

# Frequently Asked Questions: Testing and Reporting Port Pirie Children's Blood Lead Levels after July 2021

In response to [recommendations of an independent review](#) of the Targeted Lead Abatement Program in 2020, SA Health has revised its regular reports about the trends in Port Pirie children's blood lead levels. Revised reporting and this information sheet came into effect from 1 July 2021 (updated February 2022).

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## Why are we concerned about lead in Port Pirie?

The Port Pirie environment is contaminated with lead from more than 130 years of smelting activities in the city.

Even small amounts of lead can be toxic when ingested or inhaled. SA Health has been delivering a lead abatement public health program for the Port Pirie community since 1985 to reduce lead exposure.

More information about health effects of lead can be found at:

<https://www.nhmrc.gov.au/guidelines-publications/eh58> and [sahealth.sa.gov.au/lead](http://sahealth.sa.gov.au/lead).

More information about the Port Pirie lead program and its services can be found at:

<https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/resources/services+we+provide+environmental+health+centre>

## Why do we collect blood samples to measure lead?

After lead has been swallowed or inhaled and then absorbed from the gut or airways it circulates in the bloodstream. Measuring the level of lead in blood (i.e. the concentration) is the most accepted indicator (i.e. biomarker) of a person's exposure to lead during the previous five to six weeks.

Long-term exposure to lead cannot be measured accurately from blood tests because lead deposits in parts of the body such as teeth and bones. Testing of teeth and bones is difficult, not widely available, and the results are difficult to interpret.

## How do we collect blood samples in Port Pirie?

SA Health's local Environmental Health Centre provides a voluntary blood screening program for the Port Pirie community.

Blood samples are collected from young children and some pregnant women using a capillary technique. The finger is cleaned, and blood is collected into a capillary tube from a simple finger prick. This testing method is generally less distressing for young children than collecting venous blood samples, so it is more likely that children will return for subsequent testing. Pregnant women may also have venous blood lead tests arranged through their doctor.

## What units do we use to measure blood lead levels?

Lead levels in blood are usually reported as micrograms per decilitre which can be shortened to  $\mu\text{g/dL}$  (sometimes written as  $\text{ug/dL}$ ). A decilitre is 100 millilitres. Laboratories usually also report the lead level as micromoles per litre shortened to  $\mu\text{mol/L}$  (sometimes written as  $\text{umol/L}$ ).

To convert micromoles per litre to micrograms per decilitre: multiply the value by 20.72

$$1 \mu\text{mol/L} = 20.72 \mu\text{g/dL}$$

$$1 \mu\text{g/dL} = 0.048 \mu\text{mol/L} \text{ and } 5 \mu\text{g/dL} = 0.24 \mu\text{mol/L}$$

## Why do we test young children under five years of age?

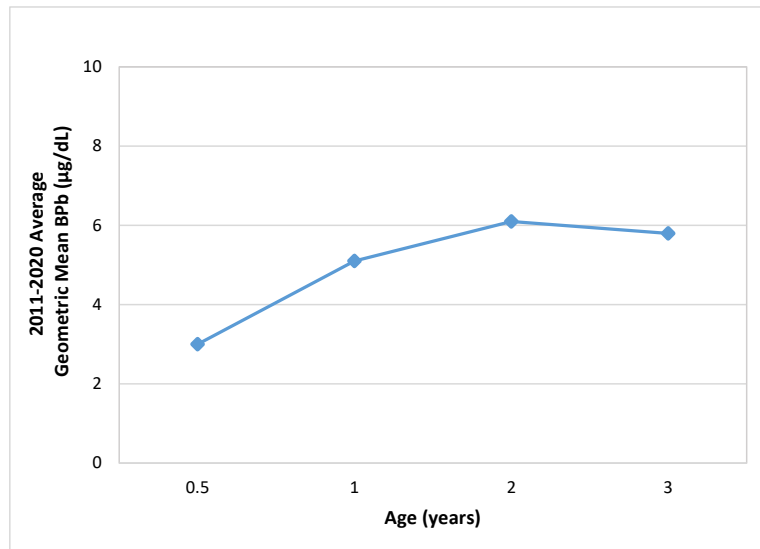
Babies and young children are at higher risk from lead because:

- > their nervous systems and brains are developing rapidly and are susceptible to damage
- > they absorb and retain greater amounts of lead than adults
- > early childhood behaviour such as crawling and playing on the floor, mouthing toys, and hand-to-mouth action increase the likelihood of young children coming in contact with surfaces around the home that can be contaminated with lead dust.

Research shows that the steepest rise in lead exposure occurs during the first two years of life. So, SA Health's lead abatement program targets interventions to reduce lead exposure in early childhood – with particular attention on infants and toddlers less than two years of age.

After the age of two years, children start to reduce mouthing behaviour and have less contact with contaminated surfaces as they learn to walk, so their lead exposure begins to decrease. By the time children reach their third birthday, in most cases their lead exposure has plateaued and is usually starting to reduce (Figure 1).

Figure 1: Typical blood lead changes with age



## Why do we test pregnant women?

Lead in the mother's blood passes virtually unhindered into her unborn child which can affect her baby's development. This means a baby is born with almost the same blood lead level as their mother (research shows that newborns have around 87% of their mother's lead level at birth).

The mother's blood lead level measured closest to the time of birth (either before or directly after) indicates an approximate baseline blood lead level for her baby.

The mother's result is also an important indicator of whether there might be any unexpected lead sources around the home that need to be removed. So, it helps expectant or new parents prepare their homes for the baby.

## When do we test mothers and children?

Women who are pregnant or planning pregnancy should be tested early to determine their recent lead exposure and whether there may be possible lead sources around the home that need to be removed before their baby is born. Pregnant women should also be tested close to birth (pre- or post-birth) to indicate their baby's baseline lead level.

Children are first tested at six months of age and then at one year, two years and three years of age, usually within one month of their birthday.

Children with elevated blood lead levels may be tested more frequently than once a year. Their test results are used to work out the best interventions to help reduce their exposure risk. Every test result is used to make sure that the most appropriate actions are taken quickly and are tailored to suit each child's changing exposure situation. Each child's most recent blood lead result (while they are less than five years of age) is used by SA Health to generate publicly available population blood lead reports.

## Why don't we test older children?

Children older than four years are less likely to be tested because their risk of lead exposure and subsequent developmental effects is reducing. After a child reaches two to three years of age, their blood lead levels have usually peaked and plateaued (see Figure 1). If they have not had an elevated blood lead result (above 5 micrograms per decilitre) by then, it is unlikely they will go on to have a high level. In discussion with the Environmental Health Centre, parents may choose for their children not to have any more blood tests unless the home lead exposure risk changes, for example, the family moves to a higher lead risk area of the city or they undertake dust-generating renovations. However, children that have or are likely to have elevated levels are encouraged to keep having tests until they are five years of age when their risk of exposure to lead is usually reducing and much lower than for younger children.

Public health screening programs, like Port Pirie's blood testing program, screen those people at risk of developing health effects. Older children who have had consistently low blood lead levels are considered to be at low risk of lead exposure and health effects and may not be routinely tested unless their exposure situation changes. As with any other medical test, children are not tested if they have a low or negligible risk.

## Why are population blood lead reports published once a year?

In response to recommendations from an [independent review](#), from July 2021 SA Health has returned to public reporting of the population blood lead levels for Port Pirie children once a year. Quarterly reporting occurred from 2016 to June 2021. Annual reporting provides greater certainty and representation of the population trends because it removes seasonal variations and reports complete data with all children tested during the year represented. This improvement allows the most meaningful comparisons between calendar year to calendar year.

SA Health compiles Port Pirie's blood lead data to monitor trends and help manage the impacts of lead on the community. Population trends are a good way to keep stakeholders and the general public informed about the progress of work to reduce lead exposure in Port Pirie. This reporting is an essential part of SA Health's lead abatement public health program and allows adjustments to strategies to respond to changing community and environmental conditions.

The South Australian government, Port Pirie Regional Council, Nyrstar smelter and the Port Pirie community work closely together to coordinate actions to reduce the exposure of children to lead and to identify solutions to further reduce blood lead levels. These reports provide stakeholders with a regular picture of how the population of Port Pirie is being impacted by lead.


Annual public blood lead reports present population trends once a year but each family receives their child's individual blood lead result after each test. These results help the family to work together with the Environmental Health Centre to tailor interventions, education, assistance and support. Individual results are not identified in the public annual reports because private medical information, such as a person's blood test results, cannot be made publicly available as this would be a breach of confidentiality.

## What do the measures published in the blood lead report mean?

### Population estimates

These measures provide an estimate of how many children under five years of age live in Port Pirie. These estimates are used to calculate lower and upper limits (the 95% confidence interval) of the proportion (percentage) of children above specific blood lead levels presented in the report.

Population estimates are taken directly from or extrapolated from (for the current year) an Estimated Resident Population (ERP) of children under five years of age (0-4 years) living in



Port Pirie (SA2 location [405031122](#)) each year over the past decade. The ERPs are derived by the Australian Bureau of Statistics (ABS) from census data. The ERPs are the most reliable estimates of the population between census years because they take into account changes in population such as births, deaths, and the movement of residents in and out of the region in addition to the most recent census data. The ERPs are completely revised by the ABS each time a census is conducted and updated between censuses in August each year which provides data for the previous year. We extrapolate a population estimate for the current year by fitting a linear model to ERP data from the previous five years (this method was revised from using ERP data from the previous 10 years for the 2022 annual report onwards in response to census limitations reported by ABS in 2022 that resulted in substantial changes in ERPs for Port Pirie 2017-21 that were recalculated by ABS). This population extrapolation method using a 5-year base period improves representation of rapid short-term demographic changes in ERP.

When we report blood lead trends specifically for children at the time of their second birthday there is no accurate ABS estimate for the number of children living in Port Pirie who turned two years of age (had their second birthday) in each calendar year. To calculate the lower and upper limits (95% confidence interval) for this age group we estimate the number by extrapolating from ABS birth data for Port Pirie in the two years prior to the reporting year. ABS birth data are sourced from state birth registries and are not affected by census counts or changes in ERP.

#### **Total number of children tested**

This measure calculates how many children under five years of age who are living in Port Pirie at the time, were tested during the reporting period. If a child had more than one test in the reporting period, their most recent result is used.

#### **Percentage of children with levels above five (5) micrograms per decilitre**

This measure calculates what proportion (percentage) of children tested does not meet the current national recommendation for lead exposure.

This percentage does not represent all children aged less than five years who live in Port Pirie because not all children are enrolled in the blood screening program or had tests in the reporting year and therefore they do not have a test included in the analysis.

It can be said with a high degree of confidence (95%) that the proportion of the entire population with blood lead levels above 5 µg/dL would be expected fall between the lower limit and the upper limit (the 95% confidence interval) if every child under 5 years of age living in Port Pirie was tested. Population estimates used to calculate these limits are based on ERP data for Port Pirie.

The Australian National Health and Medical Research Council (NHMRC) updated its [recommendation](#) in May 2015 indicating that 'if a person has a blood lead level greater than 5 micrograms per decilitre, the source of exposure should be investigated and reduced, particularly if the person is a child or pregnant women'.

Even at very low levels lead may be associated with health effects. Therefore, this level of 5 micrograms per decilitre is not intended to be used as a 'safe' level of exposure or a 'level of concern' but rather a level at which sources of lead exposure need to be investigated. When we refer to children's blood lead levels being high or elevated, this means levels above the NHMRC's recommended exposure investigation level. SA Health endorses the NHMRC statements and reports this measure.

## Percentage of children with levels equal to or above 10 micrograms per decilitre

This measure calculates what proportion (percentage) of children tested does not meet the previous national recommendation for lead exposure.

This percentage does not represent all children aged less than five years who live in Port Pirie because not all children are enrolled in the blood screening program or had tests in the reporting year and therefore they do not have a test included in the analysis.

It can be said with a high degree of confidence (95%) that the proportion of the entire population with blood lead levels equal to or above 10 µg/dL would be expected to fall between the lower limit and the upper limit (the 95% confidence interval) if every child under 5 years of age living in Port Pirie was tested. Population estimates used to calculate these limits are based on ERP data for Port Pirie.

The previous NHMRC recommendation was that sources of lead exposure should be investigated when blood lead levels were higher than 10 micrograms per decilitre. However, research now shows that blood lead levels below 10 micrograms per decilitre may be associated with some health effects in adults and children.

At levels between 5 and 10 micrograms per decilitre health effects have been observed at a population levels, but at this stage the NHMRC has concluded that at these levels the evidence is not strong enough to show whether these health effects were caused by exposure to lead or by other health and lifestyle factors. At levels above 10 micrograms per decilitre, it is well-established that exposure to lead can have harmful health effects in both adults and children so SA Health continues to report this measure.

## Percentage of children with levels in each category of blood lead level

These measures show the proportion (percentage) of children with blood lead levels between 5 and 10 micrograms per decilitre; 10 and 15 micrograms per decilitre; 15 and 20 micrograms per decilitre; and children with blood lead levels above 20 micrograms per decilitre – these children are at greatest risk from lead exposure. Health effects associated with lead are more severe with higher blood lead levels.

## Do these reports represent all children who live in Port Pirie?

The sample size cannot be interpreted to represent the entire population because every child living in Port Pirie has not been tested in each reporting period. The reasons for this are:

- > Although there is a high level of community participation in the blood screening program, as with any other medical screening program, participation is voluntary and parents have the right to choose not to have their child tested or to enrol in the lead abatement program. There is no ethical way to mandate testing to test every child.
- > Some children are assessed to be at such a low risk of lead exposure and developing lead-related health effects that they do not need testing beyond three years of age as part of their management strategy. A child with a history of consistently low levels or at low risk of lead exposure do not require testing as part of their management strategy, particularly those children older than two years of age. But children at high risk of lead exposure and elevated blood lead levels are encouraged to be regularly tested.
- > Results pending re-test for confirmation are not included in this dataset but will appear in the next report.

The reports are considered very reliable for reporting the proportion of the population with blood lead levels above 10 micrograms per decilitre – those children at most risk. But children with low blood lead levels are under-represented (for the reasons given above).



To help address some of this sampling bias, a statistical range is reported (known as the 95% confidence interval). It can be said with a high degree of confidence (95%), that the proportion of the entire population with blood lead levels above 5 µg/dL or equal to or above 10 µg/dL would be expected to fall between the lower limit and the upper limit (the 95% confidence interval) of this range if every child under five years of age living in Port Pirie was tested.

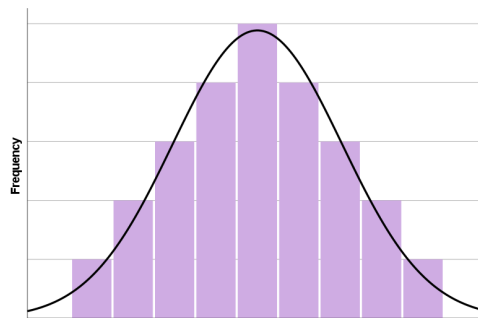
Upper and lower limits used for this range (known as the 95% confidence interval) are calculated using the most recent Estimated Resident Population (ERP) of Port Pirie children aged 0-4 years provided by Australian Bureau of Statistics (ABS). ERP is the most reliable estimate of the population between census years because it takes into account changes in population such as births, deaths, and the movement of residents in and out of the region.

## Why do we report the geometric mean blood lead level for pregnant women and for children at their second birthday?

The geometric mean, rather than the average or arithmetic mean, is the correct way to summarise and report health-related data like blood test results. But it cannot be used to guess the exact number of pregnant women or two-year old children above or below a blood lead level because of the nature of the distribution of results across the population.

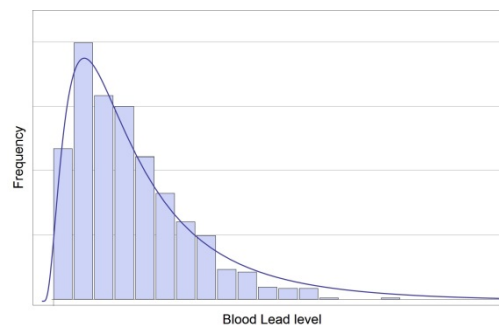
Statisticians call it a normal distribution of data if there is the same number of data points above and below the arithmetic average (i.e. a bell-shaped curve, Figure 2).

Figure 2: Typical normal distribution curve




However, blood results are not considered to be 'normally distributed' across a population (Figure 3). Most pregnant women and children have low levels so there is not exactly the same number of individuals above and below the arithmetic average.

Figure 3: Typical distribution of blood lead level results across the tested population



Blood lead levels during pregnancy or immediately post-birth are important indicators to allow early intervention to manage lead exposure and reduce risk for young children. Peer-reviewed research shows that babies are born with virtually the same blood lead levels as their mothers. It is rare that a baby's blood lead level rises above 5 micrograms per decilitre prior to the first test at six months of age unless they are exposed to an extreme direct source of lead like lead paint or lead contaminated rainwater.

Children's blood lead levels typically peak around their second birthday and then plateau and begin to reduce (Figure 1). At this age, levels are not likely to change very much. So, test results from this age group are the most useful and robust measure to determine trends in



blood lead levels for the whole population. This is also the age of children that have the highest participation in the blood testing program, so results for this age group give the best representation of lead exposure.

This is the reason why we report the geometric mean blood lead level to indicate the 'typical' blood lead level of a pregnant women or a child at their second birthday in Port Pirie.

### Why do we use a child's most recent blood lead result in the report: does this 'play down' high blood lead levels?

SA Health uses the most recent blood lead result for each child to generate the annual report. Most children only have one blood test taken in each reporting period, but for those with more than one, using the most recent test result gives the most up-to-date and accurate picture of how the population as a whole is being impacted by lead from year to year. The purpose of monitoring these trends is to monitor the overall effectiveness of all combined exposure-reduction strategies and make necessary adjustments or modifications to strategies to respond to changing community or environmental conditions.

The population health measures reported provides the tools to effectively deliver SA Health's public health program in Port Pirie.

The population trends in our reports do not determine how we protect individual children, but rather they are used to look at how the overall population is being affected to inform higher level strategic approaches to the management and reduction of exposure to lead in the Port Pirie environment. The most important way to protect individual children is to use each test result to adjust individual strategies for families; responding rapidly to their unique exposure situations. The result of every test a child has is used by SA Health staff to develop the correct approach for individual situations. Each family receives their child's individual blood lead results after each test to work together with the Environmental Health Centre to tailor their lead exposure assistance and support. Individual results are not identified in these reports because people's private medical information, such as individual blood test results, cannot be made publicly available as this would be a breach of confidentiality.

### Why don't we include every test result collected for each child in the report: does excluding multiple tests for some children from the dataset 'play down' the number of children at risk?

Most children have one test each year (taken around their birthday), but children who have high blood lead levels have more than one test taken in the reporting period. SA Health uses the most recent blood lead result recorded for each child to calculate the proportion (percentage) of children with blood lead levels above 5 or 10 micrograms per decilitre at the time of reporting. To do this, each child can only be represented once in the dataset for each reporting period.

Therefore, this is not a measure of the proportion of all test results recorded above this level; instead it is a measure of the proportion of children tested above this level.

This method allows a valid comparison of trends from year to year – comparing similar datasets each year i.e. comparing 'like with like', even though the dataset is not continuous because a different sample of children are tested in each year – new children enter the sample and older children exit the sample.

Including multiple test results for those children with the highest levels would introduce bias by over-representing children with high blood lead levels and prevent a statistically valid comparison of blood lead trends between years.



## Why don't we report the highest and lowest blood lead results measured?

SA Health does not report individual results like the highest and lowest test results for children because using results that may not be recent does not accurately reflect current population trends. In addition, reporting actual test results may allow individual families or children to be identified which breaches privacy laws and confidentiality and may discourage parents from having follow-up tests.

## Why do the numbers of children tested each year sometimes vary when comparing reports published in different years?

Ongoing routine audit of the blood-lead results database that occurs when each analysis is undertaken will continue to identify small numbers of data-entry anomalies that arise from database limitations e.g. when families change residential addresses. Correction of these anomalies can result in a minor variation (usually an increase) in the number of children's test results included in a dataset when compared to the same year in reports published in previous years. These variations are not considered to impact on reported proportions (%). Upper and lower limits may also vary between reports as they are adjusted from year to year for the estimated population size based on Australian Bureau of Statistics (ABS) Estimated Resident Population (ERP) and census data.

## Are SA Health's reporting methods valid?

The methods used provide the most appropriate analysis of blood lead trends for the purposes of public health protection and maximising SA Health's program effectiveness.

SA Health has compiled and monitored blood lead results in Port Pirie for close to 40 years to gauge trends that help manage the impacts of lead on children in the community. Regular reports are published to enable public scrutiny of the public health program. The data is not designed to be used to monitor smelter performance, nor is it an academic exercise; it is an essential part of the lead abatement program. Claims of manipulation or misleading the public are detrimental because they can damage vital engagement and participation of the Port Pirie community in coordinated efforts to reduce lead exposure and give every child the best possible start in life.

## Why did we change from using a child's maximum test result in the report to using the most recent test result?

In 2005, significant and rapid improvements in blood lead levels and lead-in-air levels were starting to occur. It was decided to use each child's most recent test in the dataset to enable the most up-to-date information about community lead impacts to be monitored. Prior to 2005, each child's maximum test result was used.

As discussed, most children have either increasing blood lead levels (those aged up to two years) or have started to plateau and reduce (those older than two years). Therefore, for most children their most recent test is more likely to be higher than their previous test result (usually taken the year before - Figure 1).

It is appropriate to use the most recent result to monitor population trends in blood lead levels.

## Can the current blood lead measures be compared with historical data and reports?

When comparing blood lead measures over the 10-year period published in each report, or comparing the current report to historical reports, consideration should be given to the multiple changes in analysis methods that have occurred over the years including:

- > Blood testing service providers for the Port Pirie community blood lead screening program changed on 1 January 2019, allowing for more advanced analytical methods to be utilised. Data from 2019 onwards should not be compared with previous years.
- > From, 2007 to June 2021 results were reported with surrogates where surrogate data (the mother's blood lead levels) was used to represent a child's blood lead level at birth and was included until either the child's first test at 6 months of age replaced it or it was removed if the child did not have any test by 9 months of age. From July 2021, results are either children tested or pregnant women tested in the reporting period. Reports from July 2021 onwards should not be compared with reports containing surrogates reported in previous years.
- > Prior to 2005 a child's maximum test was used in the analysis whereas now a child's most recent test result is used. Reports from 2005 onwards should not be compared to trends published in the 2004 and 1984 program reviews.
- > From 2007 to 2010, the number of children with blood lead levels above 10 µg/dL, was also reported using a 5-year cohort of children. This trend indicator cannot be compared with the 1-year cohort of children that is reported now.
- > A new blood-lead results database was commissioned in 2017 and operated concurrently with the existing database until 31 March 2018. Results of blood tests collected from 1 January 2018 have been extracted from the new database. Blood tests collected prior to 2018 will continue to be extracted from the old database. Routine data audit occurs when each analysis is undertaken and will continue to identify small numbers of data collection and entry anomalies (e.g. clients reporting incorrect family details). Correction of these anomalies can result in a minor variation in the number of test results included in the dataset compared to reports prepared in previous years. But this correction does not have significant impact on reported measures.

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### For more information

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