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Addressing Risks of Lead in Water and Soil

Using citizen science and a unique partnership with faith organizations

ABSTRACT

One of the most widespread environmental health hazards in the United States remains exposure to the harmful neurotoxin lead. So much lead remains in the urban environment that it is not unusual to find neighborhoods where more than 10% of children exhibit harmful levels of lead, compared to the national average of about 1%. To overcome this challenge, a partnership between IUPUI researchers and faith organizations in Indianapolis takes aim at the risk of household lead contamination by providing residents the tools they need to protect against it. The community-driven science aspect of this project is intentional—not only will the individuals who participate benefit directly, but the resulting data will also play a role in keeping communities safer more broadly.

One of the most widespread environmental health hazards in the United States remains exposure to the harmful neurotoxin lead. Although the U.S. decades ago outlawed the production of materials that contained lead, such as gasoline, paint, and solder, its dangerous legacy lingers in older cities and neighborhoods. The lead remains on old structures painted with lead-based paints, and in the water pipes that comprise our aging drinking water infrastructure. But what many are not aware of is that a major repository of lead is soils and the dust generated from them. Why soils? It is because they captured a century of lead deposited from burning leaded gasoline, industrial sources, and degrading lead-based paint, and concentrated it in the upper few inches of soils where children play and vegetables grow. It is this lead-

infused soil that generates dust on dry summer days.

So much lead remains in the urban environment that it is not unusual to find neighborhoods where more than 10% of children exhibit harmful levels of lead, compared to the national average of about 1%. If lead is present in a young child's blood while their brain systems are forming, it permanently distorts the critical neurons that do all of the signaling and communications work in the brain. The result of this exposure is the stuff of a behavioral psychologist's nightmares—permanently lowered IQ, increased attention deficit disorders, poor short-term memory, and decreased risk-aversion. Incarceration rates for individuals exposed to lead in their youth are higher than individuals without high levels of lead in their bodies, a statistical correlation that is tied to the negative neurocognitive impacts of lead poisoning. Legacies of racism and segregation mean that lead exposure rates are significantly higher for lower income communities of color, creating economic and educational challenges for these communities that can last for generations.

To overcome this challenge, a partnership between IUPUI researchers and faith organizations in Indianapolis is taking aim at the risk of household lead contamination by providing residents the tools they need to protect against it. As a part of the Center for Urban Health at IUPUI's long-term effort to map lead levels across the city—and in collaboration with the IUPUI Arts & Humanities Institute's research on the Anthropocene—are working with the Indianapolis Ministerium's Faith Lead Initiative to distribute lead test kits to residents on the near northwest side. With funding provided by the Indiana University Environmental Resilience Institute through the Prepared for Environmental Change Grand Challenge program, the kits provide participants with free, reliable lab results on potential lead exposure in their homes—information that is often out of reach due to barriers such as cost and lack of education on the risks of lead.

It's relatively low concentrations. But once you get any lead in your body, the acids in your stomach dissolve it, and it gets in your bloodstream. And once it's in your blood, it's very hard to get out because it's stored in your bones.

The tests' results will also contribute to anonymous public data on household lead levels across Indianapolis through the center's Map My Environment website. This is the first time the website will contain data on lead levels in water, along with the soil and dust being collected as part of this effort. There are regulations about the allowable amount of lead in water, but the truth is there's no safe level of lead. The concerns on this front are real, as evidenced in a 2020 report on childhood lead poisoning from the Indiana Advisory Committee to the U.S. Commission on Civil Rights.

The project's focus on tap water is significant since lead contamination is most common in homes with aging infrastructure, such as lead pipes, which can lose the protective mineral layer that prevents heavy metals from leeching into drinking water. The challenge is we're not talking about a large amount of lead; it's relatively low concentrations. But once you get any lead in your body, the acids in your stomach dissolve it, and it gets in your bloodstream. And once it's in your blood, it's very hard to get out because it's stored in your bones.

Indiana does not provide free home lead analysis until children test positive twice for elevated blood lead levels. Furthermore, the state's threshold for elevated blood lead levels—10 micrograms per deciliter—is twice the amount regarded as elevated under national guidelines provided by the U.S. Centers for Disease Control and Prevention. But, the truth remains there's no safe level of lead—especially for infants and toddlers.

Research has consistently shown that lead testing rates are significantly lower in communities of color, even as the poisoning rates are significantly higher. In response to these inequities, the center's testing efforts focus on homes in downtown Indianapolis between Kessler Boulevard and Meridian Street, from 16th to 38th streets. A second, larger phase of the project—open to residents across the state—is planned for later summer, 2021. This effort is supported by the Environmental Resilience Institute at Indiana University.

In spring 2021, volunteers at First Baptist Church North Indianapolis assembled the first 200 lead test kits (Fig. 1) for distribution in cooperation with local organizations such as GroundWork Indy, the Kheprw Institute, the Flanner House and partner churches of the Indianapolis Ministerium.

Another 200 kits will be distributed in Muncie, Indiana, in cooperation with Ball State University. The kits include bottles for sampling water and bags for sampling soil and dust, along with educational materials on lead protection (Fig. 2).

Fig. 1. Community members assemble the water lead test kits at First Baptist Church North Indianapolis.
Photo credit: Liz Kaye, Indiana University

The lead testing project spoke to church leaders' desire to provide leadership and programming to improve their members' health. The fact that participants could learn about their home's lead levels while keeping the home's location

Fig. 2. The collection kits include bottles for samples and informational material on the risks of lead in homes. Photo credit: Liz Kaye, Indiana University

anonymous was also significant, as some members were hesitant to pursue professional lead testing due to concerns about government repercussions.

The collection effort builds upon previous work from the Center for Urban Health, which has offered free soil analysis since 2012 and free dust analysis since 2018. Over 2,500 soil and 600 dust samples have been analyzed since the start of these programs, with results returned to participants. The center had not been able offer free water testing until now because water collection requires special equipment compared to plastic baggies for dirt and soil.

Each kit includes five plastic water vials, a large bag to collect household dust, three small bags to collect soil samples, and informational material on lead in the home. These kits are returned to the laboratory at IUPUI where they undergo an array of analyses to determine the content of lead in water, soil, and dust (Figs. 3, 4). A numbered sticker is used to protect the anonymity of participants, and the results are returned to the participants themselves, with recommendations on how to mitigate any hazards that are detected. In the case of lead, mitigation is pretty straightforward, so long at the source of the exposure (soil, dust, water) is identified.

The community-driven science aspect of this project is intentional—not only will the individuals who participate benefit directly, but the resulting data will also play a role in keeping communities safer more broadly. This type of partnership is designed to provide true agency to the participants—these communities have passion and commitment, and only lack science to take action to protect their children's health, and indeed, the well-being of the community moving forward. Additionally, the results are valuable research tools themselves, having contributed to over a dozen peer-reviewed journal articles in scientific journals. Of course, most normal human beings who aren't in the academic world don't read scientific journals. That's why our program is steadfastly committed to producing parallel informational products that are designed with and for the general public, and we recommend that other community-driven science programs do the same. Such reciprocity is vital for truly meaningful community partnerships.

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Fig. 3. An IUPUI researcher tests a water sample for lead content in a lab on the IUPUI campus.
Photo credit: Liz Kaye, Indiana University

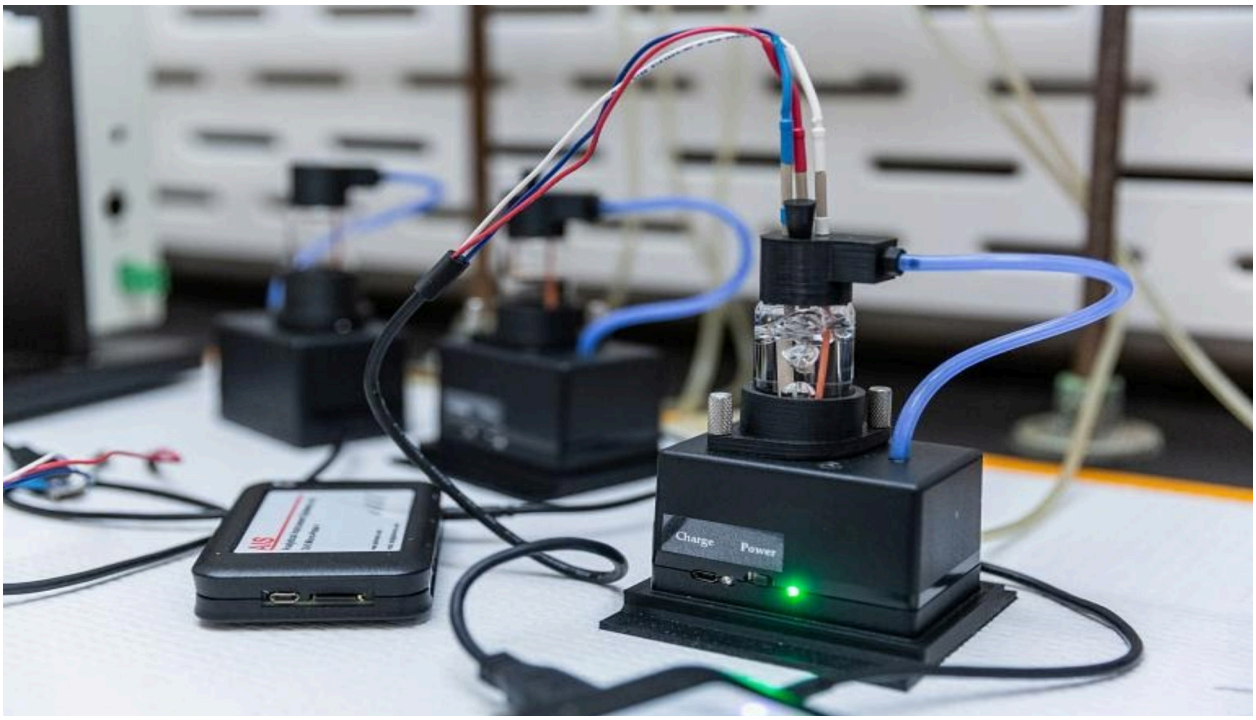

Fig. 4. Laboratory instruments are used by scientists to quantify the amount of lead in the water samples from households Photo credit: Liz Kaye, Indiana University