic rise was attributed to the increased availability of prescribed barbiturates in quantities that could be lethal. After restrictions on their availability were applied in July 1967, the resulting fall in suicide rates was attributed directly to this public health response to the 'barbiturate poisoning epidemic'.[440] All female age groups (Figure 5.8) showed an increase in the suicide rate, but the characteristic 'volcano-shape' – the sharp rise during the 1960s to a peak in 1967, and the subsequent fall into the 1970s – was most evident for those in the age group 25 years and above.

Figure 5.8: Arrest of the barbiturate epidemic – age-specific female suicide rates*, 1907-2003



Note: *Rates are five-year moving averages.
Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 75.

Initially, the observation that there had been substantial increases in the suicide rates for both men and women in Australia from 1955, led to a systematic investigation into the trend and likely causative factors. Examination revealed that the rise in female suicides from 1960 to 1967 was sharper than the rise among males, in both numbers of suicides and the proportionate increase in the rate.[440] The increases were most evident in the category of 'self-poisoning by use of therapeutic substances'. In this

category, the absolute numbers of these deaths increased fourfold in males, and sevenfold in females, between 1955 and 1967.[440] In 1955, 'suicide by drugs' represented seven per cent of male, and 16% of female suicides. By 1967, the proportions were 29% and 61% respectively.[440]

Analyses of related categories of deaths showed that, from 1960 to 1967, the increases in accidental drug deaths in adults were due to barbiturates and other sedative drugs.[440] It also suggested that this category of 'accidental drug deaths' contained what were described as 'hidden suicides'. In total, it was estimated that there had been 899 drug suicides in 1967, a substantial increase over the 346 in 1961, which were already 100 more than the previous year. The number reduced to 685 in 1968, the year following restrictions on the availability of these drugs.

Public health practices

As a result of changes to the subsidisation of health care in 1960, a wide range of prescription medicines became available at a nominal set price. These included barbiturate sedatives and hypnotics, analgesics and amphetamines, at quantities of 100-300 tablets or capsules on one prescription (including repeats). Analyses showed that there was a correlation between the estimated total number of drug suicides and the number of sedative prescriptions issued on the Pharmaceutical Benefits Scheme (PBS), which was thought to represent between 80 to 90% of the total sedative supply in the community.

In July 1967, greater restrictions were placed on the prescription of barbiturates and other drugs available through the PBS. From then on, only 25 tablets of any hypnotic-strength barbiturate were able to be dispensed on a single prescription.[440]

Other contributing factors were pharmaceutical innovation, which had developed more effective barbiturates that were also more toxic in overdose, and the pharmaceutical practices of the day, with the subsidising of some drugs, and their aggressive marketing by pharmaceutical corporations to medical practitioners. After the prescribed amount was reduced, suicide rates from this cause started to fall over the next three years. Eventually, less toxic benzodiazepines became available, which also contributed to a reduction in suicide numbers.

Factors critical to success

Factors that were critical to the success of this initiative were elements typical of the public health cycle of observation (monitoring and surveillance), which highlighted the problem, followed by investigation to determine the cause, and whether it could be prevented, and how best to do so. Action was taken quickly, and by mid July 1967, the availability of barbiturates had been drastically curtailed by limiting the number of capsules dispensed per prescription. The decrease in the number of drug-related suicides was almost immediate and further reductions took place year by year.

The public health measure that successfully addressed this problem was to restrict the availability of potentially dangerous drugs and chemicals (including drugs of dependence) to enable their safe and effective use. Scheduling was the legal process used to achieve this. All states then adhered to the *Standard for the Uniform Scheduling of Drugs and Poisons*.[441] While scheduling was legally a jurisdictional matter, changes to schedules were made at a national level by the National Drugs and Poisons Schedule Committee.

Future challenges

Modern day pressures to make more drugs available to the community had to be balanced with the need to ensure that they continued to be used safely and effectively.[441]

Box 5.5 Analgesic nephropathy – an example of limiting a potentially harmful drug

Analgesic nephropathy was a preventable cause of chronic renal failure. For nephrologists (kidney specialists), this represented an important diagnosis because it was one of the few causes of progressive chronic renal impairment that was avoidable.[442] In the 1960s, analgesic abuse (e.g., over-use of Bex and Vincent's powders) in Australia caused a fifth of all cases of end-stage renal disease requiring dialysis or kidney transplantation.[443]

'In process factories in Australia, especially in and around Newcastle, the use of Bex and Vincent's powders achieved epidemic proportions, with some women consuming as many as 30 of these powders a day. They were for women what Toohey's and Resch's pilseners were for men. This might have been regarded as a cultural habit of no consequence had it not been for the regrettable impact Bex and Vincent's had on kidneys.' P. Kincaid-Smith. [444]

It was Priscilla Kincaid-Smith and her group in Melbourne, together with the Brisbane pathologist, A F Burry, who clearly established these compound analgesics containing phenacetin as the culprit.[444] There were conspicuous geographic and regional differences in the incidence of analgesic nephropathy in Australia and across the world, and as the consumption of analgesics was partly cultural, the effect of different regulatory environments could be seen in variable rates of end-stage renal disease.[445,446]

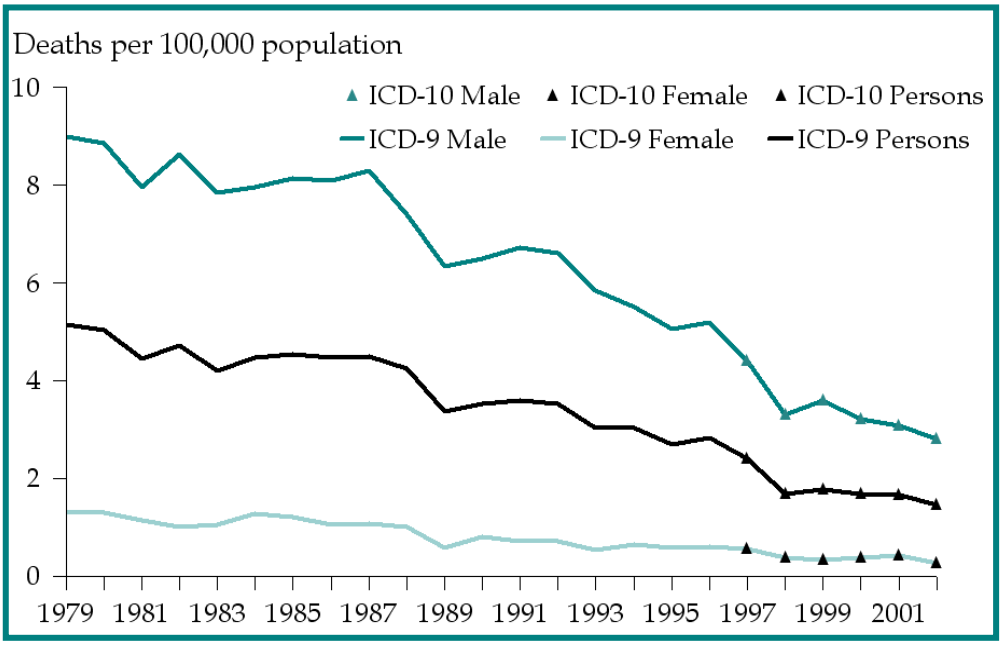
A study published in 1974 found that, in Australia, 20 to 25% of patients accepted into haemodialysis programs had analgesic nephropathy.[447] After phenacetin was removed from the medications in 1967 and 1976, and legislation was enacted in 1979 banning the sale of 'over the counter' compound analgesics, there was a significant decline in phenacetin consumption.[448] The legacy of analgesic nephropathy remained for decades, however, as the effects of excessive use took many years to manifest. This public health effort showed the major impact that drug regulatory environments could have on identified, but unintentional, problems arising from the widespread availability of certain potentially dangerous drugs.

5.4 Gun control and reduction in gun-related deaths

1988 onwards

From 1979-2002, suicide was consistently the most common type of firearm-related death, accounting for 77% of all firearm deaths over that period.[449] Other firearm-related deaths included homicides and accidental deaths, and those of undetermined intent. For these reasons, there were strict regulations on the sale, importation, ownership, storage and handling of guns and other firearms in the Australian community. Legislative restrictions on the ownership of, and access to, firearms were acknowledged as a successful method of reducing suicide deaths by this means, and even overall suicide rates.[434] In 2002, the rate of firearm-related deaths for Australia was less than a third of the rate it had been in 1979 (Figure 5.9).[449]

Figure 5.9: Firearm-related deaths, 1979–2002



Note: ICD-9 and ICD-10 are different versions of the International Classification of Disease.
Source: Kreisfeld, *Firearm deaths and hospitalisations in Australia*, 2005, p. 3.

The marked downward trend in male firearm-related deaths preceded national gun law reforms, and indicated that other factors were at play. These included growing urbanisation and less access to guns, inter-generational declines in the ability to use firearms, and the normalising, even in rural areas, of not owning guns (e.g., less visibility because firearms were locked away and shooting skills were no longer passed on to new generations).[434,450]

Public health practices

In 1987, after the Hoddle and Queen Street massacres in Melbourne, which resulted in the deaths of 15 people, the Australian government established a National Committee on Violence, which proposed uniform national firearm laws among its recommendations. Although two states refused to adopt a national approach at the time, Victoria tightened restrictions on semi-automatic long firearms in 1988.[451]

In the wake of the Port Arthur massacre of 35 people in Tasmania on 26 April 1996, an agreement between Australia's state and territory governments led to a suite of historic and radical reforms to the nation's gun laws. The main provisions of the national gun reforms were:

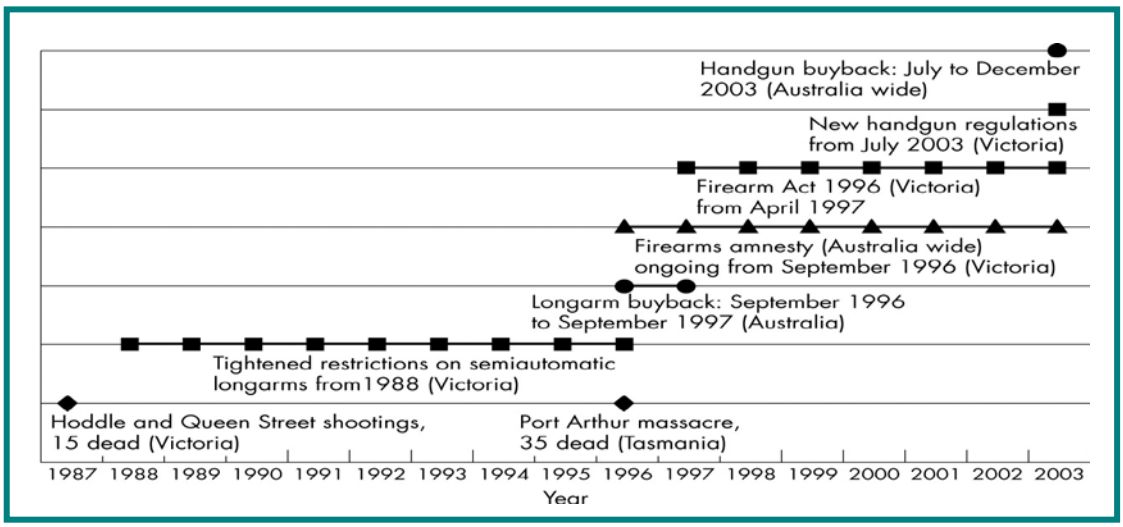
- a ban on the importation, ownership, sale, resale, transfer, possession, manufacture and use of semi-automatic and pump-action shotguns and rifles;
- a compensatory 'buyback' scheme, funded by an increase in the Medicare levy, which paid gun owners the market value of any prohibited guns handed in;
- the registration of all firearms, as part of an integrated shooter licensing scheme;
- shooter licensing, based on the requirement to prove a 'genuine' reason for owning a firearm;
- obligations to store all guns securely; and
- nationally uniform gun laws across the states and territories.[452]

The National Firearms Buyback Scheme operated for twelve months from September 1996. Over this period, 660,959 firearms were collected and destroyed nationwide, with a total compensation cost of almost $394 million.[452]

In 1996, the Australian Police Ministers' Council agreed to a ten-point nationwide agreement on firearms, to be implemented by each state and territory. The Victorian response, the *Firearms Act 1996*,

was implemented on 30 April 1997 (Figure 5.10).[452] Chapman documented how, in the preceding decade, reforms to the gun laws were advocated by public health, domestic violence and law reform groups.[453] Community activism and involvement in the issue was also strong in the wake of the Port Arthur tragedy.

Figure 5.10: Timeline of various elements of the Victorian and Australia-wide interventions



Source: Ozanne-Smith et al., *Injury Prevention,* 2004, p. 280.

Both the Victorian and Australian rates of firearm-related deaths had been roughly steady from 1979. After the first Victorian reforms, however, in the period 1988 to 1995, the number of firearm-related deaths fell substantially, and by a greater proportion in Victoria (17.3%) than in the rest of Australia. A further decrease took place between 1997 and 2000, after the national reforms were implemented. Declines in firearm-related deaths for the rest of Australia occurred from 1997 (a 14.0% reduction compared with Victoria). The reduction in the rate of firearm-related suicides, in particular, was statistically significant.[451]

Chapman highlighted the importance of the 1996 reform that banned semi-automatic and pump action shot guns.[453] As they had the capacity to fire multiple rounds quickly, these gun types were frequently used in mass killings. After the Port Arthur tragedy, there were no mass shooting incidents (an incident in which four or more people were shot) up to 2006, whereas in the previous 18 years there were 13 mass shootings, in which 112 people were killed and another 52 people were injured.[453]

> *'The Australian Firearms Buyback remains the world's most sweeping gun collection and destruction program. A combination of laws making semiautomatic and pump-action shotguns and rifles illegal, paying market price for surrendered weapons, and registering the remainder were the central ingredients.' – Chapman et al., 2006.*[453]

In Australia, the public health response included legislation and regulation, and, in some cases, restrictions on the sale, importation, ownership, storage and handling of guns and other firearms in the community. The comparison of Victoria with the rest of Australia showed dramatic declines in the rates of firearm-related deaths for the 22 years between 1979 and 2000, against a background of strong legislative reform. Earlier legislative reform in Victoria was associated with more rapid initial declines in that state, before the 'catch up' by the rest of Australia after nation-wide regulation. There were also declines in household ownership of firearms, firearm licences, and licensed shooters after the national firearms buyback scheme was implemented. Changes were coupled with considerable publicity, unprecedented community awareness, and accompanying advocacy for gun control reform from anti-gun groups and the community. State and territory governments entered into the National Handgun Control Agreement in the wake of a further multiple-person shooting at Monash University in Victoria in 2002.

Although it appeared likely that other changes in background factors (such as improved emergency medical responses and treatment) were also important, the reform of gun laws and tightening of gun

controls had a demonstrable impact on reductions in firearm-related deaths. Later analyses of the period 1979 to 2003 showed statistically significant declines in firearm suicides, and in total firearm deaths, after the introduction of the gun reform laws. The decline in the non-firearm suicide death rate after the gun law reforms did not support claims of 'method substitution' in suicides (e.g., the substitution of other methods – such as poison – for the use of firearms).[454]

Factors critical to success

The decline in gun deaths, after the gun buy-back scheme and reforms of gun ownership laws, was a public health success and was celebrated as such by the NSW Public Health Forum in 2003.[455] This initiative exemplifies the injury prevention principle of limiting the availability of methods of suicide and self-harm.[401]

> ***Survey respondent:*** *'The Gun Control legislative changes [were a public health success] – after Port Arthur, the Coalition for Gun Control led by Rebecca Peters forced unparalleled changes in legislation to reduce gun deaths'.*

The (then) Prime Minister, the Hon. John Howard, stated that 'we were able to persuade the states to pass very tough gun control laws because this [was] a state matter'. Each state passed their own legislation with various amendments, such as introducing minors' permits. The figures 'showed a very sharp drop in gun-related deaths. So it [was] unarguably the case that these laws saved lives'.

Incontrovertible evidence that reductions in firearm-related deaths were attributable to changes in legislation and regulation of firearms came from a study by Ozanne-Smith and colleagues, who compared the state of Victoria with Australia as a whole.[451]

> *'Dramatic reductions in overall firearm-related deaths and particularly suicides by firearms were achieved in the context of the implementation of strong regulatory reform.' – Ozanne-Smith et al., 2004.*[451]

Future challenges

Ozanne-Smith and colleagues speculated about whether the very low rate of firearm-related fatalities achieved in Australia by the year 2000 (less than 2 per 100,000 population) meant that 'vision zero' – the total elimination of firearm-related fatalities – was achievable.[451]

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6 Reducing risk factors for chronic diseases: 1960s onwards

'As in many other developed nations, Australia has experienced a 'health transition' from infectious to chronic diseases, with influenza and tuberculosis being replaced by circulatory (cardiovascular) diseases and cancer as the major causes of death'. – Beaglehole & Bonita, 1997.[456]

Over the 20th century, the dramatic decline in infectious diseases was accompanied by a significant rise in life expectancy, and in chronic diseases. From the 1920s and 1930s onwards, there was a substantial increase in coronary artery disease and stroke, and in lung cancer (especially in males), up until the 1970s.[3] Better medical treatments were responsible for some of the rise in life expectancy of people with certain chronic diseases in the latter part of the century, although these are not attributable to public health effort.[239]

By the end of the century, chronic diseases accounted for the majority of the burden of disease in Australia, and the prevalence of these diseases as a group had risen, despite reductions in some diseases.[359] The realignment of the health system to address chronic diseases and their risk factors more effectively remained a challenge, as different models were required from those used successfully to reduce infectious diseases. Public health approaches included both primary and secondary prevention and were aimed at:

- reducing modifiable risk factors;
- screening whole and high-risk populations; and
- committing to a national approach to priority-setting and policy development.

Box 6.1 National Health Priority Areas

- Cancer control
- Injury prevention and control
- Cardiovascular health
- Diabetes mellitus
- Mental health
- Asthma, and
- Arthritis and musculoskeletal conditions.[457]

In 1998, a number of national health priorities were identified, which included cardiovascular health, asthma, cancer control, and diabetes (Box 6.1). Mental health, arthritis and musculoskeletal conditions were subsequently added. The *National Chronic Disease Strategy* (2006) provided a coordinated national approach to the prevention and management of chronic diseases.[359]

Strategies to reduce modifiable risk factors using behavioural change at a population level were developed (e.g., addressing coronary heart disease risk through dietary changes and smoking cessation), along with methods of protection to reduce harmful sun exposure and skin cancer.

Population-based screening programs were initiated to detect early breast, cervical and bowel cancers. Prenatal and perinatal screening for a number of genetic and congenital disorders was also developed.

Survey respondents: *'The health promotion and support given by NGOs led to a net increase in survival years for those with chronic conditions.'*

'The healthy eating, exercise and self-management support given by our big NGOs made a big contribution to the public health effort and continues to contribute to population wide health promotion efforts.'

'Screening and case finding and therefore earlier treatment of certain cancers saved some lives and offered others many years of healthier living.'

A range of NGOs was established, often by clinicians and/or people suffering from a disorder and their families. These community-based agencies undertook health promotion and disease prevention activities, as well as providing support to patients. Many were involved in community education campaigns to highlight the effects of particular illnesses and harmful exposures. There was significant health literacy work undertaken in schools, communities, workplaces and through the media, which all continued to improve the knowledge of the general community about health protection.

From the 1990s, a specific focus on mental health issues began to address the social stigma of mental illness and, through effective promotion and earlier detection, to develop community awareness of mental health as a driver of health and wellbeing.

Thus, examples of successful public health approaches to reduce risk factors for chronic disease at a population level included:

- decreased tobacco smoking (Sub-section 6.1.1);
- decreased alcohol-related harm (Sub-section 6.1.2);
- sun safety measures to reduce skin cancer (Sub-section 6.1.3); and
- needle and syringe exchange programs to reduce bloodborne transmission of chronic infectious diseases (Sub-section 6.1.4).

Successful public health actions to reduce the rates of some chronic diseases (Section 6.2) included:

- strategies to decrease fatal heart attacks after record numbers in the 1970s (Sub-section 6.2.1);
- stroke prevention and reduction in high blood pressure (Sub-section 6.2.2); and
- organised screening for certain cancers (Section 6.3).

Public health practices

Universal public health programs addressed preventable and modifiable risk factors for a range of chronic diseases. Successful strategies included those with a focus on diet (e.g., reducing intake of saturated fats and salt, increasing consumption of calcium, fruit and vegetables), smoking (e.g., QUIT smoking campaigns), and alcohol-related harm (e.g., codes for the responsible service of alcohol). Other strategies, aimed at increasing physical activity and fitness and better weight control, appeared to be less successful. There was, however, a considerable time-lag before behavioural changes became apparent at a population level, as shown in the gradual impact of tobacco control measures on reducing smoking rates.

The creation of partnerships between governments, health professionals, NGOs, consumers and public health researchers further strengthened many of the applied measures.

Current examples of annual prevention initiatives include the following annual designated weeks:

- April/May - National Heart Week;
- July - National Diabetes Week;
- September - National Stroke Week;
- November - National Skin Cancer Action Week.

Table 6.1: Historic highlights of successful risk factor and chronic disease control

1930s	Gastric cancer rates fell as a result of better refrigeration, reduced consumption of salted, smoked, and chemically preserved foods, more fruit and vegetable intake, and improved living standards.
1950s	The first drugs to lower blood pressure developed.
1956	Australian statistician, Oliver Lancaster, identified that skin cancer was related to exposure to sunlight.
1959	The National Heart Foundation established.
1960s	Research into the role of risk factors in chronic diseases, such as coronary heart disease and diabetes. Australian media campaigns started to highlight the dangers of smoking to health.
1961	The Cancer Council of Australia established.
1968	Commonwealth labelling regulations on cigarettes introduced (enacted 1973).
1970s	Peak in the century-long rise in cardiovascular disease. Gradual decriminalisation of public drunkenness.
1972	Cancer registration required under state and territory legislation. Mandatory warnings on cigarette packets.
1972-75	First national tobacco campaign: *National warning against smoking*. Commonwealth ban on advertising of tobacco products on radio and television.
1981	'Slip slop slap' campaign to encourage sun protection behaviours.
1982	Australasian Association of Cancer Registries (AACR) formed. WA – first attempt in the world to pass tobacco control legislation (unsuccessful). Creation of WA 'QUIT' campaign ('only dags need fags').
1983	National Stroke Foundation established. WA government increased retail tobacco licence fees and allocated $2 million per year for community anti-smoking education, including the QUIT campaign.
1985	Inception of Australia's *National Drug Strategy* and a harm minimisation framework.
1986	First government report on passive smoking (NHMRC): *Effects of passive smoking on health*. First Needle and Syringe Program (NSP) outlet opened – on a trial basis – in NSW.
1987	Victorian *Tobacco Act* passed, enacting the principle of hypothecation. Domestic airlines smoke-free.
1988	SunSmart - launched by the Cancer Council. All Australian government offices smoke-free.
1989	The National Heart Foundation's Tick Program started. Hepatitis C virus identified.
1991	Screening for breast and cervical cancers commenced. National Health Policy on Tobacco in Australia. Healthway established in WA.
1992	Federal government passed the *Tobacco Advertising Prohibition Act* (four states had already passed similar Acts). National blood alcohol limit of 0.05 for drivers of vehicles set.
1994	Australian Cancer Network established. The *National Hepatitis C Action Plan* released.
1997	Second NHMRC report on passive smoking and National Tobacco Campaign used by countries overseas.
1998	National SunSmart Schools program launched. *The Grog Book* for Aboriginal and Torres Strait Islander communities first published. First National Health Priority Areas.
1999	National Tobacco Strategy 1999 to 2002-03 endorsed. The first *National Hepatitis C Strategy 1999-2000 to 2003–2004* launched and needle exchange programs funded.
2000	Evaluation of the National Tobacco Campaign: 922 premature deaths averted and $24 million saved.
2001	NHMRC published the *Australian alcohol guidelines*.
2003	Returns on government investment in tobacco control: $2 for every $1 of expenditure on public health programs.
2004	strokesafe™ developed. Around 100 manufacturers and 1200 food products carried the Tick trademark. The *National Drug Strategy: Australia's Integrated Framework 2004-2009* and the *National Tobacco Strategy 2004-2009* endorsed. New system of graphic health warnings on tobacco products.
2005	*National Hepatitis C Strategy 2005-2008* released.
2006	*National Alcohol Strategy 2006-2009* endorsed. National bowel cancer screening commenced. Graphic health warnings appeared on all Australian-manufactured and imported tobacco products. National Skin Cancer Awareness Campaign for Summer 2006-07 launched.

6.1 Influencing risk factors at a population level

1960 onwards

Certain risk factors for chronic diseases (for example, genetic susceptibility, age and sex) cannot be prevented. Others can be reduced in the population by changing human behaviours and modifying the social and environmental factors that facilitate the risky behaviour. The *National Chronic Disease Strategy* listed the known biomedical, behavioural, and social risk factors for chronic diseases (Figure 6.1).

Figure 6.1: Risk factors for chronic diseases

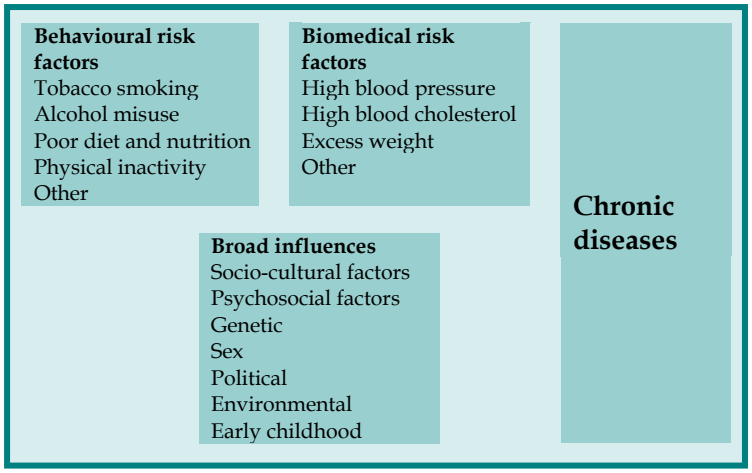
Behavioural and social risk factors	Biomedical risk factors
Poor health in early childhood	Excess weight*
Tobacco smoking*	High blood cholesterol*
Risky and high risk alcohol use*	High blood pressure*
Poor diet and nutrition*	Genetic factors
Physical inactivity*	Depression
Excessive sun exposure	
Social isolation	

**indicates factors common to several major chronic diseases*

Source: NHPAC, *National Chronic Disease Strategy*, 2006, p.13.

Australian and international public health research identified the importance of the social determinants of health (e.g., education, income) in association with the traditional risk factors (e.g., smoking, diet) in the development of chronic disease (Figure 6.2). These broader determinants affect health through many pathways, including material wellbeing (e.g., access to food and shelter), environments (e.g., access to recreational facilities, exposure to dust in remote areas), access to services (e.g., health care, transport, education), and psychosocial wellbeing (e.g., early childhood experiences, social support, levels of stress). They form the backdrop for the emergence of individual risk-taking behaviours and, in this way, these risk factors can be said to be patterned by socioeconomic position.

Figure 6.2: Relationships of risk factors to chronic diseases



Source: AIHW, *Chronic diseases and associated risk factors in Australia 2001*, 2002, p. 96.

Public health practices

Seven largely preventable risk factors with major impacts on the incidence and prevalence of chronic diseases were monitored by the Australian Institute of Health and Welfare (AIHW). Around one third of the burden of chronic diseases was attributed to these risk factors, and most were increasing in prevalence by the start of the 21st century.[259]

They were:

- tobacco smoking;
- risky and high-risk alcohol use;
- physical inactivity;
- poor diet and nutrition;
- excess weight;
- elevated blood pressure; and
- high blood cholesterol.

At the end of the 20th century, tobacco smoking was one risk factor for chronic disease that was decreasing in the population, with reductions evident in the rates of smoking – especially in males – and a gradual decline in the public acceptability of smoking. This was attributed to the efficacy of the tobacco control measures, which were assessed as a major public health success.

Public health practitioners who were surveyed for this report were more equivocal about the evidence for successful reductions in alcohol-related harm. However, alcohol restrictions on drivers, coupled with active enforcement of alcohol levels by police random breath-testing, averted a proportion of road accidents and subsequent injuries and deaths. Changing population behaviour to limit harmful sun exposures was also a public health success, beginning with the 'Slip! Slop! Slap!' campaign in 1981. Needle and syringe exchange programs, to minimise the potential harm of sharing infected needles, also contributed to quantifiable reductions in certain bloodborne infectious diseases (hepatitis B and C, and HIV/AIDS). Changes in diet, such as reductions in the intake of saturated fats and salt, played a role in reducing fatal heart attacks, which were the commonest cause of premature deaths around the middle of the 20th century.

Screening for risk factors proved to be a successful approach to case-finding for certain cancers, thereby offering opportunities for earlier clinical intervention and treatment. Cervical and breast cancer screening programs commenced in 1991, and screening for bowel cancer in 2006.

Factors critical to success

Multi-pronged approaches that were universal (population-wide) in their reach proved to be the most successful public health responses to the rising prevalence of preventable risk factors for chronic diseases in the latter part of the 20th century. These were flexibly tailored or targeted to certain groups in the population, and adapted over time. Tobacco control strategies, for example, were implemented across a number of fronts by a broad coalition of organisations, to address tobacco use and withdrawal, passive smoking, tobacco advertising, taxation, pricing, sales restrictions, public education, and community acceptance of changed norms such as smoke-free premises and non-smoking behaviour in enclosed and public places. Campaigns were successfully tailored to address tobacco use in priority groups, such as targeting youth smoking.

The success of these approaches highlighted the importance of a consistent public health message delivered across society in many formats, and sustained over a time span that could be decades. In the example of tobacco control, this resulted in an unarguable public health success – community-wide behavioural change to 'non-smoking' (although more achieved in higher than lower socioeconomic groups) – and a corresponding reduction in smoking-related diseases and premature deaths. It was the breadth of the response, using multiple strategies across different sectors, simultaneously and over time, that was essential to modifying smoking behaviour across the population.

Future challenges

By the start of the 21st century, both universal and targeted health promotion approaches were used to reduce chronic diseases and their risk factors further, and it was anticipated that the largest population benefit would come from more effective prevention. Higher prevalence rates of smoking, obesity, and

elevated blood pressure in lower socioeconomic groups were well documented, reflecting differences in chronic disease risk factors, in exposures to the broader determinants of health, and in responses to public health campaigns. Many experts believed that traditional approaches to health promotion would no longer be as effective, because risk factors and health-damaging behaviours were strongly patterned by environmental and social factors that accompanied stressful lives, lack of education, poverty, discrimination and disadvantage.[458]

In 2005, it was estimated that the treatment of chronic diseases (and injuries) accounted for nearly 70% of health care expenditure in Australia.[459] A large proportion of the disease burden was preventable, but, as many chronic diseases had their antecedent risk factors apparent in childhood and adolescence, a long lead time was required to reduce their incidence across the population.

Despite the benefits of health promotion and disease prevention, most health expenditure was still directed at acute care in hospitals and other health care institutions, after illness was already established.[357] This resulted in treating those who had already become 'patients' with costly pharmaceuticals, diagnostic technologies, or corrective surgery, rather than initially preventing or delaying the illness from occurring.

Gross and colleagues concluded that 'early prevention and better coordinated management of chronic conditions will require changes in the methods of financing and paying for health care, inspired and supported by strong leadership from our politicians'.[460] They noted that 'economic incentives to the community to reduce their risk and look after their health have not been conspicuous', as health economists generally argued against investments in public education and information to modify demand for health care, preferring to argue for supply-side regulation. Later evidence on the impact of demand-side strategies in chronic disease management trials, however, showed that demand-side strategies worked better than supply-side strategies.[460]

Further challenges included:

- translating the *National Chronic Disease Strategy* and its associated programs into effective action to reduce the burden of chronic diseases;
- ensuring that new directions and organisational structures improved access to a fully functioning continuum of care; and
- reducing health inequalities.[461]

As knowledge gained from public health research into chronic diseases and their associated risk factors improved, there was also scope for 'best practice' to be more widely implemented. The National Institute of Clinical Studies identified the following evidence-practice gaps in the public health arena:

- ceasing 'unnecessary' screening for lung cancer with chest X-rays; and
- vaccinating against influenza to increase coverage in those aged under 65 years who were at risk due to pre-existing health conditions.[126]

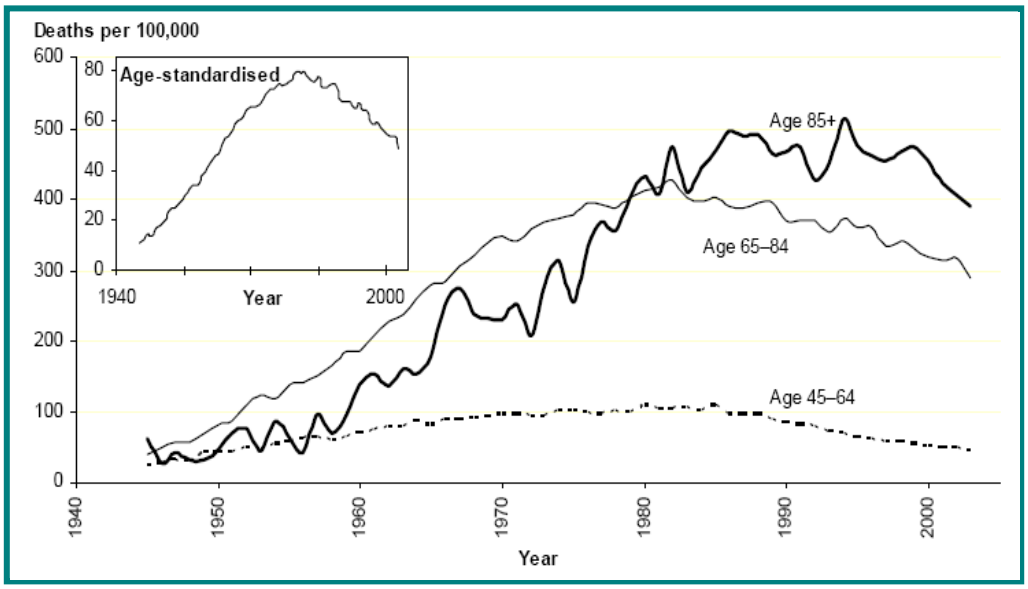
6.1.1 Decreased tobacco smoking

1970s onwards

Tobacco use is the most significant preventable cause of both cancer and heart disease.[462] Over the 20th century, knowledge from public health research and a raft of tobacco control measures led to significant reductions in tobacco smoking rates and in tobacco-related diseases, contributing to increased longevity, improved quality of life, less disability and fewer deaths. Other gains accrued as smoking rates continued to fall and exposure to passive smoke reduced.[463] Tobacco-related diseases include cancer, heart disease and chronic obstructive pulmonary disease. Tobacco smoking killed more men than women – around 13,000 men compared to 6,000 women – but the number of women dying from this cause was increasing by the end of the 20th century.[464]

Cancer was the major cause of smoking-related deaths in men and women. Of five-year survival rates for cancers, those for lung cancer were among the lowest (less than 15% overall, with only a small improvement over the last two decades).[464] Lung cancer occurred most often in older people as it took decades for the cancer-causing agents to have their full effect (Figure 6.33 and Figure 6.44).[25]

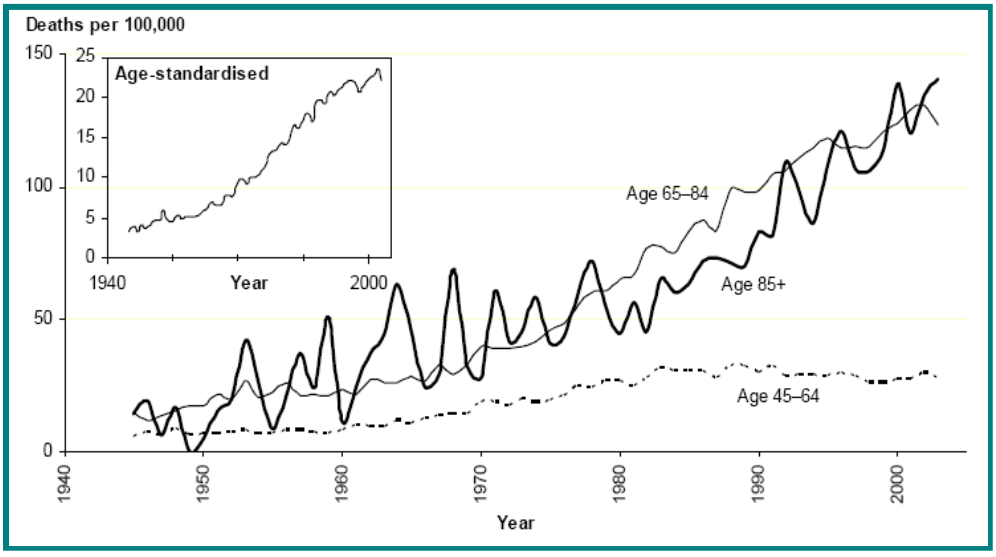
Figure 6.3: Male age-specific and age-standardised death rates for lung cancer, 1945-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 54.

At the peak in 1982, the age-standardised male death rate from lung cancer was 80 deaths per 100,000 population; by 2000, rates had fallen to 55 deaths per 100,000 and in 2004, further still, to 50 deaths per 100,000 population.[25] For females, the death rate for lung cancer increased substantially after 1945 and showed little evidence of the reduction evident for males (Figure 6.44).[25] Smoking rates in girls exceeded those in boys.

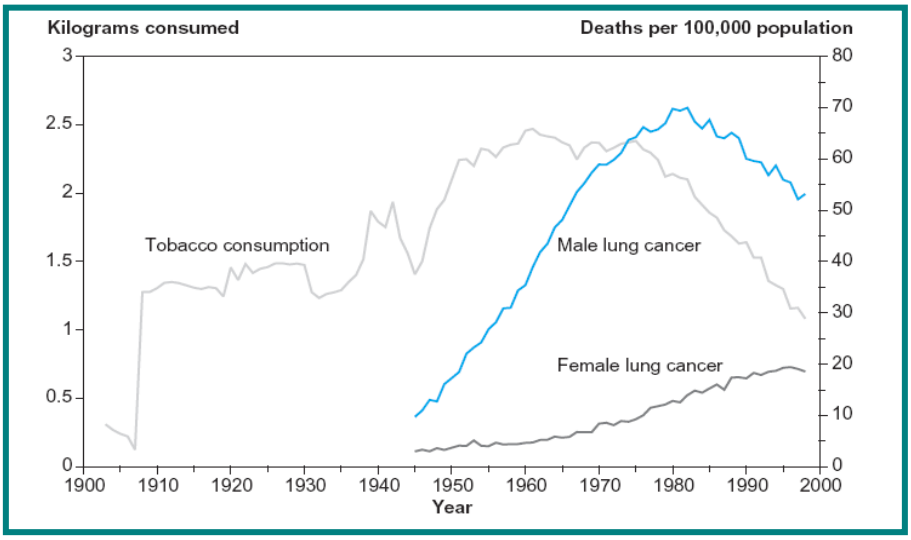
Figure 6.4: Female age-specific and age-standardised death rates for lung cancer, 1945-2003



Source: AIHW, *Mortality over the twentieth century in Australia,* 2006, p. 54.

While there was a major decrease in the consumption of tobacco products from the mid-1970s, the death rates reflect the lag time evident in the relationship between tobacco consumption and the development of lung cancer (Figure 6.55).

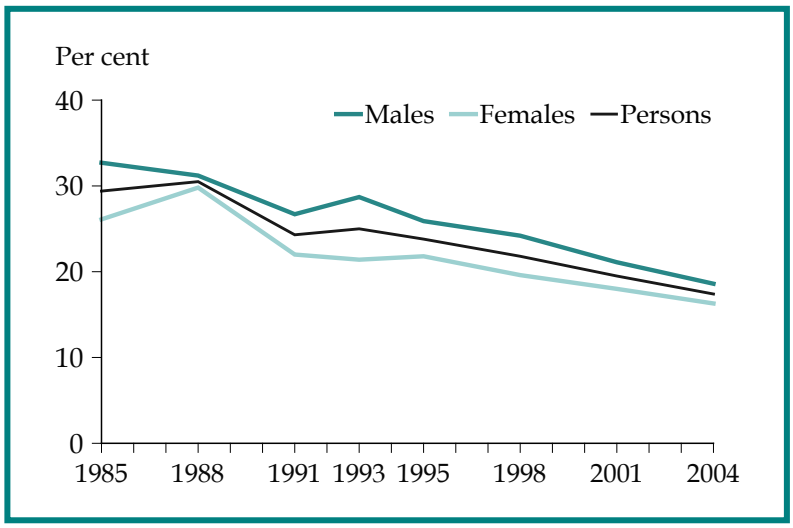
Figure 6.5: Per person consumption of tobacco products (left hand scale) and death rates from lung cancer, 1903-1998



Source: AIHW, *Australia's health 2000*, 2000, p. 354.

Estimates from survey data showed that regular daily smoking rates for those aged 14 years and over fell by 40% in the twenty years to 2004: from 29% in 1985 to 17% in 2004 (Figure 6.66).[465] Rates for males declined more sharply (by 43%) than those for females (38%), resulting in daily smoking rates of 18.6% for males and 16.3% for females in 2004.

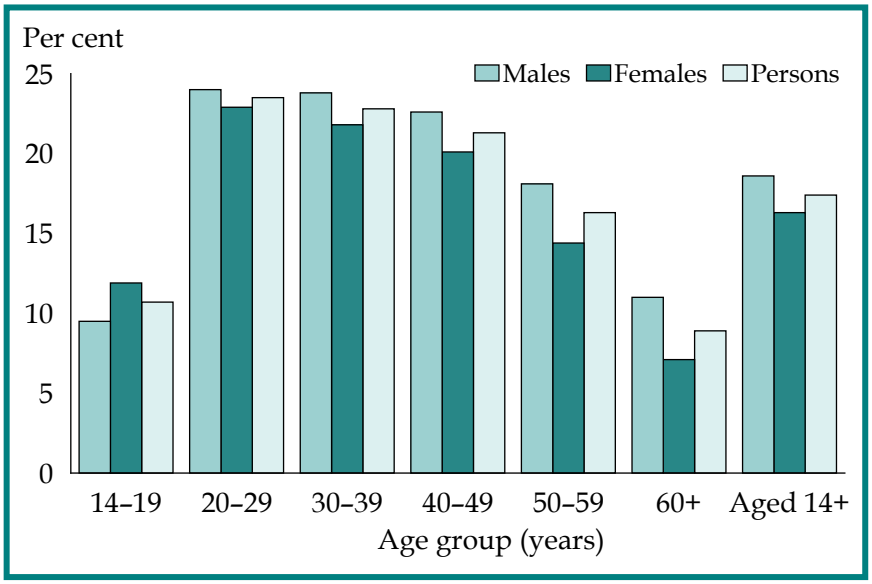
Figure 6.6: Daily smokers – population aged 14 years and over, 1985-2004



Source: AIHW, *Statistics on drug use in Australia 2004*, 2005, p. 5.

Overall, there were more male current smokers than female. However, this pattern was reversed in the youngest ages: for those aged 14-19 years, 10% of males smoked daily compared to 12% of females (Figure 6.77).[465] The prevalence of daily smoking was also highest in the younger age groups, with 24% of men and 23% of women aged 20-29 years reporting that they were daily smokers.[465] People aged 60 years and over were the least likely to be daily smokers, with only 9% overall (11% of males and 7% of females).[465]

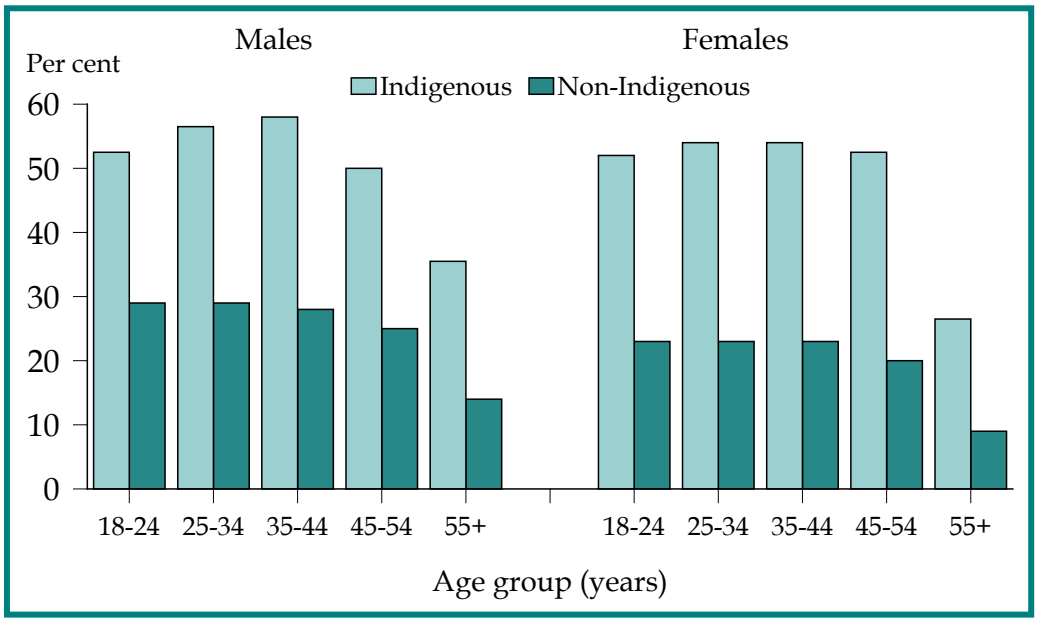
Figure 6.7: Daily smokers – population aged 14 years and over, by age and sex, 2004



Source: Chart by PHIDU; data: AIHW, *2004 National Drug Strategy Household Survey: detailed findings*, 2005, p. 19.

For Indigenous Australians, the daily smoking rate was estimated to be 50% in 2004-05[466], with data from ABS health surveys for 1995 and later years recording little apparent change. Smoking rates for both men and women were far higher across all age groups, compared with the non-Indigenous population (Figure 6.88). These smoking rates were of particular concern, given the already poorer health of this population.

Figure 6.8: Current daily smokers aged 18 years and over, by Indigenous status, sex and age, 2004-05



Source: ABS, *2004-05 National Aboriginal and Torres Strait Islander Health Survey*, 2006, p. 9.

Analysis of data from the *National Aboriginal and Torres Strait Islander Social Survey* in 2002 revealed that the likelihood of risky health behaviours decreased with higher levels of schooling.[467] This was particularly evident for smoking, with a rate of 39% for Aboriginal and Torres Strait Islander people aged 18 to 34 years who had completed Year 12, compared to a rate of 70% for those whose last year of schooling was Year 9 or less.[154] For those aged 35 years and more, the gradient was less marked, from 42% (completed Year 12) to 48% (Year 9 or less). These data suggested more effective ways to reduce smoking would be through improving the social determinants of health, in this case, the educational attainment levels of young Aboriginal and Torres Strait Islander peoples.

Aboriginal and Torres Strait Islander mothers also had much higher rates of smoking during pregnancy than non-Indigenous mothers. For example, in 2005, some 55% of Aboriginal and Torres Strait Islander mothers in NSW smoked at some time during their pregnancy, compared with only 13% of non-Indigenous mothers.[468] This was an improvement from 2001 when 59% of Aboriginal and Torres Strait Islander mothers reported that they had smoked while pregnant.

Public health practices

In the latter part of the 19th century, strong anti-smoking views were held by colonial politicians, and the first legislative control over tobacco was enacted in 1882 (the SA *Smoking Regulation Bill*) to prevent children from using tobacco, as tobacco smoking was seen as 'the pathway to ruin'.[30] All the states enacted legislation to ban the sale of tobacco products to children aged under 16 years and, until the 1970s, these laws were the only restriction on the sale and marketing of tobacco.

By the end of World War II, nearly three quarters of adult males and a quarter of adult females smoked, and there was a substantial tobacco-growing industry in Australia, with some regions economically dependent on the crop.[469] By the 1950s, medical evidence was accumulating that tobacco smoking was harmful and was linked to the rising incidence of lung and other cancers. Tobacco smoking was then increasingly recognised as a public health problem. Federal legislation was introduced in the late 1960s to enable a health warning to be applied to cigarette packets, although the legislation was not enacted until 1973, when the message 'Warning – Smoking is a health hazard' first appeared on packets of cigarettes.[470] Bans on 'direct' (rather than incidental) radio and television advertising commenced in 1976 under federal broadcasting legislation, and there were state bans on outdoor advertising from 1987, and nationally, on advertising from 1992 (although there were some exemptions).

In 1987, as part of a landmark strategy, the Victorian *Tobacco Act 1987* levied a wholesale tax on tobacco products sold in Victoria to fund the Victorian Health Promotion Foundation (VicHealth), with a mandate to promote health and buy out tobacco industry sponsorship of sport and the arts. VicHealth quickly increased funding for QUIT and other health promotion programs, and replaced tobacco company sponsorship of sporting and other events. VicHealth was the world's first health promotion foundation funded by a tax on tobacco, establishing the principle of 'hypothecation', in which tobacco taxes levied by the state are used to support health promoting organisations and activities to reduce smoking. The SA *Tobacco Products Control Act* was amended in 1988 and established Foundation SA[471] and Healthway, the WA health promotion foundation, commenced operation as a result of the WA *Tobacco Control Act 1990*.[472]

The *National Health Policy on Tobacco in Australia* was adopted by the Ministerial Council on Drug Strategy in 1991 as part of the National Campaign Against Drug Abuse. The policy's first premise was the acceptance of the need for a long-term and comprehensive program and it stated that there

> *'…. had long been recognition... that the resolutions to this problem lie not in a piecemeal approach but in the adoption of a carefully planned, comprehensive, long-term approach encompassing education and information, legislation and restrictive measures and cessation services.'*[473]

A framework for national tobacco control activities by the Australian, state and territory governments was then provided by the *National Tobacco Strategy 1999 to 2002-03*[216] and its successor, the *National Tobacco Strategy 2004-2009,* which outlined a long-term plan to improve health and reduce the social costs of tobacco in all its forms (Box 6.2).[474]

Box 6.2 *National Tobacco Strategy 2004-2009*: Guiding principles

'Our progress in reducing population exposure to tobacco in all its forms depends on how well we tackle:

- the most prevalent factors still driving smoking uptake;
- the most significant barriers to smoking cessation;
- the factors driving continuing high levels of smoking in some workplaces and institutions particularly among disadvantaged groups; and
- the technical, communication and regulatory difficulties posed by the development of tobacco products (and alternative nicotine delivery systems) that potentially reduce harm resulting from continuing tobacco use and nicotine dependence.

To address these challenges, the *National Tobacco Strategy* seeks to adopt policies and programs where there is compelling evidence of potential effectiveness. The intent is to be as efficient as possible and address the significant inequity that is caused or exacerbated by tobacco use in this country.

1 Being as effective as possible

- Adopt a comprehensive approach that addresses the cultural, pharmacological and behavioural factors that affect smoking uptake, the nature of nicotine dependence, the reinforcement of continued smoking and the process of smoking cessation.
- Build on what has been achieved so far and the lessons learned from experience and from systematic research.
- Focus on approaches most likely to advance the objectives.
- Take into account the global nature of the tobacco industry and the need, therefore, to learn from international experience and to contribute to international initiatives to halt the tobacco pandemic.

2 Being as efficient as possible

- Work in partnership to make better use of collective skills and resources.
- Build capacity and maintain energy and enthusiasm within the workforce.
- Assess the impact of all major new initiatives, adjusting our approach as needed.

3 Striving for greater equity

- Try to reach people from all sections of the community, over the course of their lives and day to day, in the settings in which they work, shop and socialise.
- Endorse efforts to address disadvantage.
- Put extra effort into initiatives for groups among whom the burden of disease and disadvantage is particularly high.'

Source: Ministerial Council on Drug Strategy, *National Tobacco Strategy 2004-2009: the strategy*, 2005, p. 17.

The public health activities that contributed to the long-term success in reducing tobacco smoking included:

- identification and promulgation of the risks of active tobacco smoking (which had been known from 1957), and of passive smoking (the first NHMRC report on passive smoking was published in 1986);
- tobacco control legislation and bans;
- regulation and policing of sales to minors;
- QUIT programs, health education, promotion and social marketing campaigns;
- voluntary adoption of, and legislated, smoke-free premises: offices, restaurants, clubs and hotels, other entertainment venues and enclosed spaces; and
- monitoring and publicising information on population smoking practices (e.g., tobacco smoking rates, age of uptake, numbers of children in smoke-free homes).

Factors critical to success

In its review of one hundred years of mortality, the AIHW identified the reduction of more than 30% in male death rates from lung cancer (from the peak in these rates in the 1980s) as one of the notable successes of public health over the 20th century.[25] The relationship of tobacco smoking to lung cancer had long been studied, but, as lung cancer became the leading cause of death from cancer (and remained so at the end of the century), public health practitioners worked hard to develop ways to achieve reductions.[3]

Initially, public health interventions were led by a small group of committed, visionary individuals, although Simon Chapman (one of these) disputed this, describing the 'many, often unsung, people [who] have oxygenated the huge changes achieved in smoking in Australia'.[475] Jamrozik described how the strategies used to try to control tobacco had to be based on science, rather than on evidence of their effectiveness, because no one had attempted population-wide change on such a scale before, and therefore, no evaluative evidence of their likely success or failure was available.[76]

> ***Survey respondent:*** *'QUIT smoking initiatives needed a multi-pronged approach (health promotion, legislation, incorporation into acute care) and battled vested interests in the corporate sector. Yet smoking rates steadily declined, and balances were struck between individual and community rights. It was a great example of cumulative changes to community attitudes and behaviour.'*

Public health measures to reduce smoking threatened the industries that profited from smoking. These industries had significant resources to fund rear-guard actions to prevent, circumvent (e.g., in relation to advertising) or delay specific actions.[476] One example was the legal action brought by the Tobacco Institute of Australia Ltd. against the NHMRC in 1996, when it appeared likely that the NHMRC's second report on passive smoking would lead to more rigorous restrictions on smoking in public places such as restaurants.[477]

Public health advocates faced many challenges from the tobacco industry, and, while the metaphors of David and Goliath or 'being pecked to death by ducks' lie at two extremes, it was a battle against vested interests, political inertia (in the face of compelling medical evidence) and the maintenance of the status quo.[475] Public health advocacy, sustained leadership by champions, many hands and persistence in the face of adversity were significant factors behind the success.

> *'Public health advocacy often requires pushing governments to act and being critical of inaction.'*
>
> – S Chapman, *Medical Journal of Australia*, 2002.[475]

Other elements were the use of a multifaceted strategy, and a consistent message reinforced by fiscal measures (Australia had one of the highest taxation rates on tobacco products in the world), and legislation enacted both federally and by the states and territories to control tobacco. Advertising and promotion of tobacco products by all media was banned in Australia, and campaigns marketed non-smoking behaviour and provided support for those wishing to quit.[30] The allocation of taxed funds to attempt to control the consumption of, and remedy the harm done by the taxed product was also critical to the ability of health promotion programs to reduce tobacco consumption.

Public health monitoring of smoking rates and the provision of community information about tobacco (e.g., age of initiation of smoking, smoking cessation rates, smoke-free premises, and ways to quit) were intrinsic to the success of the strategy (Box 6.3). Detailed evaluations of tobacco control campaigns were also important, as they demonstrated the enormous costs of smoking and the potential savings associated with reductions in population smoking rates.

Cost-effectiveness

Economic evaluation demonstrated that substantial gains could be made through further investment in tobacco control, and the benefits far outweighed the costs.[474] An evaluation of the first six-month phase of the National Tobacco Campaign in 1997 estimated that a total of $9 million had been spent (by Commonwealth, state and territory governments), with resultant savings of $24 million, indicating that the campaign had paid for itself 'more than twice over'.[480] It was estimated that the first six months had prevented 922 premature deaths and achieved an additional 3,338 person years of life up to the age of 75 years. This conservative estimate did not include various social costs, and a broader societal perspective was considered likely to yield a far stronger cost-effectiveness result.

Box 6.3 The WA QUIT Campaign

'The WA QUIT Campaign was the first well-funded comprehensive health promotion campaign at a state level. It had a strong outcome in terms of achieving lower smoking rates and lower lung cancer rates than other states.' – Survey respondent

From 1984 to 2004, the WA QUIT Campaign was conducted year round by QUIT WA (formerly the Smoking and Health Program), in the Population Health Division of the Department of Health, WA. The state-wide campaign encouraged and supported adult smokers to quit smoking.[478]

'Only dags need fags'

The WA QUIT Campaign commenced in 1984, using the slogan 'only dags need fags' as part of the campaign: a slogan that was still memorable in 1998 among respondents to a survey who were asked what message came to mind after the interviewer said 'smoking'.[479]

Strategies implemented by QUIT WA (formerly the Smoking and Health Program) were evidence based and consistent with the best international practice on tobacco control, and included:

- mass media campaigns,
- legislation,
- quitting support,
- school and public education,
- promotion and sponsorship of healthy behaviours,
- support for smoke-free policies,
- collaboration across sectors, and
- research and evaluation.[479]

Tobacco smoking was responsible, directly and indirectly, for a considerable number of cases of illness and deaths. Ridolfo and Stevenson estimated that there were approximately 19,000 deaths attributable to tobacco use in 1998.[481] The VicHealth Centre for Tobacco Control calculated that if smoking prevalence were reduced by five per cent to 15% over five years, at least 50,000 fewer Australians would die prematurely over the following 30 years, and reductions in health-care expenditure would total more than $1 billion. Investment in tobacco control was therefore described as 'a blue chip investment', and it was calculated that

> *'a $10 per capita tobacco control program modelled on international best practice would provide social rates of return higher than those of just about any other social policy'.*[482]

Abelson and colleagues estimated that, over the longer term (30 years), government investment of $176 million in public health programs to reduce tobacco consumption returned an $8.4 billion net benefit, with 17,400 premature deaths averted.[87] Public health tobacco control programs that were costed included:

- national mass media campaigns to warn and educate the public of the dangers of smoking;
- health warnings on cigarette packets;

- regulations restricting the promotion of cigarettes as well as the conditions under which cigarette products might be consumed; and
- changes in taxes which contributed to a 154% price increase in tobacco products.

These programs were conservatively assessed as being responsible for a 10% decline in tobacco smoking and therefore for 10% of the benefits. Benefits attributed to public health programs totalled $12.3 billion, comprising longevity gains (estimated at $9.6 billion), improved health status gains ($2.2 billion), and lower health care costs ($0.5 billion).[87]

A study by Hurley calculated the positive impact of even short-term and modest reductions in smoking rates, on the numbers of hospitalisations of people aged 35–64 years for heart attack and stroke, and the associated costs of two different scenarios, over a seven-year period.[483] In scenario 1, smoking prevalence decreased by 1% in the first year, and in scenario 2, smoking prevalence decreased by 1% each year for five consecutive years. Under scenario 1, almost 1,300 hospitalisations would be avoided over seven years, saving about $20.4 million in health-care costs; and for scenario 2, over 4,000 hospitalisations would be avoided, saving about $61.6 million (approximately 2.75% of the costs of hospitalisations for these conditions over the period).[483] These studies showed that there were substantial gains still to be made through further investment in tobacco control.

Future challenges

At the end of the 20th century, death rates from smoking-related diseases in Aboriginal and Torres Strait Islander peoples remained a serious concern, with Indigenous Australians much more likely to die from these diseases, and at younger ages.[154]

Social gradients in smoking behaviour demonstrated that those living in lower socioeconomic status areas were more likely to be daily smokers than those from more affluent areas. Data from the ABS 2004-05 *National Health Survey* showed that 30% of people in the most socioeconomically disadvantaged fifth of the population were daily smokers, compared to only 14% of people in the least disadvantaged areas.[356]

Therefore, future action included tackling smoking rates in harder to reach sub-populations, such as:

- Indigenous Australians, especially young people and pregnant women;
- young people in general, and especially young women; and
- those who were socioeconomically disadvantaged.

6.1.2 Decreased alcohol-related harm

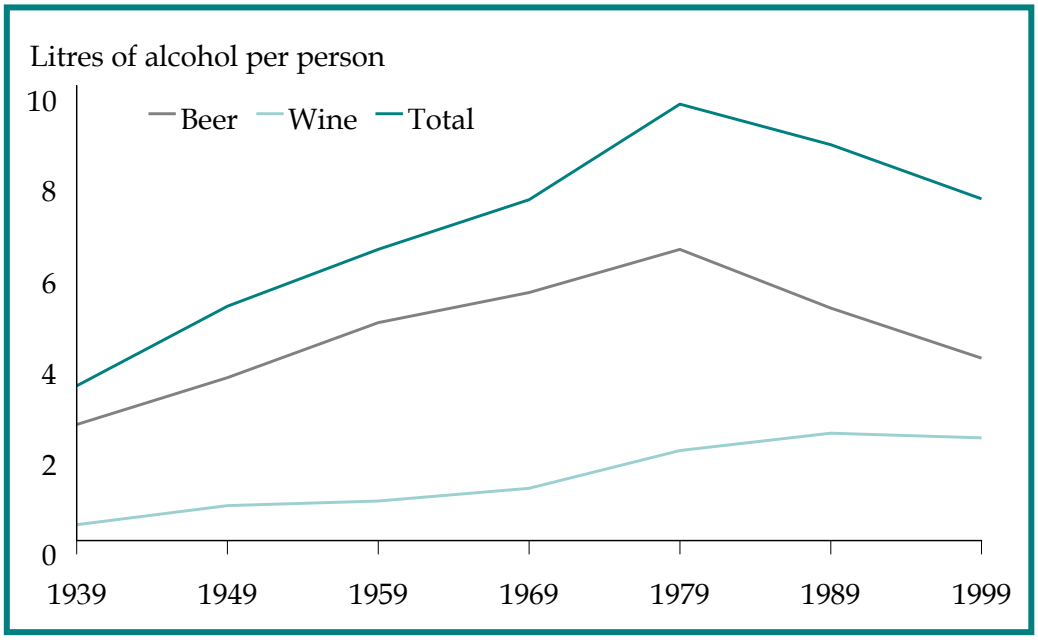
1970s onwards

Alcohol is a drug (a psychoactive substance) that promotes relaxation and euphoria, and has some health protective effects when used in moderation (for example, low levels of red wine consumption may have a protective effect against cardiovascular disease). Over-consumption of alcohol can, however, 'impair motor skills and judgement, produce intoxication and dependence, cause illness and death and have other harmful effects on our daily social, economic and living environments'.[484] Excessive consumption is detrimental to the liver and many other organs, and is implicated in conditions such as hypertension, some cancers and obesity.[360]

Alcohol is the most widely used and socially acceptable drug in Australia.[485] In 2004, 83% of adult Australians reported that they drank alcohol.[484] The *National Alcohol Strategy 2006-2009* asserted that 'too many Australians now partake in "drunken" cultures rather than drinking cultures'.[484] The resulting alcohol-related harms included death, injury, disease, crime, violence, unemployment and family breakdown. The ABS' long-term estimates of alcohol consumption per person aged 15 years

and over per year (in litres of beer, wine and total alcohol consumed) showed that consumption rose from 1939 to 1979, and then fell steadily in 1989 and 1999 (Figure 6.99).[360]

Figure 6.9: Apparent per person consumption of alcohol, by persons 15 years and over, 1939-1999

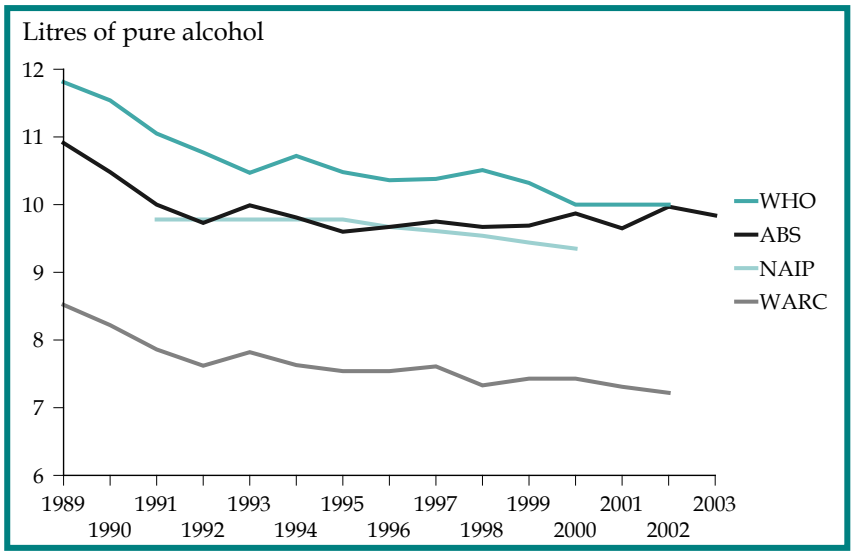


Note: Apparent per person consumption is total apparent consumption divided by mean resident population for the period; 'consumption' refers to estimates of supply and utilisation, rather than actual intake.

Source: ABS, *Australian social trends 2002*, 2002, p. 84.

Shorter-term trend data from 1989, using litres of pure alcohol per person (i.e., taking into account the different alcohol percentages of beer, wine and spirits), also showed an overall fall in average alcohol consumption, despite varying estimates from different sources (Figure 6.10). However, the proportion of the population who drank alcohol steadily increased, reaching 83% in 2004, the latest year for which data were available.[484]

Figure 6.10: Estimates of per capita alcohol consumption, 1989-2003



Key: WHO - World Health Organization; ABS - Australian Bureau of Statistics; NAIP - National Alcohol Indicators Project; WARC - World Advertising Research Centre.

Source: NAS, *National Drug Strategy 2006-2009*, 2006, p. 9.

Although the average consumption of alcohol per person in Australia declined from the 1980s, it remained high by world standards, and patterns of risky alcohol use remained a cause for concern. There was no level of alcohol intake deemed 'safe for everyone' – generally, the more alcohol consumed, the higher the risk of harm to people's health and wellbeing – and there were some groups (e.g., pregnant women, children) for whom alcohol was not recommended. The NHMRC endorsed the *Australian alcohol guidelines* in 2001 for the population and for specific groups (e.g., people taking medication or drugs, pregnant women). These set out the different levels of risk of harm (low risk, risky, and high risk) from both short-term and long-term alcohol consumption. Short-term alcohol-related harms were 'injuries from violence, accidents, falls, having unprotected sex and alcohol poisoning', while long-term harms included various diseases such as cancer, diabetes, and brain damage.[487]

Alcohol and your health, Australian alcohol guidelines

NHMRC poster[486]

The *National Alcohol Strategy 2006-2009*, endorsed by the Ministerial Council on Drug Strategy (MCDS) in 2006, aimed to prevent and minimise alcohol-related harm and develop safer drinking cultures in Australia by:

- reducing the incidence of intoxication among drinkers;
- enhancing public safety and amenity at times and in places where alcohol was consumed;
- improving health outcomes among all individuals and communities affected by alcohol consumption; and
- facilitating safer and healthier drinking cultures through community understanding about the special properties of alcohol, and regulation of its availability.[484]

Public health practices

Liquor licensing and regulation, especially in relation to driving under the influence of alcohol, and restrictions on marketing and the advertising of alcohol; alcohol taxation, pricing and availability controls; and supply restrictions (e.g., no sales to minors, Indigenous community-determined alcohol restrictions and bans (see Box 6.6, below) all contributed to reducing the harm associated with risky alcohol use).

The gradual decriminalisation of public drunkenness from the 1970s onwards identified the need for a comprehensive public health response to risky drinking cultures and alcohol-related harm (Box 6.4). Other interventions included municipal 'dry zones' (alcohol-free public spaces in urban areas), and designated driver programs as a practical measure to reduce drink driving.

Box 6.4 Decriminalisation of public drunkenness, 1970s-

Drinking to intoxication or drunkenness was 'a major cause of short-term alcohol-related illness, injury and social problems.[484] Single occasion drinking to excess ('binge drinking') had wide-reaching impacts on the health and safety of both individuals and communities because of its high incidence, the large number of people affected (both directly and indirectly, e.g., from associated risky behaviours such as unsafe sex) and because much of the injury and loss of life occurred in young adulthood.

Public drunkenness was first made a criminal offence in England in 1606, and later, most colonial and then state parliaments in Australia adopted similar laws.[488] There was a subsequent shift from treating intoxication as a criminal offence requiring policing, to providing public health remedies such as sobering up centres and diversionary programs. The NT decriminalised the offence of being intoxicated in public in 1974 and was the first Australian jurisdiction to do so.[485] Most jurisdictions (ACT, NSW, NT, SA, Tasmania, and WA) decriminalised the offence of public drunkenness.[484]

Alcohol-related harm reduction and minimisation programs that contributed to changes in alcohol consumption at a population level included:

- risk behaviour reduction programs (e.g., 'Don't Drink & Drive' campaigns);
- training for staff dispensing alcohol (e.g., responsible service of alcohol hospitality staff training);
- education programs (e.g., drug education in schools);
- brief counselling interventions by GPs targeting risky or unsafe drinking practices; and
- treatment programs for problem drinkers.[489-492]

The legislature, licensing authorities, and police monitoring and enforcement were non-health sectors involved in successfully addressing this public health issue. For instance, in relation to alcohol and driving, the legislatures set driver alcohol limits, and police conducted random breathalyser tests on roads and were responsible for additional aspects of monitoring and enforcement (e.g., fines, loss of licence) (see Sub-section 5.1.1, *Road traffic safety,* and Box 6.5).

The NHMRC guidelines provided information on using alcohol safely and avoiding harmful consequences. They also quantified in 'standard drink' units, different levels of risk arising from consumption of alcohol in varying amounts, in the short- and long-term. Information based on the evidence-based guidelines was widely used in alcohol awareness and education campaigns to develop better community literacy in the quantities of different types of alcohol that made up a 'standard drink', and in measures to ensure low-risk drinking (e.g., 'Count your drinks for better health').

Alcohol guidelines stipulated that, to remain under a blood alcohol concentration of 0.05% (the legal limit for driving), no more than two standard drinks for males and one standard drink for females should be consumed in the first hour, with one standard drink per hour or less, subsequently. Although some population survey results (2006) indicated 'some erosion' in community understanding of these safe drinking limits, around one half of beer drinkers interviewed accurately nominated the number of standard drinks in a stubby or can of full strength beer (46%, down from 54% in 2005). Furthermore, 50% of males (57% in 2005) and 28% of females (33% in 2005) had an accurate knowledge of both parts of the guideline that would enable their blood alcohol level to remain under 0.05% (the type of alcoholic drink, and the drinks per hour).[495] A range of government-funded resources, including posters, were available to improve community awareness and understanding of safe drinking practices (e.g., *Changing the mix: a guide to low-risk drinking for the veteran community*, published by the Australian Department of Veterans' Affairs).[496]

At the start of the 21st century, publicly-funded alcohol and other drug information and treatment agencies provided services in each state and territory, and there were also specialist services (such as withdrawal and detoxification centres) to treat and manage individuals with particular alcohol dependency problems. GPs devised effective 'brief alcohol interventions' to assist risky drinkers to adopt healthier drinking behaviours.

Box 6.5 Alcohol and driving

Drink driving was a major cause of injury, disability and premature loss of life. Alcohol – the most important cause of road deaths – was a factor in up to a third of driver and pedestrian deaths.[493] In 2004, one in seven people (14 years and over) admitted to having driven a vehicle whilst under the influence of alcohol.[494] Of all the causes of deaths related to alcohol, road crash injury was the second commonest, causing close to 5,000 deaths in the ten years up to 2001.

The burden of personal suffering and the monetary cost of road crashes were estimated at $15 billion in 1996, and substantial public benefits accrued from the implementation of road safety programs.[494]

A marked reduction in alcohol-related road deaths followed the national campaign to reduce drink driving, with the proportion of alcohol-related road fatalities decreasing from 44% in 1981 to 29% in 1996.[484] This decrease was attributed to changes in legislation, increased enforcement and social marketing campaigns to deter drink driving. The net present value of the benefits of road safety programs from 1970-2010 was estimated at $13.4 billion, while road safety programs were estimated to have saved governments $750 million a year in the late 1990s.[87]

'Brief alcohol interventions are effective in reducing alcohol consumption among non-treatment seeking patients who drink excessively. Such interventions are typically 5 to 30 minutes in duration and involve a combination of motivational interviewing and counselling techniques.' – RACP & RANZCP, 2005.[493]

The MCDS noted that alcohol-associated fatality rates had decreased while the number of treatment services had increased over the period of the *National Drug Strategy*' (from 1985 onwards).[497] Some programs were also successfully addressing issues of alcohol and violence, but there was much more to be done in this area.

In 1989, the alcohol beverage industry introduced a self-regulatory system for regulating alcohol advertising, prior to the involvement of the MCDS in 2002.[484] A new Alcoholic Beverages Advertising Code was introduced in April 2004. Industry self-regulation was criticised as part of public health arguments for the government to regulate, monitor and report on alcohol advertising, especially in relation to young people.[498] The Australian government allocated $5 million to DrinkWise Australia, an organisation funded by the liquor industry, for alcohol education programmes in 2005-06.[499] It was hoped that DrinkWise would advocate for strategies that were supported by evidence of their effectiveness.[500]

Factors critical to success

Reducing the amount of alcohol consumed overall, and in risky and dangerous ways, required a concerted community effort and ongoing changes in culture, attitudes and behaviour. An unequivocal area of success, however, was in reducing alcohol-related deaths and injuries on our roads. Factors critical to this success were the national approach (e.g., establishing the national 0.05% blood alcohol limit in 1992), and leadership from all states and territories in the monitoring and enforcement of that limit by police, through random breathalyser testing, and in the courts through fines and licence removals. As a result of these and other measures such as social marketing (e.g., 'Don't drink and drive' media campaigns and designated driver programs), there were major shifts in community perceptions about acceptable behaviour. The later use of popular sporting figures as role models and significant penalties enforced by sporting clubs for poor behaviour (much of it alcohol-fuelled) highlighted the extent of the cultural shift that had occurred.

Financial incentives and disincentives, regulation and taxation to reduce levels of harmful alcohol use were shown to be most successful when implemented as one part among many in a comprehensive approach to prevention.[501]

Cost-effectiveness

The misuse of alcohol was responsible, directly and indirectly, for a considerable number of accidents, injuries, illnesses and deaths. The National Drug Research Institute (NDRI) estimated that in 2001, 3,000 deaths were attributable to alcohol consumption at risky and high-risk levels.[494]

In 2006, a review concluded that alcohol harm reduction interventions to reduce road trauma were well-founded in evidence, but there was limited research to support the effectiveness of other interventions.[502]

In 1992, the NT began the Living with Alcohol (LWA) program, a 'comprehensive program to reduce alcohol consumption and alcohol-related harms'.[503] It was funded by a small levy on all alcoholic beverages of three per cent or greater alcohol content by volume, which effectively raised the price of these beverages by around five cents per standard drink. The LWA Levy was removed in 1997 as a result of a High Court ruling; however, the LWA program continued until 2002, funded by redirected taxes collected by the federal government.

Evaluation of the impact of the first four years of the LWA program (1992-93 to 1995-96) showed a 22% reduction in per capita consumption of alcohol over the period, and reductions in hazardous drinking patterns, rates of road fatalities and serious road injury, as well as alcohol-related hospitalisations and deaths. Over the four years, the LWA program was estimated to have prevented 129 deaths and over 2,100 alcohol-related hospital admissions, saving the NT government more than $124 million in health care costs and lost productivity.[507] A longer term evaluation (from 1992 to 2002) confirmed that the program had resulted in significantly reduced alcohol-attributable deaths and financial savings to the NT.[507] The later study concluded that there was strong evidence of both short- and long-term benefits to be gained from combining the strategies of:

- implementing alcohol taxes related to alcohol strength and thereby increasing the real cost of alcohol (as in the LWA Levy), together with
- comprehensive programs and services to reduce alcohol-related harms (funded by the alcohol taxes above).

Furthermore, the long-term LWA program was effective in reducing acute harms in both Indigenous and non-Indigenous communities (Box 6.6).[507]

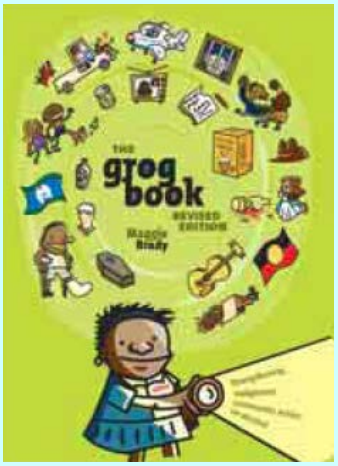
Box 6.6 Community-controlled alcohol supply restrictions

'Licensing restrictions used by Indigenous communities in Australia have taken two forms to restrict supply of alcohol… declaring areas 'dry' and… using liquor laws to control availability. These initiatives can be successful but only when initiated and supported by the communities themselves'.[493]

Liquor law controls on the availability of alcohol included licensing restrictions, conditions on trading hours and days, and limits on amounts and types of 'take-away alcohol' (e.g., limits on cask wine). Community controls required significant community support and limited alternative sources of alcohol to maximise their effectiveness. Evaluations of alcohol supply restrictions in remote Aboriginal communities and towns with substantial Aboriginal representation demonstrated reductions in alcohol consumption and alcohol-related harms (e.g., reduced injury).[504] Common factors necessary for success included that:

- restrictions were part of a whole program addressing reduced alcohol consumption and related harm;
- restrictions (and the whole program) had the active support of a representative section of the community including the Aboriginal community; and
- the community engaged and persisted in the struggle to implement restrictions.[505]

The active support of liquor licensing and enforcement authorities was fundamental to success.



The Grog Book by Maggie Brady was a resource for advice on how to manage alcohol problems at the community level for Aboriginal and Torres Strait Islander communities first published in 1998. Funded by the Australian government, a revised edition was available in 2005.

Future challenges

Despite the steady decline in overall alcohol consumption in Australia, Indigenous Australians did not benefit to the same degree from the associated health gains and, in particular, suffered a greater share of the burden of acute alcohol-related harm.[493] While there were some advances in the prevention and treatment of alcohol-related problems, risky and high-risk alcohol consumption continued at unacceptably high levels. Evidence-based interventions at both the clinical and population levels were needed.[493]

Some measures (e.g., aligning taxation with alcohol strength) were not yet implemented, despite evidence of their effectiveness. Social 'messages' about responsible alcohol use needed to be more consistent – as with tobacco control – rather than co-existing with behaviours such as drinking promotions (e.g., half-price 'happy hours') and relatively low prices for high alcohol content drinks (packaged to appeal to young people) that facilitated an acceptability of binge drinking.

Marketing of alcohol to young people remained a concern. The alcohol beverage industry was officially 'self-regulating', after introducing its own alcohol advertising system in 1989. Public health

researchers argued that the self-regulating system was not working, especially in relation to alcohol advertising and promotions that were targeted at young people.[498] Increased government surveillance and regulation was needed.

The *National Alcohol Strategy* recommended monitoring and annual reporting of the advertising and promotion of alcohol.[484] A study estimated that Australian government taxation revenue from consumption of alcohol by adolescents (aged 12 to 17 years inclusive) was seven times the amount spent on interventions to educate this age group about the potential dangers of alcohol, reflecting the 'substantial disparity' between earnings and expenditure on prevention.[508]

Fiscal vertical inequity meant that, while the Commonwealth received the most revenue from alcohol taxation, the states and territories incurred most of the costs associated with alcohol-related problems (including social, hospital and treatment costs), as well as those of law enforcement activity (e.g., policing, liquor licensing procedures, responsible service of alcohol laws (NSW)), courts, jails, rehabilitation, and the social consequences of alcohol-related violence.[501]

Recommended strategies to reduce the health-related impact of high-risk alcohol consumption were:

- the systematic reform of alcohol taxation to reflect public health as well as economic considerations (to include social and community costs as well as taxation benefits to, primarily, federal government) – this meant taxing alcoholic beverages according to alcohol content rather than beverage class or cost;
- the allocation of a proportion of alcohol taxation revenue to fund alcohol prevention, treatment and research (similarly to taxes on tobacco products, and as was done in the NT's LWA program);
- addressing the proliferation of alcohol sales outlets under changes in competition policy, as there was good evidence that the density of outlets was associated with increased risky alcohol use.[500,509,510,484]

There also needed to be better prevention of specific alcohol-related harms, such as alcohol-related violence, and greater uptake of effective treatment options for alcohol dependence (e.g., early and brief interventions, pharmacotherapy).[484] The extent of alcohol-related problems among Indigenous communities remained a national concern.[484]

6.1.3 Sun safety measures

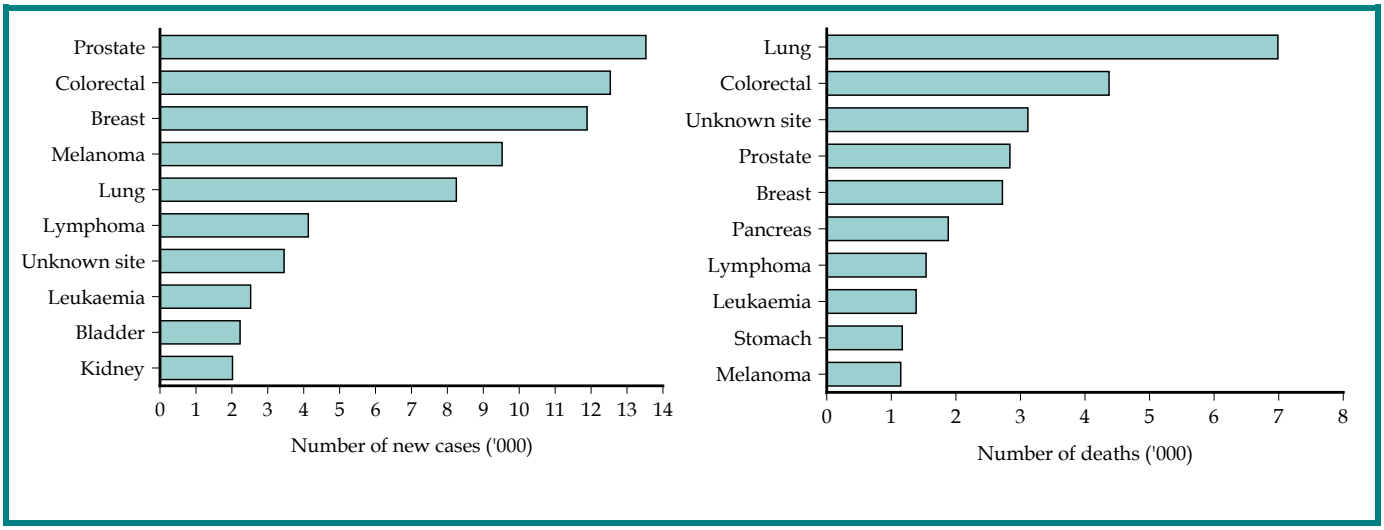
1981 onwards

Australia had the highest rate of skin cancer in the world, with two in three people likely to develop some form of skin cancer during their lifetime.[511] In 2002, the number of people treated for skin cancer was more than four times the number of people with all other types of cancer combined.[512]

Melanoma made up about two per cent of all skin cancers and was able to be treated effectively if diagnosed early, but had a poor prognosis if the tumour was diagnosed at an advanced stage, underscoring the need for early detection.[512,513] Early treatment for the more prevalent non-melanocytic skin cancers (NMSC) reduced disfigurement and deaths from this cause.[514] In 2002, it was estimated that almost two per cent of Australia's population – four per cent of those aged 40 years or over and eight per cent of those aged 70 years and over – were treated for NMSC.[513]

More than 1,600 Australians died from melanoma and NMSC in 2005.[515] The incidence of and deaths from melanoma, relative to other common cancers in 2001 are shown in Figure 6.11.

Figure 6.11: Incidence and deaths from the most frequent cancers, 2003

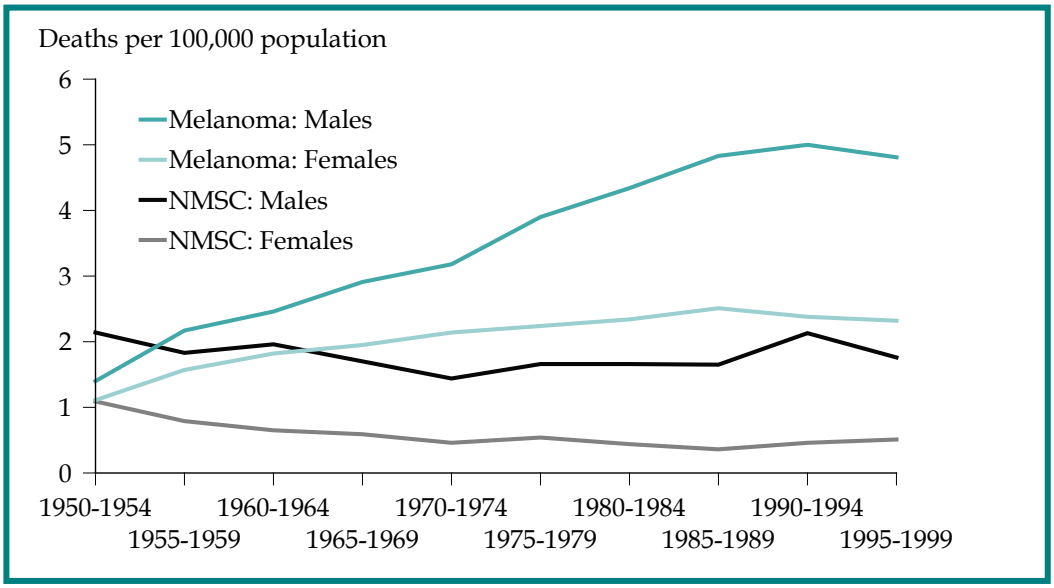


Source: Charts by PHIDU; data: AIHW & AACR, *Cancer in Australia: an overview, 2006*, 2007, pp. 8, 44; cancer incidence – National Cancer Statistics Clearing House, AIHW data compilation from state & territory cancer registries (non-melanocytic skin cancer incidence not shown as not routinely reported to cancer registries); deaths – National Mortality Database, AIHW.

Ultraviolet (UV) radiation from the sun was the main cause of skin cancer. Most ultraviolet radiation is derived from sunlight, but also from artificial sources, such as tanning booths or sunlamps. The relationship between exposure to sunlight and skin cancer was first recognised by an Australian statistician, Oliver Lancaster, in 1956.[516] His comparison of skin cancer rates among Caucasians showed a correlation with latitude and the amount of sunlight. The northern regions had far higher rates than those in the south of Australia.[517] The fourth *National Non-melanoma Skin Cancer Survey* (2002) and trend analyses, from the time of the first survey in 1985, supported this relationship.[513] The association with latitude, being Australian-born, and having fair skin (with less melanin or skin pigment) confirmed the role of UV radiation exposure in skin cancer.[513]

Over the 20th century, deaths from melanoma rose from the 1930s, when they were first recorded, to 1985, increasing at an annual rate of 6% in men and 3% in women. After peaking in the period 1985-1989, female deaths from melanoma trended down, with rates for male deaths following some five years later.[518] Deaths from NMSC declined up to the 1950s and continued to fall in women (Figure 6.12). The later rise in young men was related to the incidence of NMSC in those with HIV/AIDS.[518]

Figure 6.12: Trends in age-standardised death rates for melanoma and non-melanocytic skin cancer (NMSC), males and females, 1950-1955 to 1995-1999



Source: Giles & Thursfield, *Canstat: Trends in cancer mortality, Australia 1910-1999*, 2001, p. 13.

Evidence suggested that promoting the early detection of melanoma resulted in the diagnosis and treatment of thinner tumours and an increase in survival rates.[518-520] Many melanomas were discovered by people themselves or by a family member.[521] Social marketing and public education campaigns aimed at primary prevention (e.g., the Cancer Council of Victoria's SunSmart program) contributed to significant changes in population behaviour.[522] The results were evident in the decline in melanoma incidence.

Although UV radiation over-exposure is harmful, some skin exposure is essential to produce vitamin D. Vitamin D is required for healthy bone development, and a relative deficiency is associated with a range of conditions, including osteoporosis, rickets and other bone diseases; autoimmune diseases (e.g., multiple sclerosis), hypertension and cardiovascular disease.[523-525]

It remained a public health challenge to shape this complex message appropriately to ensure that the population, in all geographic areas and through the seasons, received adequate sun exposure for healthy vitamin D uptake, without risking the harms of over-exposure to ultraviolet radiation.[526]

Public health practices

Public health's role in promoting sun safety measures included raising community awareness about the risks of over-exposure to the sun, and researching, advocating for and educating the public on sun protective behaviours and self-screening to identify early skin cancers using social marketing, education and awareness campaigns. Many of these measures to reduce and prevent harmful over- exposure to the sun were especially important for prevention in children as NMSC and melanoma typically may take decades to develop.

Promising early results showing a decline in melanoma in younger people were proof of the value of encouraging changes in behaviour to be more sun protective (e.g., wearing hats and covering up, reducing exposures during peak UV radiation times, and applying sunscreen).

Community-wide health promotion campaigns included the memorable 'Slip, slop, slap' (from 1981, Box 6.7), 'SunSmart' (from 1988) and 'Cover up', to get people to protect their skin and to screen themselves for skin cancers. Many of these campaigns were multi-faceted in their approaches.

Box 6.7 Twenty-four years of 'Slip! Slop! Slap!'

One of the most successful public health campaigns in Australia's history was launched in 1981, when 'a cheerful seagull in board shorts, t-shirt and hat tap-danced his way across our TV screens singing a jingle that you just couldn't get out of your head':

Slip, Slop, Slap!
It sounds like a breeze when you say it like that
Slip, Slop, Slap!
In the sun we always say "Slip Slop Slap!"

Slip, Slop, Slap!
Slip on a shirt, slop on sunscreen and slap on a hat,
Slip, Slop, Slap!
You can stop skin cancer - say: "Slip, Slop, Slap!"[527]

The 'Slip Slop Slap' slogan became institutionalised as the core message of the Cancer Council's SunSmart program for schools and local communities. The Cancer Council believed its 'Slip Slop Slap' campaign played a key role in the dramatic shift in sun protection attitudes and behaviour over the next two decades. People covered up more and made better use of shade.[511]

The key sun protection messages were then expanded to ensure a focus on individual and environmental strategies including SLIP on sun-protective clothing, SLOP on SPF30+ sunscreen, SLAP on a hat, SEEK shade and SLIDE on some sunglasses.[528]

Sid the Seagull puts his youthful good looks down to a healthy diet, plenty of exercise, and being SunSmart. "Avoiding overexposure from the sun doesn't just help prevent skin cancer, it helps you avoid premature ageing," he said.

Source: Illustration – Paul Sloss; based on a character by Alex Stitt. Reproduced courtesy of The Cancer Council Victoria.

For example, as well as the use of the mass media, the SunSmart program involved sponsorship of sporting associations; professional education; working with schools, early childhood services and workplaces; ongoing research; and program evaluation.[527]

Hundreds of schools were accredited as 'SunSmart schools' with comprehensive sun protection policies in place to protect students. SunSmart schools increased their shaded areas, scheduled outdoor activities when UV radiation risk was lowest, and ensured that students wore wide-brimmed hats ('no hat, no play' policies) and were taught about the need for sun protection.

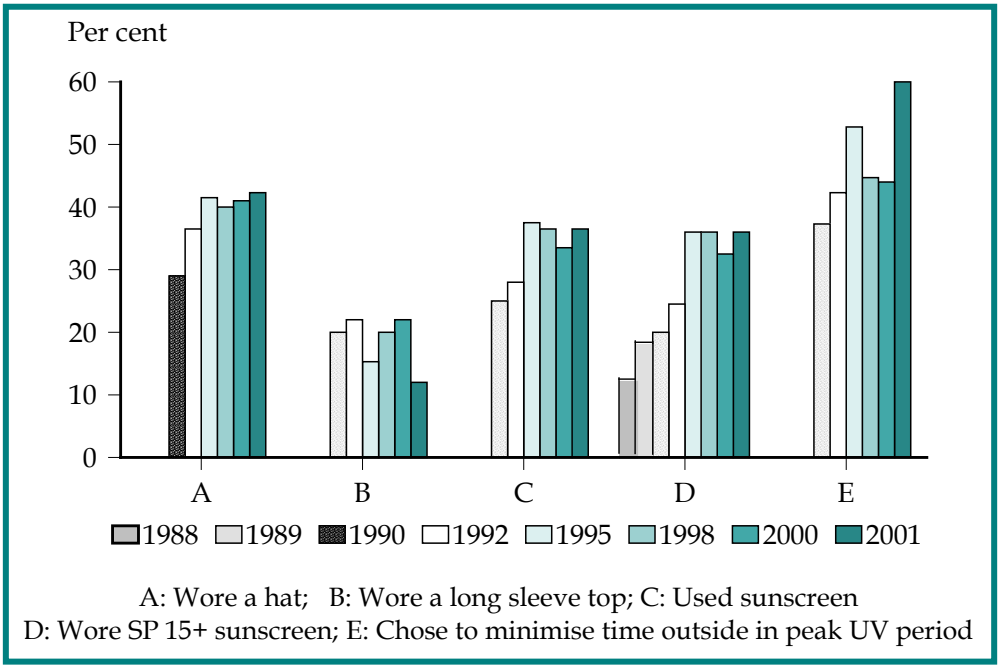
Policies were adapted to allow for some sun exposure each day, especially during winter in the southern States.[527] Samanek and colleagues set out beneficial sun exposure times for major population centres and for different times of the year in Australia, to inform such changes.[529]

Cancer registries, which began in 1972, monitored melanoma incidence, survival and death rates. A national population survey monitored the incidence of melanoma and NMSCs from 1985, paying close attention to age-specific trends in order to assess the effectiveness of sun safety strategies for particular age groups.[530]

> ***Survey respondent:*** *'Sun protection is one of the very few primary prevention interventions for any cancer for which there is RCT [randomised clinical trial] in full evidence (see Green et al., Lancet, 1999)'.*[530]
>
> *'The promotion of SunSmart knowledge and behaviours though research, community education, structural changes, advocacy, and mass media [is a public health success]'.*

Sun safety products, such as sunscreen skin creams and UV-protective shade materials and clothing, were developed and promoted. The SunSmart UV Alert, an initiative of the Cancer Council Australia, the Bureau of Meteorology and the Australian Radiation Protection and Nuclear Safety Agency, based on the WHO Global Solar UV Index, was launched in 2005 to highlight the harm of excess sun exposure.[531] Population surveys in Victoria demonstrated that behavioural changes had occurred from 1988 to 2001, with more people protecting themselves by wearing hats and protective clothing, using sunscreen, and avoiding sun exposure in peak UV radiation periods (Figure 6.13).[532]

Figure 6.13: Percentage of Melbourne residents taking certain sun protective measures between 11 am and 3 pm on the previous Sunday, 1988-2001



Source: SunSmart Victoria, *SunSmart Program* 2003-2006, 2002, p. 9.

Modelling the extension of the Victorian SunSmart Campaign across Australia confirmed the program's value for money.[533] Federal funding for a National Skin Cancer Awareness Campaign was allocated in 2005-2006, a move welcomed by the Cancer Council Victoria as 'an important contribution to reinforcing the behavioural changes that had taken decades to establish' in Victoria.[534]

Finally, public health research into the development and testing of vaccines against skin cancer offered possible protection for the population in the future.

Factors critical to success

These programs addressed a significant health problem, as Australia had the highest incidence of skin cancer in the world. Public education programs, focusing on reducing harmful sun exposures from childhood, had a measurable impact on the health of later generations. Cornerstones of success included:

- research quantifying the problem and its importance at a population level, and identifying effective prevention measures;
- successful behavioural change programs, run over decades, and applied with persistence and growing sophistication;
- community compliance in adopting sun protective behaviours, including early detection;
- collection of data for monitoring (incidence, deaths, treatment and survival rates); and
- adoption of successful state-based programs and other proven public health measures at a national level.

The public health aim of protecting the population from the risk of skin cancer remained ambitious in scope. Early introduction of community education and awareness campaigns over 25 years before – with the start of the 'Slip Slop Slap' campaign – undoubtedly contributed to the success of behavioural changes (Box 6.7). Campaigns that were initially led by non-government organisations such as the Cancer Council Australia and its affiliates, then by state and territory health departments, and later extended at a national level by the Australian government, demonstrated a successful 'bottom-up' approach that built on previous achievements (Box 6.8).

The multi-faceted approach included the development of protective products (e.g., sunscreens), programs for whole communities (e.g., the SunSmart Schools Program), and public information devices that improved over time. Public health research and monitoring, and program evaluation provided evidence of successful strategies, which could be scaled up and extended nationally to improve population coverage. Population surveys from 1985 monitored age-specific trends to assess the effectiveness of sun safety strategies. Lastly, in response to new information on the amount of sun skin exposure needed for sufficient Vitamin D production, public health messages were modified quickly to present new and complex messages to the community effectively.

Cost-effectiveness

A study of the potential cost-effectiveness of a national campaign to prevent skin cancers was modelled on extending the Victorian SunSmart Campaign across the whole of Australia. It concluded that such a program would be 'excellent value for money'.[533] Assuming a national twenty-year campaign with an investment of $5 million each year (i.e., 28 cents per person, and doubling the previous expenditure by state and territory governments and Anti-Cancer NGOs), it was estimated that the program would avert 4,300 premature deaths and cost $1,360 per life-year saved (or $14,360 per death deferred). The program would be likely to generate a net saving to government of $103 million.[533]

These results were robust for a range of cost and outcome variations, and funding for a National Skin Cancer Awareness Campaign was announced in the 2005-2006 federal budget.[534]

Future challenges

At the start of the 21st century, a number of major challenges remained.

These included:

- adjusting sun protection messages to incorporate information about sun exposure requirements for adequate vitamin D production;
- further promoting sun protection behaviours, including the proper application of sunscreen and protecting the neck and head;
- public education to improve knowledge about the risks of sun exposure – including the dangers of solarium sun tanning, which also warranted national action to prevent further deaths from melanoma from this cause;
- promoting early detection (e.g., self-screening by individuals) and appropriate treatment;
- public health research into better detection and treatment; and
- monitoring the adequacy of the population's levels of vitamin D – especially those at risk of vitamin D deficiency including elderly people, those who were institutionalised or house-bound, babies of mothers who were deficient in vitamin D, and those who covered their skin for religious or cultural reasons.[526,524,536]

Box 6.8 Role of NGOs in public health: The Cancer Council Australia

The Cancer Council Australia, established in 1961 by the pre-existing state Cancer Councils, is Australia's peak national non-government cancer control organisation. Its goal is to 'lead the development and promotion of national cancer control policy in Australia, in order to prevent cancer and reduce the illness, disability and death caused by cancer'.[535]

The Cancer Council Australia and members developed position statements on a range of issues to do with cancer, its detection and treatment, and national cancer prevention policy. They provided up-to-date, evidence-based, information about all aspects of cancer. Nearly 140,000 people contacted Cancer Councils for information and support in 2005, mainly through the Cancer Council Helpline.[535] In the same year, major national fundraising raised about $28 million to support cancer research and services, and $26.5 million was allocated in cancer research grants.[535]

A survey on public awareness about the Cancer Council (2005) showed that it was Australia's third most-recognised charity, and more than a quarter of adults surveyed said that they – or someone close to them – had 'used or benefited from the Cancer Council's services and activities'.[535]

6.1.4 Needle and syringe exchange programs

1990s onwards

Needle and syringe exchange programs (NSPs) were implemented to limit the spread of bloodborne viral infections among injecting drug users. These infective agents included the Human Immunodeficiency Virus (HIV), hepatitis B (HBV) and hepatitis C (HCV).

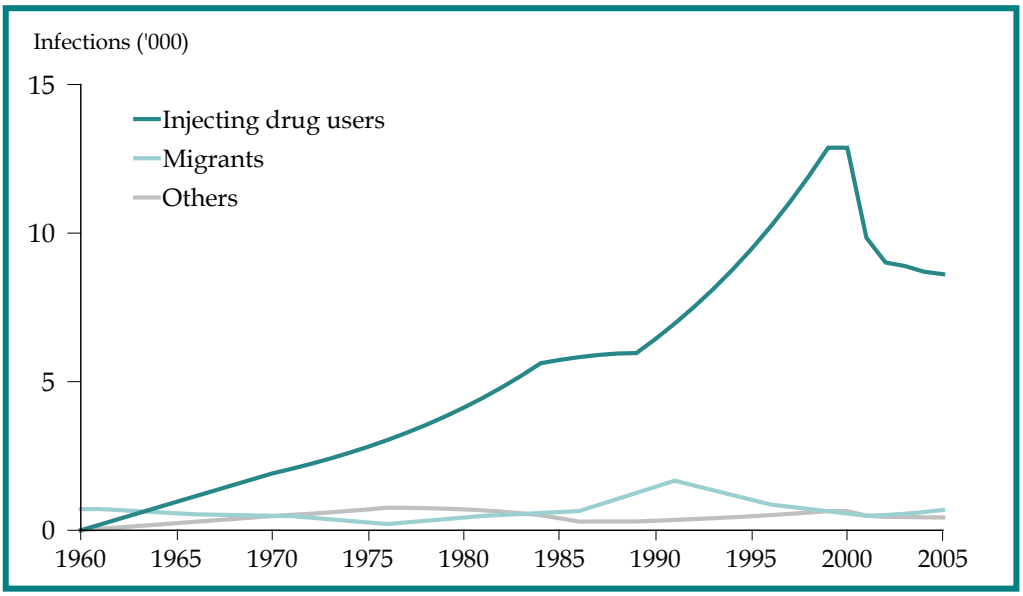
Human Immunodeficiency Virus, first identified in 1981, is a bloodborne virus that greatly impairs immunity to a range of other infections and causes the Acquired Immune Deficiency Syndrome (AIDS).[80] Hepatitis B virus is a virus that is transmitted by blood and blood products (including contaminated needles), sexual contact or from mother to child (vertically). A small percentage of individuals with acute hepatitis B infection develop a chronic infection and, ultimately, cirrhosis or liver cancer. Hepatitis C is a bloodborne virus, first identified in 1989, which causes inflammatory liver disease; and was one of the most frequently notified infectious diseases in Australia in the last decade of the 20th century.[537] Bloodborne viruses can be transmitted from person to person in a variety of ways that include:

- sharing equipment used to inject drugs – it was estimated that 80% of hepatitis C infections and 90% of new infections were due to unsafe injecting practices;

- non-sterile tattooing or body-piercing techniques, or medical or dental procedures (mainly procedures performed in countries other than Australia); and
- through infected blood or blood products – about five to ten per cent of people with hepatitis C acquired the virus in this way in the 1970s and 1980s. However, as all blood and blood products were screened for hepatitis C antibodies from 1990, the risk of transmission through blood transfusions was subsequently very low.[538-540]

Hepatitis B and C infections were common causes of liver disease-related death, but drug-related deaths were more frequent among injecting drug users.[540] Although most of those infected with HCV did not have a shortened life expectancy, the impact on their quality of life was detrimental. While a vaccine existed for HBV, there was no vaccine for HCV, making other preventive public health measures critical. An estimate of HCV incidence by the Hepatitis C Virus Projections Working Group [HCVPWG] showed an increasing rate of HCV infections in injecting drug users to a peak of 14,000 new HCV seroconversions in 1999, and a subsequent decline (Figure 6.14).[538]

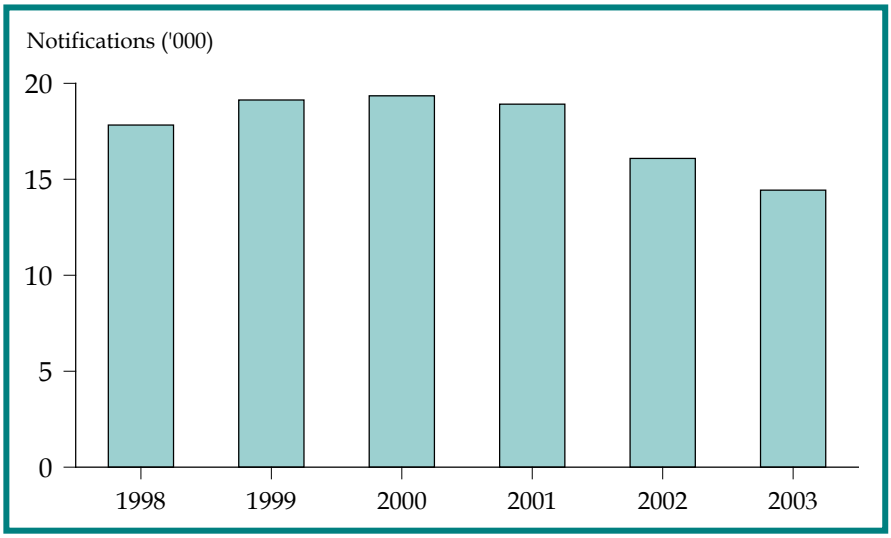
Figure 6.14: Trend in number of hepatitis C infections, by exposure category, 1960-2005



Source: HCVPWG, *Estimates and projections of the hepatitis C virus epidemic in Australia 2006*, 2006, p. 31.

Trends in the notification rate of new diagnoses of HCV infection showed a peak in 2000 of 107 cases per 100,000 population (Figure 6.15). The notification rate fell 63.4 per 100,000 population by 2005, representing a 40% decline from the year 2000.[541,80]

Figure 6.15: Trend in notifications of hepatitis C, 1998-2003

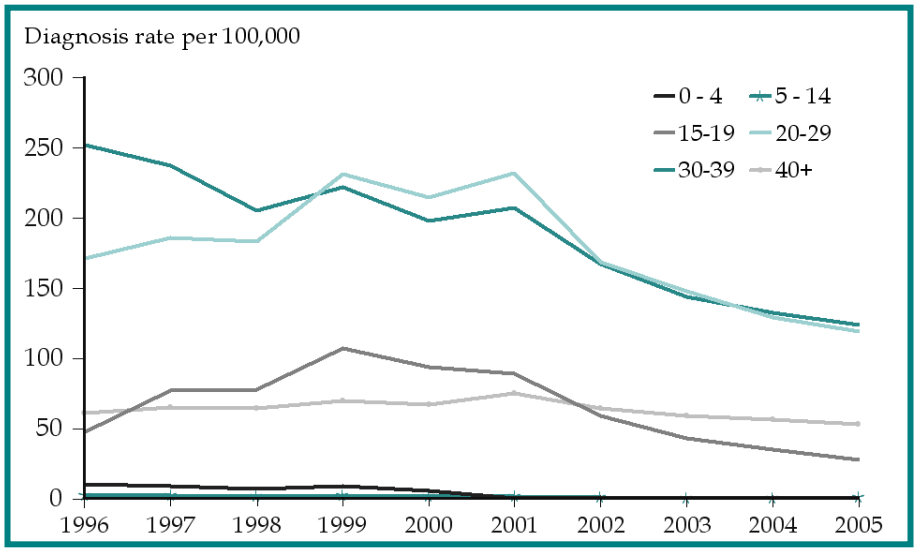


Source: DoHA, *National hepatitis C strategy 2005-2008*, 2005, p. 4.

HCV transmission occurred most often in people with a history of injecting drug use. In 2004, around 73% of people with new hepatitis C infections reported such a history.[541] The rate of diagnosis decreased in the 15-19 year age group (down by 68% between 2001 and 2005), suggesting a declining incidence among young people who used injecting drugs (Figure 6.16).[80,542]

Hepatitis C was a stigmatising condition and there was discrimination against people whose hepatitis C status became known, due to largely unfounded fears of easily acquiring the infection and the close association of hepatitis C with injecting drug use.[539] Such attitudes were a disincentive for those at risk of infection to being tested for hepatitis C and seeking treatment.

Figure 6.16: Trends in age-specific diagnoses of hepatitis C, 1996-2005



Source: NCHECR, *HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report, 2006*, 2006, p. 16.

Public health practices

Needle and syringe exchange programs (NSPs) were aimed at preventing the spread of HIV, hepatitis B and C, and other bloodborne diseases. Their operation required partnerships between public health agencies, the police, NGOs and people with or at risk of hepatitis C. There was a need to change policing policies and operating guidelines, and enact legislation to remove barriers to program implementation.[542] For example, the NSW *Drug Misuse and Trafficking Act 1985* was amended in 1988 to permit possession of needles and syringes, thereby promoting safe injecting practices by removing

legal prohibitions, and making injecting drug users less likely to share or re-use needles and syringes, and more likely to dispose of used equipment safely.[542]

In 1990, NSPs were instigated on a national basis and, a year later, were established in most states and territories, resulting in over 3,000 NSP outlets across Australia.[80,539] NSPs were supported by the harm minimisation framework that had informed the different phases of Australia's *National Drug Strategy* from its inception in 1985.[497]

The principle of harm minimisation promoted better health, social and economic outcomes for the community and individuals through a range of approaches, one of which was NSPs (Box 6.9). NSPs were described as 'the cornerstone of Australia's response to bloodborne viruses such as HIV/AIDS and hepatitis C amongst injecting drug users'.[497] Distribution of sterile injecting equipment helped to reduce the risk of transmission of bloodborne viruses.

Box 6.9 Harm minimisation and harm reduction

'Harm minimisation does not condone drug use; rather, it refers to policies and programs aimed at reducing drug-related harm. It aims to improve health, social and economic outcomes for both the community and the individual, and encompasses a wide range of approaches, including abstinence-oriented strategies'. Australia's strategy focused on licit and illicit drugs and aimed to prevent anticipated harm and reduce actual harm, through:

- supply reduction strategies to disrupt the production and supply of illicit drugs, and the control and regulation of licit substances;
- demand reduction strategies to prevent the uptake of harmful drug use, including abstinence orientated strategies and treatment to reduce drug use; and
- harm reduction strategies to reduce drug-related harm to individuals and communities.'

Source: Ministerial Council on Drug Strategy, *The National Drug Strategy: Australia's integrated framework 2004-2009,* 2004, p. 2.

NSPs also provided a contact point for a difficult-to-reach subpopulation to access a range of services which included:

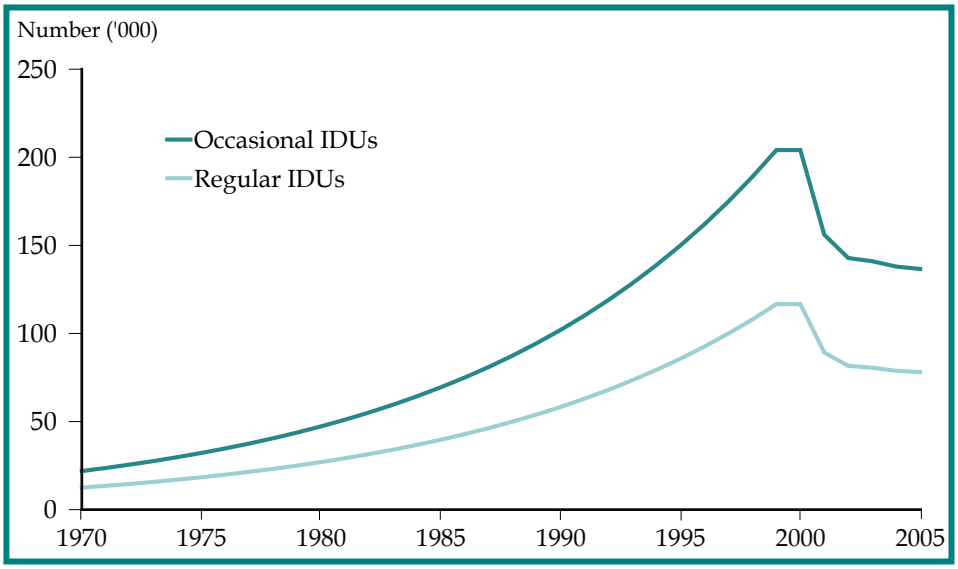
- education and information on the reduction of drug-related harm;
- referral to drug treatment;
- primary health care;
- referral to medical, legal and social services; and
- safe disposal of injecting equipment.[501]

The programs also addressed the possibility of infection by sexual contact by providing condoms and safe sex information. NSPs thus served a broad public health function by engaging the injecting drug-using population, offering health services, reducing the likelihood of incurring further harm to themselves and society, and protecting the wider community by safely collecting used injecting equipment.

In 1994, the *National Hepatitis C Action Plan* was released, and, from 1996, hepatitis C was included as part of the *National HIV/AIDS Strategy*.[537] Achievements of the first *National Hepatitis C Strategy* for the period 1999-2000 to 2003-2004 included developing a strong partnership approach, and identifying and researching advances in the treatment of chronic hepatitis C.[537,543] The *National Hepatitis C Strategy 2005-2008* built on the achievements of the first strategy and outlined a framework for a national approach.[537]

Best estimates of the numbers of injecting drug users (total of regular and occasional injecting drug users) in Australia over the period 1970 to 2005 are shown in Figure 6.17.[544]

Figure 6.17: Estimated number of injecting drug users (IDUs), 1970-2005



Source: HCVPWG, *Estimates and projections of the hepatitis C virus epidemic in Australia 2006*, 2006, p 24.

Surveys suggested sero-prevalence rates (the percentage of a population testing positive for infection via a blood test) of 50-60% for hepatitis C, 23-52% for hepatitis B, and 1-3% for HIV. The low prevalence of HIV was partly attributed to the early introduction of harm reduction programs such as needle and syringe exchange, and methadone maintenance programs. However, the higher virulence of hepatitis B and hepatitis C meant a degree of continued transmission, even among injecting drug users accessing these programs, and remained a challenge for public health practitioners and others working in this difficult area.[501]

Factors critical to success

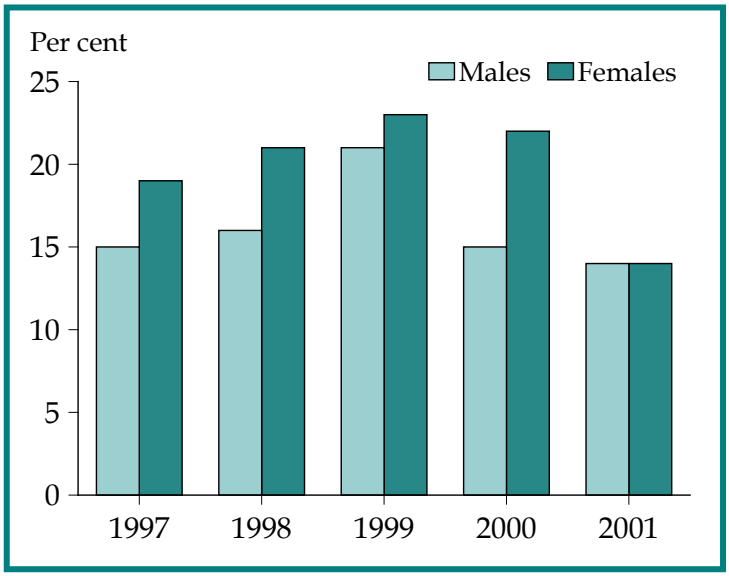
Initially, NSPs were surrounded by controversy, with claims that they 'condoned' and even 'encouraged' drug use, rather than minimised the harm arising from it; hence, determination and persistence was needed by the decision-makers who first advocated for, and later ensured, the wider implementation of NSPs.

The first NSP was started as a trial in NSW in 1986, and the concept was identified early as a cost-effective national strategy. NSPs were specifically identified in the *National HIV/AIDS Strategy* and first funded under the Public Health Outcome Funding Agreements (PHOFA) in 1999-2000, and thus, were costed as part of national public health expenditure reporting.[24] 'Unsafe sharing of needles' became one of the public health performance measures routinely reported as part of benchmarking health system performance from 2002.[24] The data in Figure 6.18 were collected in surveys carried out by the needle and syringe exchange programs in 2001 from 2,342 respondents.

Needle and syringe exchange programs (NSPs) were successful because of the advocacy and leadership of those who established them in Australia early in the HIV/AIDS epidemic.[545] Their efficacy was evident in the higher rates of HIV and HCV in countries that established programs later.[111]

Survey respondent: *'Prevention of HIV/AIDS amongst injecting drug users through needle syringe programs (NSPs) [was a public health success] – countries that implemented NSPs early in the epidemic kept their rate of HIV in injecting drug users below 2% (closer to 1% in Australia), yet countries which delayed this intervention, even just for a couple of years, had rates from 15-50%. This was a lot of cases of HIV prevented.'*

Figure 6.18: Injecting drug users reporting sharing a needle and syringe in the preceding month, 1997-2001



Source: NHPC, *National report on health sector performance indicators 2003*, 2004, p. 67.

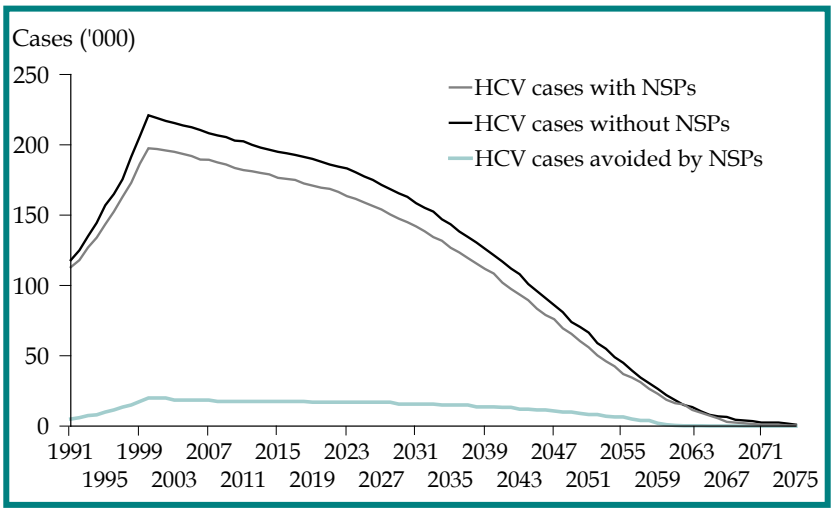
The successful adoption of effective harm reduction measures such as NSPs was a key element in reducing the transmission of bloodborne diseases among injecting drug users and the wider community, especially in the absence of effective vaccines against HCV and HIV.

Cost-effectiveness

A 2002 report confirmed the economic advantages of harm reduction strategies such as NSPs.[542] Between 1988 and 2000, as a result of NSPs, an estimated 25,000 HIV infections and 21,000 HCV infections were prevented among injecting drug users. The report estimated that, by 2010, 4,500 HIV-related deaths and 90 HCV-related deaths would have been prevented by the timely intervention of these programs. The prevention of infections and deaths represented a cost saving of up to $783 million in HCV treatment and $7,025 million in HIV treatment, for an investment of $150 million (in 2000 prices) in NSPs by Australian governments between 1991 and 2000. This was more than a fifty to one return on investment; and it was estimated that the original investment was not only fully recouped, but had been surpassed by the end of the investment period, without taking into account any future savings.

Without the introduction of NSPs from 1988, it was estimated that approximately 16,000 injecting drug users (out of an estimated 21,000) would have developed chronic hepatitis C (Figure 6.19).[542]

Figure 6.19: Projected numbers of Hepatitis C cases with, without and avoided by needle and syringe exchange programs



Source: Health Outcomes International et al., *Return on investment in needle and syringe programs in Australia,* 2002, p. 34.

A review of harm reduction strategies in 2006 concluded that there was 'solid efficacy, effectiveness and economic data' to support NSPs specifically and their widespread adoption as an overall policy approach to illicit drugs.[502]

Future challenges

> *'Maintenance and expansion of needle and syringe exchange programs will remain the single most important component of Australia's harm-minimisation efforts. Adherence to the principles of harm minimisation is the only way to control [the HCV] epidemic until a vaccine becomes available – and this is unlikely to occur within a decade.' – KJR Watson, 2000.*[546]

> ***Survey respondent:*** *'our relative lack of success in preventing hepatitis C also needs to be reflected upon.'*

A survey of HIV-testing and hepatitis-testing and vaccination services in drug and alcohol agencies indicated that more than two decades after the NHMRC called for all injecting drug users to be vaccinated against hepatitis B (HBV), there was still a gap between Australian guidelines and current practice.[547] Winstock and colleagues noted that this situation might become less important as universal vaccination for infants for HBV had been introduced in 2000; however, many injecting drug users remained at risk. A sizeable proportion of drug and alcohol agencies did not provide cost-effective, evidence-based interventions against bloodborne viruses – a situation that was inconsistent with Australian policy and the 'expectation of reasonable public health care and harm reduction'. They observed that increased takeup of identified best practice and other opportunities to improve the health and reduce harm in this population represented a worthwhile future investment.[547]

The *National Hepatitis C Strategy* identified the following priorities:

- improving the capacity of NSPs to ensure that groups that previously had had poor access to the information and means of preventing HCV infection (e.g., Aboriginal and Torres Strait Islander people who engaged in risk behaviours, people in custodial settings such as prisons, and people from culturally and linguistically diverse backgrounds) were educated about HCV and measures to avoid it;
- improving access to treatment and increasing its uptake among people with HCV, as, although it had become possible to cure 50% or more of those who underwent treatment, only around 1% of people diagnosed with HCV were being treated annually; and

- improving surveillance to understand better the prevalence of HCV, and the extent of the behaviours and situations which put people at risk of contracting HCV.[537]

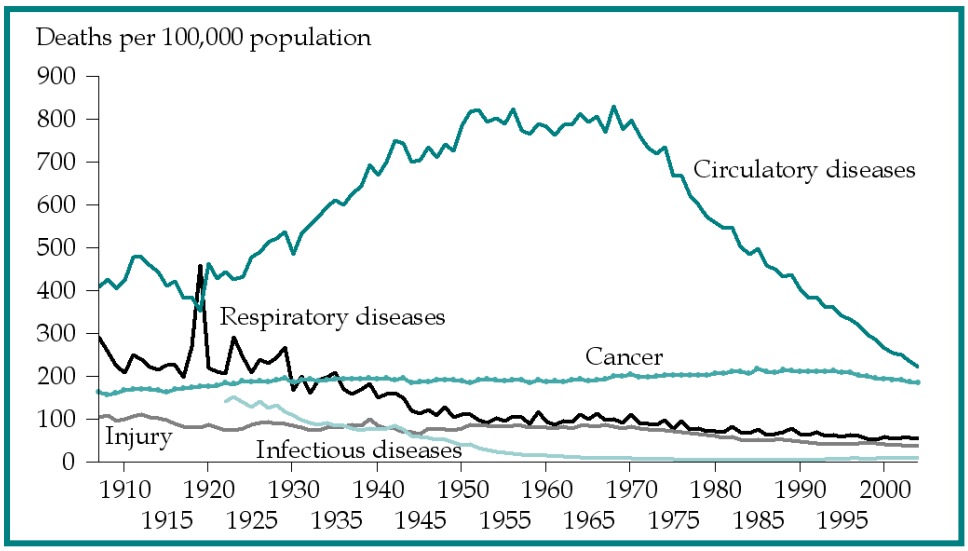
6.2 Reducing non-communicable chronic diseases

1901 onwards

'In the first years of the twentieth century, cardiovascular disease was already recognised as a significant contributor to the mortality of Australians. It was the fourth most common cause of death in Australia after pneumonia, tuberculosis, and diarrhoeal disease, and it was much more common than cancer'. – AIHW, 2000.[3]

During the early 20th century, as in other developed nations, Australia experienced a 'health transition' from infectious diseases to chronic, non-communicable diseases, with circulatory system diseases and cancer replacing infectious and respiratory system diseases (such as influenza and tuberculosis) as the main causes of death (Figure 6.20).[456]

Figure 6.20: Death rates by major causes, age standardised, 1907-2004

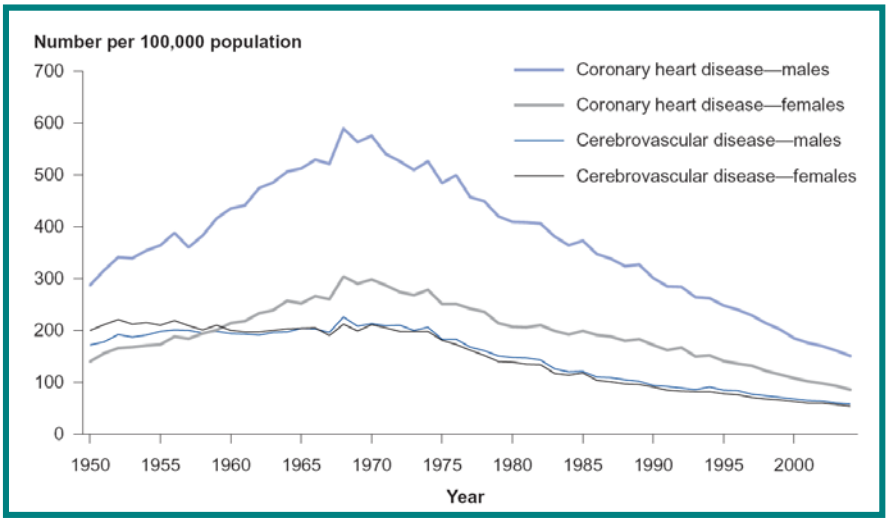


Source: Portfolio Statistics & Standards Section, Economic & Statistical Analysis Branch, Portfolio Strategies Division, DoHA; data: AIHW GRIM workbooks.

Circulatory system diseases are diseases of the heart and blood vessels in the body. They include coronary heart disease, other forms of heart disease, stroke, and peripheral vascular disease. Most of these diseases share a number of preventable risk factors including tobacco smoking, high blood pressure, high blood cholesterol, overweight and obesity, physical inactivity, chronic high alcohol use, and diabetes.

Early in the 20th century, there was a rapid rise in circulatory system diseases, with increases tending to follow economic prosperity and urbanisation.[548] The rise in death rates was from the two major types of circulatory system diseases – coronary or ischaemic heart disease, and cerebrovascular disease (including stroke). In Australia, deaths from ischaemic heart disease rose sharply through the century for both males and females, and peaked around 1970, after which rates fell rapidly.[3] By 2004, rates were well below the levels seen in 1950 (Figure 6.21).

Figure 6.21: Death rates from the main circulatory system diseases, 1950-2004



Source: AIHW, *Australia's health 2006*, 2006, p. 64.

Circulatory system diseases resulted in 47,637 deaths (36% of all deaths in Australia) in 2004. They were also a leading cause of disability, with an estimated 1.4 million Australians (6.9% of the population) having some form of associated disability. Around 18% of people surveyed in the 2004-2005 National Health Survey reported that they were affected by one or more long-term diseases of the circulatory system (equivalent to 3.5 million Australians).[356]

After adjusting for age differences between the two populations, Aboriginal and Torres Strait Islander peoples were 1.3 times more likely than non-Indigenous people to report heart disease and/or circulatory system problems.[466] The prevalence of hypertension (high blood pressure) was similar to that of non-Indigenous Australians who were ten years older, and Indigenous Australians had far higher hospitalisation rates for circulatory system diseases across all age groups (two to three times higher for those aged 45-64 years.[154]

Aboriginal and Torres Strait Islander peoples also experienced much higher death rates from circulatory system diseases across all ages, with the largest differences in the younger age groups, 25-34 and 35-44 years.[466] In these age groups, Indigenous males recorded a rate nine to ten times that of non-Indigenous males, while Indigenous females recorded a rate 12 to 13 times those of non-Indigenous females (based on age-specific death rates).[466]

Ischaemic heart disease and cerebrovascular disease (especially stroke) remained the two leading causes of deaths for both sexes in 2004.[13] Together, these two causes of death accounted for more than a quarter of all deaths, especially among older age groups.

In the following sub-sections, public health contributions to reducing some forms of circulatory system disease are described:

- the reduction in fatal heart attacks after their peak in the 1970s (Sub-section 6.2.1); and
- stroke prevention and reductions in high blood pressure (Sub-section 6.2.2).

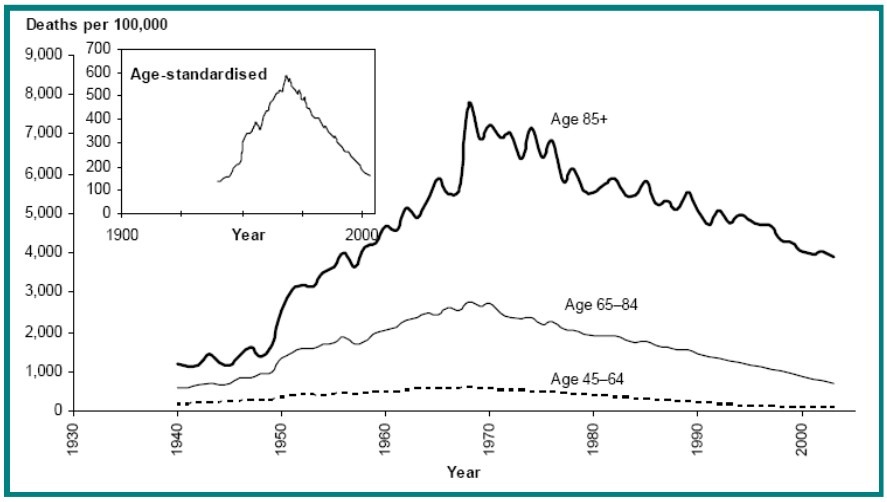
6.2.1 Reduction in fatal heart attacks

1940s onwards

Coronary heart disease is also referred to as 'ischaemic heart disease', and deaths from this cause are sometimes called 'fatal heart attacks'. Heart attacks are life-threatening emergencies that occur when one or more of the heart's blood supply vessels (the coronary arteries) suddenly become blocked. In 2006, it was reported that four out of ten people who suffered a heart attack died within 12 months of the attack; and more than half of these people died before they reached hospital.[13]

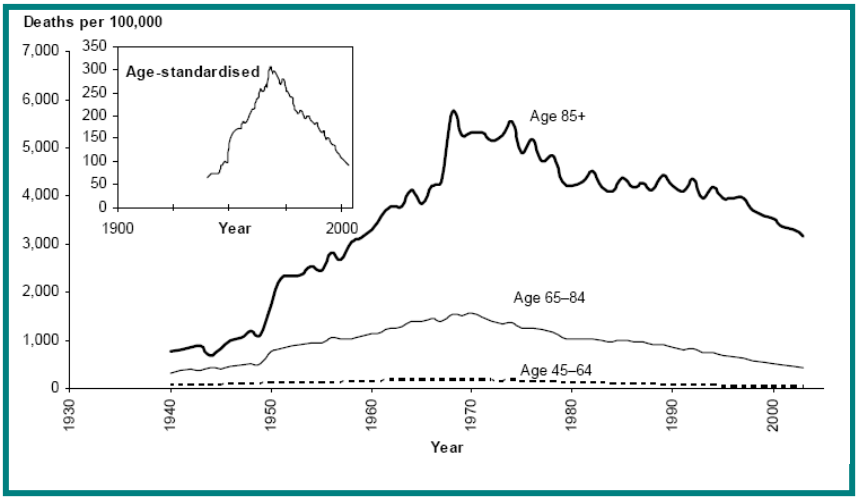
Rapid and large increases in population death rates from ischaemic heart disease occurred in most Western countries during the 20th century, with rises following increasing prosperity, urbanisation, and modernisation, which were associated with changes in diet (greater fat and salt intake), reductions in physical activity, and more sedentary lifestyles.[3,548] Deaths from this cause rose sharply through the 20th century for both males and females, to a peak around 1970, after which rates fell rapidly – by more than 60% in the following thirty years (Figure 6.22 and Figure 6.23). In the last half of the century, ischaemic heart disease remained Australia's major cause of death, especially among older age groups.

Figure 6.22: Age-specific and age-standardised death rates for ischaemic heart disease, males, 1940-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 67.

Figure 6.23: Age-specific and age-standardised death rates for ischaemic heart disease, females, 1940-2003



Source: AIHW, *Mortality over the twentieth century in Australia*, 2006, p. 67.

In 1950, death rates were 287 per 100,000 population for males and 140 per 100,000 population for females.[3] They rose to 575 and 298 per 100,000 population for males and females, respectively, in 1970. Thereafter, they fell to 185 deaths per 100,000 population for males and to 108 per 100,000 population for females in 2000.[3] Rates were then well below those of 1950, and there was a consequent improvement in life expectancy, especially at older ages.

Ischaemic heart disease death rates fell for both males and females, and at all adult ages (seen in the age-standardised rates in the box in Figure 6.22 for males and Figure 6.23 for females) as well as in the age-specific trends for males and females aged from 45 to 64 years, 65 to 84 years, and 85 years and over. Falling death rates had the greatest impact on older age groups.

Major improvements in coronary heart disease (CHD) within the last decade of the century (from 1993-1994 to 1999-2000) included:

- falling onset of major coronary events – with a 20% decline in incidence rates;
- better overall survival from major coronary events – a 12-16% decline in case-fatality rates;
- fewer hospital admissions for heart attack (a major component of CHD) – a 12% decline in acute myocardial infarction (AMI) admission rates;
- better within-hospital survival for AMI – a 17-19% decline in within-hospital case-fatality rates for AMI; and
- lower risk factor levels – with large declines in tobacco smoking and blood pressure levels from 1980.

Public health practices

From the 1960s, there was an increasing awareness from research of the part played by risk factors – such as high blood pressure and blood cholesterol, smoking and diet, particularly saturated fat and salt intake – in the large, relatively rapid increase in the incidence of cardiovascular disease.[549]

> *'The evolution of the epidemic of cardiovascular disease was paralleled by a rapid increase in the understanding of how the heart functions and of the contribution of risk factors to heart disease. It was also a time of significant development in methods to diagnose and treat heart and other circulatory problems. The application of this knowledge ultimately resulted in a decline in cardiovascular death rates.' – AIHW, 2000.*[3]

Box 6.10 Role of NGOs in public health: The Heart Foundation, 1959-

There were many non-government agencies that played a role in prevention and health promotion, such as the Heart Foundation, which was established in 1959.[552] The Foundation's purpose was to improve the 'heart health' and reduce disability and death from heart, stroke and blood vessel disease by:

- promoting and conducting research to gain and apply knowledge about heart, stroke and blood vessel disease, its prevention and treatment; and
- promoting and influencing behaviour which improved heart and blood vessel health by conducting education and other programs directed at health professionals, those with heart disease, and the Australian community at large.

The Foundation operated a range of programs and activities, e.g., the 'heart health tick' program, and Lipid Management Guidelines, among others.

The Heart Foundation's 'heart health message' was:

- enjoy healthy eating;
- be active ;
- be smoke-free; and
- have your cardiovascular disease risk status checked regularly by your doctor.[552]

Clay and colleagues (2006) valued the benefit of the $170 million plus contribution made by the Foundation over the previous 40 years to Australian cardiovascular research funding at more than $1.36 billion in greater longevity and wellness in the population.[553]

Large overall declines in cardiovascular death rates suggested that broad population effects with a relatively short time-lag were responsible, rather than individual behavioural changes. Australian research indicated that, for the period 1969-1978, there was a decline in rates of ischaemic heart disease events as well as death rates, consistent with both reductions in risk-factor levels as well as improved acute medical treatment.[550] Later analyses, based on data after 1980, confirmed that the large decrease in the burden of ischaemic heart disease (and stroke) reflected successful primary prevention measures to reduce population risk factors (resulting in reductions in levels of tobacco smoking, dietary changes, and better controlled high blood pressure and high blood cholesterol) together with improvements in acute treatment.[357]

Although there were many contributory factors, changing population food habits played a part.[311] The earliest declines in Australia probably arose from a change in the balance and types of fats in the national diet.[3] Dietary fats associated with increased risk of coronary heart disease included trans-fats and saturated fats, while polyunsaturated fats were protective.[551] Apparent consumption of fats showed two trends in Australia in the 1960s and 70s, with consumption of butter decreasing and that of margarine and plant oils increasing (i.e., a change from saturated to unsaturated fats).[551,310] These changes predated the decline in the death rate by around seven years (see Section 4.3).[310]

The National Heart Foundation (NHF) was established in 1959, and became a lead agency in the fight against heart disease (Box 6.10). It introduced the concept of one-week public awareness campaigns when it commenced Heart Week in 1968, and promoted healthy eating through cookbooks, education programs and community forums from 1974 onwards.[553]

In the 1970s, public discussion of the role of diet increased in response to the evident rises in heart disease, stroke, hypertension and diabetes.[303] *Dietary guidelines for Australians* were first published in 1982 and were widely endorsed and used for nutrition education by NGOs with interests in health, like the NHF.[35] Consequent dietary changes such as that from butter to margarine and oils, the use of less salt in cooking and food preparation, and increases in the consumption of fresh fruits and vegetables had a positive impact on risk factors for cardiovascular disease (see Section 4.3).

In 1989, the NHF launched the 'Pick the Tick' food approval program to help consumers make 'healthier food choices, easier choices'.[552] Within five years, the program had gained the support of more than 120 companies and the NHF tick appeared on more than 600 products. Australian governments ran various media campaigns (e.g., QUIT smoking campaigns), communicating directly with the general public and indirectly via GPs.

At the start of the 21st century, there was an increased community understanding of the role of protective factors, such as polyunsaturated fat and reduced salt in the diet, in preventing heart disease. Food labelling that identified less salty foods, and reduced-fat varieties of food types (e.g., low fat dairy products) enabled consumers to choose 'heart-healthy' foods. National strategies encouraged healthy eating, physical activity and non-smoking behaviours (see Section 4.3 and sub-section 6.1.1). However, there was differential uptake of healthier options across society, and it proved difficult to promote healthy eating in the context of lifestyles and environments that frequently encouraged the opposite.

Box 6.11 ***National Service Improvement frameworks:*** **Guiding principles**

'In identifying the health service needs of the Australian community, the *National Service Improvement frameworks*:

- adopt a population health approach;
- prioritise health promotion and illness prevention;
- achieve person-centred care and optimise self-management;
- provide the most effective care;
- facilitate coordinated and integrated multidisciplinary care across services, settings and sectors;
- achieve significant and sustainable change;
- ensure that progress is monitored;
- locate people, families and communities affected by chronic disease at the centre of care;
- span both the continuum of care and the life course for the condition and embrace, where necessary, prevention, diagnosis, rehabilitation, living with the condition, and palliation;
- span different clinical and community settings;
- acknowledge that many chronic diseases share risk factors (e.g., nutrition, obesity, physical activity);
- support and encourage the application of evidence-based practice;
- focus on the need for disadvantaged, special population groups and Aboriginal and Torres Strait Islander people in particular to have access to appropriate health services – including people with mental disorders; the frail elderly; people with disabilities; people who are socioeconomically disadvantaged; people in regional, rural and remote communities; and people from culturally and linguistically diverse communities;
- acknowledge carers and families affected by chronic disease as being part of the broader experience of these conditions.'

Source: National Health Priority Action Council (NHPAC), *National service improvement framework for heart, stroke and vascular disease*, 2006, p. 13 [adapted].

Reductions in overall cardiovascular death rates were related to successful prevention strategies, particularly those leading to changes in diet and reduced smoking rates, in addition to clinical advances in better control of risk factors and management of cardiovascular conditions.[554] Clinical treatments were supported by public health research and the monitoring of incidence and death rates from these causes nationally.

The *National strategy for heart, stroke and vascular health in Australia,* endorsed by Australian Health Ministers in 2004, provided a plan for further improving cardiovascular health and reducing the prevalence of heart, stroke and vascular disease.[555]

In 2005, Australian Health Ministers endorsed the *National chronic disease strategy* and the *National service improvement framework for heart, stroke and vascular disease* (Box 6.11). The latter was a high-level guide to the most effective care for heart, stroke and vascular health in terms of:

- reducing risk;
- finding disease early;
- managing acute conditions;
- addressing long-term care; and
- care in the advanced stages of disease.[556]

Growing awareness of risk factors generally enabled those who were educated and more affluent to make healthier choices. There was evidence that groups of people who were less educated and with lower incomes were not able to make these choices as easily, often as a direct result of their poorer socioeconomic status and the environments in which they lived. Lower levels of risk factors were reported by higher-status occupation groups, indicating that the healthier behaviours associated with markedly lower levels of ischaemic heart disease were also more easily achieved by those groups.[550]

Factors critical to success

At the start of the 21st century, cardiovascular disease remained a national health priority. In 2006, a study determined that avoidable deaths from ischaemic heart disease in Australia and New Zealand were 'about equally split' between those deaths currently avoidable through incidence reduction and those avoidable through (improved) treatment of established disease.[557] This confirmed that the public health strategies that reduced the important cardiovascular risk factors had a measurable impact on the health of the population, in addition to improved case finding and clinical treatment.

The rapid rise in coronary heart disease up to 1970 was a significant public health problem that affected adult males and females of all ages. With a population-wide focus, strategies to reduce cardiovascular disease were ambitious in scope. They operated across Australia at all levels of government, and through partnerships with many NGOs. Public health researchers also had a successful role in examining and monitoring the efficacy and cost-effectiveness of overall preventive strategies.[557]

Cost-effectiveness

In 2003, the net benefit of public education programs to reduce coronary heart diseases was assessed at $8.5 billion for an investment of $810 million over the period 1970-2010.[87] Ten per cent of the reduction in smoking and 30% of the reduction in high blood cholesterol was attributed to public health activity. Benefits attributable to public health programs were $994 million (in 1996), composed of longevity gains ($828m), improved health status gains ($100m), and lower health care costs ($66m). The return on investment of public health programs alone was, therefore, better than one to one, and when total returns were taken into account, better than ten to one.

The Productivity Commission noted, in relation to changes in expenditure for various diseases, that direct expenditure growth of 26% for cardiovascular disease was well below the average of 37% for all diseases.[558] They attributed the reduced expenditure to the declining incidence in disease attributable to smoking and other behavioural factors, as well as improved preventive medical technologies.

Future challenges

> *'Although a significant proportion of cardiovascular disease is preventable, the prevalence of risk factors, such as tobacco smoking, high blood pressure, physical inactivity and poor nutrition that are amenable to change still remains high in the Australian population. It has been estimated that 80%*

of all adult Australians have one modifiable cardiovascular risk factor and 10% have three or more such factors' – Tonkin et al., 1999.[559]

At the end of the 20th century, four in ten Australian adults had two or more major modifiable risk factors for coronary heart disease, and, in 1999-2000, there were 48,313 major coronary events, or 132 such events per day. Fifty per cent of these coronary events were fatal; and one in eight patients who suffered a heart attack died in hospital. Future challenges included:

- greater effort on the part of the population to modify risk factors for cardiovascular diseases;
- minimising socioeconomic disadvantage especially in population groups where rates had not fallen as substantially, such as those on low incomes and Aboriginal and Torres Strait Islander peoples; and
- wider use of proven secondary prevention measures, such as cardiac rehabilitation programs.[560-562]

Death rates from cardiovascular disease for Aboriginal and Torres Strait Islander peoples were around twice those of the non-Indigenous population. In some instances, rates were far higher: for example, Aboriginal and Torres Strait Islander people in the NT had the highest recorded occurrence of rheumatic heart disease in the world, reflecting high levels of exposure to Group A streptococci, which, in turn, were related to overcrowding and continued poor living conditions.[563] These potentially avoidable differences needed to be addressed urgently.

6.2.2 Stroke prevention and high blood pressure reduction

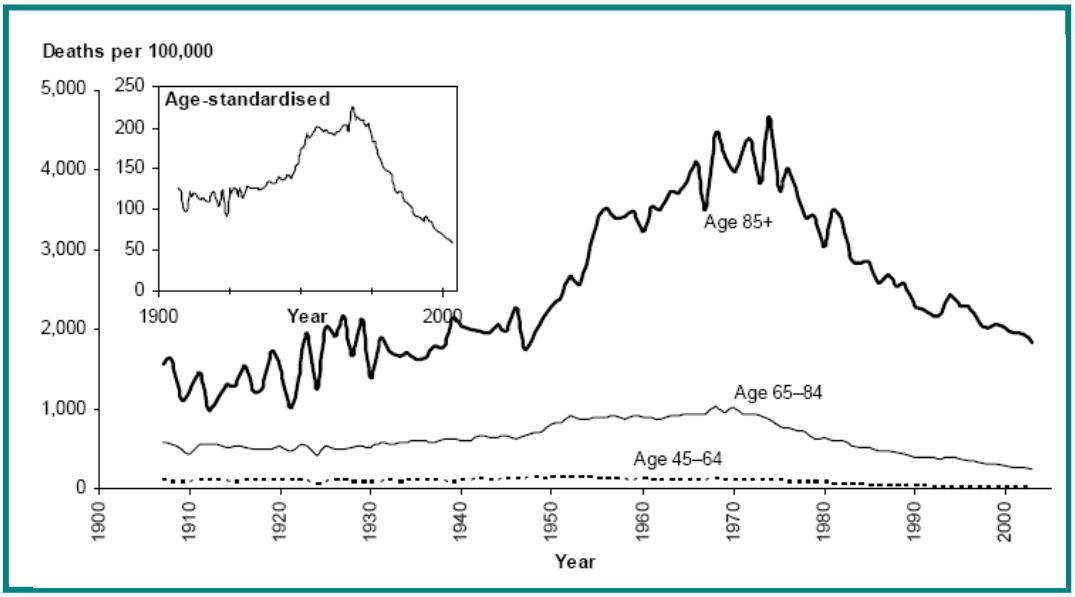
1907 onwards

Cerebrovascular disease refers to any disorder of the blood vessels supplying the brain or its covering membranes. Stroke is its commonest manifestation, and occurs when an artery supplying blood to the brain becomes blocked or bleeds, resulting in weakness or paralysis of various areas of the body. High blood pressure, or hypertension, is a major risk factor for cerebrovascular disease.

In addition to age, sex, congenital abnormalities and genetic inheritance, risk factors for cerebrovascular disease included smoking, high blood pressure, high cholesterol, physical inactivity, excess weight (overweight or obesity), poor diet, and excessive alcohol consumption.[564,565] Diet (particularly high salt intake), obesity, excessive alcohol consumption and insufficient physical activity also contributed to high blood pressure.[25]

During the 20th century in Australia, cerebrovascular disease was one of the ten leading causes of death in adults, both males and females (Figure 6.24 and Figure 6.25). After increasing from the 1930s, there was a reduction of more than two-thirds in the rate of deaths in males and females from this cause from 1968 to 2000 (in the box in Figures 6.24 and 6.25).[3,25] This decline in the death rate from stroke and other cerebrovascular disease was largely attributable to population-wide improvements in a number of risk factors (especially reductions in smoking), the development and application of drugs to lower blood pressure and treat and prevent blood clots, and advances in clinical treatment.[3] Yet, despite this improvement, stroke remained Australia's second highest cause of death (after ischaemic heart disease) and one of the significant causes of ongoing disability in adults.[566]

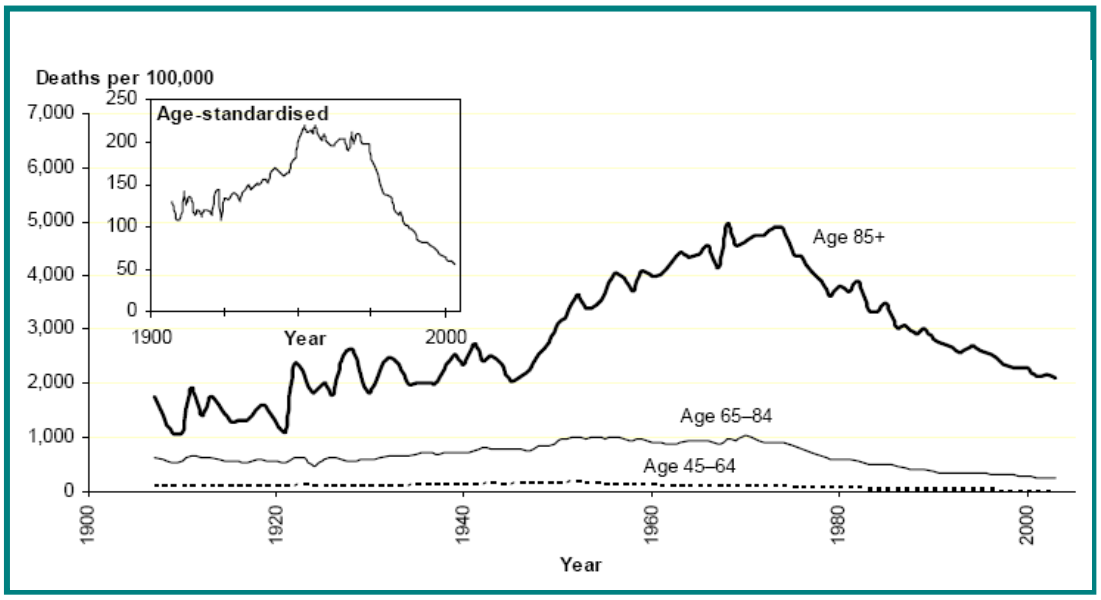
Figure 6.24: Age-specific and age-standardised death rates for cerebrovascular disease, males, 1907-2003



Source: AIHW, *Mortality over the twentieth century in Australia,* 2006, p. 65.

From early in the century until the late 1960s, death rates from cerebrovascular disease in people aged 45 years and over increased from just fewer than 130 deaths per 100,000 population in 1907, to more than 220 per 100,000 population, mainly due to a rise in death rates for those aged 85 years and over. From then on, death rates fell dramatically, and, by 2000, they were half the early-century levels.

Figure 6.25: Age-specific and age-standardised death rates for cerebrovascular disease, females, 1907-2003



Source: AIHW, *Mortality over the twentieth century in Australia,* 2006, p. 65.

By 2003, death rates were 60 per 100,000 males and 57 per 100,000 females aged 45 years and over.[25] Death rates fell for both males and females, and for all groups aged 45 years and over. Still, an estimated 40,000 to 48,000 stroke events occurred in Australia annually. Most of these (around 70%) were 'first-ever' strokes.[13]

An AIHW analysis of the 2003 ABS *Survey of Disability, Ageing and Carers* estimated that around 346,700 Australians had suffered a stroke at some time in their lives, with four out of five of those who reported having had a stroke being 60 years of age or older.[13] More women than men had had a stroke, but when the data were age-standardised, the rate was higher in men, who tended to be younger at the time of their first stroke.[13]

Stroke caused much disability. In 2003, an estimated 282,600 people with a history of stroke also reported a disability, with about half attributed to stroke.[13] Stroke survivors with a disability were more likely to have a 'profound core activity limitation' than the average person with a disability: this meant that they needed assistance with activities of daily living such as communication, mobility and self-care.

Public health practices

At the start of the 20th century, it was not possible to treat high blood pressure, although it could be measured. Over the century, there were many developments in the understanding of the mechanisms of elevated blood pressure and cerebrovascular disease, as well as in clinical treatments. Towards the end of the century, there were substantial increases in the use of blood pressure-lowering, and blood clot-preventing prescription drugs which were subsidised and therefore universally available to those who needed them, through the Pharmaceutical Benefits Scheme.

Essential approaches to improving cerebrovascular health included public health programs to reduce risk factors for stroke such as smoking (e.g., QUIT programs), high salt intake, and untreated high blood pressure; and education campaigns to improve community understanding about preventable risk factors for stroke.

Research by the National Stroke Foundation (NSF) into community understanding of stroke and its risk factors showed that awareness generally improved over the three years to 2006, although less so in men (Box 6.12).[566]

The *National strategy for heart, stroke and vascular health in Australia* (2004) provided a plan for further reducing the prevalence of heart, stroke and vascular disease, and improving the cerebrovascular health of Australians (see sub-section 6.2.1).[555]

Factors critical to success

Public health strategies to address and reduce the impact of cerebrovascular disease were successful largely through their impact on reducing the preventable risk factors, smoking and high blood pressure. Tobacco control and smoking cessation measures, and education about behavioural change, diet and the dangers of high blood pressure had a measurable impact on the cerebrovascular health of the population. Although the disease remained a significant health problem for males and females, especially those aged 65 years and over – and more needed to be done to reduce obesity and improve fitness – there was a much better understanding of the disease, and a range of effective options available to help reduce its impact, by the end of the century.

Box 6.12 Role of NGOs in stroke prevention: the National Stroke Foundation

The National Stroke Foundation (NSF) was established in 1983 as a not-for-profit organisation committed to reducing the impact of stroke on Australians. The NSF aimed to save 110,000 lives from death and disability following stroke. To achieve this, the organisation had four key priorities:

1. Raising awareness and preventing stroke;
2. Improving treatment for people with stroke;
3. Improving life after stroke; and
4. Research.

strokesafe™ was a public health program developed by the NSF and launched in 2004, which aimed to teach Australians how to make themselves safe from stroke.[568]

Public health strategies were ambitious in scope, and functioned Australia-wide via a range of partnerships between government and non-government agencies (such as the National Stroke Foundation and local community groups). Public health practitioners played an active role in ensuring that effective approaches were available to the whole population, including advocating for affordable pharmaceutical treatments, effective behavioural change, and researching cost-effective population-wide approaches to further reduce risk factors and cerebrovascular disease.

Cost-effectiveness

In 2003, Abelson and colleagues estimated that public health programs to reduce tobacco smoking had, by 1998, averted an unstated proportion of the 2,900 premature deaths attributed to stroke and cancers other than lung cancer, in people aged between 35 to 74 years.[87]

Other public health programs that addressed factors such as improved diet (especially less salt in the diet) and more exercise were also thought to have contributed cost-effectively to the reductions in deaths and disability from stroke over the last third of the 20th century.[568]

Future challenges

As the second leading cause of death and a major cause of continuing disability, stroke remained a significant public health problem. It affected different groups in the population. An analysis of ABS *National Health Surveys* for the decade 1989 to 2001 showed that people aged 25-64 years living in socioeconomically disadvantaged areas were more likely to report raised blood pressure, smoking, overweight and obesity, alcohol consumption at harmful levels (males), and fair or poor health than their more affluent counterparts.[569] Socioeconomic differences in preventable risk factors for cerebrovascular disease needed to be better addressed.

There were significant opportunities for further risk factor reductions through stroke awareness and education campaigns, and through additional public health investment (Box 6.13). Population ageing and increased life expectancy were likely to be future challenges, as age was an unavoidable risk factor.

More progress was required in:

- reducing socioeconomic and other amenable differences in preventable risk factors for cerebrovascular disease;
- appropriately organised population screening (e.g., case finding by GPs) combined with targeting of high risk population groups;
- increasing population awareness of stroke; and
- public health research into stroke prevention strategies for ageing populations.

Box 6.13 Strokes can be prevented

'The signs of stroke could be any one, or combination of, the following:

- Weakness or numbness or paralysis in the face, arm or leg on either or both sides of the body;
- Difficulty speaking or understanding;
- Dizziness, loss of balance or unexplained fall;
- Loss of vision, sudden blurred or decreased vision in one or both eyes;
- Headache – usually severe and of abrupt onset or unexplained change in the pattern of headaches;
- Difficulty swallowing.

These signs (called a Transient Ischaemic Attack – TIA) may last only a few minutes or several hours. They are often a warning of an impending stroke and must never be ignored.

FAST is an easy way to remember the key signs of stroke: **F**ace weakness, **A**rm weakness, **S**peech difficulties, **T**ime to act fast. If you experience the signs of stroke or recognise them in someone else, call 000 immediately. Prompt action can prevent further damage to the brain and assist recovery.

Strokes can be prevented. Eating healthily, participating in exercise, not smoking and ensuring a normal blood pressure level can all help to reduce the risk of stroke.'

Source: National Stroke Foundation (NSF), 'Stroke fact sheet', NSF, Melbourne, 2007.

6.3 Organised screening for certain cancers

1960 onwards

'Because of the success of the national cervical cancer screening program in detecting and following up pre-cancerous abnormalities, Australia's cervical cancer incidence and mortality rates have been declining steadily for many years. They are both well below the averages for the more developed countries of the world, and also below those of the UK, Canada, the US and New Zealand.'

– AIHW & AACR, 2004.[464]

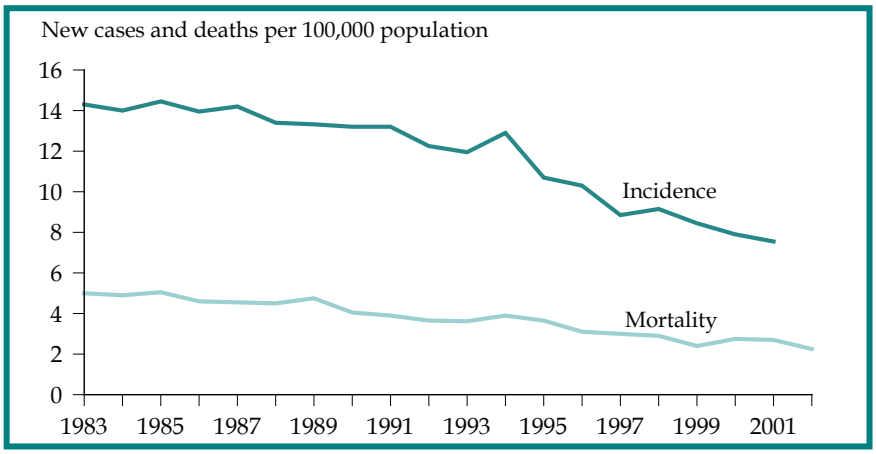
Organised screening for cancers in Australia began with cervical cancer and breast cancer screening programs in 1991. A program for bowel cancer screening started in 2006 following a successful two-year pilot. Screening of targeted high-risk groups (e.g., identified by age and/or sex) was accompanied by early intervention and treatment, supported by disease registers and population monitoring. Organised screening, concurrent with advances in clinical diagnosis and treatment, contributed to successful reductions in incidence and deaths, and improvements in survival rates for these cancers.

Cervical cancer

Causes of cervical cancer include sexually transmitted human papilloma virus (HPV) and associated risk factors including smoking, diet and oral contraception.[327] The death rate from cervical cancer fell from the early 1960s when Papanicolau (Pap) smears were first advocated for early detection. Evidence suggested that screening every two years could prevent up to 90% of the commonest form of cervical cancer (squamous cell type).[570]

The National Cervical Screening Program commenced in 1991. From 1990, the incidence of all types of cervical cancer almost halved and death rates also declined (Figure 6.26).[571] These steadily decreasing rates were attributed in part to the success of the National Cervical Screening Program, which screened women in targeted age groups, and detected and monitored pre-cancerous abnormalities and early stage cervical cancer.[464] Towards the latter part of the century, Australia's rates of incidence and death were well below those in other developed countries, including the UK, the USA, Canada and New Zealand.[464]

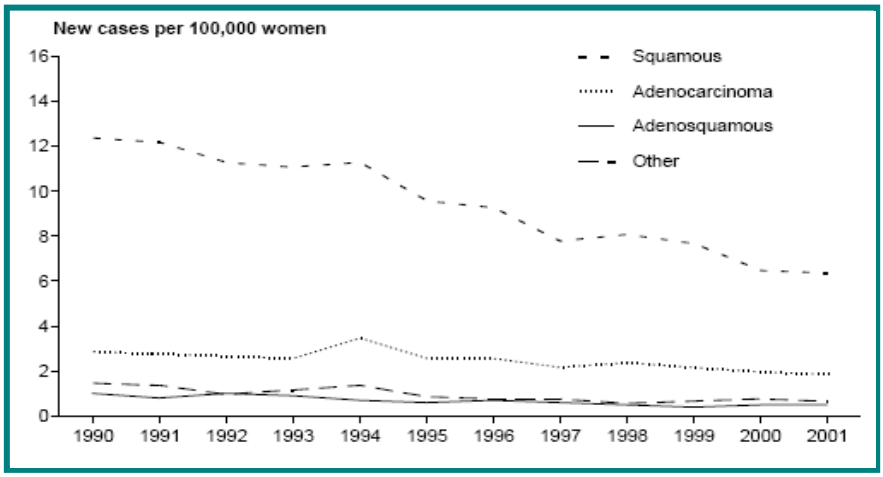
Figure 6.26: Trends in age-standardised incidence and death rates for cancer of the cervix, 1983-2002



Source: AIHW & AACR, *Cancer in Australia 2001*, 2004, p. 36.

Figure 6.27 indicates the decreasing age-standardised incidence rates of various types of cervical cancer per 100,000 women aged 20-69 years, with the difference being statistically significant for almost all types of this cancer over the period shown.[571]

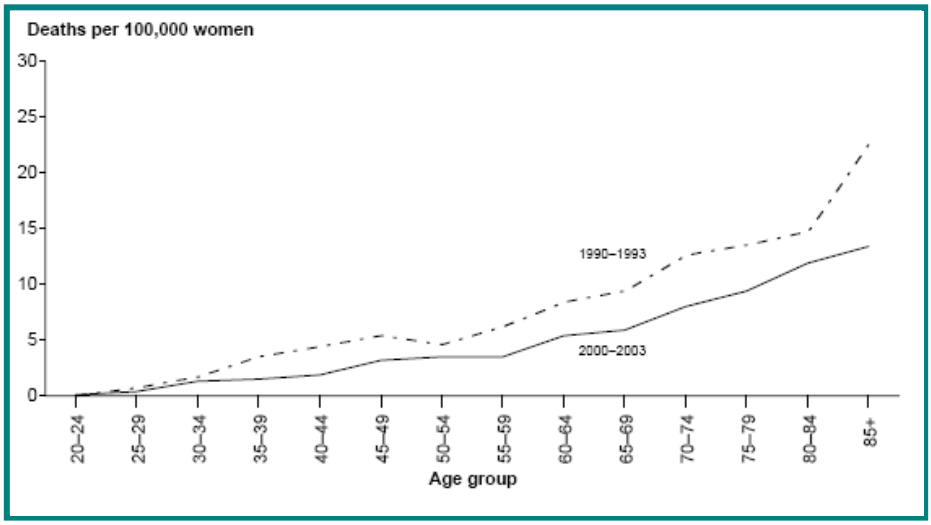
Figure 6.27: Age-standardised incidence rates of cervical cancer by histological type, women aged 20-69 years, 1990-2001



Source: AIHW, *Cervical screening in Australia 2002-2003*, 2005, p. 25.

There were fewer deaths from cervical cancer in 2000-2003 than in 1990-1993, and in almost all age groups, except for 20-24 year old women for whom there was no change (Figure 6.28). The decline in mortality rates, particularly for the oldest age groups in 2000-2003, is evident when compared with the earlier period. Although rates fell dramatically, age-specific death rates for cervical cancer remained higher in older women.

Figure 6.28: Age-specific cervical cancer death rates by age group, 1990-1993 and 2000-2003

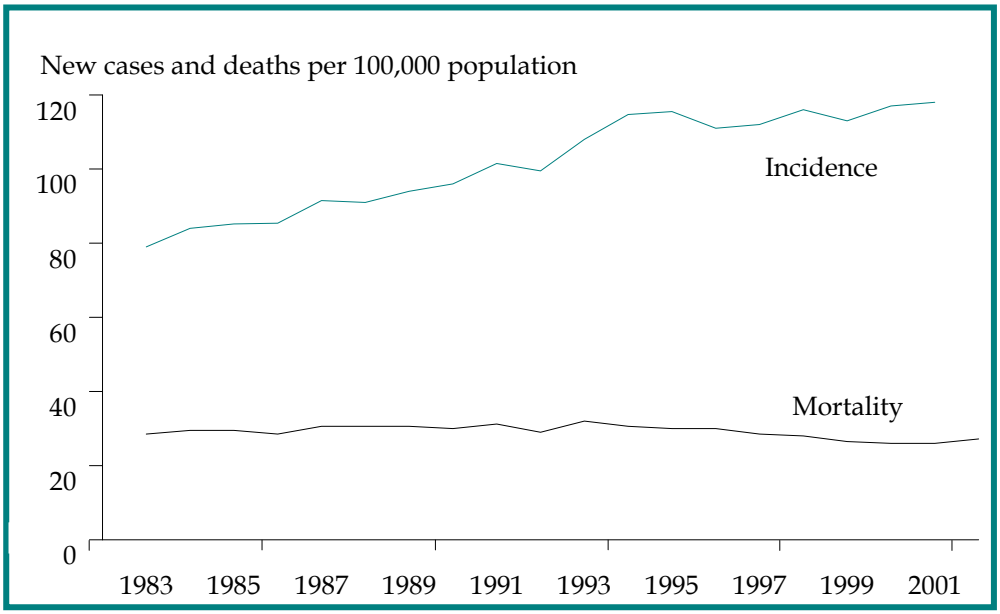


Source: AIHW, *Cervical screening in Australia 2002-2003*, 2005, p. 29.

Breast cancer

Breast cancer was the most frequently diagnosed cancer and the commonest cause of cancer-related death in females. Despite a rise in reported new cases, deaths of women from breast cancer declined (with a decrease of around 2.2% per year for each year from 1991 to 2001) (Figure 6.29).[464] Causes of breast cancer were only partially understood, and there were no proven means of primary prevention. Screening aimed to reduce deaths by up to 30%, although, in the short term, it could raise apparent incidence rates through increases from reporting.[572]

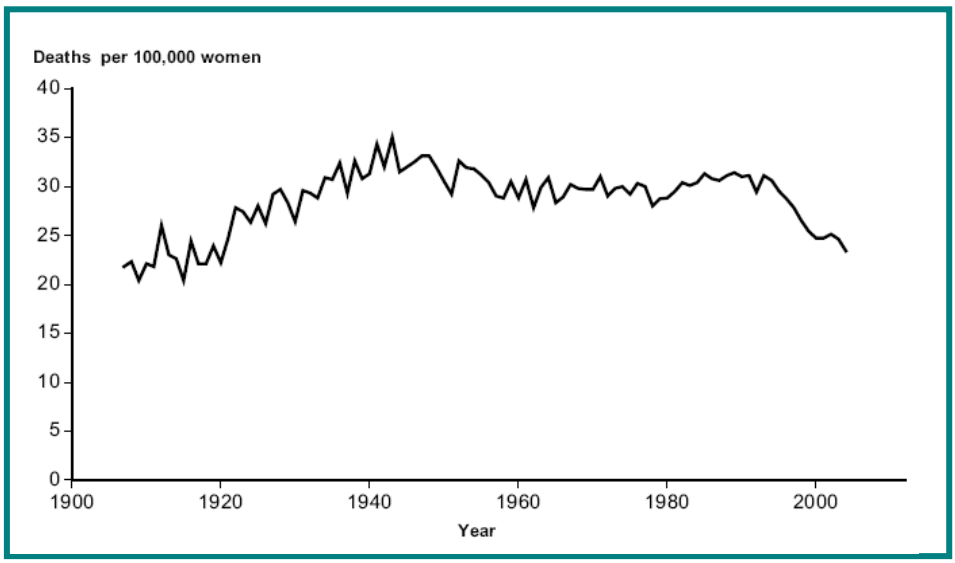
Figure 6.29: Trends in incidence and mortality rates for breast cancer, 1983-2002



Source: AIHW & AACR, *Cancer in Australia 2001*, 2004, p. 32

Over the 20th century, the age-standardised rate of female deaths from breast cancer trended upwards from 1907 (21.8 deaths per 100,000 females) when data were first collected, to an apparent decrease in the early 1940s, followed by a plateau until the 1990s, when a fairly sharp decline was evident relatively soon after the implementation of the national breast screening program, with a rate of 23.4 deaths per 100,000 females in 2004 (Figure 6.30).[572]

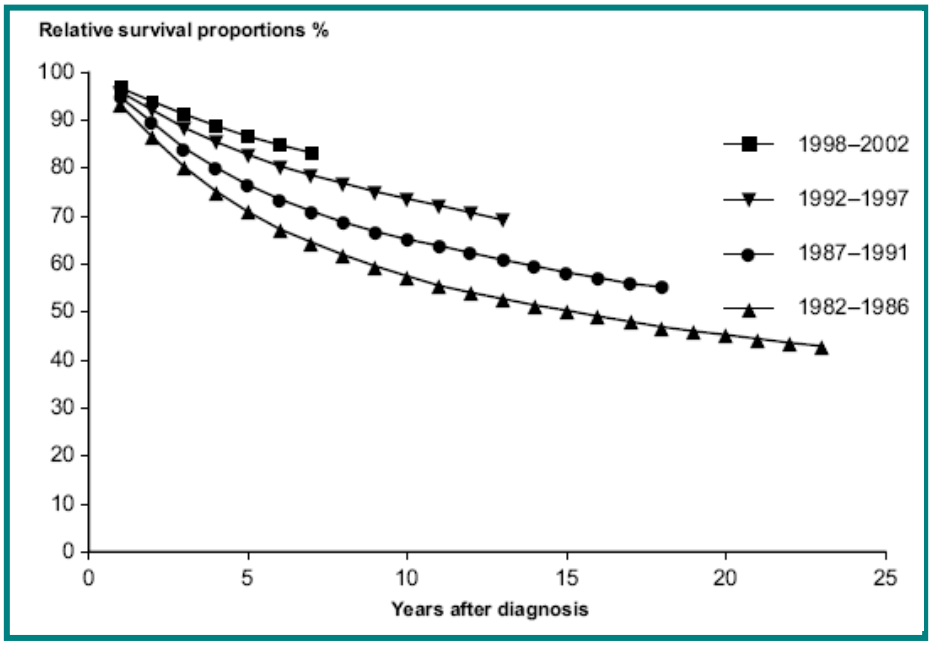
Figure 6.30: Age-standardised mortality rates for breast cancer, females, 1907-2004



Source: AIHW & NBCC, *Breast cancer in Australia: an overview, 2006*, 2006, p. 22.

From 1991, screening for breast cancer in women in the high-risk group (50-69 years) was undertaken by BreastScreen Australia. Women diagnosed with breast cancer also benefited from clinical advances in treatment. Five-year relative survival (the length of time lived after the initial diagnosis of cancer) increased considerably, from 70.9% in 1982-1986, to 86.6% in 1998-2002 (Figure 6.31), and further improvement was expected.[572]

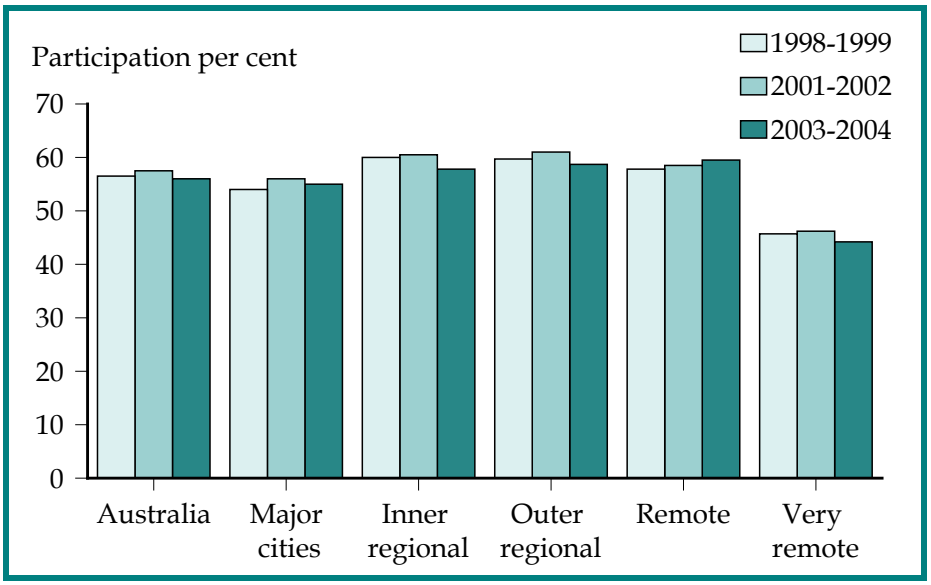
Figure 6.31: Breast cancer in females – relative survival proportions by years after diagnosis for periods of diagnosis, 1982-1986 to 1998-2002



Source: AIHW & NBCC, *Breast cancer in Australia: an overview 2006*, 2006, p. 32.

Screening and early detection programs were supported by population-based cancer registers and coverage estimates from population health surveys. The estimated national participation rate in BreastScreen Australia, for the two-year period of 2003-2004, showed that the age-standardised participation rate of women in the target age group (50 to 69 years) was 55.7%, but a statistically significant decrease from the rate of 57.1% recorded for 2001-2002 (Figure 6.32).[573] These results underestimated total national screening, as a small proportion was performed outside the Program (i.e., in private clinics).

Figure 6.32: Trends in participation of women aged 50-69 years in BreastScreen Australia by region, 1998-1999, 2001-2002 and 2003-2004



Source: AIHW & DoHA, *BreastScreen Australia monitoring report 2003-2004*, 2007, p. 6.

Age-standardised participation rates for 2003-2004 varied by state and territory, ranging from a high of 63.1% in SA to a low of 43.1% in the NT.[574] The rate of 35.3% for Aboriginal and Torres Strait Islander women in the target age group was substantially lower than that for non-Indigenous women (55.4%); however, it had increased from 30.3% in 1998-1999. Rates for women who reported not speaking

English as their main language at home were also lower (at 42.8%) than those for English-speaking women (58.0%). Age-standardised participation rates varied markedly between areas, with lower participation in 'Major cities', probably indicating greater use of private radiology services (but data were not available); and lower participation in 'Very remote' areas, reflecting a lack of services and greater proportions of Indigenous women not being screened in these areas (Figure 6.32).

Bowel cancer

Bowel cancer (colorectal cancer, or cancers of the colon and rectum) had the second highest incidence for both men and women, and was the most common registrable cancer overall in 2003, with 12,536 new cases.[464] In 2003, about 84 Australians died each week from bowel cancer, a cancer that could be treated successfully if detected in the early stages; however, fewer than 40% of bowel cancers were detected early.

The evaluation of the *Bowel Cancer Screening Pilot Program 2002-2004* showed that an organised bowel cancer screening program was feasible, acceptable and cost-effective for Australia. Funding of $43.4 million was allocated over three years for a National Bowel Cancer Screening Program, to be phased in from 2006.

Program participants completed a simple test at home and mailed it to a diagnostic centre for analysis. Such screening tests were shown to be effective, and participants with a positive result were then referred by their general practitioner for further investigation (e.g., a colonoscopy).

Public health practices

The direction of public health practice was the organised screening of average risk population groups in high incidence and mortality age groups, in order to provide early detection and referral for appropriate treatment, for those cancers that were amenable to population-wide approaches. Screening was targeted to whole population groups, and aimed for universal coverage within those groups (although there were shortfalls).

Population screening programs that were introduced in the early 1990s became highly organised and used increasingly sophisticated methods, such as recall and reminder systems to maximise their coverage and retain the involvement of their target populations. They routinely monitored and assessed the 'participation' or coverage of targeted groups, allowing particular populations to be identified and addressed (e.g., differences between rural/remote and urban populations that might be remedied by using mobile screening units).[572,573]

Corresponding population health monitoring and epidemiology were used to ascertain the reach of organised programs in the community, to identify harder-to-reach sub-populations, and to examine factors that might increase the efficacy of programs for these groups.[575] Cancer registries provided complementary data on treatment and survival rates, while clinical groups prepared guidelines and assessed the evidence to identify best practice and any changes necessary to achieve it.

Factors critical to success

National publicly-funded screening programs were one of the successful factors behind reductions in preventable cancers, increasing their early detection. Success was also achieved because intervention included a range of appropriate treatments, based on regularly updated clinical guidelines, and supported by cancer registries and active case surveillance and research.[576] Data from cancer registries were collated and published, thus enabling incidence, mortality and survival rates to be calculated, resulting in evidence-based identification of 'best practice' treatment and management. Screening programs were quality controlled and evaluated for effectiveness. Treatment modalities were also audited for compliance with clinical guidelines and best practice recommendations (e.g., the National Breast Cancer Audit).[577]

These programs were increasingly 'vertically integrated' and evidence-based, with collaboration between the different levels of government, screening agencies, health care providers, cancer-related NGOs and public health practitioners; and with strong links between screening, case-finding, cancer registry information collection and analyses of cases, and primary research all contributing to practice improvements in the detection and treatment of these cancers.

Lastly, public health researchers and scientists continued to contribute to improvements in the understanding of the natural history of specific cancers and their causes.

Future challenges

At the start of the century, in 2003-2004, the national cervical screening coverage rate for the target population (age range 20 to 69 years) was 60.7% and the breast screening coverage rate for the target population (age range 50 to 69 years) was 55.6% – both should have been higher.[574,573] For example, it was estimated that if 70% of Australian women aged between 50 and 69 years participated in mammography breast screening, breast cancer death rates would fall by up to 30%.[578]

Future challenges included extending the coverage of cancer screening and related services, especially for women in rural and remote areas who had lower cervical and breast screening participation rates, and higher cervical cancer death rates, than those living in urban areas; and for Aboriginal and Torres Strait Islander women who had higher cervical cancer rates than their non-Indigenous counterparts.[579,580,464] There was a need to improve Indigenous identification within the cervical screening dataset to enable national monitoring of the participation of Indigenous women in cervical screening and improve strategies to encourage greater use of screening services by these women.

In relation to breast cancer screening, the risks of over-detection and/or over-treatment also warranted attention. While screening for breast cancer meant better case ascertainment, it also led to more aggressive (and sometimes overly aggressive) clinical treatment.[581] Anxiety in participants arising from being falsely diagnosed as having breast cancer (false positives), and lack of, or delays in, treatments were undesirable.[581] Furthermore, there was a need for the risks of routine mammographic breast-screening to be more clearly outlined to women prior to screening, and for the benefits and risks to continue to be monitored.[582]

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7 Improving health and safety at work

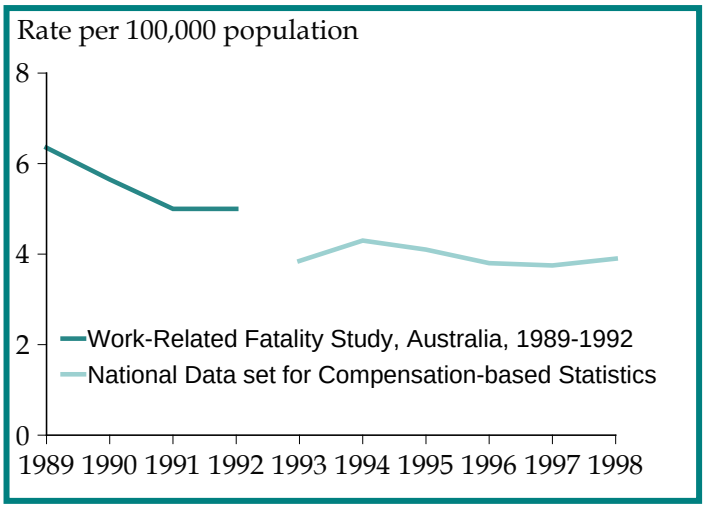
Employment and working conditions are two of the key determinants of population wellbeing. For employed people, those who have more control over their work circumstances, work in safe environments and have fewer stress-related demands in their jobs, are likely to be healthier.[583] People without secure and satisfying work are less likely to have an adequate income; and unemployment and under-employment are generally associated with reduced life opportunities, financial hardship and poorer health and wellbeing.[584]

At the beginning of the 20th century, the emphasis in occupational and industrial health was on providing basic public health amenities for the first time (such as toilets and ventilation in workplaces), and on setting limits and special provisions for the employment of women and children. Over the century, the fields of occupational health and safety developed, resulting in improvements in the working conditions of employees across a wide range of industries and occupations. Workplace hazards and injuries were significant causes of disability and related health problems, but workplaces were also increasingly the sites of public health programs to improve health (e.g., workplace-based hearing screening, blood pressure monitoring, and screening for preventable genetic conditions).

Work-related fatalities made up a significant proportion of accidental deaths throughout the century. Working conditions in the earlier part of the century were often highly dangerous, involving substantial exposure to a range of toxic substances or immediate physical risks. Occupational health and safety (OHS) issues were relatively later matters of legislative concern in Australia, with some employers and unions previously focusing more on agreed extra payments (e.g., 'danger money') for working in risky or hazardous environments.[585] Occupational health hazards, however, remained for many workers, with the complexity of modern work processes bringing new problems alongside improvements.[586]

In relation to work-related injuries, two major changes in the economy were reflected in the reduced risk of hazardous occupational exposures. The first of these was the movement of a significant proportion of workers from the most hazardous sectors (e.g., mining, manufacturing, agriculture) to the relatively safer service industry sectors. The second was the transition from manual work to automation, which resulted in fewer people engaged in hazardous occupations, and therefore, less exposure per unit of risk.[587] It was difficult to demonstrate some of these changes, as there were no national, centralised systems for the collection of data for work-related deaths, injuries, and risk exposures (incident and disease) over much of the century. However, later time trend data indicated some success in this period (Figure 7.1).[588]

Figure 7.1: Work-related death rates, 1989-1998



Source: National Occupational Health and Safety Commission, *Data on OHS in Australia,* 2000, p. 29.

One study that analysed data from 1989-1992 estimated that an average of just under 2,300 deaths occurred in Australia annually, from occupational exposure to hazardous substances (including acute chemical poisoning).[589] Workers in particular industries had very high exposures to certain hazards: for example, exposure to asbestos (which caused the fatal diseases of lung cancer and mesothelioma) was very high in certain industries (e.g., asbestos mining and export) and occupations.[590] In some cases, these hazards were being eliminated – for instance, asbestos was eventually not 'mined, milled or manufactured' in Australia because of the risk to health. Public health success in reducing exposures to asbestos and lead are described in Sections 2.2 and 2.1.

There were marked variations in the safety of different industries and types of work and in the health of those who worked in them. An analysis of death rates in males working in manual versus non-manual occupations found that, while mortality for both declined markedly during the period 1966 to 2001, for males in manual occupations the decline was 44%, whereas for males in non-manual occupations, the decline was higher, at 59%. These declines slowed after the mid-1980s.[591]

The National Occupational Health and Safety Commission, (NOHSC) was a Commonwealth authority established as a tripartite statutory body (with representation from employers, employees, and government) under the *National Occupational Health and Safety Commission Act 1985*, and its primary role was to facilitate and implement the government's *National Occupational Health and Safety (OHS) Strategy*.[30] It was succeeded by the Australian Safety and Compensation Council (ASCC) in 2005.[597]

> *'Australia's continuing high rates of work-related fatal and non-fatal injury and disease present a significant challenge to us all. Every year, significant numbers of people die and many more are severely affected by work-related injuries and diseases. There have been significant improvements in OHS performance in recent years but considerable scope exists for further progress.'*
>
> *– National Occupational Health and Safety Strategy 2002-2112, 2002.*

In 2000, the NOSHC published a report that provided an overview of OHS in Australia as described by national data collections.[592] This directly supported the *National Improvement Framework* goal of prevention, and was the most comprehensive study to date on work-related injury and disease in Australia. The main findings were that:

- the health burden due to occupation was a significant component of the total public health burden;
- the health burden due to disease was much higher than that due to injury, and cancer appeared to be the main disease problem;
- there were no significant decreases in the level of injury and disease over the decade (1989-1998) – although an improvement in death rates was apparent (Figure 7.1);
- risks of fatal and non-fatal injury varied with age – rates rose steadily to about age 64 years, and increased dramatically for workers over that age;
- risks of fatal and non-fatal injury varied by industry, with consistently high rates in agriculture, mining, transport and construction (timber and fishing industries had low numbers but exceptionally high rates; while manufacturing had high numbers of both but only high rates of non-fatal injury, when compared with all industries); and
- risks of fatal and non-fatal injury varied by occupation, with consistently high rates among plant and machine operators and drivers, labourers and tradespersons. Paraprofessional workers, managers and administrators (including farmers) had moderately high rates of fatal injury.[592]

Later data indicated that Australia's work-related fatality rate had decreased overall, at a higher rate than that of a number of the best performing countries in the world (Figure 7.2).

Figure 7.2: Comparison of Australia's work-related injury fatality rate with selected best performing countries, 1999-2001 to 2003-2005 (projected)

Source: Workplace Relations Ministers' Council, *Comparative performance monitoring report: comparison of occupational health and safety and workers' compensation schemes in Australia and New Zealand,* 2006, p. 4.

Information on fatalities where workers' compensation was applicable also showed a decreasing rate from 1996-97.[593] Although these data did not include all work-related fatalities (for instance, contractors were excluded), and were confounded by other factors, they appeared to indicate improving safety in Australian workplaces. There was, however, a pressing need for improved collection and analysis of national data on work-related fatalities, injuries, exposures and resulting diseases and conditions.

Public health practices

In 1854, the *Public Health Act* of Victoria, the colony with the largest manufacturing industry in Australia at the time, empowered Local Boards of Health to require factories of more than 20 people to provide a sufficient number of 'water closets' (toilets) and other basic public health amenities that were not commonly provided to employees.[5] From 1885, laws to protect workers were progressively enacted. For example, the state factory acts prohibited the employment of children (aged less than 13 years) and regulated the employment of minors (aged more than 13 but less than 16 years), which led to a reduction in industrially-related child deaths.[30] The Victorian *Factories and Shops Act 1885* regulated the employment of women and youths, by setting a (less onerous) working week of 48 hours for females and males under 16 years.[5]

The Harvester Judgement, delivered in the (then) Commonwealth Court of Conciliation and Arbitration in 1907, was a landmark judgement. The ruling stated that the employer was required to pay his employees a wage that guaranteed a standard of living reasonable for 'a human being in a civilised community'.[594] It created the concept of a minimum wage, and the legal requirement for employers to pay a basic wage sufficient for a worker and family to live 'in frugal comfort'.

> ***Survey respondent:*** *The Harvester Judgement was a public health success as it created a 'frugal but adequate wage for all adult Australian male workers, with major impact on poverty-related illness.'*

Occupational and industrial health and safety remained largely matters for the states and territories after Federation in 1901, and most of the earlier developments occurred at this level (Box 7.1). For instance, the Victorian *Health Act* of 1919 enacted regulations to govern dangerous occupations, and, in

1923, the Dangerous Trades Regulations were issued under this *Act*, requiring every medical practitioner to notify specified occupational illnesses due to:

- certain substances – carbon bisulphide, carbon monoxide, lead, mercury, nitrous fumes, phosphorus, chloride of sulphur, turpentine or cyanogen compounds (e.g., cyanide);
- ulceration of skin or mucosal surfaces due to chrome, irritant dust, or caustic or corrosive liquids;
- septic poisoning due to handling meat or meat products; and
- pneumoconiosis (a lung condition caused by inhalation of dust) due to organic and inorganic dusts.[5]

The character of modern OHS legislation developed largely from the 1970s, in the wake of the influential Robens Report, the result of a British inquiry into then current UK health and safety legislation. The Report found that there was 'too much law' *per se*, that much of the law was obsolete or too focused on standard-setting, that agencies were fragmented, that self-regulation was not as effective as it could be, and that, most importantly, real progress was only possible with the cooperation and commitment of all employees.[30]

Box 7.1 The way it was… working conditions early in the 20th century

'The position in Australia was not substantially different from that in Britain. Long hours, child labour and destitution following unemployment or injury all presented as problems in Australia as they did in Britain. The remedial legislation in some cases contained detailed provisions directed to improving health and safety – for example, the Victorian Factories and Shops Act 1890. *In other cases, it was more limited – for example, the South Australian* Factory Act 1894 *which followed the English models by: expressly limiting the hours of women and children, setting age limits on employment; and imposing only rudimentary safety and health requirements such as ventilation and the guarding of dangerous machinery. The requirements were also of limited application (to the metropolitan area) and excluded shops and workplaces with less than six workers. Yet, there were arguments that these requirements should be left to self-regulation… Dr Magarey MLC [SA] argued that the proposed Act gave extraordinary powers to inspectors (it did not) and that it might be better for under 13 year olds to be at work rather than on the streets.'*

– C Reynolds, 1995.[30]

At the start of the 21st century, the area of OHS was governed by a framework of acts, regulations, and underpinning codes of practice and standards, many of which were industry-level standards.[595] Each state and territory had a central piece of legislation, which were their principal *Occupational Health and Safety Acts*. This jurisdictional legislation generally established tripartite bodies consisting of employer, employee, and government parties, with functions to oversee the operation of OHS legislation.[30] Australia's no-fault compensation schemes provided support to injured workers and promoted rehabilitation and their return to work.

Over the 20th century, there were major reductions in fatalities, as a result of substantial changes in industrial, occupational and work-related practices and safety measures. These included:

- the development of modern OHS legislation;
- a raft of measures to reduce workers' exposure to hazardous substances;
- the establishment of registries to track workers who suffered from certain hazardous exposures and injuries (e.g., the Australian Mesothelioma Program and Register, which began in 1980; the Australian Spinal Cord Injury Register, which began in 1995 and had full coverage of new incident cases of spinal cord injury from 1986);
- the National Coronial Information System, used to address the links between safe design and occupational safety (see Section 5.2); and
- campaigns on a range of issues (e.g., to enforce sun protection on construction sites, or to target the use of seatbelts on forklifts – there were 85,000 forklifts in Victoria alone).[718,30,596]

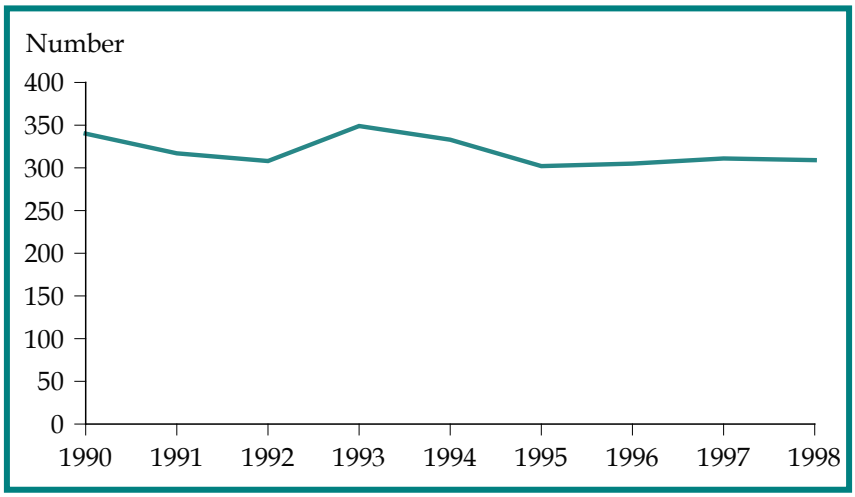
Certain industries had historically higher or relatively intractable work-related injury rates and risks relative to other sectors, and these continued to require concerted effort. Industries identified as priorities were:

- agriculture, forestry and fishing;
- construction;
- health and community services;
- manufacturing;
- mining; and
- transport and storage.[598]

In terms of agricultural industries, improvements in safety on farms were necessary as they were residences where non-working adults and children lived (and visited), as well as worksites. Farms contained dangerous equipment and chemicals, and agricultural industries had rates of work-related deaths that were among the highest in Australia.[599] Farm injuries resulted in between 20 to 60 presentations to rural hospital emergency departments for every 100 farms annually.[599] A comparative study of farm-related fatalities from 1989 to 1992 found that the fatality rate was four times higher for the agricultural industry (20.6 per 100,000 workers) than the all-industry rate (5.5 per 100,000 workers) during the same period.[600] Information from this and other studies was used to develop health and safety risk profiles for agricultural industries, which promoted the development of guidelines, hazard checklists, and other tools to help farmers manage their OHS risk.[600]

Farmsafe Australia was incorporated in 1993, and, in 1996, set ambitious goals and targets for achievement in the first *Farmsafe Australia Strategy 1996-2001*.[601] A review in 1999 found that, apart from reductions in deaths due to tractor roll-over, there was little evidence of progress in achieving the targets (). There had been progress, however, in implementing the strategy and significant improvements were expected within the following decade.[602]

Figure 7.3: Deaths from injury of farm managers and workers, 1990-1998



Source: Farmsafe Australia Inc., 'Farm Safety Facts', [n.d.].

The safety of children on farms was a major concern, with an average of one child (under 16 years) fatally injured on an Australian farm every ten days, and many more hospitalised or requiring medical treatment.[603] Targets set by Farmsafe Australia for 2002-2007 aimed at reductions in:

- injury related deaths on farms, by 30%;
- compensable injury, by 30%;
- hospital admissions due to farm injury, by 30%; and
- the number of young people on farms (aged 15-24 years) with noise-induced hearing loss, by 15%.[604]

The key public health principle driving measures to ensure safe working environments was the knowledge that work-related death, injury and diseases were preventable, not inevitable. Improvements in the assessment, elimination and control of risks and the development of a safety culture, especially in hazardous industries were also important. Later movement towards mechanisms

to develop and audit compliance with regulatory regimes and frameworks helped to shift OHS in proactive directions (and away from the former focus on non-compliance). Regulatory authorities increasingly offered advisory services, awareness and education programs and other assistance to support workplaces, employees and employers to comply with health and safety standards.

A national strategy, the *National Occupational Health and Safety Strategy 2002-2012* was endorsed by the Workplace Relations Ministers' Council (WRMC) in 2001. It was described as a landmark development, because it enshrined the commitment of all Australian governments, the Australian Chamber of Commerce and Industry and the Australian Council of Trade Unions, to work cooperatively on national priorities to improve OHS, and achieve minimum national targets to reduce the incidence of workplace deaths and injuries. National Priority Action Plans were endorsed by the WRMC in 2002:

- to reduce high incidence and severity risks;
- to strengthen the capacity of business and workers to manage OHS effectively;
- to prevent occupational diseases more effectively;
- to eliminate hazards at the design stage; and
- to strengthen the capacity of government to influence OHS outcomes.[593]

Comparative Performance Monitoring reports from 1998 enabled trend analysis on the OHS and workers' compensation schemes operating in Australia, providing information to assess progress on the strategy, and the success of differing approaches to the prevention of work-related injury and disease.[597] The strategy was reviewed in 2004-05 and found to be contributing to improvements in OHS, through the focus on a national effort and the setting of targets based on data.[593] As with other areas, OHS was a state responsibility, and the evaluation found that all Australian OHS authorities had integrated the strategy into their business plans, and that members of the ASCC were working on education and compliance campaigns, to engage industry in activities in support of the strategy's goals for priority risks and industries. As a consequence of the review, an additional target was adopted, for 'Australia to achieve the lowest rate of work-related traumatic fatalities in the world by 2009'.[593]

Factors critical to success

The success of measures to provide safe working environments for all Australians relied on the recognition that work-related death, injury and diseases were preventable, and that it was the responsibility of everyone to take action to ensure safe workplaces and work situations, and eliminate hazardous practices.

Public health measures began in the latter half of the nineteenth century with basic requirements such as the provision of toilets, ventilation, fire escapes and first aid equipment. These developed into a highly regulated system ensuring that in all jurisdictions, the duty of care owed to workers and third parties was shared by all whose actions could affect their health and safety. For example:

- employers had to provide safe and healthy workplaces and safe systems of work;
- employees had to work in as safe a manner as possible; and
- suppliers, designers and manufacturers had to provide safe products and accurate information about the safe use of materials and equipment.[593]

Public health data collection and tracking activities, such as registers of workers who suffered injury or injurious exposures, and studies on the mechanisms of work injury and fatality (e.g., falls from a height, being hit by moving objects) all contributed to preventive programs to reduce the effects of occupational injury.[605]

Cost-effectiveness

While there were no overall cost-benefit analyses for OHS programs in Australia, the cost of workplace accidents (e.g., industrial and occupational fatalities, injuries resulting in loss of a limb or blindness) and hazardous exposures resulting in disability (e.g., industrial deafness) or diseases (e.g., mesothelioma) were estimated by Worksafe Australia in 2000 at a minimum of $27 billion annually.

The economic cost of the health impacts of occupational exposure to hazardous substances in 1991 was estimated at $160 million in health service utilisation and productivity losses nationally. Direct costs of hospital treatment were $38 million; indirect costs due to temporary illness and permanent disability (i.e., lost productivity) were $20 million, while productivity losses due to premature mortality were $102 million. The study confirmed previous findings that the impact of occupational exposure to hazardous substances was an important public health problem.[589]

Table 7.1: Historic highlights of improving health and safety at work

1854	The *Public Health Act* of Victoria of 1854 empowered Local Boards of Health to require factories of more than 20 people to provide a sufficient number of 'water closets' (toilets).
1876	A Select Committee of the NSW Legislative Assembly recommended legislation to define the age at which children should be permitted to work in paid employment.
1885-	Laws to protect workers e.g., *Factory Acts* (Vic 1885, SA 1894, NSW 1896) regulating the employment of minors.
1907	The Harvester Judgement (living wage, and called the basic wage for many decades).
1921	Commonwealth Division of Industrial Hygiene established; then ceased operation in 1932 during the Great Depression.
1926	The *NSW Workers' Compensation Act 1926* enacted.
1929-30	First medical appointment to private industry made by Broken Hill Pty. Ltd.
1949	Occupational Medicine Section established at the School of Public Health and Tropical Medicine in Sydney.
1972	Publication of the influential Robens Report, the result of a UK inquiry into then current health and safety legislation.
1970s	Development of modern occupational health and safety (OHS) legislation in the states and territories began. The National Occupational Health and Safety Commission established.
1984	The SA Mathews Report set out general propositions on which new OHS legislation was based.
Mid 1980s-	State legislation enacted e.g., the *Occupational Health and Safety Act 1983* (NSW), 1985 (Vic), *Occupational Health, Safety and Welfare Act 1984* (WA), 1986 (SA).
1987	Domestic airlines became smoke-free.
1988	All federal government offices became smoke-free.
1991	The *Occupational Health and Safety (Commonwealth Employment) Act* enacted.
1993	Farmsafe Australia Inc. set up with the aim of enhancing the wellbeing and productivity of Australian agriculture through improved health and safety awareness and practices.
Late 1990s-	State legislation refreshed, e.g., the *Occupational Health and Safety Act 2000* (NSW) repealed the earlier (1983) act.
1996	First Farmsafe Australia Strategy 1996-2001.
2001	The Workplace Relations Ministers' Council (WRMC) endorsed the *National Occupational Health and Safety Strategy 2002-2012*.
2002	National Priority Action Plans for the period 2002-2005 endorsed by the WRMC in 2002. Second *Farmsafe Australia Strategy for 2002-2007*.
2004-05	Review of the National Occupational Health and Safety Strategy found that it was contributing to improvements in OHS. The Australian Safety and Compensation Council (ASCC) replaced the National Occupational Health and Safety Commission.

Future challenges

In 2006, further challenges included making Australian workplaces free from death, injury and disease, by achieving the National OHS Strategy targets:

- to sustain a significant, continual improvement in the incidence of work-related fatalities with a reduction of at least 20% by 30 June 2012 (with a reduction of 10% being achieved by 30 June 2007);
- to reduce the incidence of workplace injury by at least 40% by 30 June 2012 (with a reduction of 20% being achieved by 30 June 2007); and
- to achieve the lowest rate of work-related traumatic fatalities in the world by 2009.[593]

The safety of children on farms remained a major concern. Key Farmsafe Australia recommendations included:

- creating a securely fenced house yard where children could play; and
- establishing farm safety rules that everyone followed.[601]

While noting that the ASCC was working towards improved data collection and analysis, there was a continuing need to improve available information on work-related fatalities, injuries, risk exposures and related disease conditions at the national level, so that data were comparable over time, and could be used to identify best practice and to monitor progress towards the targets.

8 Universal access to health care, pharmaceuticals and technology: 1948 onwards

At the start of the 21st century, Australia had a world-class system of health care financing and provision, whereby people were able to access publicly subsidised health care services, pharmaceuticals, and medical technologies and devices, through a range of service and funding arrangements. These included government funding of public hospital and medical services; subsidised pharmaceutical products delivered through the Pharmaceutical Benefits Scheme (PBS); and medical devices (e.g., cardiac pacemakers, artificial hip joints) made available in hospitals following approval by the Medical Services Advisory Committee.

Medicare (and its predecessor, Medibank) and the PBS, in its various forms, were more than simply health care delivery systems, for their development was an intrinsic part of the re-structuring and financing of medical services towards the goal of better health in Australia.

However, access to these services was not universal for the Indigenous population, especially in remote areas of the country. Health services operating in remote and traditional communities had difficulty using the standard Medicare claims' process, and people living in these areas could be unaware of their entitlements. In many country towns, there was no access to Indigenous-specific services, mainstream services were often not culturally sensitive, and staff could be racist in their attitudes. In 1997, a range of initiatives were undertaken to increase Aboriginal and Torres Strait Islander enrolment in Medicare and to support the claiming of Medicare rebates on behalf of Indigenous Australians.[606]

> ***Survey respondents:*** *'These systems of financing health care were among the leading public health successes of the century, not just because they provided more universal access to health care based on need, but also because structurally, they helped to restrain rising health costs and market failures in health care through pricing negotiation with suppliers of medical and health services and pharmaceutical drugs. While not perfect, these were significant system advances, ensuring health services remained affordable for individuals and for the community/taxpayers as a whole.'*
>
> *These public health successes were 'policy initiatives rather than interventions.'*

The development of Medicare and the Pharmaceutical Benefits Scheme

Beddie described the situation of the health system at the end of the 1960s – that led to the implementation of Medibank in 1975 – as 'under pressure'.[318] The costs of hospital treatment and the health care of chronically ill people were continuing to grow. Around 17% of people in the population had no health insurance, others were under-uninsured and the net cost of insurance was highest for the lowest-paid contributors.[318] High medical fees and rapidly increasing premiums fell disproportionately on people with low incomes and those who were chronically ill.[607] Total health expenditure over the decade rose from $683 million in 1961 to $1.7 billion in 1971, well above the rate of GDP increase.[608] By the time of the 1969 election, 'health issues had assumed a prominent role on the political agenda'.

Debate about health and welfare nationally was kindled by analyses from the Institute of Applied Economics Research, headed by an economist, Ronald Henderson. In 1966, Henderson concluded, after surveying living conditions in Melbourne, that one in 16 people were living in poverty: 'Australia was not, after all, an entirely lucky country'.[318] Henderson's colleagues, Richard Scotton and John Deeble, who were investigating health insurance, published proposals for a compulsory national health insurance scheme in 1968.[609] Their ideas were adopted by Gough Whitlam when he became Leader of the Opposition.[318] A *Committee of Inquiry into Health Insurance*, chaired by Mr Justice Nimmo, reported in 1969 and both sides of politics committed themselves to the reform of the health system.[607]

The National Public Health Partnership, in their discussion of the public health landscape of Australia (1998), described 'the major debate of the 1970s' as being how to ensure universal access to health care, and the development of community-based primary health care services.[9] The result was the introduction of the federal system of 'Medibank' in 1975 by the Whitlam government, after overcoming resistance from a number of quarters including the Liberal-Country Party, the voluntary health insurance sector and the Australian Medical Association (AMA).[607]

Medibank was a tax-funded, national health insurance scheme that provided universal coverage of the population for medical expenses. It was administered by a newly established Health Insurance Commission (HIC). Medibank was so popular that, in the first few months of operation, the HIC processed many more than the expected 90,000 claims per day.[607]

Medibank's future became unclear after the dismissal of the Whitlam government in November 1975. The Liberal-Country Party caretaker government under Malcolm Fraser promised to maintain Medibank, while also committing to significant reductions in public expenditure.[607] The Fraser government attempted to balance these competing priorities in a complex series of changes that initially retained Medibank, but as a non-compulsory alternative to private health insurance. These changes ultimately resulted in Medibank being dismantled.

The cost and affordability of health care was 'a perennial theme' during the 1970s.[318] For the Fraser government, Beddie noted, 'this meant a greater role for the private sector in the financing of health'.[318] In 1981, the Commonwealth accepted the recommendations from the Jamison Inquiry into hospital efficiency, that primary responsibility for the financing of hospital services be returned to the states and that patients be paid directly or through health insurance for services received. Block grants to the states calculated on a per-capita basis replaced previous cost-sharing arrangements, adding to pressure on hospitals to find more cost-efficient methods of service delivery (e.g., day surgery).[610]

After a Labor government was returned to office in 1983, the Minister for Health, Dr Neal Blewett quickly reinstated a universal scheme of taxpayer-funded health cover. Medicare came into operation in February 1984 and was a key component in the prices and income accord that the government had negotiated with the Australian Council of Trade Unions, as part of its anti-inflation strategy.[318]

Medicare remained the national health insurance program, providing access to a doctor of choice for out-of-hospital health care, free public hospital care, and subsidised pharmaceuticals.[9] Medicare also supplied health care services for sub-populations with particular needs, by targeting preventive services for at-risk groups and improving medical services.[9] The Medical Benefits Schedule (MBS) listed the fees to be paid for various medical services provided by approved practitioners.

'Bulk billing', a feature of Medibank reinstituted under Medicare, was a mechanism by which 'insurance' payments could be made directly to medical practitioners through Medicare Australia (formerly the HIC). More importantly, the essence of bulk-billing meant that there was no required co-payment of the fee by the patient (that is, no 'gap' to be paid), and the doctor accepted the rebate (85% of the scheduled fee) as full payment.

The principles upon which Medicare was founded, to provide universal access and insurance for resident Australian and New Zealand citizens, and people who had applied for, or received, permanent residency, were:

- free and equal access to public hospital treatment (made available through the Australian Health Care Agreements between the Australian and state/ territory governments); and
- universal access to the Medicare rebate for out-of-hospital services (e.g., general medical practitioners (GPs), medical specialists).[610]

While Medicare did not guarantee universal access to services *per se*, it did guarantee universal access to the Medicare rebate. Efforts were made by Medicare Australia to ensure that those who 'slipped

through the net' – primarily some in remote Aboriginal and Torres Strait Islander communities – were subsequently covered. Medicare Australia's Service Charter included the promise to 'increase awareness of our services amongst Indigenous Australians'.[611] Aboriginal and Torres Strait Islander Australians could voluntarily identify themselves as such when enrolling for Medicare. By the end of March 2007, there were 159,003 people who had done so in their Medicare enrolments. In the NT, Indigenous enrolments were at 98%.[611] Medicare also initiated a dedicated Aboriginal and Torres Strait Islander Access telephone helpline that received 34,779 calls in the nine months ending in March 2007.[611] However, for the financial year 2001-2002 (the latest year for which data were available), Medicare benefits per person for Indigenous people were only 39% of the non-Indigenous per person average, despite their poorer health status.[612]

> 'Medicare [was a] system of universal health insurance … based on a combination of revenue raised by levy and taxes. It had two key components: the first provided access to public hospital services for all Australians; the second, "medical Medicare", supported access to general practitioner and specialist services, the latter on referral. Specialist services included pathology and other diagnostic procedures such as x-ray.'
>
> – S Leeder, 1999.[749]

The Pharmaceutical Benefits Scheme

Pharmaceutical agents and medications assumed an ever-increasing role in the public's health, especially in the control of chronic diseases (e.g., cardiovascular disease) and their risk factors (e.g., high blood pressure).

A fore-runner of the PBS was created in 1948 in response to concerns that some Australians could not afford the life-saving new medicines that had become available after World War II. There had also been much earlier arrangements in 1919 that subsidised pharmaceuticals to groups such as ex-service men and women.[613]

The modern PBS was established in 1960 to provide a range of subsidised prescription medicines that the community could access (after they had been approved by the Therapeutic Goods Administration (TGA)), at prices affordable to both the community and the government. A patient contribution (or co-payment, initially of five shillings) was also introduced in an attempt to control both volume and expenditure.[614] From its inception, the PBS grew exponentially, from a provider of a limited number of free 'life-saving and disease-preventing drugs' (159), to an extensive scheme of over 590 subsidised medications (in May 2002), available in many different forms and brands.[614]

In 1964, an Adverse Drug Reaction reporting scheme for prescription medicines was introduced. An independent medical panel with expertise in the evaluation of medicine safety (the Adverse Drug Reactions Advisory Committee (ADRAC)) was formed in 1970 to advise the TGA on the safety of medicines. The reporting scheme received and reviewed all reports of suspected adverse reactions to prescription medicines, vaccines, over-the-counter medicines and complementary medicines. Serious reactions and reactions to newly marketed drugs were reviewed by ADRAC, which produced an *Australian Adverse Drug Reactions Bulletin* six times a year.[615]

The TGA ensured that, after subsidised pharmaceuticals had been evaluated according to their efficacy and cost-effectiveness, they were scheduled and made available to all Australians. For the financial year 2001-2002, however, per person PBS benefits for Indigenous people were 33% of the per person PBS benefits for non-Indigenous people.[612] This included the special supply arrangements under Section 100 of the *National Health Act 1953* (see Section 9.2).

Health care technologies

In 1937, the *Therapeutic Substances Act* was passed, but its promulgation was delayed by the advent of World War II.[318] In 1956, the *Therapeutic Substances Act 1953* repealed the previous *Act* and gave the Commonwealth control of the importation and interstate trading of therapeutic substances.[616] It was reviewed in 1966 (after the thalidomide tragedy) so that Commonwealth powers could be used to

require manufacturers to establish the safety, quality and efficacy of imported therapeutic goods.[617] The *Therapeutic Goods Act 1989* created the TGA and the Australian Register of Therapeutic Goods (ARTG), which compiled information on therapeutic goods for use in humans. In practice, the ARTG was a computer database of two broad classes of therapeutic goods, medicines and medical devices.[618] Unless therapeutic goods were specifically exempted, they had to be entered as 'registered' or 'listed' goods before they could be supplied or exported from Australia. There were about 63,400 products on the ARTG in 2005.

Health care technologies improved dramatically over the second half of the 20th century. A range of effective and less invasive treatments emerged, and demand for them grew. To manage this, a National Health Technology Advisory Panel was established in the early 1980s. The Australian Health Technology Assessment Committee replaced the Panel in 1986 and became the Medical Services Advisory Committee (MSAC) as part of the 1997/98 Budget initiative, aimed at strengthening the evidence base of the MBS. MSAC's role was to advise the federal Minister for Health and Ageing about the strength of evidence relating to the safety, effectiveness and cost-effectiveness of new medical technologies and procedures, and whether they should be publicly funded.

The Therapeutic Device Program was established in 1984 as a response to community concern over the numerous medical devices coming onto the market. The program's advisory body, the Therapeutic Device Evaluation Committee, held its first meeting in 1987.[616] It was replaced by the Medical Device Evaluation Committee (MDEC) in 2002. The role of the MDEC, as a statutory expert committee, was to provide independent medical and scientific advice to the Minister for Health and Ageing and the TGA on the safety, quality and performance of medical devices supplied in Australia.[619]

The Prostheses and Devices Committee (PDC) was set up by the Minister for Health and Ageing in 2004 to advise on the listing and benefit levels of prostheses and medical devices.[620] The Prostheses List recorded the no-gap and gap-permitted prostheses and the benefits payable for them. The *National Health Amendment (Prostheses) Act 2005* regulated the benefits paid for prostheses and medical devices by private health funds to hospitals for private patients.[620] The intention under the *Act* was to have at least one no-gap prosthesis available for each relevant MBS item performed in private hospitals, and to use the least expensive, most clinically effective item as a benchmark (similar to the use of generic drugs as a cost containment measure in the PBS), while continuing to provide a choice of prostheses dependent on a 'modest premium' paid by the patient.[620,621] The PDC was advised by Clinical Advisory Groups, members of the Panel of Clinical Experts and the Prostheses and Devices Negotiating Group in making its recommendations.[620]

Advances in medical services and technologies resulted in many procedures and applications becoming widely available to improve screening, diagnosis and treatment, and to prevent unnecessary suffering and deaths (e.g., X-rays, machines that made open heart surgery possible, prosthetics and artificial implants). For example, insulin pumps for diabetic patients could prolong life by an average of five years, by reducing diabetes-related complications.

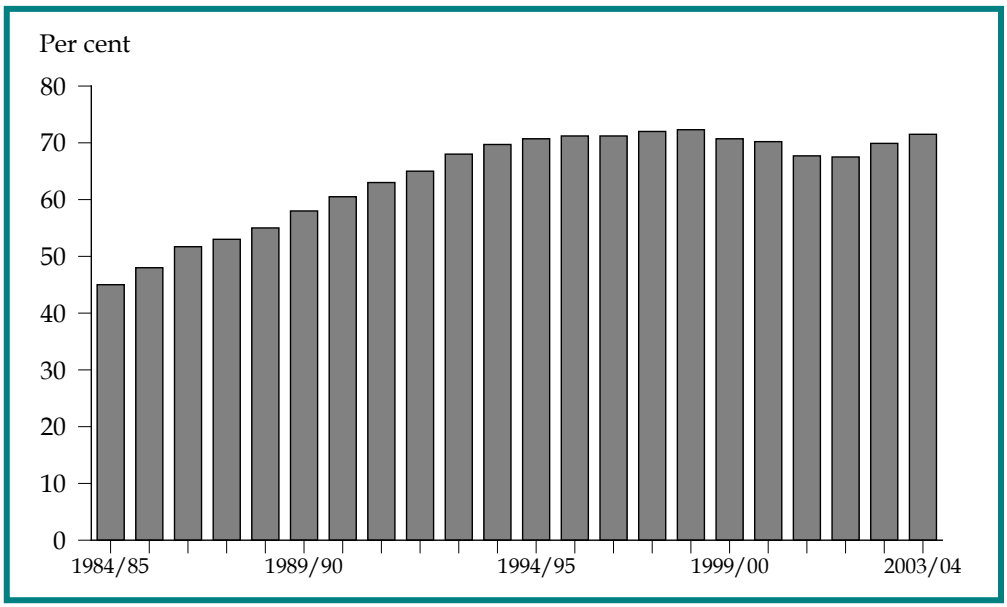
Public health practices

The advent of Medibank, and its subsequent reincarnation as Medicare, resulted in access to medical care for all Australians, according to their health needs and regardless of their capacity to pay. Although there were changes to Medicare over the decades, this universal system aimed to ensure that basic health care was available to everyone. It revolutionised the payment for, and financing of, health care in Australia.

Encouraging GPs to bulk-bill was a way of ensuring that capacity to pay did not determine ability to access health services. The increase in the percentage of Medicare services that were bulk-billed provided evidence that it was an important component of the system. Some argued that a decline in bulk-billing contributed to broader health inequalities, as, without this system, access to health care increasingly relied on capacity and willingness to pay, rather than on health need.[610]

The bulk-billing rate rose to 76.6% in the June quarter of 2006 – the highest rate after Medibank was re-launched as Medicare in 1984 (Figure 8.1). Rates for young people (at 83.8%), and people in rural areas (at 71.3%), in particular, increased to record levels in 2006.

Figure 8.1: Percentage of Medicare services bulk billed, 1984/85 to 2003/04



Source: Medicare Australia, *Medicare statistics*, 2006.

Australia's PBS system was a world-class system, delivering accessible, affordable quality medicines, which the Australian Government subsidised and guaranteed for the entire population.[622] It was recognised internationally as a 'superior pharmaceutical pricing scheme', and described as 'controlling costs … to pay what the drugs are therapeutically worth'.[623] The schedule expanded and, by the early 1990s, it covered drugs for most common treatable conditions.[624]

In order to gain a listing on the PBS, a drug had to be assessed for safety, quality and efficacy (under criteria specified in the *National Health Act 1953*) by the Australian Drug Evaluation Committee, a committee of the TGA.[624] After a drug was recommended, its sponsor applied to the Pharmaceutical Benefits Advisory Committee (PBAC) for listing on the PBS, and the Pharmaceutical Benefits Pricing Authority negotiated a price to be paid to the manufacturer. Despite lower growth after 2000-01, the PBS remained the fastest growing area of health expenditure, because of:

- the listing of newer and more expensive drugs;
- some over-prescribing;
- consumer expectations;
- the ageing of the population; and
- intensive marketing by the pharmaceutical industry.[624]

The PBAC also played a major role in implementing the *National Medicines Policy*.[625] This policy identified the need for a partnership of many stakeholders (Australian governments; health educators, practitioners and health care providers and suppliers; health care consumers; the pharmaceutical industry; and the media) to work together to achieve better health outcomes 'for all Australians, focusing especially on people's access to, and wise use of, medicines'.[626]

The PBS was a key factor in the pharmaceutical control of chronic diseases, as it ensured the availability of many useful drugs. Drug safety was regulated by the TGA, which monitored the safety and quality of pharmaceuticals and medical devices. 'Quality Use of Medicine' initiatives were important in making the best use of medications (Box 8.1).

The Australian Code of Good Manufacturing Practice for medicinal products (fully implemented in 2003) was the mechanism by which a manufacturer had to demonstrate compliance with good manufacturing practice in order to be licensed to manufacture a therapeutic good in Australia.[628]

The TGA was also responsible for public health assessments of agricultural and veterinary chemicals and operated an Office to support the Gene Technology Regulator.[318] Under the *Gene Technology Act 2000*, a national scheme for the regulation of genetically modified organisms was established, to protect the health and safety of people and the environment, by identifying and managing risks posed by gene technology, and by regulating genetically modified organisms.[629]

Box 8.1 Quality Use of Medicines

Quality Use of Medicines (QUM) was one of the central objectives of Australia's *National Medicines Policy*. The goal of the National Strategy for QUM was to make the best possible use of medicines to improve health outcomes for all Australians. QUM meant:

- selecting management options wisely;
- choosing suitable medicines if a medicine was considered necessary; and
- using medicines safely and effectively.

QUM applied equally to decisions about medicine use by individuals, and those that affected the health of the population.

The term 'medicine' included prescription, non-prescription and complementary medicines.[627]

In relation to medical technology and devices, GPs and specialists prescribed drugs and ordered diagnostic tests; surgeons and other specialists selected appropriate procedures, prostheses and medical devices; and hospitals purchased large diagnostic and surgical equipment and administrative support systems.[558] Australia had a number of rationing systems in place, for instance, to ensure appropriate access to very expensive diagnostic equipment, such as MRI (Magnetic Resonance Imaging) machines.

The TGA had the role of safeguarding public health and safety by regulating medicines, medical devices, blood and tissues. Problems with medicines (including vaccines) and medical devices, including adverse reactions, device incidents, product deficiencies and defects, were reported to the TGA for investigation and appropriate action (such as recall of a product).

The technique of Health Technology Assessments (HTA) was developed and used by government to evaluate health care technologies, inform technology-related policy-making in health care, and ensure that the technologies that were introduced were appropriate and cost-effective. Community awareness of new technologies, however, was an important driver of demand.

Factors critical to success

Universal access, when coupled with high quality services and affordable medicines, represented the epitome of a successful health care system. Medicare was designed to be a 'universal and institutionalised' health insurance system. The risks of individual and population ill health were insured against collectively. Australia's health care system, and especially its universalism, were highly valued by the community, and defended by most of those to whom it applied.[630]

> *'The principle of universality, on which Medicare has been built, takes seriously the reality that sickness and accidents happen chaotically to any of us, and that a humane and caring society wishes all its citizens to have the same access to the same standard of care, according to need, and unrelated to their financial status.' – S Leeder, 2003.*[630]

In a world of rising health care costs, the cost-effectiveness of Australia's universal health care system was a crucial factor in its political success, and, with growing bipartisan support, it developed into an enduring institution.

Cost-effectiveness

The advent of bulk billing and the various changes to payment systems introduced by Medicare Australia, helped restrain the costs of health care in Australia. With administrative costs at 3% of total turnover, Medicare Australia processed more than 400 million transactions annually, paying benefits of approximately $16 billion, through a network of 238 offices and over 1,000 access points in pharmacies and rural transaction centres, national telephone claiming, call centres and online services.[611] Medicare Australia claimed to be 'one of the largest and most efficient health benefit and information processing agencies in the world'.[611]

Preventable health care-related adverse events, however, were estimated at $2 billion a year in direct costs (5% of annual health care expenditure), and indirect costs of $400 million a year in legal and compensation expenses (about 1% of the health budget).[631] These were likely to increase as health care became more complicated and susceptible to medical error.[631]

In 2003, a comparison of the costs of pharmaceuticals under the PBS and those under the United States system indicated costs of up to $2.4 billion per year less in Australia.[632]

> ***Survey respondent:*** *'Universal access to health care, a.k.a. Medicare, was one of the world class achievements for public health. Look at the vast populations of the world who did not have such basic guarantees and what inequities were created in health status. And Medicare was absolutely an example of "the organised approach by society". It has to be on the list!'*

Cost-benefit analyses were used routinely in these public health areas, underpinning decisions to list pharmaceuticals on the PBS, to include new vaccines in the universal immunisation schedule, and to implement new screening programs (e.g., bowel cancer screening, newborn hearing screening). PBAC's routine use of cost-effectiveness techniques, as the basis for price negotiations with manufacturers, demonstrated that decisions to fund new drugs could be based on formal measures of cost-effectiveness, in addition to factors such as the quality of underlying evidence, the magnitude of clinical benefit, and the availability of alternative treatments.[624]

Cost containment measures, such as the use of generic drugs listed on the PBS to constrain the cost and use of higher priced but clinically equivalent non-generics, and the 'benchmarking' of medical devices remained cost-effective strategies. For example, the *National Health Amendment (Prostheses) Act 2005* was expected to 'have a significant impact on reducing growth in private health insurance premiums by reducing the rate of growth in prostheses benefits' as a range of clinically effective prostheses was to be available at 'no gap' prices.[633]

There were suggestions that new devices (e.g., prostheses) would have to prove that they performed better than existing items in order to be eligible for approval for addition to the Australian Register of Therapeutic Devices.[634] These measures would effectively constrain price increases and improve the value for money of these public financing systems.

The Productivity Commission, reporting on the impacts of advances in medical technology, determined that it was likely that the overall benefits had outweighed the costs.[558] The Commission noted that the cost-effectiveness of individual technologies varied widely, and was not able to be ascertained for all, and that technology also drove increasing health care costs.

Future challenges

Further challenges lay in improving the equity and universality of access to quality health care. In 2003, Leeder identified areas where Australians did not have equitable access for a variety of reasons:

> *'Some general practitioners have closed their books, health care services are scarce in poorer areas, and, in rural towns, "up-front" payments for consultations are increasing while bulk-billing is in decline… Public hospital infrastructure [was] growing old and need[ed] replacement…Access to high technology is patchy (e.g., investigation and treatment of heart disease is more common among privately insured patients). Access to timely surgery is uneven, with private patients getting it quickly and public patients waiting longer….Access to dentistry and ancillary health care services is inequitable – better access to high-quality services is offered to those who are privately insured and/or wealthy' – S Leeder, 2003.*[630]

Better access of rural, remote and Indigenous populations to a range of health services, especially medical specialists and specialised treatments for cancer and other chronic diseases was required.[558] Universal services also needed to be customised further for socioeconomically disadvantaged populations, including Aboriginal and Torres Strait Islander peoples.[611]

There was a need to minimise the effects of inappropriate antibiotic and other pharmaceutical use, limit unnecessary diagnostic tests (e.g., X-rays) and prevent pharmaceutical misadventure. Pharmaceutical side effects, over-prescription and over-dosage were significant causes of hospital admissions, illness and some avoidable deaths.

Demand for health care itself, and for medical technology, needed effective and ongoing management, as community expectations of medical technology and health care continued to rise.[635] The Productivity Commission noted that there were variations in cost-effectiveness, and relatively low use of some technologies by some demographic groups (e.g., Indigenous Australians were significantly less likely to undergo heart procedures such as angioplasty with stenting, even though they had a higher prevalence of coronary heart disease).[558] Their findings indicated that there was scope to further reduce inequalities in access to health care.

High failure rates in some hip and knee replacement devices were of concern, and the TGA established a review of the process for prosthesis approval.[636,634] The 2006 Inquiry into Health Funding recommended an outcomes-based assessment process be introduced to examine the clinical benefits of new prostheses prior to their use, and to review the effectiveness of those already in use (Box 8.2).[637] Generally, public health needed to improve registers, tracking, auditing and monitoring of the quality of devices and procedures that utilised them. Device recalls, retrieval and disposal also required attention.

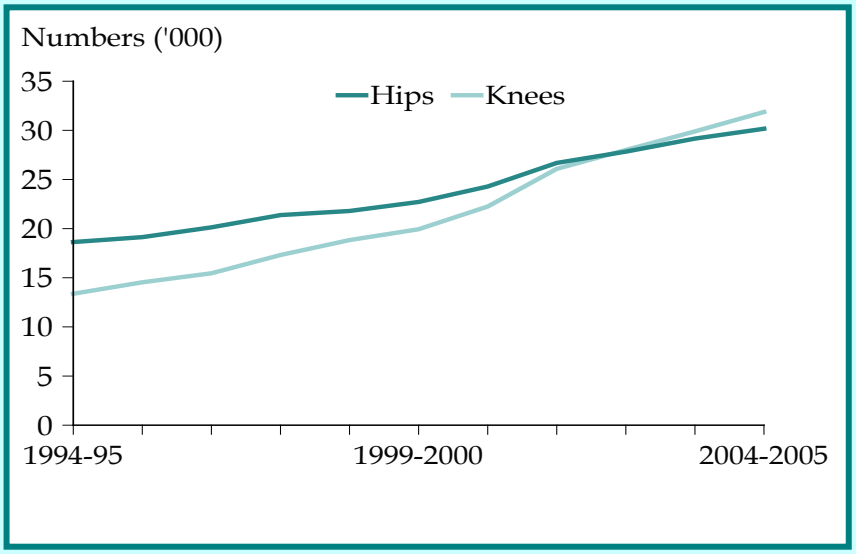
The report of the House of Representatives Standing Committee on Health and Ageing's Inquiry into Health Funding in 2006 highlighted the persistent bias of health funding agreements in treating rather than preventing illness, and in failing to promote wellness.[637] While acknowledging the extension of services covered by the MBS (e.g., to include GPs providing coordinated care for chronically ill patients and incentives for earlier intervention in selected at-risk groups), the report noted that there were clear benefits in investing in prevention and earlier detection of chronic conditions, to avoid significant costs of future hospital treatment. It also highlighted the need to strengthen the capacity of primary health care services to promote wellness and continuity of care.

The government subsidising of private health insurance and private health services was one further challenge to its capacity to provide equitable and universal access to quality health care across Australia. Continuing reform of the Australian health system was needed to meet the needs of an ageing population, shortages in the health workforce, the rapid rate of development of new health technologies, and the increasing complexity of health care and rising community expectations.

Box 8.2 Improving artificial joint and hip replacement procedures

The National Joint Replacement Registry (NJRR) was established in 1999 to provide data on the outcomes of patients receiving hip and knee replacements. The Registry linked 'an individual patient, their diagnosis, the operative joint and the specific prostheses used'.[636] The success of a procedure could be determined by linking data to subsequent procedures for that individual. Joint replacement was one of the commonest surgical procedures undertaken in Australia. In the period 1994-1995 to 2004-2005, the number of procedures increased by 93.8% (Figure 8.2), and was expected to increase as the population continued to age.

Figure 8.2: Hip and knee replacement procedures, 1994-1995 to 2004-2005



Source: Graves & Wells, *A review of joint replacement surgery and its outcomes*, 2006, p. 16.

A 2006 review estimated that the outcome data from NJRR had led to a significant reduction in the number of revised hip and knee replacements, equivalent to 1,200 fewer operations a year. In addition to substantial patient benefits, this reduced expenditure by around $16-32 million per year. The cost of operating the registry was less than 0.1% of expenditure on joint replacement surgery.[638]

The NJRR could also identify emerging problems. Faulty prostheses could be identified and removed from the market far sooner with a national registry. In the USA, where no registry existed, it could take hundreds or thousands of operations before a faulty prosthesis was identified. A critical factor in the success of the NJRR was the central role of orthopaedic surgeons, both individually and through their professional organisation, in obtaining the cooperation of other stakeholders – hospitals, orthopaedic prosthetic companies and state governments – and an Australian government commitment to fund the Registry.[636]

Table 8.1: Historic highlights of universal access to health care, pharmaceuticals and technology

1919	Repatriation Pharmaceutical Benefits Scheme established to provide free pharmaceutical products to ex-service men and women who were veterans of World War I and the Boer War.
1937	*Therapeutic Substances Act* passed but not promulgated and later repealed by the *Therapeutic Substances Act 1953*.
1947	*Pharmaceutical Benefits Act 1947.*
1948	Items listed in the Commonwealth Formulary supplied at Commonwealth expense to remote health establishments (e.g., bush nursing centres) approved as hospitals, for the purpose of providing pharmaceutical benefits to geographically isolated communities.
1950	Implementation of a wider-reaching but limited scheme to make a list of 139 'life saving and disease preventing drugs' freely available to the community under the *Pharmaceutical Benefits Act 1947*.
1953	*National Health Act 1953* passed.
1954	Pharmaceutical Benefits Advisory Committee (PBAC) established, to recommend drugs and medicines to be subsidised by pharmaceutical benefits.
1956	*Therapeutic Substances Act 1953* enacted.
1960	Pharmaceutical Benefits Scheme (PBS) introduced following the passage of the *National Health Act No. 72 1959*, and an expanded range of drugs available for the general public.
1964	Adverse Drug Reaction reporting scheme for prescription medicines introduced.
1968	Scotton and Deeble published proposals for a compulsory national health insurance scheme.
1969	The Committee of Inquiry into Health Insurance, chaired by Mr Justice Nimmo reported, and both sides of politics committed themselves to reform of the health system.
1970	The Adverse Drug Reactions Advisory Committee (ADRAC), a subcommittee of the Australian Drug Evaluation Committee (ADEC) formed to advise on the safety of medicines.
1973	Oral contraceptives listed on the PBS for the first time.
1974	Establishment of the Health Insurance Commission.
1975	Establishment of Medibank, the first tax-funded universal health insurance scheme. Community health centres established.
Early 1980s	The National Health Technology Advisory Panel (NHTAP) formed. Medibank dismantled.
1984	Medicare set up and the Therapeutic Device Program established.
1986	'Safety net' arrangements established to protect chronically ill people from huge pharmaceutical costs. NHTAP replaced by the Australian Health Technology Assessment Committee (AHTAC).
1989	Commonwealth *Therapeutic Goods Act, 1989*. Therapeutic Goods Administration (TGA) and the Australian Register of Therapeutic Goods (ARTG) established.
1990	Good Manufacturing Practice (GMP) codes introduced.
1997/98	The Medical Services Advisory Committee (MSAC) replaced AHTAC.
1999	National Joint Replacement Registry established to assess outcomes of patients receiving hip and knee replacements.
2000	The *National Medicines Policy* released.
2001	*Gene Technology Act 2000*.
2003	*Therapeutic Goods Act 1989* amended.
2004	The Prostheses and Devices Committee (PDC) established to advise on listing and benefit levels of prostheses and medical devices.
2005	The Health Insurance Commission became Medicare Australia. Bulk-billing incentives increased. *National Health Amendment (Prostheses) Act 2005* passed.
2006	Highest Medicare bulk-billing rate since 1984 (at 76.6% for the June quarter 2006).

9 Improving public health practice

At the start of the 21st century, the primary functions of public health interventions were to protect and promote health and to prevent illness, injury and disability in the population.[9] Some enabling (or instrumental) activities were also required to make sure that the public health sector had the capacity, capability and competence to achieve its primary functions (Figure 9.1).[639] The development and maintenance of a skilled workforce, essential infrastructure, partnerships and research were critical to the role of public health, and underpinned its success.

Figure 9.1: An overview of public health functions

Primary functions	Assess health of populations	Monitor health Evaluate health risks and benefits Assess health inequalities
	Protect the public from threats to health	Prepare for threats to health Respond to threats to health Control and mitigate risks to health
	Promote health and prevent disease, disability and injury of populations	Promote health and wellbeing Prevent the occurrence of disease, disability and injury Detect disease, disability or injury in its early stages
Instrumental functions	Ensure public health capability	Develop and maintain the public health workforce Develop and maintain public health infrastructure Build public health partnerships
	Build the evidence base for public health	Conduct public health research Evaluate public health interventions

Source: Gruszin et al., *Public Health Classifications Project, Phase one: final report*, 2006, p. vi.

Modern public health practitioners operated in a variety of settings, using a range of methods that drew on many scientific disciplines, technologies and skill-sets (e.g., communicable disease control, food safety, health education, social marketing and urban planning).[639] The public health sector also facilitated partnerships at all levels of government (i.e., national, state and local governments) and with other agencies, including educational institutions and schools, workplaces, road safety units, product manufacturers, environmental protection authorities, non-government organisations (NGOs), community groups, and those representing consumers (Box 9.1), as well as academics and researchers.

The Australian government was the major source of public health funding, while the state and territory governments mostly applied those funds.[111] Public health activity was costed at the program level and its success or otherwise was determined using technical measures such as effectiveness, population health status indicators, disease burden and potentially avoidable mortality.[13,357,557]

Public health employers and occupations were varied: there was no single occupation or industry group.[640] The workforce was pyramid-shaped, with a small percentage of dedicated public health specialists, and a larger majority of 'general health and associated workers' who undertook public health activities on either a regular or occasional basis.[639]

Many public health activities occurred outside of the government health sector: in local government, community groups, schools, kindergartens, workplaces, health-related NGOs, and non-health government departments, including planning and environmental protection agencies. Some traditional public health functions were funded by non-health portfolios (e.g., sewage disposal, provision of safe drinking water).

Significant public health functions that developed over the 20th century are described in this chapter. Essential resource and infrastructure components of public health included:

- healthy public policies;
- the public health workforce, and workforce development capacity (e.g., university and other training courses);
- funding and investment;
- partnerships;
- technical and physical infrastructure (e.g., public health laboratories and public health units in state and territory Health Departments);
- information and data collection systems (e.g., notifications of infectious diseases, population health surveys, registers – children immunised, cancer cases); and
- legislative infrastructure (e.g., public health lawyers, laws, regulations and standards).

Box 9.1 Consumers' Health Forum of Australia, 1987-

The Consumers' Health Forum of Australia (CHF) was an important part of the public health infrastructure that was created in the 1980s. It was an independent member-based, non-government organisation for health consumers. It helped shape Australia's health systems by representing and involving consumers in health policy and program development.[641] It received funding from the federal Department of Health and Ageing.

Health policy was developed by the CHF through extensive consultation with members, ensuring a broadly representative health consumer perspective, rather than narrower political or sectional interests. Priority consumer health issues for CHF included:

- the safety and quality of health care;
- appropriate use of medicines; and
- effective health care for people with chronic conditions.[641]

Government involvement in public health started with policy that was frequently enacted in legislation. Legislation and regulation, and their monitoring and enforcement were pivotal tools in underpinning public health effort from colonial times (pre-Federation) (Box 9.2). The first national public health legislation in Australia was the Commonwealth *Quarantine Act 1908*.[30] While this *Act* provided for enforcement powers to detain and isolate individuals, much of the later public health legislation focused on changing population attitudes and behaviours, such as legislating for the mandatory wearing of seat belts in cars, and to limit alcohol intake when driving.

Box 9.2 Early public health legislation

The first comprehensive attempt at regulating public health was the English *Public Health Act 1848*, which

'provided remedial powers for nuisances and authorised the undertaking of public health work… provided controls over slaughter houses, common lodging houses and offensive trades. It contained building requirements; that all houses had to be built with drains, where possible connecting with a sewerage system or if not, a cesspit. It… created a public health structure; a General Board of Health was established as a national public health authority. At a municipal (local council) level Local Boards of Health were established with the power to appoint surveyors and inspectors of nuisances.[30] Responsibilities for sewers were vested in the Local Board and there were powers to control and cleanse'.[30]

The first public health act in Australia was the Victorian *Public Health Act 1854*. The English *Public Health Act 1875*, and the smallpox epidemics in the 1880s produced further colonial public health legislation: in Victoria in 1883 and 1889; Queensland in 1884; Tasmania in 1885; WA in 1886; SA in 1884 and 1898; and NSW in 1896.[9]

Public health practices

At the beginning of the 21st century, the public health sector had built an evidence base by conducting public health research and evaluating public health interventions. Interventions – programs, services and activities – addressed health issues across the areas of population health and wellbeing, diseases and conditions, injury, disability and functioning, as well as other areas (e.g., environmental, and socioeconomic factors) that also affected the population's capacity to be healthy.

Australian public health research was internationally applicable, from vaccine development to epidemiological studies (Section 9.3). Basic science, undertaken across many disciplines from microbiology to toxicology, supported public health epidemiology and played a major role in health interventions (e.g., in identifying the dangers of asbestos). The social sciences informed health promotion, health education, health policy development, social

marketing and other behavioural interventions, and were used in research, the investigation of the burden of disease, and the evaluation of program implementation. Survey design, data analysis and anthropological methods were other important tools used to support public health activity.

Evidence-based medicine made a significant, and growing, contribution by identifying gaps between current public health practice and best evidence practice (for example, the systematic reviews of evidence undertaken by the Cochrane Collaboration, and studies by the National Institute of Clinical Studies).[126, 642] Health economics evolved as a discipline, developing tools to model comparative information for use in resource allocation and priority-setting for investment in public health. For example, it became good practice to base policy decisions about inclusions to the national immunisation schedule (and to other national programs, such as the PBS and organised cancer screening programs) on cost-benefit and cost-effectiveness studies.

Public health data collection was funded, although there was an opportunity for further investment in data analysis and its use in supporting policy development. Monitoring, surveillance and the assessment of population health were increasingly important tools for public health (Section 9.4).

Many public health practitioners surveyed for this report commented on the crucial importance of public health legislation in relation to many of the public health successes described in this report (Box 9.3). Australians were generally prepared to accept that some of their individual civil liberties would be restricted for the sake of the public good. They had, in the main, endorsed the introduction of strategies such as the wearing of seatbelts, random breath testing, and smoke-free premises' legislation, in a similar way to their acceptance of the need for quarantine for the treatment of infectious diseases in earlier times (e.g., people with tuberculosis agreed to go to sanatoria for treatment).[76] When quarantine was inappropriate, as for example, for people living with HIV/AIDS, the law was used to address possible discrimination, which might have impeded public health actions to protect the wider community and treat sufferers.

Tobacco hypothecation (the principle of taxing tobacco to pay for strategies to reduce tobacco usage), and the creation of health promotion foundations, were 'world firsts' in public health legislation. The taxation system was also used as a public health tool, with consumers paying more for some unhealthy products (e.g., increased taxes on tobacco).

National public health policies aimed to provide a consistent response by governments to public health issues, and to set parameters for action and targets to be achieved. Examples included the *Tuberculosis Control Strategy*, the *National Tobacco Strategy*, the *National HIV/AIDS Strategy*, the *National Women's Health Strategy* and the *National Aboriginal Health Strategy*. In the latter half of the century, uniform national legislation and strategies were enacted and implemented at jurisdictional levels with appropriate local adaptation (e.g., in road safety, occupational health and safety, and food safety).

Box 9.3 Legislation identified as public health successes by survey respondents

The *Pure Food Acts*

Public health legislation 'provided security (e.g., food could not be intentionally or unintentionally contaminated, asbestos had to be collected and disposed of in specific ways, cars had to have specific safety features)'

Legislation to control and isolate infectious cases of notifiable diseases

The Harvester Judgement (living or basic wage)

Increasingly stringent legislation to ensure air, food, water and product quality – and greater penalties for failing to do so

Food surveillance and regulation

Occupational health and safety legislation

Road safety – compulsory seat belts, motor cycle helmets, drink driving legislation, speed limits

Legislation to change behaviours at a population level: drink driving legislation, seat belt wearing legislation

Introduction of Australian standards for items from baby baths to toys, vehicles to clothing

Gun control – changes in legislation (after the Port Arthur tragedy) to reduce gun deaths

Australia was an early pioneer of health impact assessment methodology and in the development of municipal public health plans (Box 9.4).

Australian public health advocates also contributed to international public health forums, chief among which was the World Health Organization (WHO). Australia had an ongoing relationship with the WHO from its inception, and participated in global public health efforts, such as the successful smallpox and polio eradication programs, and the subsequent measles' eradication campaign. Australian public health reference laboratories provided annual data to the WHO on the strains of influenza in the region. There was also a national commitment to contributing data on a wide range of health indicators, to allow international comparison and monitoring of population health and wellbeing.

Box 9.4 Health impact assessment

'At the policy level, Health Impact Assessment (HIA) [was] gaining increasing recognition as a tool for assessing the potential effects of a policy or program on health. HIA which systematically addresses equity also offered a way of incorporating equity concerns into the decision-making process. However, HIA was a comparatively new field, and decision makers were not usually trained in assessing the impact of policy decisions on equity. Through the Public Health Education and Research Program, the Australian government commissioned the development of an HIA framework to assist decision makers in systematically identifying potential health equity impacts of policies. This equity-focused HIA framework was tested to assess whether and where it added value to the decision-making processes.'[643]

Other significant components of public health not detailed in this report were public health laboratories, including reference laboratories that typed and provided critical data on infectious diseases; and dedicated public health physical infrastructure, such as sentinel animal programs (e.g., the 59 sentinel chicken flocks maintained around Australia to provide early warning of infectious viruses).[644]

The modern public health practice of preparing for and responding to public health emergencies was another important component, which involved:

- establishing systems and means of effective command;
- control and communication strategies to ensure that there were coordinated responses to emergencies and disasters (e.g., natural disasters such as bushfires, floods and cyclones); and
- nation-wide planning (e.g., for avian flu and other pandemics).[645]

Survey respondents: *There were public health successes in 'Smoke free and QUIT smoking initiatives as part of a multi-pronged approach – health promotion, legislation, incorporation into acute care – [where] balances have been struck between individual and community rights.'*

'Driven by and owned by the population, there is increasing awareness of healthy behaviours (i.e., food selection, exercise, mental and spiritual health) and scepticism about the appropriateness of certain medical interventions. The health sector has inputted in many important ways into changing beliefs about health – through information, individual consultations and through dialogue at all levels.'

Communication strategies in these cases included the need to inform the community and control public panic, as this could cause problems in addition to those related to the original emergency (demonstrated internationally after the SARS outbreak). While identifying these response systems as components of successful public health practice, survey respondents suggested that they could not as yet be cited as successes as they were still largely untested. The implementation of risk mitigation strategies, health impact assessments, and some other risk-related techniques were also relatively new developments that needed further assessment over the longer term to determine their efficacy.

There was no doubt that the public health practice of 'an organised response' to the protection and promotion of health and the prevention of illness, injury and disability in the population saved lives during the 20th century. Supporting, training and developing a specialised public health workforce (Section 9.1), conducting public health research

Survey respondent: *'Getting organised saves lives.'*

(Section 9.3), and monitoring and surveying the population's health (Section 9.4) were some of the essential elements. The successful establishment of an Aboriginal Community-Controlled Health sector is also included in this chapter, as it developed over more than thirty years into an organised, extensive and sustainable service, dedicated to improving the health and wellbeing of Indigenous Australians (Section 9.2).

Further public health practices operated over the longer term, and required sustained investment and the dedication of resources to this end. Many of the strategies and achievements described in this report were achieved after decades – in some cases, a century – of effort and investment by the public health sector.

Finally, the practice of public health included the many ways in which public health practitioners engaged with the community in promoting health and maintaining safe environments, and in warning of health risks. In the later decades of the 20th century and in the 21st century, public health successfully shifted its emphasis from legal coercion to strategies that encompassed persuasion, engagement and participation in working towards the public health ideal of 'an active partnership with citizens'.[1]

9.1 Training the public health workforce

1907 onwards

The earliest national government investment in public health education and training occurred in 1907, with the formation of the Australian Institute of Tropical Medicine (AITM). It was subsequently incorporated into the School of Public Health and Tropical Medicine (established in 1930), as part of the federal Department of Health, but based at the University of Sydney.[646] At the start of the 21st century, the Anton Breinl Centre for Tropical Medicine (named in 2002, in honour of the director of AITM from 1910 to 1921) occupied the site of the original AITM, at the James Cook University in Townsville.

The Australian and New Zealand Society for Epidemiology and Research into Community Health, established in the late 1970s, was one of the first professional associations to make a contribution to the development of public health practice, research, policy and debate, especially via its peer-reviewed journal. It became the Australian Public Health Association (APHA) in 1986, taking on a broader role in advocacy and policy development. By 2006, the Public Health Association of Australia (PHAA) had contributed policies and advocacy across the spectrum of public health issues, held an annual conference for public health practitioners, and had special interest groups to maintain 'watching briefs' on particular public health areas.[647]

The PHAA was one among many public health organisations, which also included the Australian Health Promotion Association, the Australasian Faculty of Public Health Medicine, the Australian Epidemiology Association, the Australian Institute of Environmental Health, the Biostatistics Collaboration of Australia, and the Health Services' Research Association of Australia and New Zealand.

> ***Survey respondent:*** *'[The] Kerr White report of 1986 recommended expansion of public health training in Australia to build workforce capacity so that today public health professionals deliver a breadth of services to support the above listed public health interventions that were previously unimagined or dependent on small numbers of elite practitioners, and therefore unable to be implemented or limited to large population centres.'*

When the federal government commissioned the Kerr White review of the research and educational requirements for public and tropical health in 1986, there was only one School of Public Health in Australia.[648] The Kerr White Review Report (1986) recommended a decentralisation of public health training and the redistribution of funds, from the School of Public Health and Tropical Medicine, to new public health institutions across Australia.

It also proposed that:

- public health training become more multidisciplinary;
- a Public Health Education and Research Program (PHERP) be formed;
- an Australian Institute of Health be established; and
- a principal committee of the NHMRC be dedicated to public health research (the Public Health Research and Development Committee).[648,649]

The report emphasised the need to orientate the health services' sector towards a more preventive focus.[650]

In response to the recommendations of the Kerr White Review, the federal Department of Health established the Public Health Education and Research Program (PHERP) (which , *inter alia,* established postgraduate public health education programmes in universities other than Sydney and James Cook), the Public Health Research and Development Committee of the NHMRC, and the Australian Institute of Tropical Medicine (which was re-established at the James Cook University of North Queensland, after an absence of 56 years).[649] PHERP was an initiative to strengthen national capacity to educate and train the public health workforce, and apply a greater focus on prevention.[650,651]

Public health practices

By 2006, both undergraduate and post-graduate courses (e.g., Master of Public Health (MPH), Master of Applied Epidemiology) were available, and there were approximately twenty MPH courses across Australia (Box 9.5). Although there were more schools of public health than twenty years earlier, and university faculties of public health in all jurisdictions, most had not attracted large numbers of 'high quality' postgraduate students, and a dearth of such students was a major barrier to public health research.[655] The Australian Network of Academic Public Health Institutions was formed to promote collaboration among Australian academic institutions involved in public health education and research, and to partner with governments to respond better to the national interest.

The growth of public health education in Australia contributed significantly to increased capacity; and greater investment in the tertiary education sector resulted in more public health undergraduate and MPH degree courses, and in the numbers of public health doctorates. The development of the *Population Health Competencies and Qualifications Package* by the Industry and Skills Council for the Vocational Education and Training sector was another important initiative to strengthen public health practice in Australia.

Box 9.5 Public health officers' training programs, 1993-

The Victorian Public Health Training Scheme (VPHTS), an opportunity to develop a broad understanding and exposure to public health practice in Victoria through a two year full-time training program, was an initiative of the Public Health Division of the Department of Human Services, and accredited by La Trobe University. For medical graduates, the program was accredited by the Australasian Faculty of Public Health Medicine of the Royal Australasian College of Physicians.[652]

VPHTS was structured to develop public health competencies and skills through practical experience with six placements in a range of public health settings. A position on the scheme was designated specifically for a person of Aboriginal or Torres Strait Island background.

VPHTS won the 2005 B-HERT National Award for Outstanding Achievement in Education and Training Collaboration, awarded by the Business and Higher Education Round Table.

NSW also had a well-established, three year Public Health Officer Training Program (from 1994).[653,640] The first Indigenous trainee completed the Program in 2001.[654] By 2005, WA had also commenced a three year competency-based Population Health Training Program.[650]

Additional capacity in tropical medicine resulted from Commonwealth core funding for the Anton Brienl Centre, and the Australian Centre for International and Tropical Health and Nutrition, established in 1995 as a joint venture between the Queensland Institute of Medical Research and the University of Queensland. PHERP also funded the National Centre for Epidemiology in Population Health (NCEPH) at the Australian National University in Canberra, as well as individual universities and consortia offering postgraduate degrees and short courses for the professional development of the public health workforce.[651] General Practice Divisions, medical colleges and professional associations were other points of contact for public health practitioners from various disciplines.

In response to public health workforce needs in national priority areas identified by the PHERP Review, Australian government funding was made available for the 2006-2010 phase of PHERP to target specific workforce needs in:

- Indigenous health;
- biosecurity and disaster management;
- obesity, physical activity and nutrition; and
- other emerging priorities.[651]

> ***Survey respondent:*** *'The universities were the successful drivers who introduced public health training to health professionals [and] should be encouraged to introduce public health curricula and courses in disciplines such as engineering, business management, finance, economics, politics, and philosophy.'*

Innovative approaches in education and training technologies contributed significantly to the development of public health infrastructure, and this investment enabled public health education to become more widely available across Australia. Later directions included innovative delivery modes such as web-based, intensive and semester-length approaches; distance education modules for practitioners in rural and remote Australia and those working with Indigenous communities; mentorship arrangements; capacity building in Equity-focused Health Impact Assessment; and the establishment of registrar positions to enhance the public health capacity of general practitioners.[651]

There were significant increases in the Indigenous public health workforce, mainly during the latter part of the 20th century. By 2003, there were over 50 trained Indigenous medical practitioners, while 35 Indigenous students had commenced a course in general medicine in 2002.[656] Membership of the Australian Indigenous Doctors' Association (AIDA) in 2003 included 55 Indigenous medical practitioners and 70 Indigenous medical students.

Several initiatives to improve Indigenous workforce capacity were underway. For instance, the Puggy Hunter Memorial Scholarship Scheme, (established in 2002) provided scholarships for Indigenous students in health careers. AIDA and the Congress of Aboriginal and Torres Strait Islander Nurses continued to increase their capacity and assistance and support to members, especially medical and nursing students.

Factors critical to success

Improvements in training, the increasing professionalism of the public health sector, and the implementation of a continuous learning model were some of the critical factors in the development of the public health workforce. The growth of public health education successfully contributed to increasing public health capacity and capability.

For public health medical practitioners and other professional public health staff, continuous refreshment of skills became the norm, as the knowledge required to fulfil their roles increased over time. The availability of specialised training and development, and greater professionalisation were all nominated as public health successes by survey respondents.

The development of an Indigenous public health workforce, including the roles of Aboriginal and Torres Strait Islander Health Workers and Environmental Health Workers (Box 9.6 and Box 9.7), and increasing numbers of Indigenous doctors, nurses, allied health professionals and researchers began to make a contribution, but more progress was still required.

Future challenges

In considering the future directions for public health workforce development, the PHERP Review identified that innovative strategies were needed to respond to the future challenges of:

- globalisation;
- transformations in science and medical technologies (e.g., genomics and health informatics);
- demographic and community trends;
- the changing nature of work, and of the health workforce;
- the evolution of health systems and the impact of health system reform; and
- the demands of health stewardship and leadership.[650]

The skills' shortage directly affecting the health industry and an older health workforce resulting from Australia's increasingly ageing population were major challenges.[659] Continued improvements in population health depended on securing a sufficient future supply of qualified public health practitioners.

Box 9.6 Developing an Indigenous public health workforce

The development of an Indigenous public health workforce began with the important roles of Aboriginal and Torres Strait Islander Health Workers and Environmental Health Workers. By 2001, there were 853 Aboriginal and Torres Strait Islander people employed as Health Workers, representing almost 23% of all Aboriginal and Torres Strait Islander people in health occupations (3,742 people) and 93% of all workers in this occupation.[657] The 114 Aboriginal and Torres Strait Islander Environmental Health Workers were 3.5% of the 3,302 people employed in this occupation, and 3% of all Aboriginal and Torres Strait Islander people working in health occupations.

The endorsement of the Aboriginal Health Worker and Torres Strait Islander Health Worker national competency standards in 1998 first recognised the role of these health workers nationally. Later, revised national competencies and qualifications in Aboriginal and Torres Strait Islander health work introduced a national standard of qualifications, clarified their role and helped strengthen the recruitment and retention of Indigenous Health Workers.

A strong Indigenous public health workforce required effective recruitment, development, training and retention practices, as identified by the PHERP Review on strengthening workforce capacity for population health.[650] More Indigenous academics were needed to lead and teach these programs.[658]

Although a good start had been made, increasing Indigenous public health workforce recruitment, development, training and retention (as recommended by the PHERP Review) remained significant issues.[659] Building public health capacity in the broader health workforce and related industries, such as transport, housing and urban planning, was also essential.

Innovative strategies were required to address recruitment and retention issues in the public health workforce, including improved workforce monitoring and planning. A coordinated system for the collection of public health workforce information and data was needed to ensure that the numbers and distribution of public health practitioners were adequate for future requirements.

Box 9.7 Environmental Health Workers in Indigenous communities, 1993-

Environmental Health Workers promoted and enhanced environmental health (housing, water quality, control of mosquitoes and other vectors, refuse, food safety and sewage) in Indigenous communities. They were first introduced in the NT in 1993, and were subsequently employed in most states and territories.[658]

9.2 Aboriginal Community-Controlled Health Services

1971 onwards

In 1971, the first Aboriginal Community-Controlled Health Service (ACCHS) was established by the local Aboriginal community in the suburb of Redfern in Sydney, to address the discrimination experienced in mainstream health services, the ill health and premature deaths of Aboriginal people, and the need for culturally appropriate and accessible health services.

Community-controlled health service provision was defined as:

> *'… the local community having control of issues that directly affect[ed] their community. Aboriginal people must determine and control the pace, shape and manner of change and decision-making at local, regional, state and national levels…' – The Ottawa Charter for Health Promotion, 1986.*[8]

ACCHSs were characterised by the principle of self-governance. Each was initiated by the local Indigenous community, was based in and controlled by that community, and delivered holistic and culturally appropriate primary health care to Aboriginal people. From 1971 onwards, a growing number of these services delivered community-controlled primary care and health promotion, identifying social health determinants, addressing ways to reduce inequalities, and advocating for improvements in Indigenous health.

ACCHSs adopted an integrated primary health care model that was consistent with the philosophy of Aboriginal community control and a holistic view of health, and with public health perspectives:

> *'Aboriginal health is not just the physical well being of an individual but is the social, emotional and cultural well being of the whole community in which each individual is able to achieve their full potential thereby bringing about the total well being of their community. It is a whole-of-life view and includes the cyclical concept of life-death-life.' – National Aboriginal Health Strategy, 1989.*[660]

The health of Aboriginal and Torres Strait Islander populations improved on a number of measures, but not all, and a very significant disparity in health status remained between Aboriginal and Torres Strait Islander peoples, and other Australians. Some of the infrastructure required to deliver benefits, such as an Indigenous public health workforce, were being addressed in part, and a number of the preconditions for improving health were in place.[656] However, much faster progress was needed.

In 2004, it was reported that Indigenous mortality rates had declined over the four previous decades and life expectancy was expected to improve.[661,662] The contribution of infectious diseases, maternal, perinatal and nutritional conditions to the burden of disease had decreased. Excess mortality and morbidity, however, still persisted, and an increase in chronic diseases also added to the poorer overall health of Indigenous Australians.[663]

Time trends indicated that the health of Aboriginal and Torres Strait Islander populations had improved slightly in those jurisdictions that had the best quality data (SA, WA, and NT). Over the period 1991 to 2003, there was a 16% decrease in deaths from all causes, a 44% decline in infant deaths and a 55% fall in perinatal deaths.[154] Deaths caused by circulatory system diseases declined at a faster rate than for other Australians and the gap between the two narrowed.[154] Low birthweight, however, was still twice as prevalent among infants of Indigenous mothers compared with other infants; and large disparities still remained in the occurrence of chronic diseases, infectious diseases, poor oral health, and hearing loss, and in significantly lower life expectancies.[154]

Alarmingly, some diseases, long since eradicated in the non-Indigenous population, still affected the Indigenous population (e.g., leprosy, rheumatic fever, donovanosis).[664-666] Although there was better management and falling rates of trachoma, otitis media, and sexually-transmitted diseases in some remote communities, more needed to be accomplished in others to address these diseases.

While some observers pointed to the failures in Aboriginal and Torres Strait Islander peoples' health and apportioned blame to the health system for the poorer health in these communities, others, such as Ernest Hunter, believed that, from the time of the first ACCHS in 1971, much had changed for the

better.[656] In the early 1970s, there was a very limited non-Indigenous health workforce, and no Aboriginal and Torres Strait Islander health workforce; little understanding of the policy context of Indigenous health; and virtually no appropriate research capacity.[656] Employment opportunities declined in the downturn of the 1970s and social conditions worsened, community housing and sanitation were 'appalling', health services were poorly resourced, community governance was in its infancy, and new problems were appearing in a policy vacuum.[656]

In 1967, when 90% of eligible voters voted to change the Australian Constitution in a referendum, the Commonwealth parliament was finally empowered to enact laws for Aboriginal peoples and Torres Strait Islanders and to include these Australians in the Census. From 1996, there was an increase of 146% in real terms in Australian government funding for Indigenous-specific health programs, with corresponding increases in the numbers of staff employed in these services and in the episodes of health care provided.[667] By 2003, major capital works in the health sector in the 1980s and 1990s had provided facilities so that health services could be delivered, a (small but growing) workforce had been developed, a federal role in Indigenous Australians' health was apparent, and there was growing cooperation across the divide separating the community-controlled and the mainstream health sectors.

> *'It was only approximately three decades ago that governments began taking Indigenous health seriously, around the time that the community-controlled sector came into being. It is only in the last decade that it has been a national priority.' – E Hunter, 2003.*[656]

Public health practices

The development of ACCHSs was an organised response by Aboriginal and Torres Strait Islander peoples to prevent illness and promote health in their populations, and 'the practical expression of Aboriginal self-determination in Aboriginal health'. ACCHSs aimed:

- to provide sustainable services built up over more than thirty years;
- to address many of the determinants of poor health;
- to be responsive to their communities; and
- to provide effective mechanisms for primary health care delivery.

> ***Survey respondents:*** *The health of Indigenous Australians 'has a long way to go to reduce the health inequalities', and 'needs to be a top priority'.*

There were more than 140 ACCHSs operated by Indigenous communities across Australia in 2005.[669] They varied in size from large multi-functional services providing a range of services and employing several medical practitioners, to small services without medical practitioners, which relied on Aboriginal Health Workers and nurses to provide primary care, preventive health care and health education.[668] Approximately one-third of ACCHSs provided 24-hour emergency care.[668] ACCHSs also played a vital role in linking with mainstream health care services.

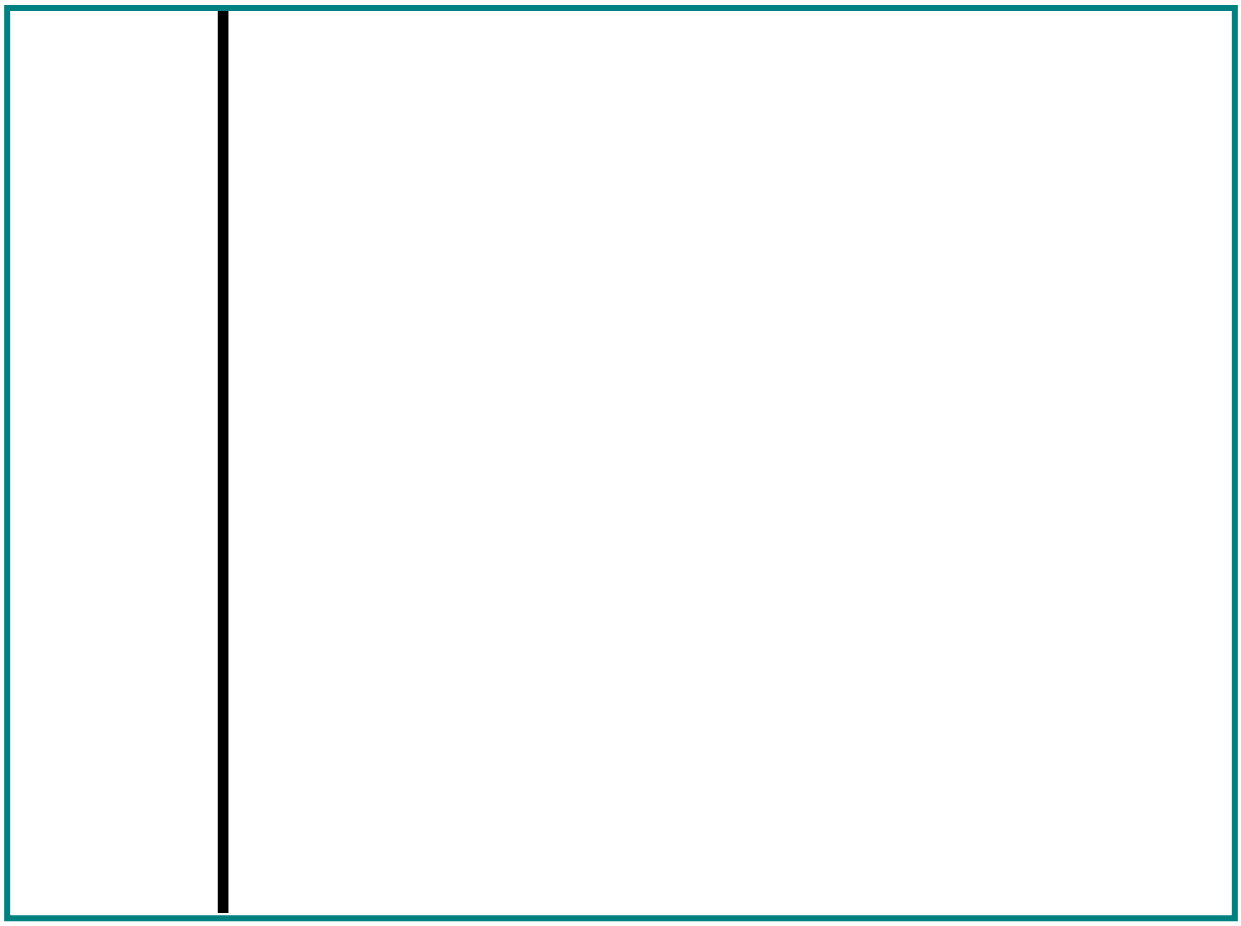
ACCHSs received funding from the Australian government, state and territory governments, or both. The Australian government provided funding to the ACCHSs via the Office for Aboriginal and Torres Strait Islander Health (OATSIH). OATSIH-funded community-controlled health organisations and the Indigenous populations they served were widely spread across Australia, including the most remote areas of the country (Map 9.1).

All Australian government-funded ACCHSs that employed doctors or allied health workers could apply to be covered by Medicare and patients using these services were bulk-billed. This applied to around 120 of the Australian government-funded services. State and territory governments also funded a number of community-based Indigenous primary health care services.

In addition, there were about 100 Northern Territory and Queensland government Indigenous primary health care services in rural and remote locations, where there was no private provider that offered bulk-billing through Medicare. The Medicare funds received from direct billing were used for the provision of additional primary health care services for Aboriginal and Torres Strait Islander peoples.

By June 2005, ACCHSs provided substantial employment, with a workforce of approximately 215 full-time equivalent medical practitioners, 292 nurses, 665 Aboriginal Health Workers, and a range of allied health workers, totalling around 3,000 full-time equivalent staff.[668] The services offered significant employment opportunities for Aboriginal and Torres Strait Islander health professionals: around 61% of ACCHS employees in the 141 services spread across Australia were Indigenous Australians.[668]

Map 9.1: OATSIH-funded community-controlled health organisations, 2006-2007, and 2006 Indigenous population



Note: OATSIH-funded community-controlled health organisations are those that were identified as community-controlled by OATSIH's funding system, ORAC. Population figures are by 2006 Statistical Local Area, from the 2006 Census Indigenous Usual Place of Residence count.

Source: Produced by the Office for Aboriginal and Torres Strait Islander Health (OATSIH), Program Management and Implementation Section, 2008.

The ACCHS consultations were more complex than those in private general practices, with a 1998 study reporting 'more young patients, more new patients, more home visits, more new problems and problems managed per patient, and more consultations leading to emergency hospital admission'.[670] Moreover, in many ACCHSs, Aboriginal Health Workers were the first point of contact for patients, and only 35% of consultations involved GPs.[670]

Later comparisons between Indigenous primary care consultations in the ACCHS sector and those in mainstream general practice in 2000 and 2001 concurred with these findings. The ACCHS patients had a younger age distribution, and consultations required the management of significantly more problems (1.65 problems per consultation compared to 1.48 for Indigenous patients in non-ACCHS practices, and 1.45 problems per consultation for non-Indigenous patients).[671] Aboriginal Health Workers and nurses participated in a large number of consultations.[671] Thus, the ACCHSs played an important part in the health system by providing care for Aboriginal and Torres Strait Islander patients with complex care needs.

The National Aboriginal Community Controlled Health Organisation (NACCHO) was the national peak Indigenous health body representing ACCHSs throughout Australia.[672] It was established in the

1990s, superseding the National Aboriginal and Islander Health Organisation (NAIHO) that had been formed in 1976.[669]

NACCHO was governed by an elected Aboriginal Board of Directors and worked:

- to create conditions which enhanced Aboriginal peoples' access to primary health care services and other services in the event of sickness;
- to advocate for resources for ACCHSs to meet fully the health and health-related needs of their communities;
- to assess health needs for the prevention, treatment and control of epidemic, endemic, and chronic diseases affecting Indigenous peoples; and
- to improve the effectiveness and cultural validity of national health policies, programs and initiatives for Indigenous peoples.[669]

In 1994, in partnership with the Royal Australian College of General Practitioners (RACGP), NACCHO developed the nation's first curriculum in Aboriginal health for GP Registrars, and a supplementary Indigenous health training module for GPs was produced in 2000.

Collaborative efforts led to the establishment of the Section 100 (S100) pharmaceutical access scheme in 1999 (Box 9.8). Section 100 of the *National Health Act 1953* was used to provide access for remote Aboriginal communities to all drugs on the Pharmaceutical Benefits Scheme (PBS). This allowed eligible Indigenous health services to be supplied PBS medicines in bulk through the community pharmacy, which was then reimbursed directly by the Health Insurance Commission (later, Medicare Australia). Medicines became more accessible to the community and more closely integrated with primary health care.

The Scheme ensured that Aboriginal and Torres Strait Islander people in remote areas could access PBS medicines at no cost. In 2004, there were 47 ACCHSs and 128 state- and territory-operated Aboriginal Health Services in remote areas that accessed medicines using S100, and access to medicines had significantly increased.[673,674]

Box 9.8 S100 – Improving Indigenous access to medicines, 1999-

In 2004, an evaluation of the PBS Medicine Supply Arrangements for Remote Area Aboriginal Health Services reported many positive assessments, such as:

'"I think the biggest strength is being able to have the luxury of getting the medicine we should have. What that means for our patients is that they get the same care that they'd be getting if they saw a GP in Alice Springs and that's the way it should be"(Doctor, NT).

The evaluation concluded that the program had increased access to medicine in all jurisdictions, especially oral hypoglycaemic agents, ACE inhibitors, asthma medicine and acute medicines used to treat conditions prevalent in Aboriginal and Torres Strait Islander communities.[674]

In 2005, Couzos suggested that improving the use of medications by Indigenous people in non-remote areas was a government 'best buy' and a cost effective way to reduce the excess burden of disease faced by Aboriginal and Torres Strait Islander peoples.[673] The majority of the diseases causing 'excess deaths' were treatable with medications (e.g., medication that was cost-effective in preventing renal failure in the Aboriginal population).[675,676]

Expansion of the program to non-remote areas at a cost from $41 million per year – at prescribing rates based on S100 utilisation rates – to $96 million per year if prescribing rates increased to the average Australian level – required less than a 2% increase in PBS expenditure.[675,676] The per capita level of PBS spending on Aboriginal and Torres Strait Islander peoples, however, still needed to be set higher because of the excess burden of disease suffered by these populations.

A federal budget initiative to establish medicines on the PBS specifically for Aboriginal and Torres Strait Islander peoples was implemented in 2004, in response to a NACCHO proposal to address Indigenous health needs.[677]

The 2004 launch of the Medicare Benefits Schedule (MBS) item 710 (a rebate for an Aboriginal and Torres Strait Islander adult health check for those aged 15-54 years) was the direct outcome of NACCHO's advocacy, as was the MBS rebate for a child health check (for Aboriginal and Torres Strait Islander children aged 6 weeks to 14 years).[678,679]

Other efforts towards addressing health inequality included the reform of the Commonwealth Hearing Services' Program for a reduced age threshold for Indigenous peoples, and the new Asthma Spacers Ordering Scheme to address the identified poor access to spacer devices.[680] [681,682] The national vaccination schedule was also tailored to prevent infectious diseases to which Indigenous children were particularly susceptible (see Sub-section 1.3.1).[683]

ACCHSs and their state and national representative bodies effectively advocated for Aboriginal and Torres Strait Islander peoples' health, and, slowly, mainstream health services started to change to better meet the needs of Indigenous Australians. However, there was little firm evidence to prove a demonstrable contribution to improved Indigenous health via this mechanism of health service delivery.

Factors critical to success

The underlying factor that was critical to the success of ACCHSs was that of Indigenous self-determination – health services developed by the Indigenous community for their members, and in line with the Aboriginal and Torres Strait Islander view of health which incorporated wellbeing and a whole-of-life perspective, and which non-Indigenous health services appeared unable to adopt.

> *'How do you link the body part funding and the body part [government] departments to a holistic framework of fixing the health problem? … you have the dollars for the ears, the dollars for the eyes, dollars for the heart, the kidney. Well, it's alright if you're in a system where you can actually go off and have the opportunity of seeing all these things in one place but, as we all know out there, this is not the case. So you are constantly dealing with different [national] policies, let alone the States and Territory policies… I think to myself… we might as well talk to the brain because it must [be] in charge of the body and we can get some sense out of that fellow. Then we get to the brain and we find… I asked the Minister this: "Why do you white people break things into pieces?" and then, "you've got the Department of the Brain?" [only to] find out we've got different parts of the brain… It's all in parts again so we go to suicide prevention, national injury, crime strategies, the stolen generation, the drug strategy, emotional wellbeing – why? Why? It's so confusing for the individual person, for anybody to make any sense out of it.' – Dr Arnold ('Puggy') Hunter, recipient of the Human Rights and Equal Opportunity Commission's Human Rights Medal in 2001 and former Chair of the National Aboriginal Community-Controlled Health Organisation, who passed away at the age of 50 years in 2001.*[684]

Future challenges

Future challenges for improving the health of Aboriginal and Torres Strait Islander peoples in both ACCHSs and in mainstream primary health care services, included:

- correcting the under-funding of primary health care services provided to Aboriginal and Torres Strait Islander peoples to reflect better their greater need for services;
- increasing the development, retention and training of the Indigenous public health workforce, including enhancing and supporting the role of Aboriginal Health Workers;
- implementing 'well person' health checks in general practice (including the development of a communication strategy for the broader Indigenous population to increase the use of such services);

- improving pharmaceutical access for Indigenous people in non-remote areas;
- reducing racism and discrimination in mainstream health services;
- improving Indigenous identification in health information collections;
- better dissemination of Indigenous data, especially those from Aboriginal Medical and Health Services; and making a sustained major investment in improving the health of Aboriginal and Torres Strait Islander peoples, in true partnership with Indigenous Australians.[685,686,606,678,650]

Finally, the health of Australia's Indigenous population was unlikely to improve significantly until the legacy of colonisation and historic displacement from land, culture and spirit was acknowledged, and the broader determinants of their wellbeing effectively addressed.[687]

9.3 Research into public health

1915 onwards

> *'Researchers active in public health are needed to provide informed advice on the benefits and costs of proposed public health measures; for example, the detection and prevention of cancer and cardiovascular disease.' – WP Anderson, 1997.*[688]

In 1915, the first substantial medical research institution, the privately-funded Walter and Eliza Hall Institute, was established in Melbourne.[689] The Baker Institute (Alfred Hospital, Melbourne) followed in 1926, with the Kolling Institute (Royal North Shore Hospital, Sydney) in 1931, and the Kanematsu Institute (Sydney Hospital) in 1933.

It was not until 1936 that the federally-funded National Health and Medical Research Council (NHMRC) was set up. At first, it was closely integrated into the structure of the federal Department of Health; but, as research assumed greater importance during World War II and medical scientists assumed more prominence in the NHMRC, research support was increased. The annual endowment that had been thirty thousand pounds in 1937 reached almost one million pounds just ten years later, in 1947.[1]

The NHMRC's Public Health Research and Development Committee (PHRDC) was established in 1986, in response to the recommendations of the Kerr White Review. The formation of the PHRDC gave greater recognition to public health research, more access to funding and a central focus on training a public health workforce.

The *National Health and Medical Research Council Act 1992* included objectives:

- to raise the standard of individual and public health; and
- to foster public health research and training throughout Australia.[690]

In 1993, the Bienenstock review examined the functioning of the NHMRC and recommended that an overarching strategy to guide health research be developed for Australia.[691] Despite advances in public health research and training (consistent with the recommendations of that report), the PHRDC was subsequently merged with the Medical Research Endowment Fund, and public health funding was 'in jeopardy of losing its well-earned profile'.[692] In 2006, public health research was still not recognised as a separate entity in the NHMRC funding arrangements.[693]

In 2002, the Australian government announced the following national research priorities:

- an environmentally sustainable Australia;
- promoting and maintaining good health;
- frontier technologies for building and transforming Australian industries; and
- safeguarding Australia.[699]

Arguably, at least three if not all of these strategic areas were related to public health. The national research priority area, of 'promoting and maintaining good health', had the following four goals:

- a healthy start to life;
- ageing well, ageing productively;
- preventive health care; and
- strengthening Australia's social and economic fabric.[699]

The NHMRC was to fund a program of research to address the latter two goals together (funding of $10 million over five years was allocated in support of this program with a focus on 'larger scope and longer duration' proposals).[699] The NHMRC also provided monies for public health graduate scholarships and fellowships for training in public health research in Australia and overseas.[700]

Public health practices

There were many examples of specific pieces of public health research that had a global impact, from the work of Fenner in eradicating smallpox, to Dwyer and Ponsonby's identification of effective preventive strategies for Sudden Infant Death Syndrome (SIDS), and Bower and Stanley's discovery of the role of folate in neural tube defects - all conditions that could be prevented.[702,300,395] Other examples of successful public health research ranged from identifying exposure to UV radiation in sunlight, and rubella as a cause of deafness. Eight significant research achievements are detailed in Box 9.9.

Box 9.9 Successful public health research

Specific examples included:

- raising awareness of and changing sun exposure behaviours [Lancaster, Armstrong, Holman];
- limiting exposure to asbestos and reducing incidence of asbestosis and mesothelioma [WA group];[701]
- reduced exposure to lead with lead abatement and removal programs (e.g., petrol, paint), monitoring of those exposed, policy changes [McMichael, Baghurst and others];
- reductions in cigarette smoking attributable to campaigns, leading to reduced lung cancer and respiratory diseases [North Coast Healthy Lifestyle campaign, 1970s];
- reduction in deafness caused by rubella [Gregg];
- prevention of birth defects caused by thalidomide [McBride]; and
- interventions to prevent iodine deficiencies in remote inland populations [Hetzel].

A number of research reports highlighted successes attributable to research which, while not identified as 'public health', nevertheless enhanced the health of the public. Three of these reports are described below.

1. *Promoting the health of Australians: case studies of achievements in improving the health of the population* identified areas of public health improvement, including:
   - the control of HIV/AIDS;
   - the prevention of cardiovascular disease;
   - reduced smoking and better tobacco control;
   - reduced death and illness from road injury and trauma; and
   - reduced deaths from cervical cancer.[703]
2. *The virtuous cycle: working together for health and medical research* detailed case studies that demonstrated the connection between research – some of which was in the public health area – and improvements in the health of the population or in the performance of the health system, including:
   - HIV/AIDS control;
   - *Haemophilus influenzae* immunisation;
   - bicycle helmets in Victoria;

- scalds' prevention in NSW;
- folate and the prevention of neural tube defects;
- managing lead contamination in Broken Hill;
- prevention of SIDS; and
- the *Strong Women Strong Babies Strong Culture Program* in the NT.[704]

3. *Ten of the best: NHMRC funded health & medical research successes* contained two programs of public health research:
    - the impact of breastfeeding on allergies and asthma in childhood; and
    - community attitudes to colorectal cancer screening.[705]

While there was much effective public health practice, it was less clear that public health research had been as successful. Despite the evidence that it was in prevention that the largest health gains were to be made in population health improvement, the level of research investment in this area was still far from adequate to achieve that goal.

Future challenges

With the restructuring of the NHMRC research program, the public health sector needed to advocate further for increased resources to better reflect the contribution that it could make to research that could improve the health of the population.

9.4 Monitoring the public's health

1901 onwards

The monitoring and assessment of the state of a population's health in order to improve overall health (i.e., the health of the whole population rather than of an individual) is one of the oldest public health activities. It was necessary because the whole community benefited from public health actions to ensure clean safe drinking water and food, removal of refuse and sewage to prevent disease, immunisation coverage sufficient to provide 'herd' immunity, and so on.

From the inception of the earliest data collections on vital statistics in Australia (commencing in Tasmania in 1838, before Federation) and the first analyses of all-cause deaths, a range of public health disciplines emerged and developed.[5] These included epidemiology (the study of the patterns, causes, and control of disease in groups of people), biostatistics and sophisticated techniques, such as the calculation of odds, risk ratios and fractions of the burden of disease that were attributable to various diseases, conditions and risk factors.[357]

These enabled the monitoring of the health status of population sub-groups (some of whom, such as Aboriginal and Torres Strait Islander peoples, were numerically small) and specific geographic areas in relation to the whole population. This information underpinned public health policy development and implementation, priority-setting and resource allocation. Public health reporting was able to identify potentially preventable or modifiable health-related inequalities, so that resources could be targeted towards their reduction.[706] An Australian government-commissioned study on the socioeconomic determinants of health found, generally, that people living in low socioeconomic areas:

- had higher death rates for most major causes of death;
- experienced more ill health; and
- used the acute health care system more often because of their poorer health, and made less use of preventive services.[569]

An effective public health system was essential, not only to preserve and enhance population health status, but also to lessen health disparities between groups in the population, and to reduce the costs of reparative health services. Towards the end of the 20th century, it was in potentially preventable diseases, disability and injury that the greatest gains were to be made to improve the Australian population's health. Public health monitoring and assessment techniques and disciplines provided the tools to identify and intervene to improve the health of the most disadvantaged groups, and of the population as a whole.

Public health practices

> *'Australia has been exceptionally well provided with statistical systems since, approximately, 1850; and is, therefore, in a better position than, probably, any other country to present reliable statistics. The statistics which express the state of public health of a community are grouped under the general term "vital statistics". These "vital statistics" show, numerically, the number of the population, its age- and sex-constitution, the additions to the population by births and migration, and the losses to the population by deaths and migration. Vital statistics should also, to be complete, give information as to the amount of sickness; but the main vital statistics collected relate only to deaths.'*
> *– JHL Cumpston, 1989.*[5]

Vital statistics (data pertaining to births, deaths and marriages) were the first statistics to be collected in Australia which permitted the health of the population to be monitored. Registration of deaths became compulsory in 1838 in Tasmania, 1841 in WA, 1842 in SA, 1853 in Victoria and 1856 in NSW and Queensland; and compulsory registration of the cause of death followed later.[5]

The Australian parliament passed the *Census and Statistics Act* in 1905, thereby enabling the national coordination of statistical collections; and the Commonwealth Bureau of Census and Statistics (now the Australian Bureau of Statistics [ABS]) was created in 1906. A uniform census was developed in 1901 to coincide with the federation of the colonies, and the first *Australian Census of Population and Housing* was conducted in 1911, with the latest in 2006.[707]

In 1906, the *International Classification of Causes of Death* was adopted as the standard classification for use in all states and nationally, as recommended by the Commonwealth Statistician.[5] Later, Australia adopted other international classification systems (such as those for diseases, disability and external causes of injury); and was an early user of standardised and internationally accepted systems of data collection and classification.

The ABS conducted the first *Australian Health Survey* in 1977-78, surveying a representative sample of the population, and producing a wealth of data, some of which were used in compiling this report.[708] Further *National Health Surveys* were conducted at approximately six-year intervals: in 1983, 1989, 1995 and 2001. The 2001 *National Health Survey* was the first in a new series of health surveys to be conducted at three-yearly intervals, with the next survey undertaken in 2004-05.

The Census provided demographic data on age, sex, and other attributes relevant to calculating rates and defining population groups, while the National Health Surveys generated basic information on the health of the population, for use by researchers to investigate a multiplicity of health and related issues. The existence of time series, such as the Census and National Health Surveys, was important as it was the collection of standardised information over time that permitted the identification of longer term trends. Those trends allowed an assessment as to whether Australia's health had improved, and in which areas, over the 20th century. They also identified areas that needed to be targeted by the public health sector, in order to improve the health of disadvantaged groups within the population.

The Australian Institute of Health and Welfare (AIHW) was a significant component of the health monitoring infrastructure from the time of its creation as the Australian Institute of Health in 1987, with a brief to 'report to the nation on the state of its health'.[709] In 1992, its ambit was expanded to include statistics on community services as well as health, and it became the AIHW to reflect this change. The AIHW contributed to the monitoring of population health through its program of

publications, and its ability to draw together data from the ABS and other sources to present a comprehensive picture of the health of the Australian population biennially.[13]

The AIHW, in association with the ABS, also reported regularly on the health of Aboriginal and Torres Strait Islander peoples.[154] The publication of dedicated reports on Indigenous health was credited with contributing to the awareness of, and ability to monitor, the major health inequalities affecting this population group. Such information also provided a base from which to argue the case for action.[656]

> *'In the community at large, population surveys offer the only mechanism for obtaining information about health status, health risks, and health-related behaviours.'*
>
> *– L Jorm, NSW Public Health Bulletin, 2001.*[710]

Monitoring the health (and health risk) status of groups in the population relative to the norm (or average) of the whole population, and to that of the most advantaged groups, allowed the identification of avoidable differences within the population, and the better targeting of resources and programs to improve their health status. The first national *Social Health Atlas* in Australia, which illustrated these disparities, including geographic variations, was published in 1992.[711] This was followed by a second edition in 1999, providing detailed information on the distribution of socioeconomically disadvantaged groups, on associations between socioeconomic disadvantage and health status, and on changes in the absolute and relative levels of the health status of disadvantaged groups.[712,713] Later atlases reported on potentially avoidable mortality and hospitalisations.[714,557]

Although the National Health Survey was undertaken regularly from 1977–78, its sample size was not large enough to yield estimates for small local areas, and did not cover the most remote areas of Australia, those areas with high proportions of Indigenous populations. From the 1990s, state-based population health surveys were developed to supply up-to-date regional health information, and to assist in health planning, the management of chronic diseases, and the evaluation of public health and other interventions.[715,716] Most of the states and territories undertook population health surveys and published their findings.

A range of other information systems also contributed to the monitoring and surveillance of public health, including:

- the Hospital Morbidity Database (compiled by AIHW from data collected by the states and territories) that provided information on people who were hospitalised, the cause of their hospitalisation, and details on the length of their stay, surgical procedures, and other information relating to their hospital admission;
- Medicare Australia's data on the population's use of Australia's universal health insurance scheme, Medicare, and of pharmaceuticals (when data were made available);
- population-based disease registries which held data on cases of cancer (excluding skin cancer), diabetes and end-stage renal failure;
- the BEACH© program (Bettering the Evaluation And Care of Health) which provided information on general practice activity (visits to GPs);
- the National Perinatal Data Collection which collected data on all births and perinatal deaths in Australia (based on hospital notifications from state and territory perinatal data collections);
- the national dental data collections that provided information from the National Dental Telephone Interview Survey (commencing in 1994) and other surveys on dental health and access to services;
- the *Community Housing Infrastructure Needs Survey* (CHINS) that collected data on housing and environmental conditions in Aboriginal and Torres Strait Islander populations in urban, rural and remote areas;
- the first *National Survey of Mental Health and Wellbeing* in 1997, which gathered baseline information about the prevalence of mental illness in Australia, with a second survey planned;
- the 2004-05 *National Aboriginal and Torres Strait Islander Health Survey* (NATSIHS), the largest health survey of Indigenous Australians ever conducted, with a sample size of 10,439 persons (or

about one in 45 of the total Indigenous population). This survey, conducted in remote and non-remote areas throughout Australia, collected information from Indigenous Australians about health related issues, including health status, risk factors and actions, and their socioeconomic circumstances; and

- the *Survey of Disability, Ageing and Carers* (conducted by ABS) which provided information on people with disabilities, on older people, and carers.

Over the 20th century, a substantial investment was made in public health reporting, which supported many individual data collections, including registers, surveys and inventories. For example, the condition of the Australian environment was reported upon every five years (the latest being *Australia – State of the environment 2006*); and all known pollutant emissions were registered in a national inventory.[717,718] Monitoring, surveillance and other assessments of the population's health were essential in underpinning the capacity of the public health sector to perform its primary functions.

Factors critical to success

According to Cumpston, it was Australia's early start that led to the excellence of its statistical collections. The willingness to use standard definitions and methodologies also contributed to the success of monitoring activities, and allowed Australia to contribute actively to the development of international data collections, and to benchmark against similar countries overseas.[5]

Public health training and research were also important, as the necessary disciplines developed to a sophisticated level, and required sustained investment to build and retain capability and capacity. Government involvement at many levels was a further factor, as surveillance to detect diseases and events – especially those that occurred in small populations or were relatively rare – was statistically challenging, with high resource requirements.[719]

Future challenges

In 2006, the challenges for the future were the maintenance of the many excellent data collections that existed to monitor population health in Australia, and the establishment of an ongoing program of regular national health surveys, to ensure that the latest information was available to underpin policy and program development. While a national child nutrition and physical activity survey and an adult mental health survey were planned, remaining areas which had no up-to-date, nationally representative data were those of child and adolescent mental health, nutrition, and biomedical and other risk factors for the commoner chronic diseases.[720]

Other challenges lay in making better use of the data that were routinely collected, and in analysing data and disseminating the results in ways that would allow greater use by the community. On the policy side, there was a need to use data and research more effectively to advocate for those whose health and wellbeing were currently the poorest in society.

In summary, future challenges included:

- developing data collections to fill the remaining gaps in data;
- making data more accessible to the community;
- using data more effectively to underpin policy and program development; and
- undertaking research to make a difference to the health of the most disadvantaged in Australian society.

Table 9.1: Historic highlights of successful public health organisation, infrastructure and training

1907	Earliest government investment in public health education and training, with the formation of the Australian Institute of Tropical Medicine (subsequently incorporated into the School of Public Health and Tropical Medicine at the University of Sydney).
1910	The Australian Institute of Tropical Medicine (AITM) was formed.
1915	The Walter and Eliza Hall Institute founded in Melbourne – the first (private) major medical research institution in Australia.
1921	Federal Department of Health established.
1925	Royal Commission on Health undertaken.
1927	Federal Health Council established – the first formal mechanism to encourage cooperation between the Commonwealth, state and territory governments.
1928	The Anti-Cancer Foundation established.
1930	National School of Public Health and Tropical Medicine established at Sydney University.
Late 1930s	Central Cancer Registry implemented and registration of cancer cases commenced.
1936	National Health and Medical Research Council (NHMRC) established (replacing the Federal Health Council in 1937).
1959	The National Heart Foundation established.
1970s	The Australian and NZ Society for Epidemiology and Research into Community Health (ANZSERCH) established. National Aboriginal and Islander Health Organisation (NAIHO) formed.
1971	The Aboriginal Medical Service opened in Redfern, Sydney, becoming the first Aboriginal Community-Controlled Health Organisation (ACCHO).
1981	Australia became a signatory to the WHO *Health For All 2000 Strategy*.
1984	Australian Community Health Association formed.
1985	Federal government commissioned the Kerr White Review of research and educational requirements for public and tropical health in Australia. The National Occupational Health and Safety Commission, established in 1983, became a statutory body. Australian Public Health Association (APHA) formed (from ANZSERCH).
1986	The Public Health Research and Development Committee (PHRDC) of the NHMRC established in response to the recommendations of the Kerr White Review.
1987	Australian Institute of Health (AIH) created as a statutory body to report to the nation on the state of its health. Public Health Education and Research Program (PHERP) formed to strengthen national capacity to educate and train Australia's public health workforce. Consumers' Health Forum of Australia established.
1989	*National Aboriginal Health Strategy* published. *National Women's Health Policy* launched. First *National HIV/AIDS Strategy*.
1990s	NAIHO became the National Aboriginal Community Controlled Health Organisation (NACCHO).
1992	Salmond Review of Public Health Education and Research highlighted the overall success of PHERP; and recommended a more strategic approach to future allocation of PHERP funds. The *National Health and Medical Research Council Act 1992* included the objective to foster public health research and training throughout Australia. The AIH became the Australian Institute of Health and Welfare (AIHW) and included community services' statistics in its ambit.
1993	The Bienenstock Report on the functioning of the NHMRC recommended an overarching strategy to guide health research in Australia.
1994	NACCHO, in partnership with RACGP, developed Australia's first curriculum in Indigenous health for GP Registrars, and, in 2000, developed a supplementary training module for GPs.
1996	Creation of the National Public Health Partnership.
1998	The Wills Review focused on the future role of health and medical research in Australia to the year 2010.
1999	Independent review of Phase II of PHERP recommended increased funding and public health research on national health priorities.
2001	The NHMRC established Capacity Building Grants in Population Health Research.
2003	The National Strategic Framework for Aboriginal and Torres Strait Islander Health published.
2005	Review of Phase III of PHERP recommended strengthening workforce capacity for population health in national health priority areas.
2006	National Public Health Partnership dismantled, and two new committees established in its place.

10 Measuring success and learning from the past

In discussing the public health successes in Australia from 1901 to 2006, this report has highlighted the development of many programs that contributed to better health of the population. However, these operated within the context of significant, non-programmatic drivers of improved health, namely, rising living standards, fertility transition, improved education, the introduction of the basic wage, and so forth. These social and economic reforms of the 20th century should not be overlooked, and they remained the most important determinants of the public's health at the start of the 21st century.

This chapter draws out a number of key factors which have underpinned successful public health programs, and they serve to reinforce the lessons of the past. Such observations may assist public health action in the future, particularly in addressing the challenge of persisting inequalities in health across the population. From 1901, public health successes featured in this report were in the areas of:

- Control of infectious diseases
  - *Sanitation and hygiene*:
    - Safe water, 1901-
    - Food safety, 1901-
  - *Screening and disease surveillance*:
    - Tuberculosis control, 1948-
    - HIV/AIDS strategy, 1989-
  - *Organised mass immunisation:*
    - Childhood immunisation, 1932-
    - Adult immunisation, 1991-
  - *Aseptic procedures & medicines, 1901-*
- Maintaining a safe environment
  - *Environmental lead reduction, 1979-*
  - *Less exposure to asbestos, 1960s-*
  - *Decrease in passive smoking, 1995-*
- Improved maternal, infant and child health
  - *Safer birthing practices, 1930s-*
  - *Improved health of infants, 1920s-*
  - *Promotion of breastfeeding, 1964-*
  - *Preventing infant deaths from SIDS, 1991-*
- Better food and nutrition
  - *Food technology development, 1901-*
  - *Food regulation, 1905-*
  - *Improved nutrition, 1901-*
- Preventing injury
  - *Road traffic safety, 1970s-*
  - *Preventing injuries: childhood drowning, 1986-*
- Preventing injury (continued)
  - *Preventing suicide: restricting the availability of potentially dangerous drugs, 1960s-*
  - *Gun control and reduction in gun-related deaths, 1988-*
- Reducing risk factors and chronic diseases
  - *Reducing risk factors:*
    - Tobacco smoking, 1970s-
    - Alcohol-related harm, 1970s-
    - Sun safety measures, 1981-
    - Needle and syringe exchange programs, 1990s-
  - *Reducing non-communicable chronic diseases:*
    - Reduction in fatal heart attacks, 1970s-
    - Stroke prevention and high blood pressure reduction, 1990s-
    - Organised screening for cancers:
      - ◊ Breast cancer, 1991-
      - ◊ Cervical cancer, 1991-
      - ◊ Bowel cancer, 2006-
- Improving health and safety at work, 1901-
- Universal access to health care, pharmaceuticals and technology, 1948-
- Improving public health practice:
  - *Training the public health workforce, 1907-*
  - *Aboriginal Community-Controlled Health Services, 1971-*
  - *Research into public health, 1915-*
  - *Monitoring public health, 1901-*

Many of these public health programs were confirmed as successful by a survey of public health experts from across Australia (Table 10.1).

Table 10.1: Important criteria cited by respondents to the Public Health Successes Survey[721]

Criterion	Details
Impact	Interventions or programs that demonstrated a measurable impact on the population's health.
Importance	Interventions or programs addressing a significant public health issue.
Ambitious in scale	Interventions or programs implemented on a national or universal scale.[721]
Directly attributable to public health	Interventions or programs that had a health impact directly attributable to public health effort, rather than primarily to wider social and economic improvement.
Duration	Interventions or programs that functioned 'at scale' for at least five consecutive years.[721]
Cost-effectiveness	Interventions or programs that used a cost-effective approach.

What factors contributed to public health successes over the last century?

The public health interventions described in this report share a number of common elements:

1. A focus on a public health problem adversely affecting a significant number of Australians;
2. An effective contribution, largely attributable to the efforts of the public health sector, to ameliorating the problem;
3. Implementation at a national level, or across the whole population;
4. Leadership, stewardship and informed advocacy by public health practitioners and other champions;
5. Approaches that were complex and required action across a number of different fronts;
6. Sustained efforts to effect change, often over many years; and
7. Support of the wider community.

Each of these is discussed in further detail below.

1. **A focus on a public health problem adversely affecting a significant number of Australians**

   All the interventions described in this report aimed to address health problems which affected particular sections of the community or the entire community, or had the potential to do so. In general, the larger the number of individuals affected by a health problem, the greater the likelihood that support would become available to address it – scientifically, financially, and politically.

   Examples included actions to reduce the incidence of many infectious diseases such as poliomyelitis, tuberculosis and HIV. These were conditions that had affected or were likely to affect high numbers of people – from the polio epidemics of the late 1930s, 1940s, 1950s and early 1960s, to the risk of bloodborne and sexually transmitted HIV infections in the later years of the century. These diseases were life-threatening and had other deleterious consequences for the population's health, and effective interventions were needed to control and limit their incidence. One such example was the introduction of polio vaccines in 1956 (Salk) and 1966 (Sabin), followed by mass immunisation programs. With the ongoing immunisation of young children, poliomyelitis was finally eradicated in Australia towards the end of the century.

2. **An effective contribution, largely attributable to the efforts of the public health sector, to ameliorating the problem**

   Amelioration of many of the public health problems identified in this report was often due to specific public health effort. Examples included the multi-pronged strategy to address HIV/AIDS transmission, the development of Medicare and the PBS, and environmental lead abatement programs. For each of these interventions, a significant problem or need was assessed, and options and solutions identified, and then implemented successfully in a sustainable manner, for the benefit of the population.

   There were some notable exceptions where effective programs were not primarily led by public health. One example was the improvements in food technology, which were driven mainly by industry and by economic change (e.g., the spread of domestic refrigeration), although public health microbiologists, food chemists, and agricultural and veterinary specialists also played a role in improving the supply of safe food, processing and packaging.

   For an improvement in the public's health to be attributed conclusively to a public health intervention, the evidence of effectiveness must be sufficiently comprehensive to encompass its complexity; and adequate descriptive information about the intervention, its context and its impact needs to be available.[722] For some interventions, such evidence was hard to find or absent, making attribution 'primarily to public health', difficult. While this was only one limitation, there remains a need for better documentation and archiving of the details of implementation processes, and greater investment in thorough program evaluation, in order to identify and cost successful interventions in the future; but this attribution will not always be possible given the complexities of what determines health.

3. **Implementation at a national level, or across the whole population**

   In order to tackle problems that affected large segments of the population, successful interventions and programs had to be ambitious in their scale of implementation. Approaches ranged from programs that were applied across the whole population (e.g., Medicare), to those that targeted a specific population group (e.g., immunisation against pneumococcal infection for Aboriginal and Torres Strait Islander children and adults). Others focused on minority groups who had specific health needs – one example being the successful needle and syringe exchange programs that aimed to limit the interpersonal transmission of bloodborne infectious diseases, such as hepatitis, in those who injected illicit drugs intravenously.

   The scale at which public health interventions were implemented was often wide-ranging and, sometimes, the scope and approach was controversial. Significant efforts were needed to ensure that there was also broad support from decision-makers, those in the population who would be affected, and the wider community. A successful example was the national HIV/AIDS program which had to be implemented rapidly, and resulted in Australia curbing its infection rate far earlier than any other country.

4. **Leadership, stewardship and informed advocacy by public health practitioners and other champions**

   Many public health research findings with the capacity to benefit the population's health were adopted and implemented by decision-makers and the community; examples included effective preventive strategies to address SIDS, and the use of folic acid supplementation to reduce neural tube defects.[723] In these areas, there were few who disagreed with the interventions and no powerful groups whose interests were likely to be challenged. Some successful public health interventions were led by small groups of committed public health practitioners and others who initiated action based on science, as there was often no existing evidence of effectiveness at the time when the programs were initiated.[76] Examples included the population screening and treatment of tuberculosis, mandatory seat belt legislation and other road safety measures, and legislated tobacco control measures.

In other areas, where public health interventions initially lacked wide community support, or were likely to diminish the profitability of certain industries and groups, progressive public health policy and strategic leadership by informed advocates and champions (exhibiting what some survey respondents explicitly identified as 'bravery' and 'courageousness'), were more fundamental to success. For example, early measures to improve industrial and occupational safety, such as public health restrictions on the work that could be done by children and women, were not popular with many employers of the time. Other initiatives were difficult to implement because of reluctance from employees to change their work habits or practices. Strategies to control HIV/AIDS, the reform of gun control laws, and the needle syringe exchange program, were all unpopular with some segments of the community. In other areas, public health advocates had to challenge powerful vested interest groups, the *status quo*, or political inertia in the face of growing scientific evidence offering contrary advice (e.g., early evidence of the harm to health arising from tobacco use and exposure to asbestos).

Thus, leadership and champions, a skilled and committed public health workforce, and persistent advocacy in the face of opposition were all important factors that contributed to successful programs and interventions.

5. Approaches that were complex and required action across a number of different fronts

Many successful public health interventions were complex, program-based and depended upon a wide range of environmental influences. Some had to initiate action across a number of sectors in addition to health, and to utilise a plethora of strategies, from policy change and legislative amendment, to community engagement and economic reform. Although legislation and regulation were not always necessary, they were critical to the success of some of the public health achievements reported here (e.g., early quarantine law, authority to notify and act on infectious disease cases, legislative occupational health and safety requirements).

Managing such diversity of strategies in an often challenging environment required committed and far-sighted leadership. Successful public health initiatives also depended upon political support, and high-level political engagement was a vital factor in the drive to improve immunisation rates, to enact legislative bans on tobacco advertising and sponsorship, gun control reforms, and to make the decades-long journey towards national, uniform food regulation. More gradual efforts to convince decision-makers ultimately succeeded in delivering nationally agreed public health information for the community (e.g., consistent speed and blood alcohol levels for drivers; national food safety standards).

The importance of consistent public health messages, delivered nation-wide in many forms (from social marketing to regulation) over time and with the accord of governments and communities, cannot be overemphasised. The persistence of such approaches led to some of the most remarkable public health achievements in changing community-wide attitudes and behaviours (e.g., the decrease in smoking resulting in large reductions in smoking-related diseases, and the impact of seatbelts in reducing road trauma injuries and deaths).

6. Sustained efforts to effect change, often over many years

Successful public health interventions generally required detailed planning and implementation, significant levels of funding, and other mechanisms over a period of many years, to ensure their sustainability and ultimately, to reap the predicted benefits for the community. Ongoing investment was a crucial factor: the capacity and will to invest significant financial and other resources in broadly-based, multi-faceted public health ventures to address complex health issues with multiple determinants, over lengthy periods of time (i.e., for decades).[87]

Even when a program targeted a specific geographic area (such as programs to reduce the blood lead levels in residents of lead-affected communities), it needed to do so for substantial periods of time (at least five years). In other areas, it was likely to take many decades of effort to achieve identifiable change, and there was seldom any prospective evaluation of the process

of implementing the intervention or of its effects over the longer term. The health economist and Nobel Laureate, Robert Fogel, identified 'the long lags that frequently occur between the time that certain investments are made and the time that their benefits occur'.[239] He concluded that the efficiency gains of OECD countries in the period 1910-1980 were due to investments made up to a century earlier – among which were public health investments, including the construction of improved water supply facilities, the decontamination of the milk supply, the development of effective quarantine systems, and the sanitising of urban slums.

Sustained efforts were also important for the many public health programs that required behavioural and attitudinal change on the part of the population in order to be successful (e.g., increasing breast feeding rates, and the control of tobacco to reduce rates of smoking). Others required structural changes in the environment, such as the building of sanitation infrastructure (e.g., sewage removal, drinking water distribution systems) and the closure of asbestos mines. Behavioural, attitudinal and structural changes frequently needed lengthy and sustained periods of investment before the sought-after health benefits could be achieved.

7. **Support of the wider community**

Clearly, a successful outcome does not only result from the intervention itself and its method of delivery, but also arises from the interaction with the particular group for whom the intervention is designed, and the social, economic and cultural context in which that group exists. Tailoring interventions and making them socially and culturally appropriate is essential, as is the recognition that interventions may sometimes have unintended effects of making health inequalities worse, by virtue of differential outcomes among population groups (e.g., smoking cessation programs).[724] This latter challenge still awaits an effective public health solution.

Engagement with the community and the involvement of a majority of community members were significant elements of many successful public health interventions. These ranged from obtaining community compliance with movement restrictions (e.g., for quarantine purposes and in tuberculosis sanatoria), to population health requirements (e.g., maintaining 'herd' immunity), and growing adherence to safer, health-protecting practices (e.g., wearing seatbelts, smoking cessation during pregnancy).

Difficulties in measuring the success of public health interventions

Public health interventions are multi-faceted, complex programs that must reach substantial numbers of the affected population in order to be considered effective. Therefore, the evidence to support their effectiveness must be sufficiently comprehensive to encompass their scope and complexity. In order to determine for the purposes of this report those interventions deemed to be successful, evidence of various types was sought. As indicated earlier, a detailed scan of the published and grey literature was undertaken, looking particularly for evaluations detailing program efficacy, cost-effectiveness and sustainability.

In order to provide convincing evidence, evaluations must also be able to distinguish between the success and failure of the implementation of an intervention, as well as the outcomes of the intervention itself. As Rychetnik and colleagues commented, 'if an intervention is unsuccessful, the evidence should help to determine whether the intervention was inherently faulty (that is, failure of intervention concept or theory), or badly delivered (failure of implementation). Furthermore, proper interpretation of the evidence depends upon the availability of adequate descriptive information on the intervention and its context, so that the transferability of the evidence can be determined'.[722]

Overall, there were relatively few comprehensive evaluations and even fewer economic evaluations; thus, only limited objective evidence about the outcomes of many of the public health interventions was available to support their inclusion in the report.

There was convincing cost-benefit information for the following public health interventions:

- water safety, food safety and food regulation;
- universal immunisation against a range of infectious diseases, and measures to contain HIV/AIDS and hepatitis C infection (e.g., needle and syringe exchange programs);
- tobacco control strategies and programs, including smoking cessation programs, advertising bans, and fiscal incentives (taxation, hypothecation) supported by legislation;
- injury prevention strategies such as road safety initiatives (e.g., RBT and police enforcement, legislation and social marketing campaigns), and the prevention of falls;
- population-wide measures to reduce cardiovascular disease and associated risk factors;
- cancer screening, detection and early intervention; and
- water fluoridation and food fortification (e.g., with iodine, thiamine).

There was limited economic evaluation of interventions such as the *Health Promoting Schools program*, and either cost or benefit information, but not both, for a number of other programs. By 2006, the routine use of economic evaluation to underpin decision-making still occurred in only a few public health areas: the listing of pharmaceuticals on the PBS, the addition of new vaccines to the universal immunisation schedule, and the introduction of new population screening programs (e.g., bowel cancer screening, newborn hearing screening).

While there were many cost-effectiveness studies on single public health issues (such as tobacco control), and others that compared packages of different measures (such as road traffic safety initiatives), there were few that costed the major public health programs, policies and strategies that were in place over a long period of time.[482,725,87] Reasons for this included a paucity of data (e.g., on the costs of long-standing programs) and of evidence (e.g., evidence of cost-effectiveness) required to undertake such analyses. This reflected a lack of funded research for some strategies; for others, research on the comparative cost-benefits of various possible interventions was only 'at a formative stage', even in relatively well-researched areas, such as road trauma.[401] In still other areas, economic evaluation of this type lagged far behind, and, by 2006, the basic 'information requirements for cost-benefit and cost-effectiveness assessment [could] not be met' for most public health interventions.[402]

For public health problems that required attitudinal and behavioural change on the part of the community, evidence generated from pilot start-up and small-scale programs was often highly localised, and lacked a 'critical mass' to generate evidence of its impact, making it difficult to draw convincing conclusions or to apply it more widely.[402] Much of the historic material that was examined for the report adopted a case study approach, because of the 'difficulties involved in comprehensive evaluations of the outcomes of broad-based programs that aim[ed] to affect complex health issues with multiple determinants'.[726]

As a result of these factors, the survey of public health experts was conducted to elicit informed, but subjective, views of practitioners and researchers about public health successes. It was generally believed by survey respondents that most of the public health successes reported had been cost-effective – despite a lack of actual evidence to support this. Nevertheless, as indicated above, a small number of later studies quantified the benefits – well in excess of the costs – of implementing food safety programs in high risk sectors of the food industry, and of hepatitis C and HIV infections 'foregone' through the implementation of needle syringe exchange programs.[49,542]

For future public health interventions to be identified as 'successes', adequately resourced and more thorough evaluations will be required, including evidence from cost-benefit or cost-effectiveness studies. There is a growing body of work that addresses 'best' or 'good enough' evidence for particular public health interventions, and in other areas, gaps between practice and evidence have been identified.[126,377,728] Much wider use of economic evaluation in public health is needed, both routinely in risk-based assessment and in determining investment decisions and program funding priorities. In the future, directions for public health interventions should be informed by evaluations of what is known from research and from practice about the efficacy and the cost-effectiveness of particular approaches; and recommendations about whether to begin, to continue, or to cease particular activities, and the most appropriate ways to implement them.

The continuing challenge of remedying inequalities in health across the population

Despite the many achievements of public health in improving the wellbeing of Australians over the last century, the problem of inequalities, or differences in health across the population, continues to resist amelioration. The burden of premature mortality and rising levels of morbidity have remained disproportionately concentrated among those who are the most socioeconomically disadvantaged in the nation, with none more so than the members of Australia's Indigenous populations.

In its review of the improvements in health over the 20th century, the AIHW concluded that the evident benefits had not been shared equally:

> *'In the year 2000, although life expectancy for most Australians has increased significantly, that of Indigenous peoples is at levels not seen in the rest of the population since 1900. Large inequalities in death rates from many causes also persist for disadvantaged populations in Australia, in spite of the long list of achievements in health during the twentieth century. Reducing the inequalities will also be a priority for the twenty-first century.'*
> – *AIHW, 2000.*[3]

A study suggested that some early signs of 'putting the brakes on chronic disease mortality' (primarily from better access to health care) were apparent in the Indigenous populations of the Northern Territory. Such public health programs that offer improvements in the health of Aboriginal and Torres Strait Islander peoples needed to be consolidated and extended more widely.[662]

> *'The health of every individual citizen contributes to national wellbeing, thereby making health such a vital resource that its regulation must be an essential function of government. Furthermore, health consistently rates as an issue of concern for all Australians. It is intensely personal and, given the nature of health, a public good, a highly political issue. It is generally believed that governments are in the best position to encourage positive behaviour (such as immunisation, food and road safety) which will benefit the whole community, while discouraging dangerous activity such as smoking and drink driving. Moreover, given that health is regarded as a human right, public financing of essential health services is also accepted, as is the government's role in ensuring that those who are most in need receive adequate care.'*
>
> – F Beddie, *Putting life into years: the Commonwealth's role in Australia's health since 1901*, 2001.[318]

However, much more remained to be done. The assumption that health improvement in the population overall reduces health inequalities in segments of the population, had not been borne out by the available evidence.[724] Greater efforts were required to determine the precise ways that public health interventions and policies impacted positively and negatively on the different segments within the population. Cost-effective public health programs also needed to be integrated better with the wider socioeconomic determinants of health, and with the broader canvas on which public health activities were both delivered and determined.[712]

Conclusion

The public health successes of the 20th century were those that addressed problems that had a significant impact on the health of the population. The interventions employed a range of methods, and many of the most successful were complex and multi-faceted, instituting public health action across many areas – for example, legislation, fiscal incentives, social marketing and health promotion, and provision of public health services. This complexity and multi-faceted approach applied equally to early public health successes, such as tuberculosis control from the late 1940s, as well as to later examples, such as the tobacco control strategy from the 1970s.

The preventable differences in health status across the population that developed from unequal health gains need to be remedied:

> *'The key to reducing societal vulnerability to the health impacts of climate change is to enhance existing public health infrastructure and intervention programs.'*
>
> – RW Sutherst, *Clinical Microbiology Reviews*, 2004.[744]

The NHMRC Health Advancement Committee's review of infrastructure for promoting the health of Australians in 1997 suggested that the key elements of successful approaches were:

- strategic direction;
- technical expertise (including surveillance, research and evaluation);
- supportive structures for implementation; and
- sustained investment.[703]

The review identified that the greatest improvements in health were achieved in areas where there had been a sustained response that engaged many components of the health sector, such as health workers, hospitals, non-government organisations, universities and public health practitioners, and, most importantly, community members. In addition, it also recognised that the work of other non-health sectors had also been an essential factor.[703]

While there are inherent difficulties in comprehensively assessing the outcomes of broad-based public health activity from the vantage point of a one hundred-year perspective, most of the public health interventions described here achieved benefits for the community. While more remains to be done, much has been learned over the last century, which can be applied by those charged with achieving future public health successes in the hundred years to come.

Appendices

Appendix A: Advisory Group*

An Advisory Group provided support to PHIDU on the project.

Chair:

Professor Tony McMichael, National Centre for Epidemiology and Population Health (NCEPH), Australian National University (ANU)

Members

Dr Sophie Couzos, National Aboriginal Community Controlled Health Organisation

Ms Liz Furler, Motor Accident Commission

Ms Michele Herriot, Health Promotion Branch, SA Dept. of Health

Dr Diana Hetzel, Public Health Information Development Unit (PHIDU), The University of Adelaide

Dr Jim Hyde, National Public Health Partnership

Professor Vivian Lin, School of Public Health, La Trobe University

Ms Helen Moore, Centre for Epidemiology and Research, NSW Health – working at University of NSW

Ms Cora Shiroyama, Population Health Division, Australian Dept. of Health and Ageing (DoHA)

Appendix B: List of contributors*

Public health practitioners and experts who participated in the survey, shared their thoughts on the public health successes of the last century, and consented to being identified in the report are listed below.

A warm 'thank you' is extended to all the participating survey respondents, who provided not only their opinions but a wealth of material to support them; and feedback on the survey process itself.

Mr Brad Adams	Environmental Health Officer, Queensland Health
Dr Rosemary Aldrich	Associate Director, Clinical Governance, Hunter New England Area Health Service, NSW
Dr Elizabeth Barrett	Medical Advisor, NSW Rural Doctors' Network
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Dr Graham Brown	Head, Division of Infection and Immunity, The Walter and Eliza Hall Institute of Medical Research
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Ms Sophie Dwyer	Director, Environmental Health Unit, Queensland Health
Professor Terry Dwyer	Director, Murdoch Children's Research Institute, Melbourne
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Professor Mark Ferson	Director, Public Health, South Eastern Sydney Illawarra Area Health Service
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Professor Sandy Gifford	Head, Refugee Health Research Centre, La Trobe University
Dr Gerard Gill	Postgraduate student, University of Tasmania
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Dr Basil Hetzel AC	Chairman, Hawke Centre, University of South Australia
Professor Konrad Jamrozik	Professor, Evidence-based Health Care, University of Queensland
Mr Andrew Jones-Roberts	Public Health Association of Australia (Victorian Branch)
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Professor Timothy Mathew	Medical Director, Kidney Health Australia
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Professor Peter McDonald	Emeritus Professor, Flinders University and Professorial Fellow, University of NSW
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Ms Alison Pascoe	Senior Project Officer, Southern Adelaide Health Service
Dr Susan Rennie	Senior Manager, Nillumbik Community Health Service, Victoria
Professor Ian Ring	Professorial Fellow, Centre for Health Service Development, University of Wollongong
Dr Andy Robertson	Divisional Director, Health Protection Group, WA Dept. of Health
Dr Priscilla Robinson	Senior Lecturer, La Trobe University
Dr Peter Sainsbury	Director, Population Health, Sydney South West Area Health Service
Dr Rosalie Schultz	Public Health Medical Officer, Department of Health and Community Services, NT
Assoc. Professor John Scott	Health Sciences Faculty, The University of Queensland
Mr Ian Scott	Department of Injuries and Violence Prevention, World Health Organization
Professor Mary Sheehan	Director, Centre for Accident Research and Road Safety, Queensland University of Technology
Ms Joan Shortt	Health Promotion Manager , Dental Health Services Victoria

Ms Kate Silburn	Senior Project Officer, Australian Institute for Primary Care
Professor Malcolm Sim	Director, Centre for Occupational and Environmental Health, Monash University
Professor Donald Simpson AO	Emeritus Professor of Neurosurgery, The University of Adelaide
Dr Julie Smith	Research Fellow, Australian Centre for Economic Research on Health, Australian National University
Dr Ron Somers	Acting Director, Epidemiology Branch, SA Dept. of Health
Professor Jeffery Spickett	Head, School of Public Health, Curtin University of Technology
Dr John Stanhope	Retired public health physician
Dr Judy Straton	Director, Child and Community Health, WA Dept. of Health
Ms Kylie Strong	SunSmart Program Manager, The Cancer Council of Victoria
Mr Fearnley Szuster	Senior Research Fellow, Public Health Information Development Unit, University of Adelaide
Dr Peter Talbot	Director, Focus Consulting (Vic.) Pty. Ltd.
Ms Sarah Tennant	Research Officer, Public Health Information Development Unit, University of Adelaide
Dr Peter Thorn	Public health physician, Northern Territory
Ms Sonya Tremellen	Primary Health Care Consultant, General Practice Divisions, Victoria
Dr Mark Veitch	Public Health Physician, The University of Melbourne
Assoc. Professor Theo Vos	School of Population Health, University of Queensland
Assoc. Professor Rae Walker	Public Health, La Trobe University
Mr Peter Ward	Lecturer, Environmental Management, University of Western Sydney
Dr David Whiteman	NHMRC Senior Research Fellow, Queensland Institute of Medical Research

Lastly, a sincere 'thank you' to the members of our pilot group for testing the survey.

*Please note that the individuals above have been identified by the titles and positions that they held at the time of their contribution.

Appendix C: Methodology used to develop this report

A literature search and review of the evidence of successful public health measures in Australia were undertaken. These identified only a slender amount of material that analysed and assessed the economic benefits of public health activity in Australia over the period 1901-2005. This report has drawn on the material identified in the literature review, and on interventions identified by those public health practitioners who responded to the survey.

Survey

The project team developed a survey questionnaire in order to ascertain the views of a wide range of public health practitioners and specialists.

Methodology of the survey

The survey was piloted by a small group and revised on the basis of feedback from the pilot and comments from the Advisory Group members.

The final survey was initially publicised by:

- the Public Health Association of Australia (PHAA) in their April 2006 newsletter to an estimated 800 members;
- the Australian Health Promotion Association (AHPA) by an email to members;
- the Australasian Faculty of Public Health Medicine (AFPHM) to all fellows and trainees of the Faculty;
- the Health Services' Research Association of Australia and Zealand via their listserv to members;
- the Biostatistics Collaboration of Australia to Steering Committee members;
- reviewers and contributors to *Environmental Health*, the journal of the Australian Institute of Environmental Health via the Institute; and
- the Public Health Information Development Unit (PHIDU) at The University of Adelaide on the PHIDU website.

It was also mailed to a shortlist of 150 nominated public health practitioners and researchers. A telephone interview was offered as an alternative to completing the survey, and practitioners were asked to distribute the survey among their colleagues. Reminders were emailed with an extended deadline. The time period over which the survey sought input was from the beginning of April to the middle of June, 2006.

The survey was also distributed by third parties to:

- all public health staff of the Victorian Department of Human Services by an officer of that department; and
- the Aboriginal and Torres Strait Islander Public Health Special Interest Group of the PHAA by the head of that group (170+ members).

A total of 100 surveys were completed and returned. There were 11 apologies. Results of the survey analysis are shown below.

Ranking of 'Public Health Successes' topics

Respondents were given the choice of working from a 'Blank slate' or using a 'Work from lists' in order to rank topics, with number 1 being the most important. There was also an option to add any

important public health successes that were not listed. Table A.1 shows the results from those who worked from lists (79 out of 99 surveys).

The highest ranking topics were '*Infectious disease control*' (placed first, with an overall score of 2.7), '*Safe drinking water*' (second, with a score of 3.1), '*Infant and maternal mortality reductions*' (third, score of 3.8), and '*Tobacco control*' (fourth, score of 4.8) (highlighted in the table below). The most frequently ranked topic was 'Road traffic safety' (ranked by all 79 respondents). The next most frequently ranked topics were '*Infectious disease control*', '*Infant and maternal mortality reductions*', '*Tobacco control*', and '*Safe drinking water*'. There was good agreement that these were successful public health interventions.

Table A.1: Respondents' ranking of topics from the Public Health Successes' Survey

Most often ranked	No. of respondents ranking this topic (n=79)	Overall score	Rank	Topics listed in the survey (Part B – 14 topics)
Equal 2nd	78	2.7	1	Infectious disease control
5th most often ranked	77	3.1	2	Safe drinking water
Equal 2nd	78	3.8	3	Infant and maternal mortality reductions
Equal 2nd	78	4.8	4	Tobacco control
1st most often ranked	79	6.0	5	Road traffic safety
	74	6.4	6	Advances in occupational & industrial safety
	64	6.4	6	Public health influence on health & other policies
	71	7.9	7	Organised screening, early detection & treatment
	65	9.3	8	Water fluoridation
Least often ranked (one of two)	61	9.9	9	Aboriginal Community-Controlled Health movement
	68	10.0	10	Environmental lead reduction
Least often ranked (one of two)	61	10.1	11	Food fortification
	63	10.5	12	Alcohol-related harm reduction and minimisation
	64	10.6	13	Domestic injury prevention

'Public health influence' although ranked sixth overall, was not ranked by 15 respondents (in other words, there was less agreement that this was a success than on the topics ranked 1 to 5 above).

The least often ranked topics (i.e., ranked by the fewest respondents) were '*Aboriginal Community-Controlled Health movement*' (with rankings from 1 – most important – to 14), '*Food fortification*' (rankings from 1 to 14), and '*Alcohol-related harm reduction*' (rankings from 1 to 15). '*Alcohol-related harm reduction*' and '*Domestic injury reduction*' received the lowest overall scores (10.5 and 10.6 respectively).

Additional important public health successes nominated

As well as ranking the topics provided in the 'Work from lists' section of the questionnaire, some respondents ranked and/or nominated additional topics. Other respondents working from the 'Blank slate' area also provided additional topics. The following topics were most often nominated as 'important public health successes' that had not been listed in the questionnaire.

- Safer, healthier foods, improved nutrition, dietary changes (13 respondents).
- Sun Safety campaigns / Sun protection / Skin cancer prevention (11).
- Medicare – universal health system /Medicare and PBS (10).
- Measures to address chronic diseases and associated risk factors (10). Improvements in cardiovascular health were most frequently nominated together with breast and cervical cancer screening. Obesity was most frequently identified as a challenge.
- Sewerage and sanitation (waste disposal & control) / Sanitary engineering (8).
- Harm reduction and minimisation for addictions (8).
- Mental health – promotion, awareness and early detection (3 respondents saw substantial gains – despite bad press).
- Free oral health / Public dental programs (3).
- Disaster and emergency preparedness and management (3).

Among existing topics, the most frequently nominated subtopic was immunisation (13 respondents). Other sub-topics under 'Infectious disease control' that were specifically nominated were (in order) HIV/AIDS control (5 respondents), Polio campaign & eradication (4), Tuberculosis (4), near eradication of *Haemophilus influenzae* type b (Hib) invasive infection (2), Smallpox (2), as well as Diphtheria, Leprosy, Malaria, Congenital syphilis; and control of STIs, animal borne infections (e.g., brucellosis), and milk-borne infections (through pasteurisation and refrigeration). Delaying the entry of influenza into Australia and quarantine measures to safeguard human, animal and crop health (2), and improvements in the surveillance and notification of infectious diseases (2) were also nominated.

A range of measures addressing the social determinants of health were also nominated, such as better education and general living standards, improved health literacy through work in schools and the active role of the media, better housing (less over-crowding), smaller family size, greater wealth, etc.

Public health legislation (3), training, and professional advocacy (3) were also nominated, as well as the influence of basic science supporting epidemiology, and transactional research. Occupational and industrial legislation was also identified (3) as contributing to improvements in worker health.

In environmental health (aside from sanitary engineering and waste control) the topics most often nominated were reduced exposures to toxins and poisons (including lead and asbestos) and improved air quality. Global warming and environmental degradation were also mentioned in comments.

A range of measures affecting infant and maternal health and mortality were nominated including reduction in SIDS (6), sepsis control, improved medical treatment, breastfeeding, antenatal clinics, birth control, and improvements in birthweight of Aboriginal babies (although methods used were questioned).

The role of the Aboriginal Community-Controlled Health Movement was identified as reducing health inequalities, and was ranked both very high and very low by respondents who included it (61 respondents), some of whom blamed it for not improving the health of Indigenous peoples (as if it were solely responsible for their health); others concerns expressed concerns about only relying on one model of health care delivery. Some respondents commented that they could not rank it because they lacked personal experience or knowledge. Environmental Health Workers in Indigenous communities were nominated as a success by some, with the qualification that more needed to be done. There were many comments made by respondents generally in relation to the parlous state of the health Australia's Indigenous populations (see below).

Comments

In free form comments, the most frequent topic cited was the poor health of Indigenous populations, with remarks such as '*the overall health of people in remote NT Aboriginal communities remains appalling*', '*the state of Aboriginal health is a national disgrace*', '*Aboriginal Health is most important and impact of the many programs has been very poor*', and '*Indigenous health needs to be a top priority*'. No other area of public health received so many adverse and angry comments on what had not been achieved. A few respondents identified the inequitable gains in specific areas (e.g., Safe drinking water, 1901 – *Except for Aboriginal communities who still don't have this*; Infant and maternal mortality reductions, 1901 – *Except for Aboriginal communities who still don't have this*, Aboriginal Community-Controlled Health movement – *There is a long way to go to reduce the health inequalities*) and so on.

Selection criteria

Ranking of selection criteria

Respondents who worked from lists were asked to rank the factors that they considered important in making their selection of public health successes over the last century.[721] The highest scored selection criteria were Impact (ranked by all respondents who ranked criteria with an overall score of 2.3) and Importance (ranked by 68 of 69 respondents, score of 2.8) (highlighted in pale blue in Table A.2 below).

Table A.2: Respondent ranking of selection criteria from the Public Health Successes Survey

Most often ranked	No. of respond-ents ranking this criteria (n=69)	Overall score	Rank	Selection criteria
1st most often ranked	69	2.3	1	Impact
2nd most often ranked	68	2.8	2	Importance
	63	4.1	3	Ambitious in scale
	63	4.5	4	Directly attributable to the public health effort
	62	4.6	5	Duration
	63	5.1	6	Cost-effectiveness

Cost-effectiveness received the lowest overall score (5.1), which may reflect the lack of available and appropriate data on which to base assessments of cost-effectiveness.

Additional selection criteria nominated

As well as ranking the selection criteria provided in the 'Work from lists' section of the survey, some respondents nominated additional factors that were important in forming their decision. These are roughly grouped, using shading to highlight similar concepts, in Table A.3.

Factors were identified as positive and negative factors. Among positive factors, general and specific outcome criteria (e.g., severity of effects if no intervention, increase in healthy life years) formed the largest group nominated. 'Equity and universality', 'ethics', 'bravery and imagination' were among specific qualities identified as important factors, along with 'evidence-based' and 'intellectually

rigorous'. Targeting of interventions, including those focusing young people was another important positive factor. Community-controlled, empowering and democratising factors were also identified, along with the comprehensiveness of strategies and the importance of public perception, acceptance and support.

There were fewer negative factors identified. These were 'avoiding catastrophic failures', 'flawed community development approaches', and 'the impact on rural communities'.

Table A.3: Additional selection criteria nominated by respondents to the Public Health Successes Survey

Positive factors	Details
Outcome	Interventions that proved to have long term health benefits for the whole population (2 respondents)
Severity of non-intervention	Severity of effect if no intervention took place/ Type of risk – e.g., minimal deaths occur without water fluoridation.
Increase in healthy life years	Interventions which resulted in net gain in life expectancy for the population (related to Impact)
Disability years saved	Interventions which reduced injury- or illness-related disability years (also related to Impact)
Equity	The most important programs often addressed issues of equity.
Universal	Interventions that had an impact on the whole population and where the individual did not incur a specific cost or charge.
Legislative impact	Smoking and seat belt laws, for example, had universal application and a dramatic public health impact
Ethical	Adherence to millennium development goals and other internationally recognised ethical yardsticks.
Brave / Courageous	Dr Neil Blewett's response to HIV showed immediate and clever thinking with relatively little evidence to inform the decision.
Imaginative	Farsighted in use and development of resources.
Evidence-based	Relied upon convincing scientific fact
Intellectually rigorous	Good use of intellectual capacity
Correct targeted approaches for disadvantaged groups	Targeted approach, targeting of disadvantaged groups, correct targeting. Addressed those with the most needs such as Aboriginal populations. (3 respondents)
Measures aimed at young people	
Community-controlled	
Community and personal empowerment	Public health efforts which encouraged the public to be participants in their own health and well-being, not solely objects on which health professionals acted to produce health
Democratisation of knowledge	The efforts put into effective translation of knowledge about health issues and risk to health in order to dispel misinformation, malpractice and public anxiety.
Factors that had multiple criteria and obvious political support and funding had a greater success.	Persons driving the program were highly motivated and committed and had the political backing and funds to succeed. Legislation was amended for the purpose and media was involved in the support of the initiative.
Comprehensive, multi-strategy effort	
Unique Australian contribution	Alcohol/ driving/ tobacco

Table A3... continued

Positive factors	Details
Australia is not an island	WHO/ immunisation/ smallpox eradication/ polio
Public engagement	Addressed a problem perceived by the public to be important / Public acceptance / Public support (3 respondents)
Partnership in delivery	
Physical environment	
Personal experience/ Exposure	Interventions you were informed about or had personal experience with might often bias your decision making
Negative factors	**Details**
Catastrophic failures	Another influence in the choice of intervention was to steer away from any intervention that contributed to what the Lancet describes as "catastrophic failures of public health". Health promotion and lifestyle "programs" that failed to address "upstream factors" fall into this category.
Flawed community development approach	A negative influence on the choice of "success" was, e.g., the perceived failure of public health approaches to Aboriginal health. Comments such as "Mainstream health services are in crisis so how are Aboriginal people to manage their health system if we can't - especially as they are at the bottom of Maslow's hierarchy & do not have adequate resources & infrastructure". "Mainstream health services have abrogated their responsibility for Aboriginal health in the name of a poorly managed attempt of "giving control to the community."
Impact on Rural communities	Some public health strategies did not benefit rural communities – e.g., Water fluoridation.

The Public Health Successes' Survey Questionnaire is in Appendix D.

Appendix D: Public Health Successes – Australia, 1901-2005: Survey questionnaire

What are the outstanding public health successes of the last century?

We are interested in learning which Australian public health measures you believe have been the most successful over the last 100 years or so (from 1901 to 2005). They may be current or no longer operating. We are also keen to understand why you believe these have been the most successful public health measures or interventions – what factors were important in making your choice?

The questionnaire should take approximately 10 minutes to complete. You may choose to work from a 'blank slate' to nominate your public health successes and criteria (start at Part A), or you may prefer to work from a 'starter' list to select the most important, or add any that are not listed (start at Part B).

Whichever method you prefer, the last thing we ask you to do is to make any extra comments and provide acknowledgement information (finish at Part C).

The aim of the project is to publish a report on the public health successes that have improved the health of Australians over the last century.

The project has been commissioned by the Australian Government Department of Health and Ageing and is overseen by the National Public Health Information Working Group. A small group chaired by Professor Tony McMichael is advising the project.

We've made a start on listing public health achievements in Australia over the last century including some priority public health interventions in the last 20 years. These are in Section B.1, and organised chronologically. Selection criteria that have been used in similar exercises (e.g., to choose between competing topics) are listed in Section B.2.

To complete the questionnaire, start at Part A if you prefer to work from a 'blank slate' or start at Part B if you would rather work from or add to starter lists already compiled. Whichever method you use, please also complete Part C.

Responses can be emailed, faxed or posted to:

PHIDU,

The University of Adelaide,

Level 9, 10 Pulteney St,

Adelaide SA 5005.

Instructions: Please complete both sections of EITHER Part A OR Part B, AND finish with Part C.

PART A: WORK FROM A 'BLANK SLATE'

A.1 Topics: In the blank table below, please nominate the key Australian public health successes that you believe have contributed to the improved health of Australians over the last hundred years or so (i.e., from 1901 to 2005). The achievements or interventions may be current.

Please nominate up to ten public health successes in the table below, with number 1 being the most important.

No.	Public health successes	Details (additional explanation)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

A.2 Selection criteria: What factors were important in forming your decision about the public health successes you nominated in Section A.1?

Please rank the criteria that were of importance, with number 1 being the most important.

No.	Criteria	Details
1		
2		
3		
4		
5		

Please finish the survey by completing Part C.

Instructions: Please complete both sections of EITHER Part A OR Part B, AND finish with Part C.

PART B: WORK FROM LISTS

B.1 Topics: In the tables below, please nominate from the first table (or add to the second table) the key Australian public health successes that you believe have contributed to the health of Australians over the last hundred years or so (i.e., from 1901 to 2005). The achievements or interventions may be current.

Please nominate by numbering, in order of importance, topics from the first table (insert a number in the third column, with number 1 being the most important), and add any topics you believe should be there but are missing, to the second (blank) table following.

Topics	Details of intervention/s and outcome/achievement	No.
Public health influence on health and other policies, 1901- [i.e., the whole of the twentieth century]	Promulgation of the concepts and practice of public health, today defined as the organised response by society to protect and promote health and to prevent illness, injury and disability through the public health practices of health assessment, health protection, health promotion, and prevention of disease, disability and injury.	
Safe drinking water, 1901-	Public health engineering, and setting and monitoring of standards for drinking water quality to achieve reductions in water-borne diseases.	
Infant and maternal mortality reductions, 1901-	Improved sanitation and hygiene, living and birthing conditions; ante and post-natal care; breastfeeding support, education & promotion; parent education; better nutrition programs including the school milk program, and health-promoting schools programs; to achieve reductions in infant and maternal mortality, healthier babies and children, improved immunity and life expectancy. Targeted services and programs to improve birthweight and health of Aboriginal babies and mothers (from the 1980s-). Monitoring and researching SIDS (Sudden Infant Death Syndrome) to identify prevention strategies, and health education and health promotion campaigns to promote preventive SIDS strategies (1991-).	
Infectious disease control, 1901-	Control of epidemics; immunisation against vaccine-preventable diseases; screening and early intervention for tuberculosis; STI clinics; needle exchange programs; and infection control in hospitals leading to fewer deaths and illnesses from, and eradication of, some infectious diseases. Includes: HIV/AIDS control (1985-).	
Advances in occupational and industrial safety and improvements in working conditions, 1901-	Advances in occupational and industrial safety, and improvements in working conditions; occupational health and safety legislation; environmental and occupational exposure standards setting, monitoring and regulating; and environmental mitigation programs to achieve improved safety at work and fewer occupational fatalities, injuries, and hazardous exposures.	
Water fluoridation, since the 1960s-	Fluoridation of drinking water to strengthen teeth from childhood.	

Topics	Details of intervention/s and outcome/achievement	No.
Road traffic safety, 1960s-	Seat belt legislation, random breath testing; all-states maximum speed limit 110km, and blood alcohol limit 0.05; improved product design and car safety features; improved roads and traffic management; and mandatory helmet wearing legislation to achieve reductions in road trauma fatalities and injuries.	
Food fortification, since the 1960s-	Fortification of salt with iodine, flour with thiamine, and various foods with folate (voluntary) to reduce preventable deficiency diseases and congenital malformations.	
Organised screening, early detection, and treatment, from the late 1960s-	Organised screening, early detection, and treatment to achieve fewer deaths and less disability from preventable or treatable conditions, which are amenable to detection by screening. Includes: screening newborns for congenital metabolic conditions, late 1960s-; screening for cervical cancer, 1991-; screening for breast cancer (aged 50-69 years), 1991-; newborn hearing screening, in some states from 2000-.	
Aboriginal community controlled health movement, from 1971-	Aboriginal community-controlled health services delivering primary care to Indigenous populations to promote health and prevent illness.	
Tobacco control, 1982-	Multi-faceted Tobacco Control Strategy to prevent smoking-related deaths and respiratory disease and to improve living conditions (smoke-free premises).	
Domestic injury prevention, from 1986-	Health education and health promotion campaigns, product safety and legislated product changes, monitoring, identifying & researching preventable injuries to achieve reductions in preventable fatalities and injuries in domestic settings.	
Environmental lead reduction, 1986- (earlier in point source communities)	Lead-free petrol and paint; environmental lead remediation and abatement programs to achieve reduced environmental exposure to lead.	
Alcohol-related harm reduction and minimisation programs, 1990s-	Risk behaviour reduction programs, liquor licensing and regulation, education and training for staff serving alcohol, designated driver programs; community-determined alcohol restrictions and bans to prevent alcohol-related harm including injuries and hospitalisations.	

If you feel that there are important public health successes that are not listed above, please add them below.

B.2 Selection criteria: We are keen to understand why you believe the public health measures nominated in the previous section have been the most successful. What factors were important in forming your decision? Some selection criteria that have been used in similar exercises are shown in the table below.[721]

Please rank the criteria that were most important in forming your decision on the public health successes that you nominated in Section B.1, with number 1 being the most important. If different or additional factors were important in forming your decision, please add them to the blank table.

Suggested criteria	Details	No.
Ambitious in scale	Interventions or programs implemented on a national, nation-wide, or universal scale. Programs may be characterised as 'national' if they represent a national-level commitment, even if they have targeted a problem affecting a limited geographic area. Programs implemented on a pilot basis, or within only a few local areas are excluded.	
Importance	Interventions or programs addressing a problem of public health significance.	
Impact	Interventions or programs that have demonstrated a clear and measurable impact on a population's health.	
Duration	Interventions or programs that have functioned 'at scale' for at least five consecutive years.	
Cost-effectiveness	Interventions or programs that you believe have used a cost-effective approach.	
Directly attributable to the public health effort	Interventions or programs that have had a health impact that is directly attributable to the specific public health effort rather than primarily to broad social and economic improvement.	

Were there other or additional factors that were important in forming your decision? Please add them below.

Instructions: Finish the survey by completing Part C.

PART C: Comments and acknowledgements

C.1 Comments: Please make any other comments on related areas or issues in the box below.

C.2 Acknowledgements: We would like to acknowledge your contribution as a survey participant in the final report. Please mark the 'Yes' box below if you agree that we may acknowledge you in the report, and provide details. If you don't agree, please mark 'No'.

☐ Yes – acknowledge my contribution in the report

If yes, in order to be acknowledged, please provide your details below:

Name .....

Position .....

Organisation .....

Email address for return of draft: .....

OR

☐ No – do not acknowledge my contribution in the report.

Survey process

Responses are due by [a deadline]. Responses can be emailed, faxed or posted.

Surveys will be analysed as a group to provide information to the report (they will not be individually identified). Your participation will be acknowledged in the report if you have agreed in section C.2.

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Appendix E: Defining health

The Commonwealth of Australia, *World Health Organization Act 1947* (Schedule I, Section 3) initiating Australia's membership of the World Health Organization, defines health as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'.[738]

The public health principles that the *Act* sets out are still pertinent today:

> "The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.
>
> The health of all peoples is fundamental to the attainment of peace and security and is dependent upon the fullest co-operation of individuals and States.
>
> The achievement of any State in the promotion and protection of health is of value to all.
>
> Unequal development in different countries in the promotion of health and control of disease, especially communicable disease, is a common danger.
>
> Healthy development of the child is of basic importance; the ability to live harmoniously in a changing total environment is essential to such development.
>
> The extension to all peoples of the benefits of medical, psychological and related knowledge is essential to the fullest attainment of health.
>
> Informed opinion and active co-operation on the part of the public are of the utmost importance in the improvement of the health of the people.
>
> Governments have a responsibility for the health of their peoples which can be fulfilled only by the provision of adequate health and social measures."

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List of shortened forms

AAA	Australian Automobile Association
AAMS	Australian Academy of Medicine and Surgery
AAQ	Ambient Air Quality
ABA	Australian Breastfeeding Association
ABARE	Australian Bureau of Agricultural and Resource Economics
ABC	Australian Broadcasting Commission
ABS	Australian Bureau of Statistics
ACA	Australian Consumers Association
ACCHS	Aboriginal Community-Controlled Health Services
ACEM	Australasian College for Emergency Medicine
ACHR	Australian Centre for Health Research
ACIR	Australian Childhood Immunisation Register
ACITHIN	Australian Centre for International and Tropical Health and Nutrition
ACRA	Australian Cardiac Rehabilitation Association
ACSQHC	Australian Commission on Safety and Quality in Health Care
ACT	Australian Capital Territory
ACTM	Australasian College of Tropical Medicine
ADCA	Alcohol and other Drugs Council of Australia
ADEC	Australian Drug Evaluation Committee
ADRAC	Adverse Drug Reactions Advisory Committee
AEDI	Australian Early Development Index
AGPS	Australian Government Publishing Service
AGPSCC	Australian General Practice Statistics and Classification Centre
AHMC	Australian Health Ministers' Conference
AHPA	Australian Health Promotion Association
AHURI	Australian Housing and Urban Research Institute
AIDA	Australian Indigenous Doctors Association
AIDS	Acquired Immune Deficiency Syndrome
AIFS	Australian Institute of Family Studies
AIH	Australian Institute of Health
AIHW	Australian Institute of Health and Welfare
AIHW NPSU	Australian Institute of Health and Welfare, National Perinatal Statistics Unit
AISRAP	Australian Institute for Suicide Research and Prevention
AITM	Australian Institute of Tropical Medicine
a.k.a.	also known as
AMA	Australian Medical Association
AMI	Acute myocardial infarction
ANAO	Australian National Audit Office
ANCAHRD	Australian National Council on AIDS, Hepatitis C and Related Diseases
ANZFA	Australia New Zealand Food Authority
AOA	Australian Orthopaedic Association
APY Lands	Anangu Pitjantjatjara Yankunytjatjara Lands

AQIS	Australian Quarantine Inspection Service
ARIA	Accessibility/Remoteness Index of Australia
ARTG	Australian Register of Therapeutic Goods
ASCC	Australian Safety and Compensation Council
ASHM	Australasian Society for HIV Medicine Inc.
ATC	Australian Transport Council
ATSB	Australian Transport Safety Bureau
ATSE	Australian Academy of Technological Sciences and Engineering
ATSIC	Aboriginal and Torres Strait Islander Commission
AUSTEHC	Australian Science and Technology Heritage Centre
AWSC	Australian Water Safety Council
BA	Biotechnology Australia
BAC	Blood alcohol content
BFHI	Baby Friendly Health Initiative
BMI	Body mass index
BoM	Australian Government Bureau of Meteorology
BTE	Bureau of Transport Economics
BTRE	Bureau of Transport and Regional Economics
CASANZ	Clean Air Society of Australia and New Zealand
CATSIN	Congress of Aboriginal and Torres Strait Islander Nurses
CDNA	Communicable Diseases' Network Australia
CHD	Coronary heart disease
CHE	Centre for Health Economics
CHF	Consumers' Health Forum of Australia
CIE	Centre for International Economics
CIJIG	Commonwealth Interdepartmental JETACAR Implementation Group
COAG	Council of Australian Governments
COSA	Clinical Oncological Society of Australia
CPI	Consumer Price Index
CRCATH	Cooperative Research Centre for Aboriginal and Tropical Health
CRCWQ&T	Cooperative Research Centre for Water Quality and Treatment
CSANZ	Cardiac Society of Australia and New Zealand
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSL	Commonwealth Serum Laboratories
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
DCPC	Drugs and Crime Prevention Committee
DEC NSW	Department of Environment and Conservation, NSW
DEH	Australian Government Department of Environment and Heritage
DEST	Commonwealth Department of the Environment, Sport and Territories
DFaCS	Australian Government Department of Families and Community Services
DFaCSIA	Australian Government Department of Families, Community Services and Indigenous Affairs
DHAC	Australian Government Department of Health and Aged Care
DHFS	Commonwealth Department of Health and Family Services
DNA	Deoxyribonucleic acid

DoHA	Australian Government Department of Health and Ageing
EAGAR	Expert Advisory Group on Antimicrobial Resistance
EPHC	Environment Protection and Heritage Council
EU	European Union
FaCS	Commonwealth Department of Family and Community Services
FAO	Food and Agriculture Organization of the United Nations
FASTS	Federation of Australian Scientific and Technological Societies
FHBH	Fixing Houses for Better Health
FPA	Family Planning Australia
FRRC	Food Regulation Review Committee
FSANZ	Food Standards Australia New Zealand
GAP	Good agriculture practice
GDP	Gross domestic product
GM	Genetically modified
GMP	Good manufacturing practice
HACCP	Hazard Analysis and Critical Control Point
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HfH	Housing for Health
Hib	*Haemophilus influenzae* type b
HIC	Health Insurance Commission
HIV	Human Immunodeficiency Virus
HMAC	Housing Ministers' Advisory Council
HMRSR	Health and Medical Research Strategic Review
HOI	Health Outcomes International
HREOC	Human Rights and Equal Opportunity Commission
HTA	Health technology assessment
HUS	Haemolytic Uraemic Syndrome
IDI	International Diabetes Institute
IFIP	Imported Food Inspection Program
ISG	Influenza Specialist Group
ISH	International Society of Hypertension
JETACAR	Joint Expert Advisory Committee on Antibiotic Resistance
LWA	Living with Alcohol program (NT)
MCDS	Ministerial Council on Drug Strategy
MDEC	Medical Device Evaluation Committee
MDRTB	Multi-drug resistant TB
MIAA	Medical Industry Association of Australia Inc.
MMR	Maternal mortality ratio
MMR	Measles, mumps, rubella (vaccine)
MRI	Magnetic resonance imaging
MRSA	Methicillin-resistant *Staphylococcus aureus*
MSAC	Medical Services Advisory Committee
MUARC	Monash University Accident Research Centre
NACCHO	National Aboriginal Community Controlled Health Organisation

NAIHO	National Aboriginal and Islander Health Organization
NAS	National Alcohol Strategy
NCADA	National Campaign Against Drug Abuse
NCCI	National Cancer Control Initiative
NCHECR	National Centre in HIV Epidemiology and Clinical Research
NCIRS	National Centre for Immunisation Research and Surveillance of Vaccine-Preventable Disease
NCIS	National Coroners' Information System
NDARC	National Drug and Alcohol Research Centre
NDRI	National Drug Research Institute
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHC	Nganampa Health Council
NHFA	National Heart Foundation of Australia
NHMRC	National Health and Medical Research Council
NHPA	National Health Priority Areas
NHPAC	National Health Priority Action Council
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NICS	National Institute of Clinical Studies
NIP	National Immunisation Program
NISU	National Injury Surveillance Unit
NJRR	National Joint Replacement Registry
NMSC	Non-melanocytic skin cancers
NOHSC	National Occupational Health and Safety Commission
NPHP	National Public Health Partnership
NRMMC	Natural Resource Management Ministerial Council
NSF	National Stroke Foundation
NSPs	Needle and syringe exchange programs
NSW	New South Wales
NSW EPA	NSW Environment Protection Authority
NSW RTA	NSW Roads and Traffic Authority
NTAC	National Tuberculosis Advisory Committee of CDNA
NWQMS	National Water Quality Management Strategy
OECD	Organisation for Economic Co-operation and Development
OHS	Occupational health and safety
PBAC	Pharmaceutical Benefits Advisory Committee
PBS	Pharmaceutical Benefits Scheme
PC	Productivity Commission
PDC	Prostheses and Devices Committee
PHAA	Public Health Association of Australia
PHERP	Public Health Education and Research Program
PHIDU	Public Health Information Development Unit
PHOFA	Public Health Outcome Funding Agreements
PHRDC	Public Health Research and Development Committee of the NHMRC
PHU	Public Health Unit

PVC	Polyvinyl chloride
QA	Quality Assurance
QALY	Quality-adjusted life year
QIMR	Queensland Institute of Medical Research
QISU	Queensland Injury Surveillance Unit
Qld	Queensland
QUT	Queensland University of Technology
RACGP	Royal Australian College of General Practitioners
RACP	Royal Australasian College of Physicians
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
RANZCP	Royal Australian and New Zealand College of Psychiatrists
RBT	Random Breath Testing
RDI	Recommended Dietary Intake
RLSSA	Royal Life Saving Society Australia
SA	South Australia
SAA	Standards Association of Australia
SCATSIH	Standing Committee on Aboriginal and Torres Strait Islander Health
SCC	Statistical Consulting Centre
SCRGSP	Steering Committee for the Review of Government Service Provision
SEIFA	Socio-Economic Index for Areas (disadvantage score)
SIDS	Sudden Infant Death Syndrome
SIGNAL	Strategic Inter-Governmental Nutrition Alliance
SIPP	Strategic Injury Prevention Partnership
SMH	Sydney Morning Herald
STIs	Sexually transmissible infections
TB	Tuberculosis
TGA	Therapeutic Goods Administration
UK	United Kingdom
UN	United Nations
UQ	University of Queensland
US	United States
UV	Ultraviolet radiation
UVB	Ultraviolet radiation B
VCTC	VicHealth Centre for Tobacco Control
VHPF	Victorian Health Promotion Foundation
WA	Western Australia
WACRRM	Western Australian Centre for Remote and Rural Medicine
WARC	World Advertising Research Centre
WHO	World Health Organization
WHOSIS	World Health Organization Statistical Information System
WKS	Wernicke-Korsakoff Syndrome
WRMC	Workplace Relations Ministers' Council
µg/dL	Micrograms per decilitre

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Glossary

Abatement
Reducing the degree or intensity of, or eliminating, pollution (including from emissions). The term abatement is normally used to indicate treatment systems to reduce the emission of pollutants into the atmosphere. Typical abatement systems include scrubbers, cyclones, bag filters, electrofilters, and activated carbon beds.[729]

Adverse event
An injury resulting from a medical intervention, not the underlying condition of the patient. Also referred to as 'iatrogenic injury' - unintended or unintentional harm or suffering arising from any aspect of health care management. An adverse event is preventable if it is due to an error in management due to failure to follow accepted practice at an individual or system level, where accepted practice is the current level of expected performance for the average medical practitioner or system that manages the condition in question.[730]

Angina
Temporary chest pain or discomfort when the heart's own blood supply is inadequate to meet extra needs. ***See also*** **Circulatory system disease**.

Angiosarcoma
A malignant vascular tumour, which can result from prolonged exposure to vinyl chloride monomers.

Antimicrobial
An antimicrobial is a substance that kills or slows the growth of microbes like bacteria (antibacterial activity), fungi (antifungal activity), viruses (antiviral activity), or parasites (antiparasitic activity).

Apgar score
A practical method of evaluating the physical condition of a newborn infant at 1 minute and 5 minutes after birth. The score represents a number arrived at by scoring the heart rate, respiratory effort, muscle tone, skin colour, and response to a catheter in the nostril. Each of these objective signs can receive 0, 1, or 2 points. A perfect Apgar score of 10 means an infant is in the best possible condition. An infant with an Apgar score of 0-3 needs immediate resuscitation.[243]

Asbestosis
A chronic and progressive lung disease caused by inhaling asbestos fibres over a period of time. It may take five to 20 years before symptoms develop. The accumulated, inhaled asbestos fibres produce scarring (fibrosis) of the lung which makes the lungs stiffen and stops them working properly. Asbestosis causes breathlessness, tightness in the chest, persistent coughing and the skin may have a bluish tinge from lack of oxygen. Getting enough oxygen from each breath needs a much greater effort. Asbestosis usually worsens over time. It can lead to respiratory failure and death. There is no cure for this disease.[193]

Benchmarking
A quality assurance process in which an organisation sets goals and measures its performance in comparison to those of the products, services, and practices of other organisations that are recognised as leaders.[32]

Benefit-cost analysis
A systematic compilation of net social benefits and costs associated with a project or policy change.[32]

Biosecurity
Protection of natural resources from biological invasion and threats.

Biotechnology
The use of biological processes, organisms, or systems to manufacture products intended to improve the quality of human life. Many of the principles and some of the techniques involved are ancient. Fermentation, for example, in which microbes are used to produce beer, wine, cheese, bread and

yoghurt, has been practised for thousands of years. Traditional plant and animal breeding techniques involve applications of biotechnology. Biotechnology now encompasses a wide range of technologies using living organisms to create products and perform tasks for a practical result. Examples can be found in crop and livestock production and food processing, in pharmaceuticals and medicine, in industrial production, and in waste management for cleaning up oil spills and neutralising hazardous wastes (bioremediation).[324]

Breast milk substitute
Any food being marketed or otherwise presented as a partial or total replacement for breast milk, whether or not suitable for that purpose.[282]

Caesarean Section
Operative birth by surgical incision through the abdominal wall and uterus.

Campylobacter
A group of bacteria that is a major cause of diarrhoeal illness.

Cardiovascular disease
See **Circulatory system disease**

Causal pathways
The complex interactions between genetic and environmental risks over time which contribute to a particular outcome. Such pathways can be networks of causal factors acting together, all of which are important to produce the disease/problem.

Cerebrovascular disease
Any disorder of the blood vessels supplying the brain or its covering membranes. See also **Stroke**.

Chlorination
Use of chlorine as a means of disinfection.

Circulatory system disease
Any disease of the heart or blood vessels, including heart attack, angina, stroke and peripheral vascular disease.

Codex Alimentarius
A food quality and safety code developed by the Codex Alimentarius Commission of the Food and Agriculture Organization of the United Nations and the World Health Organization.

Contaminant
Biological or chemical substance or entity, not normally present in a system, capable of producing an adverse effect in a biological system, seriously injuring structure or function.

Coronary heart disease
See **Ischaemic heart disease**

Cost-benefit analysis
A comparison of alternative interventions in which costs and outcomes are quantified in common monetary units.

Cost-effectiveness analysis
A comparison of alternative interventions in which costs are measured in monetary units and outcomes are measured in non-monetary units, e.g., reduced mortality or morbidity.

Cost-utility analysis
A form of cost-effectiveness analysis of alternative interventions in which costs are measured in monetary units and outcomes are measured in terms of their utility, usually to the patient, e.g., using QALYs.

Cryptosporidium
Micro-organism commonly found in lakes and rivers that is highly resistant to disinfection. *Cryptosporidium* can cause outbreaks of gastrointestinal illness, with symptoms that include diarrhoea, nausea and stomach cramps. People with severely weakened immune systems (i.e., severely

immunocompromised people) are likely to have more severe and more persistent symptoms than healthy individuals (adapted from US Environmental Protection Agency).

Current daily smoker
A person who smoked one or more cigarettes (or cigars or pipes) per day, on average, at the time of interview.

Demand reduction
Strategies that aim to seek a reduction of desire and preparedness to obtain and use drugs, in order to both prevent harmful drug use and also prevent drug-related harm.

Determinants of health
Factors which influence health status and include individual factors (such as age, gender and ethnicity; behaviour such as smoking, alcohol consumption, diet and physical exercise), the physical, economic and social environments, including housing quality, the workplace and the wider urban and rural environment; and access to health care. All of these are closely interlinked and differentials in their distribution lead to health inequalities.

Direct costs
The fixed and variable costs of all resources (goods, services, etc.) consumed in the provision of an intervention as well as any consequences of the intervention such as adverse effects or goods or services induced by the intervention. They include direct medical costs and direct non-medical costs such as transportation or child care.

Disease prevention
Measures taken to prevent the occurrence of disease, to arrest or slow its progress and to reduce its consequences. See also **Prevention, Primary prevention.**

Drug-related harm
Any adverse social, physical, psychological, legal or other consequence of drug use that is experienced by a person using drugs or by people living with or otherwise affected by the actions of a person using drugs.

Echinococcosis
See **Hydatid disease**

Effectiveness
The extent to which a specific intervention, when used under ordinary circumstances, does what it is intended to do.

Environmental health
Those aspects of public health concerned with the factors, circumstances, and conditions in the environment or surroundings of humans that can exert an influence on health and well-being. More generally, it describes the effect of the environment on human health.

Environmental tobacco smoke
See **Passive smoking**

Epidemic
An outbreak of a disease or its occurrence at a level that is clearly higher than previously existed.

Escherichia coli
A type of bacteria found in the gastrointestinal system of the body; and used as an indicator of faecal contamination of water.

Ever breastfed
An infant that has ever been put to the breast, or has received expressed breast milk but has never been put to the breast.[733]

Evidence-based medicine
The use of the best evidence from scientific and medical research to make decisions about the care of individual patients. It involves formulating questions relevant to the care of particular patients,

searching the scientific and medical literature, identifying and evaluating relevant research results, and applying the findings to the care of patients.

Exclusive breastfeeding
An infant who receives only breast milk and no other liquids or solids apart from drops or syrups containing vitamins, mineral supplements or medicines.[273]

External causes
See **Injury and poisoning, deaths from**

Fatal heart attacks
See **Ischaemic heart disease**

Fetal death (stillbirth)
The birth of a child who did not at any time after delivery breathe or show any other evidence of life, such as a heartbeat. Fetal deaths include only infants weighing at least 400 grams or of a gestational age of at least 20 weeks.

Food regulation
Actions by government which affect the safety or quality of, or the information available in relation to food; encompassing all types of government regulation-making, industry self-regulation, compliance and enforcement activities; and covering relevant activities of all businesses in the supply chain.[330]

Food regulatory system
The legislative and voluntary codes and enforcement activities associated with the various foods and food components.

Food security
Exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life.[734]

Formaldehyde
A component of many glues and resins, produced and used in the chemical and plastics' industries and used in the manufacture of pressed wood products.

Formula or infant formula
A breast milk substitute manufactured in accordance with applicable Codex Alimentarius standards, to satisfy the normal nutritional requirements of infants up to between four and six months of age, and adapted to their physiological characteristics.[273]

Fortification
The addition of one or more essential nutrients to a food for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups.[384]

Fully breastfed
Infants who receive almost all of their nutrients from breast milk but take some other liquids such as water, water-based drinks, oral rehydration solutions, ritual fluids, and drops or syrups. It excludes any food-based fluids.[273]

Functional foods
Those foods promoted on a health platform based on scientific evidence. They include minimally transformed foods (such as fruit and vegetables), containing known bioactive components, as well as substantially and elaborately transformed food products, including foods and beverages with known or added bioactive ingredients. The difference between functional foods and all other foods in these categories is that the benefits of the functional foods have been scientifically substantiated.[735]

Gene technology
A specific subset of biotechnology, based on the manipulation and modification ('recombination') of the genetic material of living organisms to develop new characteristics, processes and products.[323]

Genetic modification
The changing of organisms by the incorporation or deletion of genes in order to alter or introduce new characteristics.

Genomics
The study of the structure of the genome (all the genes and genetic information) and information contained in the chromosomes of an organism, and includes gene mapping, gene sequencing and gene function.

Greywater
Waste water from t showers, baths, hand basins, laundry tubs and washing machines. It does not include wastewater from toilets, kitchen sinks and dishwashers.

Haemolytic Uraemic Syndrome
A condition which follows an infection (usually diarrhoea or upper respiratory tract) and is characterised by disordered blood clotting, damage to red blood cells and acute renal failure. HUS can be fatal, or result in long-term damage to kidneys and other organs, including the pancreas and brain (children and elderly people are particularly susceptible).[736]

Harm
Refers to disease, injury, suffering, disability and death; it also describes the adverse effects that may result from drug use.[737]

Harm minimisation
Policies and programs aimed at reducing anticipated and actual drug-related harm; and improving health, social and economic outcomes for both the community and the individual. Both licit and illicit drugs are the focus of Australia's harm-minimisation strategy, which offers a comprehensive approach to drug-related harm, involving a balance between reductions in demand, supply and harm.[537]

Harm reduction
Activities and services that acknowledge the continued drug use of individuals, but aim to minimise the harm that such behaviour causes; such strategies are designed to reduce the impacts of drug-related harm on individuals and communities.[537]

Hazard
A circumstance or agent that can lead to harm, damage or loss. Public health hazards may be environmental, nutritional or related to alcohol or other drugs, food safety, communicable and non-communicable diseases, and injury.

Hazard Analysis and Critical Control Points
A system that enables the production of safe meat and poultry products through the analysis of production processes; the identification of all likely hazards and of critical points in the process at which these hazards may be introduced into a product and therefore should be controlled; the establishment of critical limits for control at those points; the verification of these prescribed steps; and the methods by which the processing establishment and the regulatory authority monitor the efficacy of process control through the HACCP plan.[51]

Health
A state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.[738]

Health care
Those services provided to individuals or communities to promote, maintain, monitor, or restore health. Health care is not limited to medical care, and includes self-care.

Health claim
A statement linking consumption of a food, or a component of a food to a disease or health-related condition.[342]

Health hardware
The items in a house that help maintain the health of the occupants; methodology developed by

Nganampa Health Council (in 1987) to assess health hardware identified nine essential healthy living practices: 1. washing people; 2. washing clothes/bedding; 3. waste removal; 4. nutrition; 5. reduce crowding; 6. separation of dogs and children; 7. dust control; 8. temperature control; and 9. reduced trauma.[161]

Health inequalities
Differences in the health status of groups within a population. Such differences may be related to age, gender, ethnicity, genetic inheritance or access to material resources, education, satisfying and safe work, services and so forth. They may be unavoidable (e.g., those that are age-related) or may be amenable to change (those due to socioeconomic differences).

Health inequities
Differences in the health status of groups within a population that are potentially avoidable, and thus perceived as unfair or unjust.

Health Promoting Schools
This program aims to create a school environment where all members of the school community work together to provide students with integrated and positive experiences and structures that promote and protect their health. This includes both the formal and informal curricula in health, the creation of a safe and healthy school environment, the provision of appropriate health services, and the involvement of the family and the wider community in efforts to promote health.

Health promotion
Activities concerned with 'positive health and well-being; with the whole of life… involving a complex notion of health to include bodily, mental, social and spiritual states… and [occurring] incrementally over time… linked to everyday life and community and is about changing the balance of power in the human and health domains'.[694]

Health promotion system
The framework for creating supportive environments where healthy choices are either possible or easier for individuals.

Health protection
Activities designed to avoid any deterioration in health by preventing or minimising the exposure of the community to potential illness. It is particularly concerned with risks to health arising where the individual has little or no control.

Health Technology Assessment
The systematic evaluation of properties, effects, and/or impacts of health care technology, both direct and unintended consequences, to inform technology-related policy-making in health care.

Healthy living practices
see **Health hardware**

Healthy public policy
Policy characterised by an explicit concern for health, equity and accountability, with the aim of improving the conditions under which people live: secure, safe, adequate, and sustainable livelihoods, lifestyles, and environments, including housing, education, nutrition, information exchange, child care, transportation, and necessary community and personal social and health services. Policy adequacy may be measured by its impact on population health.[695]

Hepatitis
Inflammation of the liver from any cause.

Hydatid disease
A potentially fatal parasitic disease that can affect animals, including wildlife and commercial livestock, and humans. A hydatid is the larval form of a tapeworm, and also describes a cyst filled with liquid that forms as a result of infestation by tapeworm larvae (as in echinococcosis).

Hypertension
Defined by the WHO and the International Society of Hypertension as a systolic blood pressure

measurement of 140 mmHg or more; or a diastolic blood pressure reading of 90 mmHg or more; or receiving medication for high blood pressure.[696]

Hypothecation
The principle of using the monies raised by taxation of an unhealthy product to fund measures to remedy the harm done by the taxed product; for example, tobacco taxes used to support health promoting organisations and activities to reduce smoking.

Iatrogenic
Harm or injury arising from or associated with health care.

Illicit drug
A drug for which the production, sale, possession or use is prohibited. An alternative term is 'illegal drug'.

Incidence
The number of new occurrences of a variable in a population over a particular period of time, e.g., the number of cases of a disease in a country over one year.

Indirect costs
The cost of time lost from work and decreased productivity due to disease, disability, or death. In cost accounting, the term refers to the overhead or fixed costs of producing goods or services.

Infant mortality
All deaths occurring from birth and during the remainder of the first year of life. It is expressed using the *infant mortality rate,* which is the number of deaths of those aged less than 1 year divided by the number of live births for that year.[698]

Initiation of breastfeeding
An infant's first intake of breast milk.

Injury and poisoning deaths
Deaths from motor vehicle and other accidents, suicide, assault, poisoning, drowning, burns and falls, and complications of medical and surgical care.[697]

Ischaemic heart disease
A disease characterised by reduced blood supply to the heart.

Lifetime risk of maternal death
The probability of becoming pregnant and the probability of dying as a result of that pregnancy cumulated across a woman's reproductive years; more simply, it is the probability of maternal death faced by a pregnant woman.[698]

Live birth
A live birth occurs when a fetus, whatever its gestational age, exits the maternal body and subsequently shows any sign of life, such as voluntary movement, heartbeat, or pulsation of the umbilical cord, for however brief a time and regardless of whether the umbilical cord or placenta are intact.[743]

Low birthweight
A birthweight of less than 2,500 grams.[698]

Maternal death
A death of a woman while pregnant or within 42 days of the termination of the pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.[698]

Maternal mortality rate
The number of maternal deaths in a given period per 100,000 women of reproductive age during the same time period; it reflects the frequency with which women are exposed to risk through their fertility.[698]

Medicalisation
The process by which non-medical problems are defined and treated as if they are medical issues.

Mesothelioma
A cancer of the outer covering of the lung (the pleura) or the abdominal cavity (the peritoneum).

Meta-analysis
Systematic methods that use statistical techniques for combining results from different studies to obtain a quantitative estimate of the overall effect of a particular intervention or variable on a defined outcome. This combination may produce a stronger conclusion than can be provided by any individual study.

Neonatal death
Death of a live born baby within 28 days of birth.[698]

Neural tube defects
Abnormalities in the development of the spinal cord and brain in the fetus.[13]

Overweight or obese adults
Overweight is defined as having a body mass index (BMI) greater than or equal to 25 and less than 30, while obesity is defined by a BMI greater than or equal to 30. BMI is body weight in kilograms divided by the square of height in metres.

Passive smoking
Exposure of a person to tobacco smoke, or the chemicals in tobacco smoke, who is not smoking. The smoke is known as 'environmental tobacco smoke (ETS).

Pathogens
Disease-causing micro-organisms (e.g., bacteria, viruses, protozoa).

Perinatal
The period around the time of birth.

Perinatal death
A fetal or neonatal death of at least 20 weeks' gestation or at least 400 grams birthweight.[698]

Pertussis
A highly infectious, bacterial disease of the air passages marked by explosive fits of coughing and often a whooping sound on breathing in. It is more commonly known as 'whooping cough' and is preventable by vaccination.

Population health
Organised efforts focused on the health of defined populations in order to promote and maintain or restore health, to reduce the amount of disease, premature death and discomfort and disability due to disease. The study of population health focuses on understanding health and disease in a community, and on improving health and wellbeing through health approaches that address the disparities in health status between social groups.[13]

Precautionary principle
An approach to the management of risk of harm or damage to human health or the environment when scientific knowledge is incomplete.

Preterm birth
Birth before 37 completed weeks of gestation.[698]

Prevalence
The proportion of a population having a particular condition or characteristic: e.g., the percentage of people in a city who smoke.

Primary prevention
Actions taken to avoid disease or injury before they occur.

Prognosis
A prediction of the course and probable outcome of a disease based on the condition of the patient and the activity of the disease.

Prostheses
An artificial device to replace or assist damaged or missing bodily parts; examples include cardiac pacemakers and defibrillators, cardiac stents, hip and knee replacements and intraocular lenses, as well as human tissues such as human heart valves, corneas, bones (part and whole) and muscle tissue.

Psychoactive drug
Any substance that affects the central nervous system and alters the mood, perception or consciousness of an individual who has consumed it.

Public health medicine
The branch of medical practice primarily concerned with the health and care of populations.

Public health research
Research involving communities or populations, to identify the factors which contribute to ill-health in populations and ways of influencing these factors to prevent disease. It includes epidemiology, social and behavioural sciences, health services' research on population-based health interventions, and evaluating the efficacy and effectiveness of preventive measures.[704]

Puerperal sepsis or puerperal fever
Infection of the female genital tract following childbirth, abortion, or miscarriage.

Puerperium
The period which elapses after the birth of a child until the mother is again restored to her usual condition.

Q fever
A zoonotic disease in Australia, caused by the bacterium *Coxiella burnetii* which mainly affects sheep and cattle but can be transmitted to humans after contact with infected animals. Symptoms are similar to those of influenza, and include fever, headache and lung inflammation.

QALY (Quality-Adjusted Life Year)
A measure of the outcome of actions (either individual or treatment interventions) in terms of their health impact; a unit of health care outcomes that adjusts gains (or losses) in years of life subsequent to a health care intervention by the quality of life during those years.

Quality assessment
A measurement and monitoring function for determining how well health care is delivered in comparison with applicable standards or acceptable boundaries of care.

Quality assurance
Activities intended to ensure that the best available knowledge concerning the use of health care to improve health outcomes is properly implemented. This involves the implementation of health care standards, including quality assessment and activities to correct, reduce variations in, or otherwise improve health care practices relative to these standards.

Quarantine
The isolation of people who have a disease or who have been exposed to a disease and may therefore become infected as a result of the exposure.

Remote
Geographical areas within the 'Remote Australia' and 'Very remote Australia' categories of the Australian Standard Geographical Classification (ASGC) Remoteness structure.

Remoteness Area
Within a state or territory, each Remoteness Area represents an aggregation of non-contiguous geographical areas which share common characteristics of remoteness, determined in the context of Australia as a whole. The delimitation criteria for Remoteness Areas are based on the Accessibility/

Remoteness Index of Australia (ARIA). ARIA measures the remoteness of a point based on the physical road distances to the nearest Urban Centre in each of the five size classes.

Risk assessment
The overall process of using available information to predict how often hazards or specified events may occur (likelihood) and the magnitude of their consequences (adapted from AS/NZS 4360:1999).

Screening
The use of a test to check people who have no symptoms of a particular disease, to identify people who might have that disease and to allow it to be treated at an early stage when a cure is more likely.

Secondary prevention
Action to identify and treat an illness or injury early on with the aim of stopping or reversing the problem.

Seroconversion
The development of a detectable level of antibodies that occurs after a person has been exposed to and become infected by a micro-organism such as the hepatitis C virus.

Sewage
Waste material collected from internal household and other building drains.

Sexually transmissible infection
An infection that is passed to another person through sexual contact.

SIDS
see **Sudden Infant Death Syndrome**

Social determinants of health
The economic and social conditions under which people live which influence their health.

Stroke
An acute injury in which the blood supply to a part of the brain is interrupted by a sudden blockage or bleeding.

Sudden Infant Death Syndrome (SIDS)
The abrupt and unexplained death of an apparently healthy infant aged between one month and one year.

Supply reduction
In relation to alcohol and other drugs, this refers to interventions designed to disrupt the production and supply of illicit drugs.

TB
see **Tuberculosis**

Technology
The application of scientific or other organised knowledge--including any tool, technique, product, process, method, organisation or system--to practical tasks. In health care, technology includes drugs; diagnostics, indicators and reagents; devices, equipment and supplies; medical and surgical procedures; support systems; and organisational and managerial systems used in prevention, screening, diagnosis, treatment and rehabilitation.

Tertiary prevention
Interventions to contain or retard the damage caused by a serious injury or a disease that has progressed beyond the early stages.

Toxicity
The extent to which a compound is capable of causing injury or death, especially by chemical means.

Toxicology
The study of poisons, their effects, antidotes and detection.

Tuberculosis
An infectious bacterial disease that affects the lungs, causing fever-like symptoms and ultimately, the destruction of tissue. It may spread to other parts of the body, causing secondary problems and may be fatal if not treated.

Universal health insurance
Health insurance which covers an entire population.

Upstream (or macro), midstream, downstream (or micro) factors
A model used for understanding the connection between health and socioeconomic status which involves identifying factors affecting health as 'upstream' (or macro) factors, 'midstream' (or intermediate) factors, and 'downstream' (or micro) factors. Macro factors include social and economic determinants outside the health system such as education, income, and housing. These are clearly influenced by government policies on economic growth and income distribution. Intermediate factors include psychosocial processes like social support networks; and the health care system itself, easy access to which is critical for those most socially disadvantaged. Micro factors include malfunctioning of the individual's biological systems which directly produce illness.[1]

UV Index
A way of describing the daily level of solar ultraviolet (UV) radiation intensity. Each point on the Index scale is equivalent to 25 milliWatts/square metre of UV radiation.

Virology
The study of viruses including their structures, modes of action and disease processes and the identification of possible interventions at the cellular level.

Water recycling
A generic term for water reclamation and reuse.

Zoonosis
An infectious disease that occurs naturally in animals and can be transmitted to humans. The agents of infection can be parasites, bacteria, viruses or fungi.

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References

[1] MJ Lewis, *The people's health* [2 vols.], Westport, CT & London, Praeger, 2003.

[2] J Powles, *Public engagement and public health*, Institute of Public Health, Cambridge, 2003.

[3] AIHW, *Australia's health 2000,* AIHW, Canberra, 2000.

[4] NHMRC, *The health effects of passive smoking: a scientific information paper*, NHMRC, Canberra, 1997.

[5] JHL Cumpston (MJ Lewis, ed.), *Health and disease in Australia: a history,* AGPS, Canberra, 1989.

[6] WHO, *Primary health care: Report on the conference of primary health care*, WHO, Geneva, 1978.

[7] WHO, *World Health Organization global strategy for health for all by the year 2000,* WHO, Geneva, 1981.

[8] WHO, *The Ottawa Charter for Health Promotion* – Charter adopted at an International Conference on Health Promotion, The move towards a new public health, November 17-21, 1986 Ottawa, Ontario, Canada, 1986.

[9] National Public Health Partnership (NPHP), *Public health in Australia: the public health landscape: person, society, environment,* NPHP, Melbourne, 1998.

[10] NSW Health, *Healthy People 2005: new directions for public health in NSW*, NSW Health Department, Sydney, 2000.

[11] NPHP, *Highlights of public health activity in Australia 2000-2001*, NPHP, Melbourne, 2002; citing NSW Health, *Healthy People 2005*, 2000.

[12] Minnesota Department of Health, *CHS Planning Guidelines: Public Health Principles*, MDH, St. Paul MN, [n.d.].

[13] AIHW, *Australia's health 2006*, AIHW, Canberra, 2006.

[14] RG Evans & GL Stoddart, 'Producing health, consuming health care', *Social Science and Medicine,* 1990, 31(12): 1347-1363.

[15] WHO Commission on Social Determinants of Health, 2006.

[16] JP Brosco, 'Successes and missed opportunities', *Pediatrics,* 2005, 115(4): 1134-1135.

[17] K McKenzie, 'Racism and health', *British Medical Journal*, 2003, 326(7380): 65-66.

[18] Y Paradies, 'A systematic review of empirical research on self-reported racism and health', *International Journal of Epidemiology*, 2006, 35(4): 888-901.

[19] R Harris, M Tobias, M Jeffreys et al., 'Racism and health: the relationship between experience of racial discrimination and health in New Zealand', *Social Science & Medicine*, 2006, 63(6): 1428-1441.

[20] MH Brenner, 'Fetal, infant and maternal mortality during periods of economic instability', *International Journal of Health Services*, 1973, 3(2): 145-159.

[21] R Catalano, 'The health effects of economic insecurity', *American Journal of Public Health* 1991, 81(9): 1148-1152.

[22] R Taylor, M Lewis & J Powles, 'The Australian mortality decline: all-cause mortality 1788-1990', *Australian and New Zealand Journal of Public Health*, 1998, 22(1): 27-36.

[23] PZ Pilzer, *The wellness revolution*, John Wiley & Sons, Hoboken, NJ, 2002.

[24] NHPC, *National Health Performance Framework Report: a report to the Australian Health Ministers' Conference,* Queensland Health, Brisbane, 2001.

[25] AIHW, *Mortality over the twentieth century in Australia: trends and patterns in major causes of death*, AIHW, Canberra, 2006.

[26] S Sax, *A strife of interests: politics and policies in Australian health services*, Allen & Unwin, Sydney, 1984.

[27] CDC, 'Ten great public health achievements - United States, 1900-1999', *Morbidity and Mortality Weekly Reports*, 1999, 48(12): 241-243.

[28] A Davis & J George, *States of health: health & illness in Australia*, Harper & Row, Sydney, 1988.

[29] Australian Dictionary of Biography (online).

[30] C Reynolds, *Public health law in Australia*, The Federation Press, Sydney, 1995.

[31] CRCWQ&T, *Drinking water facts: drinking water treatment*, CRCWQ&T, Adelaide, 2003.

[32] Productivity Commission (PC), *Arrangements for setting drinking water standards: International benchmarking*, AusInfo, Canberra, 2000.

[33] NHMRC & NRMMC, *Australian drinking water guidelines*, AGPS, Canberra, 2004, referring to NHMRC & AWRC, *Desirable quality for drinking water*, AGPS, Canberra, 1980.

[34] WHO, *Guidelines for drinking-water quality*, vol. 1, (3rd ed.), WHO, Geneva, 2004.

[35] IH Lester, *Australia's food and nutrition*, AGPS, Canberra, 1994.

[36] DEWR, 'The National Water Quality Management Strategy (NWQMS)' [website], 2005.

[37] SE Hrudey & EJ Hrudey (eds.), *Safe drinking water: Lessons from recent outbreaks in affluent nations,* IWA Publishing, London, 2004.

[38] EPHC, 'National guidelines for water recycling' [website], 2006.

[39] EPHC, NRMMC & AHMC, *Australian guidelines for water recycling: managing health and environmental risks (Phase 1),* EPHC, NRMMC & AHMC, Canberra, 2006.

[40] C Hickey & C Cowie, 'Taking the plunge: recreational water quality guidelines', *NSW Public Health Bulletin*, 2003, 14(8): 177-180.

[41] NHMRC, *Guidelines for managing risks in recreational water,* NHMRC, Canberra, 2005. Previous guideline: NHMRC, *Australian guidelines for recreational use of water*, NHMRC, Canberra, 1990.

[42] PM Byleveld, A Hunt & JM McAnulty, 'Cryptosporidiosis in the immunocompromised: weighing up the risk', *Medical Journal of Australia*, 1999, (171): 426-428.

[43] LO Goslin, 'Law and ethics in population health', *Australian and New Zealand Journal of Public Health,* 2004, 28(1): 7.

[44] ABS, *Housing and infrastructure in Aboriginal and Torres Strait Islander communities, Australia 2001*, ABS, Canberra, 2002.

[45] OAH Jones, N Voulvoulis & JN Lester, 'Potential ecological and human health risks associated with the presence of pharmaceutically active compounds in the aquatic environment', *Critical Reviews in Toxicology*, 2004, 34(4): 335.

[46] AHMAC, *Healthy mouths healthy lives: Australia's National Oral Health Plan 2004-2013*, SA Dept. of Health, Adelaide, 2004.

[47] M Koopmans & E Duizer, 'Foodborne viruses: an emerging problem', *International Journal of Food Microbiology*, 2004, 90(1): 23-41.

[48] A Taege, 'Foodborne disease', in WD Carey (ed.), *The Cleveland Clinic Disease Management Project*, The Cleveland Clinic Foundation, Cleveland OH, 2004.

[49] Food Science Australia & Minter Ellison Consulting (FSA & MEC), *The National Risk Validation Project: final report*, DoHA, Canberra, 2002.

[50] ANZFA, *Food safety standards – costs and benefits: an analysis of the regulatory impact of the proposed national food safety reforms*, ANZFA, Canberra, 1999.

[51] KL Hulebak & W Schlosser, 'Hazard Analysis and Critical Control Point (HACCP) history and conceptual overview', *Risk Analysis*, 2002, 23(2): 547.

[52] OzFoodNet, 'OzFoodNet – enhancing surveillance for foodborne disease in Australia' [website], 2005.

[53] OzFoodNet Working Group, 'Burden and causes of foodborne disease in Australia: annual report of the OzFoodNet network, 2005', *Communicable Diseases Intelligence*, 2006, 30(3).

[54] OzFoodNet Working Group, 'Reported foodborne illness and gastroenteritis in Australia: annual report of the OzfoodNet network, 2004', *Communicable Diseases Intelligence*, 2005, 29(2).

[55] G Hall & M Kirk, *Foodborne illness in Australia: annual incidence circa 2000*, DoHA, Canberra, 2005.

[56] PHAA, 'Foodborne disease: give us the evidence', PHAA, Canberra, 1998.

[57] CD Dalton, J Gregory, MD Kirk et al., 'Foodborne disease outbreaks in Australia, 1995 to 2000', *Communicable Diseases Intelligence*, 2004, 28(2): 211-224.

[58] FSA & MEC, *The National Risk Validation Project: final report*, 2002.

[59] M Kirk, 'Foodborne surveillance needs in Australia : harmonisation of molecular laboratory testing and sharing data from human, animal, and food sources', *NSW Public Health Bulletin*, 2004, 15(1-2): 13-17.

[60] TA McMeekin, J Baranyi, J Bowman et al., 'Information systems in food safety management', *International Journal of Food Microbiology*, 2006, 112(3): 181-194.

[61] P Abelson, M Potter Forbes & G Hall, *The annual cost of foodborne illness in Australia*, DoHA, Canberra, 2006.

[62] LA Cox Jr, DA Popken, JJ Van Sickle et al., 'Optimal tracking and testing of US and Canadian herds for BSE: a Value-of-Information (VOI) approach', *Risk Analysis*, 2005, 25(4): 827.

[63] Allen Consulting Group, *Food safety management systems costs, benefits and alternatives*, DoHA, Canberra, 2002.

[64] RM D'Souza, NG Becker, G Hall et al., 'Does ambient temperature affect foodborne disease?' *Epidemiology*, 2004, 15: 86-92.

[65] LA Selvey & JW Sheridan, *The health benefits of mitigating global warming in Australia,* Climate Action Network Australia, Sydney, 2002.

[66] AMA, *Position statement: climate change and human health,* AMA, Canberra, 2004.

[67] AA Khasnis & MD Nettleman, 'Global warming and infectious disease', *Archives of Medical Research*, 2005, 36(6): 689-696.

[68] J Dean, 'Gastroenteritis prevention: improving the health of young Indigenous populations', *Journal of Rural and Remote Environmental Health,* 2003, 2(1): 6-13.

[69] M Gracey & J Cullinane, 'Gastroenteritis and environmental health among Aboriginal infants and children in Western Australia', *Journal of Paediatric Child Health,* 2003, 39(6): 427-431.

[70] NCHECR, *HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report, 2006*, NCHECR, Sydney, 2006.

[71] NTAC of CDNA, *National strategic plan for TB control in Australia beyond 2000*, CDNA, Canberra, 2002.

[72] DoHA, 'Tuberculosis notifications in Australia: annual reports' [website], DoHA, Canberra, 2006.

[73] G Simpson, 'BCG vaccine in Australia', *Australian Prescriber*, 2003, 26(6): 144.

[74] R Lumb, I Bastian, T Crighton et al., 'Tuberculosis in Australia: bacteriologically confirmed cases and drug resistance, 2004', *Communicable Diseases Intelligence* 2006, 30(1): 102-108.

[75] NNDSS, '*Notification rate of Tuberculosis, received from State and Territory health authorities in the period of 1991 to 2006 and year-to-date notifications for 2007*', NNDSS, 2007.

[76] K Jamrozik, 'The "larrikin element" and public health', presentation to PHAA conference, Perth, 2005.

[77] P Roche, I Bastian, V Krause, and members of National Tuberculosis Advisory Committee for Communicable Diseases Network Australia, 'Tuberculosis notifications in Australia, 2005', *Communicable Diseases Intelligence*, 2007, 31(1): 71-80.

[78] G Simpson & T Knight, 'Tuberculosis in Far North Queensland, Australia', *International Journal of Tuberculosis and Lung Disease*, 1999, 3(12): 1096-1100.

[79] HC Walpola, V Siskind, AM Patel et al., 'Tuberculosis-related deaths in Queensland, Australia, 1989-1998: characteristics and risk factors', *International Journal of Tuberculosis and Lung Disease*, 2003, 7(8): 742-750.

[80] ANCARHD, 'HIV chronology – a history of HIV/AIDS', *The ANCARHD Bulletin*, 31, Feb 2002.

[81] NCHECR, *HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report, 2006*, NCHECR, Sydney, 2006; calculations by Portfolio Statistics & Standards Section, Economic & Statistical Analysis Branch, Portfolio Strategies Division, DoHA, 2006.

[82] NCHECR, *HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report, 2007*, NCHECR, The University of New South Wales, Sydney; AIHW, Canberra, 2007.

[83] C Treloar, S Loveday & N Booker, *Tough on drugs, soft on evidence?* NCHSR, Sydney, 2006.

[84] DCSH, *National HIV/AIDS Strategy: a policy information paper*, AGPS, Canberra, 1989.

[85] J Ballard, 'Australian policy-making on HIV and hepatitis C', in Australasian Society for HIV Medicine Inc. (ASHM), *HIV and hepatitis : policy, discrimination, legal and ethical issues*, ASHM, Sydney, 2005.

[86] DoHA, *National HIV/AIDS Strategy: revitalising Australia's response 2005-2008*, DoHA, Canberra, 2005.

[87] P Abelson, R Taylor, J Butler et al., *Returns on investment in public health: an epidemiological and economic analysis prepared for the Department of Health and Ageing*, DoHA Canberra, 2003.

[88] JA Guthrie, GJ Dore, AM McDonald et al., for the National HIV Surveillance Committee, 'HIV and AIDS in Aboriginal and Torres Strait Islander Australians: 1992-1998', *Medical Journal of Australia,* 2000, 172(6): 266-269.

[89] MR Wright, C Giele, PR Dance et al., 'Fulfilling prophecy? Sexually transmitted infections and HIV in Indigenous people in Western Australia', *Medical Journal of Australia*, 2005, 183: 124-128.

[90] RJ Chappel & EM Dax, 'Blood screening – the next generation in testing', *Australian and New Zealand Journal of Medicine*, 1999, 29(6): 763-764.

[91] JM Kaldor, 'HTLV-1 and blood safety: let the community decide', *Medical Journal of Australia*, 1997, 166(9): 454.

[92] J Ballard, 'The politics of AIDS', in H Gardner (ed.), *The politics of health: the Australian experience*, Churchill-Livingstone, Melbourne, 1989.

[93] 'The History of HIV in Victoria', Access at the Alfred [website], 2003.

[94] A Mijch, 'Discrimination and workers,' in ASHM, *HIV and hepatitis*, 2005.

[95] Therapeutic Goods Administration (TGA), 'Regulation of blood' [website], DoHA, Canberra, 2005.

[96] AIHW, *Australia's health 2004*, AIHW, Canberra, 2004.

[97] J Brotherton [compiler], 'Festschrift for Professor Margaret Burgess AO', *Communicable Diseases Intelligence*, 2004, 28(3): 349-355.

[98] M Burgess, 'Immunisation: a public health success', *NSW Public Health Bulletin*, 2003, 14(1): 4.

[99] T Adams, 'Farewell to polio in the Western Pacific', *Bulletin of the World Health Organization*, 2000, 78(12).

[100] P McIntyre, H Gidding, R Gilmour et al., 'Vaccine-preventable diseases and vaccination coverage in Australia, 1999-2000', *Communicable Diseases Intelligence*, 2002, 26(S1): x.

[101] Immunise Australia Campaign, 'Information' [website], DoHA, Canberra, 2006.

[102] J Brotherton, P McIntyre, M Puech et al., 'Vaccine-preventable diseases and vaccination coverage in Australia, 2001-2002', *Communicable Diseases Intelligence,* 2004, 8(S2): S95.

[103] Immunise Australia Program, 'Aboriginal and Torres Strait Islander People' [website], DoHA, Canberra, 2007.

[104] PB McIntyre, HF Gidding & GL Gilbert, 'Measles in an era of measles control', *Medical Journal of Australia*, 2000, 172(3): 103-104.

[105] NCIRS, *Australian measles control campaign 1998: evaluation report*, University of Sydney, Royal Alexandra Hospital for Children, Sydney, 1999.

[106] NCIRS, 'Research – Laboratory surveillance and serosurveys: national serosurveys' [website], NCIRS, Sydney, 2007.

[107] Immunise Australia Program, *Let's work together to beat measles: a report on Australia's measles control campaign*, DHAC, Canberra, 2000.

[108] SCRGSP, *Report on government services 2006*, PC, Canberra, 2006.

[109] T Abbott, 'Free chickenpox vaccine from 1 November [2005]', Minister for Health and Ageing, Canberra, 2005.

[110] Medicare Australia, *Australian Childhood Immunisation Register statistics: immunisation coverage graphs – March 2007*, Medicare Australia, Canberra, 2007.

[111] AIHW, *National public health expenditure report 2001-02 to 2003-04*, AIHW, Canberra, 2006.

[112] DFaCSIA, 'Family Assistance Legislation and Consolidated Disallowable Instruments' [website], DFaCSIA, Canberra, 2006.

[113] NPHP, *Model provisions for the certification of immunisation status on school and child care entry*, NPHP, Melbourne, 2000.

[114] S Carleton [producer], *The Health Report: immunisation*, ABC, Sydney, 1998.

[115] G Nossal, 'Releasing the spirit of democracy in international health', ABC, Ballarat, 2004.

[116] NCIRS, 'Research – Childhood Immunisation Coverage' [website], NCIRS, Sydney, 2006.

[117] ACIR, 'Australian Childhood Immunisation Register (ACIR)' [website], ACIR, Canberra, 2006.

[118] NHMRC, *The Australian immunisation handbook*, NHMRC, Canberra, 2003.

[119] Influenza Specialist Group (ISG), *Influenza: a guide for general practitioners,* ISG, Melbourne, 2006; citing JW De Ravin & PN Gerrard, 'The effect of influenza on Australian mortality', *Annual Transactions of the Australian Institute of Actuaries 1984*, 1984: 471-479.

[120] ISG, *Treatment of influenza in inter-pandemic periods*, ISG, Melbourne, 2006.

[121] AIHW, *2004 Adult Vaccination Survey: summary results*, AIHW & DoHA, Canberra, 2005.

[122] SM Firestone, IG Barr, PW Roche et al., 'Annual report of the National Influenza Surveillance Scheme, 2005', *Communicable Diseases Intelligence*, 2006, 30(2): 190.

[123] T Abbott, 'Improving national health systems', Minister for Health and Ageing, Canberra, 2006.

[124] T Abbott, 'Australia secures guaranteed supply of flu vaccine', Minister for Health and Ageing, Canberra, 2004.

[125] L Halliday, L Roberts & A Hampson, 'Annual report of the National Influenza Surveillance Scheme, 1998', *Communicable Diseases Intelligence*, 1999, 23(7-8): 186.

[126] NICS, *Evidence-practice gaps report,* vol. 2, NICS, Melbourne, 2005.

[127] J Mills & T Yapp, *An economic evaluation of three CSIRO manufacturing research projects*, CSIRO, Canberra, 1996.

[128] H Kelly, J Attia, R Andrews & RF Heller, 'The number needed to vaccinate (NNV) and population extensions of the NNV: comparison of influenza and pneumococcal vaccine programmes for people aged 65 years and over', *Vaccine*, 2004, 22(17-18): 2192–2198.

[129] T Jefferson, D Rivetti, A Rivetti et al., 'Efficacy and effectiveness of influenza vaccines in elderly people: a systematic review', *Lancet*, 2005, 366(9492): 1165-1174.

[130] PB McIntyre & RI Menzies, 'Immunisation: reducing health inequality for Indigenous Australians', *Medical Journal of Australia,* 2005, 182(5): 207-208.

[131] H Burns, 'Germ theory: invisible killers revealed', *British Medical Journal*, 2007, 334(S1): S11.

[132] R Bud, 'Antibiotics: the epitome of a wonder drug', *British Medical Journal*, 2007, 334(S1): S6; citing FM Burnet, *Natural history of infectious disease* (2nd edn.), Cambridge University Press, Cambridge, 1953.

[133] JETACAR, *The use of antibiotics in food-producing animals: antibiotic-resistant bacteria in animals and humans*, DHAC & DAFF, Canberra, 1999.

[134] DoHA, 'Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR): implementing JETACAR' [website], DoHA, 2004.

[135] JETACAR, 'National summit on antibiotic resistance: commitment and communication', *CIJIG Communiqué*, 2001, 1(1).

[136] NHMRC, 'Expert Advisory Group on Antimicrobial Resistance (EAGAR)' [website], NHMRC, 2007.

[137] DoHA, *Strategy for Antimicrobial Resistance (AMR) surveillance in Australia*, DoHA, Canberra, 2003.

[138] Australian Council for Safety and Quality in Health Care, *National strategy to address health care infections*, Australian Council for Safety and Quality in Health Care, 2003.

[139] PHIDU, *Improving Indigenous identification in communicable disease reporting systems*, PHIDU, Adelaide, 2004.

[140] PJ Collignon, IJ Wilkinson, GL Gilbert et al., 'Health care-associated *Staphylococcus aureus* bloodstream infections: a clinical quality indicator for all hospitals', *Medical Journal of Australia*, 2006, 184(8): 404-406.

[141] PS Craig & E Larrieu, 'Control of cystic echinococcosis/hydatidosis: 1863-2002', *Advances in Parasitology*, 2006, 61: 443-508.

[142] PJ McCullagh, 'Hydatid disease: medical problems, veterinary solutions, political obstacles', *Medical Journal of Australia*, 1996, 164(1): 7-8; quoting I Clunies Ross, 'A survey of the incidence of *Echinococcus granulosus* (Batsch) or hydatid disease in NSW', *Australian Veterinary Journal,* 1926, 2: 56-67.

[143] JM Goldsmid, 'Custom, culture and health in the tropics', in JM Goldsmid, & PA Leggat (eds.), *Primer of Tropical Medicine*, Australasian College of Tropical Medicine, Brisbane, 2005.

[144] DJ Jenkins & K Power, 'Human hydatidosis in New South Wales and the Australian Capital Territory, 1987-1992', *Medical Journal of Australia*, 1996, 164(1): 14-17.

[145] J Anderson, Federal Primary Industries and Energy Minister, 'Launch of the video: *The travelling parasite*', 1996.

[146] A Sarre, 'Hydatids – when a dog is not man's best friend' [web article], *Nova: Science in the news*, 2000.

[147] JM Goldsmid & J Pickmere, 'Hydatid eradication in Tasmania: point of no return?', *Australian Family Physician*, 1987, 11: 1672-1674.

[148] S King & G Hutchinson, *Hydatids – you, too, can be affected* (2nd edn.), NSW Dept. of Primary Industries, Sydney, 2005.

[149] Tasmanian Department of Primary Industries and Water, 'Hydatid disease', Hobart, 2006.

[150] C Donaldson, *The Tasmanian hydatid control programme*, University of New England, Armidale, 1988.

[151] DoHA, 'Australian national notifiable diseases list' [website], CDNA, 2006.

[152] enHealth Council, *The National Environmental Health Strategy: implementation plan*, Commonwealth of Australia, Canberra, 2000.

[153] M Neutze, 'Population issues and physical planning', *Journal of the Australian Population Association*, 1984, 1: 89-98.

[154] ABS & AIHW, *The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples*, ABS, Canberra, 2005.

[155] ABS, *Housing and infrastructure in Aboriginal and Torres Strait Islander communities, Australia 2001*, ABS, Canberra, 2002.

[156] RS Bailie & KJ Wayte, 'Housing and health in Indigenous communities: key issues for housing and health improvement in remote Aboriginal and Torres Strait Islander communities', *Australian Journal of Rural Health*, 2006, 14(5): 178-183.

[157] SCRGSP, *Overcoming Indigenous disadvantage: key indicators 2005*, Productivity Commission, Canberra, 2005.

[158] Qld Health, *The Queensland Health Aboriginal and Torres Strait Islander Environmental Health Strategy 2001-2006*, Qld Government, Brisbane, 2001.

[159] Indoor Air Quality Special Interest Group of the Clean Air Society of Australia and New Zealand (CASANZ), *Indoor air quality in Australia: a strategy for action*, FASTS, Canberra, 2002.

[160] P Pholeros, S Rainow & P Torzillo, *Housing for Health: towards a healthy living environment for Aboriginal Australia*, Healthabitat, Newport Beach, 1993.

[161] Nganampa Health Council (NHC), *Report of Uwankara Palyanyku Kanyintjaku: a strategy for well-being*, NHC, APY Lands, 1987.

[162] C Shannon, J Wakerman, P Hill et al., *Achievements in Aboriginal and Torres Strait Islander health: summary report,* CRCATH on behalf of the SCATSIH, Canberra, 2003.

[163] HMAC, *Building a better future: Indigenous housing to 2010*, HMAC, Canberra, 2001.

[164] Healthabitat, 'Healthabitat: a brief history' [website], Healthabitat, 2006.

[165] SGS Economics & Planning, in conjunction with Tallegalla Consultants, *Evaluation of Fixing Houses for Better Health Projects 2, 3 and 4*, FaCSIA, Canberra, 2006.

[166] T McPeake & P Pholeros, 'Fixing houses for better health in remote communities', *National Housing Conference 2005*, AHURI, Melbourne, 2005.

[167] A McMichael, R Woodruff, P Whetton et al., *Human health and climate change in Oceania: a risk assessment 2002*, DoHA, Canberra, 2003.

[168] NSW DEC, *Air pollution economics: health costs of air pollution in the Greater Sydney Metropolitan Region*, DEC NSW, Sydney, 2005.

[169] RJS Beeton, KI Buckley, GJ Jones et al., *Australia state of the environment 2006*, 2006, citing DEH, *State of the air: national ambient air quality status and trends report 1991–2001*, DEH, Canberra, 2004.

[170] Australian Government Department of the Environment and Heritage (DEH), *State of the air: community summary 1991–2001*, DEH, Canberra, 2004.

[171] BTRE, *Health impacts of transport emissions in Australia: economic costs*, BTRE, Canberra, 2005.

[172] DM Stieb, P De Civita, FR Johnson et al., 'Economic evaluation of the benefits of reducing acute cardio-respiratory morbidity associated with air pollution', *Environmental Health: A Global Access Science Source,* 2002, 1: 7.

[173] NHMRC, *Revision of the Australian guidelines for lead in blood and lead in ambient air*, NHMRC, Canberra, 1993.

[174] DEH, *Lead alert facts: lead in house paint*, DEH, Canberra, 2005.

[175] EJ Maynard, LJ Franks & MS Malcolm, *The Port Pirie Lead Implementation Program: future focus and directions*, SA Dept. of Health, Adelaide, 2006.

[176] DL Simon, EJ Maynard & KD Thomas, 'Living in a sea of lead – changes in blood- and hand-lead of infants living near a smelter', *Journal of Exposure Science and Environmental Epidemiology*, 2006/07/05/online, 2006.

[177] D Lyle, B Balding, H Burke et al., 'NSW Lead Management Program in Broken Hill', *NSW Public Health Bulletin*, 2001, 12(6): 165-167.

[178] J Galvin, J Stephenson, J Wlodarczyk et al., 'Living near a lead smelter: an environmental health risk assessment in Boolaroo and Argenton, New South Wales', *Australian Journal of Public Health*, 1993, 17(4): 373-378.

[179] Wesley Mission, *Green conscience: the ongoing struggle for a clean, green Newcastle*, Wesley Mission, Newcastle, 2002.

[180]ABS, *Australian social trends, 1997*, ABS, Canberra, 1997; citing J Donovan, P Anderson, C Daley et al., *Lead in Australian children: report on the National Survey of Lead in Children*, AIHW, Canberra, 1996.

[181] B Gulson, K Mizon, M Korsch et al., 'Changes in the lead isotopic composition of blood, diet and air in Australia over a decade: globalization and implications for future isotopic studies', *Environmental Research*, 2006, 100(1): 130-138.

[182] DEH, *Lead and compounds fact sheet*, DEH, Canberra, 2005.

[183] D Lyle, AR Phillips, WA Balding, H Burke, D Stokes, S Corbette & J Hall, 'Dealing with lead in Broken Hill – trends in blood lead levels in young children 1991-2003', *Science of the Total Environment*, 2006, 359: 111-119.

[184] NOSCH, *Control of inorganic lead at work,* AGPS, Canberra, 1994.

[185] DEH, *National Pollutant Inventory*, DEH, 2005.

[186] DB Mak, AJ Plant, M Bulsara et al., 'Impact of lead transport on children's blood and environmental lead levels', *Australian Journal of Rural Health*, 2003, 11(4): 169-174.

[187] NSW EPA, 'Sources of lead in the environment', NSW EPA, Sydney, 2003.

[188] E O'Brien, *Annual report of The LEAD Group Inc. 2002: ten year review of objectives*, The LEAD Group Inc., Sydney, 2002.

[189] DM Reith, P O'Regan, C Bailey et al., 'Serious lead poisoning in childhood: still a problem after a century', *Journal of Paediatrics and Child Health*, 2003, 39(8): 623-626.

[190] NR Wigg, 'Low-level lead exposure and children', *Journal of Paediatric Child Health*, 2001, 37(5): 423-425.

[191] E O'Brien, *Annual report of The LEAD Group Inc. 2002,* The Lead Education and Abatement Design (LEAD) Group Inc., 2002.

[192] J Leigh & T Driscoll, 'Malignant mesothelioma in Australia, 1945-2002', *International Journal of Occupational and Environmental Health*, 2003, 9(3): 206-217.

[193] Victorian Government Department of Human Services, Better Health Channel, *Asbestos and your health*, 2005.

[194] G Giles, D Jolley, S Lecatsas et al., *Atlas of cancer in Victoria*, Anti-Cancer Council of Victoria, Melbourne, 1988.

[195] JC McNulty, 'Malignant pleural mesothelioma in an asbestos worker', *Medical Journal of Australia*, 1962, 2: 953-954.

[196] K Takahashi, M Huuskonen, A Tossavainen et al., 'Ecological relationship between mesothelioma incidence/mortality and asbestos consumption in ten western countries and Japan', *Journal of Occupational Health,* 1999, 41(1): 8-11.

[197]ACT Asbestos Taskforce, *Asbestos management in the ACT*, ACT Government, Canberra, 2005.

[198] DA Ferguson, G Berry, T Jelihovsky et al., 'The Australian Mesothelioma Surveillance Program 1979-1985', *Medical Journal of Australia*, 1987, 147: 166-172.

[199] NOHSC, *Data on OHS in Australia: the overall scene,* NOHSC, Canberra, 2000; citing NOHSC, *The incidence of mesothelioma in Australia 1994 to 1996: Australian Mesothelioma Register Report,* NOHSC, Sydney, 1999.

[200] G Berry, 'Prediction of mesothelioma, lung cancer, and asbestosis in former Wittenoom asbestos workers', *British Journal of Industrial Medicine*, 1991, 48(12): 793-802.

[201] NH de Klerk, BK Armstrong, AW Musk et al., 'Prediction of future cases of asbestos-related disease among former miners and millers of crocidolite in Western Australia', *Medical Journal of Australia*, 1989, 151(11-12): 616-620.

[202] P Prince, J Davidson & S Dudley, *In the shadow of the corporate veil: James Hardie and asbestos compensation*, Parliamentary Library, Canberra, 2004.

[203] NSW Health Department, *NSW Tobacco and Health Strategy 1995-1999*, NSW Health Department, 1995.

[204] EA Mitchell & J Milerad,' Smoking and sudden infant death syndrome', in *International consultation on environmental tobacco smoke (ETS) and child health*, WHO, Geneva, 1999.

[205] FP Perera, V Rauh, RM Whyatt et al., 'A summary of recent findings on birth outcomes and developmental effects of prenatal ETS, PAH, and pesticide exposures', *Neurotoxicology*, 2005, 26(4): 573-587.

[206] S Chapman, R Borland, M Scollo et al., 'The impact of smoke-free workplaces on declining cigarette consumption in Australia and the United States', *American Journal of Public Health*, 1999, 89(7): 1018-1023.

[207] JE Bauer, A Hyland, Q Li et al., 'A longitudinal assessment of the impact of smoke-free worksite policies on tobacco use', *American Journal of Public Health*, 2005, 95(6): 1024-1029.

[208] NHPC, *National report on health sector performance indicators 2003*, AIHW, Canberra, 2004.

[209] C Miller & JA Hickling, Phased-in smoke-free workplace laws: reported impact on bar patronage and smoking, particularly among young adults in South Australia, *Australian and New Zealand Journal of Public Health*, 2006, 30(4): 325.

[210] C Miller, M Wakefield, S Kriven et al., 'Evaluation of smoke-free dining in South Australia: support and compliance among the community and restaurateurs', *Australian and New Zealand Journal of Public Health*, 2002, 26(1): 38-44.

[211] S Chapman, R Borland & A Lal, 'Has the ban on smoking in New South Wales restaurants worked? A comparison of restaurants in Sydney and Melbourne', *Medical Journal of Australia*, 2001, 174(10): 512-515.

[212] D Hammond, GT Fong, MP Zanna et al., 'Tobacco denormalization and industry beliefs among smokers from four countries', *American Journal of Preventive Medicine*, 2006, 31(3): 225-232.

[213] M Gonzales, LH Malcoe, MC Kegler et al., 'Prevalence and predictors of home and automobile smoking bans and child environmental tobacco smoke exposure: a cross-sectional study of US- and Mexico-born Hispanic women with young children', *BMC Public Health*, Oct 27 2006, 6: 265.

[214] DoHA, 'Tobacco – passive smoking', DoHA, Canberra, 2004.

[215] NPHP, *National response to passive smoking in enclosed public places and workplaces – a background paper*, NPHP, Melbourne, 2000.

[216] DHAC, *National Tobacco Strategy 1999 to 2002-03: a framework for action*, DHAC, Canberra, 1999.

[217] NPHP, 'Legislation Reference Network: national response to passive smoking in enclosed public places and workplaces', NPHP, Melbourne, 2003.

[218] The Cancer Council NSW, *Environmental Tobacco Smoke and Children Project: strategic plan 2001-2005*, The ETS and Children Taskforce, Sydney, 2001.

[219] The ETS and Children Project Taskforce, 'The ETS and Children Project: evaluating our project', The ETS and Children Taskforce, Sydney, 2006.

[220] KM Emmons, M Wong, SK Hammond et al., 'Intervention and policy issues related to children's exposure to environmental tobacco smoke, *Preventive Medicine*, 2001, 32(4): 321-331.

[221] P Abelson, R Taylor, J Butler et al., *Returns on investment in public health: an epidemiological and economic analysis prepared for the Department of Health and Ageing*, DoHA, Canberra, 2003.

[222] Centre for Epidemiology and Research, *2003-2004 Report on child health from the New South Wales Population Health Survey*, NSW Department of Health, Sydney, 2006.

[223] F Stanley, 'Centenary article – Child health since Federation', in ABS (eds.), *Year book Australia 2001*, ABS, Canberra, 2001.

[224] ABS, *Deaths, Australia, 2005*, ABS, Canberra, 2006.

[225] MH Brenner, 'Fetal, infant and maternal mortality during periods of economic instability', *International Journal of Health Services*, 1973, 3(2): 145-159.

[226] R Catalano, 'The health effects of economic insecurity', *American Journal of Public Health,* 1991, 81(9): 1148-1152.

[227] R Taylor, M Lewis & J Powles, 'The Australian mortality decline: all-cause mortality 1788-1990', *Australian and New Zealand Journal of Public Health*, 1998, 22(1): 27-36.

[228] D P Keating & C Hertzman (eds.), *Developmental health and the wealth of nations,* Guilford Press, New York, 1999.

[229] J Heckman, 'Policies to foster human capital', *Research in Economics,* 2000, 54: 3-56.

[230] Australian Government Taskforce for Child Development, Health and Wellbeing, *The national agenda for early childhood: a draft framework*, Commonwealth of Australia, Canberra, 2004.

[231] FaCSIA, 'Stronger Families and Communities Strategy (SFCS) 2004-2009', FaCSIA, Canberra, 2006.

[232] COAG, *Council of Australian Governments meeting communiqué, 14 July 2006*, COAG, Canberra, 2006.

[233] J Kaipio, S Nayha & V Valtonen, 'Fluoride in the drinking water and the geographical variation of coronary heart disease in Finland, *European Journal of Cardiovascular Prevention and Rehabilitation*, 2004, 11: 56-62.

[234] JM Armfield, 'The extent of water fluoridation coverage in Australia' [Letters], *Australian and New Zealand Journal of Public Health*, 2006, 30(6): 581-582.

[235] AHMAC National Advisory Committee on Oral Health, *Healthy mouths healthy lives: Australia's National Oral Health Plan 2004-2013*, SA Department of Health, Adelaide, 2004.

[236] NJ Cochrane, S Saranathan, MV Morgan et al., 'Fluoride content of still bottled water in Australia', *Australian Dental Journal*, 2006, 51(3): 242-244.

[237] JM Armfield, KF Roberts-Thomson, GD Slade et al., *Dental health differences between boys and girls: The Child Dental Health Survey, Australia 2000*, AIHW, Canberra, 2004.

[238] JM Armfield, KF Roberts-Thomson & A J Spencer, *The Child Dental Health Survey, Australia 1999: trends across the 1990s*, The University of Adelaide, Adelaide, 2003.

[239] RW Fogel, 'Economic growth, population theory, and physiology: the bearing of long-term processes on the making of economic policy', in T Persson [ed.] *Nobel lectures: Economic sciences, 1991-95*, World Scientific Publishing Co, Singapore, 1997.

[240] T McKeown, *The role of medicine*, Blackwell, London, 1979.

[241] EA Sullivan & JF King (eds.), *Maternal deaths in Australia 2000-2002*, AIHW NPSU, Sydney, 2006.

[242] WHO, *Maternal mortality in 2000: estimates developed by WHO, UNICEF and UNFPA*, WHO, Geneva, 2004.

[243] PJ Laws, N Grayson & EA Sullivan, *Australia's mothers and babies 2004*, AIHW NPSU, Sydney, 2006.

[244] O Weil & H Fernandez, 'Is safe motherhood an orphan initiative?', *Lancet,* 1999, 354(9182): 940-943.

[245] CM De Costa, 'The contagiousness of childbed fever: a short history of puerperal sepsis and its treatment', *Medical Journal of Australia*, 2002, 177(11/1): 668-671.

[246] OECD, *OECD Health Data 2006: a comparative analysis of 30 countries*, OECD, Paris, 2006.

[247] JS McCalman, 'The past that haunts us: the historical basis of well-being in Australian children', in S Richardson & MR Prior (eds.), *No time to lose: the well-being of Australia's children*, Melbourne University Press, Melbourne, 2005.

[248] F Yusuf & S Siedlecky, 'Legal abortion in South Australia: a review of the first 30 years', *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 2002, 42(1): 15-21.

[249] J Brotherton [compiler], 'Festschrift for Professor Margaret Burgess AO', *Communicable Diseases Intelligence*, 2004, 28(3): 349-355.

[250] RANZCOG, *Antenatal screening tests: College statement 2004,* RANZCOG, Melbourne, 2004.

[251] TD Hughes, 'Excessive use of caesarean section rates', *Medical Journal of Australia,* 1939, 11: 947-948.

[252] CM de Costa & S Robson, 'Throwing out the baby with the spa water?', *Medical Journal of Australia*, 2004, 181(8): 438-440.

[253] SK Tracey, 'Home births in Australia: the midwife's perspective', *O & G*, 2004, 6(3): 204-205; O Olsen & MD Jewell, Home versus hospital birth (Cochrane Review), in *The Cochrane Database of Systematic Reviews*, 2007.

[254] NPSU, 'National Perinatal Statistics Unit (NPSU)' [website], NPSU, 2006.

[255] VD Swaisland & MB Douie, *Sex in Life – Young Women*, [sex education booklet], Racial Hygiene Association of New South Wales, Australia, c1935. Collection: Powerhouse Museum, Sydney.

[256] M Hicks, 'The rags: paraphernalia of menstruation - advice for girls' [Powerhouse Museum collection index website], Powerhouse Museum, Sydney, [n.d.].

[257] DH Wyndham, '*Striving for national fitness: eugenics in Australia 1910s to 1930s'*, A thesis submitted in fulfilment of the requirement for the degree of Doctor of Philosophy, Department of History, University of Sydney, July 1996.

[258] National Foundation for Australian Women, 'Street, Jessie Mary Grey (1889-1970)', in Australian Women's Archives Project (AWAP) Website, Nowra, NSW, 2007.

[259] M Foley, 'Goodisson, Lillie Elizabeth (1860?-1947)', in *Australian Dictionary of Biography*, Melbourne University Press, Melbourne, 1983, 9: 47-48.

[260]AMA, *Lifting the weight – low birth weight babies: an Indigenous health burden that must be lifted*, AMA, Canberra, 2005.

[261] M Coory & T Johnston, 'Reducing perinatal mortality among Indigenous babies in Queensland: should the first priority be better primary health care or better access to hospital care during confinement?', *Australia and New Zealand Health Policy*, 2005, 2: 11.

[262] DoHA, *2006 National HIV testing policy*, DoHA, Canberra, 2006.

[263] Portfolio Statistics & Standards Section, Economic & Statistical Analysis Branch, Portfolio Strategies Division, DoHA; data: ABS, *Deaths, Australia* and historical *Demography bulletins,* from 1908 to 2006.

[264] N Thomson, 'A review of Aboriginal health status', in J Reid & P Trompf (eds.), *The Health of Aboriginal Australia*, Harcourt Brace & Company, Sydney, 1991.

[265] Partnerships Queensland, *Future Directions Framework for Aboriginal and Torres Strait Islander Policy in Queensland 2005-2010: Baseline Report 2006*, Qld Department of Communities, Office for Aboriginal and Torres Strait Islander Partnerships, Brisbane, 2006.

[266] SH Cochrane, J Leslie & DJ O'Hara, 'Parental education and child health: intra-country evidence', *Health Policy and Education*, 1982, 2(3-4): 213-250.

[267] BM Wilcken, 'Does every baby get a newborn screening test?', *Medical Journal of Australia*, 2003, 179(8): 400.

[268] H Coates & K Gifkins, 'Newborn hearing screening', *Australian Prescriber*, 2003, 26: 82-84.

[269] NSW Health, *Does your child have a personal health record?*, NSW Health, Sydney, 2006.

[270] E Murphy, 'Three year outcome of the NSW Statewide Infant Screening Hearing Program', paper presented to 37th PHAA annual conference, 25-27 September 2006, Sydney.

[271] EA Mitchell & J Milerad,' Smoking and sudden infant death syndrome', in *International consultation on environmental tobacco smoke (ETS) and child health*, WHO, Geneva, 1999.

[272] FP Perera, V Rauh, RM Whyatt et al., 'A summary of recent findings on birth outcomes and developmental effects of prenatal ETS, PAH, and pesticide exposures', *Neurotoxicology*, 2005, 26(4): 573-587.

[273] NHMRC, *Dietary guidelines for children and adolescents in Australia incorporating the infant feeding guidelines for health workers*, AusInfo, Canberra, 2003.

[274] ES Mezzacappa & ES Katlin, 'Breast-feeding is associated with reduced perceived stress and negative mood in mothers', *Health Psychologist*, 2002, 21(2): 187-193.

[275] MW Groer & MW Davis, 'Cytokines, infections, stress, and dysphoric moods in breastfeeders and formula feeders', *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 2006, 35(5): 599-607.

[276] JP Smith, 'Mothers' milk and markets', *Australian Feminist*, 2004, 19(45): 369-379.

[277] MC Latham, *Human nutrition in the developing world,* FAO, Rome, 1997.

[278] G Mather, 'Bringing up baby: 1950s maternal and infant nutrition programmes', *Outskirts: feminisms along the edge,* vol. 7, 2000; citing King T, *Feeding and caring of baby*, Macmillan, London, 1933.

[279] M Walker, 'A fresh look at the risks of artificial infant feeding', *Journal of Human Lactation*, 1993, 9(2): 97-107.

[280] IH Lester, *Australia's food and nutrition*, AGPS, Canberra, 1994.

[281] Nursing Mothers Association of Australia (NMAA), '*Mothers fully breastfeeding at three and six months, Victoria, 1950–1992'*, 1993.

[282] WHO, *International code of marketing of breast-milk substitutes*, WHO, Geneva, 1981, p. 4.

[283] ABS, *Breastfeeding in Australia, 2001*, ABS, Canberra, 2003.

[284] NHMRC, *Infant feeding guidelines for health workers*, NHMRC, Canberra, 1996.

[285] MS Fewtrell, 'The long-term benefits of having been breast-fed', *Current Paediatrics*, 2004, 14: 97-103.

[286] WHO, *Protecting, promoting and supporting breastfeeding: the special role of maternity services*, WHO/UNICEF, Geneva 1989.

[287] BL Philipp & A Radford, 'Baby-Friendly: snappy slogan or standard of care?', *Archives of Disease in Childhood: Fetal and Neonatal Edition*, 2006, 91(2): F145-149.

[288] BFHI, '*Baby Friendly Health Initiative: protecting, promoting and supporting breastfeeding in Australia'*, BFHI, 2006.

[289] DoHA, 'National Breastfeeding Strategy, 1996-2001', DoHA, Canberra, 2003.

[290] Australian Institute of Family Studies (AIFS), *The Longitudinal Study of Australian Children 2004 Annual Report*, AIFS, Melbourne, 2005.

[291] R Boyd & E McIntyre, 'Improving community acceptance of breastfeeding in public: a collaborative approach', *Breastfeeding Review*, 2004, 12(2): 5-10.

[292] E McIntyre, D Turnbull & JE Hiller, 'Breastfeeding in public places', *Journal of Human Lactation,* 1999, 15(2): 131-135.

[293] JP Smith, JF Thomson & DA Ellwood, 'Hospital system costs of artificial infant feeding: estimates for the Australian Capital Territory', *Australian and New Zealand Journal of Public Health*, 2002, 26(6): 543-551.

[294] JP Smith, 'Mothers' milk and markets', *Australian Feminist*, 2004, 19(45): 369-379.

[295] ABS, *Health of children in Australia: a snapshot, 2004-05*, ABS, Canberra, 2007.

[296] ABA, *Australian Breastfeeding Leadership Plan (ABLP)*, 2004.

[297] AIHW, 'Australia's babies: their health and wellbeing', *AIHW Bulletin,* 2004, 21: 4-12.

[298] R Gilbert, G Salanti, M Harden et al., 'Infant sleeping position and the sudden infant death syndrome: systematic review of observational studies and historical review of recommendations from 1940 to 2002', *International Journal of Epidemiol*ogy, 2005, 34(4): 874-887.

[299] T Dwyer, AL Ponsonby, CL Blizzard et al., 'The contribution of changes in the prevalence of prone sleeping position to the decline in SIDS in Tasmania', *Journal of the American Medical Association,* 1995, 273(10): 783-789.

[300] T Dwyer, AL Ponsonby, NM Newman et al., 'Prospective cohort study of prone sleeping position and sudden infant death syndrome', *Lancet* 1991, 337(8752): 1244-1247.

[301] T Dwyer, 'The Menzies Centre for Population Health Research', *Medical Journal of Australia,* 2001, 175(11-12): 617-620.

[302] PHAA, 'Sudden Infant Deaths Syndrome (SIDS) Policy', PHAA, Canberra, 2005.

[303] T Dwyer & AL Ponsonby, 'The decline of SIDS: a success story for epidemiology', *Epidemiology*, 1996, 7(3): 323-325.

[304] CJ Freemantle, FJ Stanley, AW Read et al., *The First Research Report: patterns and trends in mortality of Western Australian infants, children and young people 1980-2002*, WA Department for Community Development, Perth, 2004.

[305] N Spencer & S Logan, 'Sudden unexpected death in infancy and socioeconomic status: a systematic review', *Journal of Epidemiology & Community Health*, 2004, 58(5): 366-373.

[306] T Vos, S Begg, Y Chen et al., 'Socioeconomic differentials in life expectancy and years of life lost in Victoria 1992-1996', *NSW Public Health Bulletin*, 2001, 12(5): 126-130.

[307] CJ Freemantle, AW Read, NH de Klerk et al., 'Patterns, trends, and increasing disparities in mortality for Aboriginal and non-Aboriginal infants born in Western Australia, 1980-2001: population database study', *Lancet*, 2006, 367(9524): 1764.

[308] JA O'Dea, *Nutrition education, then and now: implications for the prevention of childhood obesity*, Nutrition Australia, 2004.

[309] WHO, *Diet, nutrition and the prevention of chronic diseases: report of a Joint WHO/Food and Agriculture Organization Expert Consultation*, WHO, Geneva, 2003.

[310] BS Hetzel, JS Charnock, T Dwyer et al., 'Fall in coronary heart disease mortality in USA and Australia due to sudden death: evidence for the role of polyunsaturated fat', *Journal of Clinical Epidemiology,* 1989, 42(9): 885-893.

[311] DCK Roberts, 'Dietary factors in the fall in coronary heart disease mortality', *Prostaglandins Leukotrienes and Essential Fatty Acids*, 1991, 44(2): 97-101.

[312] C Burns, *Literature review: the link between poverty, food insecurity and obesity with specific reference to Australia*, VicHealth, Melbourne, 2004.

[313] MB Katan & NM De Roos, 'Promises and problems of functional foods', *Critical Reviews in Food Science and Nutrition*, 2044, 44: 369–377.

[314] K O'Dea & JI Mann, 'Importance of retaining a national dietary guideline for sugar', *Medical Journal of Australia*, 2001, 175: 165-166.

[315] RA Stanton, 'Nutrition problems in an obesogenic environment', *Medical Journal of Australia*, 2006, 184(2): 76-79.

[316] G Peachey, 'National standards for food safety', ABARE, Canberra, 2005.

[317] M Caraher & J Coveney, 'Public health nutrition and food policy', *Public Health Nutrition*, 2004, 7(5): 591-598.

[318] F Beddie, *Putting life into years: the Commonwealth's role in Australia's health since 1901*, DHAC, Canberra, 2001.

[319] ATSE & AUSTEHC, *Technology in Australia, 1788-1988*, Melbourne: Australian Science and Technology Heritage Centre, 2000.

[320] R Delforce & J Hogan, 'Overview: Australian food industry, 2004-05', in Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), *Australian food statistics 2005*, DAFF, Canberra, 2005.

[321] DC Paik, DV Saborio, R Oropeza et al., 'The epidemiological enigma of gastric cancer rates in the US: was grandmother's sausage the cause?', *International Journal of Epidemiology* 2001, 30: 181-182.

[322] G Peachey, 'National standards for food safety' presentation to ABARE Outlook Conference 2005, ABARE, Canberra, 2005.

[323] Biotechnology Australia (BA), *Australian biotechnology: a national strategy*, BA, Canberra, 2000.

[324] Agriculture and Food Policy Reference Group, *Creating our future: agriculture and food policy for the next generation*, ABARE, Canberra, 2006.

[325] S Leeder, 'Genetically modified foods – food for thought', *Medical Journal of Australia*, 2000, 172(4): 173-174.

[326] JL Huppatz & PA Fitzgerald, 'Genetically modified foods – safety and regulatory issues', *Medical Journal of Australia*, 2000, 172(4): 170-173.

[327] G Giles & V Thursfield [eds.], *Canstat: Trends in Cancer Mortality, Australia 1910-1999,* Anti-Cancer Council of Victoria, Melbourne, 2001.

[328] LA Craig, 'The effect of mechanical refrigeration on nutrition in the United States', *Social Science History,* 2004, 28(2): 325-336.

[329] H Dietrich & R Schibeci, 'Beyond public perceptions of gene technology: community participation in public policy in Australia', *Public Understanding of Science*, 2003, 12(4): 381-401.

[330] Food Regulation Review Committee (FRRC) ['the Blair Review'], *Food: a growth industry – the report of the Food Regulation Review*, Commonwealth of Australia, Canberra, 1998.

[331] R Polya, *Food regulation in Australia – a chronology*, Dept of the Parliamentary Library, Canberra, 2001.

[332] B Bailey, *Bills Digest No. 71 1996-97: Australia New Zealand Food Authority Amendment Bill 1996*, Dept of the Parliamentary Library, Canberra, 1996.

[333] M Tapley, *Bills Digest No. 120, 2000-01: Australia New Zealand Food Authority Amendment Bill 2001*, Department of the Parliamentary Library, Canberra, 2001.

[334] R Stringer & K Anderson, *Environmental and health-related standards influencing agriculture in Australia*, Centre for International Economic Studies (CIES), University of Adelaide, 2000.

[335] FSANZ, *Country of origin labelling of food: a guide to standard 1.2.11 country of origin requirements (Australia only)*, 1st edn., FSANZ, Canberra, 2006.

[336] M Koopmans & E Duizer, 'Foodborne viruses: an emerging problem', *International Journal of Food Microbiology*, 2004, 90(1): 23-41.

[337] Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), 'Food', DAFF, Canberra, 2007.

[338] J Sumner, G Raven & R Givney, 'Have changes to meat and poultry food safety regulation in Australia affected the prevalence of Salmonella or of salmonellosis?', *International Journal of Food Microbiology*, 2004, 92(2): 199-205.

[339] S Crutchfield, J Buzby, P Frenzen et al., '*The economics of food safety and international trade in food products',* paper presented at the International Institute of Fisheries Economics and Trade (IIFET) Conference, Oregon State University, 2000.

[340] C Tanner, AJ Beaver, AG Carroll et al., *Imported food – national competition policy review of the Imported Food Control Act 1992*, [DAFF], Canberra, 1998.

[341] K Cao, O Maurer, S F Scrimgeour et al., 'The economics of HACCP (hazard analysis & critical control point): a literature review', *Agribusiness Perspectives Papers 2004*, Paper 64, 2004.

[342] M Lawrence, 'The Australian food regulatory system: troubling times ahead?', *Australian Review of Public Affairs*, 2001, 10.

[343] C Williams, 'Preparing for biothreats', *2003 Chief Health Officer Seminar Series*, ACT Health, Canberra, 2003.

[344] RCA Thompson, IL Owen, I Puana et al., 'Parasites and biosecurity – the example of Australia', *Trends in Parasitology*, 2003, 19(9): 410-416.

[345] IJ East, 'Adoption of biosecurity practices in the Australian poultry industries', *Australian Veterinary Journal*, 2007, 85(3): 107-112.

[346] SIGNAL, *Eat well Australia: an agenda for action for public health nutrition 2000-2010*, NPHP, Canberra, 2000.

[347] RH Steckel, 'Stature and the standard of living', *Journal of Economic Literature*, 1995, 33(4): 1903-1940.

[348] DZ Loesch, K Stokes & RM Huggins, 'Secular trend in body height and weight of Australian children and adolescents', *American Journal of Physical Anthropology*, 2000, 111(4): 545-556.

[349] M Henneberg & D Veitch, 'Is obesity as measured by body mass index, and waist circumference in adult Australian women in 2002 just a result of the lifestyle?', *Journal of Human Ecology* 2005, 13: 85-89.

[350] AIHW, *Chronic diseases and associated risk factors in Australia, 2001*, AIHW, Canberra, 2002.

[351] M Chopra, S Galbraith & I Darnton-Hill, 'A global response to a global problem: the epidemic of overnutrition', *Bulletin of the World Health Organization*, 2002, 80(12): 952-958.

[352] BM Popkin, 'Global nutrition dynamics: the world is shifting rapidly toward a diet linked with non-communicable diseases', *American Journal of Clinical Nutrition*, 2006, 84(2): 289-298.

[353] B Caballero & B Popkin, *The nutrition transition: diet and disease in the developing world*, Academic Press, London, 2002.

[354] C Short, C Chester & P Berry, *Australian food industry: performance and competitiveness* [ABARE Research Report 06.23, Prepared for the Australian Government Department of Agriculture, Fisheries and Forestry], ABARE, Canberra, 2006.

[355] Population Health Division, *The health of the people of New South Wales – Report of the Chief Health Officer – Health-related behaviours: Fruit and vegetable consumption in children and adults*, NSW Department of Health, Sydney, 2006.

[356] ABS, *National health survey 2004-05: summary of results*, ABS, Canberra, 2006.

[357] C Mathers, T Vos & C Stevenson, *The burden of disease and injury in Australia*, AIHW, Canberra, 1999.

[358] NPHP, *National Aboriginal and Torres Strait Islander nutrition strategy and action plan 2000-2010,* NPHP, Melbourne, 2000.

[359] NHPAC, *National Chronic Disease Strategy*, DoHA, Canberra, 2006.

[360] ABS, *Australian social trends, 2006*, ABS, Canberra, 2006.

[361] M Booth, AD Okely, E Denney-Wilson et al., *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2004: summary report*, NSW Department of Health, Sydney 2006.

[362] C Burns, *Literature review: the link between poverty, food insecurity and obesity with specific reference to Australia*, VicHealth, Melbourne, 2004.

[363] Gracey MS, 'Nutrition-related disorders in Indigenous Australians: how things have changed', *Medical Journal of Australia*, 2007, 186(1): 15-17.

[364] KL Webb & SR Leeder, 'New Year's resolution: let's get rid of excessive food prices in remote Australia', *Medical Journal of Australia*, 2007, 186(1): 7-8.

[365] HPSA, 'Australian Health Promoting Schools Association' [website], 2005.

[366] H Dixon, R Borland, C Segan et al., 'Public reaction to Victoria's "2 Fruit 'n' 5 Veg Every Day" campaign and reported consumption of fruit and vegetables', *Preventive Medicine,* 1998, 27(4): 572-582; citing Health Dept. of WA, 'Fruit 'n' Veg With Every Meal campaign background information document', Health Promotion Services Branch, Perth, 1990.

[367] M Miller & C Pollard, 'Health working with industry to promote fruit and vegetables: a case study of the Western Australian Fruit and Vegetable Campaign with reflection on effectiveness of inter-sectoral action', *Australian and New Zealand Journal of Public Health*, 2005, 29(2): 176-182.

[368] CM Pollard, MR Miller, AM Daly et al., 'Increasing fruit and vegetable consumption: success of the Western Australian Go for 2&5® campaign', *Public Health Nutrition*, 2008, 11(3): 314-320.

[369] Australian Government Go for 2 & 5® campaign, 'Why Go for 2 & 5®?' [website], [n.d.]; run under licence from the Dept. of Health, WA, the campaign owner [J Woods, Dept. of Health, WA, personal communication 2008].

[370] NHMRC, *Nutrient reference values for Australia and New Zealand,* NHMRC, Canberra, 2006.

[371] GC Marks, K Webb, IHE Rutishauser et al., *Monitoring food habits in the Australian population using short questions*, DHAC, Canberra, 2001.

[372] FSANZ, 'Monitoring and surveillance' [website], 2007.

[373] FSANZ, *The 21st Australian Total Diet Study: a total diet study of sulphites, benzoates and sorbates*, FSANZ, Canberra, 2005.

[374] M Lean, L Gruer, G Alberti et al., ABC of Obesity: Obesity – can we turn the tide? *British Medical Journal* 2006, 333: 1261-1264.

[375] Choice, 'Childhood obesity: it's time to take action' [web article], *Choice*, online September 2006.

[376] E Brunner, D Cohen & L Toon, 'Cost-effectiveness of cardiovascular disease prevention strategies: a perspective on EU food based dietary guidelines', *Public Health Nutrition*, 2001, 4(2B): 711–715.

[377] L Segal, D Mortimer & K Dalziel, *Risk factor study - how to reduce the burden of harm from poor nutrition, tobacco smoking, physical inactivity and alcohol misuse: cost utility analysis of 29 interventions*, Centre for Health Economics at Monash University, Melbourne, 2005.

[378] AJ Lee, K O'Dea & JD Mathews, 'Apparent dietary intake in remote Aboriginal communities', *Australian Journal of Public Health*, 1994, 18: 190-197.

[379] MS Harrison, T Coyne, AJ Lee et al., 'The increasing cost of the basic foods required to promote health in Queensland', *Medical Journal of Australia*, 2007, 186(1): 9-14.

[380] J Meedeniya, A Smith & P Carter, *Food supply in rural South Australia: a survey on food cost, quality and variety*, Eat Well SA, Adelaide, 2000.

[381] 'Remoteness of the community was considered a major factor in growth retardation' in studies by AE Dugdale et al. (1994) cited in T Coyne et al., *Towards Healthy Growth and Development: Issues of overweight, obesity and undernutrition among children in Queensland*, Qld Health, Health Information Centre, Brisbane, 2001.

[382] HEN, *What is known about the effectiveness of economic instruments to reduce consumption of foods high in saturated fat and other energy dense foods for preventing and treating obesity*, Geneva, WHO, 2006.

[383] G Cannon, 'The rise and fall of dietetics and of nutrition science, 4000 BCE-2000 CE', *Public Health Nutrition*, 2005, 8(6A): 701-705.

[384] FSANZ, *Proposal P230: Consideration of mandatory fortification with iodine*, 2006.

[385] M Li, CJ Eastman, KV Waite et al., 'Are Australian children iodine deficient? Results of the Australian National Iodine Nutrition Study', *Medical Journal of Australia*, 2006, 184: 165-169.

[386] HB Gibson, *Surveillance of iodine deficiency disorders in Tasmania 1949-1984*, 2nd edn., Myola, Launceston, 2006.

[387] BS Hetzel, 'Iodine deficiency disorders and their eradication', *Lancet,* 1983, 2(8359): 1226-1229.

[388] BS Hetzel & JT Dunn, 'The iodine deficiency disorders: their nature and prevention', *Annual Review of Nutrition*, 1989, 9: 21-38.

[389] K Guttikonda, JR Burgess, K Hynes et al., 'Recurrent iodine deficiency in Tasmania, Australia: a salutary lesson in sustainable iodine prophylaxis and its monitoring', *Journal of Clinical Endocrinology and Metabolism*, 2002, 87(6): 2809-2815.

[390] JA Seal, Z Doyle, JR Burgess et al., 'Iodine status of Tasmanians following voluntary fortification of bread with iodine', *Medical Journal of Australia*, 2007, 186(2): 69-71.

[391] LR Drew & AR Truswell, 'Wernicke's encephalopathy and thiamine fortification of food: time for a new direction?', *Medical Journal of Australia*, 1998, 168: 534-535.

[392] CG Harper, DC Sheedy, AI Lara et al., 'Prevalence of Wernicke's encephalopathy in Australia: has thiamine fortification of flour made a difference?', *Medical Journal of Australia*, 1998, 168: 542-545.

[393] L Connelly & J Price, 'Preventing the Wernicke-Korsakoff syndrome in Australia: cost-effectiveness of thiamine-supplementation alternatives', *Australian and New Zealand Journal of Public Health,* 1996, 20(2): 181-187.

[394] P Lancaster & T Hurst*, Trends in neural tube defects in Australia,* Australian Food and Nutrition Monitoring Unit, Brisbane, 2001.

[395] C Bower & FJ Stanley, 'Dietary folate as a risk factor for neural-tube defects: evidence from a case-control study in Western Australia', *Medical Journal of Australia*, 1989, 150: 613-619.

[396] C Bower & FJ Stanley, 'Issues in the prevention of spina bifida', *Journal of the Royal Society of Medicine*, 1996, 89: 436-442.

[397] FSANZ, *Consideration of mandatory fortification with folic acid: final assessment report proposal P295*, FSANZ, Canberra, 2006.

[398] WH Foege, 'Challenges to public health leadership', p 411, in R Detels, WW Holland, J McEwen et al. (eds.), *Oxford textbook of public health* (3rd ed.), Vol. 1: The scope of public health, OUP, Oxford, 1997, pp. 403-415.

[399] Choice, 'Nutrition: fortifying food with vitamins and minerals', *Campaigns update: Nov 2003*, Choice, 2003.

[400] AIHW & NHPA, 'Why is injury prevention and control a National Health Priority Area?' [website], AIHW, Canberra, 2005.

[401] DHFS & AIHW, *National health priority areas report: injury prevention and control 1997*, DHFS & AIHW, Canberra, 1998.

[402] J Moller, 'Current costing models: are they suitable for allocating health resources? The example of fall injury prevention in Australia', *Accident Analysis & Prevention*, 2005, 37(1): 25.

[403] Australian Transport Safety Bureau (ATSB), *Road safety in Australia: A publication commemorating World Health Day 2004*, ATSB, Canberra, 2004.

[404] ATSB & ABS, 'A history of road fatalities in Australia', in ABS (eds.), *Year Book Australia, 2001*, ABS, Canberra, 2001.

[405] Australian Transport Council (ATC), *The National Road Safety Strategy 2001-2010*, ATC, Canberra, 2000.

[406] ATC, *National Road Safety Strategy 2001-2010 progress report: November 2005*, ATC, Canberra, 2005.

[407] A Delaney, K Diamantopoulou & M Cameron, *Strategic principles of drink driving enforcement*, Monash University Accident Research Centre (MUARC), Melbourne, 2006.

[408] NSW RTA, *Road Safety 2010: A framework for saving 2,000 lives by the year 2010 in New South Wales,* NSW RTA, Sydney, 2002.

[409] Simpson D, personal communication, 2006.

[410] WA Office of Road Safety, 'Campaign "Restraints" – Restraints facts' [website], 2006.

[411] M Schmertmann & A Williamson, 'A brief overview of injury in New South Wales', *NSW Public Health Bulletin,* 2002, 13(4): 66-70.

[412] ABS, 'Children's injuries', in *Year book Australia, 2006*, ABS, Canberra, 2006.

[413] I Scott, 'Prevention of drowning in home pools – lessons from Australia', *Injury Control and Safety Promotion*, 2003, 10(4): 227-236.

[414] JH Pearn, J Nixon & I Wilkie, 'Freshwater drowning and near drowning accidents', *Medical Journal of Australia*, 1976, 139(2): 942-946.

[415] JH Pearn & J Nixon, 'Swimming pool immersion accidents: an analysis from the Brisbane Drowning Study', *Medical Journal of Australia*, 1977, 140: 432-437.

[416] JS Lawson & TI Oliver, 'Domestic swimming pool drowning in children – positive results of a practical prevention program', *Australian Paediatric Journal*, 1978, 14: 275-277.

[417] Australian Consumers Association, 'Swimming pool safety', *Choice Magazine,* 1977.

[418] Standards Association of Australia (SAA), *MP 33-1977 Guide to swimming pool safety*, SAA, Sydney, 1977.

[419] SAA, *AS 1926-1979 Fences and gates for private swimming pools*, SAA, Sydney, 1979.

[420] KM Edmond, JR Attia, CA D'Este et al., 'Drowning and near-drowning in Northern Territory children', *Medical Journal of Australia,* 2001, 175: 605-608.

[421] WR Pitt & DT Cass, 'Preventing children drowning in Australia: we need to take a scientific approach to drowning prevention', *Medical Journal of Australia*, 2001, 175: 603-604.

[422] AWSC, *National Water Safety Plan 2004-07*, AWSC, Sydney, 2004.

[423] Royal Life Saving Society Australia (RLSSA), *The national drowning report 2005*, RLSSA, Sydney, 2005.

[424] WA Department of Health, *Western Australian Water Safety Framework 2004-2007: A Strategic Framework for Addressing Drowning, Near-drowning and Related Injury in Western Australia*, Western Australian Government, Perth 2004.

[425] D Cass, F Ross & L Lam, 'Childhood drowning in New South Wales 1990-1995: a population based study', *Medical Journal of Australia*, 1996, 165: 610-612.

[426] National Public Health Partnership (NPHP), *The National Injury Prevention and Safety Promotion Plan: 2004-2014*, NPHP, Canberra, 2005.

[427] L Bugeja, *Drowning deaths at public swimming pools, Victoria – July 1988-June 2002*, State Coroner Victoria & State Government Victoria Department of Human Services, Melbourne, 2004.

[428] National Coroners' Information System (NCIS), *The benefits of the National Coronial Information System (NCIS): the world's first national database of coronial information,* Victorian Institute of Forensic Medicine, Melbourne, 2005.

[429] J Pearse, Manager, National Coroners Information System (NCIS), personal communication, 2007.

[430] C Cantor, K Neulinger, J Roth et al., *National Youth Suicide Prevention Strategy – setting the evidence-based research agenda for Australia* (Literature review), DHAC, Canberra, 2000.

[431] R Hassan, 'Social factors in suicide in Australia', *Trends and Issues in Crime and Criminal Justice,* no. 52, Australian Institute of Criminology, Canberra, 1996.

[432] T Hamilton, 'Youth suicide in Australasia', *Emergency Medicine*, 2002, 14(1): 18.

[433]ABS, *Suicides, Australia 1994-2004*, ABS, Canberra, 2000.

[434] A Beautrais, 'Suicide prevention strategies 2006', *Australian e-Journal for the Advancement of Mental Health*, 2006, 5(1): 2.

[435] DoHA, *Living Is For Everyone (LIFE): a framework for prevention of suicide and self-harm in Australia*, DoHA, Canberra, 2000.

[436] JJ Mann, A Apter, J Bertolote et al., 'Suicide prevention strategies. A systematic review', *Journal of the American Medical Association*, 2005, 294(16): 2064-2074.

[437] A Whitlock, 'Suicide in Brisbane, 1956-1973: the drug-death epidemic', *Medical Journal of Aust*ralia, 1975, 1: 737-743.

[438] P Mitchell, *Valuing young lives: evaluation of the National Youth Suicide Prevention Strategy*, Australian Institute of Family Studies, Melbourne, 2000.

[439] CH Cantor, K Neulinger & D De Leo, 'Australian suicide trends 1964-1997: youth and beyond?', *Medical Journal of Australia,* 1999, 171: 137-141.

[440] G Oliver & BS Hetzel, 'An analysis of recent trends in suicide rates in Australia', *International Journal of Epidemiology,* 1973, 2: 91-101.

[441] RFW Moulds, 'Drugs and poisons scheduling', *Australian Prescriber*, 1997, 20: 13.

[442] B Mackinnon, M Boulton-Jones & K McLaughlin, 'Analgesic-associated nephropathy in the West of Scotland: a 12-year observational study', *Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association – European Renal Association*, 2003, 18(9): 1800-1805.

[443] CI Johnston, ME Cooper, AJ Taylor et al., 'Defining moments in medicine: internal medicine', *Medical Journal of Australia,* 2001, 174: 9-11.

[444] P Kincaid-Smith, 'Pathogenesis of the renal lesion associated with the abuse of analgesics', *Lancet*, 1967, 1: 859-862.

[445] JH Stewart, 'Analgesic abuse and renal failure in Australasia', *Kidney International*, 1978, 13: 72-78.

[446] P Michielsen & P de Schepper, 'Trends of analgesic nephropathy in two high-endemic regions with different legislation', *Journal of the American Society of Nephrologists*, 2001, 12(3): 550-556.

[447]AP Disney & PG Row, 'Australian maintenance dialysis survey', *Medical Journal of Australia*, 1974, 2(18): 651-656.

[448] WM Bennett & ME DeBroe, 'Analgesic nephropathy – a preventable renal disease', *New England Journal of Medicine*, 1989, 320(1): 1269-1271.

[449] R Kreisfeld, *Firearm deaths and hospitalisations in Australia*, National Injury Surveillance Unit, AIHW, Adelaide, 2005.

[450] J Harrison, NISU, personal communication, 2006.

[451] J Ozanne-Smith, K Ashby, S Newstead et al., 'Firearm related deaths: the impact of regulatory reform', *Injury Prevention*, 2004, 10: 280-286.

[452] S Chapman, 'The decline in gun deaths', *NSW Public Health Bulletin*, 2003, 14(3): 48-50.

[453] S Chapman, P Alpers, K Agho et al., 'Australia's 1996 gun law reforms: faster falls in firearm deaths, firearm suicides, and a decade without mass shootings', *Injury Prevention*, 2006, 12(6): 370.

[454] S Faltas, G McDonald & C Waszink, *Removing small arms from society: a review of weapons collection and destruction programmes*, Small Arms Survey, Geneva, 2001.

[455] S Leeder, 'Celebrating the past; awakening the future: the NSW Public Health Forum highlights public health successes in NSW', *NSW Health Public Health Bulletin*, 2003, 14(3): 41-43.

[456] R Beaglehole & R Bonita, *Public health at the crossroads: achievements and prospects,* Cambridge University Press, Cambridge, 1997.

[457] NHPAC, 'National Health Priority Areas', 2002.

[458] M Daniel, S Moore & Y Kestens, 'Framing the biosocial pathways underlying associations between place and cardiometabolic disease', *Health & Place*, 2007, 14(2): 117-132.

[459] AIHW, *Health system expenditure on disease and injury in Australia, 2000-01*, AIHW, Canberra, 2005.

[460] PF Gross, SR Leeder & MJ Lewis, 'Australia confronts the challenge of chronic disease', *Medical Journal of Australia*, 2003, 179: 233-234.

[461] C Dowrick, 'The Chronic Disease Strategy for Australia', *Medical Journal of Australia*, 2006, 185(2): 61-62.

[462] Cancer Council Australia, '*Tobacco control*', 2007.

[463] MJ Thun & A Jemal, 'How much of the decrease in cancer death rates in the United States is attributable to reductions in tobacco smoking?', *Tobacco Control*, 2006, 15: 345-347.

[464] AIHW & AACR, *Cancer in Australia 2001*, AIHW, Canberra, 2004.

[465] AIHW, *National Drug Strategy Household Survey: detailed findings*, AIHW, Canberra, 2005.

[466] ABS, *2004-05 National Aboriginal and Torres Strait Islander health survey*, ABS, Canberra, 2006.

[467] ABS, *National Aboriginal and Torres Strait Islander Social Survey, 2002,* ABS, Canberra, 2004.

[468] NSW Health Department , 'New South Wales mothers and babies 2003', *NSW Public Health Bulletin*, 2004, 15(S-5): 1-116.

[469] SD Woodward, 'Trends in cigarette consumption in Australia', *Australia and New Zealand Journal of Medicine*, 1984, 14: 405-407.

[470] S Doyle, 'Australian Tobacco Timeline, Tobacco Control Supersite' [website], The University of Sydney, 2000.

[471] QUIT Victoria, *Tobacco in Australia: facts and issues*, QUIT Victoria, Melbourne, 1995.

[472] VicHealth, *The Story of VicHealth: a world first in health promotion,* VicHealth, Melbourne, 2005.

[473] National Campaign Against Drug Abuse (NCADA), *National Health Policy on Tobacco in Australia and examples of strategies for implementation*, NCDA, Canberra, 1991.

[474] Ministerial Council on Drug Strategy (MCDS), *National tobacco strategy, 2004-2009*, Commonwealth of Australia, Canberra, 2004.

[475] S Chapman, 'Agent of change: more than "a nuisance to the tobacco industry"', *Medical Journal of Australia*, 2002, 177(11/12): 661-663.

[476] N Gray, 'Smoking – time to ring the alarm bells again: 1998 offers a golden opportunity for evolutionary tobacco control legislation', *Medical Journal of Australia*, 1998, 168: 204-205.

[477] K Jamrozik, S Chapman & E Woodward, 'How the NHMRC got its fingers burnt', *Medical Journal of Australia*, 1997, 167: 372-374.

[478] WA Department of Health, 'QUIT WA' and 'About QUIT WA' [websites], 2006 & 2005.

[479] J Clarkson, RJ Donovan, B Giles-Corti et al., *Survey on Recreation and Health 1992-1998: Volume 3: Healthway and Health Messages*, Perth, The University of Western Australia, 1999.

[480] R Carter & M Scollo, 'Economic evaluation of the National Tobacco Campaign' (Chapter 7), in Hassard K (ed.), *Australia's National Tobacco Campaign: Evaluation report volume two: Every cigarette is doing you damage*, DHAC, Canberra, 2000.

[481] B Ridolfo & C Stevenson, *The quantification of drug-caused mortality and morbidity in Australia, 1998*, AIHW Canberra, 2001.

[482] VicHealth Centre for Tobacco Control, *Tobacco control: a blue chip investment in public health*, VicHealth Centre for Tobacco Control, Melbourne, 2003.

[483] SF Hurley, 'Short-term impact of smoking cessation on myocardial infarction and stroke hospitalisations and costs in Australia', *Medical Journal of Australia*, 2005, 183(1): 13-17.

[484] NAS, *National Alcohol Strategy 2006-2009: towards safer drinking cultures*, DoHA, Canberra, 2006.

[485] DCPC, *Public drunkenness in Victoria – final report*, DCPC, Parliament of Victoria, Melbourne 2001.

[486] NHMRC, *Alcohol and your health* (poster), [Australian alcohol guidelines AG70, National Drug Strategy Resources], DoHA, Canberra, [no date].

[487] NHMRC, *Australian alcohol guidelines: health risks and benefits*, Commonwealth of Australia, Canberra, 2001.

[488] A Graycar, 'Crime and justice centenary article: crime in twentieth century Australia', in ABS, *Year Book Australia, 2001*, ABS, Canberra, 2001.

[489] Catholic Education Commission, NSW and The Association of Independent Schools, NSW, *Guidelines to support the development of school-based drug education policies and practices,* Commonwealth of Australia, Canberra, 2001.

[490] D Mortimer, L Segal & K Dalziel, *Risk factor study: how to reduce the burden of harm from poor nutrition, tobacco smoking, physical inactivity and alcohol misuse: cost utility analysis of 6 interventions to promote safe use of alcohol*, Centre for Health Economics, Monash University, Melbourne, 2005.

[491] N Bertholet, JB Daeppen, V Wietlisbach et al., 'Reduction of alcohol consumption by brief alcohol intervention in primary care: systematic review and meta-analysis', *Archives of Internal Medicine*, 2005, 165(9): 986-995.

[492] F Shand, J Gates, J Fawcett et al., *Guidelines for the treatment of alcohol problems*, Commonwealth of Australia, Canberra, 2003.

[493] RACP & RANZCP, *Alcohol policy, 2005*.

[494] T Chikritzhs, T Stockwell, H Jonas et al., 'Towards a standardised methodology for estimating alcohol-caused death, injury and illness in Australia', *Australian and New Zealand Journal of Public Health*, 2002, 26(5): 443-450.

[495] D Pennay, *Community attitudes to road safety – Wave 19, 2006,* ATSB, Canberra, 2006.

[496] DVA Alcohol Management Project Team, *Changing the mix: a guide to low-risk drinking for the veteran community*, DVA, Canberra, [2001]. See also, DVA, 'The right mix:' [website], DVA, Canberra, 2007.

[497] MCDS, *The National Drug Strategy: Australia's integrated framework 2004-2009*, AusInfo, Canberra, 2004.

[498] K Donovan, R Donovan, P Howat et al., 'Magazine alcohol advertising compliance with the Australian Alcoholic Beverages Advertising Code', *Drug and Alcohol Review*, 2007, 26(1): 73-81.

[499] DoHA, 'Health budget 2006-2007: DrinkWise Australia' [website], DoHA, 2006.

[500] WD Hall & R Room, 'Assessing the wisdom of funding DrinkWise', *Medical Journal of Australia*, 2006, 185(11/12): 635-636.

[501] ADCA, *Policy positions of the Alcohol and other Drugs Council of Australia: prevention*, ADCA, Canberra, 2003.

[502] A Ritter & J Cameron, 'A review of the efficacy and effectiveness of harm reduction strategies for alcohol, tobacco and illicit drugs', *Drug and Alcohol Review*, 2006, 25(6): 611-624.

[503] T Chikritzhs, T Stockwell, R Pascal et al., *The Northern Territory's Living with Alcohol Program, 1992-2002: revisiting the evaluation*, NDRI, Perth, 2004.

[504] National Expert Advisory Committee on Alcohol, *National Alcohol Strategy: a plan for action 2001 to 2003-04*, DHAC, Canberra, 2001.

[505] J Harrison, E Miller & S Gruszin, '*Harm reduction by means of restriction of alcohol supply in communities in remote Australia, with particular reference to Aboriginal communities*', 2001.

[506] M Brady, *The grog book: strengthening Indigenous community action on alcohol*, DoHA, Canberra, 2005.

[507] T Stockwell, T Chikritzhs, D Hendrie et al., 'The public health and safety benefits of the NT's Living With Alcohol program', *Drug and Alcohol Review*, 2001, 20: 167-180.

[508] CM Doran, MB Gascoigne, AP Shakeshaft et al., 'The consumption of alcohol by Australian adolescents: a comparison of revenue and expenditure', *Addictive Behaviors*, 2006, 31(10): 1919. [Costing was in $US].

[509] G Edwards, P Anderson, T Babor et al., *Alcohol policy and the public good*, Oxford University Press, Oxford, 1994.

[510] PS Haber, KM Conigrave & AD Wodak, 'NSW Alcohol Summit: getting a better grip on our favourite drug', *Medical Journal of Australia*, 2003, 179(10): 521-522.

[511] MP Staples, M Elwood, RC Burton et al., 'Non-melanoma skin cancer in Australia: the 2002 national survey and trends since 1985', *Medical Journal of Australia*, 2006, 184(1): 6-10.

[512] AIHW & AACR, *Cancer in Australia: an overview, 2006*, AIHW, Canberra, 2007.

[513] NCCI, *The 2002 National Non-melanoma Skin Cancer Survey*, NCCI, Melbourne, 2003.

[514] The Cancer Council Australia, *Position statement: screening and early detection of skin cancer,* The Cancer Council Australia, Sydney, 2004.

[515] AIHW, *State & territories GRIM (General Record of Incidence of Mortality) Books*, AIHW, Canberra, 2005.

[516] HO Lancaster, 'Some geographical aspects of the mortality from melanoma in Europeans', *Medical Journal of Australia*, 1956, 1: 1082-1087.

[517] Statistical Consulting Centre (SCC), The University of Melbourne, 'Sunlight and skin cancer', SCC, Melbourne, 2005.

[518] GG Giles, BK Armstrong, RC Burton et al., 'Has mortality from melanoma stopped rising in Australia? Analysis of trends between 1931 and 1994', *British Medical Journal*, 1996, 312: 1121-1125.

[519] DM Roder, CG Luke, KA McCaul et al., 'Trends in prognostic factors of melanoma in South Australia, 1981-1992: implications for health promotion', *Medical Journal of Australia,* 1995, 62: 25-29.

[520] P Jelfs, G Giles, D Shugg et al., 'Cutaneous malignant melanoma in Australia, 1989', *Medical Journal of Australia*, 1994, 161(3): 182-187.

[521] HK Koh, DR Miller, AC Geller et al., 'Who discovers melanoma? Patterns from a population-based survey', *Journal of the American Academy of Dermatology*, 1992, 26(6): 914-919.

[522] D Hill & J Boulter, 'Sun protection behaviour – determinants and trends', *Cancer Forum*, 1996, 20: 204-211.

[523] The Cancer Council Australia, *Risks and benefits of sun exposure*, The Cancer Council Australia, Sydney, 2007.

[524] AL Ponsonby, RM Lucas & IAF van der Mei, 'UVR, vitamin D and three autoimmune diseases - multiple sclerosis, type 1 diabetes, rheumatoid arthritis', *Photochemistry and Photobiology*, 2005, 81(6): 1267-1275.

[525] J Reichrath, 'The challenge resulting from positive and negative effects of sunlight: how much solar UV exposure is appropriate to balance between risks of vitamin D deficiency and skin cancer?', *Progress in Biophysics and Molecular Biology*, 2006, 92(1): 9-16.

[526] C Sinclair, 'Risks and benefits of sun exposure – implications for public health practice based on the Australian experience', *Cancer Forum*, 2006, 30(3): 202-206.

[527] Cancer Council Victoria, The, 'SunSmart Victoria: Campaigns and advertising: The eighties' [website], The Cancer Council Victoria, 2006.

[528] Additional text updating the Sid the Seagull message provided by S Heward, Manager, SunSmart; updated Sid the Seagull image provided by M Hooper; The Cancer Council Victoria.

[529] AJ Samanek EJ Croager, P Gies et al., 'Estimates of beneficial and harmful sun exposure times during the year for major Australian population centres', *Medical Journal of Australia*, 2006, 184(7): 338-341.

[530] A Green, G Williams, R Neale et al., 'Daily sunscreen application and betacarotene supplementation in prevention of basal-cell and squamous-cell carcinomas of the skin: a randomised controlled trial', *The Lancet*, 1999, 354(9180): 723-729.

[531] OB Carter & RJ Donovan, 'Public (mis)understanding of the UV index', *Journal of Health Communication*, 2007, 12(1): 41-52.

[532] SunSmart Victoria, *SunSmart Program 2003-2006: submission to the VicHealth review of the SunSmart Program July 2002*, The Cancer Council Victoria, Melbourne, 2002.

[533] R Carter, R Marks & D Hill, 'Could a national skin cancer primary prevention campaign in Australia be worthwhile?: an economic perspective' *Health Promotion International*, 1999, 14(1): 73-82.

[534] The Cancer Council Victoria, 'Budget a mixed picture for cancer' [Media release], 12 May 2005.

[535] The Cancer Council Australia, *Profile and annual report, 2005*, The Cancer Council Australia, Sydney, 2006.

[536] SunSmart Victoria, '*New campaign warns of the dangers of solarium use*', SunSmart Victoria, Melbourne, 2007.

[537] DoHA, *National hepatitis C strategy 2005-2008*, Commonwealth of Australia, Canberra, 2005.

[538] Hepatitis C Virus Projections Working Group (HCVPWG), *Estimates and projections of the Hepatitis C Virus epidemic in Australia 2002*, NCHECR, Sydney, 2002.

[539] Senate Community Affairs References Committee, *Hepatitis C and the blood supply in Australia*, Commonwealth of Australia, Canberra, 2004.

[540] J Amin, M Law, M Bartlett et al., 'Causes of death after diagnosis of hepatitis B or hepatitis C infection: a large community-based linkage study', *The Lancet*, 2006, 368(9539): 938-945.

[541] NCHECR, *HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report, 2005*, NCHECR, Sydney, 2005.

[542] Health Outcomes International (HOI), in association with the NCHECR & M Drummond, *Return on investment in needle and syringe programs in Australia: report*, DoHA, Canberra, 2002.

[543] DHAC, *National Hepatitis C Strategy 1999-2000 to 2003-2004*, DHAC, Canberra, 2000.

[544] HCVPWG, *Estimates and projections of the hepatitis C virus epidemic in Australia 2006*, 2006.

[545] S Hurley, D Jolly & J Kaldor, 'Effectiveness of needle-exchange programmes for prevention of HIV infection', *The Lancet*, 1997, 349: 1797-1800.

[546] KJR Watson, 'Preventing hepatitis C virus transmission in Australians who inject drugs', *Medical Journal of Australia*, 2000, 172: 55-56.

[547] AR Winstock, CM Anderson & J Sheridan, 'National survey of HIV and hepatitis testing and vaccination services provided by drug and alcohol agencies in Australia', *Medical Journal of Australia*, 2006, 184(11): 560-562.

[548] S Yusuf, S Reddy, S Ôunpuu et al., 'Global burden of cardiovascular diseases Part II: Variations in cardiovascular disease by specific ethnic groups and geographic regions and prevention strategies', *Circulation*, 2001, 104(23): 2855-2864.

[549] CC Kelleher, JW Lynch, L Daly et al., 'The "Americanisation" of migrants: evidence for the contribution of ethnicity, social deprivation, lifestyle and life-course processes to the mid-20th century coronary heart disease epidemic in the US', *Social Science & Medicine*, 2006, 63(2): 465.

[550] AJ Dobson, RW Gibberd, SR Leeder et al., 'Occupational differences in ischaemic heart disease mortality and risk factors in Australia', *American Journal of Epidemiology*, 1985, 122(2): 283-290.

[551] KS Reddy & MB Katan, 'Diet, nutrition and the prevention of hypertension and cardiovascular diseases', *Public Health Nutrition*, 2004, 7(1): 167-186.

[552] Heart Foundation, The, 'About us' [website], National Heart Foundation Australia, 2004.

[553] MA Clay, C Donovan, L Butler et al., 'The returns from cardiovascular research: the impact of the National Heart Foundation of Australia's investment', *Medical Journal of Australia*, 2006, 185(4); 209-212.

[554] BL Lloyd, 'Declining cardiovascular disease incidence and environmental components', *Australian and New Zealand Journal of Medicine*, 1994, 24(1): 124-132.

[555] National Heart, Stroke and Vascular Health Strategies Group, *National strategy for heart, stroke and vascular health in Australia*, DoHA, Canberra, 2004.

[556] NHPAC, *National service improvement framework for heart, stroke and vascular disease*, DoHA, Canberra, 2006.

[557] A Page, M Tobias, J Glover et al., *Australian and New Zealand atlas of avoidable mortality*, PHIDU, The University of Adelaide, Adelaide, 2006.

[558] Productivity Commission (PC), *Impacts of Advances in Medical Technology in Australia*, PC, Canberra, 2005.

[559] A Tonkin, AE Bauman, S Bennett et al., 'Cardiovascular health in Australia: current state and future directions', *The Asia Pacific Heart Journal*, 1999, 8(3): 183-187.

[560] NP Stocks, P Ryan, H McElroy et al., 'Statin prescribing in Australia: socioeconomic and sex differences: a cross-sectional study', *Medical Journal of Australia*, 2004, 180(5): 229-231.

[561] P McElduff & AJ Dobson, 'Trends in coronary heart disease: has the socioeconomic differential changed?', *Australian and New Zealand Journal of Public Health*, 2000, 24(5): 465-473.

[562] NE Hayman, M Wenitong, JA Zangger et al., 'Strengthening cardiac rehabilitation and secondary prevention for Aboriginal and Torres Strait Islander peoples', *Medical Journal of Australia,* 2006, 184(10): 485-6.

[563] JR Carapetis & BJ Currie, 'Preventing rheumatic heart disease in Australia', *Medical Journal of Australia,* 1998, 168: 428-9.

[564] ST Turner & E Boerwinkle, 'Genetics of hypertension, target-organ complications, and response to therapy', *Circulation*, 2000, 102(20), suppl. 4: IV40-45.

[565] AIHW, *Chronic diseases and associated risk factors in Australia, 2006*, AIHW, Canberra, 2006.

[566] NSF, *National Stroke Foundation annual review 2003: setting the priorities for stroke*, NSF, Melbourne, 2003.

[567] AIHW, *Heart, stroke and vascular diseases, Australian facts 2004*, AIHW, Canberra, 2004.

[568] National Stroke Foundation, *The national stroke report 2006*, NSF, Melbourne, 2006. NSF, 'About the National Stroke Foundation' [website], NSF, 2006.

[569] G Turrell G, L Stanley, M de Looper et al., *Health inequalities in Australia: morbidity, health behaviours, risk factors and health service use*, QUT & AIHW, Canberra, 2006.

[570] HS Mitchell & GG Giles, 'Cancer diagnosis after a report of negative cytology', *Medical Journal of Australia*, 1996, 164(5): 270-273.

[571] AIHW, *Cervical screening in Australia 2002-2003*, AIHW, Canberra, 2005.

[572] AIHW & NBCC, *Breast cancer in Australia: an overview, 2006*, 2006.

[573] AIHW & DoHA, *BreastScreen Australia monitoring report 2003-2004*, AIHW, Canberra, 2007.

[574] AIHW, *Cervical screening in Australia 2003-2004*, AIHW, Canberra, 2006.

[575] MD Coory, PS Fagan, JM Mulleret al., 'Participation in cervical cancer screening by women in rural and remote Aboriginal and Torres Strait Islander communities in Queensland', *Medical Journal of Australia,* 2002, 177(10): 544-547.

[576] National Cervical Screening Program, *Screening to prevent cervical cancer: guidelines for the management of asymptomatic women with screen-detected abnormalities*, NHMRC, Canberra, 2005.

[577] A Cuncins-Hearn, M Boult, W Babidge et al., 'National Breast Cancer Audit: overview of invasive breast cancer management', *ANZ Journal of Surgery*, 2006, 76(8): 745-750.

[578] The Cancer Council Australia, *The National Cancer Prevention Policy (2004-06)*, The Cancer Council Australia, Sydney, 2004.

[579] JR Condon, BK Armstrong, A Barnes et al., 'Cancer in Indigenous Australians: a review', *Cancer Causes Control* 2003, 14(2): 109-121.

[580] KE Jong, DP Smith, XQ Yu et al., 'Remoteness of residence and survival from cancer in New South Wales', *Medical Journal of Australia*, 2004, 180: 618-622.

[581] SM Lockwood, N Bruce & R Manaszewicz, 'Model of outcomes of screening mammography: women's decisions about screening depend on many factors', *British Medical Journal*, 2005, 331(7512): 351.

[582] O Olsen & PC Gøtzsche, 'Cochrane review on screening for breast cancer with mammography', *The Lancet*, 2001, 358: 1340-1342.

[583] Health Canada, *Population health in Canada: a working paper,* Health Canada, Ottawa, 1997.

[584] D Hetzel, A Page, J Glover et al., *Inequality in South Australia: key determinants of wellbeing. Volume 1: The evidence*, Department of Health (SA), Adelaide 2004.

[585] S Deery & D Plowman, *Australian industrial relations*, 2nd ed., McGraw-Hill, Sydney, 1985.

[586] M Hyde, P Jappinen, T Theorell et al., 'Workplace conflict resolution and the health of employees in the Swedish and Finnish units of an industrial company', *Social Science & Medicine*, 2006, 63(8): 2218-2227.

[587] J Harrison, NISU, personal communication, 2006.

[588] G Robotham, '*Has occupational health and safety in Australia progressed in the last 25 years? Critical reflections of an occupational health and safety professional',* Occupational Health & Safety Change Pty Ltd, 2000.

[589] S Morrell, C Kerr, T Driscoll et al., 'Best estimate of the magnitude of mortality due to occupational exposure to hazardous substances', *Occupational Environmental Medicine*, 1998, 55: 634-641.

[590] J Leigh & T Driscoll, 'Malignant mesothelioma in Australia, 1945-2002', *International Journal of Occupational and Environmental Health*, 2003, 9(3): 206-217.

[591] AIHW, 'Australian health inequalities 2: trends in male mortality by broad occupational group', *AIHW Bulletin*, 2005, 25: 1-12.

[592] NOHSC, *Data on OHS in Australia,* 2000.

[593] ASCC, *National Occupational Health and Safety Strategy 2002-2112*, ASCC, Canberra, [updated] 2006.

[594] HB Higgins, 'Ex parte HV McKay (Harvester Case), (1907) 2 CAR 1', in *Law Internet Resources*, Parliament of Australia, Parliamentary Library, Canberra, 1907.

[595] P O'Connor, *Spinal cord injury, Australia 2000-01*, AIHW, Adelaide, 2003.

[596] Injury Issues Monitor, 'Prevention by design: the role of design in serious work-related injury' (NOHSC), *Injury Issues Monitor*, 2005, 33: 5-6.

[597] WRMC, *Comparative performance monitoring report: comparison of occupational health and safety and workers' compensation schemes in Australia and New Zealand* (8th edn.), OASCC, Canberra, 2006.

[598] ASCC, 'Priority industries' [website], OASCC, 2006.

[599] L Fragar, 'Agricultural health and safety in Australia', *Australian Journal of Rural Health*, 1996, 4(3): 200-206.

[600] RC Franklin, RJ Mitchell, TR Driscoll et al., 'Agricultural work-related fatalities in Australia, 1989-1992', *Journal of Agricultural Safety and Health*, 2001, 7(4): 213-227.

[601] Farmsafe Australia, *Goals targets and strategies 1996-2001*. Farmsafe Australia, Moree, NSW, 1996.

[602] LJ Fragar & R Franklin, *Farmsafe Australia goals, targets and strategy 1996-2001: mid-term review*, Rural Industries Research and Development Corporation & the Australian Centre for Agricultural Health and Safety, University of Sydney, 1999.

[603] Farmsafe Australia Inc., 'Child Safety on Farms' [website], Farmsafe Australia Inc., Moree, NSW, [n.d.].

[604] Farmsafe Australia Inc., *Productive Australian farms free from health and safety risk: business plan 2002-07*, Farmsafe Australia, Moree, NSW, 2002.

[605] ASCC, *Statistical report notified fatalities: July 2005 to June 2006*, ASCC, Canberra, [n.d.].

[606] Urbis Keys Young, *Evaluation of Aboriginal and Torres Strait Islander Access to Major Health Programs* DoHA. Canberra, 2006.

[607] L Buckmaster & J Davidson, *The proposed sale of Medibank Private: historical, legal and policy perspectives* (Research brief no. 2, 2006-07), Parliament of Australia, Parliamentary Library, Canberra, 2006.

[608] B Browning, 'Health funding and medical professionalism – a short historical survey of the relationship between government and the medical profession in Australia', in Australian Academy of Medicine and Surgery (AAMS), *History of medicine*, AAMS, Sydney, 2000.

[609] RB Scotton & JS Deeble, 'Compulsory Health Insurance for Australia', *Australian Economic Review*, 1968, 4: 9-16.

[610] A Elliot, *Is Medicare universal?*, Parliament of Australia, Canberra, 2003.

[611] Medicare Australia, 'About us: service charter: support information: you said: make it easy for me', [website], Medicare Australia, 2006.

[612] AIHW, *Expenditures on health for Aboriginal and Torres Strait Islander peoples, 2001-02,* AIHW, Canberra, 2005.

[613] C Sloan, *A History of the Pharmaceutical Benefits Scheme 1947–1992,* Department of Human Services and Health, Canberra, 1995.

[614] A Biggs, 'The Pharmaceutical Benefits Scheme – an Overview', Commonwealth of Australia, Canberra, 2003.

[615] DoHA, TGA, '*Australian Adverse Drug Reactions Bulletin* [website], DoHA, 2007.

[616] DoHA, Therapeutic Goods Administration (TGA), 'Therapeutic goods administration', DoHA, 2002.

[617] W Silverman, 'The schizophrenic career of a "monster drug"', *Pediatrics*, 2002, 110(2): 404-406.

[618] DoHA, TGA, 'Australian register of therapeutic goods (ARTG)' [website], TGA, 2005.

[619] DoHA, TGA, 'Medical Device Evaluation Committee (MDEC)' [website], TGA, 2007.

[620] DoHA, 'Prostheses List' [website], DoHA, 2007.

[621] Commonwealth of Australia, Parliamentary debates, *House of Representatives, Official Hansard*, No. 5, Monday, 14 February 2005, p. 91.

[622] RO Day, DJ Birkett, J Miners et al., 'Access to medicines and high-quality therapeutics: global responsibilities for clinical pharmacology', *Medical Journal of Australia*, 2005, 182(7): 322-323.

[623] C Hamilton, B Lokuge & R Denniss, 'Barrier to trade or barrier to profit? Why Australia's Pharmaceutical Benefits Scheme worries US drug companies', *Yale Journal of Health Policy, Law and Ethics*, 2004, 4(2): 373-385.

[624] DA Henry, SR Hill & A Harris, 'Drug prices and value for money: the Australian Pharmaceutical Benefits Scheme', *Journal of the American Medical Association*, 2005, 294: 2630-2632.

[625] TA Faunce & the Medical School and Law Faculty, Australian National University (ANU), '*Teaching PBAC cost-effectiveness evaluation of pharmaceuticals in global regulatory context*', ANU, Canberra, 2005.

[626] DoHA, *The National Medicines Policy*, DoHA, Canberra, 2000.

[627] DoHA, *The national strategy for Quality Use of Medicines*, DoHA, Canberra, 2002.

[628] DoHA, TGA, 'Australian code of good manufacturing practice for medicinal products' [website], 2006.

[629] DoHA, Officer of the Gene Technology Regulator, 'About the OGTR' [website], DoHA, 2007.

[630] SR Leeder, 'Achieving equity in the Australian health care system', *Medical Journal of Australia*, 2003, 179: 475-8.

[631] IA Scott, 'Is modern medicine at risk of losing the plot?' *Medical Journal of Australia*, 2006, 185(4): 213-216.

[632] K Lokuge & R Denniss, *Trading in our health system? The impact of the Australia-US Free Trade Agreement on the Pharmaceutical Benefits Scheme* [Discussion paper no. 55], Australia Institute, 2003.

[633] DoHA, *Submission to Senate Community Affairs Legislation Committee Inquiry into the National Health Amendment (Prostheses) Bill 2004*, DoHA, Canberra, 2005.

[634] S Graves, personal communication, 2007.

[635] J Doust & C Del Mar, 'Why do doctors use treatments that do not work?', *British Medical Journal*, 2004, 328: 474-5.

[636] S Graves & V Wells, *A review of joint replacement surgery and its outcomes: appropriateness of prostheses and patient selection*, ACHR, Melbourne, 2006.

[637] House of Representatives Standing Committee on Health and Ageing, *The Blame Game: report on the inquiry into health funding*, The Parliament of the Commonwealth of Australia, Canberra, 2006.

[638] N Swan [producer], *The Health Report: the quality of artificial hips and knees*, ABC, Sydney, 21 November 2005.

[639] S Gruszin, L Jorm, T Churches et al., *Public Health Classifications Project phase one: final report*, NPHP, Melbourne, 2006.

[640] L Riddout, D Gadiel, K Cook et al., *Planning framework for the public health workforce: discussion paper*, NPHP, Melbourne, 2002.

[641] Consumers' Health Forum of Australia (CHF), 'Consumers' Health Forum of Australia' [website], CHF, 2006.

[642] Cochrane Library, The, *Cochrane Database of Systematic Reviews* [website], The Cochrane Library, Wiley InterScience, London, 2007.

[643] E Harris, SJ Simpson, R Aldrich et al., 'Achieving equity in the Australian health care system', *Medical Journal of Australia*, 2004, 180(6): 308.

[644] DFAT, '*Australian disease surveillance and response systems*', DFAT, Canberra, 2004.

[645] See for example: DoHA, *The Australian Health Management Plan for Pandemic Influenza*, DoHA, Canberra, 2006.

[646] National Public Health Partnership (NPHP), *Public health workforce development: background paper*, NPHP, Melbourne, 1998.

[647] Public Health Association of Australia (PHAA), 'Public Health Association of Australia' [website], PHAA, 2006.

[648] F Baum, *The new public health: an Australian perspective*, Oxford University Press, Melbourne, 1998.

[649] DV Canyon & DN Podger, 'Towards a new generation of simulation models in public health education' *Australian Journal of Educational Technology,* 2002, 18(1): 71-88.

[650] Public Health Education and Research Program (PHERP) Review Steering Committee, *The Public Health Education and Research Program Review 2005: strengthening workforce capacity for population health*, Department of Health and Ageing, Canberra, 2005.

[651] DoHA 'Public Health Education and Research Program' [website], DoHA, 2004.

[652] Victorian Government, Department of Human Services, 'Victorian Public Health Training Scheme' [website], 2007.

[653] NSW Health, 'NSW Public Health Officer Training Program' [website], NSW Health Department, Sydney, 2008.

[654] C Kerr, 'Rural health in NSW', *NSW Public Health Bulletin*, 2001, 12(6): 149-150.

[655] S Russell, *Public health/health promotion research workforce: development, progression and retention,* Victorian Public Health Research and Education Council, Melbourne, 2004.

[656] E Hunter, 'Staying tuned to developments in Indigenous health: reflections on a decade of change', *Australasian Psychiatry*, 2003, 11(4): 418-423.

[657] Community Services and Health Industry Skills Council (CSHISC), *Aboriginal and Torres Strait Islander participation in vocational education and training: research report*, Commonwealth of Australia, Canberra, 2006.

[658] S Vlack, Coordinator, Indigenous Health Unit, School of Population Health, University of Queensland, personal communication, 2006.

[659] Productivity Commission, *Australia's health workforce*, Productivity Commission, Melbourne, 2005.

[660] National Aboriginal Health Strategy Working Party, *A national Aboriginal health strategy*, Commonwealth Department of Aboriginal Affairs, Canberra, 1989.

[661] JR Condon, T Barnes, J Cunningham et al., 'Improvements in Indigenous mortality in the Northern Territory over four decades', *Australian and Zealand Journal of Public Health*, 2004, 28(5): 445-451.

[662] DP Thomas, JR Condon, IP Anderson et al., 'Long-term trends in Indigenous deaths from chronic diseases in the Northern Territory: a foot on the brake, a foot on the accelerator', *Medical Journal of Australia*, 2006, 185(3): 145-149.

[663] Y Zhao & K Dempsey, 'Causes of inequality in life expectancy between Indigenous and non-Indigenous people in the Northern Territory, 1981-2000: a decomposition analysis', *Medical Journal of Australia,* 2006, 184(10): 490-494.

[664] N Zweck, P Roche & S Couzos, 'Leprosy', in *Aboriginal primary health care: an evidence-based approach*, Oxford University Press, Melbourne, 2003.

[665] S Couzos & J Carapetis, 'Rheumatic Fever', in *Aboriginal primary health care: an evidence-based approach*, Oxford University Press, Melbourne, 2003.

[666] National Centre in HIV Epidemiology and Clinical Research, 'National Donovanosis Eradication (Elimination) Project 2001-2004', *Australian HIV Surveillance Report*, 2003, 19(4): 1-7.

[667] Office for Aboriginal and Torres Strait Islander Health (OATSIH), information provided November 2006.

[668] DoHA & NACCHO, *Service activity reporting 2003-04 key results: a national profile of Commonwealth funded Aboriginal primary health care services*, Commonwealth of Australia, Canberra, 2006.

[669] P Hunter, N Mayers, S Couzos et al., 'Aboriginal Community Controlled Health Services', in DoHA, *General Practice in Australia: 2004*, DoHA, Canberra, 2005.

[670] DP Thomas, RF Heller & JM Hunt, 'Clinical Consultations in an Aboriginal community-controlled health service: a comparison with general practice', *Australian and New Zealand Journal of Public Health*, 1998, 22(1): 86-91.

[671] SL Larkins, LK Geia, KS Panaretto, 'Consultations in general practice and at an Aboriginal community controlled health service: do they differ?', *Rural and Remote Health*, 2006, 5: 560.

[672] NACCHO, 'National Aboriginal Community Controlled Health Organisation' [website], NACCHO, 2006.

[673] S Couzos, 'PBS medications: improving access for Aboriginal and Torres Strait Islander peoples', *Australian Family Physician*, 2005, 34(10): 841-844.

[674] M Kelaher, D Taylor-Thomson, N Harrison et al., *Evaluation of PBS Medicine Supply Arrangements for Remote Area Aboriginal Health Services under Section 100 of the National Health Act,* Cooperative Research Centre for Aboriginal and Tropical Health and the Program Evaluation Unit, University of Melbourne, 2004.

[675] NACCHO, AMA & Pharmacy Guild, *Final joint proposal: Position paper on improving access to PBS medications for Aboriginal peoples and Torres Strait Islanders*, 2004.

[676] J You, W Hoy, Y Zhao et al., 'End stage renal disease in the Northern Territory: current and future treatment costs', *Medical Journal of Australia*, 2002, 176: 461-465.

[677] DoHA, 'Improving the capacity of the Pharmaceutical Benefits Scheme (PBS) to meet the needs of Aboriginal and Torres Strait Islander Australians', Canberra, 2006.

[678] NR Mayers & S Couzos, 'Towards health equity through an adult health check for Aboriginal and Torres Strait Islander people', *Medical Journal of Australia,* 2004, 181(5): 531-532.

[679] NACCHO, *Medicare rebate for the health assessment of Aboriginal and Torres Strait Islander persons – proposal to benefit Aboriginal health,* NACCHO, Canberra, 2001.

[680] NACCHO, Response to the 'Report on the delivery of hearing health services to Aboriginal and Torres Strait Islander peoples', 2001.

[681] Australian Government, *Budget 2005: Indigenous affairs fact sheet – Indigenous budget measure 10: Hearing Services Programme – extend eligibility (expansion of access to the Australian Government Hearing Services Programme for Indigenous Australians),* Commonwealth of Australia, Canberra, 2005.

[682] S Couzos & S Davis, 'Inequities in Aboriginal health: access to the Asthma 3+ Visit Plan', *Australian Family Physician*, 2005, 34(10): 837-840.

[683] PB McIntyre & RI Menzies, 'Immunisation: reducing health inequality for Indigenous Australians', *Medical Journal of Australia,* 2005, 182(5): 207-208.

[684] P Hunter, 'Community Control and Primary Health Care for Indigenous Health', keynote presentation to the *5th National Rural Health Conference*, Adelaide, March 1999.

[685] AMA, *Position statement on Aboriginal health 2005*, AMA, Canberra, 2005.

[686] BR Henry, S Houston & GR Mooney, 'Institutional racism in Australian health care: a plea for decency', *Medical Journal of Australia*, 2004, 181(10): 517-520.

[687] IT Ring & D Firman, 'Reducing indigenous mortality in Australia: lessons from other countries', *Medical Journal of Australia*, 1998, 169(10): 528-533.

[688] WP Anderson, 'Funding Australia's health and medical research', *Medical Journal of Australia*, 1997, 167: 608-609.

[689] Walter & Eliza Hall Institute, 'A Profile of The Walter and Eliza Hall Medical Research Institute' [website], Walter & Eliza Hall Institute, Melbourne, 2004.

[690] ANAO, *Governance of the National Health and Medical Research Council*, Commonwealth of Australia, Canberra, 2003.

[691] J Bienenstock, *External review of the National Health and Medical Research Council*, AGPS, Canberra, 1993.

[692] P Dunn, 'Rural public health: critically addressing the research agenda', in *National Rural Public Health Forum 12-15 October 1997: Papers*, National Rural Health Alliance, Canberra, 1997.

[693] T Nolan, 'Accelerating the pace of health and medical research', presentation to PHAA conference, Perth, 2005.

[694] J Raeburn & I Rootman, *People-centred health promotion*, John Wiley & Sons, London, 1998.

[695] N Milio, 'Glossary: healthy public policy', *Journal of Epidemiology and Community Health*, 2001, 55(9): 622-623.

[696] WHO/ ISH, '1999 guidelines for the management of hypertension', *CVD Prevention*, 1999, 2(2): 76–111.

[697] WHO, *International statistical classification of diseases and related health problems: 10th revision*, WHO, Geneva, 1992.

[698] WHO, *Maternal mortality in 2000: estimates developed by WHO, UNICEF and UNFPA*, WHO, Geneva, 2004.

[699] NHMRC, 'Preventive health care and strengthening Australia's social and economic fabric strategic award', 2006.

[700] NHMRC, 'Public health (Australia) fellowships', 2006.

[701] MST Hobbs, SD Woodward, B Murphy et al., 'The incidence of pneumoconiosis, mesothelioma and other respiratory cancer in men engaged in mining and milling crocidolite in Western Australia', in JC Wagner (ed.), *Biological effects of mineral fibres*, International Agency for Research on Cancer, Lyon, 1980.

[702] F Fenner, 'Nature, nurture and my experience with smallpox eradication', *Medical Journal of Australia,* 1999, 171(11-12): 638-641.

[703] NHMRC, *Promoting the health of Australians: case studies of achievements in improving the health of the population*, NHMRC, Canberra, 1996.

[704] HMRSR ['Wills review'], *The virtuous cycle: working together for health and medical research*, Commonwealth of Australia, Canberra, 1998.

[705] NHMRC, *10 of the best: NHMRC funded health & medical research successes*, NHMRC, Canberra, 2006.

[706] JD Glover, DMS Hetzel & SK Tennant, 'The socioeconomic gradient and chronic illness and associated risk factors in Australia', *Australia and New Zealand Health Policy*, 2004, 1: 8.

[707] ABS, 'The population census – a brief history', in *Year book Australia, 2005*, ABS, Canberra, 2005.

[708] ABS, *History of the ABS National Health Survey: Background paper*, ABS, Canberra, [no date].

[709] GJ Fitzsimmons, KR Sadkowsky & Population Health Unit, AIHW, 'The Australian Institute of Health and Welfare', *Communicable Diseases Intelligence*, 2002, 26(4): 605-607.

[710] L Jorm, 'Health surveys: building an information base for population health in NSW', *NSW Public Health Bulletin*, 2001, 12(8): 213.

[711] J Glover & A Woollacott, *A Social Health Atlas of Australia*, Commonwealth Department of Health and South Australian Health Commission, Adelaide, 1992.

[712] G Turrell, B Oldenberg, I McGuffog et al., *The socioeconomic determinants of health: towards a national research program and a policy and intervention agenda*, Queensland University of Technology School of Public Health, Brisbane, 1999.

[713] J Glover, K Harris & S Tennant, *A social health atlas of Australia*, Public Health Information Development Unit, The University of Adelaide, Adelaide, 1999.

[714] A Page, S Ambrose, J Glover et al., *Atlas of avoidable hospitalisations in Australia: ambulatory care-sensitive conditions*, PHIDU, Adelaide, 2007.

[715] CATI TRG, 'Nation-wide CATI health surveys', NPHP, Melbourne, 2000.

[716] J Pope & S Gruszin, *Chronic disease and associated risk factors information monitoring system: the results of an audit of Australian data collections and policies and a review of the international experience*, La Trobe University, Melbourne, 2003.

[717] RJS Beeton, KI Buckley, GJ Jones et al., *Australia state of the environment 2006*, DEH, Canberra, 2006.

[718] NOHSC, 'OHS laws explained: the legal framework' [website], 2006.

[719] B Radunz, 'Surveillance and risk management during the latter stages of eradication: experiences from Australia', *Veterinary microbiology*, 2006, 112(2-4): 283-290.

[720] D Hetzel (ed.), *A proposal for the Australian Health Measurement Survey program,* PHIDU, Adelaide, 2003.

[721] R Levine & What Works Working Group with M Kinder, *Millions saved: proven successes in global health*, Center for Global Development, Washington DC, 2004.

[722] L Rychetnik, M Frommer, P Hawe et al., 'Criteria for evaluating evidence on public health interventions', *Journal of Epidemiology and Community Health,* 2002, 56: 119-127.

[723] S Chapman, 'Advocacy in public health: roles and challenges', *International Journal of Epidemiology,* 2001, 30: 1226-1232.

[724] M Kelly, 'Public health guidance and the role of new NICE', *Public Health*, 2005, 119(11): 960-968.

[725] S Torpey, K Ogden, M Cameron et al., *Indicative benefit/ cost analysis of road trauma countermeasures: interim report for discussion*, MUARC, Melbourne, 1991.

[726] B Oldenburg, P Kelly, C MacDougall et al., *Building capacity to improve public health in Australia – case studies of academic engagement*, ANAPHI, Brisbane, 2005.

[727] Biotechnology Australia, 'Summary of the outcomes from the 2003 evaluation of the National Biotechnology Strategy and Biotechnology Australia', BA, Canberra, 2003.

[728] TS Weeramanthri & K Edmond, *Northern Territory Preventable Chronic Disease Strategy – the Evidence Base: Best buys and key result areas in chronic disease control*, Territory Health Services, Darwin, 1999.

[729] STMicroelectronics, Glossary, 2007.

[730] M Edmonds, 'Health informatics: adverse events, iatrogenic injury and error in medicine', University of Adelaide, Adelaide, 2004.

[731] National Information Center on Health Services Research and Health Care Technology (NICHSR), 'HTA 101: Glossary', US National Library of Medicine, Bethesda, MD, 2006.

[732] The Cochrane Collaboration, 'Cochrane – Glossary of terms in The Cochrane Collaboration', 2007.

[733] K Webb, GC Marks, M Lund-Adams et al., *Towards a national system for monitoring breastfeeding in Australia: recommendations for population indicators, definitions and next steps*, Australian Food and Nutrition Monitoring Unit, Brisbane, 2001.

[734] FAO, *The State of Food Insecurity in the World 2001,* 2002, Rome.

[735] L Tapsell, 'Functional foods: benefits based on scientific evidence', in Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), *Australian food statistics 2005*, DAFF, Canberra, 2005.

[736] SA Dept. of Health, *Haemolytic uraemic syndrome (HUS) and Shiga toxin producing Escherichia coli (STEC)*, Government of SA, Adelaide, 2004.

[737] WB Runciman, 'Shared meanings: preferred terms and definitions for safety and quality concepts', *Medical Journal of Australia*, 2006, 184(10): S41-S43.

[738] Commonwealth of Australia, *World Health Organization Act 1947*, Schedule I, Section 3.

[739] J Raeburn & I Rootman, *People-centred health promotion*, John Wiley & Sons, London, 1998.

[740] N Milio, 'Glossary: healthy public policy', *Journal of Epidemiology and Community Health*, 2001, 55(9): 622-623.

[741] WHO/ ISH, '1999 guidelines for the management of hypertension', *CVD Prevention*, 1999, 2(2): 76–111.

[742] WHO, *International statistical classification of diseases and related health problems: 10th revision*, WHO, Geneva, 1992.

[743] WHO, *Maternal mortality in 2000: estimates developed by WHO, UNICEF and UNFPA*, WHO, Geneva, 2004.

[744] RW Sutherst, 'Global change and human vulnerability to vector-borne diseases', *Clinical Microbiology Reviews*, 2004, 17: 136-173.

[745] W Maher, I Lawrence & A Wade, *Drinking water quality, Australia* [State of the Environment Technical Paper Series (Inland Waters)], Department of the Environment, Sport and Territories, Canberra, 1997.

[746] Maddern GJ. 'The surgical scrub? Who cares?' [Editorial], *ANZ Journal of Surgery* 2004, 74: 720.

[747] L Featherstone, 'Surveying the mother: the rise of antenatal care in early twentieth-century Australia', *Limina* 2004, 10: 16-31.

[748] K Cunningham, R Hockey, R Pitt et al., 'Ten years on: toddler drowning in Qld 1992-2001', *Injury Bulletin* 2002, 75: 2.

[749] S Leeder, *Healthy medicine: challenges facing Australia's health service,* Allen & Unwin, Sydney, 1999.