Lead in Water: Cause for Concern?

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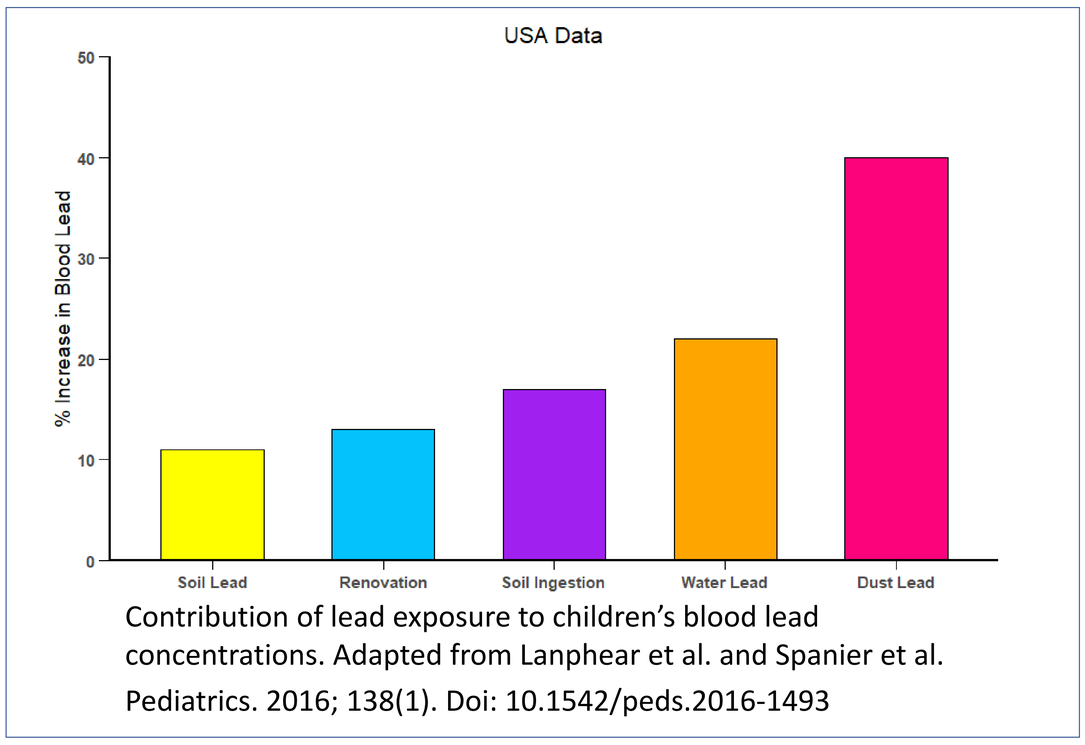
Lead in Drinking Water

Lead (Pb) occurs in drinking water and can cause organ damage, cardiovascular disease, cancers, and lifelong neurological and developmental impairment.

- Water is a significant source of blood lead in children in high-income country (HIC) settings (AAP, 2016)
- "The primary source of lead in drinking-water is leaching from lead-containing materials in water systems." (WHO, 2022)
- Limited evidence available on lead in drinking water in low- and middle-income countries (LMICs).



Contribution of lead exposure to children's blood lead concentrations. Adapted from Lanphear et al. and Spanier et al. Pediatrics. 2016; 138(1). Doi: 10.1542/peds.2016-1493

Methods: Lines of Evidence

Three lines of evidence on global occurrence and sources of lead in drinking water:

Field study (primary data)

- 261 rural water systems in 3 West African countries

Literature review (secondary data)

- >1,000 studies in English from >60 countries

Lab studies (primary data)

- Corrosion studies of parts from rural water system

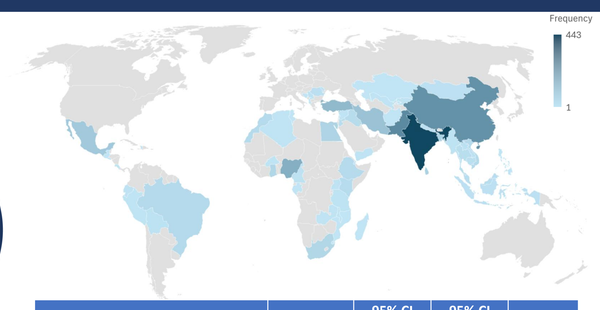
Results: Systematic Review

Search literature databases:
PubMed, EBSCO Global Health, Web of Science

Initial search retrieved >40,000 results

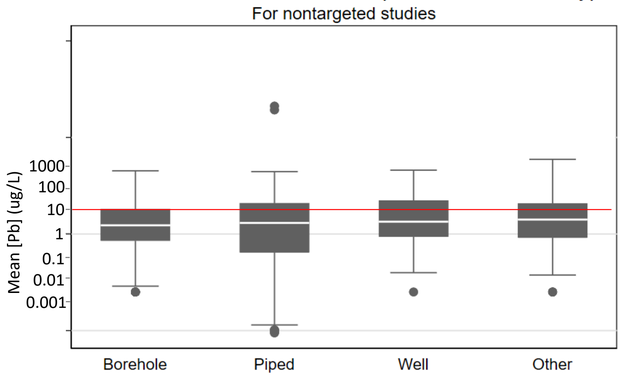
Inclusion criteria:

- Peer-reviewed, 1969-present
- Full-text in English
- Usable primary data from LMIC
- Drinking water
- Metal of interest: **Lead**
- (Other metals studied: Antimony, Arsenic, Cadmium, Chromium, Copper, Iron, Manganese, Mercury, Nickel, Selenium, Uranium, Tin, Zinc)

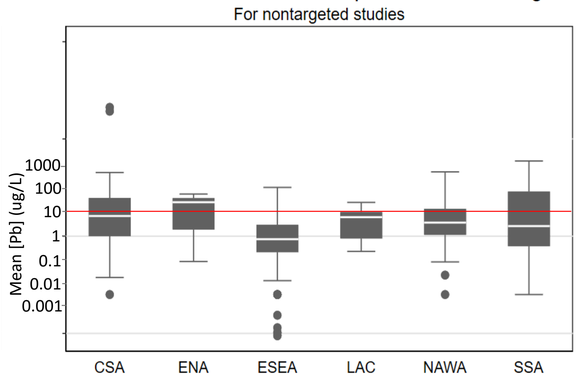


Exceedances	Proportion	95% CI (Lower)	95% CI (Upper)	n
a) All studies	0.326	0.303	0.349	1447
b) Nontargeted	0.297	0.260	0.334	535
c) Nontargeted: high-quality	0.286	0.249	0.323	513
d) Nontargeted: ICP-MS	0.161*	0.123	0.199	300
e) Nontargeted: ICP-MS, ex-PRC	0.212*	0.162	0.263	213

Mean concentrations of lead in sample sets vs Source Type
For nontargeted studies



Mean concentrations of lead in sample sets vs SDG Region
For nontargeted studies



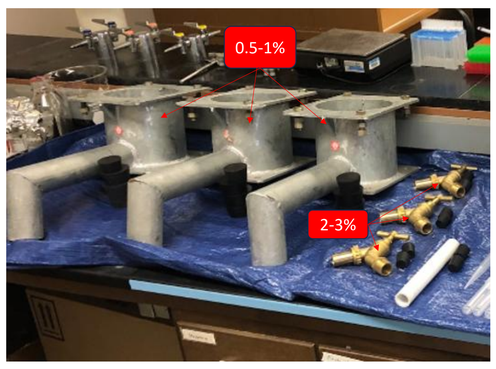
Results: Lab Study

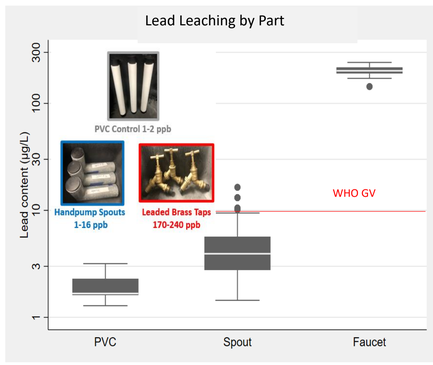
Main Findings:

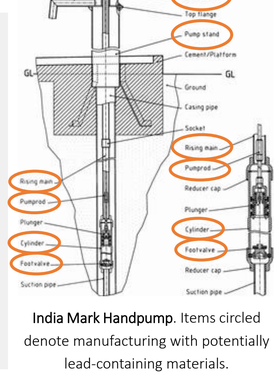
Lead tested in common galvanized & brass parts exceeded international standards

Lead leached into water at levels of concern from tested parts

Suggests opportunity for prevention: avoiding the use of leaded brass in water systems







India Mark Handpump. Items circled denote manufacturing with potentially lead-containing materials.

Take-Aways

Lead occurs at levels of concern in LMICs across all studied sources and SDG regions (although occurrence in ESEA*, LAC may be lower)

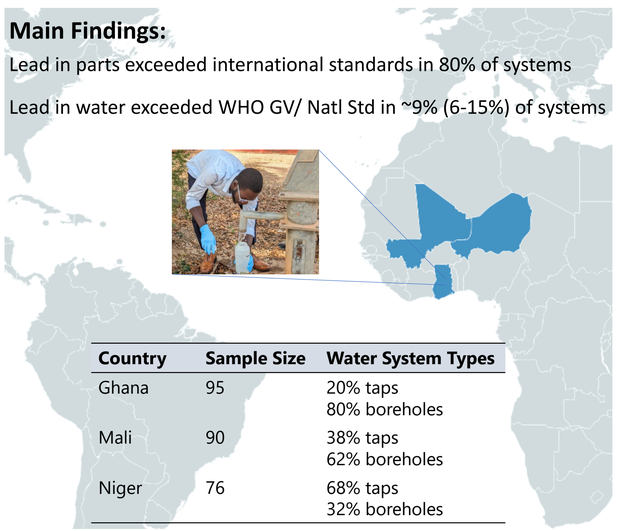
Occurrence linked to lead-containing parts: Brass and galvanized steel implicated; Stainless steel and other non-leaded alternatives available.

Results: Field Study

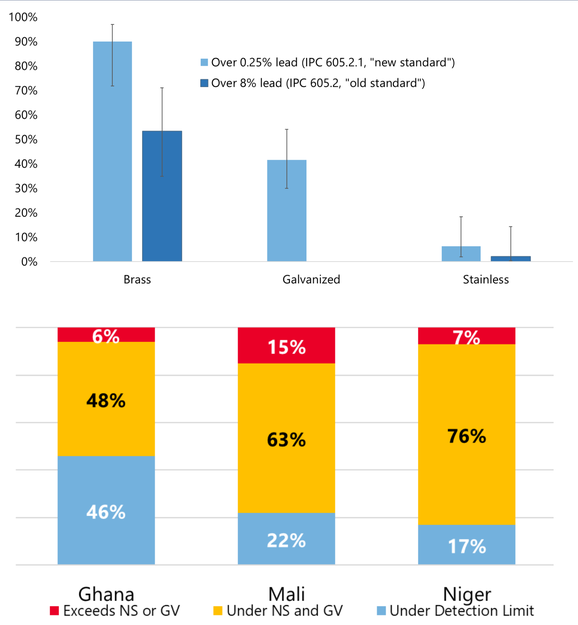
Main Findings:

Lead in parts exceeded international standards in 80% of systems

Lead in water exceeded WHO GV/ Natl Std in ~9% (6-15%) of systems



Country	Sample Size	Water System Types
Ghana	95	20% taps 80% boreholes
Mali	90	38% taps 62% boreholes
Niger	76	68% taps 32% boreholes



Actions and Next Steps

- Available evidence sufficient to undertake no-regrets primary prevention on lead in drinking water now
- Policy/regulatory reforms can protect supply chains
- Monitoring/surveillance capacity strengthening needed (lead in plumbing products, drinking water)
- Global Lead-Free Water Pledge:

Selected References:

Council on Environmental Health, Lanphear, B. P., Lowry, J. A., Ahdoot, S., et al. (2016). Prevention of childhood lead toxicity. *Pediatrics*, *138*(1), e20161493.

World Health Organization. (2022). Lead in drinking-water: health risks, monitoring and corrective actions: technical brief.

Fisher, M. B., Guo, A. Z., Tracy, J. W., et al. (2021). Occurrence of lead and other toxic metals derived from drinking-water systems in three West African countries. *Environmental Health Perspectives*, *129*(4), 047012.