Outline

• Background
• Sources and routes of exposure
• Health effects
• Societal and economic 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
Exposure to lead from paint can occur through its lifecycle

• Manufacture - lead pigments and driers:
  ➢ Inhalation and ingestion exposure to raw materials during mixing
  ➢ Environmental contamination from spills, unsafe waste disposal

• Use - application:
  ➢ Inhalation of paint aerosols
Exposure to lead from paint can occur through its lifecycle

• Use – ageing paint:
  ➢ Paint fragments into flakes and dust that contaminate the environment (indoor and outdoor)
  ➢ Dust also produced when painted surfaces rub together e.g. window frames
  ➢ Children may ingest flakes and dust

• Removal:
  ➢ Use of abrasive methods and burning produces large amount of lead dust and fumes
Lead is a multi-system toxicant

- Main routes of exposure are ingestion and inhalation
- No known level of exposure without harmful effects
- Mechanism of toxicity is complex
- Accumulates in bone and remobilized during pregnancy, lactation and menopause
Features of lead exposure may be non-specific

- Low-level exposure – sub-clinical effects 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
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 life-long
  ➢ reduced potential for intellectual development
  ➢ increased likelihood of behavioural disorders
Children can be poisoned by lead paint

• Case report – ingestion of paint flakes (1)

• 2 year old boy with irritability, abdominal pain, anaemia

• Blood lead concentration was 64 µg/dL
  ➢ threshold for chelation is 45 µg/dL

• Abdominal x-ray showed paint flakes distributed through large intestine

Children can be poisoned by lead paint

- Case report – ingestion of paint flakes (2)

- Treatment given:
  - Whole-bowel irrigation to wash out gut
  - 4 rounds of oral and i.v. chelation therapy over 7 months with repeated hospital admissions

- Concentration of lead in paint not measured
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
• 3.6% of chronic kidney disease

https://vizhub.healthdata.org/gbd-compare/
Small IQ reduction has significant societal impact

Distribution of IQ scores in sample population

- Mean IQ = 100

Distribution of IQ scores in sample population

- Mean IQ = 95
Economic costs of lead exposure are high

• Estimated global economic losses due to reduced IQ is US$ 977 billion, i.e. ~1.2% of global GDP

• Largest economic burden is borne by low and middle income countries

• Estimated loss to China is 2% of 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 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


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