# 1 Introduction

## 1.1 Background

Over the last thirty years, as health services have greatly expanded their range and scope, interest has grown in attempting to evaluate their performance and to identify areas for improvement. Donabedian (1966) first articulated a model for assessing the quality of health services across three domains: the structure (organisation and inputs) of the service, its process of care, and the outcome for the patient.

While much work has been undertaken since then to develop techniques for evaluating structures and processes of care, methods for assessing health outcomes attributable to the care received have proved more elusive. Yet, there is continuing interest in doing so. This is because there is an ongoing need to ensure that health care investment results in improved health for individuals and populations; to understand the causes of geographic and social variation in practice; and to reduce the frequency of inappropriate, poor quality or unsafe care (Woolf 1990).

One approach to assessing the quality of health care in terms of clinical outcomes has been to identify deaths that should not have occurred, given available health care interventions. This method was initiated in 1976 by Rutstein, who prepared a list of 'amenable' health conditions in consultation with an expert panel. Deaths from these causes represented 'untimely and unnecessary deaths' and their occurrence was 'a warning signal, a sentinel health event, that the quality of care might need to be improved' (Rutstein et al. 1976). The intention was to use the list for the purposes of medical audit.

Further studies followed. In the United Kingdom, Charlton and colleagues chose 14 disease groups from Rutstein's original list for which mortality in a developed country such as the United Kingdom should be wholly avoidable (Charlton et al. 1983). The list included certain conditions such as appendicitis, where prevention of death conferred an all-of-life benefit, and others, such as hypertensive diseases, where intervention might lead only to death being deferred (Jamrozik and Hobbs 2002). The authors calculated standardised mortality ratios to summarise the variations among UK district health authorities in mortality from the selected conditions. As a result of the publication of these indicators, several district health authorities undertook confidential enquiries into implicated services with subsequent improvement in SMRs (Segal and Chen 2001).

'Amenable' mortality as an indicator of the outcome of health care has been widely applied since the pioneering work of Rutstein and Charlton, including studies of time-trends and of geographical and socioeconomic variation in such mortality within and between countries (Westerling and Rosén 2002; Treurniet et al. 2004). A number of atlases of avoidable mortality (see below) for countries of the European Community have been published (Holland 1988, 1991, 1993, 1997). A detailed review, including an annotated bibliography of published studies, has recently been made available by Nolte and McKee (2004).

The concept has also been extended from studies of mortality to studies of morbidity, generally operationalised as avoidable hospitalisations (for example, Weissman et al. 1992; Billings et al. 1996; Jackson and Tobias 2001).

Returning to mortality, there is now a pressing need to monitor not only deaths that indicate the quality of health care, but also those that largely reflect 'upstream' risk factors or determinants of health (eg, deaths attributable to tobacco consumption). The latter causes of death are considered to be responsive to national health policies concerned with prevention rather than to clinical intervention at the individual patient level (Jamrozik and Hobbs 2002). Broadening of the concept from 'amenable' to 'avoidable' mortality through inclusion of 'preventable' mortality has been characteristic of more recent work in this area (for example, Holland 1988; Simonato et al. 1998; Tobias and Jackson 2001). This development has, however, introduced uncertainty regarding causal attribution and has complicated interpretation of the concept as an indicator of the quality of health care.

Jamrozik and Hobbs (2002) have cited the example of smoking and the importance of lag time, where deaths attributable to tobacco may reflect exposure decades earlier (Doll and Peto 1981; Peto et al. 1992). They also highlight the distinction between preventing mortality from acute conditions, so conferring a benefit that persists for the whole of life, versus deferment of death from chronic disease, which also may be associated with an increase in the prevalence of functional limitation. Arguably, it is not only the reduction in mortality that is important; the quality of the years of life gained should (ideally) also be taken into account (Jamrozik and Hobbs 2002).

## 1.2 Strengths and limitations of the concept

As outcome indicators for monitoring of health system quality, effectiveness and productivity, amenable and avoidable mortality have some advantages. Mortality is the hardest of hard endpoints, so there can be little questioning of the salience of the outcome or the quality of the data. Furthermore, mortality data are available – at least in developed countries – with relatively little delay, a necessary requirement for meaningful monitoring. Finally, amenable – and especially avoidable – deaths are relatively frequent events that involve all population subgroups and allow most facets of the health system to be assessed, from primary to tertiary care and (in the case of avoidable mortality) public health services and health policy as well.

On the other hand, these indicators also have several weaknesses (Jamrozik and Hobbs 2002). Being confined to mortality, services not associated with significant case fatality (eg orthopaedic services) or the opposite (eg palliative care) cannot be evaluated using these indicators. Furthermore, in the absence of additional information, interpreting a change or difference in a mortality rate is problematic, as the change or difference could reflect variation in disease incidence, survival (case fatality) or both. Even more seriously, such a change or difference could be entirely artefactual, reflecting nothing more than a change in diagnostic criteria or coding rules.

Beyond such technical and interpretational difficulties, the extent of change in avoidable or amenable mortality is influenced by the selection of both the particular causes of death and the age range used (most studies have been restricted to people under the age of 65 years). Some conditions that were previously not preventable or treatable may have become so in the interim (Jamrozik and Hobbs 2002), so the list of avoidable and amenable conditions needs to be regularly updated to reflect preventive and therapeutic advances (Nolte and McKee 2003; Treurniet et al. 2004).

In addition, while categorical attribution of cause may be appropriate for some causes of avoidable mortality (those that are clearly either responsive to health care intervention or not), this approach is simplistic for others, as it takes no account of the counterfactual. That is, for the latter causes of death what should be modelled is the *fraction* of the deaths from each cause that may have been prevented under a specified counterfactual exposure scenario (eg, 85% of lung cancer deaths this year would have been avoided if no-one had smoked in the preceding three to four decades). Use of categorical attribution (rule-based all-or-none classification) provides only a very approximate estimate of avoidable mortality. However, the necessary data on risk exposure and exposure–outcome relationships required for counterfactual modelling may not be available.

Finally, avoidable mortality as a performance indicator has often been criticised in that it does not link clearly to other indicators of health service provision, whether of process or input. So knowing the level or distribution of avoidable mortality does not directly indicate to the politician or health service manager what corrective action needs to be taken to improve the unsatisfactory situation vis a vis health outcomes.

As Nolte and McKee (2004) have pointed out, however, critics of the avoidable / amenable mortality concept have frequently asked it to do more than it is capable of doing. Avoidable mortality cannot provide a definitive indicator of the performance of a health service or of the health system as a whole, and indeed was never intended to be used as such. Rather, it provides an indication that poor performance may exist in one or more services or other health system functions, and points the way to more focussed evaluation research and audit to uncover the precise causes of the problem and identify the necessary corrective action. Even such a limited role is not trivial, however, especially given the ease and low cost with which avoidable and amenable mortality can be monitored.

## 1.3 Condition lists

Rutstein et al.'s (1976) original list included 90 conditions which could be considered clear-cut causes of 'unnecessary untimely deaths' amenable to medical interventions available at that time. The list was designed for use internationally, rather than only in economically developed countries, and as such encompassed many conditions rarely, if ever, seen in the latter countries.

In 1983, Charlton et al. selected 14 of Rutstein et al.'s (1976) indicators for use in small area studies. The criteria involved selecting conditions thought to be responsive to medical or surgical treatment and which were sufficiently common to allow analysis at small area level in the United Kingdom. Age limits were set for each cause, and a maximum upper age limit of 64 years was defined. Charlton et al.'s list of indicators was not intended to be comprehensive, but rather to highlight where a problem might exist and to stimulate further inquiry. The stated research aim was that "if they proved useful as indicators of inadequacies in health-care provision they would provide an inexpensive, valuable, and readily available tool for health-care planners and managers". Charlton et al.'s (1983) list was the first to be widely adopted by other researchers.

In 1988, a European Community (EC) working group produced the 'European Community Atlas of Avoidable Death' using an alternative list of 17 causes of avoidable mortality (see Holland 1988). The avoidable mortality conditions were described as indicators of health policy for primary prevention

(3 indicators) and medical care indicators (14 indicators). Strict age limits were again imposed. The atlas highlighted differences between the European countries and also showed within-country variations at the small area level. Subsequent revisions of the lists followed in the 2nd and 3rd editions of the EC atlases (see Holland 1991 (vol. I and 1993 (vol. II); 1997).

Most of the subsequent research has used these early lists of Charlton et al. (based on Rustein et al.), or Holland, including monitoring or research studies in Europe, Scandinavia, Japan, the United States, Canada, New Zealand and Greenland. Some recent studies following the EC approach of Holland, with some minor modifications, include Logminiene et al. (2004), who examined avoidable mortality trends in Lithuania from 1970 to 1999, and Treurniet et al. (2004), who compared trends in fifteen European countries from 1980 to 1997.

Other researchers have also based their condition list on that of the EC working group but have incorporated more extensive changes. For example, Andreev et al.'s (2003) research into avoidable mortality in Russia from 1965 to 2000 included accidental alcohol poisoning and tuberculosis, due to their importance as causes of premature death in that country.

While the majority of research and monitoring in this area has maintained a focus on amenable mortality, the thrust of much recent research has been to include a wider set of avoidable conditions (i.e., 'preventable' conditions responsive to prevention at the individual and especially the population level, through lifestyle change, environmental modification, or health policy and regulation more generally) . A study by Simonato et al. (1998) into avoidable mortality trends in Europe from 1955 to 1994 examined causes of death amenable to intervention by primary, secondary and tertiary prevention (the latter corresponding to the classical concept of 'amenable' mortality). Simonato's avoidable mortality condition list included 23 conditions, comprising seven allocated to the subcategory of primary prevention (various cancers, chronic liver disease, and injury and poisonings); four cancer-related conditions in the secondary prevention subcategory; and the remaining twelve allocated to tertiary prevention. A subsequent analysis by Tobias and Jackson (2001) examined avoidable mortality trends in New Zealand from 1981 to 1997 under these same three categories, but expanded the list to include 56 condition groupings, reflecting advances in population-based and individual-based preventive interventions as well as health care technology. In addition, the upper age limit used to examine avoidable mortality was extended from 64 to 74 years.

## 1.4 Age limits

Most earlier studies used the upper age limit of 64 years for the majority of conditions, following either Charlton et al.'s (1983) or the EC working group lists (Holland 1988; 1991; 1993; 1997). However, as mentioned earlier, strict age groups were specified for some avoidable mortality conditions: for example, in the EC list (2nd edition, vol. I, 1991), the age range for asthma was specified as 5 to 44 years. Research by Albert et al. (1996) included a category of total avoidable mortality up to the age of 75 years, but the main analysis retained the 64 year age limit.

Most recent research, notably by Tobias and Jackson (2001), followed by Andreev et al. (2003) and Nolte and McKee (2003), has adopted an upper age limit of 74 years in order to reflect changes in life expectancy (now about 80 years in developed countries), as well as improvements in coding which have allowed a single cause of death to be coded for most deaths among older people, despite their higher prevalence of multiple co-morbidities.

However, other recent studies continue to follow the age limits set by Holland. For example, Logminiene et al. (2004) and Treurniet et al. (2004) reported that a decision was made to maintain the 64 year age limit (and follow the standard EC condition list) in order to compare findings with earlier research, allowing for assessment of trends in avoidable mortality over time.

Consistency of definitions over time has to be weighed against considerations of validity, however. The latter would favour regular updating of both coverage (i.e., condition list) and age range of the indicator, reflecting advances in prevention practice and health care technology.

## 1.5 Using avoidable mortality data

To date, most studies using avoidable and amenable mortality indicators have involved examination of the relationships between these causes of mortality (individually or more usually, collectively), socio-economic conditions, and health service factors on a small area basis, in order to evaluate the performance of specific health services from the perspectives of quality, effectiveness, or productivity.

Other studies have involved the analysis of variations in health system performance (using avoidable mortality as the sole or as one among several outcome measures) across different countries, different health administrative areas, or over time. More recent analyses have included variations in avoidable mortality by socioeconomic position and ethnicity (Westerling and Rosén 2002; Tobias and Jackson 2001). Mackenbach et al. (1988) has used the concept to quantify the contribution of health care to life expectancy gain in The Netherlands over the twentieth century.

However, the key limitation of all these studies, as outlined above, has been their inability – shared with all studies based on aggregate indexes – to identify what corrective action needs to be taken once poor system or service performance has been identified. This requires the capability to drill down into the detail, so highlighting issues of process and input mix. Nolte and McKee (2004) have proposed a solution to this conundrum, "in which analyses of amenable mortality identify areas of potential concern that are then examined in more detail by studying the processes and outcomes of care for tracer conditions, selected on the basis of their ability to assess a wide range of health system components". The use of tracer conditions alongside avoidable or amenable mortality indicators may represent a powerful methodology, one that could illuminate health care performance across the continuum from inputs through processes to outcomes.

## 1.6 Previous Australian and New Zealand research

### Australian research

The first main studies of avoidable mortality are included in the New South Wales Chief Health Officer's reports (NSW Department of Health 2002; 2004) which include an examination of avoidable mortality in New South Wales, following Tobias and Jackson's (2001) methodology. Deaths from potentially avoidable causes accounted for 80 per cent of all premature deaths (before the age of 75 years) in 1983, falling to 70% of all premature deaths in 2002. Over the 20 year period, rates of avoidable death fell by 56%. The reduction in avoidable death rate was higher for males (58%) than for females (55%) (NSW Department of Health 2004).

The earlier analysis of socioeconomic inequalities in the change in rates of avoidable deaths between 1980 and 2000 in New South Wales found that the decrease in rates for those from the highest socioeconomic group (62% in males and 55% in females) was greater than those from the lowest group (53% in males and 48% in females) (NSW Department of Health 2002; see also Hayen et al. 2002).

In the period 1996 to 2000, the death rate from 'avoidable' causes in New South Wales increased with remoteness, and was three times higher in the Very Remote areas than in Highly Accessible areas. Similar gradients were observed when avoidable deaths were divided into primary, secondary and tertiary classifications (NSW Department of Health 2002).

The National Health Performance Committee (2004) examined potentially avoidable deaths in Australia from 1980 to 2001, following methods derived from the NZ Ministry of Health (NZ) (1999) and NSW Department of Health (2002). Between 1980 and 2001, avoidable mortality decreased by 54.6% for males and 48.0% for females. Over the period, the largest decrease for males was for tertiary avoidable mortality (58.7%), followed by secondary avoidable mortality (57.2%) and primary avoidable mortality (51.9%). For females, the largest decrease was for secondary avoidable mortality (53.7%), tertiary avoidable mortality (49.5%) and then primary avoidable mortality (43.3%). The avoidable death rate for males in the most disadvantaged areas was 60.5% higher than males in the least disadvantaged areas. For females, the rates were 47.1% higher in the most disadvantaged areas.

The Victorian DHS (2005) analysed avoidable and unavoidable mortality in Victoria from 1979 to 2001, following the earlier work by Tobias and Jackson (2001). Over the period, mortality rates declined for all categories of avoidable mortality, with primary avoidable mortality showing a greater decline than secondary and tertiary. Ischaemic heart disease was the leading cause of avoidable deaths among males and females during the study period, followed by lung and breast cancers in males and females, respectively.

Recent research by Korda and Butler (2004; 2006) examined the effect of health care on mortality between 1968 and 2001, partitioning avoidable causes into three categories – those amenable to medical care; those mainly responsive to health policy, and ischaemic heart disease. They found that total avoidable death rates fell by 68% in females and 72% in males over the period. Korda and Butler concluded that the Australian trends in avoidable mortality indicated the effectiveness of the Australian healthcare system in improving population health, with Australia's experience comparing favourably with that of the nine European countries studied.

### New Zealand research

Variations of Charlton et al.'s (1983) indicator list have been used in previous studies of avoidable mortality in New Zealand (Marshall and Keating 1989; Malcolm and Salmond 1993; Malcolm 1994; Jackson et al. 1998).

As introduced in Section 1.3 above, Tobias and Jackson's (2001) research described avoidable mortality in New Zealand from 1981 to 1997, including trends and variations between groups by age, gender, ethnicity and degree of deprivation. Avoidable mortality declined 38% from 1981 to 1997; unavoidable mortality declined only 9%. In 1996-97 almost 70% of deaths in the 0 to 74 age range were considered to be potentially avoidable. Almost 80% of avoidable deaths occurred in the 45 to 74 age group. These deaths were dominated by the emergence of chronic diseases, such as ischaemic heart disease, diabetes and smoking-related cancers.

In younger age groups, injury (including suicide) dominated avoidable mortality. Males experienced a greater burden of avoidable mortality than females – a relative excess of 54% (approximately 2,000 deaths) in 1996-97. The gender difference was largely attributed to diseases and injuries amenable to primary prevention, with the largest single contribution coming from ischaemic heart disease. The gap between ethnic groups in avoidable mortality remains wide: rates for Mäori and Pacific peoples were 2 to 2.5 times higher than European rates in 1996-97. Similar gradients were found with deprivation, using a census-based small area index.

## 1.7 Guide to this report

### Purpose and provenance

With these considerations in mind, this volume, *Australian and New Zealand Atlas of Avoidable Mortality,* aims to illustrate the geographic and social variation in avoidable and amenable mortality rates both within and between Australia and New Zealand.

Explanations of the variations, however, are likely to be complex and multi-faceted, and to depend on many factors beyond the control of health care systems. The purpose of this atlas is to highlight the differences and serve as an indicator of areas where additional research may be warranted.

The list of conditions used in this atlas draws on the previous studies undertaken, but updates them to reflect recent advances in preventive and therapeutic technologies (see chapter 2, *Methods*). We believe it contains those causes of death that are potentially avoidable at the present time, given available knowledge about social and economic policy impacts, health behaviours, and health care (the latter relating to the subset of amenable causes). We hope that this atlas will promote the use of 'avoidable mortality' (including within this rubric the subset of 'amenable mortality') as an indicator to assist in monitoring the quality, effectiveness and productivity of the Australian and New Zealand health systems in the 21st century.

## 1.8 Contents

The atlas has 9 chapters and an appendix. The chapters are:

## 1.9 References


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