LEAD RESEARCH

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RECOMMENDED

Research Report:

Closing knowledge gaps about lead exposure in low- and middle-income countries

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We are grateful to the experts who took the time to offer their thoughts on this research: Rachel Bonnifield, Lee Crawfurd, Dr. Lucia Coulter, Dr. Jenna Forsyth, Perry Gottesfeld, Drew McCartor, James Snowden, and Santosh Harish.

We thank Dr. Rosie Bettle for bringing this idea to our attention.

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Executive Summary

Lead (element - Pb) poisoning presents a global health crisis with far-reaching consequences. An estimated one-third of children worldwide, predominantly in low- and middle-income countries (LMICs), have dangerously elevated blood lead levels. This exposure results in impaired cognitive development, diminished learning outcomes, and reduced adult productivity. The average IQ loss may be nearly 6 points, which potentially translates to a 4% reduction in lifetime earnings. This amounts to an annual global economic impact of US$300-500 billion. Furthermore, lead exposure increases cardiovascular disease risk, with attributable mortality estimates ranging from 1 to 5 million deaths annually.

Despite its severity, lead poisoning remains a neglected and understudied issue. Most LMICs lack comprehensive data on lead exposure prevalence and sources. While we know the most likely culprits, the list is long[1] and it is not clear which sources are responsible for the majority of exposure in which regions. This knowledge gap has been identified as a significant barrier to progress by stakeholders in the field.

The idea explored in this report is to incubate a charity specifically focused on closing these knowledge gaps. The organization could pursue two primary strategies:

1. Conduct widespread lead-content studies (i.e., measuring how much lead is present in different consumer products and household items) across diverse geographies to build a comprehensive understanding of environmental lead presence.
2. Offer a suite of methodologies – including blood lead level (BLL) measurements and sophisticated apportionment studies (i.e., studies aimed at more conclusively identifying the sources of exposure) – in select countries to produce actionable recommendations for reducing lead exposure.

Given the necessity of fostering relationships with local stakeholders, including government officials, academics, and NGOs, this charity may then be well-positioned to assist in implementing its recommendations through policy advocacy or manufacturer support.

The experts we spoke with were broadly supportive of this idea. Most agreed that significant knowledge gaps exist and that a new charity could effectively address

[1] Including informal lead-acid battery recycling, the use of lead-based paints, cooking food in lead-contaminated aluminium cookware, use of ceramics with lead-based glazes, cosmetics using lead-based pigments, traditional medicines, lead-based plumbing, electronic waste, adultered toys and jewelry, and others.

them. They highlighted local data as a crucial catalyst for government action on lead exposure mitigation. While there was some disagreement about the extent to which this organization should also focus on solution implementation, experts largely agreed that the space is generally neglected, with ample space for new actors.

Specific research activities vary in their complexity and tractability. Several experts cautioned us that conducting blood-lead studies is complex, requiring ethical approvals, trained personnel, and treatment pathways for high-risk individuals. However, lead-content studies of consumer goods and environmental samples can be conducted efficiently by a small team.

Our cost-effectiveness model estimates that this charity may avert the equivalent[2] of one disability-adjusted life year (DALY) for around US$28. We note, however, that this estimate is highly uncertain, given the two-stage theory of change (i.e., research followed by action) and the fact that there are different kinds of activities this charity could undertake. The experts we spoke with thought that many types of research in this space would be cost-effective, though they did note that some methodologies (such as detailed apportionment studies) may not be worth their cost.

Our key concerns include the complexity of the charity's theory of change and the likelihood of diminishing returns on research activities. The founders will need to iteratively update their plans based on ongoing research findings, potentially scaling different methodologies or transitioning from research to implementation as opportunities for cost-effective impact emerge.

Overall, we think that this is an idea worth recommending to future charity founders.

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[2] We say ‘equivalent’ because this figure is mostly driven by the economic consequences of lower IQ.

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1 Introduction

This report evaluates the idea of a new research-oriented charity working on closing knowledge gaps about lead exposure, and its promise for the Charity Entrepreneurship Incubation Program.

This report has been produced by Ambitious Impact (AIM). AIM's mission is to cause more effective charities to exist in the world by connecting talented individuals with high-impact intervention opportunities. We achieve this goal through an extensive research process and our Incubation Program.

This process began by sourcing hundreds of ideas for potential new charities from the members of our wider network, then gradually narrowing them down and examining them in increasing depth. In order to assess how promising interventions would be for future charity entrepreneurs, we use a variety of different decision tools such as group consensus decision-making, weighted factor models, cost-effectiveness analyses, quality of evidence assessments, case study analysis, and expert interviews.

This process is exploratory and rigorous but not comprehensive – we did not research all ideas in depth. As such, our decision not to take forward a non-profit idea to the point of writing a full report does not reflect a view that the concept is not good.

2 Background

Lead (Pb) is a heavy metal that humans have extensively used for thousands of years. It is a very useful element: It's abundant, malleable, and corrosion-resistant, and its compounds have a range of useful applications, from creating brightly colored pigments to forming antiknock fuel agents and storing energy in batteries. For its versatility and wide-ranging usefulness, it used to be considered a "gift from the gods" (Reh et al., 2021).

At the same time, it is extremely toxic. A single sugar sachet's worth of lead spread over the area of an American football field would contaminate the field enough to cause lead poisoning to children spending time there (Wiblin & Harris, 2023). And despite the common belief that lead poisoning has been solved since the global ban on leaded petrol, it is in fact still very widespread: UNICEF and the charity Pure Earth estimate that one in three children worldwide suffer from lead poisoning, defined as having blood lead levels (BLL) greater than 5 µg/dL (Pure Earth, 2021). Nearly all these children live in low- and middle-income countries (LMICs). While these children's BLLs typically aren't high enough to cause signs of acute poisoning, they are sufficient to cause a whole range of developmental and metabolic problems, resulting in disrupted cognitive development and an increased risk of cardiovascular diseases.

The scale of harm is immense. Recent studies estimate that lead-exposed children may lose, on average, around 6 IQ points (Larsen & Sánchez-Triana, 2023). This loss then results in worse learning outcomes and lower productivity. In their meta-analysis, Crawfurd et al. (2023) estimate a reduction in learning outcomes of 0.12 standard deviations (SDs) for each natural log unit of blood lead, i.e., for each multiplication by ~2.7. This means that a child with a BLL of 7 µg/dL is expected to perform 0.24 SDs worse than a child with a BLL of 1 µg/dL.[3] This effect is comparable with the best educational interventions in LMICs that we are aware of, such as the Teaching at the Right Level (TARL), which is estimated to improve learning outcomes by around 0.28 SDs (Teaching at the Right Level Africa, n.d.). Crawfurd and colleagues then went on to estimate that lead exposure alone may be responsible for one-fifth of the gap in learning outcomes between rich and poor countries. Rhys Bernard and Schukraft (2021) estimate that the cognitive deficit caused by lead exposure translates into roughly US$300-500 billion[4] in lost productivity per year.[5]

[3] Note that developed countries typically have average BLLs lower than 1 µg/dL (e.g., Egan et al., 2021).
[4] Henceforth, a '$' symbol will refer to US dollars, unless otherwise stated.
[5] Though note that there is large disagreement on this exact figure, owing to uncertainty about the exact relationship between lead exposure and IQ, and between IQ and productivity in LMICs. Some authors' estimates are are in the trillions of dollars.

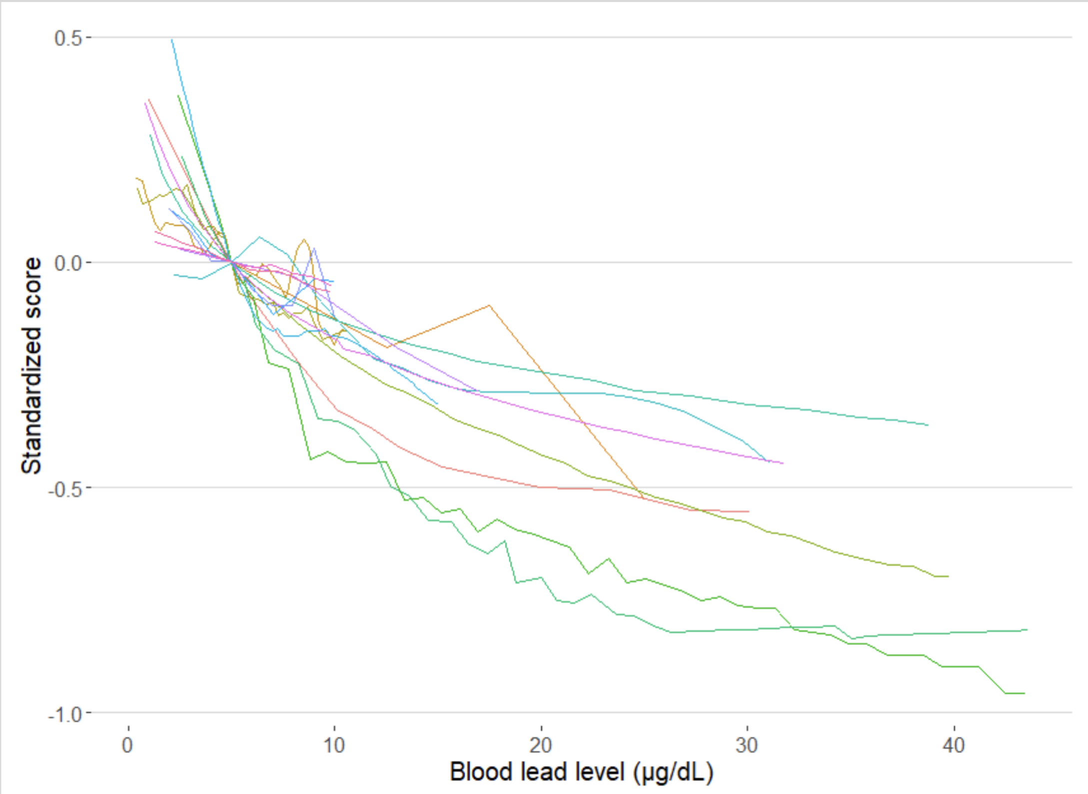

Figure 1: A dose-response relationship between BLLs and standardized learning outcomes, from Crawfurd et al. (2023). Each line represents data from one study.

Lead exposure also has various other adverse effects on human health. Recent meta-analyses have estimated that between 1.5 and 5.5 million people die each year due to the increased risk of cardiovascular diseases caused by lead exposure (GBD 2021 Risk Factors Collaborators, 2024; Larsen & Sánchez-Triana, 2023).

Despite these extensive negative effects, awareness of lead poisoning is very low, both among the general public and key decision-makers, such as government officials and aid agencies. A key problem is that lead poisoning is nearly invisible: Subclinical levels of exposure (which are most widespread) do not have any easily recognizable signs. The only way to confirm exposure is by testing people's blood for lead. However, this is rarely done in developing countries, partly due to a lack of necessary equipment and partly due to the lack of awareness that lead exposure could be a problem at all. This has created a cycle of ignorance in the global community whereby the burden of lead exposure has long been underestimated and the sources of exposure poorly understood.

Two examples demonstrate the extent of knowledge gaps concerning our understanding of lead exposure in LMICs. Firstly, very few LMICs have carried out large representative surveys of BLLs. Most countries rely on small studies carried out in specific areas, often those suspected by researchers to suffer from high levels of lead exposure. Therefore, international databases often rely on modeled imputations, which often wildly disagree with each other (Crawfurd et al., 2022). Figure 2 below displays the sizeable disagreements between estimates from two highly cited sources on lead poisoning by country: A 2021 Lancet meta-analysis (Ericson et al., 2021) and the Global Burden of Disease (GBD) study (IHME, 2020).

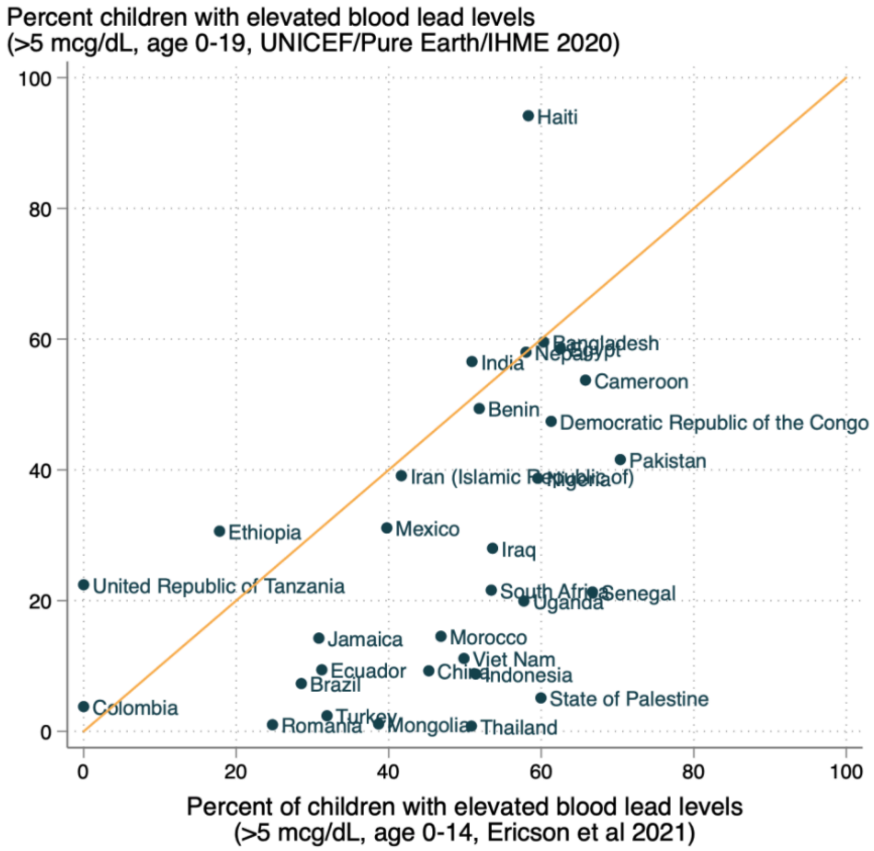

Figure 2: A chart showing the disagreement between the two leading sources of country-level data on the extent of lead poisoning. The further a data point is from the yellow line, the more the sources disagree. From Crawfurd et al. (2022).

Such a lack of reliable data predictably leads to delayed action, as was recently demonstrated in the country of Georgia. Based on earlier GBD estimates, only around 6% of children were expected to meet the 5 µg/dL BLL threshold for lead poisoning. However, when a nationally representative household survey was carried out in 2017, it was discovered that 41% of children were in fact poisoned – a problem that has since been traced to adultered spices and subsequently largely eliminated (Crawfurd et al., 2022; Forsyth et al., 2024).

Another example of our limited understanding of the sources of exposure has been highlighted by the recent Rapid Market Screening Program carried out by Pure Earth (Pure Earth, 2024). In this first-of-its-kind study, thousands of consumer products and food samples across 25 LMICs were analyzed for their lead levels. Contrary to expectations, adultered spices were found to be a problem only in a few specific countries, whereas lead-contaminated cookware was discovered to be common across most of the studied regions. This study has already inspired follow-up research and a working group on lead-contaminated cookware (Pure Earth, 2024).

While progress is being made, our understanding of the extent and the sources of lead exposure is still very limited in many LMICs, preventing these countries from taking effective action to limit exposure. Even in areas where we can make reasonable best guesses, it is often necessary to collect reliable local data in order to demonstrate to the local population and regional policymakers that there is a problem that needs to be urgently addressed (Crawfurd et al., 2022).

Therefore, this report explores the idea of incubating a charity focused on producing actionable research on lead exposure in neglected countries. This research would likely consist of a combination of studies quantifying the level of exposure, identifying the likely sources, and recommending appropriate solutions. Depending on the availability of strong local actors who can implement the solutions, this charity may itself then take on the role of the implementer.

In the next section, we explain several key concepts in lead exposure research (in the context of LMICs). Then, in Section 3, we explore the different possible theories of change for this charity and the way in which it would achieve a positive impact.

2.1 Types of research relevant to lead elimination

There are three broad types of studies relevant to improving the understanding of lead exposure in LMICs: (i) Studies of the burden of exposure, (ii) identification of the potential sources of exposure, and (iii) apportionment studies (also known as attribution studies[6]) that aim to clarify which of the potential sources of exposure are the biggest drivers of elevated BLLs, in the local context.

[6] There is a small difference between the terms: In a strict sense, 'apportionment' refers to a numerical breakdown of the different sources of exposure. Such types of studies are common in air pollution research but quite rare in lead exposure research, due to technical complexities (discussed later in this report). 'Attribution' is therefore often used for studies that make the weaker claim of causally attributing exposure to a particular source (without exact quantification of its contribution). The term 'source prioritization' is also sometimes used to refer to an exercise of ranking the suspected sources of exposure based on the available evidence. In this report, we use the terms 'apportionment' in a weaker sense that will typically come close to 'attribution' or 'prioritization'.

The first step to addressing lead exposure in a population is typically quantifying the local burden via BLL measurements. These can be done using a variety of methods: High-precision lab studies, typically using venous samples; lower-precision studies using portable equipment, using either venous or capillary (finger-prick) blood samples; or modern methods, such as X-ray fluorescence (XRF) analysis of dried blood spots (Bonnifield & Todd, 2024).

If it has been established that the population has elevated BLLs, potential sources need to be identified. There are numerous potential sources of lead exposure in LMICs, some of which have only been recognized in recent years. These include informal recycling of lead acid batteries, the use of lead-based paints, cooking food in lead-contaminated aluminium cookware, the use of ceramics with lead-based glazes, cosmetics using lead-based pigments, traditional medicines, tobacco products, plumbing, electronic waste, and others (Rhys Bernard & Schukraft, 2021). Sources may vary significantly from country to country – and between regions within countries – so local studies must typically be done. These typically consist of a combination of behavioral questionnaires and analyses of samples – including consumer products, food items, household dust, and water – for lead content. Some of these tests can be done in the field using a portable XRF machine; others require samples to be sent to a lab for analysis. See section 4.3 for more details.

Once potential sources have been identified, it may be useful to do additional research to understand which sources are the main drivers of elevated BLLs (and which are only minor contributors) so that the mitigation of the primary sources can be prioritized. These so-called apportionment studies can use one of several methods:

1. **Correlational methods**: These consist of using observational data on lead content (from the previous step), combined with BLL data, and questionnaires to understand behavioral risk factors[7] to estimate what amounts of lead from contaminated items may be inhaled or ingested. This is the most common type of apportionment study, but one that typically provides only limited and potentially biased quantitative information.[8]
2. **Isotopic methods**: These are a specific type of correlational study, which exploits the fact that different sources of lead often have different compositions of lead isotopes. This isotopic signature can then be used to point to the most likely source of lead in people's blood. Forsyth et al. (2019) used this approach in Bangladesh to test whether local women were most likely exposed to lead via food containers (cans), spices (turmeric), or soil (clay or ash). As shown in

[7] And potentially other locally appropriate methodologies, such as leachability studies that test how much of the lead contained in various items leaches into food or drinks during typical use (e.g. cooking).
[8] See Brown et al. (2022) for a recent example.

Figure 3, each of these potential sources had a different ratio of lead-206 (^{206}Pb), lead-207 (^{206}Pb), and lead-208 (^{206}Pb). Blood samples were found to be clustered near the ratios found in spices, pointing to them being the main culprit. This type of study can be very useful but requires specialized lab equipment and expertise to analyze the samples.

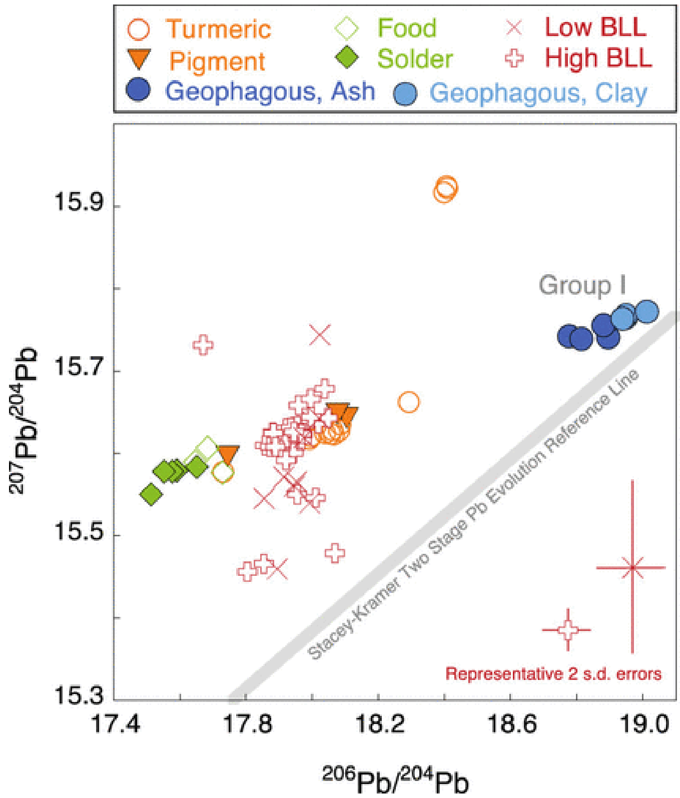

Figure 3: Lead isotope ratios in samples of spices, food containers, soil, and people's blood (Forsyth et al., 2019a).

3. **Interventional methods:** The only truly causal way to apportion sources is to conduct an intervention where the potential source of lead is removed, with BLLs measured before and after. An example of this is a study by Buerck et al. (2023) on the effects of replacing leaded water pumps with lead-free alternatives, which the authors found to reduce median BLLs from 8.6 µg/dL to 6.3 µg/dL, suggesting the pumps were responsible for around 27% of local lead exposure; see Figure 4.[9] These methods theoretically provide the best-quality information, but may be costly and complex to undertake in a way that produces accurate unbiased results (see Section 4.2 for details), so they may only be appropriate and cost-effective to undertake in selected cases.

[9] Although this study was carried out with the primary aim of evaluating an intervention, rather than as a means of apportionment.

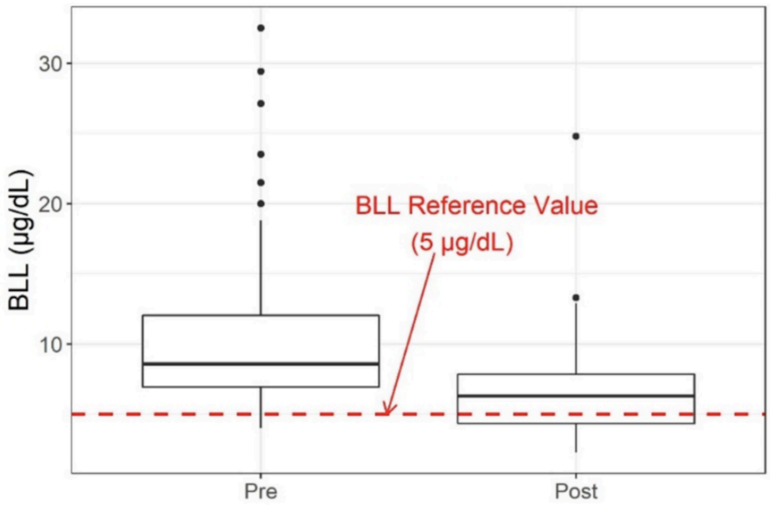

Figure 4: BLLs before and after replacing leaded water pumps (Buerck et al., 2023).

In the next section, we sketch out how an organization may use these different types of research activities in order to achieve positive impact in the world.

3 Theories of change

3.1 Barriers

Knowledge/research gaps

The idea behind this charity is to help close knowledge gaps related to lead exposure in LMICs in order to speed up mitigation efforts. The key assumption is therefore that these knowledge gaps are a barrier to action.

Each source of lead exposure is associated with a different set of barriers to action. In some cases, we have limited information about which products – and in which places – are adulterated.[10] In many cases, we have a limited understanding of source apportionment. For some sources, we already have tried and tested cost-effective solutions, while for others, scalable solutions don't yet exist. There may also be sources of exposure whose solutions will turn out to be costly and hard to scale.

In Table 1, we provide an overview of these types of barriers for nine sources of lead exposure in LMICs, plus a genetic as-yet unknown source. The table contains our personal judgments that are based on limited research; many cells are therefore likely incorrect and subject to change. Still, we hope it provides a useful introduction. Please see the spreadsheet version for details of our reasoning.

The table focuses on three types of research activities – lead content studies, BLL studies, and source-apportionment studies – and the extent to which their absence has been a barrier to action (/extent to which this type of study enables effective action). It also summarizes our understanding of the existence of cost-effective solutions and whether future research is likely to discover such solutions. The existence of cost-effective solutions is discussed in more detail in section 4.4; the idea of this charity conducting intervention-focused research is explored in section 3.3.

[10] Some adulteration happens intentionally (such as in the case of spices, which producers mix with lead compounds to achieve brighter colors, typically unaware of its toxicity) while other products get adultered accidentally (such as in the case of metallic cookware, which may be made from a mixture of recycled metals including small amounts of lead). Yet other products (such as traditional cosmetics) may have a very high lead content, but have never been scientifically assessed, so their lead content is unknown to the global community.

Table 1: Lack of research as a barrier to action. The first three columns look at three different types of research activities on lead exposure; the latter two columns look at the existence of known solutions and our judgment of whether more research would help discover new solutions.

	Did this/would this kind of research enable effective action?				
	i) Lead content studies	**ii) BLL studies**	**iii) Source apportionment studies**	***Do we already know of cost-effective solutions?***	***How likely is it that research will discover cost-effective solutions?***
Paint	Yes	Probably no	Probably no (controversial)	Yes	Not needed
Spices	Yes	Yes	Probably yes	Yes	Not needed
ULAB recycling	Not needed	Probably no	Probably yes	Probably yes	Likely
Cookware	Yes	Probably yes	Probably yes	No	Unlikely
Ceramics	Yes	Probably yes	Yes	Probably no	Likely
Cosmetics	Yes	Probably yes	Probably yes	No	Likely
Toys	Yes	Probably yes	Probably yes	No	Likely
Mining	Probably yes	Probably no	Probably no	Probably yes	Likely
Lead pumps	Probably no	Probably yes	Probably yes	Probably yes	Not needed
Unknown source	Yes	Yes	Probably yes	Unclear	Unclear

Overall, we make the following observations from the table:

- **Lead content studies** are a likely enabler in all cases except for those where we know a priori that the items contain lead (such as lead-acid batteries or lead pumps). This is because demonstrating which items in which geographical areas contain lead is typically the first step in addressing that source of exposure.
- **Local BLL studies** are likely to be an enabler in most cases since, without them, governments or other actors may not know where lead exposure is happening. Note, however, that progress may happen in the absence of such data, such as is the case with lead paint.
- **Source apportionment** studies generally have not been done, so we are uncertain about the extent to which they do/don't enable mitigation activities. The experts we spoke with somewhat disagreed on this point, some saying that apportionment is important in order to know how much attention and resources to dedicate to a given source of lead exposure, while others believed that they are often costly and uninformative and that we should focus on implementing solutions even in the absence of apportionment information. In our view, these studies are likely useful in some contexts, such as when we are unsure about the main one or two sources of exposure that deserve the most attention or in situations where governments require more convincing evidence to initiate a regulatory response.
- **Existence of tried and tested cost-effective solutions:** Whether solutions exist – or will exist – is a key concern for this charity idea. Research on lead exposure is only impactful if it can be followed by effective (and cost-effective) action. As shown in the penultimate column of Table 1, we currently only have well-documented, tractable, and cost-effective solutions to a few sources of lead exposure (namely, paint and spices). Solutions to a few other sources, such as lead-acid batteries, exist but may be too expensive or too complicated. To our knowledge, the other sources of lead exposure do not have ready-to-scale solutions.
- **Whether cost-effective solutions could exist:** The last column contains our judgment on whether research could help find cost-effective solutions (where they don't currently exist). Overall, we lean optimistic, though we are concerned that some sources of exposure, such as contaminated cookware, may be challenging to address. We return to this question in section 4.4.

Note, however, that there is disagreement on the extent to which gaps in research act as a barrier to action. In our conversation, Perry Gottesfeld said that, in his view, we have sufficient data on lead exposure in LMICs to act and that more research is not needed. While we don't know many of the details, such as which sources of lead exposure are responsible for what percentage of exposure, it doesn't matter since "all lead exposure matters" (Gottesfeld & Ismawati, 2021).

We take this concern seriously. We agree that there is a general bias (especially among researchers) in favor of doing research instead of implementing solutions and that it is often better to act sooner on imperfect information rather than postpone action until more data is available.

However, we also think that there are reasons to disagree. Firstly, resources to address health problems in LMICs are limited. Knowing where and how lead exposure happens is key to correctly prioritizing the most cost-effective solutions, both over other solutions to lead exposure and over other problems LMICs deal with. Secondly, apportioning sources of lead exposure may help direct funds to finding novel solutions. While there may be limited appetite to find solutions to lead-adulterated cookware if it's only responsible for, say, 5% of global exposure, there may be much greater motivation to find innovative solutions if it turns out that cookware is responsible for 50% of global exposure (as discussed in our conversation with Rachel Bonnifield).[11] Lastly, even if new information isn't strictly needed to inform the priorities of independent actors, it may be required in order to motivate government action.

Governments typically require more information on where and how exposure happens than other actors, such as researchers, grantmakers, or direct-delivery NGOs.[12] While these other actors may be comfortable making best guesses as to where or how exposure happens and act on incomplete information, governments may require more detailed information in order to justify allocating public funds toward a problem.

This need for local information has been highlighted by multiple experts, with Dr. Lucia Coulter saying that "country-specific evidence is really important to help inform and motivate action, and it also a useful baseline for regulatory authorities as it can help them plan enforcement" (Center for Effective Altruism, 2023, 17:10) and Perry Gottesfeld saying (in our conversation) that governments often use the lack of local data as an excuse not to act. Dr. Jenna Forsyth highlighted that governments asking for high-quality data may be justified: In Bangladesh, there are often new stories about various problems and toxic chemicals in the environment, some of which are highly overblown or outright false. Being able to present a rigorous study, ideally published in

[11] Note that this charity will likely only have capacity to undertake studies in a limited geographical region, so it's research will not be able to conclusively say answer questions about the global apportionment of lead exposure. However, even local studies would likely have informational spillovers: Generating high-quality data on local apportionment would update our best guesses about apportionment in other regions.
[12] By 'direct-delivery', we mean NGOs whose path to success doesn't depend on policy change or other government action.

a peer-reviewed journal, helps government officials decide which information to trust and take seriously. She also said that evidence linking lead sources to lead poisoning may be more important for sources that are culturally entrenched (such as a long history of using lead-based cosmetics) or where there are large financial incentives favoring the source of lead exposure (such as ULAB recycling).

Other barriers

Other barriers may also prevent effective action. Funding is an obvious one: Lead exposure in LMICs has historically been severely underfunded compared to the burden (GiveWell, 2021). However, as described in section 8.2, this situation is now changing.

The other main barrier is a lack of capacity – on the side of governments, local civil society organizations, or international NGOs – **to implement the recommended actions mitigating lead exposure.** All of the experts we spoke with brought up this barrier. While some countries have highly capable local NGOs (such as icddr,b in Bangladesh, who helped follow through on the phasing out of adultered spices there), other countries may not have groups with sufficient skills or capacity to ensure that the necessary actions are taken (e.g., laws passed, regulations enforced, or that manufacturers make voluntary changes). Historically, different actors have approached this barrier differently: IPEN and OK International have focused on building the capabilities of local groups, whereas LEEP takes a more active role in implementing lead paint bans.

To our understanding, capacity constraints vary significantly from place to place and across time. A new charity operating in this space will therefore need to assess whether there are actors present who could implement their recommended solutions. If not, the charity will have two options to ensure its research leads to impact: Decide not to operate in the country (at this time) or work on the implementation itself. We discuss these options in more depth in the next section.

3.2 Theory of change of this charity

As opposed to charities that focus on scaling specific interventions, the ToC of this charity is less clear a priori. This is because the type of research that is most impactful changes over time, based on the research done by other organizations and the most pressing questions identified by the community at a given time. The activities of this charity may also be partly driven by the interests of funders or collaborating academics rather than being fully determined by the charity leadership.

The diagram in Figure 5 attempts to capture the high-level theory of change of this charity. We note, however, that there may be alternative or additional paths to impact; these are explored in section 3.3.

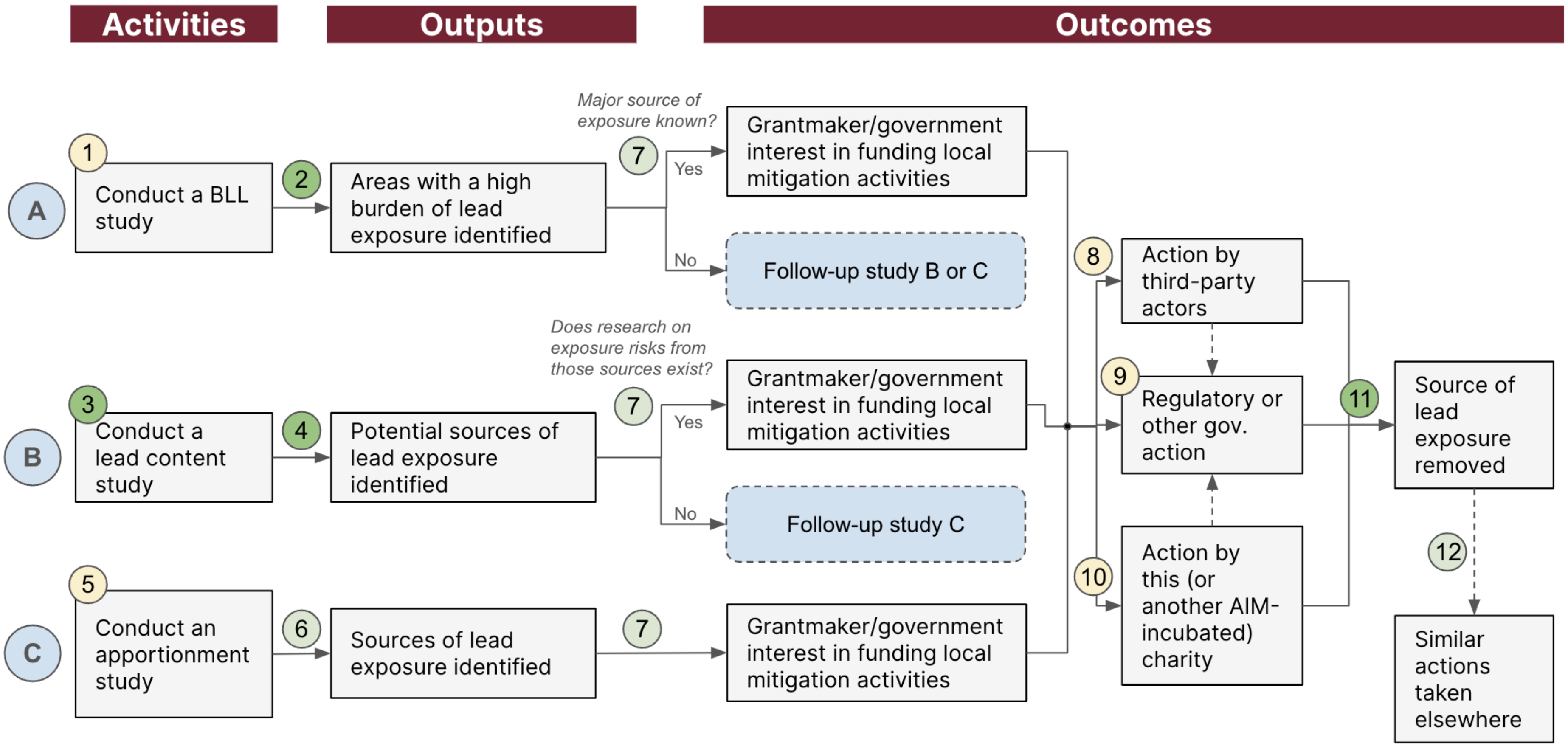

Figure 5: The primary theory of change of this charity. Note that the final step from outcomes to impact (i.e., the health benefits of reducing lead exposure) has been omitted in the interest of space and legibility.

Each numbered circle in Figure 5 is associated with an assumption about the link between elements of the theory of change. We explore these assumptions below:

1. **The charity can conduct BLL studies** (medium confidence): BLL studies are key in determining where and with what intensity lead exposure is taking place. They can either be localized – testing a sample of people (say, 100) in a specific location of interest – or be part of large, nationally representative health surveillance studies. We assume this charity would be doing the former but not the latter. However, even small BLL studies may be complicated because they involve working with human subjects and biological samples. We worry that a new, small charity may not have enough resources, connections, and experience to undertake them. However, they should be tractable once the charity has grown and built experience. As discussed in section 4.2 (and modeled quantitatively in section 7), we believe that a charity could initially focus on lead-content studies (points 3 and 4 below) and still be impactful and cost-effective. This view was shared by Santosh Harish (Open Philanthropy) in our conversation.
2. **BLL studies help identify areas of high lead exposure** (highly likely): This is what those studies are designed to do, and extensive past experiences demonstrate their usefulness.
3. **Charity can conduct lead content studies** (highly likely): These studies use different methodologies depending on what is being tested. Some items (such as household items) can be tested at the place of collection using portable XRF machines; others (such as water, food or household dust samples) may require samples to be tested in laboratories. We assume that the charity would be able to do the former tests itself and do the latter in collaboration with third parties, most likely universities. See section 4.2 for more information.
4. **Lead content studies help identify potential sources of lead** (highly likely): The emphasis here is on 'potential', as various factors can prevent confident identification, including how much gets released into the environment and how much is ingested or inhaled.
5. **Charity can conduct apportionment studies** (medium confidence): Apportionment studies typically rely on a combination of methodologies, typically including a BLL component. As such, they require a complex set of organizational and technical skills. We expect that a charity would undertake these in collaboration with academic partners, reducing the need to have many forms of expertise in-house. See section 4.2 for more information.
6. **Interventional studies help identify sources of lead exposure** (likely): Well-designed studies are likely to point to the main sources of lead exposure. However, the studies' findings may be hard to interpret if there are many overlapping sources of exposure or if the study has methodological deficiencies

(e.g., having a small sample size, not asking the right behavioral questions, or not collecting appropriate environmental samples).

7. **Funders/governments will be interested in funding mitigation activities based on this research** (likely): Funder interest in lead elimination in LMICs is growing (see sections 4.3 and 8.2 for details), which makes us reasonably confident that they will be interested in funding mitigation/elimination activities. However, the decisions of both philanthropic funders and governments will depend on the existence of cost-effective solutions, which will vary depending on the source of exposure. Encouragingly, we expect limited industry opposition in the majority of cases since lead in LMICs rarely comes from highly organized industries.[13] See section 4.4 for more detail.
8. **Third-party actors (such as other NGOs) will act on this information** (medium confidence): Whether other NGOs will implement solutions based on this research will depend on their organizational strategies, capacity, and the existence of cost-effective solutions. We are uncertain about all of these points. However, we are less concerned about this assumption since, if no other actors decide to implement a recommended solution, an AIM-incubated charity could implement it instead (including this charity; see assumption 10 below and section 3.3).
9. **Governments will take action** (medium confidence): Whether governments will take necessary lead-elimination action will depend on a complex set of factors, including the availability of solutions, their cost, complexity, and the governments' capacity. Third-party support, such as from NGOs, academics, or international agencies such as the WHO or UNICEF, will likely be needed. See section 4.3 for details.
10. **This charity will be able to take action** (medium confidence): One potential solution to third parties not taking necessary follow-up actions is for them to be done by us, i.e., an AIM-incubated charity. This could have two forms: (i) This charity itself could develop an 'implementation arm' and work not just on research but also on the scaling of solutions. This option is briefly explored in section 3.3. (ii) AIM could incubate a new solution-focused charity dedicated to scaling the suggested solution.
11. **Action results in the removal of the source of lead** (highly likely): If the action is informed by sound research, we are highly confident it will result in the removal of the source of lead.
12. **Action in one area inspires action elsewhere** (likely): Past experience with lead elimination efforts suggests that approaches trialed in some countries or

[13] The main exception is ULAB recycling, which is an ecomically profitable activity whose regulation is likely to face opposition.

regions will inspire actions in other regions – especially given that the lead elimination space is dominated by evidence-based actors with a global focus.

13. (*not shown in diagram:*) **Reduction of the source of exposure leads to decreased lead exposure, which in turn leads to health benefits** (highly likely): We are confident that, if removal is preceded by research on exposure and apportionment, it will lead to reduced BLL. We are also highly confident that reduced BLL has health benefits; see section 4.5.

There are also other considerations in terms of how this charity may operate:

i. **Doing research primarily independently or primarily in collaboration with supporting academics**: A charity that develops a robust in-house research capacity could conduct research in a maximally lean, nimble, and impact-focused way, without being slowed down by academic collaborators or having to comply with academic requirements (which may sometimes align more with 'publishability' in prestigious journals rather than with social impact). On the other hand, working with skilled and reputable academic researchers could allow the charity to work on complex research projects that are difficult to design and get off the ground.[14] It may also allow access to top talent for free – as academics may have access to independent funding to cover their expenses – or easier access to expensive equipment (such as isotope-testing technologies).[15] Lastly, working with prestigious universities and publishing in peer-reviewed journals would likely help the charity to be taken seriously by key actors, such as government ministries. Our best guess is that the charity should aim to develop an in-house capacity to run lead-content studies but collaborate with academics on other types of research.

ii. **Focus on specific methods vs. specific locations**: The charity could lean more into becoming specialized in a narrow set of methodologies and apply these skills to a variety of lead sources in a range of locations; or it could decide to focus on specific areas (e.g., specific countries or states) where there is evidence of high lead exposure and provide a comprehensive package of studies, with the aim of providing clear recommendations on how specific countries can address their lead exposure.[16]

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[14] For instance, complex interventional studies such as randomized controlled trials or difference-in-differences designs, whose design may require highly skilled econometricians.

[15] The former approach may resemble how the NGO IDinsight operates, with studies designed and carried out primarily with in-house talent, while the latter may resemble more the model of Innovations for Poverty Action, which typically works closely with J-PAL, a global network of academic international development researchers.

[16] The outputs could then resemble those produced by the Copenhagen Consensus Center, which produces country-specific "priorities" documents, which list the most cost-effective interventions a country's government can invest in.

We don't currently have a strong view on which of these options is preferable, so we encourage potential founders to consider them during the incubation process or review them after having run a pilot project.

3.3 Other potential activities for this charity

Aside from – or on top of – the activities described in the previous chapter, this charity could undertake several other types of activities. They vary in terms of how good a fit they may be for a new charity and in how well they align with the main activities from section 3.2. We discuss these options below, in a rough order of how promising we perceive them to be.

Conducting other types of research relevant to lead elimination

There are various other open questions in this area. For instance, we have a limited understanding of the leachability of different types of adultered cookware or ceramics (Pure Earth, 2024), the reliability of different BLL methods (Bonnifield & Todd, 2024), and there is still considerable uncertainty about the exact effects of lead exposure on IQ, especially at low levels of exposure (Rhys Barnard & Schukraft, 2021; Van Landingham et al., 2020). In our conversation, Santosh Harish (Open Philanthropy) suggested that working on validating low-cost research tools in LMIC contexts may be highly valuable, as would tracing supply chains for ceramics, cookware, toys, etc., to understand where exactly adulteration happens.

We don't have a strong recommendation for or against engaging in this type of research; we think that the charity directors will need to decide case-by-case whether engaging in such research topics is impactful and synergistic with their other activities. We expect that there will be cases where the charity's activities naturally align with a research question the community is interested in – such as the accuracy of XRF measurements for lead paint, which LEEP is working on (Open Philanthropy, 2024).

Implementing the recommended solutions

If the charity has invested significant resources into local research, building relationships with the government, local universities, and local NGOs, it may find itself in a very good position to continue working on the implementation of the recommended solutions. While this would constitute a significant expansion in the charity's activities and make it organizationally more complex, it would also reduce the concern that its research doesn't get acted upon. The experts we spoke with were broadly supportive of this idea, though their views slightly differed: Dr. Jenna Forsyth thought that local implementation capacity was often a critical barrier to impact and that it could therefore be highly impactful for this charity to also work on implementation. Dr. Lucia Coulter agreed with this view but highlighted that who the best implementer is will likely vary from case to case and that it is best to make this decision jointly with funders and other actors once the research phase has been completed.

Developing and testing new interventions

As highlighted in section 3.1, another barrier – other than identifying the places and sources of lead exposure – may be the lack of appropriate solutions. In some cases, scalable solutions haven't been tried at all; in other cases, there may only be proofs of concept that have never been scaled; or the existing interventions may be too expensive or too impractical. In those cases, there is a need for actors to innovate and test new cost-effective, scalable solutions.

Two examples demonstrate how implementing a solution has helped the broader community realize that solutions are more tractable than they had seemed.

i. **LEEP and lead paint**: When AIM recommended the incubation of a charity focused on banning lead paint in LMICs, there was considerable uncertainty about governments' and manufacturers' receptivity to advocacy against lead paint. However, LEEP's experience demonstrated that the government of the first country they engaged with, Malawi, was highly receptive to their message, and it committed to phasing out lead paint within months of LEEP's engagement with them. LEEP's provision of free consulting services by a paint specialist also proved effective in assisting manufacturers with switching to lead-free paints. Within two years, LEEP has demonstrated a sharp decline in the presence of lead in paint sold in Malawi, leading them to update their estimated cost-effectiveness from AIM's original estimate of $156/DALY to $14/DALY, an elevenfold improvement (LEEP, 2022). This has motivated LEEP to try to replicate their approach in nearly 20 other countries (LEEP, n.d.).
ii. **Removal of lead chromate from turmeric in Bangladesh:** It has been known for decades that lead was present in spices in Bangladesh. However, the problem wasn't addressed for a long time, and it was unclear how difficult it would be to do something about it (Forsyth et al., 2019b). However, the team of Dr. Jenna Forsyth and the NGO icddr,b then decided to implement a multi-facated intervention, consisting of disseminating their findings via scientific journals and news media, educating the public and relevant businesspeople about the risk of

adding lead chromate to turmeric, and collaborating with the Bangladesh Food Safety Authority to enforce policy disallowing turmeric adulteration. Within four years, this intervention resulted in turmeric adulteration rates dropping from 47% to 0% (Forsyth et al., 2023), with an estimated cost-effectiveness on the order of $1/DALY (Porterfield, 2023).[17] The community is now actively looking to replicate this success in other countries.

It is difficult to predict whether future research will discover similarly tractable and cost-effective solutions. However, there are a few areas where we, and the experts we spoke with, suspect low-hanging fruit may yet to be found, such as:

i. **Removing lead from toys:** The Rapid Market Study by Pure Earth (Sargysan et al., 2024) found that 13% of the toys they tested contain high levels of lead, either due to adultered paint coatings or internal electronic parts made of lead. Working with manufacturers and regulators to raise awareness of this issue and find solutions could be highly tractable.[18]
ii. **Cosmetics:** The same study found high levels of lead in 12% of samples of cosmetics, such as traditional eyeliners. Since lead-free alternatives are readily available, removing this source of exposure could be highly tractable.
iii. **Ceramic glazes:** The same study also found that 45% of tested samples of ceramics exceeded reference levels of lead, often due to the use of lead-based glazes. The development or promotion of cheap lead-free glazes may be another intervention worth exploring.

A counter-argument, mentioned by Dr. Jenna Forsyth in our conversation, is that many of the above-listed sources of lead exposure may have a similar "playbook" to paint and spices, so there isn't really a need to develop new interventions – but rather a need for local actors to implement them. However, she did say that having more country-level success stories of eliminating a source of lead exposure would show to the others that this can be done and how to go about it.

Lastly, it is worth highlighting that estimates of the cost-effectiveness of solutions are currently almost entirely missing from the lead-elimination literature. An organization that pilots implementing different solutions and documents their cost and potential benefits could generate significant value for grantmakers by helping them allocate their limited financial resources more effectively.

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[17] The cost estimate includes the program cost to project team ($360,000), ongoing monitoring ($100,000), and estimated spend by the Bangladeshi government on enforcement ($100,000).

[18] Adultered toys seem to share many similarities with adultered children's jewelry, which has been a problem in Israel (Negev et al., 2021). In that case, addressing the issue turned out to be highly tractable, once a regulatory gap was discovered: 50% of jewelry samples tested in 2016 were adultered but, after the introduction of a new standard in 2018, only 17% of samples exceeded the maximum allowed level of lead.

Lobbying for large-scale BLL testing

The importance of local, representative BLL data in LMICs has been repeatedly stressed by various actors, including NGOs, funders, and academics (e.g., Pure Earth, 2023; Crawfurd et al., 2022; Rhys Bernard & Schukraft, 2021; Ericson et al., 2021). At the moment, however, only three LMICs do this kind of representative testing: Mexico, Georgia, and China (Bonnifield & Todd, 2024). While conducting standalone representative surveys is often prohibitively expensive – costing roughly $250,000 to $1 million per country (Center for Effective Altruism, 2023, 47:30; Rhys Bernard & Schukraft, 2021) – the marginal cost of adding BLL to an existing population health survey is much cheaper. For this reason, organizations like UNICEF and the Center for Global Development have been lobbying for the addition of BLL testing to existing health surveys (Crawfurd et al., 2022; UNICEF, 2023).

However, achieving this may not be easy. CGD authors say: "Competition for inclusion of topics in DHS and MICS surveys is high. Measuring blood lead levels requires at minimum a finger prick test and so the inclusion of lead testing is high effort, when compared with other topics that may simply require interviews with households." (Crawfurd et al., 2022). As such, we are concerned that convincing governments to make this change is a difficult ask, and one that may not be a good fit for a new charity with no pre-existing government relationships and a limited track record. We, therefore, recommend that a new charity doesn't focus on this activity as its primary task but consider including it if or when it builds a strong advisory relationship with specific country governments.

4 Quality of evidence

In this section, we review the evidence – including evidence from the academic and grey literatures, expert perspectives, and some theoretical reasoning – that the argument in favor of this charity idea rests on.

4.1 Evidence that there are gaps in our understanding of lead exposure in LMICs and how to address it

Lead exposure in LMICs is a highly understudied topic. In many countries, we have limited information on (i) who is exposed and to what extent, (ii) what the sources of lead exposure are, (iii) what their relative importance is. In the subsections below, we aim to give an overview of what we do and don't know.

Burden of exposure

In many LMICs, we only have limited, and sometimes out-of-date, information about which populations suffer from lead exposure and to what extent. While estimates of the burden of exposure by country exist – including estimates of the DALY burden in the GBD study (IHME, 2024) and of average BLL by country on the LeadPollution.org website run by Pure Earth – these figures are often based on limited data. Only three LMICs – Mexico, China, and Georgia – have so far collected BLL data on exposure in a representative manner (Bonnifield & Todd, 2024). Many other countries base their estimates on a small number of local academic studies, which are often conducted around known hotspots of lead exposure (such as ULAB recycling) rather than in a representative manner, combined with imputation based on regional averages. This issue was highlighted in the systematic review by Ericson et al. (2021), who were only able to find adequate-quality BLL data from one-third of LMICs.

This is a problem for two reasons. Firstly, not having truthful data may make us – the global nonprofit and philanthropic community – miss areas that are suffering from high levels of lead exposure. As discussed in the section 2, it was not until Georgia ran its first nationally representative survey that it discovered a large problem of lead poisoning – which the country subsequently addressed within a few years.[19] Secondly, even in cases where we can make reasonable best guesses, experience suggests that

[19] An analogy can be seen here with the Global Burden of Disease study, which has proved to be an indispensable tool for the global health community in terms of prioritizing which diseases and which geographical areas to prioritize for interventions. In the lead space, the GBD (and other similar databases) are much less useful because of the low reliability of their estimates.

governments are unlikely to act unless they are presented with real, reliable local data. In some cases, this can be due to them trying to avoid having to deal with the problem, while in other cases, it may be a rational desire to be evidence-based and direct limited resources to demonstrated problems. In either case, though, local data is needed.

Sources of exposure

For a long time, the main sources of lead exposure were assumed to be known. Based on Western experiences, they were thought to be leaded petrol, lead pipes, and lead paints, plus highly visible LMIC sources of exposure, such as informal ULAB recycling.

However, there is now growing recognition of the fact that exposure in LMICs also comes from many other sources; see sections 2.1 and 3.1 for examples. However, our understanding of which sources are important in which areas is often quite limited. For instance, a recent paper set out to review the literature on the different sources of lead exposure in 15 West African countries, but the author concluded that “only countries such as Nigeria and Ghana have extensive research available regarding the different sources of Pb exposure” and the review “revealed a vast research gap on the sources and implications of Pb exposure” (Obeng-Gyasi, 2022). Even in the places where the potential sources have been mapped out, there is little quantitative understanding of their relative contribution to populations’ exposure.

Even for the better-studied sources, such as paint, there is much disagreement about how much exposure it constitutes. For example, in their Lancet review, Ericson et al. (2021) claimed that paint is only a very minor source of exposure, something that has been challenged by Brosché (2022) and others based on the limitations of available data. Rethink Priorities recently examined the question of exposure to lead from paint in LMICs, concluding that it likely makes up around 7.5% of the total economic burden – but with a 90% confidence interval of 2–15% (Kudymowa et al., 2023a).

Progress is being made. The recent Rapid Market Screening (RMS) Program by Pure Earth, which analyzed thousands of samples of consumer products and food samples across 25 LMICs, has generated the most extensive data to date on the geographical variation in potential sources of lead exposure – see Figure 6 (Sargsyan et al., 2024).

Region	Ceramic foodware %>Ref	N	Metallic foodware %>Ref	N	Plastic foodware %>Ref	N	Cosmetics %>Ref	N	Paints - large surface %>Ref	N	Toys %>Ref	N	Spices %>Ref	N	Staple dry food %>Ref	N
Latin America & Caribbean	55	44	47	92	16	62	15	136	43	46	10	122	2	187	0	36
Sub-Saharan Africa	35	68	58	104	14	96	8	188	33	115	9	163	0	240	1	146
Middle East & North Africa	54	26	25	36	8	38	24	46	41	17	4	51	1	95	0	22
Europe & Central Asia	56	85	30	79	15	60	8	107	53	72	20	186	3	162	3	34
South Asia	41	56	70	129	9	81	7	231	27	107	18	172	4	280	3	59
East Asia & Pacific	21	29	51	80	0	27	23	104	56	80	7	87	1	120	1	67
		308		520		364		812		437		781		1084		364

Figure 6: Percentage of samples exceeding lead-content reference level, by item and world region (Sargsyan et al., 2024).

However, many questions remain. Firstly, the RMS only included samples from 25 countries and, in many cases, only from selected cities. Secondly, researchable questions remain about many of these findings, such as which particular types of cosmetics/toys/cookware tend to be adultered, where exactly the adulteration happens, and how much of the lead from these items is typically ingested or inhaled. In our conversation, Dr. Lucia Coulter said that we still don't have enough information to design effective mitigation strategies and that much more research is needed. When asked about the likelihood of discovering new sources of exposure, Rachel Bonnifield told us that it's unlikely that we will find entirely new sources but that it is quite likely that some sources that are currently treated as minor ones will actually turn out to be very important and deserving of much more attention.

4.2 Evidence that a charity could address this

In this section, we focus on the question of whether a charity could feasibly address the gaps in research on lead exposure in LMICs by reviewing the experiences of existing actors together with practical considerations around the complexity of the different research tasks.

Overall, we find that the kinds of research laid out in previous sections are feasible for a charity to carry out. However, the variety of involved tasks and the need for specialist expertise mean that successfully conducting high-quality research may be more difficult than the tasks involved in running a typical AIM-incubated charity. Below, we review the feasibility of each of the three main research tasks laid out in section 3.2.

BLL studies (to understand the burden of exposure)

BLL studies would likely be a key part of the charity's methodological repertoire. BLL samples are needed not only to assess existing exposure but also, for example, to test the effects of interventions or to measure the isotopic composition in people's blood.

Given that existing organizations have been extensively involved in BLL studies, we are moderately confident that this is a feasible task for a charity to carry out. For instance, the Global Lead Program (2024) review document by Pure Earth documents numerous examples of BLL studies the nonprofit carried out between 2020 and 2023.

They may not, however, be an appropriate methodology to focus on in the first few years of the charity's operation, as they may be too complex for a new team with limited experience to undertake. As such, we recommend that a new charity focuses first on conducting lead-content studies while simultaneously building up its capabilities to run BLL studies.

Here, we review the complexities associated with BLL studies, which generally fall into three buckets: ethical considerations, the need for technical equipment, and funding.

Since BLL studies involve taking biological samples from human subjects, and doing so in an invasive way, it is crucial that strict procedures are followed. These include obtaining approval from an accredited research body to undertake this kind of research, obtaining informed consent from participants, and likely having procedures for how to deal with situations where a participant is detected to have a dangerously high level of lead (and needs to be treated for acute poisoning). Only trained staff should be allowed to take capillary (i.e. finger-prick) blood samples, and only certified phlebotomists should be taking venous blood samples. While the charity can outsource those tasks to partnering organizations, it should be able to plan for and oversee these sensitive parts of the research process. In our conversation, Drew McCartor of Pure Earth cautioned us that BLL studies are a serious undertaking that may require dozens of staff members.

Once samples are collected, they need to be analyzed. There exists a range of options for doing this, varying in accuracy, cost, convenience, and need for technical expertise (Bonnifield & Todd, 2024). In many cases, the most practical solution will be portable devices that can analyze capillary samples, such as the LeadCare II device. It allows samples to be analyzed at the point of care at a cost of around $10 per test kit (plus an initial investment of around $3000). While its precision is limited,[20] it will be satisfactory for most areas with high average BLLs. If more precision is desired, venous samples need to be collected and sent to certified laboratories for analysis. In many parts of the world, the required instruments aren't available, so testing may need to be done abroad (for example, in the USA). These methods typically cost $15-40 per sample (Forsyth, 2021).[21] Neither of these options is infeasible to use but will require careful planning and attention to detail to ensure that blood samples aren't contaminated and that the measured BLL values are accurate.[22]

Depending on the number of tested individuals, funding could also be a significant constraint. To perform a local, targeted BLL study using the LeadCare II device, the team may only need to collect ~100 capillary samples at a marginal cost of around $1000. Even with the initial equipment investment and staff costs, a study is unlikely to cost more than a few thousand dollars. However, conducting a nationally representative study using laboratory equipment can be very expensive. Pure Earth says that it costs them around $250,000 to conduct a representative BLL study of a small country or, for example, an Indian state (Center for Effective Altruism, 2023, 47:30). A survey of a bigger country apparently costs UNICEF around $1 million (based on the same presentation, supported by an expert interview). While this charity may be able to push down the cost a little if it operates in a lean way, nationally representative surveys will likely continue to be very costly.

That said, large-scale BLL studies using the fingerprick approach may be a promising option from an affordability perspective. A study of 1000s of individuals would likely only cost in the order of $10,000s, which is an amount that a small, AIM-incubated charity should feasibly be able to fundraise.

[20] Its 95% confidence interval was assessed to be ± 1.8 µg/dL – although this was for samples with concentrations around 3.5 µg/dL, which is near the device's 3.3 µg/dL limit of detection (Jones et al., 2020). Accuracy is presumably better at higher levels.
[21] Although the cost can be even higher: Based on a private conversation, the cost per BLL sample was around $65 in a recent study in Bangladesh.
[22] For instance, the LeadCare II device is known to give biased results if the ambient temperature or humidity are too high (Bonnifield & Todd, 2024).

Lead content studies

Lead content studies would likely be another key methodology used by this charity. As reviewed in section 3.1, we think that local lead content data may often be the most important enabler of effective action.

These studies are generally more feasible than BLL studies, as they do not require ethical approval or staff skilled at working with human subjects and their blood. Depending on the type of samples, different kinds of laboratory tests are used. While this requires partnering with relevant labs, the process can be relatively cheap: Dr. Lucia Coulter says that conducting a lead paint study in a single country costs LEEP no more than $4000 (Center for Effective Altruism, 2023, 47:30). To our understanding, similar costs can be expected for studies of other potential sources of exposure.

Moreover, advances are currently being made in validating the use of portable XRF machines for analyzing samples. In our conversation, Dr. Lucia Coulter said that when used correctly (e.g. with samples prepared in an appropriate way), their results correlate very highly with laboratory results (see also Frydrych and Jurowski, 2023). These machines are highly portable and easily reusable. While they currently cost around $25,000, their marginal cost is close to zero.

In our conversation, Santosh Harish (Open Philanthropy) expressed the view that data on lead content of goods in different geographies is still so limited – and progress so slow – that a new charity could be sufficiently promising even if a charity only focused on this type of research. Our cost-effectiveness analysis in section 7 is built on the assumption of only focusing on lead-content research.

One potential complication is the sequencing of BLL and lead-content studies: In order to geographically target lead-content studies in a useful way, the charity will need to know which populations suffer from high levels of lead exposure. Otherwise, its efforts could be wasted. As such, lead-content studies will likely not be the best first step in areas without good BLL information. While this doesn't make focusing on lead-content studies intractable, it is a complication that the charity will need to think through carefully.

To our understanding, there are sufficiently many areas where we know that lead exposure is a problem but where the lead-content type of information is lacking.[23] A charity choosing where to operate should use estimates of exposure from sources such

[23] None of our expert interviewees raised this as a major concern.

as LeadPollution.org (which combines real data with imputed estimates) and supplement them with country-level information from the Global Lead Forum website. In the future, a crucial resource may be a new website that Pure Earth is building, which will not only model the likely levels of lead exposure for each country but also highlight the extent of uncertainty in each estimate (based on our conversation with Drew McCartor). This charity should ideally prioritize countries where we have confident estimates of the levels of exposure but limited information on its sources.

Apportionment studies

Good-quality apportionment studies are nearly absent from the literature, and where they exist, they have typically been carried out by academic teams. As such, we have a high level of uncertainty about a charity's ability to undertake this kind of research. However, given the very limited global understanding of lead apportionment, this type of research could also be counterfactually the most impactful for the charity to undertake.

The feasibility of apportionment studies depends on the exact methodology in question (see section 2 for an overview of the different methods). Studies relying on correlational analyses of BLL and lead-content data are the most feasible type. The research team needs to collect data on exposure levels experienced by different individuals, alongside data on the lead content of potential lead sources that those individuals come into contact with (and typically a behavioral questionnaire). Then, researchers try to understand the drivers of exposure by conducting (correlational) regression analyses between variables in the dataset. Dr. Jenna Forsyth told us that the marginal cost of these studies is low: while the blood is being drawn, observations, measurements, and surveys can easily be administered.

However, the correlational nature of these studies limits their informative value. An example of this issue can be seen in the study carried out in Bihar, India, jointly by Pure Earth and the team of Dr. Jenna Forsyth (Brown et al., 2022).[24] The research team collected BLLs and samples of dust, soil, and water in 135 households that were either proximal or distal to battery recycling sites. They found that BLLs did not vary by distance to the sites and that instead they were associated with lead in spices and the number of rooms in the households (a proxy for painted walls). However, exact numerical apportionment wasn't possible due to the multiple overlapping sources of exposure and limitations of the collected data.

[24] Note that Pure Earth state on their website that this was the first apportionment study they collaborated on (Pure Earth, 2022).

Isotopic methods are a promising approach to lead apportionment that this charity should explore. These methods have been successfully used to identify sources of lead exposure in a range of studies, e.g., in Shanghai, Kolkata, and rural areas of central Bangladesh (Zhang et al., 2009; Das et al., 2018; Forsyth et al., 2019a). Conducting these studies requires collecting venous blood samples as well as samples of the suspected sources of lead. These then need to be analyzed using high-precision laboratory equipment to determine their isotopic ratios. Given the highly technical nature of this process, collaboration with skilled teams in academia or regulatory agencies is needed. Whether the benefit is worth these complications will likely vary from case to case.

Lastly, interventional studies are a promising and underutilized method of apportionment. These studies consist of a pair of BLL sample collections before and after implementing an intervention known to remove a particular source of lead exposure. While such studies are typically carried out to evaluate an intervention's effectiveness, they can also be designed to specifically answer questions about apportionment. For instance, to measure the contribution of adultered aluminium cookware to total lead exposure, researchers could replace all the cookware used in a village with cookware known to be lead-free – even if this intervention itself were of little interest (e.g., due to its high cost).

Compared to isotopic methods, interventional methods do not require specialized laboratory equipment and expertise in analyzing chemical data. However, they may require careful study designs to ensure valid results. Firstly, the studies need to be sufficiently large to have the statistical power to detect even small changes in BLLs. Secondly, the timing of the BLL sampling needs to be planned very carefully, as BLLs can take a long time to respond to changes in exposure. Forsyth (2021) reports that the mean half-life of BLLs in less heavily exposed populations is 21-28 days. However, in more heavily exposed populations, lead gets stored in bones, from where it is released much more slowly. Forsyth, therefore, recommends that pre- and post-intervention BLLs ideally be drawn about a year apart. Thirdly, BLLs may show seasonal variation, which could be accidentally mistaken for a causal effect. BLLs may need to be measured at the same time of the year to minimize the risk of biased results. Additionally, studies may need to include a control group to minimize the risk of false inference further. These considerations make interventional studies more complex, expensive, and therefore less feasible.

In conclusion, we believe that the types of research required to improve our understanding of lead exposure in LMICs are likely feasible for a charity to undertake, but they are not straightforward. Lead-content studies are likely the easiest ones to undertake, followed by small-scale BLL studies and finally different kinds of apportionment studies. To undertake the more complex types of research, the charity would almost certainly need to collaborate with teams of experienced researchers to ensure that the studies are well-designed and partner with high-quality labs that would undertake the chemical testing of the collected samples.

4.3 Evidence that relevant actions will be taken based on this research

As a research-focused rather than intervention-focused organization, the impact of this charity will depend on whether or not others will act to reduce lead exposure based on the research findings. In this section, we briefly review the evidence for and against this point, focusing on three kinds of actors: funders, governments, and other nonprofits.

We are confident that funders will act based on this type of research. Major funders in this space, including Open Philanthropy, Founders Pledge, and USAID have shown a growing interest in funding interventions to limit lead exposure in LMICs (Open Philanthropy, n.d.; Founders Pledge, 2023; USAID, 2024). In our conversations, grantmakers from Open Philanthropy and Founders Pledge have expressed interest specifically in this type of research-focused activity.

One reason for concern here is that funding in this space has historically been very limited. While we believe that this situation will change (see section 8.2 for details), there is a risk that, if funder interests change, even cost-effective solutions in the lead space will remain unfunded. In our conversation, Drew McCartor of Pure Earth cautioned that funder interest may be temporary.

We are cautiously optimistic that governments will act on this research. Our best guess is that governments will be interested, but only if they are supported in their efforts by other actors, such as nonprofits or UN agencies. In general, health, education, and economic development are key priorities for LMIC governments, so we expect a priori interest. However, many LMICs suffer from a range of urgent issues related to health and development, so governments typically have many competing priorities (and limited funding). In order for them to prioritize addressing an issue, they typically require convincing data demonstrating that there is a problem, alongside being given a tractable solution. Lastly, many LMIC governments have limited capacity to implement solutions so they may require external assistance.

Recent examples of eliminating lead compounds from paint and spices demonstrate these points. In the case of paint, LEEP has found that when presented with local data on lead levels and offered assistance with legislative changes, most governments show a willingness to act. In their 2023 annual review, LEEP reports having received government commitments in 12 countries in less than four years, with two countries so far showing evidence of regulation and enforcement (LEEP, 2024a). They believe that these successes will be highly replicable elsewhere and plan to scale up to cover 75% of LMICs by 2026.[25]

Governments have also shown high responsiveness to data on lead exposure in the case of lead in spices in Bangladesh and Georgia. As discussed in section 3.3, following the research by Dr. Jenna Forsyth and others, the Bangladesh Food Safety Authority has successfully enforced a policy that disallows turmeric adulteration, resulting in adulteration rates dropping from 47% to 0% in four years (Forsyth et al., 2023). Similarly, once BLL studies in Georgia discovered high rates of lead exposure and subsequent studies pointed to adultered spices being the main culprit, the Government of Georgia implemented a successful intervention, which reduced the maximum measured concentration of lead in spices from 14,233 µg/g in 2020 to 36 µg/g in 2022 (Forsyth et al., 2024).

Note, however, that other solutions may be less politically tractable than the examples above. Removing lead from paint and spices has minimal effect on their price or economic viability – especially if bans are applied across the whole industry. Moreover, the industry actors involved in adulteration are typically small to medium-sized local companies with limited capacity to push back against regulation. The situation may be different in other cases, such as with adultered aluminium cookware or ULAB recycling. Aluminium cookware is widespread in LMICs because it is cheap, and trying to phase it out may be met with widespread opposition and could even have negative effects if it increases the prices of cookware for people experiencing poverty. Regulations targeting informal ULAB recycling may be met with multiple pushbacks, both from the local population (for whom informal recycling is profitable) and from large companies abroad (who may be actively exporting batteries to LMICs to avoid recycling-related HIC regulations; Gottesfeld & Pokhrel, 2011). The level of government interest in mitigation activities will, therefore, likely vary depending on the source of lead exposure.

Lastly, we are uncertain about the extent to which other nonprofits will act based on this charity's research. We expect significant variation by country. While we expect other nonprofits to be interested in scaling up proven solutions to demonstrated

[25] Measured in terms of births, not by the number of countries.

problems, no suitable nonprofits may be present. As reviewed in section 6.1, there are currently only a handful of nonprofits working on implementing solutions to lead exposure in LMICs.[26] Some LMICs don't currently have any international nonprofits working on lead mitigation. Therefore, there is a risk that proposed effective solutions will not be implemented, especially if the relevant government lacks the capacity to implement the solutions.

In those cases, there are two options for how to mitigate this risk. Firstly, this nonprofit may itself decide to work on implementing the given solution (see section 3.2). This may make sense if the charity has built relationships with local stakeholders and is able to attract funding and extra talent to work on scaling the solution. However, this may constitute a significant departure from the basic theory of change of this charity and may significantly increase its operational complexity. As such, it may be reasonable for the charity directors to decide not to go in this direction. In that case, AIM may consider incubating a new charity focused on scaling that solution. While this is a solution we cannot guarantee at this point, we think it's likely that if a cost-effective, tractable, and neglected solution exists, it will be of high interest to the AIM research team and the managers of the Charity Entrepreneurship Incubation Program.

In sum, we believe that there are generally reasons to be optimistic that relevant actors will use the research produced by this charity and follow up with appropriate actions. However, it is definitely not a given that this will be the case, so this consideration should still be treated as a real threat to the charity's impact.

4.4 Evidence that solutions will be cost-effective

In order for a research-focused charity to ultimately have a positive impact on the world, there will need to be tractable, cost-effective solutions to addressing the sources of lead exposure it studies. Predicting whether such solutions will exist is not an easy task. We have already briefly explored this question in section 3.1. Here, we provide more evidence on the question through past examples, theoretical reasoning, and expert views.

We expect that solutions to lead exposure will vary widely in terms of their cost-effectiveness, depending on the source of lead exposure. In line with Table 1 in section 3.1, we can put interventions into four rough categories:

[26] At least when considering international nonprofits, not local groups. We are highly uncertain about the capacity and capabilities of local nonprofits, so we are leaving them out of this discussion.

1. **Tractable, cost-effective solutions already exist**: This is the case for lead paint and lead-adultered spices.
2. **Solutions already exist but may not have demonstrated cost-effectiveness or tractability**: This is the case, for instance, for ULAB recycling, leaded pumps, or occupational exposure from mining. These all have solutions that may be cost-effective – namely, policy tools incentivizing formal recycling, direct replacements of pumps with lead-free alternatives, and the introduction of wet spray misting in mines – but which, to our knowledge, have not been implemented at scale in many places, and we are therefore uncertain about their potential cost-effectiveness.
3. **We don't have tested solutions, but we suspect that tractable, cost-effective interventions may exist**: Examples in this category include ceramic glazes, cosmetics, and toys. The existence of appropriate solutions will depend on factors such as how concentrated the adulteration process is (i.e., how many distinct actors are involved in it) or how easy it is to replace lead with functionally comparable and economically viable alternatives. We also generally expect that solutions will get cheaper with growing demand.
4. **We don't know of tractable, cost-effective solutions, and we suspect that they may not exist**: We would currently put lead-adultered cookware in this category. While we can think of potential solutions to the cookware problem – such as applying nonpermeable coatings or handing out lead-free cookware for free – these have not yet been implemented, and we do not expect them to meet our cost-effectiveness bar.

A key unknown determining how much LMIC lead exposure will be cost-effectively addressable is the apportionment of different sources. We can think of three model scenarios for future development:

A. **The majority of exposure is from sources that can be addressed cost-effectively** (and research demonstrates that this is the case): In this scenario, mitigation efforts are likely to attract significantly more funding, and exposure will be effectively and rapidly addressed.
B. **The majority of exposure is from sources that are currently difficult to address, but the increased attention will help us find new, creative solutions**: For instance, we may find that it is possible to design economic incentives that effectively discourage the use of lead in the making of artisanal cookware.
C. **The majority of exposure is from sources that are currently difficult to address, and no cost-effective solutions are found**: In this scenario, progress on mitigating lead exposure will slow down, as global funders may turn their attention elsewhere. Exposure may then only be addressed once countries economically develop enough so that the solutions meet governments' own

cost-effectiveness bars.[27] In our view, even if we find ourselves in this scenario, finding this out (via the kind of research proposed in this report) would be impactful, as it would help grantmakers prioritize spending their funds on other, more cost-effective opportunities.

The most likely situation is some combination of the three scenarios above, varying from place to place. How exactly this will turn out is, however, difficult to predict. GiveWell (2021a) made a similar observation in a document explaining their grant decision that led to the Pure Earth Rapid Market Study, saying: "It seems likely to us that the evidence generated by Pure Earth's activities will be broadly useful to highlight potential context-specific sources of exposure. However, we are unsure whether these sources of exposure can be addressed at a level of cost-effectiveness that is competitive with GiveWell's top charities. Therefore, it seems plausible to us that GiveWell will not recommend funding to address sources of exposure identified by this work, meaning the evidence may not be acted on. We recommended funding for this work because of the low cost of collecting this information relative to our assessment of the likelihood of GiveWell or other funders acting on this evidence."

We conclude that sources of exposure likely substantially vary in terms of how easily and cost-effectively they can be addressed. It is likely that several sources of lead exposure will turn out to have cost-effective solutions, while others may not have solutions meeting our cost-effectiveness bar. It is currently unclear whether the majority of exposure happens due to cheaply addressable sources.

4.5 Evidence that reducing lead exposure has positive health effects

There is strong consensus from a large body of literature that lead is toxic to humans. No safe level of lead has been found; the current consensus is that the ideal BLL is 0 (Grandjean, 2010). Lead appears to be a substance foreign to the human body, which disrupts various cellular processes by competing with calcium and interfering with the function of calcium-based enzymes (as well as other biological mechanisms; see Bressler & Goldstein, 1991 and Szymański, 2014).

[27] Richer countries can afford to implement less cost-effective interventions. For instance, the WHO recommends that countries set local cost-effectiveness threshold proportionately with their GDP per capita (specifically, at between one and three times GDP per capita; Woods et al., 2016).

In this section, we provide a brief overview of the evidence that lead is harmful. The section is kept intentionally short, as we do not consider this evidence crucial to the consideration of founding a new charity in this space.

Firstly, and most importantly, lead is a strong developmental neurotoxicant (Caito & Aschner, 2017). Exposure to lead in all ages causes damage to the nervous system; however, prenatal and early childhood exposure are especially hazardous. This is partly because their nervous system is rapidly developing at those ages, and this process is particularly sensitive to being disrupted (Grandjean & Landrigan, 2014) and partly due to children absorbing 4-5 times more lead than adults from the same ingested amount (WHO, 2023).

Childhood exposure causes lasting cognitive and behavioral changes. Most notably, it is associated with reduced IQ. Larsen and Sánchez-Triana (2023) estimate the average loss in lead-exposed populations in LMICs to be 6 points, or 0.40 standard deviations. Interestingly, the loss of IQ seems to be the steepest at the lowest levels of exposure (Lanphear et al., 2005). However, due to measurement difficulties and methodological limitations, this point has been fiercely debated in the literature (see e.g. Wilson & Wilson, 2019 or Landingham et al., 2020). In our own model (section 7), we assume a linear relationship for simplicity.

Other studied neurological effects include an increase in the risk of depression, panic attacks, interpersonal conflict, and violence (Bouchard et al., 2009; Nevin, 2007; Stretesky & Lynch, 2001). The effect on crime – the so-called lead-crime hypothesis – has been particularly actively discussed in the literature. Some authors have attributed the majority of the observed decrease in crime in the United States to the banning of leaded petrol (Reyes, 2007). More recent studies have put the attributable fraction much lower, at between 7 and 28% of the decrease in homicides (Higney et al., 2022; Talayero et al., 2023). Nevertheless, even these figures may be highly significant due to the large burden of homicide and the cost crime imposes on society.

Aside from its neurotoxicity, lead exposure increases the risk of heart disease. A study from the USA, using the large-scale NHANES dataset, estimates that an increase in BLL from 1.0 µg/dL to 6.7 µg/dL is associated with significant increases in mortality, including all-cause mortality (hazard ratio of 1.37, 95% confidence interval [1.17–1.60]), cardiovascular disease mortality (HR = 1.70, 95% CI = [1.30–2.22]), and ischaemic heart disease mortality (HR = 2.08, 95% CI = [1.52–2.85]; Lanphear et al., 2018). The authors estimate that lead is responsible for 412,000 deaths per year in the USA alone. The exact burden is, however, very uncertain due to difficulties stemming from the effects taking years or decades to show, symptoms and causes of death being non-specific, and data being sparse. Recent meta-analyses have estimated the number of attributable deaths at 1.5 and 5.5 million per year – a nearly fourfold difference (GBD 2021 Risk Factors Collaborators, 2024; Larsen & Sánchez-Triana, 2023).

Lastly, prenatal lead exposure appears to be a risk factor for miscarriage, stillbirth, premature birth, and low birth weight (Amadi et al., 2017; Xie et al., 2013).

Overall, there is a consensus that lead exposure is harmful to humans on multiple levels. While there is currently disagreement about the exact attributable burden, with studies often producing estimates that vary severalfold, there is agreement that the burden is large, and even the lower-end estimates are highly concerning.

4.6 Evidence on externalities and second-order effects

Overall, we are not aware of any major positive or negative externalities or second-order effects. While it could be the case that reducing lead exposure for some people has a positive effect on others – e.g., due to decreased crime or due to societal benefits of increased economic productivity – we are too uncertain about the effects to give them significant weight. Additionally, mitigation activities are likely to have a mixture of positive and negative second-order effects. On the one hand, restricting the use of lead-based substances may necessitate a costly process of switching to lead-free alternatives, whose ongoing use may additionally be more costly. On the other hand, the removal of lead will likely often have the additional benefit of reducing exposure to other hazardous elements, such as arsenic and cadmium, which are lead’s common co-contaminants (OK International, n.d.). Overall, we guess that these effects may roughly balance out – although we have done limited research on these points.

5 Expert views

Overall, most of the experts we spoke with thought this was a promising idea for a new charity. There was mostly agreement that there are significant gaps in the data in a way that acts as a barrier to effective action. At the same time, there are not enough actors working on – or planning to work on – closing these gaps. The experts thought focusing on lead content studies would likely be most impactful and cost-effective. More complex apportionment studies may not always be cost-effective. There was some disagreement about the next best actions this charity should take – whether to focus on broad-based data collection, also focus on implementation, or engage in other research activities, such as helping to validate low-cost research and surveillance methods.

Rachel Bonnifield and Lee Crawfurd, Center for Global Development

Profile: Rachel Bonniefield (RB) is a Senior Fellow, and Lee Crawfurd (LC) is Research Fellow at the Center for Global Development. They have been actively involved in growing the field of lead elimination in LMICs, including publishing research papers and white papers and convening meetings with key stakeholders.

Summary of conversation

- RB and LC were supportive of this charity idea. In their opinion, there is a lot of impactful work for more organizations to do on this topic.
- They agreed that data on exposure is limited. In their own experience convening the CGG Working Group, they found that data limitations were constraining their actions.
- Collecting descriptive statistics isn't very exciting, but it is needed.
- RB raised several caveats: (i) To do the work well, a certain level of expertise is needed; (ii) Ethics approvals could make human-subjects research difficult in some countries; (iii) Each country has its own bureaucratic processes that need to be resolved, so scaling may be slow; (iv) Funding has historically been limited, constraining growth.
- RB said that apportionment studies are not always needed but can be useful in drawing attention to the problem. For example, if it turns out that cookware is responsible for the majority of lead exposure, it would likely motivate many actors to try to come up with solutions.
- There are many neglected countries. Existing organizations only have offices in 10-20 LMICs.

Dr. Lucia Coulter, Co-Executive Director, Lead Exposure Elimination Project

Profile: Lucia Coulter (LC) is the co-founder and co-executive director of LEEP, an AIM-incubated charity working on lead paint elimination across 20+ LMICs.

Summary of conversation

- Overall, LC was excited about this idea. There is space for more actors, and the research is very much needed.
- The sources of lead exposure vary from place to place (even different towns or villages within a country), so we really need a lot more resources going into testing where and how exposure is happening.
- LEEP is currently looking for new interventions (other than lead paint) to expand to. However, they are primarily looking for interventions aligned with their current model; they are unlikely to focus heavily on research.
- LC thought that there is a good case for an organization focused specifically on research. However, she said that it could make sense for this organization to then also work on implementation, especially if it has built strong local relationships during the research process. This could be decided at the relevant points in time, depending on the source of exposure and what other organizations are active in a given area.
- LC agreed that sub-Saharan Africa is very neglected and that West Africa, in particular, may be a good focus.
- There is a growing interest in lead, and funding is projected to grow, so it is now a good time for an organization like this.

Dr. Jenna Forsyth, Stanford University

Profile: Jenna Forsyth (JF) is a research scientist at the School of Medicine, Stanford University. She is a leading academic working on lead exposure and apportionment studies in several LMICs. She also collaborates with local partners on implementing regulatory action to mitigate lead exposure.

Summary of conversation

- In JF's experience, there are often two main barriers to progress: A lack of local data (on exposure levels and on source apportionment) and a lack of strong actors to implement solutions (such as publicizing research funding, working with governments, helping policy enforcement etc.). She is supportive of a new research organization but would even more like to see an organization that can do both research and implementation.

- JF said that attribution research requires a multi-disciplinary skillset in different areas of science. It could be hard for a nonprofit to have these skills in-house. She supported the idea of a nonprofit that specializes in implementing research in the field while closely collaborating with academic researchers – similar to how IPA collaborates with J-PAL researchers.
- Whether apportionment research is beneficial (or needed at all) varies from case to case. Sometimes, it is needed to confirm suspicion about the sources of exposure. Other times, it's needed mostly to attract government attention. In other cases, it may not be needed at all.
- To do this work well, it's beneficial to have strong local ties and a good understanding of a given country's situation. This suggests that it may be better for this organization to focus on building those ties in a few countries rather than spreading itself very thinly.
- JF often finds that if politically important individuals are found to be exposed – and not just lower-status members of society – the barrier to action is lowered. What matters is, therefore, not just the extent of lead exposure but who specifically is exposed.

Perry Gottesfeld, Occupational Knowledge International

Profile: Perry Gottesfeld (PG) is the executive director of OK International. He has decades of experience working in different LMICs, studying sources of lead exposure, and collaborating with local partners to build capacity on surveillance and mitigation measures.

Summary of conversation:

- PG questioned whether a new organization is needed. There are existing organizations that have built up expertise and local connections, but they have historically been funding-constrained. It may be better to direct funding to those organizations rather than starting a new entity.
- PG thought that the data limitations were overstated. In his view, we already have enough data to know that there is a problem (and where it is). However, he agreed that governments often don't act unless local data is available, so data collection may still be necessary in order to make regulatory progress.
- Local BLL studies can also be useful for building awareness and a movement around the problem.
- In PG's view, the main problem is a lack of local capacity to undertake surveillance. Many countries don't have the expertise or the technology to do accurate BLL testing.
- For this reason, OK International is focusing on building up local capacity for surveillance and mitigation.
- PG is somewhat skeptical of nonprofit models that "parachute" into countries and leave once a problem is solved.

Drew McCartor, Pure Earth

Profile: Drew McCartor (DM) is the executive director of Pure Earth. Drew has 15 years of experience designing and leading strategies to reduce public health impacts from toxic chemicals. He has managed complex and diverse multi-partner programs across Asia, Europe, Africa, and the Americas focused on pollution assessment, remediation, risk mitigation, health surveillance, research, education, and public policy.

Summary of conversation:

- DM said that the burden of lead exposure is large, and there is space for more organizations. That being said, he suggested that it may be more efficient to set up new teams within existing organizations to utilize the same infrastructure and preexisting connections.
- DM highlighted that running lead-content studies and BLL surveys are very different undertakings. The latter may require a team of several dozen people with a range of expertise.
- The sequencing of different research activities can be complex. For instance, one may need at least a mid-sized BLL study to identify exposed populations and decide where to conduct home assessments.
- It's important to build good relationships with governments and warm them up to the results and what to do about the problem. Otherwise, the government may reject the findings and refuse to collaborate with the nonprofit.

- DM expects that Pure Earth would be very interested in any data this charity would produce and would immediately think about how to address the identified sources of exposure.
- Pure Earth is in the process of building a statistical model of where and how exposure happens, with associated confidence levels. This charity's priorities could be informed by the model, and its outputs could in turn feed into it.
- Pure Earth's geographical focus has historically been on Mexico, South Asia, and some countries in Southeast Asia. DM agreed that Africa is generally receiving less attention.
- Going forward, Pure Earth plans to focus more on mitigation activities, although they do have research projects underway (including large-scale BLL surveys & home assessments in five countries and a body of work on aluminium cookware).

James Snowden and Santosh Harish, Open Philanthropy

Profile: James Snowden (JS) is a senior program officer, and Santosh Harish (SH) is a program officer at Open Philanthropy. They jointly oversee Open Philanthropy's portfolio of grantmaking related to mitigating lead exposure in LMICs.

Summary of conversation:

- Overall, JS and SH thought that this promising idea and that our ToC for this charity sounds very sensible.
- They agreed that there is a significant knowledge gap and that there aren't enough actors addressing it.
- Sub-Saharan Africa seems to be a particularly neglected region.
- SH thought that even just work focused on collecting high-quality lead-content data would be sufficiently promising. There are many countries where we don't have data, and even where we do, it is often not granular enough (as there may be subnational variation), and it may not cover locally unique sources of lead.
- However, there may be other potential promising extensions, such as working to validate lower-cost measurement methods or trace supply chains to understand where exactly adulteration happens.
- SH didn't think there were any major concerns around tractability but did highlight (i) the need to engage local stakeholders to understand potential local sources of exposure and (ii) the need to use validated measurement methods.

6 Geographic assessment

6.1 What existing organizations do

To help decide where a new organization should operate, we first provide a brief review of what existing organizations do and where they work. The review of major international actors is presented in Table 2 below. Note that small, local NGOs are not included. Many existing organizations do not undertake research activities or only focus on a few specific ones (such as lead-content studies of specific lead sources or running nationally representative BLL studies). To our knowledge, only Pure Earth, Vital Strategies, and OK International are regularly involved in multiple types of research on lead exposure.

Table 2: What existing organizations do and where they operate.

Name	What they do	Countries
Pure Earth	Pure Earth is the largest actor in this space. They have a multi-faceted approach, consisting of (i) health surveillance using BLL studies, (ii) source analyses, (iii) designing source-specific interventions, (iv) disseminating findings and recommendations to governments and funders, and (v) investing in institutional strengthening to enhance the capabilities of local actors. They collaborate with other NGOs and academics to conduct research and put it into action. In the period 2020-2023, they implemented projects in 31 countries, conducted 79 awareness-raising events, administered almost 12,000 BLL tests, and assessed over 5,800 product samples. They also run the the Toxic Sites Identification Program where they identify and clean up sites polluted by ULAB recycling and they helped found the Global Alliance on Health and Pollution.	Countries of focus: • Bangladesh • India • Georgia • Kyrgyzstan • Indonesia • The Philippines • Mexico • Colombia • Peru • Ghana They also list the following as their priority "watch list" to expand to if additional resources are secured: • Zambia • Zimbabwe • Egypt • Pakistan • Nigeria Via the Rapid Market Screening project, they worked in a total of 25 LMICs (though, to our understanding, they do not have continued presence in all of these).

Vital Strategies	Vital Strategies is a large global NGO helping governments to strengthen their public health systems. They operate in 40 countries and work on a range of public health issues, including childhood lead poisoning. They have supported governments in Peru and Bihar, India, in setting up BLL surveillance and are working to achieve this in several other locations. They also emphasize public awareness and better regulation of adultered consumer products.	Countries of focus: ● Peru ● Colombia ● India ● Indonesia ● Kyrgyzstan ● The Philippines
UNICEF	UNICEF has been focusing on the harm to children's development from lead exposure for some years. In 2018, they worked with the Government of Georgia to introduce BLL testing into the local Multiple Indicator Cluster Survey (MICS), which later relieved high levels of local lead poisoning. In 2020, UNICEF and Pure Earth co-published the influential Toxic Truth report. Based on our expert interviews, UNICEF seems like a key player when it comes to working with governments on introducing national-level BLL surveillance, with plans to work with up to 10 new governments if they can secure the necessary funding.	*We could not find up-to-date information*
International Pollutants Elimination Network (IPEN)	IPEN is a global coalition of more than 600 NGOs in over 120 countries working on reducing the risks to people and the environment caused by the production, use, and disposal of toxic chemicals. They have also been advocating for the listing of lead chromate – a key lead compound found in many paints and adultered spices – under the Rotterdam Convention, which would limit its importation. IPEN members have also engaged in awareness-raising campaigns and conversations with policymakers in a number of countries. Since 2009, they have been working on the elimination of lead in paint. We are not aware of other research activities they have undertaken.	IPEN-affiliated NGOs have collected data on lead in paint in 59 countries.
Lead Exposure Elimination Project (LEEP)	LEEP undertakes studies on lead content in paint on the market and subsequently works with policymakers and paint producers on bans (and their enforcement) and on paint reformulation. They engage in a few research activities outside of paint, including into	Currently operating in 20 countries and planning to expand to 10 new countries per year.

	cosmetics & spices and into measurement methods. They are currently exploring which other interventions to expand to, though it is unlikely that they will extensively engage in lead exposure/apportionment research (based on a conversation with Lucia Coulter).	
Occupational Knowledge International (OK International)	OK International is a nonprofit organization based in the US that seeks to reduce exposure to industrial pollutants in developing countries. They work by partnering with local organizations in LMICs, providing technical assistance, training, and certification programs, with the aim of developing local capacity to identify, monitor, and mitigate the harm of lead (among other pollutants). They run programs dedicated to lead paint, lead-acid batteries, hazardous cookware, and mining. They have done a range of lead studies, including on sources of exposure and evaluating the impact of interventions, Gottesfeld et al. (2014), Weidenhamer et al. (2016), Gottesfeld et al. (2018a), and Gottesfeld et al. (2018b).	OK International does not have local offices or staff based in LMICs. Instead, they operate in cooperation with local organizations including NGOs, academic institutions and government partners.
Global Alliance on Health and Pollution	An Alliance of various stakeholders, including the World Bank, UNEP, UNDP, UNIDO, Asian Development Bank, the European Commission, and Ministries of Environment and Health of many (LMICs), was set up by Pure Earth in 2012. It works on prioritizing addressing pollution through action plans, solutions planning, and resource mobilisation. To our knowledge, they are not engaged in major lead research activities.	Global
Center for Global Development (CGD)	The CGD is a "think- and do-tank for global development." It promotes the issue of lead exposure with governments and intergovernmental organizations, trying to draw interest and funding. They focus on bringing actors together, such as via the CGD Working Group on Lead Poisoning. They also produce various resources to support the movement, such as a report on tools for measuring lead exposure or a meta-analysis of the impact of lead on educational outcomes. It doesn't engage in direct on-the-ground research.	Global

U.S. Agency for International Development (USAID)	USAID has recently been expanding its focus on global lead exposure. They have committed $4 million toward mitigation efforts, with hopes that this will grow in the future.	Countries of focus: • South Africa • India • Bangladesh • Nigeria ... though this list may expand
Global Alliance to Eliminate Lead Paint (aka the Lead Paint Alliance)	The Lead Paint Alliance is a partnership between the United Nations Environment Program (UNEP) and the WHO, which is working on the global phase-out of paints containing lead. UNEP staff have previously been involved in lead exposure studies, but we are not aware of any systematic research programs led by them.	Global

6.2 Geographic prioritization

We have conducted a geographic prioritization to identify countries where this charity's work may be especially promising. Our weighted factor model is based on several input variables, each of which is *z*-transformed[28] and given a weighting[29] before being included in the overall country score. These variables include:

- Indicators of the scale of the problem by country
    i. **The number of births per year** (weight = 15%): Children are most vulnerable to the harms of lead exposure. Therefore, we want to prioritize countries where many children are born each year.
    ii. **The predicted average BLL in people aged <20 years** (20%): We want to prioritize countries with high levels of lead exposure. Note that this information may be inaccurate due to the limitations of existing data.
    iii. **The predicted number of children with BLL over 5 µg/dL** (10%): We also want to additionally target countries where many people are expected to be currently exposed to high levels of lead. See Figure 7 for a visual overview of this variable.

[28] A *z*-transformation subtracts the mean of a variable from each value and divides it by the variable's standard deviation. This ensures that all variables are standardized.

Additionally, two variables ('The number of births per year' and 'The predicted number of children with BLL over 5 µg/dL') were log-transformed. The reason is that these variables' values vary over multiple orders of magnitude and, without a transformation, all but the highest values would otherwise be assigned a *z*-score of near 0.

[29] These weighting are highly subjective.

- Indicators of neglectedness
    - iv. **Whether other international NGOs have offices here** (20%): We want to prioritize neglected countries. Therefore, we deprioritize countries where other organizations (that are involved in research) have offices.
    - v. **Whether other NGOs have recently been active here** (10%): We additionally deprioritize countries where other organizations have recently been active, even if they do not have an office here.
- Indicators of tractability (these are standardized across most of our geographic-prioritization models)
    - vi. **Fragile States Index** (6.25%): An index developed by The Fund for Peace that aims to capture the level of states' vulnerability to conflict or collapse.
    - vii. **Corruption Perceptions Index** (6.25%): An index developed by Transparency International, capturing the perceived level of corruption in countries worldwide.
    - viii. **Rule of Law Index** (6.25%): An index developed by the World Justice Project intended to capture how countries adhere to the rule of law in practice.
    - ix. **Freedom in the World Index** (6.25%): An index developed by Freedom House that measures the degree of civil liberties and political rights.

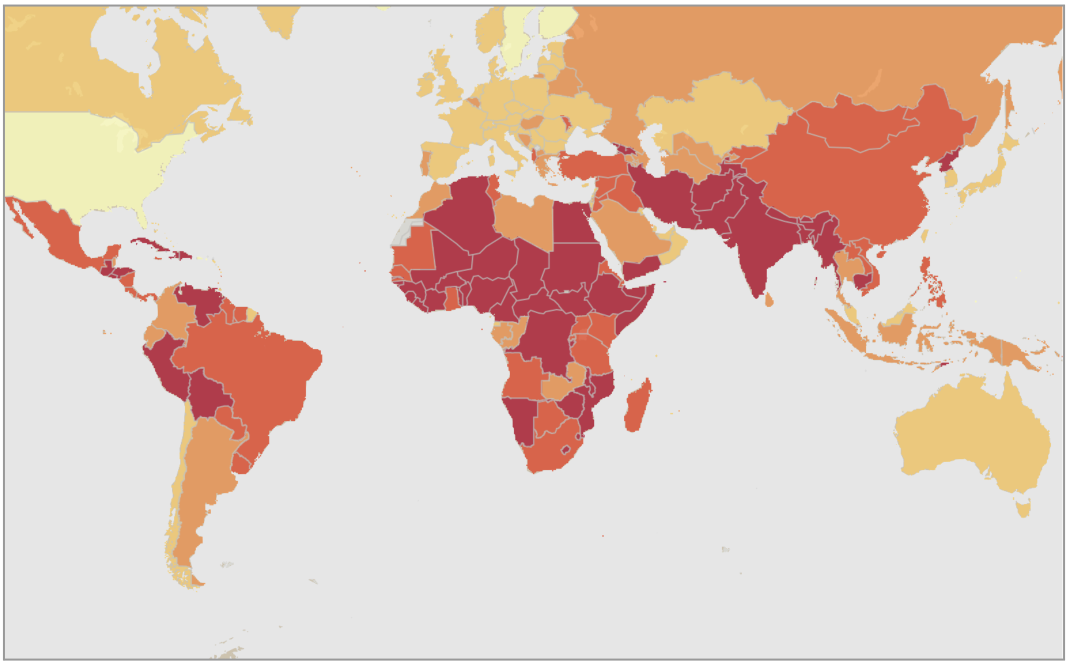

Figure 7: Geographic distribution of lead poisoning, based on available data. Dark red indicates countries with an average BLL over 5 µg/dL, dark orange between 3 and 5 µg/dL, in people aged under 20. Source: leadpollution.org.

A summary of the results from our model is shown in Table 3 below; the full model can be found in this spreadsheet.

Table 3: Geographic prioritization (summary of the top 15 countries).

#	Country	Births per year	Mean BLL in <20 yo (µg/dL)	Est. number of people with BLL >5 µg/dL	Major NGO office or recent activity
1	**China**[30]	10,775,888	3.5	48,323,297	No
2	**Sierra Leone**	266,380	9.6	4,664,387	No
3	**South Africa**	1,201,252	4.5	7,972,159	No
4	**Côte d'Ivoire**	997,291	7.0	11,616,727	No
5	**Ethiopia**	3,405,525	5.4	31,927,134	No
6	**Guinea**	444,337	9.6	7,697,403	No
7	**Liberia**	145,829	9.5	2,803,026	No
8	**Algeria**	977,190	5.4	9,587,399	No
9	**Malawi**	706,722	5.1	5,357,631	No
10	**Benin**	457,832	5.4	4,325,313	No
11	**Zimbabwe**	463,520	10.8	8,442,219	No
12	**Mozambique**	1,186,498	6.1	12,031,555	No
13	**Pakistan**	6,577,522	6.6	78,177,695	Yes
14	**Senegal**	561,021	4.0	2,568,779	No
15	**Brazil**	2,783,897	3.4	12,844,235	Yes

Please note that this exercise was done using limited information and in a limited span of time. The results should only be viewed as preliminary. Interested users are encouraged to alter or expand our model. We also suggest using the Global Lead Forum's country profiles website to better understand each country's situation.

The headline result is that sub-Saharan Africa seems like a particularly promising region. Of the top 15 countries, six are in West Africa (Sierra Leone, Côte d'Ivoire, Guinea, Liberia, Benin, and Senegal), three in Southern Africa (South Africa, Zimbabwe, Mozambique), two in East Africa (Ethiopia, Malawi), one in North Africa (Algeria), one in East Asia (China), one in South Asia (Pakistan), and one in Latin America (Brazil).

There are three other reflections worth highlighting:

- **Country-level data may hide a lot of heterogeneity**. Lead exposure can vary significantly between regions within a given country, but we only use country averages. For instance, Nigeria's mean BLL in our data is 5 µg/dL, whereas the

[30] Note that we have concerns about the tractability of working in China, but didn't want to fully exclude it from the list.

neighboring Niger's is 18.5 µg/dL. We would not be surprised if, for instance, Northern Nigeria turned out to have much higher BLLs than the estimated country average.

- **Similarly, neglectedness may vary within large countries**. For example, India was deprioritized based on the presence of other actors. But India is a huge country, with a population greater than the whole of Africa. This means that states or cities may still be neglected.
- **Most of the highest-scoring countries were excluded because they were too dangerous to work in**. This includes several countries in the African "Coup Belt" – Niger, Burkina Faso, Mali, and Chad – and other LMICs experiencing conflict, including the Democratic Republic of the Congo, Somalia, Yemen, and Haiti. If the safety situation in these countries changes, those countries may be particularly impactful to work in.

Overall, we suggest that future charity founders consider working in sub-Saharan Africa, a region that experiences a high burden of lead exposure and which is currently highly neglected (confirmed by our expert interviews). However, it is plausible that other regions will turn out to be promising as well if large countries are broken down into states and neglectedness is considered more carefully.

7 Cost-effectiveness analysis

We built a simple cost-effectiveness model **for this charity**. This model is intended to provide a ballpark estimate of the impact per dollar this charity could achieve.

Our central estimate for this charity's cost-effectiveness is $34/DALY-equivalent, or 30 DALY-equivalents/$1000. This is significantly better than our bar of ~$100/DALY.

However, this estimate is much more uncertain than that for a typical charity idea we investigate. This is because due to the complex ToC of this charity, the ultimate impact may depend on third-party activities, as well as multiple subjective inputs and modeling choices we made. In the sections below, we describe how we approached building this model, the results we obtained, and the ways in which our results may either underestimate or overestimate the true cost-effectiveness of this potential charity.

7.1 Costs

It is infeasible for us to model the cost-effectiveness of all of the activities this charity could undertake. Therefore, we decided to model only one key activity: measuring the lead content of environmental media using the XRF method. We assumed that running lead-content studies (akin to the Pure Earth Rapid Market Screening) would point to the most important local sources of lead exposure and thereby speed up mitigation activities. We assume that the charity would operate across multiple countries in West Africa.

Our model assumes the following costs:

- Fixed charity costs which include co-founder salaries and other typical overhead costs (office, travel, insurance, etc.): $130,000 in the first year and $280,000 at scale (i.e., years 3 and 4 in the model).
- Budget for additional salaries, estimated at $150,000 per year at scale.
- The purchase of two XRF machines (costing $25,000 each).
- The additional cost of running the studies, estimated at $15,000 per country.
- We assume that the charity would undertake this research in two countries in year 1, three or four countries in year 2, and five countries in years 3 and 4. For simplicity, we do not model charity activities beyond year 4.

This results in costs of $505,000 per year at scale (years 3 and 4). Note, again, that costs may be significantly higher if the charity undertakes other research activities as well, but those are not included in this model.

7.2 Effects

The primary path to impact of this charity is assumed to be via the neurobiological benefits of lead exposure mitigation. As discussed in section 4.5, lead exposure in childhood results in lasting cognitive impairment, including lower IQ and higher impulsivity. For the purposes of this model, we assumed that lower IQ results in lower productivity in adulthood, which in turn results in lower earnings and lower consumption – a modeling approach previously used by GiveWell and Rethink Priorities (GiveWell, 2021b). Specifically:

- Following GiveWell (2021a), we assumed that a 1 µg/dl decrease in BLLs throughout childhood would translate into 0.15 additional IQ points.[31]
- Then, we translated this IQ loss into a predicted loss of productivity. Again, following GiveWell, we assumed that a 1-IQ-point increase would translate into 0.67% higher income. For simplicity, we assumed that all of this extra income would be consumed (rather than saved or invested).[32]
- Lastly, we translated this increased consumption into DALY-equivalents, using an assumed equivalence between one DALY and 2.3 years of doubled consumption.
- This benefit is assumed to start 15 years after the intervention (due to the fact that children typically don't work) and last for 45 years (the typical length of a person's working life).
- Future benefits were discounted using a 4.0% discount rate (following Kudymowa et al., 2023b)

For simplicity, we did not explicitly model the health effects of reducing lead exposure. In previous models by Open Philanthropy, Rethink Priorities, and LEEP, these benefits were usually estimated to be around 20% of the consumption benefits (e.g., LEEP, 2024b).[33] As such, we apply a 20% uplift to our consumption-benefit estimate.

[31] See this document for details.
[32] See this document for details.
[33] Note that this value is highly uncertain, owing to the uncertain attribution of CVD mortality to lead exposure. It is conceivable that the true health effect is 2-3 times greater than this.

To calculate the number of people that would benefit from this intervention, we:

- Assumed that if research done by this charity is successfully followed by mitigation activities, these will reduce average BLLs by 12.5%, i.e., by 0.90 µg/dL from the current West African average of ~ 7.2 µg/dL.
- Additionally subjectively chose to attribute only 25% of this potential effect to the research activities (reserving the remaining 75% to the actor who implements the mitigation activities).
- Assumed that the typical country this charity would operate in has a population of ~18 million and records around 550,000 births per year.

Altogether, we estimate that this charity would generate 0.0038 DALY-equivalents per affected birth, for a total of 2,089 DALY-equivalents per country per year.

Lastly, we applied the following adjustments to this estimate:

- We modeled a conservative 10% chance that the charity activities will actually be followed by successful mitigation activities.
- We make several adjustments to the discount rate for future consumption benefits (on top of the baseline 4.0%):
    1. We assumed that there is a 2.0% chance per country per year that the relevant mitigation activities in lead exposure would happen even in the absence of the charity's activities. A 2.0% chance per year implies a 50% chance in 34 years. While this may seem like a long time, we think that this is a reasonable estimate given the relative lack of recent progress in this space.
    2. We add 1.7% to account for the decreasing burden per person over time. While this is calculated from GBD data for Western Africa, this estimate is highly uncertain given the wide confidence intervals. Nevertheless, this value roughly captures the intuition that the total burden is slowly decreasing as economies in the region develop.
    3. We subtract 2.3% to account for population growth in the region.

7.3 Modeling considerations

Table 4: Ways in which our model may under-/overestimate this charity's cost-effectiveness.

Ways in which this charity could be more cost-effective than modeled	Ways in which this charity could be less cost-effective that modeled
• Findings from one country could have positive spillover effects on other countries (such as neighboring countries to those tested). • There is also value of information (VOI) of conducting this kind of research and helping the global community prioritize actions mitigating lead exposure. We didn't model this VOI. • We assumed that the typical country this charity would work in has a population of about 18 million and has about 550,000 births per year. The charity could choose to work in larger countries where impacts are expected to be greater. • The relationship between IQ and productivity is assumed to be 0.67% increase in earnings per IQ point, which is a value based on studies done in LMICs. In HICs, the typical estimate is ~2.0%. Given countries' future economic development, it is conceivable that the relationship between IQ and productivity will grow in LMICs over time. • There may be other important neurotoxic effects that we didn't model, such as an increase in antisocial behavior or ADHD. • The health effects (such as on CVD mortality) could turn out to be bigger than we assumed.	• The charity may need to hire more staff members than we assumed, thereby increasing its costs and reducing cost-effectiveness. • We assumed that the average reduction in BLLs thanks to interventions spurred by this research would be 12.5%. In reality, it could be more or less than that.

Additionally, there are several other major sources of uncertainty, which could move cost-effectiveness either way:

- We attributed 25% of the effect of those subsequent interventions to this research. A fairer allocation could be more or less than this.
- We assumed that one in ten countries where this charity does lead-content research will actually implement mitigation measures based on this research. We think that this is a conservative estimate, although it could also be optimistic.
- We assumed a 2.0% per year probability that this kind of work would happen anyway. We are very uncertain about what this value should be.

8 Implementation

8.1 What does working on this idea look like?

We anticipate that much of this charity's work will be project-based. This is in contrast to many other charities AIM incubates, which instead focus on scaling up continuous interventions.

We imagine that the research projects will typically consist of the following stages:

- **Scoping**: Assessing which countries/regions/cities would be the best targets for the next research project, based on the burden of lead exposure, information gaps, potential for positive informational spillovers, etc. This stage will likely consist of desk research combined with conversations with funders and other stakeholders, and potentially country visits.
- **Government outreach**: Starting a conversation with the government of the target country, to gauge their interest and "warm them up" to the project and its potential implications.
- **Fundraising**: While smaller projects, such as local market surveys, may be affordable to undertake using the charity's own unrestricted funds, larger studies are likely to require targeted fundraising.
- **Forming partnerships**: This includes engagement with local NGOs, implementation partners, local universities, and university teams abroad. The aim of this stage is to build a collaborative team that can design and deliver the project in a rigorous, timely, and low-cost manner.
- **Detailed study design and plan**: Creating a detailed plan for how the project will be carried out. This may include a sampling strategy, statistical analysis plan, detailed plans for implementation partners, etc. If there is an intention to publish the results in an academic paper,[34] a formal study protocol may be published. Ethics approval will need to be obtained for studies involving human subjects. Some of these tasks may be done in-house, while others may be handed over to academic partners.
- **Implementation**: This stage will vary depending on the methodology employed. It may consist of collecting samples to do XRF or laboratory lead-content measurements, collecting BLL samples, administering questionnaires, working with manufacturers and supply chains to investigate the origins of adulteration with lead, etc.

[34] This may not be necessary, although some experts have told us that a peer-reviewed publication increases the likelihood that governments and the media will be interested in the results.

- **Analysis and write-up**: Data is analyzed, and results are written up, either in a report or in a paper submitted to a scientific journal. Again, some of these tasks would likely be carried out by academic partners.
- **Communicating the results**: The results of the project should be carefully communicated to relevant stakeholders, including the government, the local media, and the global lead community.
- **Collaboration with stakeholders on the next steps**: Finally, the charity should collaborate with all relevant stakeholders on planning for the next steps based on the project's findings. These may include mitigation strategies pursued by the government or third-party nonprofits, continuing engagement with the government by this nonprofit, or follow-up research projects.

We envisage that some of these projects may run in parallel while others will successively build on top of each other.

We are uncertain about the amount of time that the core charity staff will have to spend in the target countries. This could range from a considerable amount of time if the core staff are directly engaged in data collection to relatively limited amounts of time if strong local partners can take on most of these activities.

8.2 Key factors

This section summarizes our concerns (or lack thereof) about different aspects of a new charity putting this idea into practice.

Table 5: Implementation concerns

Factor	How concerning is this?
Talent	Moderate concern
Access to information	Low-moderate concern
Access to relevant stakeholders	Low concern
Feedback loops	Low concern
Funding	Low-moderate concern
Neglectedness	Low concern
Execution difficulty/Tractability	Moderate concern
Complexity of scaling	Moderate concern
Risk of harm	Low concern

Talent

This charity would benefit from certain co-founder skills. Primarily, it would be beneficial for at least one co-founder to have a background in statistical research, including study design, data collection, and analysis, in fields such as economics or environmental science. Experience in other statistically oriented social, biomedical, or natural sciences may also be beneficial, as would working with human subjects (in order to know how to navigate obtaining approvals from ethics committees/institutional review boards). While advantageous, we don't think that experience specifically with lead-exposure research is necessary.

In addition to experience, we expect that strong attention to detail, good organizational skills, and strong interpersonal skills would be beneficial, as those are key for carrying out research projects with minimal technical or implementation errors and in a way that attracts interest and buy-in from relevant stakeholders.

These are skills that we often see among participants of the Charity Entrepreneurship incubation program, so we do not have major concerns about the talent requirements of this charity.

Access

Information

Good-quality information on lead exposure is often missing. On the one hand, this poses a barrier to the charity, as it may make decision-making difficult (for instance, with respect to which country or city to operate in). On the other hand, it creates an opportunity: Closing information gaps will be a key goal of this charity, and even a negative finding (e.g., that certain consumer products contain less lead than expected) is useful and moves the field forward.

Relevant stakeholders

We expect that this charity will operate in a highly collaborative manner with other relevant stakeholders. As such, being able to access them and build positive rapport will be crucial. Based on existing charities' experiences, we do not expect this to be a particular problem. However, the charity founders should be highly sensitive to the quality of their relationships, since a negative interaction with a key stakeholder – such as local government representatives – could prevent the charity from continuing doing impactful work in a given country.

Feedback loops

We are not concerned about feedback loops for this charity. The charity directors will know very quickly whether the research they are undertaking is generating novel and useful insights – as judged by the responses of funders and other relevant stakeholders. Much of the relevant monitoring and evaluation (M&E) data will be generated directly through the charity's activities.

There are two areas where feedback may be a bit longer:

1. Certain types of research, such as conducting pre-post BLL studies, may require that measures be done a year apart.
2. Third-party stakeholders taking action based on the charity's work. While verbal indications of interest will likely be quick, effective action may take longer to be implemented. Therefore, the charity directors may have to wait for an extended period of time until they see definitive proof of the impact of their work.

Funding

Funding from funders in the AIM network

Lead exposure in LMICs has been an area of focus for multiple funders in the AIM network, including Open Philanthropy,[35] Founders Pledge, and EA Funds. All of these have, for instance, contributed to the Pure Earth Rapid Market Screening program. Schmidt Futures has also made donations to LEEP. We have also had verbal indications of continuing interest from some of these funders.

Broader funding sources

Lead exposure has historically been a highly neglected area for grantmakers. In January of this year, the Center for Global Development said it found only $11 million per year in philanthropic funding for lead in LMICs (Bonnifield et al., 2024).

However, there are signs of this changing. USAID has now committed $4 million (with hopes of that figure increasing), and the USA will be the first bilateral donor agency to join the Global Alliance to Eliminate Lead Paint (ibid). At the World Economic Forum in Davos, USAID Administrator Samantha Power presented on the path "Towards a Lead Free Future," setting out the administration's plans in this space (Garibashvili et al., 2024).

[35] Previously, GiveWell also gave out grants in this space. However, to our understanding, this portfolio has moved to Open Philanthropy, so we do not expect additional funding coming from GiveWell.

Other funders in this space include:

- Global Environment Facility (GEF): According to a Rethink Priorities report, the GEF has committed $2-3 million per year to lead exposure advocacy (Rhys Bernard & Schukraft, 2021). It previously made grants to IPEN and Pure Earth.
- Clarios Foundation: Clarios is a major manufacturer of lead-acid batteries. Their foundation works on projects related to children's health and environmental sustainability. It has previously funded some of Pure Earth's research work, such as its advocacy to integrate BLL testing into the national health survey in the Philippines (Rhys Bernard & Schukraft, 2021).
- The Swedish International Development Agency (Sida): Sida is one of the largest donors of IPEN (GiveWell, 2021a).
- Oak Foundation
- The World Bank

Neglectedness

Most of the experts we spoke with said that this area is neglected, with space for more actors.[36] This, however, somewhat varies between different research methodologies and geographies.

Methodologically, only a few organizations are engaging in lead-content studies and BLL studies, and very few are involved in more intentional apportionment research. Pure Earth has been doing home-based assessments of lead sources for many years, but their Rapid Market Screening was their first large study of lead content in consumer goods. Based on our conversation with Drew McCartor, Pure Earth plans to continue doing home assessments but do not currently have plans for more market surveys. Pure Earth and UNICEF have been the major actors working with governments on rolling out large-scale nationally representative BLL testing (though currently only working in <10 countries). Pure Earth and OK International have also done a range of smaller-scale BLL studies. In terms of apportionment research, we are only aware of one published study by Pure Earth (Brown et al., 2022), although some of their current activities – such as their working group exploring the leachability of aluminium cookware – may contribute to answering apportionment questions. Academic researchers have been more interested in this work, but are often constrained by a lack of strong local implementation partners.

[36] Though there was some disagreement about whether international or local actors should be receiving marginal funding.

Geographically, sub-Saharan Africa seems most neglected, with the largest gaps in data and few organizations working on closing them. Large organizations such as Pure Earth or UNICEF have primarily focused on South, Southeast and Central Asia and on Latin America. We think this is understandable: These regions are more developed and politically stable and therefore more tractable to work in. Also, a large fraction (around one-third) of lead-poisoned people live in South Asia alone. As such, existing organizations may have prioritized areas with the greatest burden and possibly highest cost-effectiveness. However, based on existing models, sub-Saharan Africa has some of the highest BLLs, so it is not necessarily the case that work there will be less cost-effective.

That being said, we wouldn't want to understate the neglectedness in other regions. Many states in India – whose populations are comparable with mid-sized countries – have been poorly studied. There are also countries in Southeast Asia and Latin America where existing actors have done limited work. As such, potential charity founders should consider working in those regions too.

Therefore, we think that there is ample space for a new organization focused specifically on research and data collection.

Tractability

Overall, we have moderate concerns about the tractability of this charity idea. While we believe that the proposed activities are feasible, they are not straightforward, and will require careful planning and management by the charity leadership. Please see section 4.2 for a detailed discussion.

Complexity of scaling

We are moderately concerned about how quickly and easily this charity will be able to scale. Our current view is that the charity should start with focusing on lead-content studies and then, once it builds organizational capacity and a good reputation, expand its portfolio to include other types of research (such as BLL surveys) that require more funding and more complex approval processes. However, we are not sure how exactly this scaling should happen: In our conversation, Drew McCartor of Pure Earth warned that environmental assessments and BLL studies are very different types of activities, requiring different types of expertise and organizational arrangements. In addition, we have uncertainty about the extent to which this charity should quickly grow internationally (in a way that, for instance, LEEP has done) vs. focus on growing its impact in a small number of countries.

Therefore, we expect that this charity will require regular reviews and re-strategising by the charity directors, possibly more so than typical AIM-incubated charities.

Risk of harm

Overall, we see the risk of harm as very low. There two potential risks we can think of:

1. If blood samples are drawn without following strict sanitization procedures, participants may acquire infections. This risk should be minimal, though, if samples are taken by well-trained staff.
2. If governments are not "warmed up" to the potentially alarming results of this charity's work, they may become hostile, reject the findings, and stop collaborating with the charity. This could actually slow down progress in that country compared to a scenario where the relationship has been handled well.

8.3 Remaining uncertainties

Aside from uncertainties discussed earlier in this report, we will highlight two remaining questions:

1. How to think about cost-effectiveness: What exact research activities (and in what countries) are/aren't cost-effective? How much does this vary between countries?
2. How difficult will it be to get governments to act on new sources of lead exposure?

8.4 Interactions with other AIM charities

The idea behind this charity partly overlaps with the remit of LEEP, a charity incubated by AIM in 2020. A common question we have received in the process of writing this report is why a new organization is needed, given LEEP's capabilities and success to date. There are several responses:

- Dr. Lucia Coulter, LEEP's co-founder, has told us that, while LEEP is looking to expand beyond working on lead paint, they are primarily considering focusing on activities that are synergistic with their current work. This may involve, e.g., working on adultered cosmetics. However it is unlikely that LEEP will want to extensively engage in research.

- A focus on research and data collection requires quite different organizational arrangements and strategies than working on implementing solutions. While this charity could conceivably exist as a department within LEEP – and thus benefit from LEEP's reputation and existing connections – it may also be beneficial for there to be an independent pair of co-founders who can make its own decisions about the prioritization of different activities.
- That being said, the LEEP leadership has expressed keen interest in the work of this potential charity, thinking that it could help LEEP prioritize its own activities and help design more effective mitigation strategies. Going forward, we expect that this charity will closely collaborate with LEEP (as well as other international stakeholders in this space).

9 Conclusion

Lead exposure in LMICs has historically been a neglected problem in global health. Recently, the global community has started giving more attention and resources to this issue, and there is a growing momentum to address the problem – in the same way that it has been successfully dealt with in most developed countries. However, mitigation efforts are sometimes hampered by a lack of good-quality data showing who and how is exposed to lead. Therefore, we think that this is the perfect time for a new charity to support existing efforts by addressing the existing knowledge gaps via targeted research and data-collection activities. We are excited to recommend this charity idea to the Charity Entrepreneurship incubation program.

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