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Early Warning, Emerging Issues and Futures

The Need to Eliminate Lead Paint Globally

Background

The Foresight Briefs are published by the United Nations Environment Programme to highlight a hotspot of environmental change, feature an emerging science topic, or discuss a contemporary environmental issue. The public is provided with the opportunity to find out what is happening to their changing environment and the consequences of everyday choices, and to think about future directions for policy. The 21st edition of UNEP's Foresight Brief highlights the harmful effects of Lead in Paint.

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Introduction

Lead has wide-ranging effects on health, with concomitant personal, societal and economic impacts, and thus, it was identified as one of the 10 chemicals of major public health concern globally (World Health Organization [WHO] 2019). Lead poisoning remains pervasive around the world, causing more than a million deaths a year globally (Agency for Toxic Substances and Disease Registry [ATSDR] 2020; Institute for Health Metrics and Evaluation [IHME] 2018). One of the main sources of lead poisoning is exposure to deteriorating lead paint in homes and schools, which affects primarily children, especially those living in poorer communities (United Nations Children's Fund [UNICEF] and Pure Earth 2020; WHO 2020a).* It is cheaper to eliminate lead-paint production, because once the paint has been applied to walls, it is difficult and costly to remove. The only effective way to stop exposure to this global hazard is by establishing laws that prohibit the future manufacture, import and sale of lead paint in every country (WHO 2020a). While it was once necessary to add lead for color and its anti-corrosive and drying properties, non-toxic substitutes for the lead compounds have existed for decades and are available at a comparable cost (Brosché *et al*. 2014; International Pollutants Elimination Network [IPEN] 2018; UNEP 2019a). Poisoning from lead paint is completely avoidable, and we call on all governments without effective lead-paint laws to engage with relevant stakeholders and to adopt laws banning lead paint.

Why is this an important issue?

Lead is a heavy metal that persists in the environment, is an ecotoxicant, and bioaccumulates in various organisms (Check and Marteel-Parrish 2013; UNEP 2010). Furthermore, lead is a potent neurotoxin, which enters the human body mainly through ingestion and inhalation (Rosenthal, Lanphear and Gottesfeld 2015; WHO 2020a). Exposure to lead, even at very low levels, can cause multiple adverse health effects, some very serious, especially in children under six years of age (UNICEF and Pure Earth 2020). Lead poisoning can reduce IQ and learning abilities, and increase behavioral problems, including increased violence and incarceration in early adulthood (Aizer and Currie 2019; ATSDR 2020; Mielke and Zahran 2012; UNICEF and Pure Earth 2020; Reyes 2007; Wright *et al*. 2008). These impacts on children can diminish educational attainment and total earning capacity (Attina and Trasande 2013), thereby affecting entire communities. Despite an extensive history of well-documented morbidity and mortality, exposures remain high in many countries (UNICEF and Pure Earth 2020) and represent significant global public health and socio-economic concerns.

Reduction and prevention of exposure is urgently needed to avert lead poisoning (UNICEF and Pure Earth 2020).* Regulatory controls on a range of sources of lead exposure have been demonstrated to protect public health, as reflected in declining population-level blood lead concentrations in many countries (WHO 2020a).

Past successes in reducing exposure, including replacement of lead drinking-water pipes and elimination of lead in gasoline (Council on Environmental Health 2016), demonstrate that eradicating lead hazards is an effective strategy.

Aging paint cracks and peels (**Figures 1 and 2**); when it contains lead, the resulting chips and dust pose a significant threat to children through ingestion and inhalation. Lead paint can be eradicated globally within the decade with comparatively modest effort, thereby eliminating a major source of lead poisoning for many children. Other important sources of lead exposure, including emissions from mining, smelting, combustion, incineration, manufacturing and recycling, contaminated food, and drinking water, also need to be addressed, but will require significant time and effort to control.

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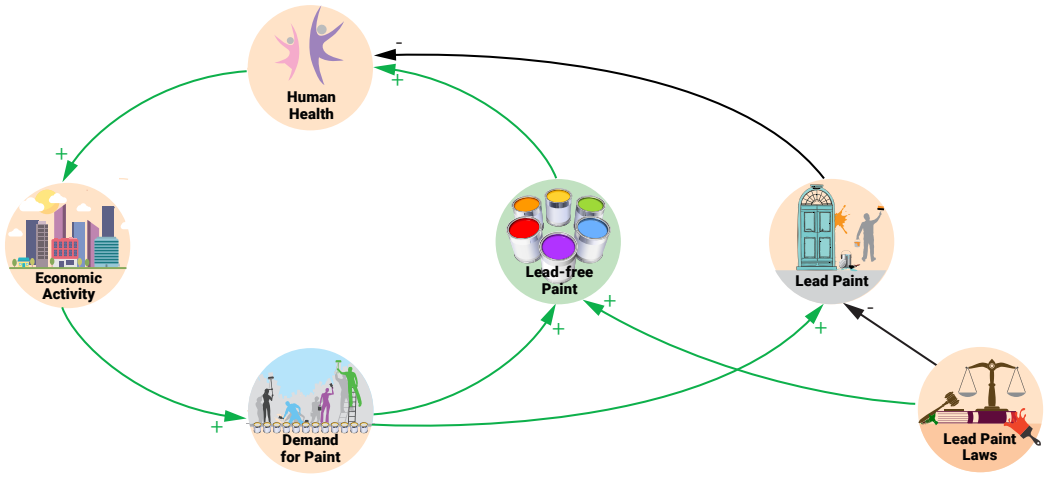
Figures 1 and 2: The cracking and peeling of lead paint on doors and windows a major source of exposure to lead.*

What are the main findings?

Health effects of lead paint

Lead performs no physiological function in the human body, but causes numerous measurable deleterious effects even at the lowest detectable blood lead levels (BLLs), where lead-poisoning symptoms are not readily apparent. This lack of symptoms at low BLLs makes early intervention challenging. In addition, treatment by chelation, the only treatment available for lead poisoning, has not been shown to reverse the neurologic consequences, underscoring the need for prevention of exposure (McKay 2013). Once lead has entered the body, it is distributed to the brain, heart, liver, kidneys and bones. It can have negative impacts on all these organ systems, but perhaps none is more detrimental than its neurotoxic effect on the developing brains of children (Mason, Harp and Han 2014; Sanders *et al*. 2009). Children who survive severe lead poisoning may be left with cognitive impairment and socio-behavioral disorders (WHO 2020a). It has been estimated that in 2017, lead exposure accounted for 1.06 million deaths and the loss of 24.4 million years of healthy life worldwide

A Systems Thinking Perspective



Economic activity drives the demand for paint. In many developing countries lead paint is still widely used, which adversely impacts human health and this in turn has a detrimental effect on economic activity. The introduction of lead paint laws changes this relationship by eliminating the use of lead paint, which reinforces the use of alternative lead-free paint resulting in a virtuous cycle of improved human health and economic activity.(+) Influence is in the same direction, (-) influence is in the opposite direction.

(IHME 2018). Death due to lead exposure is attributed to cardiovascular disease, peripheral vascular disease, chronic kidney disease, and idiopathic developmental intellectual disability (GBD Risk Factor Collaborators 2018).

For most children, lead paint is a dominant source of chronic lead exposure and will continue to be a primary source of neurotoxicity until eliminated. By 1998, the United States had controlled lead in paint manufacturing, water pipes, and gasoline, resulting in a significant decline of BLLs in children (United States President's Task Force on Environmental Health Risks and Safety Risks to Children 2018). The problem of chronic exposure to lead paint, however, remained high because lead paint that was applied before the ban still remained on the walls in older buildings. Lead paint was identified as the foremost source of children's lead exposure in the United States in an analysis of national BLL data (Lanphear *et al*. 1998). This study concluded that dust in and around homes from deteriorating lead paint was the best predictor of BLLs in children. Similarly, data from France showed that 74% of children with elevated BLLs were living in houses with lead paint (Pichery *et al*. 2011). All children, regardless of their family's economic status, and especially children under six, are more likely than adults to be affected by lead exposure because of their behavior and physiology (Evens *et al*. 2015; Ziegler *et al*. 1978). Young children crawl and play in homes and schools, and if there is peeling lead paint on windows or doors, or paint dust on the floor or in soil outside, they can inhale or ingest these lead-contaminated materials. The danger is exacerbated because older lead paint, which contains lead acetate, has a sweet taste that is attractive to young children. Other age groups should also be protected from lead exposure hence, it is important to regulate the use of lead in all types of paint (WHO 2020a).

Components of lead paint

Paint typically contains several major components, including pigments (provide color), binders (create the film), and solvents (adjust viscosity), as well as

Box 1: Select Lead-Based Components in Lead Paint

Examples of lead-based pigments	Mineralogical Name	Chemical Name/Formula
Red Lead	Minium	Lead oxide / $Pb^{2+}{}_2Pb^{4+}O_4$
White Lead	Cerussite	Lead carbonate / $Pb^{2+}CO_3$
Chrome Yellow	Crocoite	Lead chromate / $Pb^{2+}CrO_4$

Other lead-based components	Function	Examples
Driers	Components accelerate the drying process of the paint	Lead naphthenate / $C_{22}H_{14}O_4Pb$
Additives	Catalysts and other compounds provide or enhance specific properties, including: adhesion, finish, flow, durability, and resistance to biological degradation and/or frost	Lead nitrate / $Pb(NO_3)_2$

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miscellaneous other components, including driers. In the case of lead paint, lead is added to the mixture in different forms (**Box 1**) in order to produce specific colors, increase durability, prevent corrosion, and accelerate drying. Substitutes for lead-containing components exist, however, and thus eliminate the need to add this neurotoxin to paint (Brosché *et al*. 2014; IPEN 2018; UNEP 2019a).

What has been done?

Global Efforts to Eliminate Lead Paint

Developed countries banned lead paint in the 1970s and 80s, but much of the rest of the world was left behind (O'Connor *et al*. 2018). More than sixty percent of all countries still allow lead paint (**Figure 3**). The legal limits for lead content should be set as low as possible to be protective of health while also being technically feasible for paint manufacturers to achieve. Currently, the lowest existing total lead limit in paint is 90 parts per million (ppm), which is paint without added lead compounds, and is the standard in many countries with lead-paint laws (WHO 2020a) (**Figure 4**). Sampling conducted in developing countries, however, has revealed that paints with extremely high levels of lead (over 10,000 ppm and as high as 470,000 ppm) are available for sale in retail stores (IPEN 2017a; IPEN 2017b; IPEN 2020). In some countries, more than 50% of the paints sampled exceeded the 90 ppm lead-paint standard (IPEN 2017a; IPEN 2020). This is of particular concern because both the demand for paint and the rates of construction are growing faster in emerging economies than in developed countries (IHS-Markit 2019), and many communities in the developing world will be building and painting more housing and communal structures. In order to stem this tide, it is critical to enact laws now that prohibit the manufacture, import, and sale of lead paint before these structures are built.

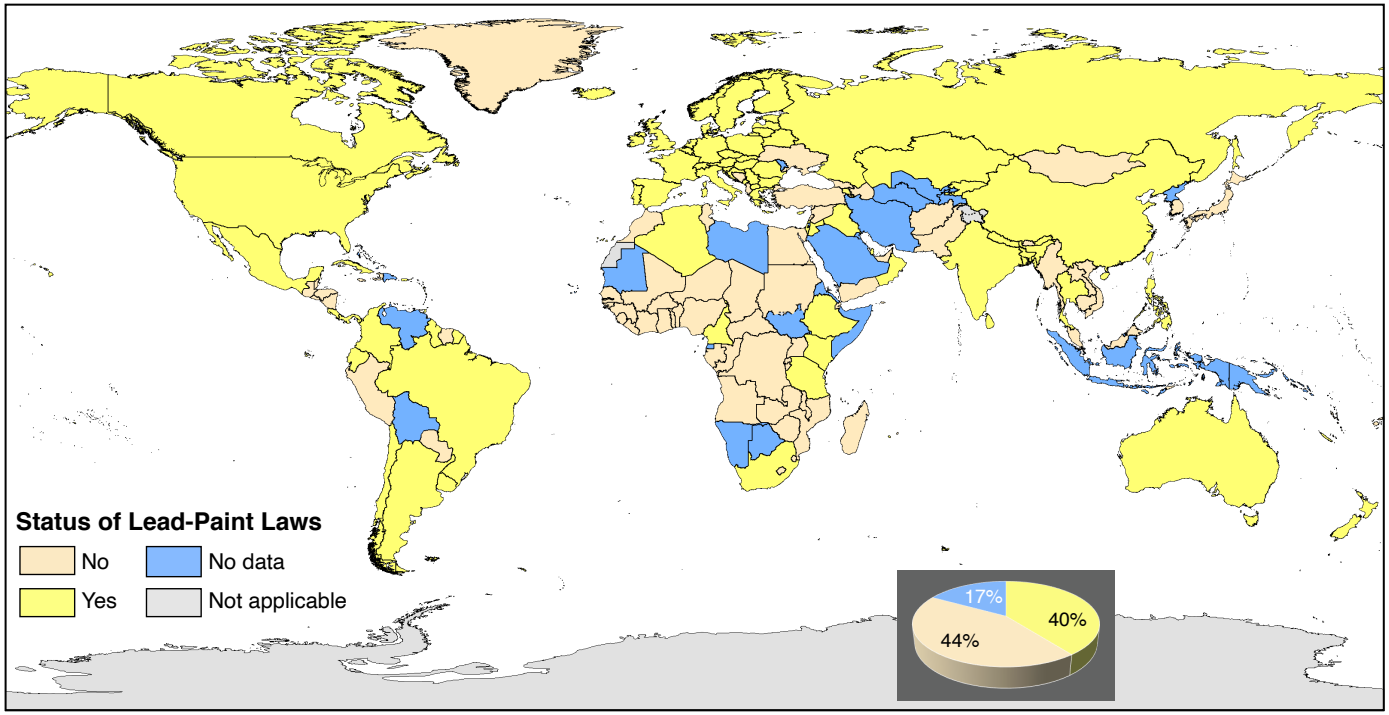


Figure 3: Map showing the status of lead-paint laws around the globe as of October 2020. Data from (WHO, 2020b), with updates from the Global Alliance to Eliminate Lead Paint.

Establishment of Lead-Paint Laws

The *Global Alliance to Eliminate Lead Paint (Lead Paint Alliance)*, a joint initiative led by the World Health Organization (WHO) and the United Nations Environment Programme (UNEP), has created a global Advisory Council chaired by the US Environmental Protection Agency (USEPA). This partnership was endorsed by the International Conference of Chemicals Management to prevent lead exposure by furthering worldwide elimination of paints containing this toxic metal. Environment Ministers passed a resolution calling on countries to establish lead-paint laws at the Third UN Environment Assembly (UNEA 2018), demonstrating increased momentum and commitment toward this goal. Health Ministers agreed to a call to action on lead paint at the 70th World Health Assembly (WHO 2017). The Lead Paint Alliance includes governments, industry, academia, and environmental and health groups and is working with countries to eliminate lead paint by helping them establish laws to prohibit the future manufacture, sale, import and distribution of lead paint.

Alliance partners have reported that countries with lead-paint laws have paint with low levels of lead (IPEN 2017a). The UN developed a Model Law and Guidance for Regulating Lead Paint (Model Law) (UNEP 2018) to help countries establish effective laws, providing a template that can be customized to address country-specific legal frameworks. The *Model Law,* available in all six UN languages, includes a lead concentration limit of 90 ppm (UNEP 2018), and is backed by a combination of governments, industry groups, and environmental organizations. As of this writing, only 77 countries (about 40% of all countries) have lead-paint laws, and

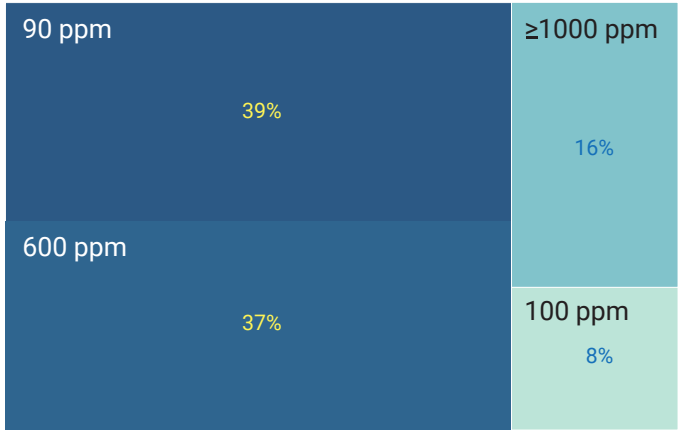
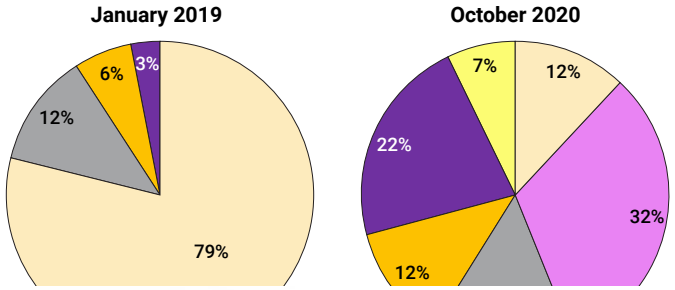


Figure 4: Percentage of the 38 countries with specific regulatory limits on total lead concentration in paint (status October 2020). Note: only 38 of the 77 countries that enacted lead-paint laws have established such a single regulatory limit. Data from (UNEP, 2019b), with updates from the Global Alliance to Eliminate Lead Paint.



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not all of these regulate all types of paint (UNEP 2020a). However, there is increasing interest in establishing and implementing lead-paint laws (**Figure 5**).

What are the policy implications?

The Lead Paint Alliance urges all countries to enact and enforce laws on lead paint, which is the only effective way to eliminate this hazard through legally-binding requirements. No other mechanism, including voluntary labeling, warning signs, or voluntary standards, has proven effective (WHO 2020a). The *Model Law* contains important provisions to ensure effectiveness, including a clear low (90 ppm) legal limit on total lead content in all paints, effective dates for compliance and enforcement,

tabid/7801/language/en-US/Default.aspx). We encourage our readers who want to get engaged in the elimination of this important health hazard to join the Alliance (https://www.unenvironment.org/explore-topics/chemicals-waste/what-we-do/emerging-issues/global-alliance-eliminate-lead-paint-1).

The use of sound scientific principles and data is an important component in establishing effective environmental and public health policies. The science detailing lead exposure, poisoning, and risks, and the benefits of regulation is well established. Eliminating lead paint through appropriate laws is an excellent example of primary prevention in environmental public health. This effort further serves as a model for the elimination of other chemical toxicants affecting the global population.

Conclusion

Most countries in the developing world still do not have lead-paint laws, but there is significant momentum in the effort to ban lead paint globally. Progress has accelerated, particularly in Africa, the continent with the fewest laws (**Figure 3**). Eliminating the danger of lead-paint exposure is a globally achievable goal. We encourage the world community to support the effort to eliminate lead paint, especially those living in countries without legally binding controls on lead paint.