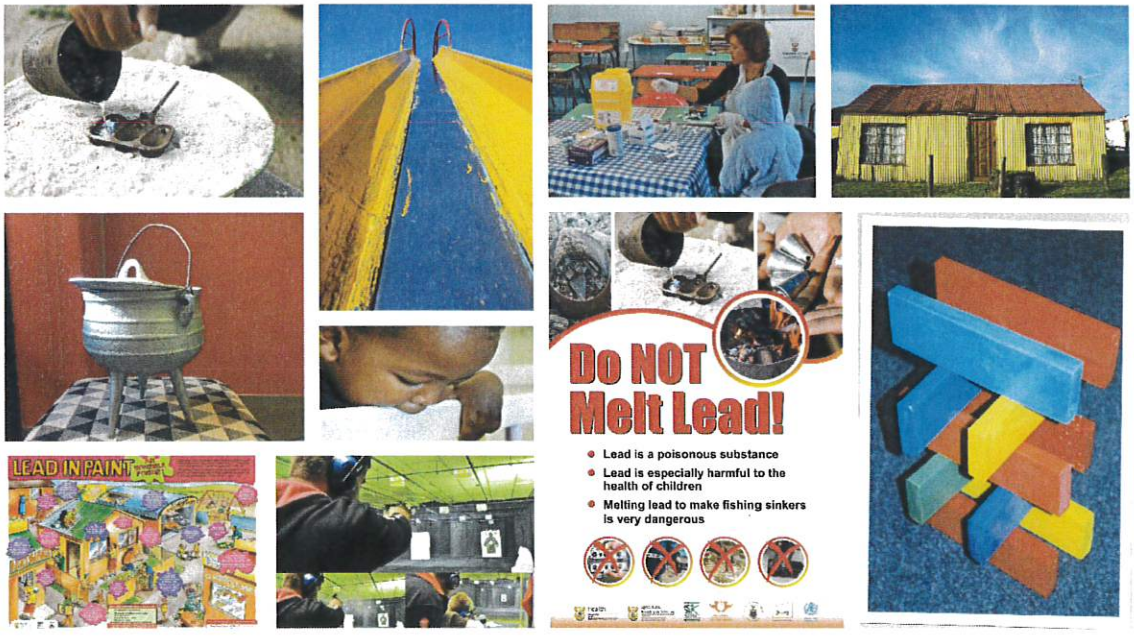
health

Department:
Health
REPUBLIC OF SOUTH AFRICA

# SOUTH AFRICAN NATIONAL LEAD EXPOSURE PREVENTION STRATEGY




**March 2020**

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## ACRONYMS AND ABBREVIATIONS

BEI – Biological Exposure Indices

CAIA – Chemical and Allied Industry Association

CSIR – Council for Scientific and Industrial Research

DBE – Department of Basic Education

DEFF – Department of Environmental, Forestry and Fisheries

DOH – Department of Health

DOL - Department of Labour

DTI – Department of Trade and Industry

DWS - Department of Water and Sanitation

LAB - Lead-acid batteries

NICD – National Institute for Communicable Diseases

NLEPWG - National Lead Exposure Prevention Working Group

NLEPS - National Lead Exposure Prevention Strategy

PIC – Poison Information Center

SAICM - Strategic Approach to Integrated Chemicals Management

SAPMA – South African Paint Manufacturing Association

SLAB – Spent Lead-acid batteries

SEIAS – Socio Economic Impact Assessment Study

USFDA – United States Food and Drug Administration

WHO – World Health Organization

## FOREWORD BY THE ACTING DIRECTOR- GENERAL

Sound management of chemicals, lead included, holds the potential for substantial health benefits. According to the World Health Organization (WHO), about 25% of the global burden of disease in humans is thought to be linked to environmental factors, including exposures to chemicals. Worldwide, lead exposure, for example, is estimated to account for 143 000 deaths per year, with the highest burden in developing regions. Childhood exposure to lead is estimated to contribute to about 600 000 new cases of intellectual disabilities every year.

The World Health Organization has identified lead as one of ten chemicals of major public health concern, requiring action by Member States to protect the health of children, women of reproductive age and workers. Formulating strategies aimed at prevention of ill-health and disease caused throughout the life course by chemicals, is one of the health-sector priority actions expected of Member States, which was resolved at the Fifty-ninth World Health Assembly (WHA 59.15) and in a number of international meetings. Due to the growing global concern of lead exposure, particularly in children, and to increase awareness of lead poisoning prevention, the United Nations Environmental Programme and the World Health Organization has declared the 3rd week of October to be International Lead Poisoning Prevention Week of Action.

Multiple sources of lead exist in South Africa, and have been associated with elevated lead exposure in some South African populations, such as children in subsistence fishing communities and workers or users of shooting ranges. The health, social and economic consequences of lead exposure in South Africa are sobering, with economists conservatively estimating that the annual cost to the South African economy exceeds R247.8 billion (Attina and Trasande, 2013). In this light, the implementation of a National Lead Exposure Prevention Strategy (NLEPS) for the country is essential.

This NLEPS will assist the country to contribute to the Sustainable Development Goals and to reach the Strategic Approach to International Chemicals Management (SAICM) goal of the sound management of chemicals by 2020, which has been adopted by the International Conference on Chemicals Management at its third (3rd) session in Nairobi, 2012.

The NLPRS outlines sources and pathways of lead exposure in South Africa, vulnerable populations, health, social and estimated economic impacts of lead exposure in the country. The range of sources of lead in the country, as outlined in the NLEPS indicates that much remains to be done by a spectrum of

stakeholders beyond the health sector. Relevant stakeholders such as key government departments, government entities, NGOs, research institutions, academic institutions, the chemical, paint, pigments, pottery, toy, ceramic ware, and child care industries, all have potential roles to play in the implementation of the NLEPS, in the interests of the protection of the environment and public health.

The contribution of everyone who has participated in the development of this NLEPS, and especially the South African Medical Research Council, is greatly appreciated. It is anticipated that your active participation in implementing this strategy will benefit South Africans and will also contribute to the implementation of regional and international efforts to prevent lead exposure and lead poisoning.

**Dr T Pillay**
**Acting Director- General: Health**
**Date:** 03/04/2020

## 1. INTRODUCTION

Lead poisoning is preventable, yet the Institute for Health Metrics and Evaluation has estimated that, based on 2015 data, lead exposure accounted for 494 550 deaths and 9.3 million disability adjusted life years (DALYs) due to long-term effects on health, with the highest burden in developing regions. The role of lead exposure in the development of intellectual disability in children is of particular concern. Even though there is widespread recognition of this problem and many countries have taken action, exposure to lead, particularly in childhood, remains of key concern to health care providers and public health officials worldwide, especially in poorly resourced countries (http://www.who.int/ipcs/leadcampaign/en/).

Lead exposure reduction contributes to the achievement of at least two of the Sustainable Development Goal (SDG) targets. For example, SDG 3.9 calls for *substantial reductions in the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination*. SDG 12.4 proposes that by 2020, *countries should achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment*.

At the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002, governments called for the phase out of lead in paint and in other sources of human exposure and for work to prevent, in particular, children's exposure to lead and to strengthening monitoring and surveillance efforts and the treatment of lead poisoning. The meeting of Ministers of the environment of the Group of Eight, held in Syracuse, Italy in April 2009, also identified the need to phase out lead in paint in the context of children's health and the environment.

The African Ministers of Health and Environment, in the Luanda Commitment of November 2010, have already highlighted their concerns over the adverse effects on human health and the environment from the use, disposal of, and exposure to, hazardous chemicals and wastes which pose a major challenge for many African governments. The Global Alliance to Eliminate Lead Paint (Lead Paint Alliance) was formed in 2011 to promote the phase-out of the manufacture and sale of paints containing lead, and eventually to eliminate the risks that such paints pose. In 2015 the International Society for Environmental Epidemiology called for a more comprehensive approach to national lead exposure reduction efforts. This

STRATEGYconstitutes a first step in the response to calls from a range of other international public health institutionsfor action on public exposure to lead (http://www.iseepi.org/documents/).

## 2. AIMS & OBJECTIVES

The aim of the NLEPS is to reduce the risks of exposure to, and the burden of ill health associated with, lead in South Africa. In so doing, synergies and coordination across relevant sectors in relation to the Strategic Approach to Integrated Chemicals Management (SAICM), and well as South Africa's commitments to achieving the Sustainable Development Goal (SDG) targets are of high importance. Actions to address lead exposure risks in the country reinforce the accomplishment of the objectives of the national implementation plan for the management of risk factors on human health and the environment. This includes the strengthening of national, provincial and local capacity for integrated monitoring and surveillance of sound chemicals management.

### *Who is the Strategy for?*

The NLEPS is a national document, directed not only to the Department of Health (DOH) but to all other key relevant national, provincial and local governments in the areas of health, environment, labour, water, education, customs and excise, trade and industry, development planning, the research community, non-governmental entities, the chemical, paint, child care, toy and children's playground and manufacturing industries, as well as civil society, and other interested and affected parties. The NLPP strategy is guided by an overarching intent, and informed by strategic objectives arising from South Africa's international obligations and commitments, to protect public health and the environment through elimination of the use of lead in paint and other relevant products, and sound management of chemicals, by 2020, and to address environmental risk factors that are contributing to lead exposure.

### *The Objectives of this document are:*

1. To outline the rationale for a strategy on lead exposure reduction in South Africa;
2. To indicate the groups most vulnerable to lead exposure in South Africa;
3. To summarize what is currently known about lead exposure in South Africa;
4. To outline specific recommended actions and role players requiredto reduce lead exposure in South Africa.

## 3. PRINCIPLES

The following principles guide the development and implementation of the NLEPS ational Lead Exposure Reduction Strategy:

### *a. Prevention*

The NLEPS will be founded on the fundamental public health principle of prevention of morbidity and mortality due to hazardous environmental exposures. Prevention is also usually the most cost-effective public health approach.

### *b. Intersectoral Cooperation and Collaboration*

Sources of exposure to lead straddle many sectors, including Trade & Industry, Mineral Resources, Education (schools with leaded paint), Fishing, Complementary Medicine, Water Affairs, Environmental Affairs, Human Settlements and Housing, and Small Business Development. Intersectoral action is therefore a fundamental pillar of any strategy to reduce public exposure to lead. The development of partnerships and mechanisms of cooperation and collaboration amongst the relevant sectors is critical to success.

### *c. Community Engagement*

Every effort will be made to consult and involve local communities in the planning and implementation of actions to reduce lead use and exposure reduction through awareness raising and educational programmes in South Africa.

### *d. Resource Implications*

Financial resources are essential to support and ensure success of the South African NLEPS and to scale up action nation-wide. The cross-sectoral nature of lead sources, and therefore action, implies the potential contribution of expertise and resources from multiple departments and sectors to implement the strategy.

## 4. WHAT IS LEAD

Lead is a naturally occurring metal found in the Earth's crust. It has a range of properties which have made it very useful in modern society and earned it the

moniker of *father of metals*. For example, it is soft, malleable, a relatively poor conductor of electricity, highly resistant to corrosion, and is able to absorb sounds and other vibrations, as well as serve as a barrier to radiation. Lead also has a low melting point and is resistant to fire (WHO, 2001).

Evidence of toxicity due to lead exposure was documented as early as 370 BC (Tong et al., 2000) and references to possible toxicity from lead exposure were found in ancient Egyptian papyrus scrolls. Lead was widely used during the ancient Roman era (for example in water pipes, glazed pottery, cooking utensils, pots used to boil and condense grape juice and to sweeten wine), and may have contributed to extensive lead poisoning at that time, especially amongst the upper classes (Hernberg, 2000).The extensive use of lead in modern society, especially since the advent of the industrial era, has resulted in widespread human exposure to this toxic metal. Due to atmospheric transmission, lead can affect the most remote regions of the world (WHO, 2010a). There are no natural mechanisms for the breakdown of lead, and once released into the environment, it persists indefinitely. Lead exposure and poisoning counts as a priority public health problem in many parts of the world.

## 5. PATHWAYS OF EXPOSURE TO LEAD

Lead may enter the body through ingestion, inhalation, dermal absorption, absorption from retained or embedded leaded foreign bodies (such as bullets or shrapnel), and trans-placental (endogenous) routes from mother to the foetus. Most human exposure to lead occurs through ingestion. People who work with molten lead, such as in the electronics industry, in subsistence fishing communities where lead may be melted to craft fishing sinkers, and "do-it-yourself" (DIY) renovators or hobbyists, may inhale lead vapour. Dermal absorption of lead is possible, but seldom occurs. Age-appropriate hand-to-mouth behaviour may result in the ingestion and swallowing of soil, paint chips and other lead containing substances.

### *What Happens to Lead in the Body?*

Once lead enters the body, it is distributed to organs such as the brain, kidneys, liver and bones. Lead easily crosses the blood-brain barrier. The half-life of lead in brain tissue is approximately two years. The body stores lead in the teeth and bones where it accumulates over time. Lead stored in bone may be remobilized into the blood during pregnancy, thus exposing the fetus.

## 6. WHO IS MOST VULNERABLE TO LEAD EXPOSURE

Young children are naturally curious, and may frequently touch and/or taste non-food items in their environment. Ingestion of lead is elevated in children with pica (ingestion of non-food items), who may for example,eat soil or pick at and eat leaded paint from walls, window and door frames and furniture. A habit of chewing nails or sucking fingers may also increase the ingestion of lead-contaminated soil or dust particles. Children at highest risk are the very young, including the developing fetus and the impoverished.

Children's particular vulnerability to the health effects of lead exposure also stem from their immature organ systems and relatively ineffective mechanisms for the metabolism of lead. Children's incompletely developed organs and systems, such as the renal and hepatic systems, are associated with less effective detoxification and elimination mechanisms compared to adults (WHO, 2010b, WHO, 2010a).The rate of absorption of lead in the gastrointestinal tract in infants and children is greater than in adults (approximately 40% versus 10% respectively).

Nutritional deficiencies, such as of iron and calcium (which are more common in children), increase the rate of absorption of lead (Bellinger, 2008a). Transport of lead through children's immature blood-brain barrier leads to a higher risk of adverse neurological and developmental effects (WHO, 2010a). Lead is retained in the bodies of children for longer periods than adults (Bellinger, 2008a). Undernourished children are more susceptible to lead because their bodies tend to absorb more lead if other nutrients, such as calcium, are lacking.

Although it is acknowledged that children are more vulnerable to lead exposure, it should also be considered that the adult population group that is working or living near or in mining areas, metal industrial areas and cottage industries due to poverty, is also vulnerable.

## 7. HEALTH AND SOCIAL RISKS OF EXPOSURE TO LEAD

The health and social consequences of exposure to lead are serious. It is of particular concern that some of the effects endure long after the source of exposure has been removed, and may be permanent or irreversible (Silbergeld, 1997).

### *7.1 Health Effects at High Levels of Exposure*

The detrimental effects of lead have been known for centuries. However, increasingly sophisticated studies undertaken in recent decades in particular, have given a finer understanding of the environmental transport and wide-ranging detrimental effects of lead on human health. Lead can have serious consequences for the health of children in particular. At very high levels of exposure (around 100 µg/dl or higher in blood), lead attacks the brain and central nervous system, causing coma, convulsions and even death.

Some of the most serious recent outbreaks of lead poisoning have occurred in African countries. These include lead poisoning from artisanal gold mining in Zamfara, Nigeria (Lo et al., 2012) and Kabwe, Zambia (Yabe et al., 2015) and from the dismantling of batteries in Senegal (Haefliger et al., 2009). In 2012 in South Africa there was an outbreak of lead poisoning amongst users of Ayurvedic medicines in the Durban area (Mathee et al., 2015).Children who survive severe lead poisoning may be left with mental retardation and behavioural disorders.

Acute, high concentrations of lead in blood, for example above 70 µg/dl, can produce severe kidney abnormalities. Initially this may be reversible but if lead exposure continues, irreversible chronic effects may result. Gastro-intestinal abnormalities (anorexia, nausea, vomiting, stomach cramps) are likely to occur (WHO, 2010a) at levels ≥50 µg/dl. At blood levels ≥40 µg/dl, lead affects the activity of enzymes needed for the proper functioning of red blood cells, leading to anaemia. Lead also decreases the life span of red blood cells, further contributing to the development of anaemia. Haemolyticanaemia occurs when high levels of lead exposure occur over a short period of time. Blood lead levels ≤30 µg/dl affect Vitamin D metabolism and calcium levels, leading in turn to abnormal growth and bone development(WHO, 2010a).

### *7.2 Effects at Low Levels of Lead Exposure*

At lower levels of exposure that cause no apparent symptoms, and that previously were considered safe, lead is now known to cause a spectrum of effects across multiple body systems. For example, low blood lead concentrations have been associated with decreased IQ scores, behavioural abnormalities (such as lowered concentration spans and hyperactivity) and aggressive or antisocial behavior (Lanphear et al., 2005, Bellinger and Dietrich, 1994, Needleman et al., 2002).

### *7.3 Lead and Behaviour*

Lead is also associated with behavioural problems, including characteristics of Conduct Disorders and Oppositional Defiant Disorders (DSM IV). This type of

behaviour includes temper tantrums, argumentativeness, active defiance and refusal to comply with adult requests and rules, deliberate attempts to annoy and upset people, frequent anger and resentment, mood instability, substance abuse, aggression towards people and animals, destruction of property, and deceitfulness, lying or stealing (Faraone et al., 2000). The longitudinal Cincinnati Lead Study showed that in children aged between 15 and 17 years there was a significant association between lead exposure and antisocial behavior (Bellinger, 2008b, Dietrich et al., 2004). The longitudinal Port Pirie Cohort in Australia study found similar results(Burns et al., 1999).

### *7.4 Aggression, Violence and Criminal Behaviour*

Studies have shown that antisocial or aggressive behaviour in childhood may result in criminal activity later in life(Liu and Wuerker, 2005). Evidence from ecological and cross-sectional studies conducted in the USA suggests that lead exposure and criminal activities are significantly associated with each other ((Wright et al., 2008, Stretesky and Lynch, 2001, Nevin, 2007, Nevin, 2000). In 2012 Naicker et al. conducted a study of lead exposure in Soweto adolescents. The researchers found that 13 year old boys with elevated blood lead levels (mean 6.3 µg/dl) were more likely to exhibit socio-behavioral problems (attacking people, arguing) (Naicker et al., 2012a). Using the same cohort, Nkomo et al found significant associations between lead exposure and both aggression and violence in boys and girls at age 15 years (Nkomo et al., 2017, Nkomo et al., 2018).

### *7.5 Cognitive Decline in the Elderly*

Over the past decade studies have highlighted the impact of chronic and cumulative lead exposure on cognitive decline in elderly men and women (Weisskopf et al., 2007, Shih et al., 2006). Cognitive decline has been shown to be a strong predictor for the development of dementia (Blacker et al., 2007). In addition to the neurological effects of cumulative lead exposure, lead adversely affects the cardio-vascular system and results in adult hypertension, ischaemic coronary heart disease, cerebrovascular accidents, and peripheral vascular disease (Vaziri and Gonick, 2008).

## 8. SOURCES OF LEAD IN SOUTH AFRICA: SELECTED RESEARCH STUDIES

Leadis widely used in modern South African society andmay be found in air, soil, dust andwater.Lead is one of the priority air pollutants of concern in South Africa.

Lead and lead compounds are and have been used in a wide variety of products found in and around our homes, including lead-based paint, ceramics, glazed pottery, pipes and plumbing materials, electrical cords, solders, batteries,ammunition, metal jewelry and cosmetics, resulting in increased lead exposure in the environment, including, homes, schools and the workplace.

The characteristics of lead have made it a highly versatile substance in modern society, and it has been used in a range of products including protective equipment (e.g. x-ray shields and fire protection gear), petrol (phased out in South African in 2006), paint, cabling, hair dye, computer and electrical equipment, wheel balancing weights, arms, ammunition and fishing sinkers (Tong et al., 2000).

### *8.1 Petrol*

Lead additives used in petrol have been one of the most important sources of lead exposure worldwide. In South Africa, where some of the highest concentrations of lead were used in petrol, the vast majority of urban children in the 1980s and 1990s had blood lead concentrations that exceeded international guideline levels. In particular, the blood lead levels of children who lived or attended schools in close proximity to busy roads were significantly elevated (von Schirnding et al., 1991b, von Schirnding et al., 1991a).
Following in the footsteps of many other countries South Africa started lowering the maximum permissible concentration of lead in petrol in the 1980s, and finally phased out the use of leaded petrol on 1 January 2006.

Studies of first grade school children undertaken in South Africa have shown how phasing out of petrol lead has been followed by declines in blood lead levels (Mathee et al., 2006, von Schirnding et al., 2001).

### *8.2 Paint*

Historically lead poisoning was referred to as ***painter's colic*** or ***painter's palsy***, and there is an old saying ***"crazy as a painter"*** referring to the strange and manic behavior of lead-poisoned painters. Famous artists such as Goya and van Gogh are thought to have suffered from lead poisoning. Lead is added to paint to fix the pigment, increase durability and speed up the drying process. Over time, as paint weather, flakes or peels from paint surfaces, lead particles may be released intothe surrounding environment, with soil and dust serving as important sinks for lead.

In South Africa lead paint has been widely applied to buildings and various items. A study undertaken across Johannesburg showed that around 20% of dwellings had been decorated with lead paint (Montgomery and Mathee, 2005). Elevated concentrations of lead have also been found in paint applied to children's playground equipment (Mathee et al., 2009), toys and new paint purchased from paint stores (Mathee et al., 2007).Paint chips or flakes may be dislodged from toys during handling or play. Children with pronounced mouthing behavior, or with pica, are at particular risk. A small screening study of children's toys in South Africa showed lead levels up to 145 000 ppm in the applied paint (compared to an international guideline level of 90 ppm). The toys had been purchased from major toy stores, supermarkets, stationery stores and flea markets, and were of local as well as international origin (Mathee et al., 2007). A study of the lead content of paint applied to playground equipment in Johannesburg, Pretoria and Ekurhuleni was undertaken in 2008. In the 49 play parks included in the study, 48% of the measurements exceeded the lead reference level of 1 $mg/cm^2$ in force at the time, and lead paint was found in 96% of the parks studied (Mathee et al., 2009).

### *8.3 Lead Exposure in Mining Areas*

The town of Aggeneys, located in the far north-western part of South Africa, near the border with Namibia, was developed to support the operation of a lead mine. A survey of the blood lead levels of young school children in Agency, and in the comparison non-mining town of Pella, around 40 kilometers away, showed that despite a higher socio-economic status (usually a protective factor), blood lead levels in Agency children were significantly elevated relative to their Pella counterparts. The mean blood lead level in Agency was 16 µg/dl, compared to 13 µg/dl in Pella. In Agency and Pella respectively, 98% and 85% of children had blood lead levels $\geq$ 10 µg/dl. Elevated blood lead levels were associated with having a father who worked in the mine (von Schirnding et al., 2003).

### *8.4 Lead Exposure in Subsistence Fishing Communities*

A study undertaken in two remote fishing villages in South Africa in 2012 showed that 18% of households had a member who regularly melted lead. Lead collected from the shoreline (lost fishing sinkers), from wheel-tyrecenters and from metal recycling depots, was usually melted in the yard of the dwelling, or inside the home. Children in 11% of households usually watched as lead was being melted, and 4% of children had themselves melted lead.In two households (n = 160) a member had accidentally swallowed a lead sinker (6% of children had been observed to place lead sinkers in their mouths), and one had been burned by

molten lead. Only 20% of the study respondents were aware of the health hazards of lead (Mathee et al., 2013).

Blood lead levels in the study children, who were in grades 0, 1 and 2 (their ages ranged from 6 to 14 years, with the mean age being 7.5 years), ranged from 2.2 to 22.4 µg/dl, with the mean level being 6.9 µg/dl. Nearly three quarters of the children studied had blood lead levels of 5 µg/dl or higher (the current reference level in the USA - (Betts, 2012). Further details of the blood lead distribution are given in the table below.

**BLOOD LEAD DISTRIBUTIONSIN REMOTE SOUTH AFRICAN SUBSISTENCE FISHING COMMUNITIES (µg/dl)**

| Town | Geometric Mean (95% CI ) | Median | Range | % ≥ 5 µg/dl | % ≥ 10 µg/dl |
|---|---|---|---|---|---|
| Struis Bay | 6.5 (5.83 ; 7.13) | 6.1 | 2.2 to 17.8 | 71.6 | 9.9 |
| Elands Bay | 8.2(7.29 ; 9.19) | 7.2 | 2.4 to 22.4 | 76.0 | 21.5 |
| **Total** | **6.9** | **6.1** | **2.2 to 22.4** | **73.8** | **15.6** |

### *8.5 Lead Exposure in the Users of Arms and Ammunition*

A comparative study of blood lead concentrations in users of shooting ranges in Gauteng indicated a four-fold elevation of the blood lead concentrations of gun shooters relative to users of archery ranges (Mathee et al., 2017a). A total of 118 (87 shooters and 31 archers) were included in the analysis. Amongst shooters 42.4% had blood lead levels ≥ 10 µg/dL, compared with only 5.9% of archers. The highest blood lead levels were found in staff at the indoor shooting ranges. There were concerns regarding poor hygiene and safety practices at the shooting ranges, such as eating and drinking within shooting areas, including amongst child users of the shooting ranges (Mathee et al., 2017b).Groups who may be at risk of lead exposure from regular use of, or presence in, shooting ranges, include police officers, certain officials in the Department of Defense, conservations, recreational shooters and hunters.

### *8.6 Traditional Medicines*

In September 2012, the South African media reported that around eight young people were being treated for lead poisoning in Durban. All those affected had

ingested an Ayurvedic treatment for acne, which was confirmed by laboratory analyses to have a very high lead content (Mathee et al., 2015). The product had been imported into South Africa from India via an internet supplier, and sold to the general public from health shops as well as through a direct sales network. The case raises serious concerns about public health risks from contaminated "traditional" or "natural" medicines, and the limitations of public health protection mechanisms in place in South Africa and other African countries in this regard.

### *8.7 Certain Cultural or Traditional Practices*

Geophagia (the deliberate ingestion of soil) is defined as a form of pica, and has been practised for centuries. The motivations for the practice ofgeophagia are poorly understood, but amongst the reasons postulated are religious beliefs, cultural, nutritional and medicinal practices, as well as famine, perceived enhancement of appearance and pregnancy-related cravings. In a study undertaken in Dar es Salaam (Tanzania) around 64% of pregnant and breastfeeding women had pica, with soil being the most common substance ingested (Nyaruhucha, 2009), while 74% in a group of pregnant women from Nairobi (Kenya), reported the habit (Ngozi, 2008). Ingestion of soil has also been shown to interfere with the bioavailability of micronutrients (leading to micronutrient deficiencies), geohelminthic infections, anemia, hypokalemia, peritoneal mesothelioma and intestinal obstruction or perforation (Thihalolipavan et al., 2012, Klitzman et al., 2002, Abrahams, 1997). Geophageousbehaviour may also increase exposure to metal contaminants in the soil, including arsenic and lead. In a study undertaken in the City of New York, women with pica were shown to have higher blood lead levels compared to their counterparts who did not practice pica (Thihalolipavan et al., 2012).

In a cross-sectional study of 307 pregnant women attending ante-natal clinics at the RahimaMoosaMother and Child Hospital in Johannesburg, 23% reported practicing pica, with one fifth specifically reporting that they ingested soil during pregnancy. Geophagia was particularly prevalent in women who had been born elsewhere on the African continent(Mathee et al., 2014). Since the placenta is a poor barrier to the transmission of lead from mother to child, the study points to a need for further research on blood lead levels in pregnant women prone to geophagia, and well as in their newborns (Mathee et al., 2014).

### *8.8 Para-occupational Exposure to Lead*

Protective measures, such as legislation, enforcement capacity, safety gear, monitoring and surveillance initiatives and awareness programmes, which are

usually strictly enforced in developed countries to prevent occupational exposure to lead, are often absent or weakly enforced in many African countries. Limited awareness of the hazards of lead may underlie risky behaviour in the workplace, such as eating, drinking and smoking in lead exposed workplace settings, and limited hand washing (Adela et al., 2012). Poor workplace practices in lead-related occupations may also pose a risk of lead exposure to the children and families of workers, since lead particles may be transferred from work to home via workers' hair, skin, clothing, footwear and vehicles (Chiaradia et al., 1997). Studies undertaken in the lead mining town of Aggeneys in the Northern Cape similiarly showed that the children of fathers who worked at the mine had higher blood lead levels than other children (von Schirnding et al., 2003). Though occupational lead exposure is not a focus of this document, para-occupational exposure is a concern for the broader public, and needs attention.

### *8.9 Cottage Industries*

South Africa has a considerable informal economy. Cottage industries constitute a sub-group within the informal economy usually involving small enterprises in which one or more members of a family or household work from the home setting. When hazardous substances are used in cottage industries, all members of the family may be exposed. Cottage industries associated with subsistence fishing, battery recycling, electrical repairs and jewellery for example, may cause lead exposure amongst all who reside in (or close to) the home (even if they are not directly involved in the work/industry). Women, young children and those with pre-existing ill health conditions, who spend a considerable portion of their days in the home setting, may be particularly vulnerable. Lead exposure in cottage industries may be worsened by limited knowledge and awareness of the associated risks. A study undertaken in five settings of poverty in Johannesburg showed that in certain neighbourhoods, as many as 37% of households operated one or more cottage industries, many of which involved the use of lead (Teare et al., 2015).

### *8.10 Traditional alcoholic home-brewed drinks*

Traditional, home-brewed alcoholic drinks are popular in many African cultures (Mosha 1996). Home brews are usually made from fermented products, but various formulations may include additional constituents, some of which may have harmful health effects. A detailed study of the methods and ingredients used in making of Khadi, a popular traditional African beer in Botswana, found that in some instances, the contents of lead acid batteries were being added to enhance potency (Pitso, 2006). It has also been shown that high temperature processing, elevated acidity and prolonged storage in metal containers may contribute to the

highly elevated levels of lead in certain African beers (Mosha et al, 1996). An analysis of a range of traditional beers in Dar es Salaam, Tanzania, revealed lead levels ranging from 0 to 0.82 ppm (Mosha et al., 1996).

### *8.11 Artisanal Cookware*

Little is known about the lead content of food prepared in certain metallic cookware in South Africa. A study of the amount of lead leaching from aluminium-type cooking pots in Cameroon raised high levels of concern. The pots are made in the informal sector from scrap metal, including car parts. While the lead content of the cookware was shown to be relatively low, significant amounts of lead (as well as aluminum and cadmium) were released into a dilute acetic acid solution during boiling orwhen left at ambient temperature. Potential exposures to lead per serving were estimated to be as high as 260 µg, indicating that such cookware may pose a serious health hazard (Weidenhamer et al., 2014). Preliminary studies of similar cookware in South Africa indicate that lead leached from the cookware, with 45 – 60% of samples tested leaching lead concentrations exceeding the maximum European Union permissible level of 10 µgPb $L^{-1}$(Street et al., 2019).

### *8.12 Ceramic ware*

Lead may be used in the pigments, as well as the glaze coating applied to ceramic ware. Following the discovery that an importation restriction had been imposed on certain items of ceramic ware from South Africa, the SAMRC undertook a screening study of the lead content of ceramic flat plates and shallow ware. Preliminary results showed that lead was determined in 59% of the 44 items of ceramic ware studied, but that leaching of lead from the ceramic ware occurred in only 2% of samples (Mathee A, unpublished data).

### *8.13 Cosmetics*

In a study undertaken in South Africa, elevated lead concentrations were found in lip liner, oil absorbent powder, mascara, concealer, lipsticks, lip gloss, and foundation. The researchers found that in a significant proportion of samples, lead levels exceeded the recommended limit of 0.10 µg/g set by the United States Food and Drug Administration (USFDA). In lipstick for example 75% of 40 samples had elevated lead concentrations. Theresearchers concluded that continuous use of cosmetic products in which lead concentration exceeds the maximum permissible level may pose a health hazard for users in South Africa over time(Brandao et al., 2012).

### *8.14 Lead acid batteries*

Lead-acid batteries (LABs) are secondary batteries that are rechargeable, where lead and lead oxide reacts with the sulphuric acid electrolyte to produce a voltage. These batteries are commonly fitted in vehicles, and if no longer usable, are regarded as waste. A typical automobile battery contains 8 - 9 kg of lead (plates) and 5 kg of sulphuric acid, and if handled improperly, poses hazards to human health and the environment. The same applies to spent lead acid batteries (SLAB) if improperly managed. SLABs are safe but can become hazardous when touching damaged cells, trying to smelt lead plates on an open fire and when handling the acids. (http://sawic.environment.gov.za/documents/4949.pdf ; Accessed 31/10/2019).

## 9. THE ECONOMIC COST OF LEAD EXPOSURE IN SOUTH AFRICA

A recent health economics study conservatively estimated that annually, around 98.2 million IQ points are lost in Africa due to lead exposure, translating into economic losses of US$ 134.7 billion. The economists who undertook the study excluded the economic impact associated with the role lead plays in other outcomes such as cardiac disease and violent or criminal behavior; the true societal cost of lead exposure is thus likely to be considerably higher. With an annual loss of around R248 billion, South Africa was ranked as the second biggest economic loser in Africa as a result of lead exposure (only Egypt ranked higher) (Attina and Trasande, 2013).

## 10. PROGRESS AND ACHIEVEMENTS UP TO NOW

### *10.1 Research*

While South Africa has no blood lead surveillance programme in place, and no complete picture of the human lead exposure situation exists, researchers at various tertiary institutions and science councils, especially the South African Medical Research Council, have undertaken a range of epidemiological studies and other investigations to describe the lead exposure situation in various groups and locations in various parts of the country (Harper et al., 2003, Kootbodien et al., 2012, Mathee, 2012, Mathee et al., 2017b, Mathee et al., 2017a, Montgomery and Mathee, 2005, Mathee et al., 2013, Mathee et al., 2014, Mathee et al., 2015, Mathee et al., 2007, von Schirnding et al., 2003, Rollin et al., 2009, Norman et al., 2007, Nkomo et al., 2018, Nkomo et al., 2017, Naicker et al., 2012b, Naicker et al., 2010b, Naicker et al., 2010a, Naicker et al., 2013, Naicker and Mathee, 2015,

Ehrlich et al., 1998, Robins et al., 1997, Mathee, 2014, Haman et al., 2015, Rollin et al., 2007, Grobler et al., 1986, Grobler et al., 1996). The information generated through these studies has allowed for the identification of some of the key risk groups and settings, and provided a basis for lobbying for important interventions, especially the phase-out of leaded petrol and controls on the use of lead in paint.

Some studies on potential lead exposure in cosmetics as well as environmental media (i.e. soil, water, grass leaves have been conducted, however more research in the areas is required to understand the cause effects to promote lead exposure prevention awareness raising and to inform policy improvement (Okonkwo, et al. 2004 and 2011; Edokpayi, et. al. 2018).

### *10.2 The Phase-Out of Lead in Petrol*

Along with African countries such as Zambia, Kenya, Madagascar, Ghana and Senegal for example, South Africa finally phased lead out of petrol on 1 January 2006. This was an important public health achievement, since, for decades, lead additives in petrol was the primary source of childhood exposure to lead. South African children who lived or attended schools close to busy roads had significantly elevated blood lead levels relative to their counterparts 50 – 100 metres, or further way(von Schirnding et al., 1991b, von Schirnding and Fuggle, 1996). Studies undertaken in the years following the reduction of the maximum permissible petrol lead level, and eventually the phase-out of leaded petrol in South Africa, indicated the benefits to children (Mathee et al., 2006, von Schirnding et al., 2001).

According to the 2006 South African State of Environment Outlook Report, despite increasing number of vehicles on the road, there is improvement in vehicle emission standards and lead emissions have ceased to be a problem.

### *10.3 Control of the Lead Content in Paint*

The research study of a first grade Johannesburg school girl with an exceptionally high blood lead concentration by the SAMRC revealed the girl had a blood lead level of 52 µg/dL, relative to the survey average of less than 10 µg/dL. Investigations by the research team showed that the girl had a strong pica habit (the ingestion of non-food substances such as paint and soil). She had been removing and eating paint from the walls of both her home and school. The analysis of paint samples collected from both settings showed levels of lead grossly exceeding international reference levels in place at the time. Researchers found that South Africa had no legislation in place to control lead in paint – the

industry was using voluntary agreements to limit the use of lead in paint, which most manufacturers were not adhering to.

The fortuitous discovery from the 2007 first grade Johannesburg school girl study and the demonstration of highly elevated lead levels in paint applied to homes (Mathee et al., 2004), playground equipment (Mathee et al., 2009a), children's toys and from new paint purchased from hardware stores (Mathee et al., 2007) is to be credited for convincing DOH to promulgate regulations to limit the lead content of paint (RSA, 2009), of which South Africa became the first country on the African continent to regulate the lead content of paint. By February 2017 South Africa was one of only 64 countries (and the first on the African continent) that had confirmed the promulgation of legally binding lead paint control measures in 2009, although it still has to achieve regulating prohibition on the supply of lead based paints by reducing the maximum permissible concentration of lead from 600 ppm to 90 ppm, and making provision for the the application of the regulations to all paints and coatings produced and used in South Africa.

The South African Paint Manufacturing Association of South Africa (SAPMA) has been campaigning since 2004 for the lowering of levels of lead in industrial paint and for offending manufacturers using lead pigments with lead levels of higher than 600pmm.

### *10.4 Phase out of lead in cosmetics*

The supply of cosmetics containing lead and its compounds is prohibited in the country as prescribed in Government Notice No. R.1861 of 10 August 1990, Lead and its compound is prohibited to be sold, manufactured or imported in terms of Regulations Prohibiting the Use of Any Active or Potentially Active Depigmenting Ingredient, Lead and its Salts, Mercury and its Salts and the Cosmetic Category Skin Bleacher, Skin Lightener or Skin whitener, under the Foodstuffs, Cosmetics and Disinfectants Act, 1954 (Act 54 of 1972), which is administered by DOH.

This Regulations will be repealed by the Regulations relating to the Labelling, Advertising, and Composition of Cosmetics, Government Gazette 40216, R.921, which was published for public comment on 19 August 2016. This Regulation will still prohibit the supply, manufacturing or importation of lead and its compounds.

### *10.5 Protection of workers to exposure to lead*

The Department of Labour (DOL) has developed the Hazardous Chemical Substances Regulations, 1995 Occupational Health and Safety Act, 1993, which

prescribe Biological Exposure Indices for Lead in blood and urine of exposed workers to serve as reference values intended to be guidelines for the evaluation of potential health hazards in the practice of industrial hygiene. However, these Regulation has been currently reviewed and published for public comment in September 2018.

DOL is also administering the Lead Regulations, Government Notice R. 236,28 February 2002, under the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), which provides for protection of workers and other people from exposure to lead in excess of the prescribed occupational exposure limits.

### *10.6 Control of Lead in domestic water*

The country has adopted a National Standards, SANS 10241, which prescribes the acceptable limit of lead (≤10µg/L )in drinking water and minimum sampling frequencies. This healthrelated standards is based on the consumption of 2L of water per day by a person of a mass of 60 kg over aperiod of 70 years. The compliance of supplied and used water with this standard is further enforced in Regulations Governing General Hygiene Requirements forFood Premises, The Transport of Food And Related Matters, Government Notice R. 628,22 June 2018, under Foodstuffs, Cosmetics and Disinfectants Act, 1954 (Act 54 of 1972); and in the National Environmental Health Norms and Standards For Premises and Acceptable Monitoring Standards for Environmental Health PractitionersGovernment GazetteNo. 39561, 24 December 2015

### *10.7 Control of Lead acid batteries*

In South Africa, SLABs are mainly managed through recycling and this has proven to be a general trend worldwide. The legal requirement for the South African battery industry to introduce a battery collection system known to the industry as a "scrap deposit", became introduced since 1942.

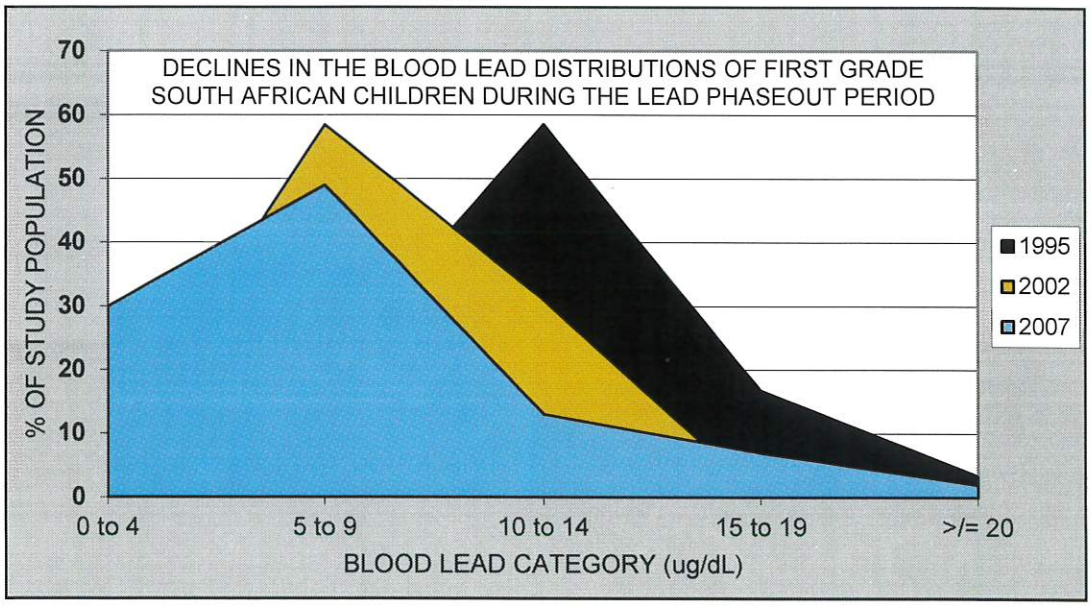
Furthermore, SLABs are also regulated as waste in the country in terms of theNational Environmental Management: Waste Act, 2008 (Act59 of 2008) as amended. SLABs waste is further controlled through waste Norms and Standards and Regulations under the Waste Act, in terms of the declaration of priority waste, extended producer responsibility, listed waste management activities, industry waste management plans, contaminated land, and other measures to protect human health and the environment (DEA document accessed March, 27, 2019 from website http://sawic.environment.gov.za/documents/4949.pdf ).

### *10.8 Raising Awareness of Lead Hazards in South Africa*

The (DOH) conducted the first lead hazard awareness campaign in South Africa in 2009. Since then the Department has driven or supported several other lead hazard awareness campaigns in collaboration with the South African Medical Research Council (SAMRC), focussing on specific sources, such as paint and lead exposure in subsistence fishing communities. Action to raise public awareness of lead hazards has also been undertaken at provincial and city or town level, for example by the Environmental Health department of the City of Johannesburg. A number of awareness raising materials (i.e. posters, leaflets,) on lead hazards have been developed.

## 11. LEAD EXPOSURE PREVENTION IN SOUTH AFRICA: THE UNFINISHED AGENDA

The removal of lead from petrol and paint, as well as the initiation and periodic conduct of lead hazard awareness campaigns in South Africa have undoubtedly contributed to reduced blood lead distributions in South African children. This was demonstrated by periodic indicator surveys
conducted by the South African MedicalResearch Council in the late 1980s, as well as in the early 1990s, and again in 1995, 2002 and 2007.




Since 2007 however, no new surveys have been undertaken to ascertain current blood lead distributions in South African children. Instead research focused on specific groups, such as children living in subsistence fishing communities, to

show that certain groups of South African children remain at high risk of lead exposure, and its health and social consequences.

### *11.1 National Blood Lead Survey*

What is currently known about childhood lead exposure has been ascertained through ad hoc, small-scale studies. While these have been useful, they do not give the comprehensive picture needed for framing and launching a national public health programme to prevent or reduce lead exposure.

### *11.2 Identifying the Places and People at Risk*

The identification of places where South Africans may be exposed to environmental lead is an important early step in a public health effort to reduce lead exposure. Such places may include the areas with mining, lead use industries, paint industries, cottage industries, local recreational parks with children's playgrounds, schools, crèches, coastal towns and villages or towns with rivers, lakes and damsand using boreholes as main source of water. The use of simple, readily available GIS technology to map high risk areas would provide a useful tool for lead exposure prevention action in South Africa.

Data from the national lead exposure risk map and the national blood lead surveywill assist in identifying those places and groups at highest risk of lead exposure, where universal lead screening might be implemented. Some countries have achieved this by adding a blood lead test to the Road to Health Card, and in liaison with the local education authorities, requiring that children be testing before being admitted to their first year of schooling. In time, a lower cost alternative may be developed, such as a screening questionnaire.

### *11.3 Reference Blood Lead Levels for Children*

Unlike many other metals, such as iron and zinc, lead performs no useful function in the human body – it only causes harm. Many countries have implemented blood lead standards or reference levels as part of their national lead exposure reduction strategies. The Centers for Disease Control and Prevention (CDC) in the United States of America, for example, has set a reference level for lead in children's blood at the 97.5$^{th}$ percentile of the distribution in that group – currently it equals 5 µg/dl(Betts, 2012). Similarly, in France, the 98$^{th}$ percentile of the blood

lead distribution in children under the age of 7 years equals 5 µg/dl (Etchevers et al., 2015).

South Africa has never developed blood lead reference levels, and associated response protocols for children. Blood lead reference levels for children (and adults) are at the heart of any lead exposure reduction strategy, and needs to be urgently developed for South Africa.

### *11.4 Law enforcement*

Enforcement of various available laws in the country by various stakeholders such as Provincial and Municipal Department of Health, National and Provincial Department of Environmental Affairs, Provincial Department of Labour, Department of Water Affairs, is key to monitor exposure to lead through various sources such as paint, cosmetics, portable water, air, and soil.

### *11. 5 Awareness raising*

Limited awareness raising on lead exposure hazard has been done, this far. A need for more awareness activities at all municipalitiesto cover a larger population. The need for education reach out to vulnerable potential lead exposure industry workers by industries and the Labour sector cannot be ignored.

## 12. KEY ACTIONS OF THE SOUTH AFRICAN NATIONAL LEAD EXPOSURE REDUCTION STRATEGY

A number of actions are still required from various stakeholders in the country to curb exposure to lead among human and in the environment.
Annexure A outlines activities and role players recommended for implementation of the National Lead Exposure Prevention Programme for South Africa. The identified actions are centered around achieving the following goals:

**Goal 1:** Eliminate the exposure of South African communities to lead hazards by 2025.
**Goal 2:** Ensuring appropriate medical, educational, nutrition, developmental, other environmental lead hazard control and research interventions.
**Goal 3:** Develop a Lead Exposure Surveillance and Monitoring System to identify trends, high risk areas and to determine best practices for primary prevention.
**Goal 4:** Develop approaches to address gaps identified in current laws and regulations; and to track progress towards achievement of set Strategy activities.

Each stakeholder shall ensure that required resources are made available to ensure implementation of the Strategy planned actions.

## 13. REVIEW OF THE STRATEGY

The content of this strategy is a living document and will be periodically reviewed and updated as the need arises to determine whether it is being implemented and to ensure it stays relevant. Various means of reviewing the Strategy will be used, which will not be limited to surveys, stakeholder workshops, data and progress report analysis. The established National Lead Exposure Prevention Working Group (NLEPWG) will be responsible for review of the Strategy.

## 14. CONCLUSION

Lead poisoning is an entirely preventable disease, and no South African child, or adult, should have to bear the health and social consequences of lead exposure. It is evident that lead exposure, through its known pathways is common in South Africa. Research in recent years has shown that certain lead-related health effects may be irreversible, and persist long after the source of exposure has been removed. Lead exposure and poisoning are not randomly distributed in the South African population, however, many sources of lead exist, to which the South African public may potentially be exposed in the places in which they live, learn, play and work. Young children and unborn foetuses are particularly vulnerable because of the incomplete stage of development of their organ systems.

The poor and disadvantaged are also at particular risk of lead exposure because they are more likely to live in contaminated environments, dilapidated and degraded dwellings, and to hold jobs with a high risk of handling lead. The apartheid system of government, which contributed to racial discrimination and inequalities in the standard of education, housing, income and employment, played a key role in which poor African communities have the highest levels of lead exposure. The variations in levels of lead exposure by economic status and skin colourstill persist to this day.

Action to protect the South African population against lead exposure has unfortunately been particularly patchy, and has lagged behind in other regions. As is the case elsewhere in Africa, lead exposure reduction efforts in South Africa may face complex challenges and obstacles. A strategy to address lead exposure will have to grapple with a broad array of local sources of lead, in the formal as well as informal sectors.

The various sources of exposure, show the need for a comprehensive, concerted and multi-faceted effort that is now required to implement the measures needed to protect the South African population. This South African National Lead Exposure Prevention Strategy constitute an important step for South Africa. It responds to the calls from the international arena as discussed and also makes an important contribution to South Africa achieving its Sustainable Development Goals.

The Strategy outlines a path towards significantly lowered levels of lead exposure and poisoning in South Africa, and in so doing increased the potential for South Africans and especially children to live healthy lives and reach their full potential in life, especially the poorest.

**Annexure A**

| KEY ACTIONS OF THE SOUTH AFRICAN NATIONAL LEAD EXPOSURE REDUCTION STRATEGY | | | | | |
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| **FOCUS AREA 1. RESEARCH AND DEVELOPMENT** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | **ESTIMATED COSTS FOR KEY ACTIVITIES** |
| | Conduct a Blood Lead survey of a nationally representative sample of children and adults | • Identify random, nationally representative sample;<br>• Conduct surveys at baby clinics;<br>• Data analysis;<br>• Preparation of report;<br>• Dissemination of study findings.<br>• | SAMRC | March 2024 | R5 million |
| | Conduct universal screening in high risk areas | • Develop questionnaire-based screening tool.<br>• Conduct screening of children for blood | SAMRC<br>DOH-Child Health | March 2024 | R2 milion |

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| | | lead in high risk areas, in collaboration with Child Health Programme in the DOH. | | | |
| | Conduct research on lead sources and pathways of exposure in designated high risk areas. | • Develop a research proposal.<br>• Facilitate approval of the proposal.<br>• Conduct research study.<br>• Compile a lead risk map for South Africa | SAMRC<br>CSIR<br>DWA<br>Academic Institutions | March 2024 | R2 million |
| | Conduct research on lead concentration and exposure from environmental media (soil, water and air) and e-waste and possible human health impact | • Develop a research proposal.<br>• Facilitate approval of the proposal.<br>• Conduct research study | CSIR<br>DWA<br>Water research commission<br>Academic Institutions | Ongoing | R500 000.00 |
| | Conductresearch on lead concentration compliance and exposure in other cosmetics (nail polish, lipstick, hair dye, etc) | • Develop a research proposal.<br>• Facilitate | SAMRC<br>CSIR<br>Academic Institutions | Ongoing | R300 000.00 |

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| | | approval of the proposal.<br>• Conduct research study | | | |
| | Conduct research on lead content compliance in paint, children's furniture, toys and play equipment following the revised 90ppm permissible lead limit content. | • Develop a research proposal.<br>• Facilitate approval of the proposal.<br>• Conduct research study | SAMRC<br>CSIR<br>Academic Institutions | Ongoing | R250 000.00 |
| | Conduct research to determine whether maternal and newborn blood lead (and other metals) are elevated in women who practice geophagia. | • Develop a research proposal.<br>• Facilitate approval of the proposal.<br>• Conduct research study.<br>• Develop an ante-natal risk assessment questionnaire to be administered during the first antenatal visit. | SAMRC<br>CSIR<br>Academic Institutions | Ongoing | R450 000.00 |
| | Conduct reviews and cost-benefit analyses of lead-safe | • Develop a | SAMRC<br>CSIR | March 2023 | R75 000.00 |

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| | alternatives. | research proposal.<br>• Facilitate approval of the proposal.<br>• Conduct research study | Academic Institutions | | |
| | Conduct research on exposure to lead in workplaces, including workforce blood lead surveys in the South African Police Service (SAPS) and South African National Defence Force(SANDF) | • Develop a research proposal.<br>• Facilitate approval of the proposal.<br>• Collaborate with SAPS and with SANDF<br>• Conduct research study<br>• Collaborate with Department of Labour to reduce maximum permissible blood lead levels for workers to 5 µg/dL | SAMRC<br>CSIR<br>Academic Institutions | March 2022 | R1.2 million |
| | Conduct a desktop study and propose recommended mechanisms to control exposure to lead from various sources, including<br>o Shooting ranges of government intuitions e.g. Metro police, SAPS; Defence)<br>o Cookware; | • Develop a research proposal.<br>• Facilitate approval of the proposal.<br>• Conduct research study | SAMRC<br>CSIR<br>Academic Institutions | March 2022 | R120 000.00 |

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| | o Ceramic ware;<br>o Batteries;<br>o Solder;<br>o Etc | | | | |
| | Conduction of research to determine if DEA Norms and Standard for contaminated land, current threshold for Lead (20 mg/kg for water resource protection; 110 mg/kg for Informal Settlement Areas; 230 mg/kg for Residential areas and 1 900mg/kg for Commercial and Industrial areas) offer communities sufficient protection from a public health perspective. | • Develop a research proposal.<br>• Facilitate approval of the proposal.<br>• Conduct research study | SAMRC<br>CSIR<br>Academic Institutions | March 2023 | R1.2 million |
| **FOCUS AREA 2<br>TRAINING AND CAPACITY BUILDING** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Train Environmental Health Practitioners (EHPs) on Lead in paint Regulations, the epidemiology of lead poisoning, lead exposure pathways, sources, investigation and prevention of outbreaks of lead poisoning; lead based paint hazards and key South African stakeholders that have role to play in lead exposure prevention | • Develop training manual and innovative training and awareness tools such as video, social media etc.<br>• Develop training project plan,<br>• Implement training project plan, | DOH | March 2022 | R240 000.00 |

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| | | • Evaluate training | | | |
| | Train Air Quality Officers on Lead as a priority pollutant, sources of lead in the environment, impacts of lead exposure in human health and the environment, the regulation of Lead in the Air Quality Legislations of the country. | • Develop training manual and innovative training and awareness tools such as video, social media etc,<br>• Develop training project plan,<br>• Implement training project plan,<br>• Evaluate training | DEA- Air Quality , supported by DOH-Environmental Health | March 2022 | R200 000.00 |
| | Train health care personnel on lead poisoning epidemiology, lead exposure pathways, sources, blood lead screening, lead poisoning and nutrition,key South African stakeholders that have role to play in lead exposure prevention. | • Develop training manual and innovative training and awareness tools such as video, social media etc,<br>• Develop training project plan,<br>• Implement training project plan,<br>• Evaluate training | WHO, NICD supported by DOH Environmental Health and Primary Health Care | March 2022 | R180 000.00 |
| | Train Labour Health and Safety | • Develop training | DOL | March 2022 | R160 000.00 |

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| | Inspectors on Lead Regulations, lead exposure pathways, sources,lead poisoning epidemiology, prevention measures among workers andkey South African stakeholders that have role to play in lead exposure prevention. | manual and innovative training and awareness tools such as video, social media etc,<br>• Develop training project plan,<br>• Implement training project plan,<br>• Evaluate training | | | |
| | Advocate for the inclusion of lead pathways, sources, health hazards and exposure prevention in the school curricula. | • Conduct school curriculum content assessment,<br>• Compile assessment report,<br>• Develop educational materials,<br>• Submission to review curriculum if necessary, and<br>• Develop educational materials | DBE | March 2021 | R75 000.00 |
| | Assess the inclusion of lead | • Conduct EHP | DOH – Environmental | March 2021 | R75 000.00 |

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| | hazard and lead exposure management in the EHP curriculum and advocate inclusion thereof | curriculum content assessment,<br>• Compile assessment report, and<br>• Submission to review curriculum if necessary | Health | | |
| **FOCUS AREA 3<br>PROTOCOLS, SOPS, STANDARDS AND GUIDELINES TO MANAGE LEAD EXPOSURE AND POISONING** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Develop a lead poisoning response protocol for health care personnel. | • Conduct literature review<br>• Compile draft lead poisoning response protocol,<br>• Submit lead poisoning response protocol or approval,<br>• Disseminate approved lead poisoning response protocol | DOH – Primary Health Care | March 2022 | R50 000.00 |

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| | Develop guideline and an investigation form to assist EHPs on investigation of outbreaks of lead poisoning. | • Conduct literature review<br>• Compile draft lead poisoning investigation guideline<br>• Submit lead poisoning investigation guideline for approval,<br>• Disseminate approved lead poisoning guideline | DOH – Environmental Health | March 2021 | ~~R50 000.00~~<br>R0.00 |
| | Develop a Standard Operating Procedure (SOP) for sampling of leaded paint and other lead-containing products, including the submission of lead products to accredited laboratories | • Conduct literature review<br>• Compile draft SOPs<br>• Submit SOPs for approval,<br>• Disseminate approved SOPs | DOH – Environmental Health supported by SAMRC, NIOH, SABS, and WHO | March 2021 | R000.00 |
| | Develop or secure a Standard Operating Procedure (SOP) or a standard for analysis of lead in paint | • Conduct literature review<br>• Compile draft SOPs<br>• Submit SOPs for | NIOH, SABS, | | |

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| | | internal approval | | | |
| | Develop Biological Exposure Indices (BEI) for lead in the lead handling industrial workplace | • Conduct literature review and stakeholder consultation.<br>• Compile draft BEIs<br>• Submit BEIs for approval,<br>• Disseminate approved BEIs | DOL | March 2021 | R0 .00 |
| | Setting ofblood lead reference levels for confirmed lead poisoning case in children and adults | • Conduct review of various approaches in other countries;<br>• Conduct stakeholder consultation and establish a working Group.<br>• Compile draftblood lead reference levels<br>• Submit blood lead reference levels for approval.<br>• Publicise and use approved blood | SAMRC, PIC, NICD | March 2021 | R0.00 |

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| | | lead reference levels | | | |
| **FOCUS AREA 4<br>EDUCATION AND AWARENESS RAISING** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Develop and review lead awareness materials for the general public;potential lead exposure industry workers, paint manufactures and importers, children's play equipment manufacturers, cottage industry, shooting rangers,lead-related hobbyists; subsistence fishing communities, battery recyclers, nutrition and lead poisoning and others. | • Conduct literature review on available information materials<br>• Draft and finalize awareness materials.<br>• Avail soft and hard copies of developed materials | DOH – Environmental Health and Port Health, Nutrition, Health Promotion<br>DEA-Air quality, Hazardous chemicals and waste, PhakisaChemicals & Waste units<br>DOL<br>SAPMA<br>CAIA<br>NGOs<br>SAMRC<br>Poison Information Centres<br>Provinces and Municipalities<br>Civil society | Ongoing | R100 000.00 |
| | Conduct lead awareness campaigns for the general public,new mothers, potential lead exposure industry workers, paint manufactures, children's play equipment manufacturers, shooting rangers,lead-related | • Develop lead awareness campaigns project plan,<br>• Implement lead awareness | DOH - Environmental Health and Port Health, Nutrition, Health Promotion<br>DEA - Air quality, Hazardous chemicals and waste, Phakisa | Annually | R80 000.00 |

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| | hobbyists; subsistence fishing communities, battery recyclers and others. | campaigns project plan,<br>• Evaluate lead awareness campaigns | Chemicals & Waste units<br>DOL<br>SAPMA<br>CAIA<br>NGOs<br>SAMRC<br>Provinces and Municipalities<br>Civil society | | |
| | Facilitate training for EHPs on the XRF portable lead analysing equipment | • Identify training provider for DOH personnel,provinces, municipalities<br>• Develop training project plan for provinces and port health regions,<br>• Implement training project plan,<br>• Evaluate training | DOH - Environmental Health and Port Health | March 2023 | R100 000 000.00 |
| | Develop information sheet on the manufacturing of paint using lead free alternatives and raising awareness on government lead regulatory initiatives to all paint manufactures and importers. | • Conduct literature review on available information materials<br>• Draft and finalize | SAPMA | Ongoing | R5000.00 |

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| | | awareness materials.<br>• Workshop and avail soft and hard copies of developed materials | | | |
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| | Conduct training and retraining on GHS Classification in relation to lead chemical , targeting EHPs, LabourHealth and Safety Inspectors, Natural Scientists, Environmental Managers | • Develop training manual,<br>• Develop training project plan,<br>• Implement training project plan,<br>• Evaluate training | DOL supported by DOH, DEA | Ongoing | R100 000.00 |
| | Promote the use of lead free alternatives in the manufacturing of products where the use of lead and its compounds is common | • Develop a promotion plan<br>• Implement the plan | CAIA | Ongoing | R100 000.00 |
| | Observe the International Lead Poisoning Prevention Week | • Develop and implement a concept document in observance of the week | All stakeholders | Annual | Costs varies depending on the nature and extent of the event |
| | | **FOCUS AREA 5** | | | |

| LEAD EXPOSURE SURVEILLANCE AND MONITORING | | | | | |
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| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Strengthen the Lead poisoning case surveillance system | • Maintain the surveillance system for reported and diagnosed lead poisoning cases.<br>• Continuous systematic collection, analysis, and interpretation of lead poisoning cases.<br>• Distribution of analyzed data for intervention and policy maker's decision. | NICD.<br><br>DOH- Surveillance Unit.<br><br>PICs | Ongoing | R100 000.00 |
| | | • Investigate and report to DOH all notified lead poisoning cases | Municipal and Provincial Environmental Health Services.<br>DOL National and Provincial Inspectorate | | R100 000.00 |
| **FOCUS AREA 6**<br>**LEAD EXPOSURE CONTROL LEGISLATION DEVELOPMENT AND IMPROVEMENT** | | | | | |

| | ACTION | KEY ACTIVITIES | STAKEHOLDERS | TARGET DATE FOR COMPLETION | |
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| | Strengthening of DOH Lead in paint legislation | • Establish a Technical Working Group.<br>• Conduct expert and stakeholder consultations<br>• Develop revised Lead in paint Regulations and the socio economic impact assessment study (SEIAS) and submit for public comment publication, and<br>• Submit final revised Lead in paint Regulation for implementation publication. | DOH | December 2020 | R500 000.00 |
| | Strengthening of DOL Lead legislation | Assess the strength and alignment of the Lead Regulations to the DOH Lead in Paint | DOL | March 2021 ad ongoing | R100 000.00 |

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| | | Regulations, and review where necessary. | | | |
| | Review the need for Atmospheric Emission Licensing, monitoring and compliance of the lead industrial sector | • Conduct literature review and stakeholder consultation.<br>• Compile draft Reviewed legislation and SEIAS<br>• Submit Reviewed legislation and SEIAS for approval.<br>• Disseminate approved Reviewed legislation | DEA – Air Quality | March 2025 | R200 000.00 |
| **FOCUS AREA 7<br>LEAD EXPOSURE CONTROL LEGISLATION COMPLIANCE MONITORING AND INTERVENTION** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Lead in paint laboratory analysis | • Advocate for the lead in paint analysis service rendering. | DOH supported by SAPMA, CAIA, NGOs, and other government departments | March 2021 | |

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| | | • Advocate and secure resources and accreditation for lead in paint analysis | SABS, NIOH and other interested private laboratories | March 2021 | |
| | Monitoring compliance with DOH Lead in paint legislation | • Develop a national plan to regularly sample products and commodities potentially containing lead, including paint products, cosmetics, water, toys and educational equipment; | DOH Provinces & Hazardous Substances Act authorized municipalities | Bi annual | R300 000.00 |
| | | • Identify lead analysis laboratories | DOH supported by SAPMA, CAIA, NGOs, and other government departments | March 2021 | R10 000.00 |
| | | • Procure and introduce the use of a portable XRF lead analysis equipment | DOH ( all levels of government), supported by DEA (Chemicals and Waste Phakisa) and other interested parties | March 2021 | R5million |
| | | • Conduct regular | DOH – Port Health | Ongoing | R100 000.00 |

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| | | • paint products inspections at points of production, sale and importation; | Regions.<br>South African Revenue Services (Customs)<br><br>Provincial Environmental Health Services and Hazardous Substances Act authorized Municipalities | | |
| | Monitoring compliance with DEA Air Quality legislation with regards to Lead in the atmosphere | • Monitor national progress in implementing National Environmental Management: Air Quality Act policy targets including national compliance to air quality standards with regards to lead (Pb) by 2020. | DEA | Ongoing | |
| | | • Monitor lead emissions in identified high risk areas through air quality | DEA | Ongoing | |

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| | | monitoring stations. | | | |
| | | • Monitor compliance of lead smelting listed category with atmospheric emission standard for lead | DEA | Ongoing | |
| | | • Objectively assess the atmospheric emission license application for lead smelting listed category to prevent human lead exposure | Air Quality Officers in Municipalities | Ongoing | R 0.00 |
| | Monitoring compliance with DOL Lead legislation | • Conduct regular inspections at lead industry points of production, sale and importation.<br>• Issue penalties or taking legal action against all | DOL | | Costs varies based on operational costs of each DOL Provincial Departments |

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| | | transgressors. | | | |
| | Implementing intervention projects | • Issue penalties or taking legal action against all transgressors<br>• Implement multi-faceted pilot intervention demonstration projects in a high risk, designated area/s to ensure lead exposure prevention is adopted. | DOH ,<br>DOL,<br>DEA,<br>DOH, DOL and DEAs Provincial departments and relevant municipalities. | March 2024 | Operational costs of each relevant Provincial Departments and municipalities. |
| **FOCUS AREA 8<br>DATA MANAGEMENT** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Development and management of databases. | Develop toy and children's playground equipment manufacturers and importers database | Municipal Environmental Health Services.<br>Regional Port Health Services. | March 2021 and ongoing | R0. 00 |
| | | Develop lead smelting industries database | DOL<br>DEA | March 2021 and ongoing | R0. 00 |
| | | Develop paint | Provincial Health | March 2021 and | R0. 00 |

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| | | manufactures and importers and retailers database | Departments supported by Municipal Environmental Health Services. Regional Port Health Services | ongoing | |
| | | Develop cosmetics sole suppliers and importers database | Municipal Environmental Health Services. Regional Port Health Services | March 2021 and ongoing | R0. 00 |
| | | Develop laboratories analyzing lead in paint and other products database | DOH | March 2021 and ongoing | R0. 00 |
| | | Develop lead exposure research inventory database | DOH | March 2021 and ongoing | R0. 00 |
| | | Develop trainings and awareness raising activities database | DOH | March 2021 and ongoing | R0. 00 |
| | | Develop national legislation on lead database | DOH, DEA | March 2021 and ongoing | R0. 00 |
| | | Develop reported and investigated lead poisoning or lead exposure cases database | DOH, Provincial and Municipal Environmental Health Services, | March 2021 and ongoing | R0. 00 |

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| | | | Poison Information Centers | | |
| | Development of an environmental lead exposure risk map for South Africa | • Identify sources of lead and high priority areas for lead exposure through desktop studies, enquiries to various sectors; anduse of the findings of the proposed blood lead survey.<br>• Developing a map of sources using GIS technology. | SAMRC | March 2025 | R100 000.00 |
| **FOCUS AREA 9<br>INFORMATION EXCHANGE** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Using various platforms to exchange information | | | | |
| | | Use available mechanisms (e.g. national, provincial and local meetings, industry meetings, | All stakeholders | Ongoing | Costs varies according to information sharing platforms |

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| | | conferences, international conferences, electronic media, media briefings, etc.) to share information and experiences on lead exposure and poisoning prevention efforts. | | | |
| | | Sharing of lessons learnt and best practices | All stakeholders | March 2021 and ongoing | |
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| **FOCUS AREA 10<br>STRATEGY MONITORING, REPORTING AND REVIEW** | | | | | |
| | **ACTION** | **KEY ACTIVITIES** | **STAKEHOLDERS** | **TARGET DATE FOR COMPLETION** | |
| | Establishment of the NLEPWG | • Draft and finalize terms of reference;<br>• Identity office bearers;<br>• Draft annual workplans for key priority | • DOH supported by NLEPWG | March 2021 and ongoing | R0. 00 |

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| | | NLEPWG activities;<br>• Review the Strategy | | | |
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| | Development of progress reports | Annually collate information on the lead hazard situation in the country and progress on implementation of the Strategy | DOH | March 2021 | R 0.00 |
| | | All stakeholders to give quarterly progress reports of their activities | All stakeholders | | R 0. 00 |
| | Review of the strategy | Mid-terms review the strategy and compile a review report with recommended amendments for future revision of the Strategy. | DOH supported by the NLEPWG | Mid-terms after Strategy approval and implementation | R 30 000.00 |

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