Short-term and Long-term Frameworks for Public Health Laboratories Responding to the Public Health Mercury Crisis

Eric Bind and Zhihua (Tina) Fan
New Jersey Department of Health, Public Health and Environmental Laboratories, Environmental and Chemical Laboratory Services, Ewing, NJ 08628

Introduction

Mercury (Hg) is a toxic metal to which people are routinely exposed. Acute and chronic exposure to Hg can cause adverse health outcomes including but not limited to the following systems:

- Neurological
- Cardiovascular
- Endocrine
- Renal
- Reproductive
- Dermal

Child exposed *in utero* to methylmercury presenting with symptoms of Minamata Disease

These effects are even more pronounced in children, especially developing fetuses where adverse birth outcomes that persist into adulthood can occur. Four main forms of Hg commonly encountered and examples of their sources are:

Mercury Species	Common sources
Methylmercury (MeHg)	Fish and seafood
Ethylmercury (EtHg)	Preservatives (e.g., thimerosal)
Inorganic mercury (InHg)	Skin lightening products (SLPs), ayurvedic medicine (e.g., cinnabar)
Elemental mercury (Hg0)	Compact fluorescent lightbulbs (CFLs), old thermometers, religious use (e.g., Santeria, Hinduism)

NJ Biomonitoring (NJB) data indicates Hg is prevalent (see **Results**). Data from other jurisdictions nationally and globally indicate the problem is widespread. Hg exposure has remained inconspicuous until lately and few public health laboratories (PHLs) have the knowledge of the issue, expertise, and resources allocated to support residents exposed to mercury in their jurisdictions. PHLs need to consider short-term and long-term responses to the Hg public health crisis to adequately serve their constituents.

Methodology

NJ Biomonitoring used four approaches to better understand the causes of the Hg crisis, current efforts to address the issue, and what public health and medical gaps remain:

Firsthand experience
- Testing clinical, water, environmental, & consumer product samples
- Emergency testing and response to individual and group exposures
- Conducting research, outreach, and education

Consulting with public health professionals
- State/city programs working on Hg (e.g., CA, MN, NYC)
- APHL's Environmental Health Committee and various workgroups
- Attending convening and other Hg-focused meetings

Consulting with medical professionals
- Program partners at University Hospital, Newark NJ
- NJ Poison Information & Education System
- Pediatrics Environmental Health Specialty Unit – Region 2

Examining frameworks and responses for other chemicals
- Lead response over the last 6+ decades
- Current state/CDC epidemiological responses
- Literature searches

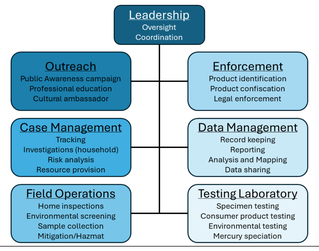
Results

The scope of the global Hg crisis is starting to emerge thanks to efforts from public health laboratories and other researchers around the world. For example:

- NJB data indicate the >11% of the NJ population is exposed to Hg above our practical health limit of 5 µg/L.
- NJB prenatal screening data indicate up to 60% of NJ newborns may be born with levels of Hg that may cause adverse health outcomes.
- CA, IN, MA, MD, MN, NY, TX, and other states have dealt with individual and environmental Hg events
- The UN/WHO found that >77% of Nigerian women have used SLPs; heavy use persists throughout Asia, Africa, and Latin America

Even though some consumer products are banned due to their Hg content, PHLs continue to find them on store shelves, and many more are readily available for purchase online. An ideal mercury public health response has a three-pronged approach aimed at:
- Reducing public demand for these Hg-containing products
- Reducing the supply of Hg in the market
- Screening to identifying exposed individuals and contaminated goods

Ideal Mercury Tracking & Response Program



The overall structure of an ideal program provides six major functions that would allow it to provide public awareness to reduce demand for dangerous products, education of professionals to amplify the messaging, tracking and case management to support exposed individuals, the ability to conduct private and commercial inspections to identify and remove dangerous products, testing of individual specimens and products, and the authority to confiscate products and take legal action.

Jurisdictions currently dealing with Hg are severely limited by the lack of comprehensive programs. Nationally, laboratory testing is limited with only a handful being capable of doing speciation analysis or willing to test SLPs due to contamination risks. Some jurisdictions do not have the authority to confiscate illegal Hg-containing products from homes or stores.

Short-term solutions
- PHLs can leverage their existing outreach capabilities to raise public and professional awareness to reduce demand rebranding materials from other states or agencies.
- PHLs with instrumentation (e.g., XRF, mercury analyzers) can test products and provide data to their jurisdictions' existing food and products enforcement branch.
- PHLs with existing LRN-C level 1 or 2 capabilities have the capability to screen blood and urine for mercury.
- Jurisdictions can rely on their existing tracking expertise (e.g., occupational, child lead) to begin their mercury response efforts.
- PHLs can conduct small pilot studies (e.g., product testing, biomonitoring) to establish risk in their jurisdictions to make the case for greater funding.
- PHLs can engage existing partnerships.

Long-term solutions

PHLs need to design a program that meets their constituents' needs. They need to work together with partners to:
- Establish a Hg health limit
- Evaluate screening policies
- Create data sharing platforms
- Set limits in food and products
- Devise medical treatment protocols
- Identify resources for response programs

APHL, CDC, medical professional groups, and other interested parties can coordinate efforts at the national and regional levels so that limited public health resources are not wasted on redundant efforts.

FDA and PHLs may collaborate on product bans. The U.S. State Department may work with the UN and other countries through the Minamata Convention to limit production.

Conclusions

Hg exposure is a global problem with some jurisdictions experiencing very high prevalence. Most people are unaware of the risks, are being exposed, and are doing nothing to address it. PHLs' missions are to safeguard the public from threats; however, few are aware of, or addressing, the Hg crisis.

We've outlined short- and long-term solutions to consider to protect individuals. PHLs have some of the building blocks needed to start the effort (e.g., outreach, tracking, and testing). A nationally coordinated effort like the response that resulted in 93% reductions in lead exposure serves as a good model and influenced the proposed Hg model. Hg has a relatively short half-life in blood (1-2 months vs. years for some other chemicals), and exposure levels can be reduced quickly. While lead is stored in bone and can be remobilized later (e.g., pregnancy, aging), Hg does not last.

As PHLs begin awareness campaigns, they must consider people's needs. For MeHg that comes from seafood, dietary changes can significantly reduce exposure. For products with Hg^0 like CFLs and thermometers, affordable replacements exist; however, people must have a safe exchange or disposal program. Messaging for religious use must be carefully crafted. SLPs produce several challenges as (1) there are societal costs to cessation and (2) clean-up of a contaminated home can costs $30K-$100K.

PHLs and their constituents can no longer afford to delay addressing the Hg crisis and risks in their jurisdictions. National efforts and collaboration are needed to help each jurisdiction do so efficiently.

References

Harada M. Minamata disease: methylmercury poisoning in Japan caused by environmental pollution. Crit Rev Toxicol. 1995;25(1):1-24. doi:10.3109/10408449509089885

McClam M, Liu J, Fan Y, et al. Associations between exposure to cadmium, lead, mercury and mixtures and women's infertility and long-term amenorrhea. Arch Public Health Arch Belg Sante Publique. 2023;81(1):161. doi:10.1186/s13690-023-01172-6

Ye BJ, Kim BG, Jeon MJ, et al. Evaluation of mercury exposure level, clinical diagnosis and treatment for mercury intoxication. Ann Occup Environ Med. 2016;28:5. doi:10.1186/s40557-015-0086-8

WHO mercury report-cwm.unitar.org/cwmplatformscms/site/assets/files/1284/mercury_flyer.pdf

nyc.gov/site/doh/health/health-topics/mercury-in-soaps-and-creams.page

Acknowledgements

Authors wish to thank:
NJDOH Metals Laboratory & NJ Biomonitoring Team
NJDOH Communications & Senior Management
NJDOH Consumer & Occupational Health Services & Child Lead
Dr. Thomas Kirn, Rosalind Finney, and ECLS Staff
APHL Environmental Health Committee & Fellowship Program
Colleagues from CA, MN, NYC, and other public health groups
CDC State Biomonitoring Grant #NU88EH00132