Health, economic and environmental impacts of lead

World Health Organization

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Global Alliance to Eliminate Lead Paint

Outline

- Background
- Sources and routes of exposure
- Health effects
- Societal and economic impacts
- Environmental impacts

Background

- Lead is a versatile and widely used toxic substance
- Human activities result in environmental contamination:
  - mining & smelting; manufacturing, use, recycling and disposal of products made with lead
- Can be used in the manufacture of paint to give properties e.g. colour, rapid drying, corrosion resistance
- Lead paint is a source of human exposure to lead

Multiple pathways of exposure to lead from paint

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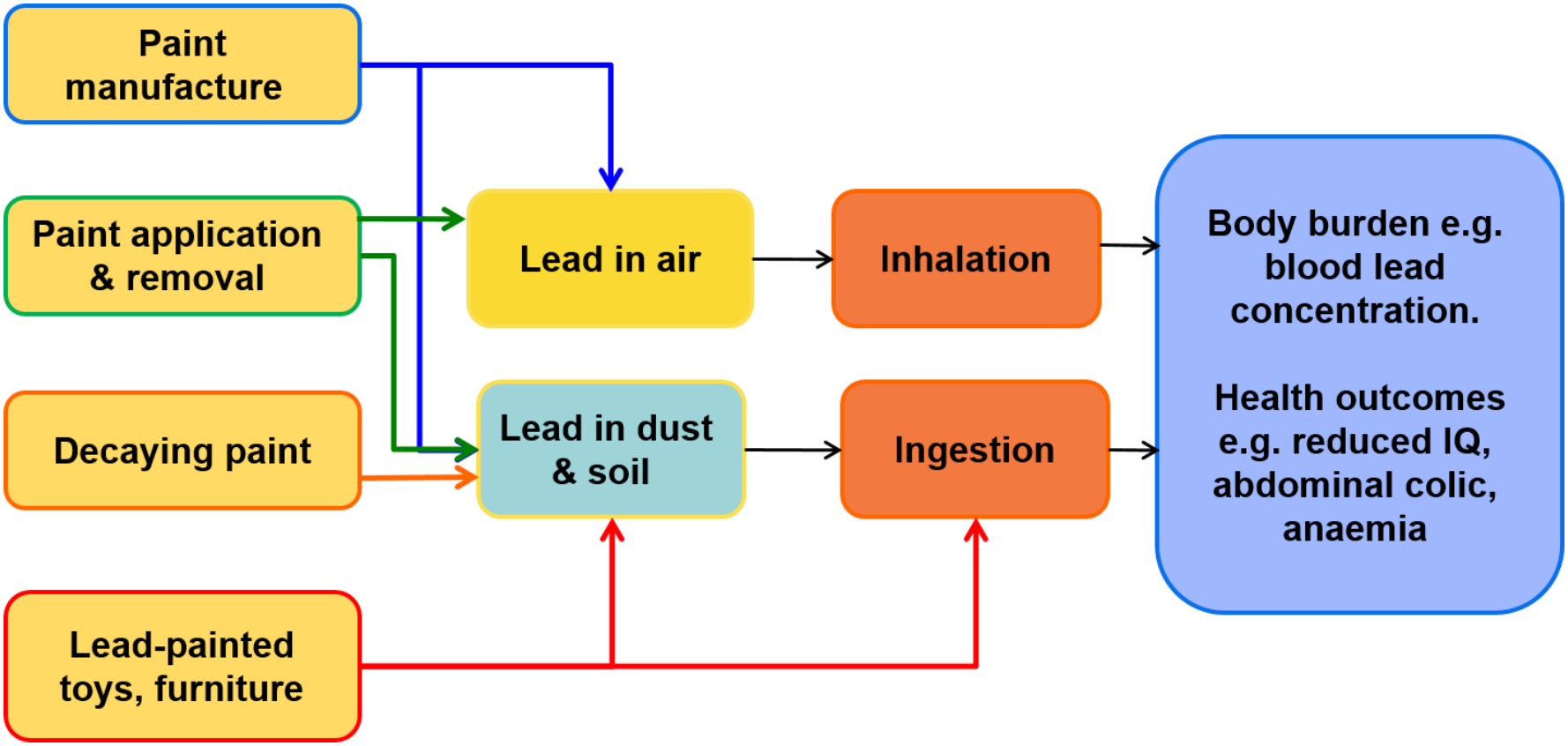

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Lead is a multi-system toxicant

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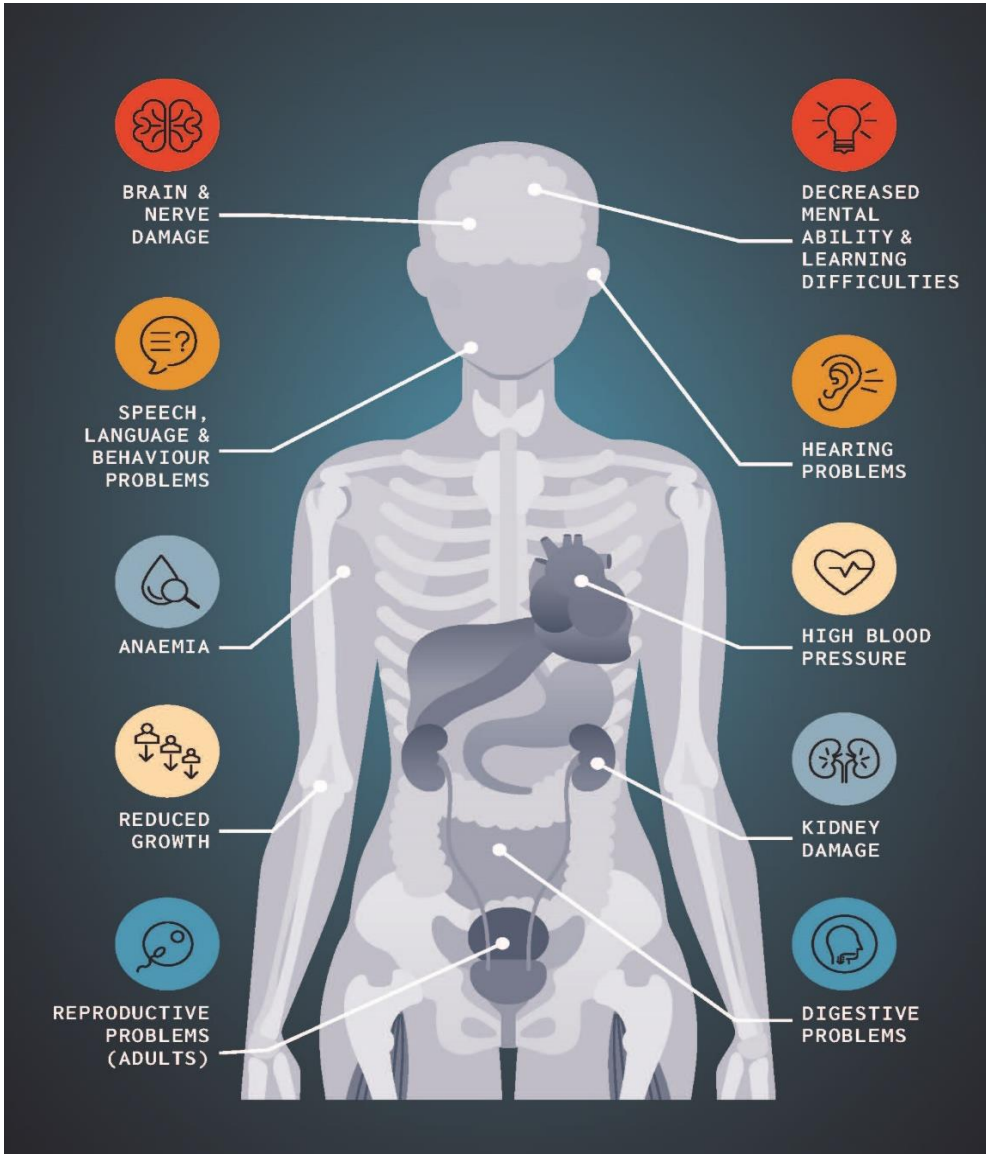
- No known level of exposure without harmful effects
- Mimics calcium and iron in the body so has effects in multiple body systems
- Accumulates in bone and remobilized during pregnancy, lactation and menopause



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Features of lead poisoning may be non-specific

- Low-level exposure – features of poisoning may be sub-clinical e.g. reduced IQ, antisocial behavior, increased risk of hypertension, myocardial ischaemia & renal disease
- Higher-level exposure – more overt poisoning, e.g. anorexia, abdominal colic, constipation, fatigue, mood changes, insomnia, anaemia,
- Severe poisoning – developmental regression in young children, convulsions, cerebral oedema, death

Guideline values related to lead exposure

- WHO/FAO tolerable dietary intake – no health protective value established
- WHO drinking water guideline value: 10 µg/L
  - Provisional value, not health-based but based on technical feasibility – concentrations should be maintained as low as reasonably practical
- Paint limit (suggested in Model Law): 90 ppm of total lead
  - Not health-based but based on technical feasibility – concentrations should be maintained as low as reasonably practical

Children are especially vulnerable

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- Greater exposure:
  - spend more time on the ground and in contact with contaminated soil and dust
  - hand-to-mouth activity, mouthing
  - absorb 4–5 times more lead from the gut than adults
- Early childhood is critical period for neurological and organ development
- Damage may be permanent
  - reduced potential for intellectual development
  - increased likelihood of behavioural disorders

Figure 2 – A large quantity of lead paint chips can be seen in this radiograph of the abdomen and pelvis of a 2-year-old boy with lead poisoning.

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Pregnant women are vulnerable

- Pregnancy mobilizes lead stored in bone, releasing it back into blood where it can be circulated to maternal tissues and the fetus
- Lead exposure may cause reduced fetal growth
- Lead exposure in pregnancy increases risk of complications e.g. hypertension

Lead causes significant burden of disease

Estimates from Institute for Health Metrics and Evaluation (IHME), 2017 data

- 1.06 million deaths from long-term effects
- 24.4 million disability adjusted life years (DALYs) lost
- 63.2% of the global burden of idiopathic developmental intellectual disability
- 12.1% of cardiovascular disease
- 1.4% of chronic kidney disease

https://vizhub.healthdata.org/gbd-compare/

Small IQ reduction has significant societal impact

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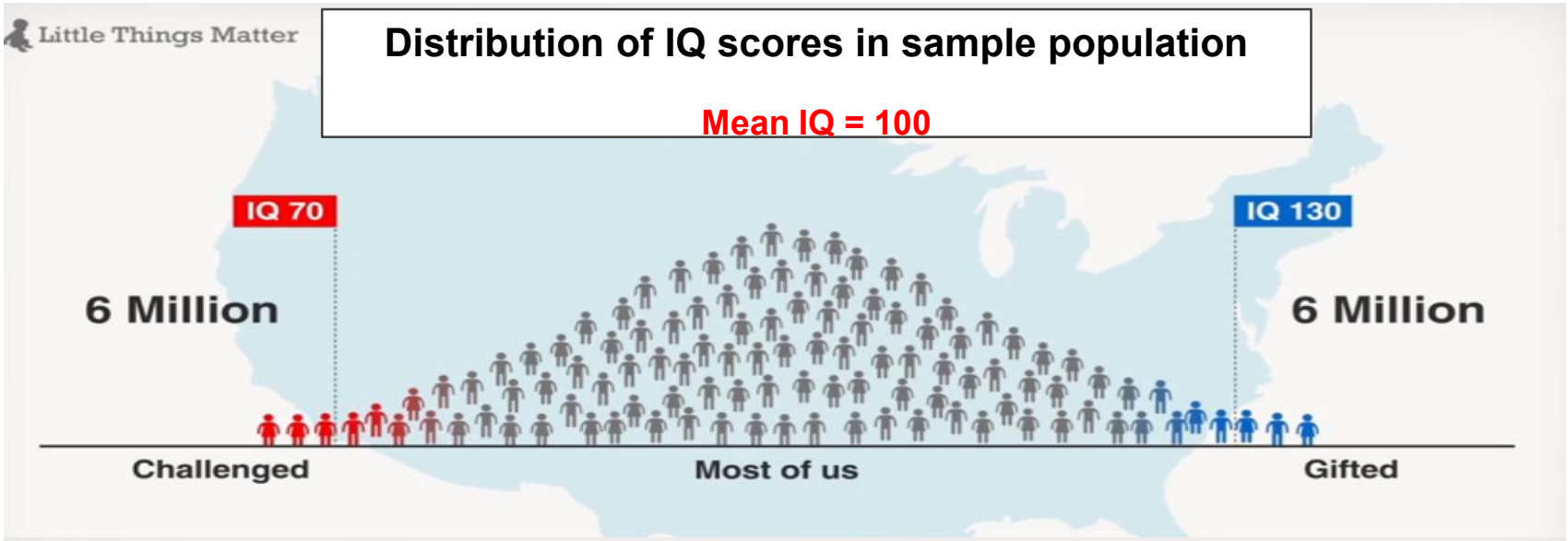

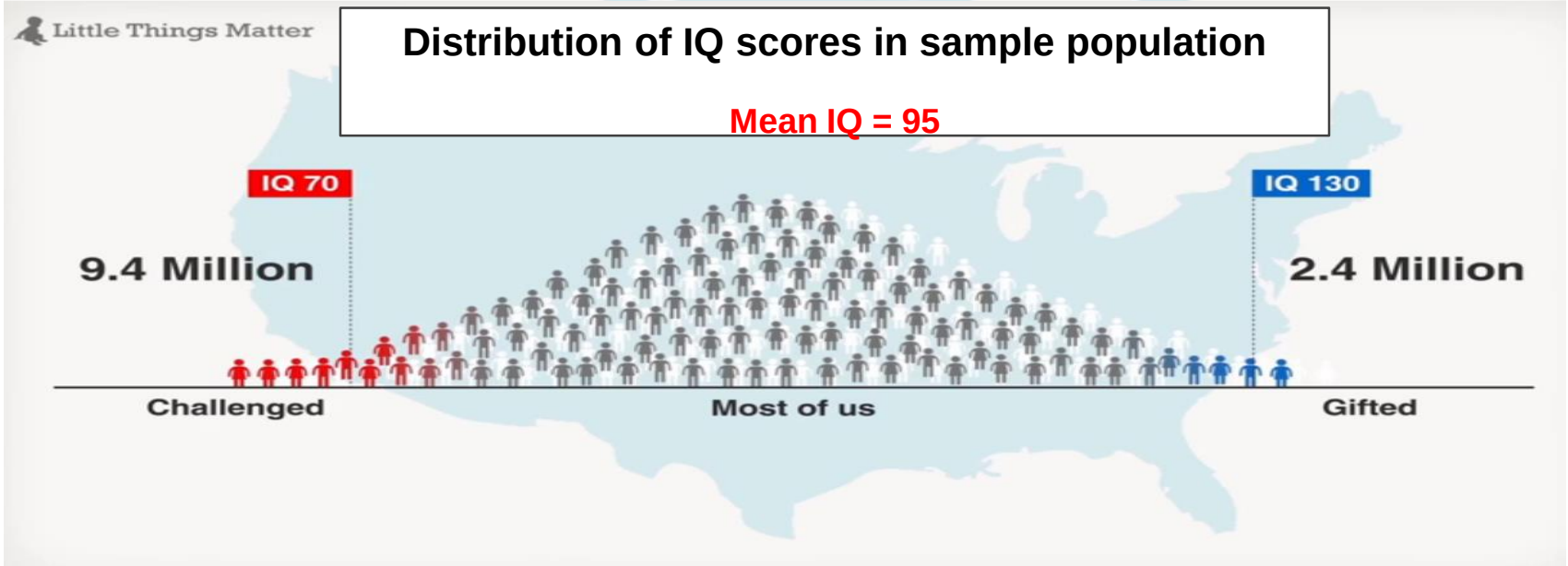

Economic costs of lead exposure are high

- Estimated economic losses due to reduced IQ is ~1.2% of global GDP
- Largest economic burden is borne by low and middle income countries – approx. $977 billion
- Regional economic losses in Asia approx. $699.9 billion

- *Attina TM, Trasande L. Economic costs of childhood lead exposure in low- and middle-income countries. Environ Health Perspect. 2013 Sep;121(9):1097-102*

Economic benefits of action are significant

- Banning lead paint now saves having to pay future costs
  - Avoids future costs of lead exposure resulting from use of lead paint now e.g. cost of reduced IQ, cost of criminality
  - Avoids future costs of hazard controls for legacy paint e.g. remediation
    - estimated costs of remediating lead-painted homes:

      France: US$ 194 – 499 million

      USA: US$ 1 – 11 billion

- *Pichery C et al. Childhood lead exposure in France: benefit estimation and partial cost-benefit analysis of lead hazard control. Environmental Health. 2011;10:44*
- *Gould E. Childhood Lead Poisoning: Conservative Estimates of the Social and Economic Benefits of Lead Hazard Control. Environ Health Perspect, 2009;117: 1162-1167*

Lead persists in the environment

- Multiple sources of lead contamination in the environment – including lead paint
- Lead can remain in the environment indefinitely
- Lead concentration in water and soil is highest near point sources
- Lead particles can undergo long-range atmospheric transport and be deposited on soil, water and crops

Lead persists in the environment

- Mobility and bioavailability are determined by pH and presence of organic and inorganic matter to which lead can bind
- Lead particles in water bodies eventually settle into sediment where the lead is relatively unavailable
- Lead compounds and fragments can be ingested and cause toxicity

Lead is toxic to organisms at all levels of complexity

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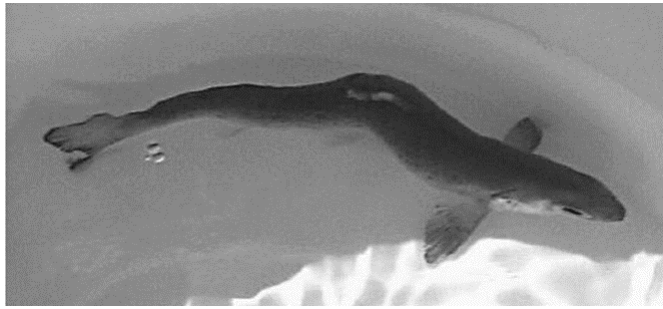
- May be toxic to soil microorganisms & invertebrates e.g. nematodes, insects
- In higher animals, damages multiple organ systems and causes growth deformities
- Secondary poisoning may occur e.g. in predators feeding on contaminated animals



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Conclusions

- Lead has wide-ranging effects on health – these have personal, societal and economic impacts
- Lead is a persistent hazard – it remains in the environment, in the home and in the human body
- Lead paint is an important source of exposure to lead
- Prevention - through banning lead paint - is better (and cheaper) than having to deal with the consequences of lead paint later on