UPDATE:

2.1a: Environmental lead reduction

Introduction

Environmental lead reduction continues to be both a public health success and a challenge, in particular for children living in the three main lead-affected communities: Port Pirie in South Australia, Mount Isa in Queensland and Broken Hill in New South Wales.

In May 2015 the National Health and Medical Research Council (NHMRC) revised their guidance on the health effects of lead following an independent evaluation of the evidence. The review 'found an association between blood lead levels less than 10 micrograms per decilitre and health effects, including reduced Intelligence Quotient and academic achievement in children, behavioural problems in children, increased blood pressure in adults and a delay in sexual maturation in adolescent boys and girls.' The report noted 'there is insufficient evidence to conclude that lead at this level *caused* any of the health effects observed.' As a result the NHMRC recommended that if a person has a blood lead level greater than 5 micrograms per decilitre (µg/dL) the source of the exposure should be investigated and reduced, especially for children and pregnant women.[1]

This reduction in the level of concern is one of a number of changes over the years. As more evidence has become available, health agencies around the world have progressively lowered the blood lead 'level of concern' from 60 µg/dL (µg/dL) to 5 µg/dL. For example, levels of concern in the US were reduced from 60 µg/dL from 1960 to 305µg/dL in 1970, to 25 µg/dL in 1985, to 10 µg/dL in 1991 and to 5 µg/dL in 2012. In Australia, the level of concern of 25 µg/dL introduced in 1983 was reduced to 10 µg/dL in 1993 and to 5 µg/dL in 2015. Of note is that in 2009 a level of 3.5 µg/dL was introduced in Germany for children aged 3 to 14 years.[2,3]

Lead Exposure

Lead exposure has reduced with the removal of lead from petrol, paint, and other products such as fishing sinkers, shot and solder. However, many buildings have old lead based paint that can be harmful to children, renovators and builders; and old plumbing, and dust in ceilings and under floors is frequently contaminated. People living in high traffic volume locations are at increased risk of lead exposure as are those living where there has been lead contamination in the past.[4] Occupational lead exposure is a reality for around 6% of the general workforce[5] and remains a significant challenge for people working in the lead industry, requiring work practices including wearing of heavy protective equipment, regular work rotations to reduce risk and constant monitoring.

Communities can be exposed with human contamination and serious environmental impact such as occurred in Esperance in Western Australia, when lead concentrate was transported through the town and handled at the Port of Esperance for several years.[6]

Conversely, Port Pirie, Broken Hill and Mount Isa communities face elevated exposure to environmental lead as a result of many decades of lead mining, smelting and processing. In Port Pirie for example, the lead-in-air emissions are the primary cause of elevated blood lead levels, but residual lead throughout the cities, and in particular 'hot spots' (e.g., railway corridors), is also harmful to health.[7] Reducing exposure to these sources of lead is challenging and expensive; the $514M redevelopment of the Port Pirie smelter to become a polymetallic processing and recovery centre is predicted to reduce levels to approximately 50% of current annual average air lead concentrations, potentially contributing to reductions in children's blood lead levels.[8,9]

In Broken Hill, lead emissions from the mines are within regulatory requirements, although critics argue contemporary mining still contributes to contamination.[10] It is likely that 'most of the community mining-related exposure arises from 'legacy lead', that is lead that already exists in the environment as well as petrol and lead paint that is unstable, or disturbed during renovations.[11] Reducing exposure requires separating the public, particularly children, from the source of lead, be it in the soil, paint, dust or other sources. Remediation of waste dumps and railway yards was undertaken in the 1990s and hazard management and abatement now focuses where the risk of the hazard is greatest (e.g., in playgrounds and near ore processing facilities).

Box 2.1a Testing blood lead levels

At birth, blood lead levels typically match those of the mother and are at their lowest level. In high-risk areas, lead levels often rise steeply for the first two years of life, as children are exposed to lead when they put things in their mouths and have increasing contact with contaminated surfaces at home and in the community. Typically levels plateau, and often begin reducing, around the age of three.[12] All parents in high exposure communities are strongly encouraged to have their babies tested at six months of age and then, depending on the reading, the frequency of retesting is determined, in line with the risk, and the associated level of intervention. Pregnant women are encouraged to be tested given lead in the mother's blood transfers virtually unhindered to the foetus.**Error! Bookmark not defined.** Caution should be taken in making comparisons between jurisdictions as the measures reported vary e.g. the most recent test result or the first or highest test result in the year.

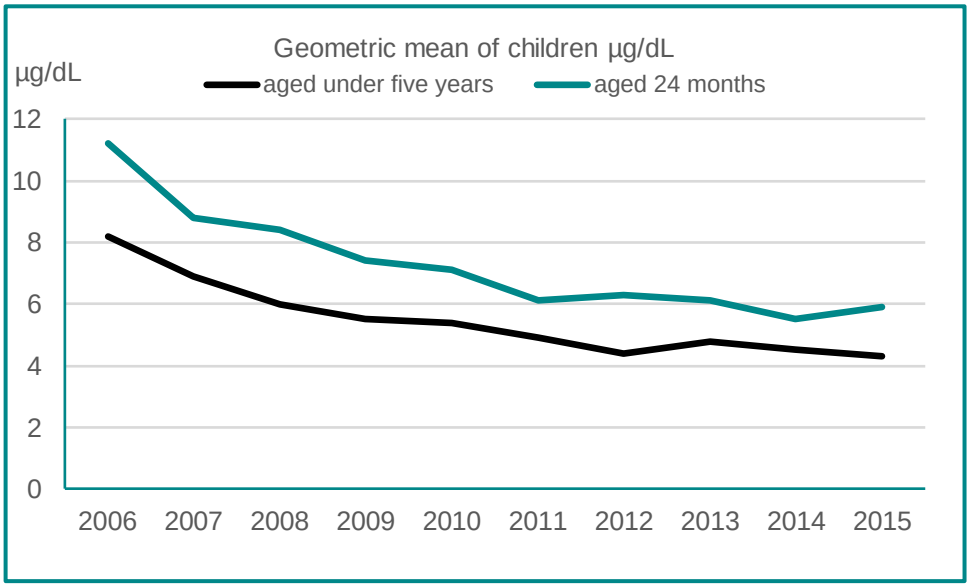
A finger prick testing method is now used to collect blood samples from children, rather than venous testing. In NSW, research showed this change contributed to an increase in the proportion of children screened annually from 0.39 in 2008 to 0.75 in 2012.[10] Screening serves to identify individuals requiring assistance and monitor the effectiveness of community programs.

Blood Lead Level Results

In Port Pirie, the geometric mean of children tested has fallen steadily since 1984.[13] In 2015 the level was 4.3 µg/dL for all children under five years (with surrogates[a])[14] that had a test and 5.9 µg/dL for children aged 24 months, the age at which levels tend to be most stable (Figure 2.1a).[15] It is important to note that these figures do not represent the levels of all children under five living in Port Pirie because children over three years of age with low risk of lead exposure do not need regular testing; also, testing is not mandatory.

[a] The data for Port Pirie include the mothers' blood lead level results measured during pregnancy or immediately post birth as a surrogate for babies under six months who have not yet had their first blood lead level test.

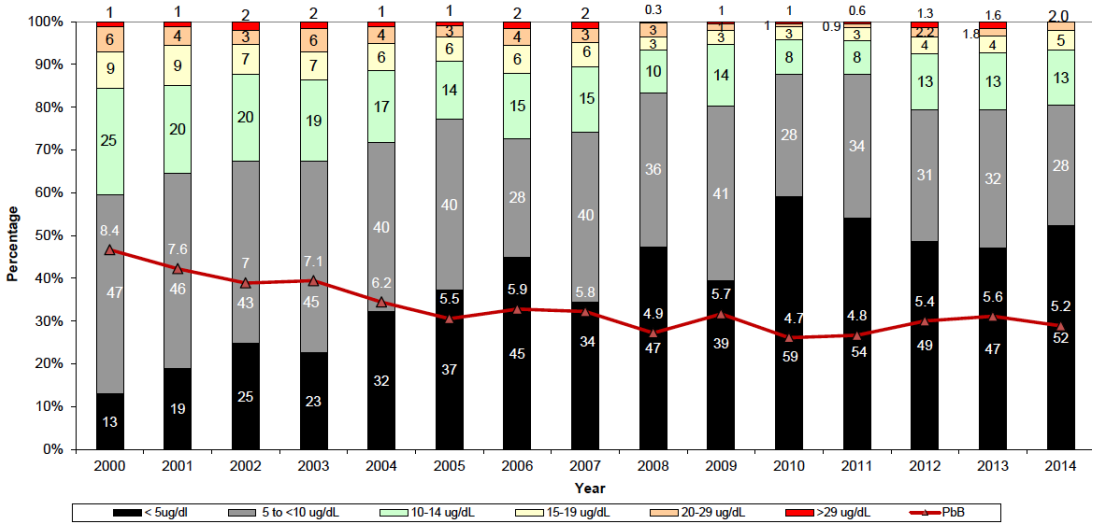
Figure 2.1a: Geometric mean of children tested aged under five years (with surrogates) and aged 24 months, by year, Port Pirie



Source: SA Health (2016). Port Pirie blood lead levels analysis of blood lead levels for 2015.

Broken Hill data show that the proportion of children with blood lead levels less than 5 µg/dL has risen from 13% in 2000 to 52% in 2014 (Figure 2.1b). At the same time the population mean has fallen from 8.4 µg/dL to almost 5 µg/dL.

Figure 2.1b: Percentage of children aged 1-4 years in Broken Hill by category of blood lead level and geomean, by year

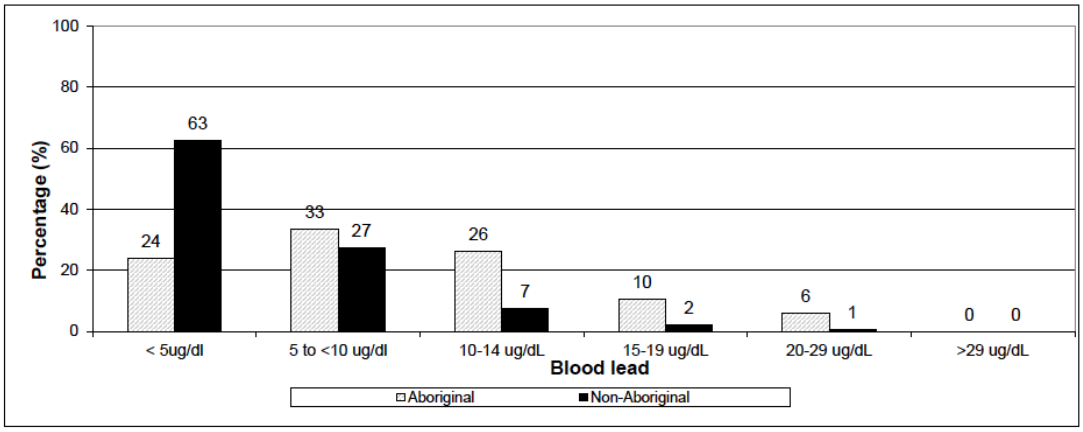


Note: Population age sex standardised percentage of Broken Hill children in each blood lead category including <5µg/dL, aged between 1 and 4 years, and population age sec standardised geometric mean (geomean), 2000-2014.

Source: Population Health Unit, Western NSW & Far West Local Health District (2015). Lead Health Report – children less than 5 years old in Broken Hill, p13

Monitoring also shows Aboriginal children consistently have lead levels 2-3 µg/dL higher than the non-Aboriginal population, and are twice as likely to have levels exceeding 10 µg/dL (Figure 2.1c).[10, 16] In 2014, 63% of non-Aboriginal children in Broken Hill had a blood lead level of less than 5 µg/dL, compared to only 24% of Aboriginal children.[17]

Figure 2.1c: Blood lead level categories by Aboriginal status for children aged 1 to 4 years, Broken Hill, 2014



Source: Population Health Unit, Western NSW & Far West Local Health District (2015). Lead Health Report – children less than 5 years old in Broken Hill, p19

In 2015, Mount Isa reports indicated no child under five years had a blood lead level of more than 10µg/dL, and average lead levels had fallen from 3.6 µg/dL in 2010 to 2.6 µg/dL in 2014. There were 11 to 13% of children (depending on the laboratory) with levels over 5µg/dL.[18] In addition to voluntary testing there is routine testing of blood lead levels on all children under five presenting to the Mount Isa Hospital.[19]

In all three States, reporting of elevated lead levels (of 5 µ/dL and above) to the State health department from laboratories and/or practitioners is either required or standard practice; this is designed to identify cases, recommend risk reduction measures and monitor the epidemiology.[20,21]

Public health practice

Public health successes rely on an 'organised response' to the protection and promotion of health.[22] All three cities operate lead abatement programs, jointly funded by industry, and state and local governments and with community engagement. These are:

- Port Pirie – Targeted Lead Abatement Program[23,24]
- Broken Hill – Broken Hill Environment Lead Program[16]
- Mt Isa – Living Safely with Lead Program[25]

These programs undertake similar activities, including:

- provision of printed and electronic information on the health effects of lead exposure, the importance of regular testing and where to be tested, tips to maintain a healthy lifestyle and eat a diet high in iron and calcium. Programs maintain a high profile at community events such as Aboriginal wellbeing days
- collaborations with schools, educators, health staff and community groups who are in a position to pass on information to the community and higher risk families and encourage screening
- greening and remediation programs in public spaces including footpaths, schools and preschools, public buildings and playgrounds.[26] Waste dumps and railway corridors are a focus: *In this area (the rail corridor near Solomontown) background lead accounted for an estimated 50% of the lead in air in Port Pirie in 2015 so managing this source of lead is now of equal priority to reducing our smelter emissions* [27]
- screening and follow up advice and support. When children have elevated blood lead levels, their level of exposure and their family's ability to reduce exposure (through cleaning, vigilant attention to hand washing, eating a healthy diet and yard greening) is assessed through home visits and consultations. Those children living in more complex family situations receive more intensive

support from the programs and more regular monitoring of lead levels (yearly or more frequently). In the 2012 to 2014 period, 26 children in Port Pirie had blood lead levels above 20 µg/dL, resulting in implementation of additional strategies such as relocation to a less contaminated environment[28]
- coordination of research and monitoring.

Monitoring and Regulation

Monitoring lead levels in the air and soil is important. In 2012, 20% of samples taken from Council-managed public spaces in Port Pirie had soil lead concentrations above the recommended level for public spaces, and 71% of samples taken from four outdoor playgrounds exceeded national standards for residential dwellings.[29] The mean surface soil lead concentration was 1472 mg/kg (the National Environment Protection Council standard for residential dwellings is 300 mg/kg).[30] This information helps prioritise remediation efforts.

Environmental Protection Authorities have the capacity to change licensing conditions in light of monitoring results. In 2011-2012 the South Australian Environment Protection Authority reviewed and strengthened Nystar's EPA licence by including additional requirements for the company to substantially reduce emissions from the smelter.[31]

Factors Critical to Success

Maintaining coordinated, collaborative, community lead abatement programs over time at sufficient intensity to reach those at highest risk whilst minimizing the hazards is critical. Broken Hill's experience shows that mainstreaming responsibility for lead management and the disbanding of governance structures contributed to a lack of visibility of the lead program, and potentially a view that lead was no longer a problem. Screening participation rates fell from 52% in 2005 to 38% in 2008, and a slowing of falls in blood lead levels of children followed.[11]

Involvement of industry, academics, local and state governments, Aboriginal organisations, the health and education sectors and the community is essential to facilitate abatement and work with higher need families. Making screening easily accessible, promoted by all practitioners and widely supported by the community is important. General practitioners and other health workers have a role in encouraging all pregnant women to be tested and reinforcing the importance of avoiding lead exposure.

Monitoring and reporting regularly to the community provides stakeholders with an up-to-date picture of the success of the program and keeps the issue in the public's view.[11] The monitoring of rising lead levels, reports on environmental contamination and advocacy of rural health researchers and environmental scientists has been credited with influencing the government decision to increase funding for the Broken Hill lead program in 2015.[32,33]

Future Challenges

A review of online public health education materials prepared by lead programs in the three communities of Port Pirie, Broken Hill and Mount Isa found inconsistent and limited or understated information about the dangers of lead exposure was provided across the three communities.[34,35]

Whilst this was rejected[36,37], the provision of up-to-date, consistent, evidence-based information to communities is a challenge. The relationship between government, industry and community in all cities is not without tension. There is potential for industry and governments to seek to underplay the harms and level of lead exposure.

Smelters and mines are major employers in the community and without these employers other health outcomes may well be compromised.[38]

Ongoing research and evaluation of programs is required to determine the contribution of different strategies to falling lead levels. There is some evidence that educational and dust control interventions are not effective in reducing blood lead levels[39] and an evaluation of a home remediation intervention showed it did not significantly change the rate of decline in blood lead levels.[40] The NHMRC however found the quality of evidence regarding intervention effectiveness to be low to very low due to small sample sizes, small number of studies and other limitations.[41]

Research on the impact of elevated lead levels on outcomes including school test scores[42] and criminality[43] will continue to be controversial but history suggests further risks may be uncovered with resulting falls in the 'level of concern'. Calls for further reductions in the blood lead reference values for children to 1 µg/dL are likely.[44]

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