

Health, economic and environmental impacts of lead



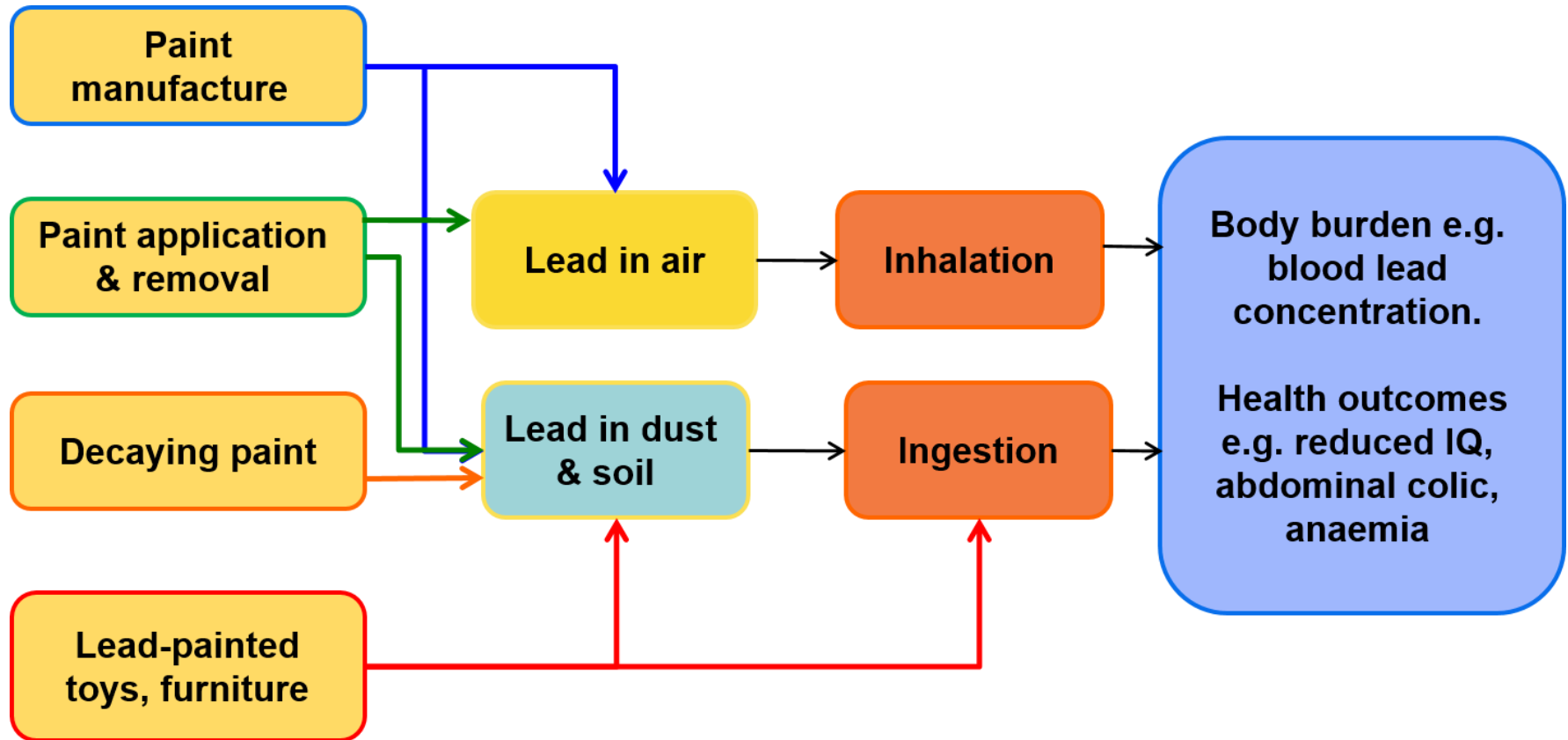
Outline

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

Background

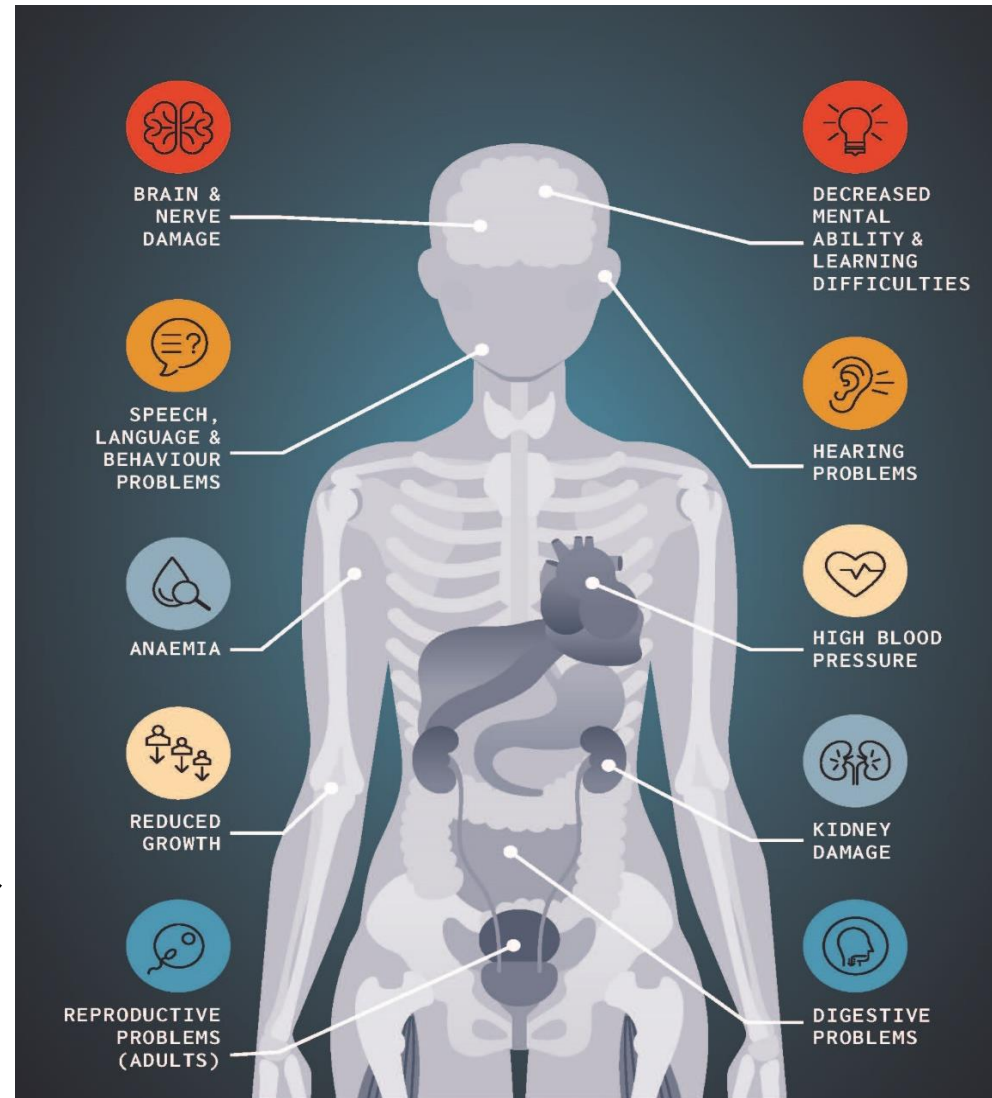
- Lead is a versatile and widely used toxic substance
- Human activities result in environmental contamination:
 - mining & smelting; manufacturing, use, recycling and disposal of products made with lead
- Can be used in the manufacture of paint to give properties e.g. colour, rapid drying, corrosion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

Multiple pathways of exposure to lead from paint



Lead is a multi-system toxicant

- 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
- Long-term effects include reduced IQ, antisocial behaviour, cardiovascular & renal disease



Children are especially vulnerable

- 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.

Pregnant women are vulnerable

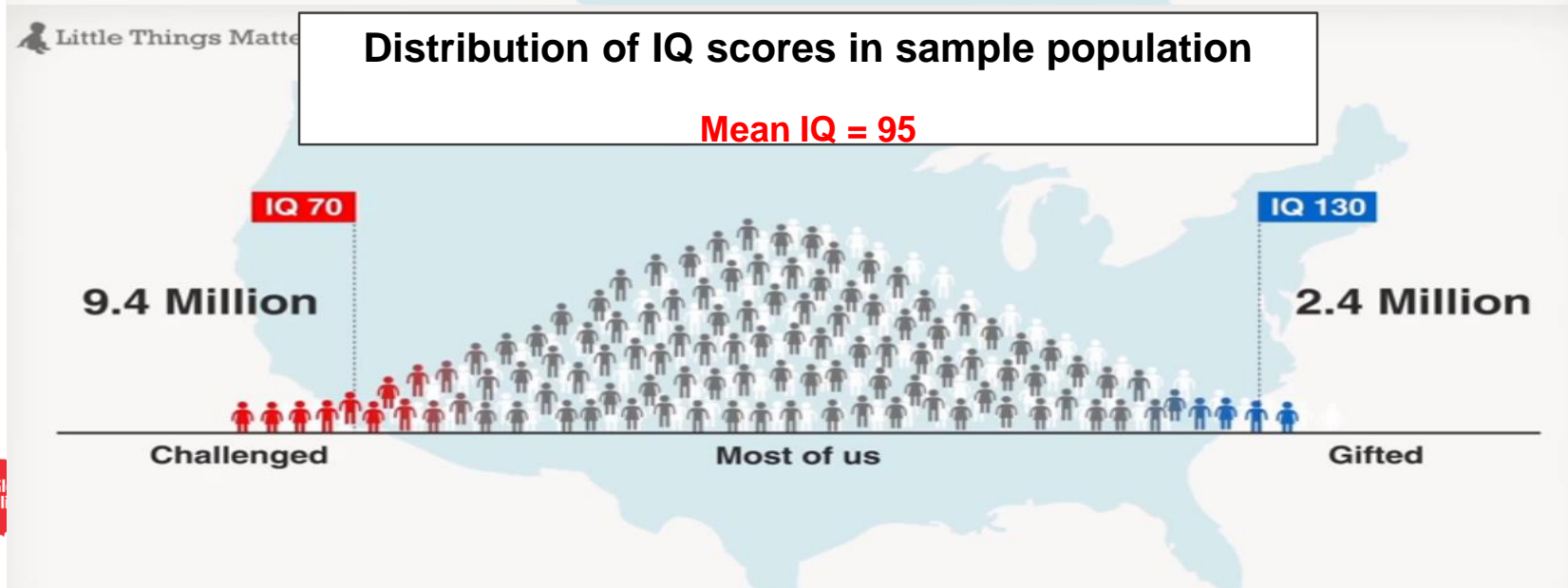
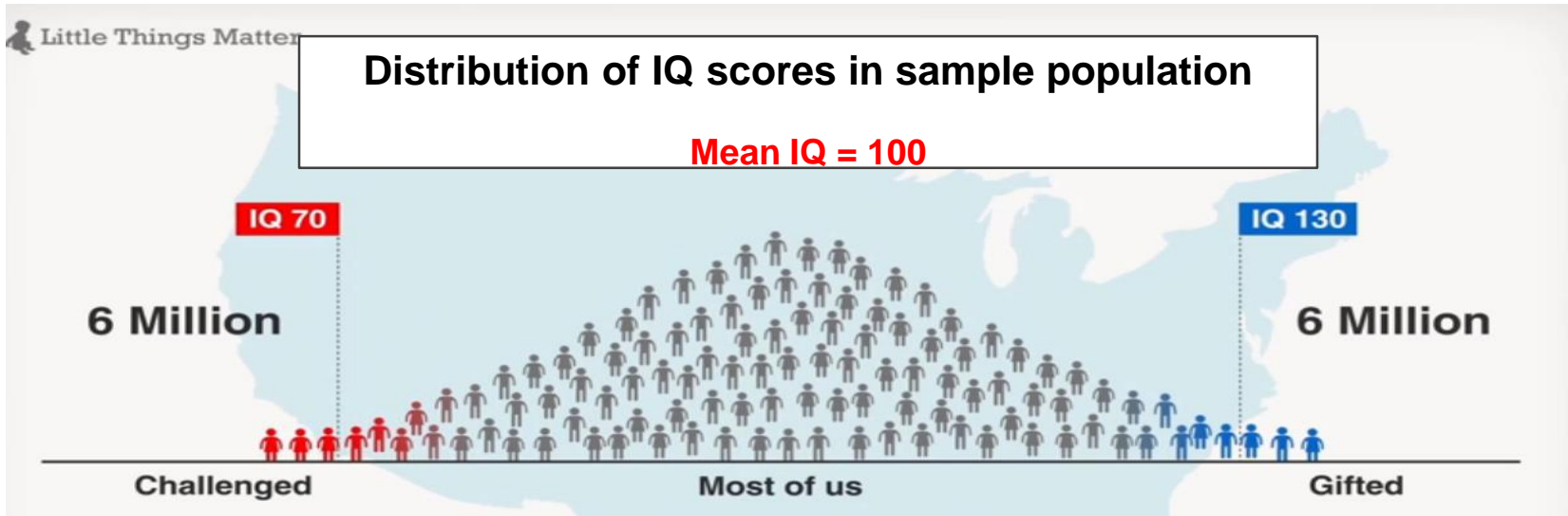
- Pregnancy mobilizes lead stored in bone, releasing it back into blood where it can be circulated to maternal tissues and the fetus
- Lead exposure may cause reduced fetal growth
- Lead exposure in pregnancy increases risk of complications e.g. hypertension

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
- 10.3% of hypertensive disease
- <https://vizhub.healthdata.org/gbd-compare/>

Small IQ reduction has significant societal impact



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 Africa approx. \$134.7 billion (4.03% of regional GDP)

- *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 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

- Lead can be released during paint manufacture, application, removal & disposal
- Old lead paint fragments into flakes & dust that contaminate the environment
- Lead can remain in the environment indefinitely
- Lead paint creates legacy of potential exposure for years into the future

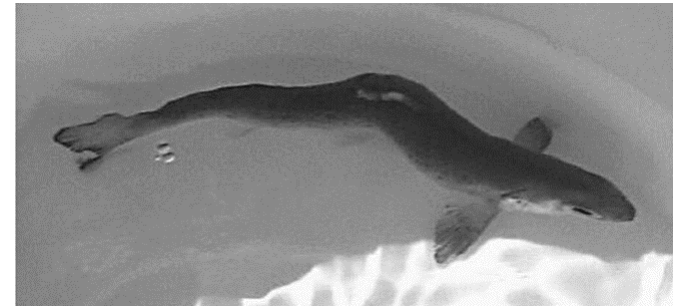


Lead has impacts on ecosystems

- Lead particles can undergo long-range atmospheric transport and be deposited on soil and water
- Lead concentration in water and soil is highest near point sources
- Mobility and bioavailability are determined by pH and presence of organic and inorganic matter to which lead can bind
- Lead in water bodies settles into sediment where it is relatively unavailable

Lead is toxic to organisms at all levels of complexity

- 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
- Bioaccumulates but does not biomagnify



Conclusions

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