LID 431

Lead Safe

A guide for health care professionals

LEAD EDUCATION PROGRAM

To obtain copies of this document, contact NSW Health's Better Health Centre in Sydney on ***(02) 9391 9000***

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Contents

IMPORTANT:
Read the overview first

This booklet is designed for people who read a lot and need to get to the important parts as quickly as possible. To do this, key information is summarised in the first section ***'Lead exposure – an overview'*** *(pages 4 to 8).*

Cross references within the margins of the summary to subsequent sections (pages 10 to 27) allow readers to obtain more detailed information on specific topics of interest.

Foreword

Message from Dr Andrew Refshauge

Scientific research in Australia and overseas has overwhelmingly concluded that exposure to even low doses of lead can result in serious and irreversible health and behavioural problems, especially in young children.

The National Health and Medical Research Council (NHMRC) reduced the national goal for blood lead levels from 25 to 10 µg/dL (1.2 to 0.48 µmol/L) in June 1993. The NHMRC announced that all Australians were to have a blood lead level (PbB) lower than 10 µg/dL (0.48 µmol/L) with the following reduction schedule for blood lead levels:

- All Australians to have a blood lead level lower than 15 µg/dL (0.72 µmol/L) by the end of 1998, with the exception of occupational exposures.
- 90 per cent of children aged 1 to 4 years to have blood lead levels below 10 µg/dL (0.48 µmol/L) by the end of 1998.

In response, NSW Health introduced mandatory reporting of all children and adults with elevated blood lead levels from December 1996.

Health professionals are a key group in minimising the harm from lead exposure.

This publication is part of the NSW Government's initiative in minimising the harm to the NSW population from lead exposure. The publication will assist general practitioners, specialist doctors, and nurses to provide accurate, up-to-date and accessible information to their patients/clients.

Over the next year there will be a progressive campaign for a number of audiences to increase awareness of lead hazards and promote lead-safe behaviours. By understanding lead hazards, health professionals will be able to contribute to the NHMRC goal of reducing the lead levels of the NSW community.

Andrew Refshauge MP
Deputy Premier
Minister for Health
Minister for Aboriginal Affairs

Message from Pam Allan

Environmental lead contamination in NSW is a complex issue, and finding solutions will require action from all sectors of the Government, as well as health care professionals, child carers, industry and other members of the community.

The Carr Government has established the Lead Reference Centre to coordinate lead programs across government and to conduct statewide education programs.

This booklet is part of a comprehensive education program that includes: training programs for health care professionals; dissemination of the latest information on lead to different groups within the community; and training for professionals in the building industry and do-it-yourself renovators.

These programs will be a major step forward in achieving our ambitious goal of a lead-safe New South Wales.

This booklet, and other materials currently in development, will provide a valuable resource to general practitioners, nurses, specialists, parent educators and other health professionals who are at the front line when dealing with the subtle, but serious, health effects of lead.

Pam Allan MP
Minister for the Environment

Lead exposure – an overview

Increasing awareness

Elevation of blood lead levels and lead poisoning are age-old problems still prevalent today, due to the continued presence of lead in our urban and rural environments. Children are particularly vulnerable to environmental exposure to lead, but adults engaged in various occupations and hobbies are also at risk.

Over the last two decades there has been a significant increase worldwide in awareness and concern about the effects of lead on human health and the environment.

New evidence suggests that lead is harmful even when blood lead levels fall within a range previously thought to be safe. Even low lead levels can have a detrimental effect on intellectual development, as the developing brain and nervous systems of children are much more susceptible to lead toxicity than those of adults.

While the effects of lead emissions have been known for many years from research in point source communities such as Port Pirie and Broken Hill, it has been established in Australia that urban and rural communities may also experience contamination from widespread use of consumer products containing lead, including lead paint and leaded petrol.

Australia, as the world's largest lead ore producer, should lead the way in addressing an exposure problem which can have serious health effects if not identified and prevented.

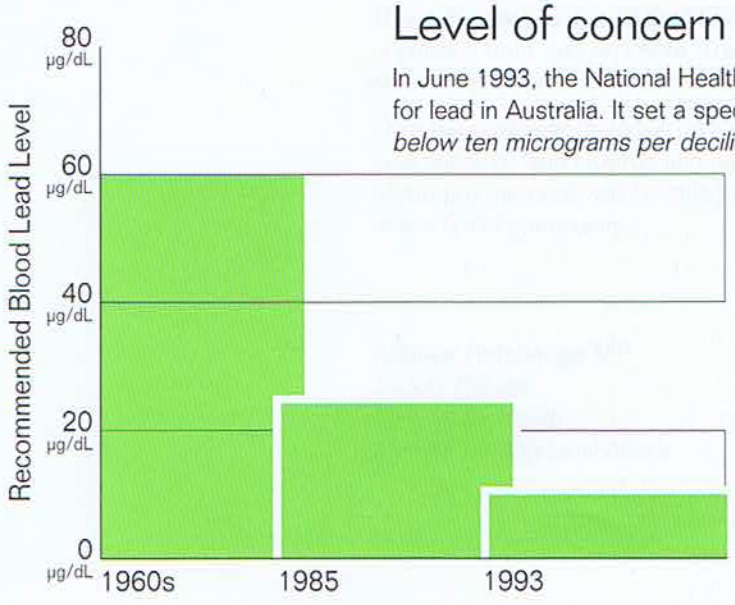
In New South Wales, the Lead Management Action Plan provides the framework for managing this problem.

Changes in National Health and Medical Research Council (NHMRC) recommendations for blood lead levels

Source: Lead Reference Centre, 1997

Level of concern

In June 1993, the National Health and Medical Research Council (NHMRC) revised its guidelines for lead in Australia. It set a specific goal *"to achieve for all Australians a blood lead level of below ten micrograms per decilitre (0.48 micromoles per litre)"*.



Studies conducted in Australia and the United States show that a 10 µg/dL (0.48 µmol/L) increase in blood lead concentration is associated with a decrease of between two and three IQ points in young children, observable in children with blood levels between 10 to 25 µg/dL (0.48 to 1.20 µmol/L).

While these effects may be clinically undetectable in individual children, the effect on the distribution of IQ scores in populations of children with higher blood lead levels can be significant, with the proportion of very bright children diminished and the numbers of children requiring special educational assistance because of lower IQs increased up to two or threefold.

Studies have also demonstrated links between childhood lead exposure and learning disabilities, impaired growth, reduced hearing acuity and behavioural problems including distractibility, aggressiveness and impulsiveness.

Adults are also at risk, if precautions are not taken, through exposure at work, pursuing hobbies which involve lead, or by undertaking home renovations.

Sources, pathways and exposures

Lead paint and lead contaminated dust is the major source of health risks to children and adults in most domestic and occupational environments. Before 1970, paint used for domestic and other applications contained significant quantities of lead.

Unsafe renovations, building or maintenance activities in pre-1970 houses and certain industrial activities will often result in contamination and expose renovators, occupants and neighbouring houses to significant health risks.

Emissions from leaded petrol when inhaled cause a general low blood lead level across the whole population. However, reductions in the use of leaded petrol since 1986 – and reduced amounts of lead in the petrol – have resulted in a decline in risk, especially to people who live near main urban thoroughfares.

Food manufactured and purchased in Australia generally has low lead levels. Risk of lead contamination may occur with root vegetables grown in contaminated soil and leafy vegetables exposed to lead dust. Food and beverages stored, cooked, reheated or served in imported craft or antique lead-glazed ceramics or porcelain, leaded crystal or glass may be contaminated with lead.

Drinking water is an uncommon source of lead in NSW. The major source is the corrosion of leaded plumbing materials in the water supply and household plumbing fixtures.

Water from lead-soldered water tanks or run-off systems from roofing with lead paint also pose a risk, especially in areas near mining and smelting sites where dust and emissions could add to the problem.

SEE ALSO

PAGE 10 • Lead paint, household dust and soil
PAGE 10 • Petrol
PAGE 12 • Food
PAGE 12 • Water

A long history

The deleterious effects of lead on the human body and lead poisoning have been known since ancient times.

Hippocrates recognised lead poisoning in miners and the toxic effects of lead – colic, mental weakness and lethargy – were noted by the physician Nicander in 400 BC. Dioscorides observed *"lead makes the mind give way"* in the second century BC.

During the industrial revolution and up to the beginning of the 20th century, lead poisoning was largely viewed as an occupational disease of adults. However the discovery of lead poisoning among Queensland children in the 1890s demonstrated that lead exposure could cause distinct childhood illness and that contaminated households posed a health risk.

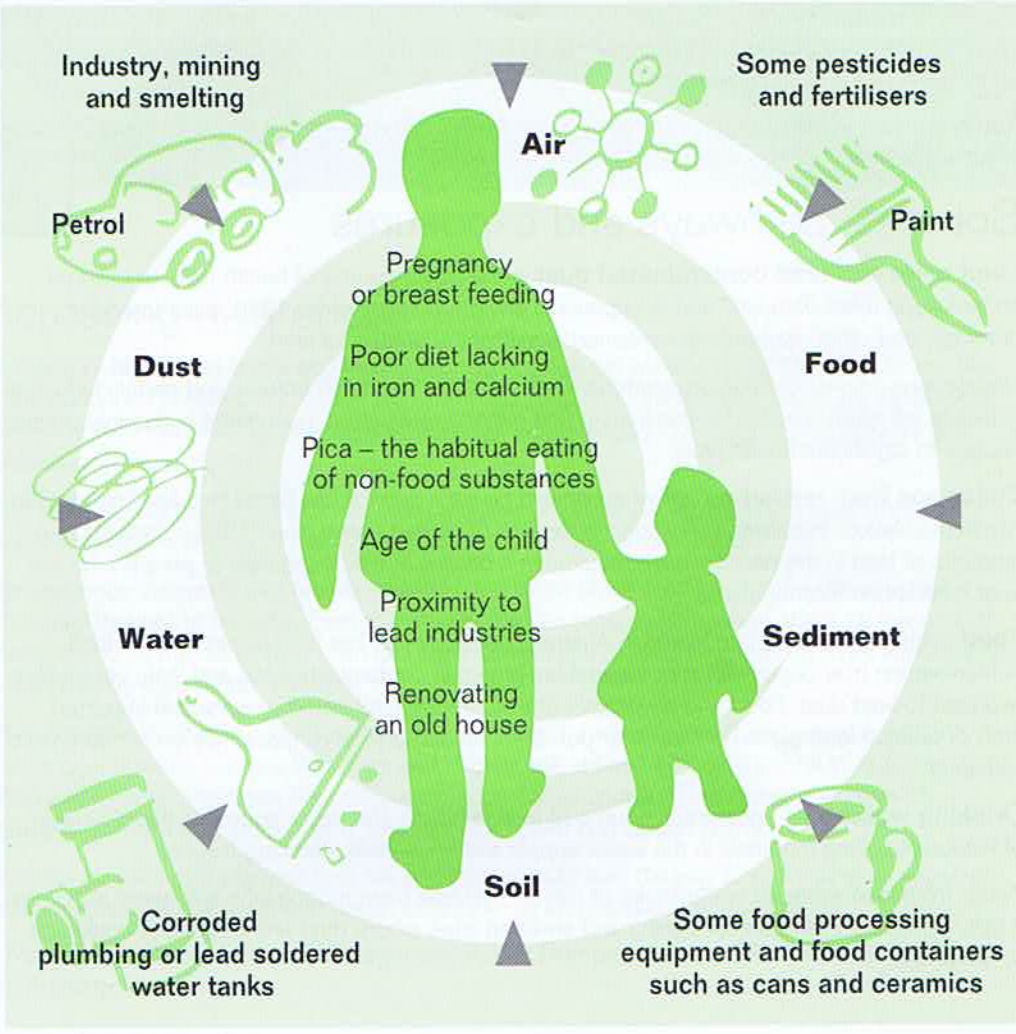
Further evidence published in the *Australian Medical Gazette* in 1897 and 1904 linked normal childhood hand-to-mouth behaviour with lead poisoning through exposure to lead dust from deteriorating lead paint.

Sources and pathways of lead in our environment

*Multiple sources of lead contribute varying amounts of lead to the environment. As lead is a useful and widely used material, all Australians are exposed to lead from **sources** (outer shaded area) such as older paint, industrial emissions and petrol and lower level sources including fertilisers and building materials. **Pathways** (outer white ring) such as dust, soil and air transfer lead from sources into living environments where they are primarily inhaled, ingested and, in some cases, absorbed through the skin. While some sources contribute more lead than others (especially older paint), combined, multiple low-level inputs of lead can result in significant aggregate exposure and a range of associated health effects.*

See 'How lead affects health' diagram page 17

Source: Lead Reference Centre, 1997



Regardless of the source, the most common routes of entry for lead into the human body are by inhaling or swallowing lead dust, or by children ingesting soil or paint chips containing lead. This usually happens when people put their hands or other objects contaminated with lead dust in their mouths, or when they breathe in lead dust.

Babies and young children aged up to 48 months and pregnant women are most at risk. Lead can cross the placenta and at low concentrations can cause problems in early neurological development. The developing brain in young children appears more vulnerable to a range of biological and environmental hazards, including lead.

Normal exploratory hand-to-mouth activity in children under two exposes them to higher risks of ingesting lead. The most extreme variant of this is pica. Children may suck fingers or toys coated with lead dust and deliberately swallow paint flakes.

Lead inhalation, contamination of clothing and cigarettes are particular hazards for workers in lead industries including mining, smelting, metal repair or foundry work, automotive repairs or breaking down old car batteries.

People living in towns or suburbs near lead mining, smelting or processing industries are also at high risk.

SEE ALSO

Sources and pathways • PAGE 10
Hazardous industries • PAGE 10
Exposures • PAGE 12
The facts about pica • PAGE 14
Children and pregnant women • PAGE 15

Individuals at risk include those working in the following:

- Lead mining, smelting and processing
- Battery recycling or manufacturing
- Bridge, tunnel and tower work, particularly welding
- Building, construction and demolition work
- Plumbing/pipe fitting
- Automotive body or radiator repair
- Brass or copper foundry work
- Computer, electrical and telephone cable repair
- Painting and decorating
- Scrap metal industry

Risk factors

A combination of risk factors should alert the health professional to the possibility of a patient's symptoms being attributable to excess lead.

(a) Potentially at-risk populations

- Unborn children
- Children 0 to 4 years
- Children of any age with developmental delay, pica or behavioural problems
- Pregnant and lactating women

(b) Increased risk of high exposure

- Occupations involving lead including trades
- Residents of point source communities
- Do-it-yourself renovators where lead paint is present
- Residents living in buildings with peeling and powdering paint

(c) Exposure to unusual sources of lead

- Hobbies and recreational e.g. casting lead sinkers
- Alternative medicines e.g. surma
- Consumer products containing lead e.g. cosmetics

(d) Circulation of skeletal lead sources

- Post menopausal women
- Retired lead workers

SEE ALSO

PAGE 15 • People at increased risk

Symptoms and health effects

When ingested, inhaled or absorbed, lead can harm virtually every organ in the human body, especially the brain, kidney and reproductive systems. Although most patients with increased blood lead levels are asymptomatic, even low levels can have serious long-term effects.

When symptoms do appear they are usually non-specific such as headache or lethargy. Symptoms of moderate to severe exposure include irritability, aggressiveness and colic leading to seizures and death.

Symptomatic lead intoxication in children generally does not occur until blood lead levels reach 45 to 50 µg/dL (2.17 to 2.42 µmol/L) though some may be overtly asymptomatic at up to 60 to 70 µg/dL (2.89 to 3.38 µmol/L). Lead encephalopathy can occur at levels above 70 µg/dL (3.38 µmol/L) and this constitutes a medical emergency.

Lead poisoning in children may manifest as developmental delay, learning difficulties, or other behavioural problems e.g. aggression, impulsiveness and restlessness. Health care professionals should consider lead as a possible contributory factor to such problems in children or adolescents.

Adults may not display symptoms until blood lead levels reach 60 µg/dL (2.90 µmol/L) and above.

SEE ALSO

PAGE 16 • Symptoms and health effects

PAGE 19 • Symptoms at a glance

Testing

SEE ALSO

Testing for lead • PAGE 22
The level of concern • PAGE 4
Lead in the workplace • PAGE 11
People at increased risk • PAGE 15

As most lead exposure is not immediately apparent and may be asymptomatic, careful questioning of the patient to identify risk factors, followed by a blood test, is the best way to confirm exposure.

Blood lead is most effectively measured in venous blood taken with lead-free equipment. Capillary or finger-prick samples may be contaminated by lead on the skin. Hair and urine testing are not recommended due to the potential for contamination from environmental sources.

Blood lead levels reflect only recent exposure, within three to six weeks. However, levels indicate whether a patient is being exposed to lead contamination and whether the medical practitioner should further investigate environmental and other risk factors. In patients who have been acutely exposed, the blood lead level may only remain elevated for three to six weeks. However, in children and adults chronically exposed, the level can take months to several years to come down.

The less commonly used measurement of dentine (tooth) lead is considered a more accurate measure of total accumulated lead in the body. However, tooth lead testing is uncommon and there is disagreement about what constitutes a 'normal' dentine level.

The NHMRC recommends blood lead tests for children at risk who:

- Are aged 9 to 48 months and live in or visit older dilapidated houses, or who have been present during renovations of older houses (i.e. painted before 1970)
- Have siblings with elevated blood lead levels or parents who work with lead
- Have pica, particularly if living in pre-1970 housing
- Are aged 9 to 48 months and live near industrial or automotive sources of lead
- Are exposed to less common pathways e.g. hobbies, alternative medicines etc.

Source: CEPA, 1994

Blood lead testing is required by the NSW WorkCover Authority for people employed in lead industries. People that pursue hobbies which involve lead should also be tested.

Mandatory notification

Since December 1996, pathology laboratories in NSW have been required by law to notify the Infectious Diseases Branch of NSW Health and appropriate public health units when a blood lead test exceeds 15 µg/dL (0.72 µmol/L).

Health care professionals, particularly GPs, have primary responsibility for the care and management of individuals with elevated blood lead levels. Public Health Unit staff may be able to assist GPs and patients in identifying lead exposure sources and in identifying professional remediation assistance.

Management and prevention

SEE ALSO

Advice for parents or adults at risk • PAGE 25

The main treatment for adults and children is to avoid or reduce lead exposure. For adults, this usually requires changes in work or hobbies. For most children, sources of lead in the home must be identified, reduced and eventually eliminated.

Health care professionals should advise people affected by lead exposure to:

(a) Reduce or remove exposure to lead

This means preventing children or adults from having access to sources of lead or hazardous situations, e.g. moving children's cots away from surfaces with deteriorating paint, or moving children or pregnant women away during home renovations.

Reducing lead hazards around the home

Source: Lead Reference Centre, 1997

(b) Reduce or remove the hazard

This means addressing existing contamination and removing the hazard itself, e.g. removing carpet which has been contaminated with paint dust, or replacing contaminated soil.

(c) Prevent the creation of lead hazards

This may include hiring a professional experienced with lead-safe practices for renovation or building work that disturbs lead dust or paint, or removing or sealing off soft furnishings before painting work.

In patients with very high blood lead levels (55 µg/dL [2.65 µmol/L] or above), medical treatment including chelation therapy may be necessary.

Identifying at-risk groups

The danger of lead

When ingested, inhaled or absorbed, lead is toxic to virtually every human organ, especially the brain, kidney and reproductive systems of both men and women. Foetuses and children are particularly susceptible to these toxic effects.

When absorbed, lead in the blood has a half-life of around 28 to 35 days. From a single exposure, lead is readily absorbed and quickly distributed to the following areas of the body:

- Blood (1%)
- Soft tissue (4%)
- Bone/teeth (95%)

Lead not excreted and stored in the body remains a source of internal exposure for 20 to 30 years half-life in bone which can be mobilised back into the blood.

Sources and pathways

(a) Lead paint, household dust and soil

Renovation of older (pre-1970) houses poses special risks, as children and adults may be exposed to and ingest older lead paint flakes or lead contaminated household dust.

Sanding or burning lead paint releases dust into the air and contaminates surrounding soil. Children may ingest or inhale the residual dust.

Removal of old paint by sand-blasting, burning, scraping, and power tool cleaning can create even greater dangers than when paint is peeling and flaking off, because the particle sizes are small enough to be deposited into furnishings, carpets or gardens, making removal difficult.

Nearly all cases of acute lead poisoning in children admitted to hospitals in recent years have been attributed to home renovation.

(b) Petrol

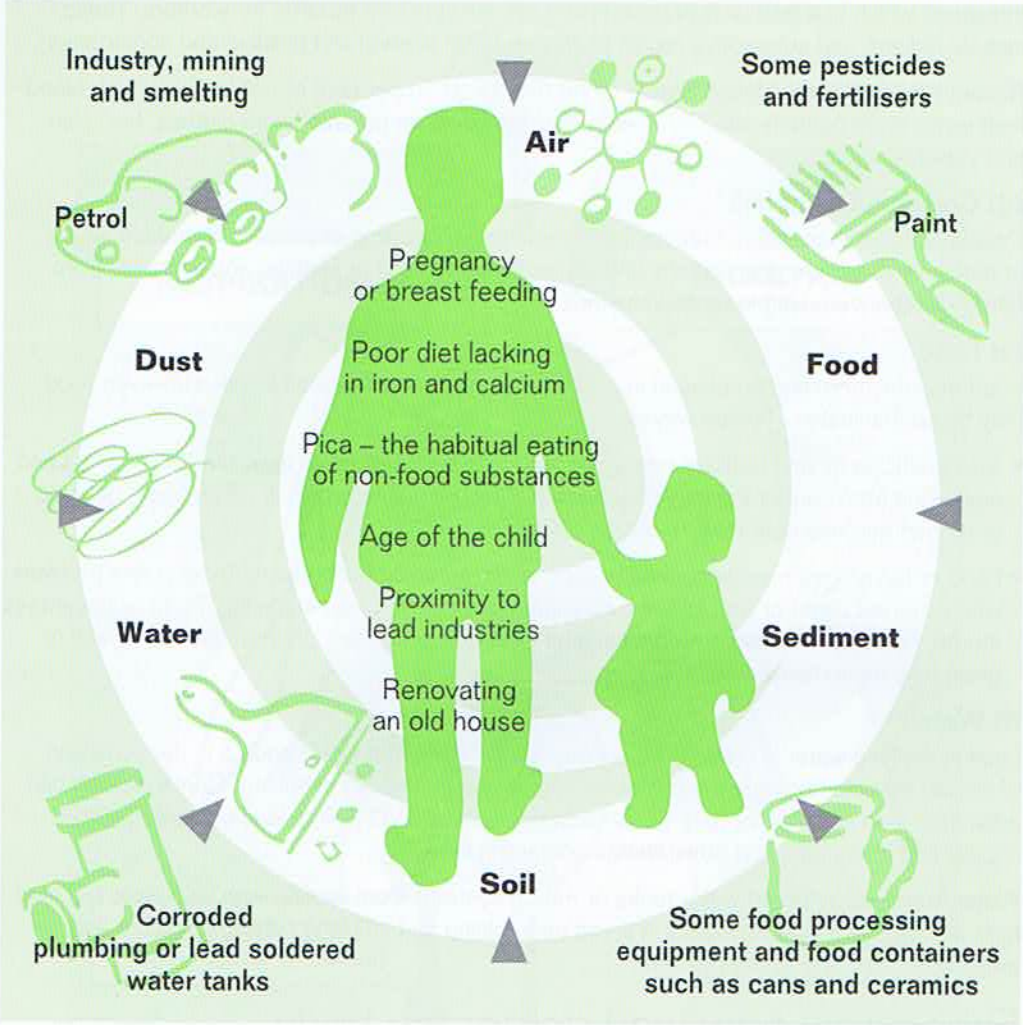
Inhalation of emissions from leaded petrol causes a general low blood lead level across the whole population. However, reductions in the use of leaded petrol since 1986 – and reduced amounts of lead in the petrol – have resulted in a decline in risk, especially to people who live near main urban thoroughfares.

As the organic lead in petrol can penetrate the skin, people that come into contact with it are at risk, e.g. people working in petrol refineries, service station workers and 'petrol sniffers'.

(c) Hazardous industries

Lead inhalation is a particular hazard for workers in lead industries including mining, smelting, petrol refining, metal repair or foundry work, or breaking down old car batteries.

Lead particles or fumes are created through sanding, scraping or burning lead surfaces, objects or lead paint, which is common in the lead industry or building renovation work.



Sources and pathways of lead in our environment

Multiple sources of lead contribute varying amounts of lead to the environment. As lead is a useful and widely used material, all Australians are exposed to lead from ***sources*** *(outer shaded area) such as older paint, industrial emissions and petrol and lower level sources including fertilisers and building materials.* ***Pathways*** *(outer white ring) such as dust, soil and air transfer lead from sources into living environments where they are primarily inhaled, ingested and, in some cases, absorbed through the skin. While some sources contribute more lead than others (especially older paint), combined, multiple low-level inputs of lead can result in significant aggregate exposure and a range of associated health effects.*

See 'How lead affects health' diagram, page 17

Source:
Lead Reference Centre, 1997

Lead in the workplace

Workers in lead industries may bring dust home on their clothes and may be exposed to lead hazards through inhalation. The occupations most at risk include:

- Lead mining, smelting and processing
- Battery recycling or manufacturing
- Bridge, tunnel and tower work, particularly welding
- Building, construction and demolition
- Plumbing/pipe fitting
- Automotive body or radiator repair
- Brass or copper foundry work
- Computer, electrical and telephone cable repair
- Painting and decorating
- Scrap metal industry

Industries which use lead or lead-based products also present hazards for workers. These include radiator and automotive repair, plumbing, panel beating and building and construction.

Recent research in the United States found that 15 to 30 per cent of children with high blood lead levels were contaminated by 'take home' lead dust on parents' work clothes, hair, skin and vehicles.

(d) Communities at risk

People who live in towns or suburbs near lead mining, smelting or processing industries are at particular risk through emissions and contamination of soil or clothing and footwear from family members working in those industries.

(e) Food

Food manufactured and purchased in Australia generally has low lead levels. However, food may be contaminated in these ways:

- Soil, pesticide or zinc fertiliser containing lead may be taken up or deposited on plants. Lead emissions from cars or industry may be deposited on plants grown in urban home gardens or market gardens near main roads.
- Food or beverages may be packed in cans with lead solder side seams (now only a problem with imported cans) or processed by equipment containing lead soldering. Food or beverages stored, cooked, reheated or served in lead-glazed ceramics or porcelain, leaded crystal or glass may be contaminated.

(f) Water

Lead in drinking water is considered uncommon in NSW. The major source is the corrosion of leaded plumbing materials in the water supply and household plumbing. Contamination can arise from lead connectors (e.g. goosenecks), lead and PVC piping, lead-soldered joins in copper and brass taps and other fittings containing lead.

Water from lead-soldered water tanks or run-off systems from roofing with lead paint and lead nails also poses a risk, especially in areas near mining and smelting sites where dust and emissions could add to the problem.

Exposures: how lead enters the body

When ingested, inhaled or entering the body by other less common means (such as through the skin), lead may be absorbed, excreted, or both, depending on age, sex, nutritional status and when the last meal was eaten.

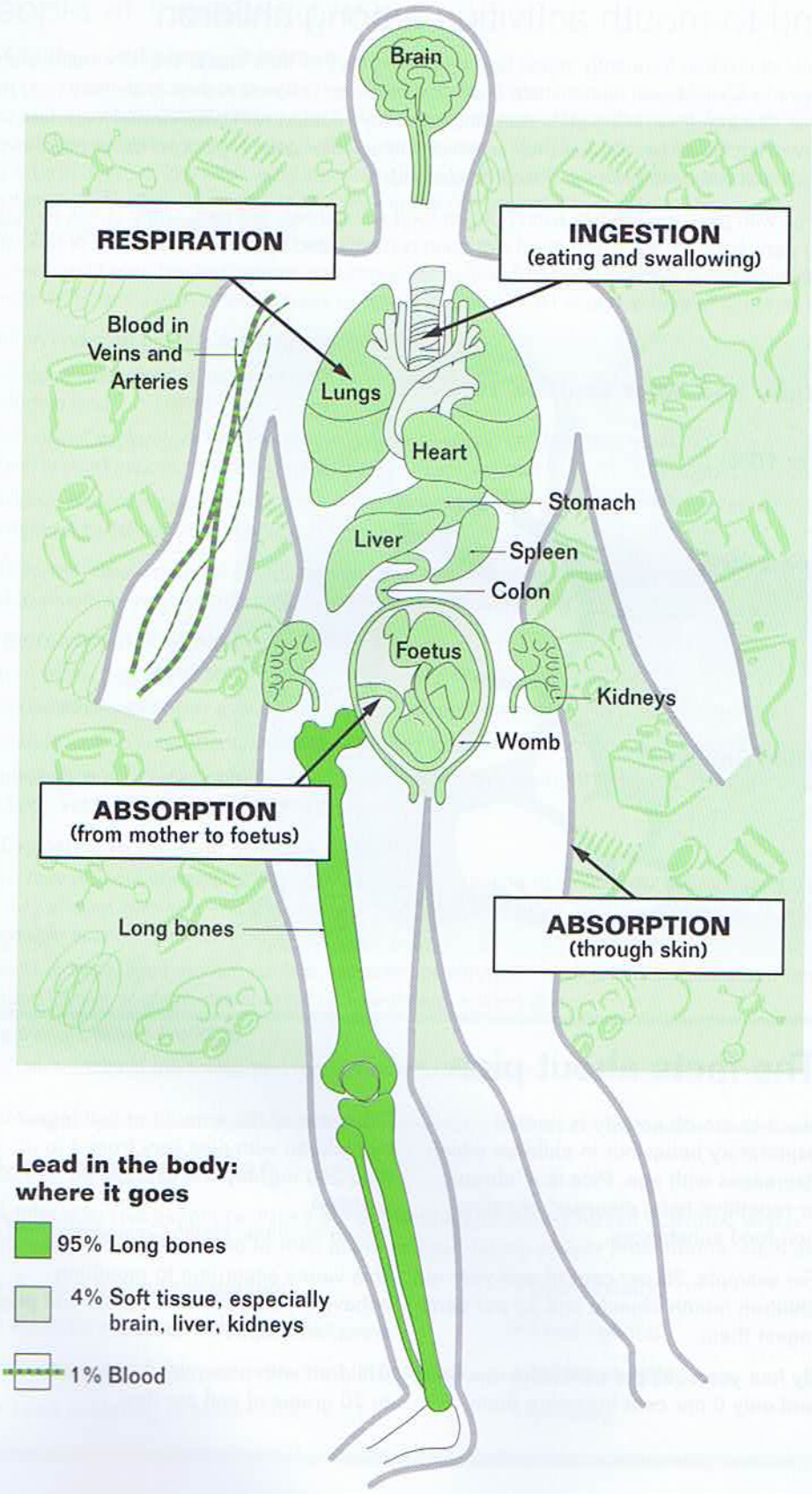
Ingestion is the most common route of exposure in children and adults who are not in occupations associated with lead. Inhalation plays a larger role in occupational exposure.

People may ingest lead through eating, smoking, or nail-biting with lead contaminated hands, particularly after renovating, working on hobbies which involve melting or casting lead, or being outside. Contamination can also occur when petrol comes into contact with the skin.

There is some evidence that pregnant women may recirculate previously stored lead if they:

- Had lead poisoning as children
- Have recently been exposed to lead
- Have accumulated lead in bone stores through repeated exposure

When the body demands more calcium for the developing foetus or during lactation, it mobilises calcium out of the bone, carrying lead with it.



Storage of lead in the body

Source:
Lead Reference Centre, 1997

Hand-to-mouth activities among children

Pre-school children frequently ingest lead by placing toys or their hands in their mouths after coming into contact with contaminated soil, household or renovation dust or deteriorating paint powder. Children may deliberately suck fingers or toys coated with deteriorated lead dust or swallow paint flakes because of their sweetish taste. Older cots, toys or windows may have been painted with lead paints and may be chewed.

Children with pica, the habitual eating of non-food substances, are particularly at risk through eating paint flakes or soil which may have been contaminated by previous industrial or renovation activities.

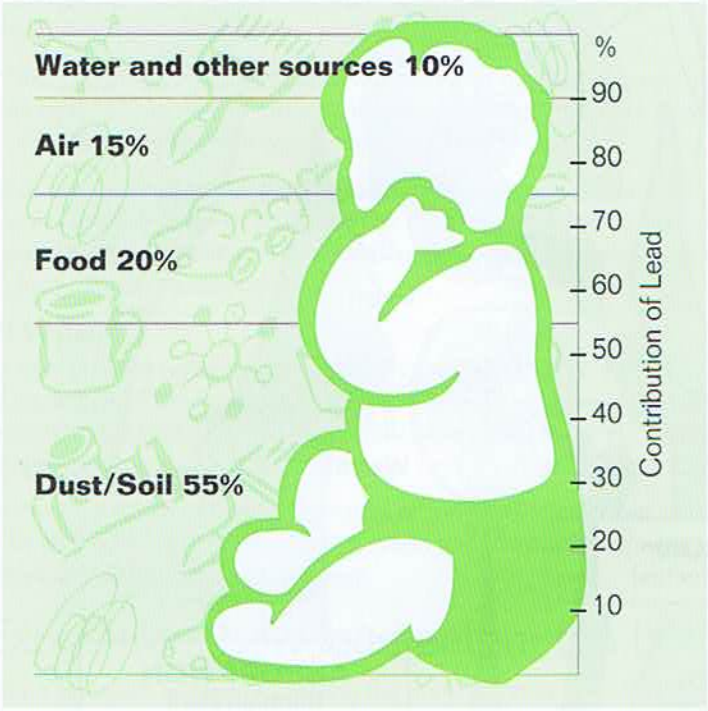
Lead pathways for two-year-old children

Approximate estimate of relative major contributions of lead to a two-year-old child in 1993.

Dust and soil are the major contributors as children live in environments where dust is often found (e.g. on the floor, under furniture) and may have behaviours such as pica which increase levels of exposure.

Percentage contributions will vary between 1993 and those found now due to government and industry initiatives to decrease lead in fuel and emissions from mining, smelting and other activities.

Source: Adapted from the Australian Lead Development Association, 1994



The facts about pica

Hand-to-mouth activity is normal exploratory behaviour in children which decreases with age. Pica is a 'chronic or repetitive habit disorder' of eating non-food substances.

For example, 78 per cent of one-year-old children mouth objects and 35 per cent ingest them.

By four years, 33 per cent were mouthing and only 6 per cent ingesting them.

Estimates of the amount of soil ingested by children with pica vary from 4 to more than 200 mg/day (on average 60 to 100 mg/day).
(South Australian Health Commission, 1991)

This varies according to mouthing behaviour, dirty clothes, hands and play areas, and exposure time.

Children with pica may consume up to 20 grams of soil per day.

People at increased risk

(a) Children and pregnant women

Lead can readily accumulate in and cross the placenta at levels below 10 µg/dL (0.48 µmol/L). *(Paul and Himmelstein, 1988; Roper, 1991).* Controversy remains about the persistence of the effects of pre-natal exposure to lead. Some studies have identified effects including higher risk of pre-term delivery, low birth weight and small-for-gestational-age deliveries, stillbirth and spontaneous abortion. Research in this area is still continuing *(Committee on Measuring Lead in Critical Populations, 1995).*

Pregnant and breastfeeding women risk exposure to lead from occupational or household sources (e.g. renovation of old houses or accumulation of dust with residues of airborne lead).

Children under 48 months are at special risk because:

- The developing brain is more vulnerable to a range of biological and environmental hazards, including lead.
- The normal exploratory hand-to-mouth activity in young children (the most extreme variant of which is pica) exposes them to higher risks of ingesting lead from a contaminated environment.
- Children absorb a much higher proportion of ingested lead than adults – up to 50 per cent compared to 10 per cent in adults.

Children with developmental delay, regardless of age, are at increased risk because of increased hand-to-mouth activity and increased levels of pica among this group.

(b) Increased risk of high exposure

Factors which may significantly increase a person's exposure to lead include:

- Occupation – working in a lead industry or work environment contaminated with lead.
- Location or living conditions – proximity to lead industries; old and/or deteriorating housing.
- Participation in unsafe hobbies or activities – renovating a pre-1970 house, casting fishing sinkers, indoor shooting, lead lighting etc.

(c) Exposure to unusual sources of lead

These may present considerable problems when attempting to locate sources of contamination and may involve intensive investigation of home, work and other living environments. Examples of possible sources include:

- Foods or beverages stored, cooked, reheated or served in lead-glazed ceramics or porcelain, leaded crystal or glass, or imported cans with lead soldering.
- Bonemeal calcium products.
- Certain traditional medicines and remedies (including alarcon, alkohl, bala goli, ghasard, greta,

Unsafe hobbies

Adults may risk exposure if they pursue hobbies or do-it-yourself activities which involve working with lead or lead paint, without taking proper precautions, such as:

- **Antique furniture restoration**
- **Radiator repair and maintenance**
- **Casting lead fishing sinkers, shot or pewter**
- **Lead soldering of electronics**
- **Boat building**
- **Lead lighting**
- **Indoor shooting**
- **Welding**

maria luisa, pay-loo-ah, surma).

- Consumer goods: some imported painted buttons; toy soldiers; plastic mini-blinds; cosmetics, including surma or kohl eye pencils, hair dyes and treatments.

(d) Circulation of skeletal lead sources

Recirculation of lead stored in the long bones from past exposure occurs particularly among people whose bones are demineralising. This group includes menopausal women and elderly people (especially those who have worked in lead industries), as well as those suffering from chronic illnesses. Mobilisation of bone lead may also occur in pregnant and lactating women.

Nutritional factors

Iron deficiency – children and adults with insufficient iron in their diets, or deficient iron stores, absorb lead more readily. Lead, through interfering with iron uptake, is likely to increase iron deficiency. Thus anaemia is more likely in children who have both iron deficiency and elevated blood lead levels.

Calcium – Deficiency of dietary calcium increases absorption of lead.

Zinc and protein – Diets deficient in zinc and protein may predispose children to increased lead absorption.

Fat – A very high fat diet promotes lead absorption. There is no evidence that a low fat diet minimises absorption.

Frequency of eating – Frequent nutritious meals are important for children. The presence of food in the stomach decreases the absorption of lead from non-food sources.

Symptoms and health effects

Although most individuals with increased blood lead levels remain asymptomatic, even low levels can have serious effects. Some asymptomatic effects include:

- Lowered IQ, abnormal cognitive development and behaviour in children.
- Neurological deficits in early childhood which may persist into late adolescence.
- Significant elevation of hearing thresholds at 500, 1000, 2000 and 4000 Hz.
- Decreased gestation, lower birth weight.

Recent research suggests serious health effects occur at much lower blood lead levels than previously recognised. Blood lead concentrations above 70 µg/dL (3.38 µmol/L) in children have long been known to produce the classic symptoms of lead poisoning: fits, cerebral oedema, brain damage and death.

Lead crossing the placenta during pregnancy or absorbed after birth can have detrimental effects on intellectual development and behaviour at blood levels as low as 10 µg/dL (0.48 µmol/L). Since few children show signs and symptoms of adverse effects at these and much higher levels, childhood lead poisoning has been called the 'silent epidemic' in the United States.

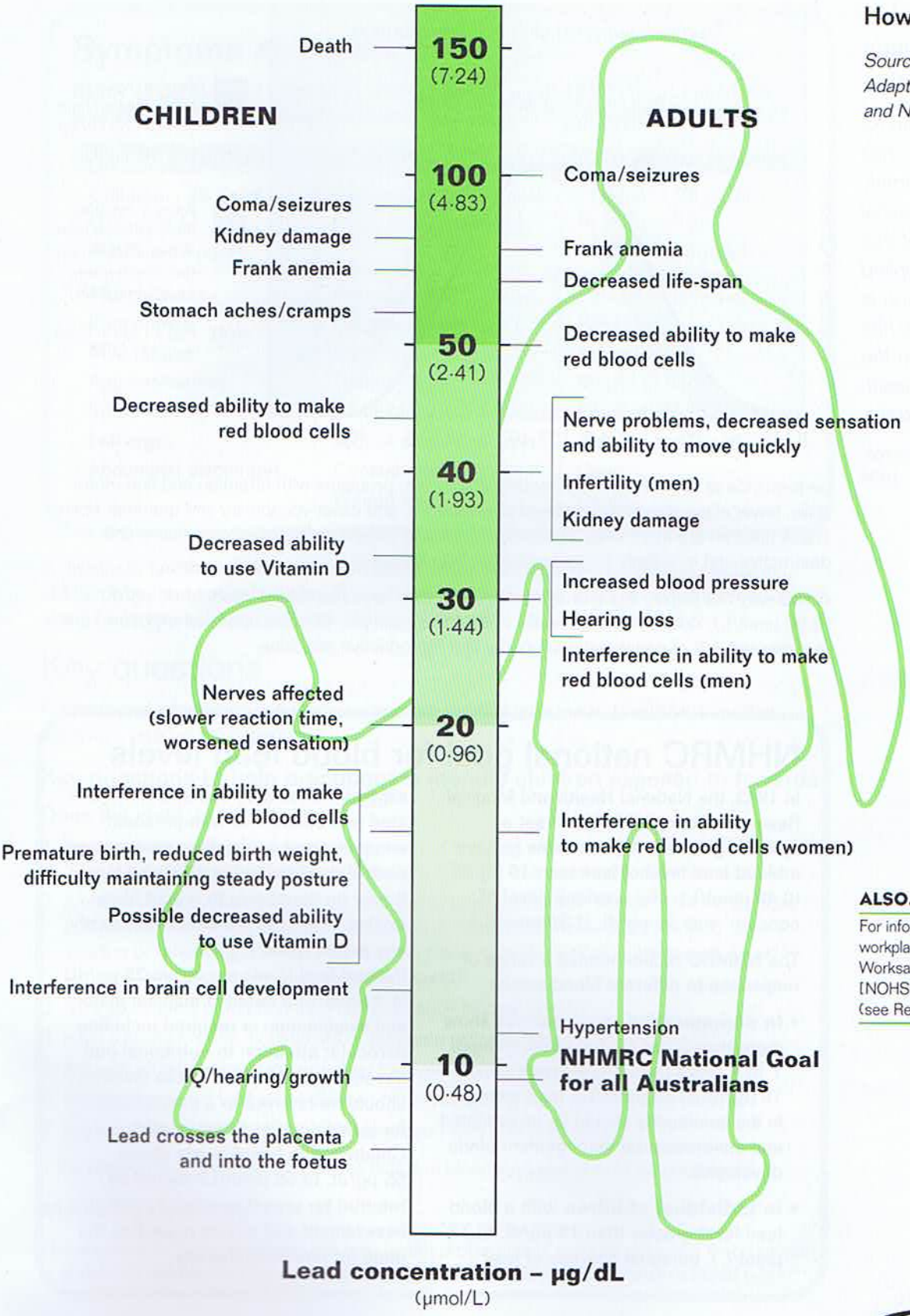
When symptoms do appear they are usually non-specific. Symptoms of moderate to severe exposure may include lethargy, intermittent abdominal pain or constipation, irritability, headache, aggressiveness, paralysis, and encephalopathy, which may lead to seizures, coma and death.

Symptomatic lead intoxication in children generally does not occur until levels are at least 45 to 50 µg/dL (2.17 to 2.42 µmol/L). Lead encephalopathy can occur with levels above 70 µg/dL (3.38 µmol/L) and this level constitutes a medical emergency.

Children exposed to chronic high lead levels in early childhood have increased risk of poor

How lead affects health

Source:
Adapted from Roper, 1991 and NHMRC, 1994



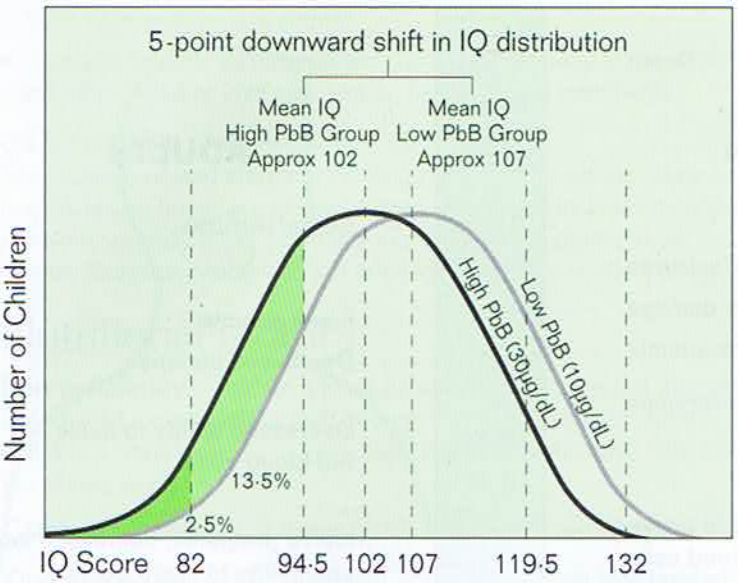
ALSO...

For information on controlling workplace lead exposures, see Worksafe Australia Standard [NOHSC: 1012 (1994)] (see References, PAGE 29)

Downward shift in IQ distribution across a population

While the effect of an IQ shift on an individual child may be relatively small, the educational and social implications of this decrease when applied across a population is most significant. This has major implications on the social, economic and health costs of lead in Australia.

Source: NHMRC, 1994



performance at school including: reading disabilities; problems with attention and fine motor skills; lower class standing; increased absenteeism; and lower vocabulary and grammar scores. These children are more likely to develop anti-social behaviour, be more aggressive and destructive and less likely to graduate from high school.

Adults may not display signs or symptoms until they have blood lead levels of 60 µg/dL (2.90 µmol/L). Adults with high levels of lead (for example, from occupational exposure) are at increased risk of peripheral neuropathy and reproductive sequelae.

NHMRC national goal for blood lead levels

In 1993, the National Health and Medical Research Council (NHMRC) set a national goal for all Australians to have a blood lead level of less than 10 µg/dL (0.48 µmol/L). The previous 'level of concern' was 25 µg/dL (1.20 µmol/L).

The NHMRC recommended a range of responses to different blood levels:

- **In communities** where surveys show more than 5 per cent of children aged 1 to 4 years have blood levels above 15 µg/dL (0.72 µmol/L), lead sources in the community should be investigated and environmental management plans developed.
- **In individual children** with a blood lead level greater than 15 µg/dL (0.72 µmol/L), personal sources of lead exposure should be evaluated, remediated and controlled, with personal education and counselling on exposure control provided to the child and family. It may be necessary to repeat blood testing to assess the effectiveness of any action taken.
  If blood lead levels are above 25 µg/dL (1.2 µmol/L) a detailed medical history and examination is required including particular attention to nutritional and developmental status. These children should be referred to a paediatrician for retesting after three months. Children with blood levels above 55 µg/dL (2.65 µmol/L) should be referred for urgent specialist paediatric assessment and advice regarding the need for chelation therapy.

Symptoms at a glance

Below 45 µg/dL (2.17 µmol/L) in children and 60 µg/dL (2.90 µmol/L) in adults, lead exposure is usually asymptomatic. (See page 23 for who should be tested.)

MODERATE	SEVERE	MEDICAL EMERGENCY
Children > 25 µg/dL (1.2 µmol/L) Adults > 60 µg/dL	Children 55 to 70 µg/dL (2.64 to 3.38 µmol/L)	Children > 70 µg/dL+ (3.38+ µmol/L) Adults > 80 µg/dL+
Muscle pains	Arthralgia	Paresis or paralysis
Paresthesia	General fatigue	Paralysis
Mild fatigue	Poor concentration	Brain oedema
Aggressiveness	Tremor	Stupor or coma
Irritability	Headache	Fits and vomiting
Lethargy	Diffuse abdominal pain	Gingival lead line
Abdominal discomfort	Constipation	Colic
	Weight loss	Death

In diagnosis, health professionals might consider elevated lead as a contributing factor in children who have intellectual disability or behavioural problems. High blood lead levels may also be a factor in children with iron deficiency anaemia.

Key questions

For additional information and follow up services contact your Public Health Unit or other resources listed in the appendix.

Key questions to help practitioners identify children exposed to hazards

Does the child...

1. live in or regularly visit a house with peeling or chipping paint built before 1970 (see pages 20-21)? This includes day-care centres, pre-schools, homes of baby-sitters or relatives.
2. live in or regularly visit a house (of relatives or neighbours) built before 1970 (see pages 20-21) with planned or ongoing renovations or remodelling? Has paint stripping, power sanding or other disturbance of paint taken place recently (including items such as old furniture, antiques, farm equipment or old cars)?
3. have pica, chew or eat non-food items, or suck his/her thumb?
4. have a brother, sister, housemate or playmate with confirmed lead poisoning?
5. live with an adult whose job or hobby involves exposure to lead?
6. live near an active lead mine, smelter, battery-recycling plant or other lead industry?
7. live with housepets that have been diagnosed with lead poisoning?

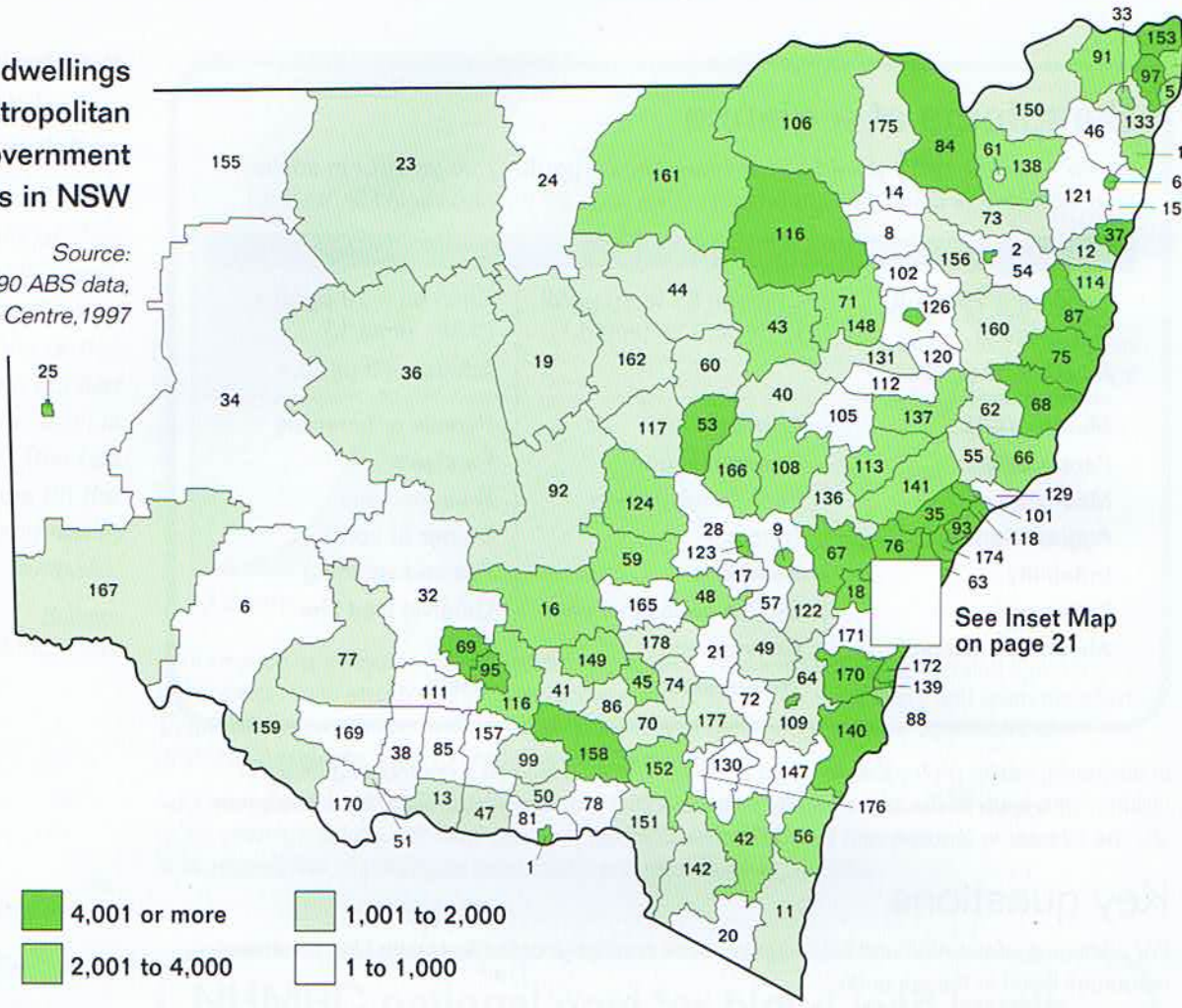
If the answer to any of these questions is yes, a blood lead test should be considered.

Medicare coverage

The answers to these questions will help health professionals compile evidence that a person is at risk – a requirement for receiving Medicare reimbursement of the cost of blood tests.

Pre-1970 dwellings in non-metropolitan Local Government Areas in NSW

Source: Compiled from 1990 ABS data, Lead Reference Centre, 1997

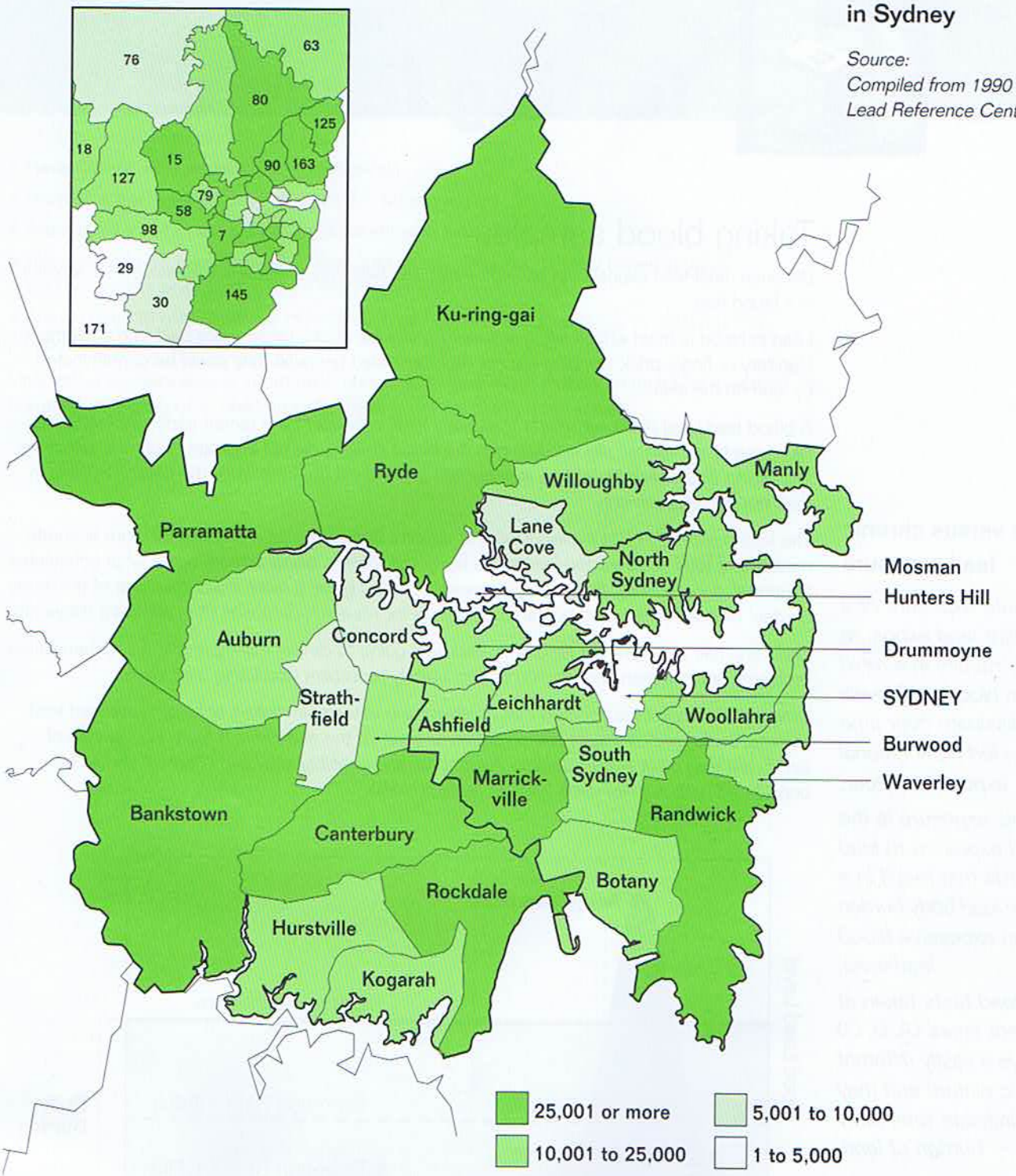


* Inner Sydney LGAs not numbered on map

1 Albury
2 Armidale
* Ashfield
4 Auburn
5 Ballina
6 Balranald
7 Bankstown
8 Barraba
9 Bathurst
10 Baulkham Hills
11 Bega Valley
12 Bellingen
13 Berrigan
14 Bingara
15 Blacktown
16 Bland
17 Blayney
18 Blue Mountains
19 Bogan
20 Bombala
21 Boorowa
* Botany
23 Bourke
24 Brewarrina
25 Broken Hill
* Burwood
27 Byron Bay
28 Cabonne
29 Camden
30 Campbelltown
* Canterbury
32 Carrathool
33 Casino
34 Central Darling
35 Cessnock
36 Cobar
37 Coffs Harbour
38 Conargo
* Concord
40 Coolah
41 Coolamon
42 Cooma-Monaro
43 Coonabarabran
44 Coonamble
45 Cootamundra
46 Copmanhurst
47 Corowa
48 Cowra
49 Crookwell
50 Culcairn
51 Deniliquin
* Drummoyne
53 Dubbo
54 Dumaresq
55 Dungog
56 Eurobodalla
57 Evans
58 Fairfield
59 Forbes
60 Gilgandra
61 Glen Innes
62 Gloucester
63 Gosford
64 Goulburn
65 Grafton
66 Great Lakes
67 Greater Lithgow
68 Greater Taree
69 Griffith
70 Gundagai
71 Gunnedah
72 Gunning
73 Guyra
74 Harden
75 Hastings
76 Hawkesbury
77 Hay
78 Holbrook
79 Holroyd
80 Hornsby
81 Hume
* Hunters Hill
* Hurstville
84 Inverell
85 Jerilderie
86 Junee
87 Kempsey
88 Kiama
* Kogarah
90 Ku-ring-gai
91 Kyogle
92 Lachlan
93 Lake Macquarie
* Lane Cove
95 Leeton
* Leichhardt
97 Lismore
98 Liverpool
99 Lockhart
100 Maclean
101 Maitland
102 Manilla
* Manly
* Marrickville
105 Merriwa
106 Moree Plains
* Mosman
108 Mudgee
109 Mulwaree
110 Murray
111 Murrumbidgee
112 Murrurundi
113 Muswellbrook
114 Nambucca
115 Narrabri
116 Narrandera
117 Narromine
118 Newcastle
* North Sydney
120 Nundle
121 Nymboida
122 Oberon
123 Orange
124 Parkes
125 Parramatta
126 Parry
127 Penrith
128 Pittwater
129 Port Stephens
130 Queanbeyan
131 Quirindi
* Randwick
133 Richmond River
* Rockdale
* Ryde
136 Rylstone
137 Scone
138 Severn
139 Shellharbour
140 Shoalhaven
141 Singleton
142 Snowy River
* South Sydney
* Strathfield
145 Sutherland
146 Sydney
147 Tallaganda
148 Tamworth
149 Temora
150 Tenterfield
151 Tumbarumba
152 Tumut
153 Tweed
154 Ulmarra
155 Unincorporated Area
156 Uralla
157 Urana
158 Wagga Wagga
159 Wakool
160 Walcha
161 Walgett
162 Warren
163 Warringah
* Waverley
165 Weddin
166 Wellington
167 Wentworth
* Willoughby
169 Windouran
170 Wingecarribee
171 Wollondilly
172 Wollongong
* Woollahra
174 Wyong
175 Yallaroi
176 Yarrowlumla
177 Yass
178 Young

Pre-1970 dwellings in Sydney

Source:
Compiled from 1990 ABS data, Lead Reference Centre, 1997



Testing for lead

Taking blood samples

Because most lead exposure is asymptomatic, the best way to confirm excessive lead exposu is a blood test.

Lead in blood is most effectively measured on venous blood, taken using lead-free equipmen Capillary or finger-prick samples are not recommended because they could be contaminated by lead on the skin.

A blood lead level does not reflect total body lead, only lead from recent exposure (within the last three to six weeks) still circulating in the blood stream, except in cases of chronic exposur The timing of the blood lead test is important and should be done while the person is living in their normal environment.

The less commonly used measurement of dentine (tooth) lead is considered a more accurate measure of total accumulated lead in the body, but there is disagreement about what constitut a 'normal' dentine level. Bone x-ray fluorescence also gives a more exact measure of the 'bo burden' of lead. These methods are used more for research purposes than standard diagnos

Urine and hair tests are not recommended as a guide to clinical management, as contaminati problems are common and they do not accurately represent circulating lead levels.

Where it is known or suspected that children have eaten paint flakes or have swallowed lead objects, health professionals should obtain an x-ray of the abdomen. If there is evidence of significant lead paint in the intestine, a cathartic and possibly activated charcoal should be considered (although its value has not been proven).

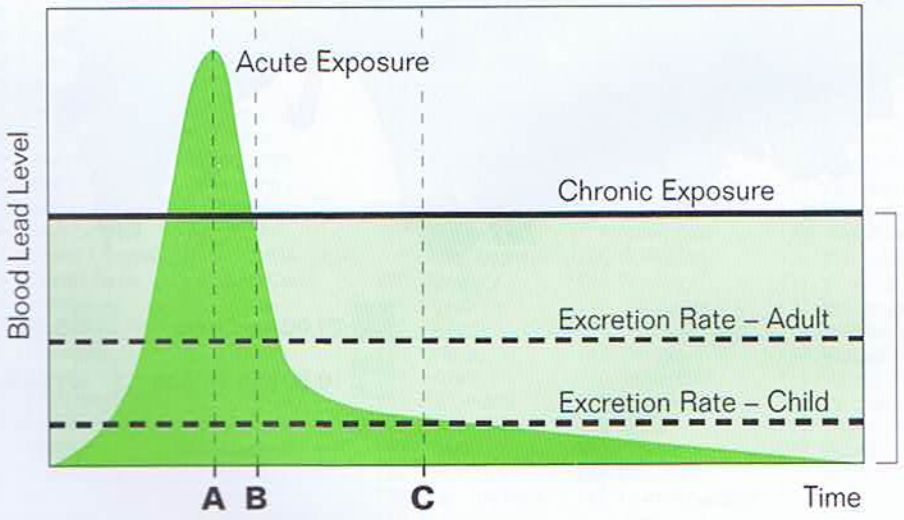
Acute versus chronic lead exposure

An acute exposure or a single major lead exposure generally results in a rapid increase in blood lead levels which dissipate over time provided no additional exposures occur.

Chronic exposure is the repeated exposure to lead hazards that result in a cumulative lead body burden and an excessive blood lead level.

Blood lead tests taken at different times (A, B, C) will give a vastly different diagnostic picture and may not indicate total body burden of lead.

Source: Lead Reference Centre, 1997



Who should be tested?

Blood lead tests are recommended for children who:

- Are aged 9 to 48 months and live in or frequently visit old dilapidated houses with peeling paint.
- Are aged 9 to 48 months and have been present during 'unsafe' renovations of older houses (painted before 1970).
- Have siblings with elevated blood lead levels.
- Have pica, particularly if living in pre-1970 housing.
- Are aged 9 to 48 months and have a parent who works with lead.
- Are aged 9 to 48 months and live near lead mines, smelters, battery breaking yards, lead ore bodies or on highways or main roads with heavy traffic.
- Are exposed to other sources of lead, such as hobbies, folk medicines, or glazed pottery used to store or cook food.

Until better epidemiological information about blood lead levels in the community is available, universal screening of all children in Australia is not considered necessary.

Management and prevention

Follow-up guidelines

The NHMRC recommends the following steps when treating patients with high blood lead lev

BLOOD LEAD LEVEL	INTERPRETATION	ACTION
5 to 9.9 µg/dL (0.24 to 0.47 µmol/L)	Doctor	Education on minimising lead exposures and absorption. Consider retesting in 3 t months depending on age and potential lead exposure risk as assessed by histo
10 to 14.9 µg/dL (0.47 to 0.72 µmol/L)	Doctor	Education on minimising lead exposures and absorption. Retest in 3 to 12 month if no increase, retest in 1 year. If >36 months, test annually until 5 years old only if potential lead exposure contin
	PHU	Provide pamphlets on sources and minimising exposure and absorption. Provide information on sampling/analys service and management options if requested.
15 to 24.9 µg/dL (0.74 to 1.20 µmol/L)	Doctor	Education on minimising lead exposures and absorption. Retest in 3 to 12 month if no increase, retest in 1 year. If >36 months, test annually until 5 years old only if potential lead exposure contin If >5% of children test above this level, broader community actions required.
	PHU	Personal counselling of parents; evalua of home situation – assess sources in t community, provide information on samp analysis and send generic recommenda on remediation. Provide pamphlets.
25 to 54.9 µg/dL (1.20 to 2.66 µmol/L)	Doctor	Refer for paediatric assessment (urgen for referral based on level), assess iron status, retest in 15 days to 3 months depending on age and level. Education on minimising exposure and absorption

BLOOD LEAD LEVEL	INTERPRETATION	ACTION
	PHU	Environmental assessment; home visit to assess obvious sources; if not obvious, take samples and advise landlord/client on analysis procedures and costs. Provide generic recommendations on remediation. Provide pamphlet.
55 µg/dL and over (2.66 µmol/L)	Doctor	Refer to hospital for urgent paediatric assessment and possible chelation.
	PHU	Environmental assessment: home visit, take samples and advise landlord/client on analysis procedures and costs. Provide generic recommendations on remediation. Provide pamphlet.

By asking questions about patients' lifestyles and living environments, and correct testing, monitoring and advice, health professionals can help people at risk to control and eliminate their exposure to lead.

For adults, this usually requires changes in exposure and work practices through work or hobbies. For children, sources of lead in the home must be detected and eliminated. By reducing hazards, exposure and risk is reduced.

Advice for parents or adults at risk

Health care professionals can advise people who appear to be affected by lead exposure to take a number of specific steps to avoid exposure.

(a) Reduce or remove exposure to lead

This means preventing children or adults from having access to sources of lead or hazardous situations, for example:

- Move children's furniture, such as cots, away from surfaces with deteriorating paint.
- Move children under five or pregnant women away from sources of exposure such as paint removal during renovations.
- Wash children's hands and faces before they eat or have a nap.

Chelation – a medical emergency

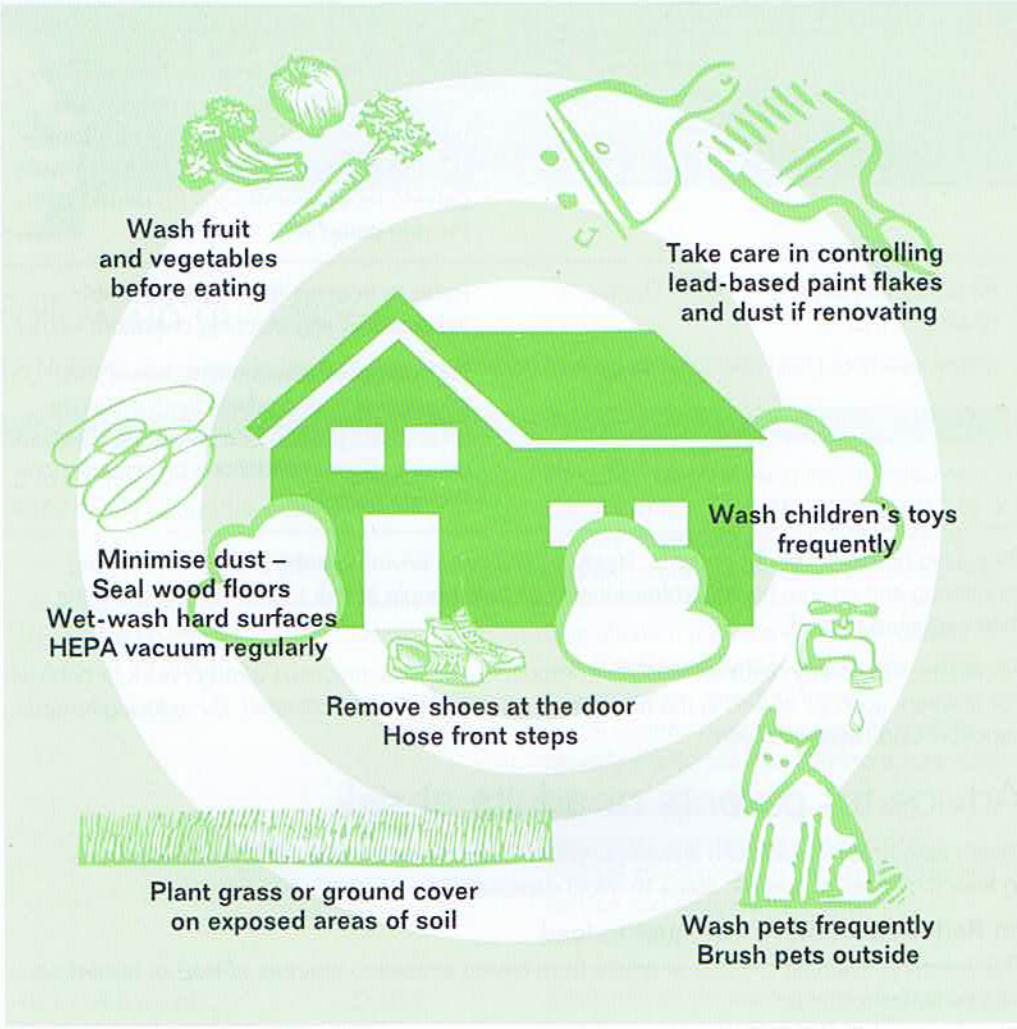
Chelation therapy is a specialised medical procedure involving the use of an oral, intravenous or intramuscular chemical agent which binds metals in the body (both toxic and beneficial) and increases excretion of the metal.

Different chelating agents (e.g. succimer, EDTA, or BAL) target lead bound to tissue in different parts of the body such as the skeleton, brain or vital organs.

Providing greater detail on the appropriate use of chelation for children and adults with lead poisoning is beyond the scope of this document, but reference materials listed at the end of this document can provide more detailed information about chelation.

Reducing lead hazards around the home

Source:
Lead Reference Centre, 1997



- Discourage children from putting dirty fingers or toys in their mouths.
- Encourage children to play in grassy areas rather than places where dirt sticks to their fingers and toys. Plant grass or ground cover on exposed areas of soil.
- Wash fruit and vegetables before eating.
- Ensure children do not have access to peeling paint or chewable surfaces painted with lead paint, especially cots, window sills and windows.
- Wash children's dummies and toys, especially those used outside, in soap and water.
- Wash family pets frequently, especially if furry. Discourage pets from sleeping on children's beds.
- Seal wood floors to reduce collection of dust between floorboards and provide an easily-cleanable surface.
- Wet-wash (at least weekly) hard surface halls, floors, stairs and windows with water mixed 4:1 with phosphate detergent, then rinse with clean water.
- Vacuum carpets slowly with a High Energy Particulate Air (HEPA) vacuum with a rigid canister to collect lead dust rather than recirculate it.
- Hose front steps and verandahs, remove shoes at the door, and brush pets outside.

(b) Reduce or remove the hazard

This means addressing existing contamination and removing the hazard itself, for example:

- Remove carpet which has been contaminated with paint dust.
- Remove lead contaminated soil by turning over bare areas near buildings, adding clean soil, mulch or gravel and moving child play areas or gardens to safer yard areas.
- Ensure children's diet has sufficient calcium, iron and zinc, which help to minimise lead absorption. Sources of zinc include wheat bran, yeast products, red meat and liver, oysters and crab. Sources of iron include poultry, red meat, liver, fish, fortified cereal, cooked legumes (beans, peas, lentils), dark green leafy vegetables. Sources of calcium include milk, cheese, yoghurt. Avoid high fat diets, which enhance lead absorption.
- Ensure young children have regular, frequent meals and snacks (up to six per day), as more lead is absorbed on an empty stomach.
- Don't store food in lead crystal glassware or pottery with lead-based glaze. Beware of imported foods in cans with lead soldering.
- Seal cracks in the ceilings of older homes, especially if near industry or other source of lead.
- As a temporary measure move furniture in front of painted surfaces that may present a lead hazard (deteriorating paint, friction, impact or chewable surfaces) to prevent child access.
- Tape or cover unsafe chewable surfaces on windows.

(c) Prevent the creation of lead hazards

This may include:

- Hiring a professional experienced with lead-safe practices for renovation or building work that disturbs lead dust or paint.
- Removing or sealing off soft furnishings before renovation or painting work and sealing off work areas with plastic and taping to prevent contamination with lead paint and dust.
- Ensuring contractors clean the work area daily during renovations and thoroughly clean the dwelling and dispose of debris before allowing families to return.
- Preventing the use of blowtorches, arc welders or high temperature heat guns which burn lead paint and create lead fumes.
- Preventing the use of abrasives or water blasting and certain machine tools such as orbital sanders, except in restricted circumstances (proper training, adequate containment and drop cloths, notification of neighbours, vacant property, and thorough cleaning and debris disposal).
- Wetting all painted surfaces to minimise dust generation and ease clean-up and disposal when wet scraping or sanding paint.

Checking the home for hazards

Take special care if renovating homes built before 1970. Seek advice about identifying lead paint in the home, controlling lead paint flakes and dust. Specialist services are available to:

- Check the lead content in paint.
- Assess the risk of lead exposure, such as peeling paint and lead dust.
- Carry out abatement or removal of hazards.

If people think their home may contain a lead hazard or lead paint, it is important to get professional advice and remediation. Do-it-yourself solutions could be more dangerous than leaving old paint alone.

See appendix for information and contact details of qualified professionals who can carry out these inspections.

Why not ban lead?

Lead is a metal which occurs naturally in the environment and is found in soil, water and air.

Lead is an essential component of many products in use every day in modern society because of its low melting point, malleability and anti-corrosive properties, and is a major contributor to the Australian economy.

Uses of lead include:

- Motor vehicle batteries
- Emergency power units
- Protective coverings to shield people using x-rays
- TV and computer screens (to absorb potentially harmful radiation)
- Building industry products including roofing materials, damp courses, and insulation
- Applications in the aerospace and aviation industries

Australia is a major producer and exporter of lead and lead products.

According to industry figures, lead (and its co-products, zinc and silver):

- Earns $1.5 billion a year in exports ($400 million for lead alone)
- Employs more than 8,000 people
- Contributes $1.3 billion a year in payments for goods and services
- Supports the economies of three regional cities – Mount Isa, Port Pirie and Broken Hill

Lead supports an active recycling industry, particularly in breaking down used car batteries.

Given the acknowledged hazards of lead exposure, the challenge for health professionals, the general public and people working in the industry is to create an environment where people ca live safely with lead.

References and further reading

- Committee on Measuring Lead in Critical Populations, 1993
  Measuring Lead Exposure in Infants, Children and Other Sensitive Populations
  Commission on Life Sciences, National Academy Press, Washington
- Commonwealth Department of Human Services and Health, 1993
  Reducing Children's Body Burden of Lead: Advice for Paediatricians
- Commonwealth Environment Protection Agency (CEPA), 1994
  Lead Alert: A Guide for Health Professionals
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- National Health and Medical Research Council, 1994
  Reducing Lead Exposure in Australia: An Assessment of Impacts Vols 1 & 2
- Roper, W, 1991
  Preventing Lead Poisoning in Young Children
  Centers for Disease Control, US Department of Health and Human Services
- South Australian Health Commission, 1991
  The Health Risk Assessment and Management of Contaminated Sites
  Adelaide, p.73
- Worksafe Australia, 1994
  Control of Inorganic Lead at Work, NOHSC: 1012 (1994)

Contacts

NSW Department of Health

For information on the potential impacts of lead on health, contact your local Public Health Unit. (See under **Health Department of NSW** in the White Pages)

NSW Environment Protection Authority (EPA) Pollution Line

PHONE 131 555

Contact the EPA for enquiries on:

- Current NSW environmental legislation
- Current regulated lead industries
- Contaminated sites
- Air quality monitoring programs in NSW

Lead Reference Centre (LRC)

PHONE (02) 9879 4988

Contact the LRC for enquiries on:

- LRC programs, policies and activities
- Education and training programs and materials
- Technologies to address lead hazards
- NSW Government progress in addressing lead management

WorkCover Authority NSW

PHONE 131 050

Contact WorkCover for occupational health and safety enquiries, including:

- Regulations and requirements on lead at work sites
- Lead hazard management codes and standards
- Protective equipment recommendations
- List of WorkCover authorised medical practitioners in NSW

Point Source Communities

The following centres coordinate the implementation of local strategies to reduce lead hazards and provide advice, counselling and education, incorporating health trained personnel to undertake blood lead testing and environmental science trained personnel to carry out sampling of home environments.

Broken Hill Environmental Lead Centre
PHONE (08) 8087 9815

North Lake Macquarie Remediation Management Centre
PHONE (02) 4965 8933

Illawarra Public Health Unit
PHONE (02) 4226 4677

Department of Public Works and Services (DPWS)

PHONE (02) 9372 8877

Contact DPWS for:

- Guidelines to Manage Lead-Based Paint in Schools and Other Public Buildings
- Code of Practice and Code of Tendering for the Construction Industry

NSW Department of Housing

PHONE (02) 9821 6111

Public housing tenants should contact the Department of Housing about any concerns over these properties.

NSW Department of Fair Trading (DFT)

PHONE (02) 9895 0111

Contact the DFT for information on rights and responsibilities under fair trading laws.