



Understanding and Mitigating the Global Burden of Lead Poisoning

CONCEPT NOTE

October 2021

Summary

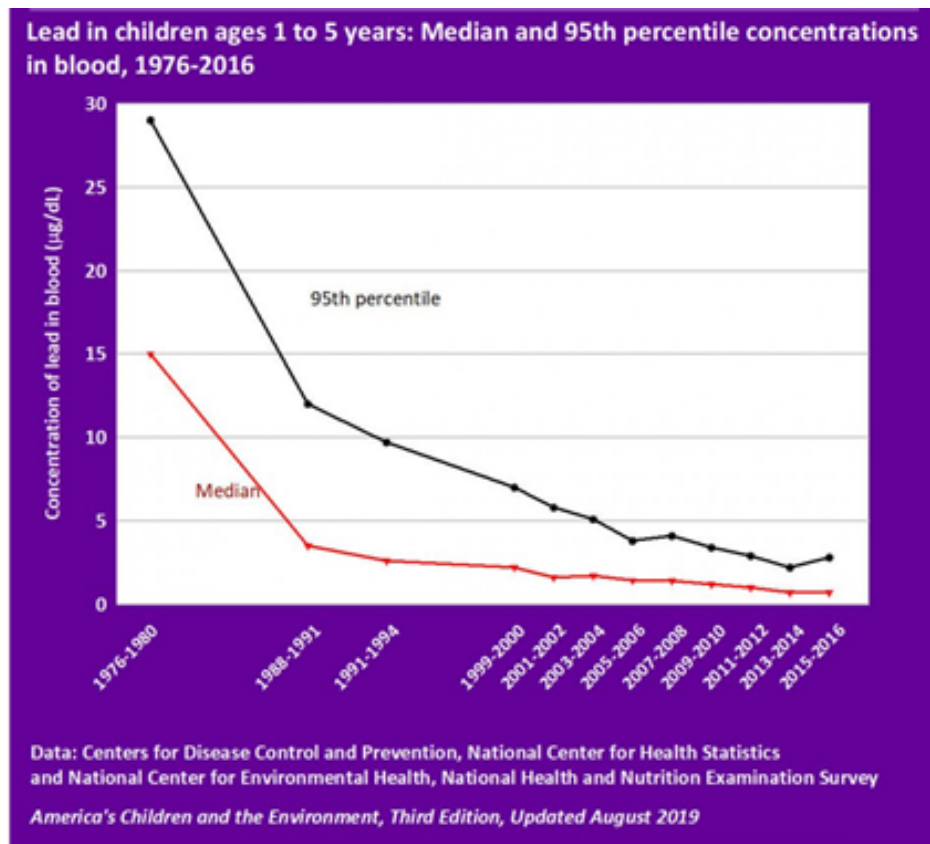
The Center for Global Development (CGD) is requesting \$1.2 million in funding for a timely two-year program of work to understand and mitigate the global burden of lead poisoning. Lead poisoning is a politically salient issue in the US, but in many low- and middle-income countries the burden is much higher and yet it does not receive sufficient political attention nor financial resources from domestic governments and the global community.

The overall goal of this work is to increase the evidence base on the importance of lead poisoning as a human capital and global welfare issue; generate actionable strategies and recommendations to better surveil and reduce the burden of global lead poisoning; and increase the salience of lead poisoning and mobilize support for mitigation within the global health and education communities. This will be achieved through empirical research, convening a high level working group and a supply chain study to identify the sources of lead poisoning. We intend to complement the excellent scientific work by PureEarth on measuring lead exposure, tracing sources of lead exposure, and remediating lead exposure with CGD's expertise in policy engagement and economic analysis.

Background

Lead is a neurotoxin that hurts human health,[1] reduces IQ,[2] lowers educational attainment,[3] causes behavioral problems,[4] and has been causally linked to crime and violence.[5] Domestically, the US has almost eliminated lead poisoning through the phase-out of leaded petrol, ban on lead paint, and replacement of lead pipes (Figure 1). Nonetheless, remaining instances of lead poisoning (though relatively rare) have high political salience, prompting an allocation of \$15 billion to replace remaining lead pipes and service lines in the Senate's recently passed bipartisan infrastructure bill.[6]

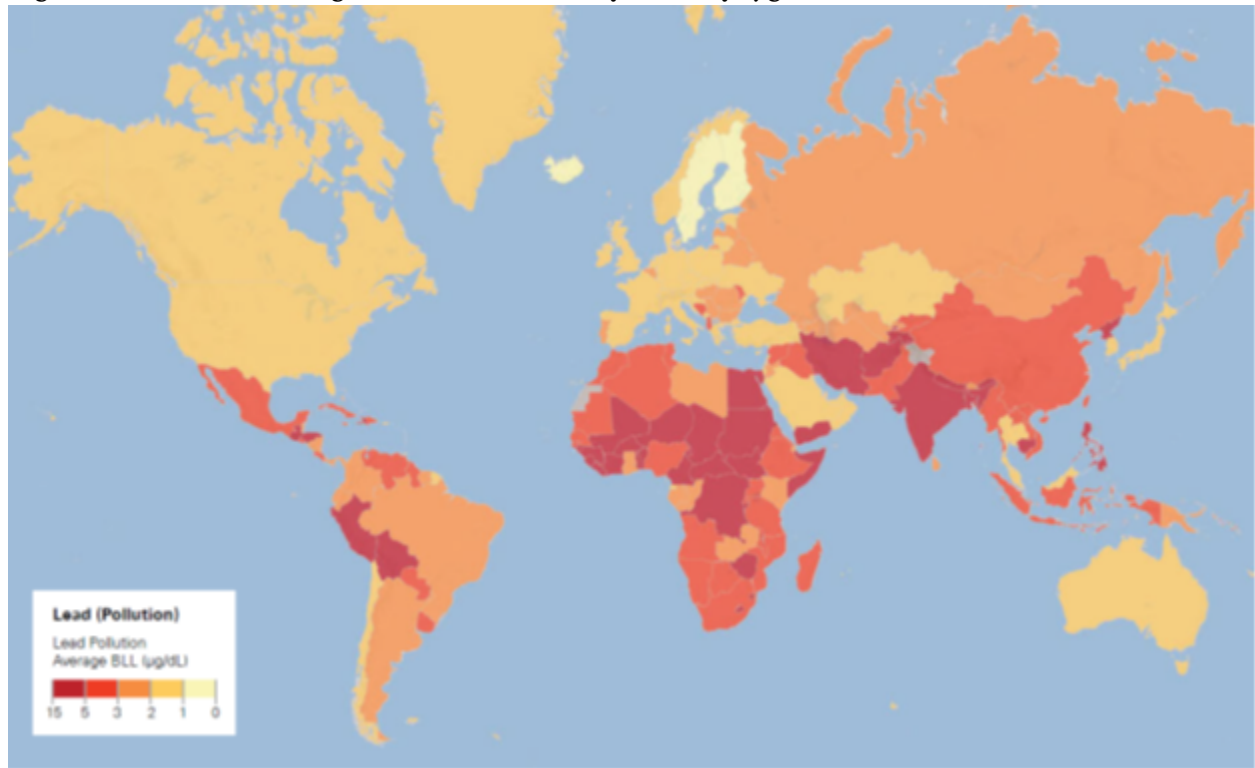
Figure 1: Blood Lead Levels Over Time, United States



Source: <https://www.epa.gov/americaschildrenenvironment/ace-biomonitoring-lead>

Yet the burden in the US pales in comparison to the global burden of lead poisoning. Though data is scarce and unreliable, the global burden of lead poisoning is enormous; it is estimated that between a third and half of children in LMICs have blood lead levels above the 5 microgram/dL threshold[7] where medical intervention is recommended by the CDC. Blood lead levels are particularly high in Central America, Andean countries, Central and West Africa, and Central and South Asia (Figure 2); in these regions *average* blood lead levels exceed the CDC reference level for medical intervention.

Figure 2: Children’s Average Blood Lead Levels by Country ($\mu\text{g}/\text{dL}$)



Source: <https://www.unicef.org/media/73246/file/The-toxic-truth-children%E2%80%99s-exposure-to-lead-pollution-2020.pdf>

This is an enormous welfare and human capital problem that strips children of their potential to thrive and adults of years of healthy life. Studies suggest that lost earnings from lead poisoning total almost \$1 trillion per year in LMICs; in Africa, estimated losses represent 4% of aggregate GDP.[8] According to IHME modelling, lead exposure is also responsible for 900,000 deaths and 22 million DALYs each year.[9] Modelling studies show that previous efforts to reduce lead exposure—most notably, the global phase-out of leaded petrol—have had enormous benefits, on the order of \$2.5 trillion globally each year.[10] This would make the phase-out of leaded petrol one of the most cost-effective interventions of all time; it is also highly suggestive evidence that other forms of lead abatement would be extremely cost-effective. However, almost all rigorous research on the cognitive, learning, and behavioral impacts of lead poisoning is drawn from high-income country settings. There is no mechanistic reason to believe that effects would differ in LMIC contexts, but local evidence would nevertheless be useful to confirm the expected relationship and motivate local intervention/investment in mitigation.

Despite this enormous burden, lead poisoning is a relatively neglected issue at the global level. There is only one organization (Pure Earth) doing substantial research and mitigation, with a small budget of about \$5 million per year.[11] Recently, GiveWell and associated groups have made a three-year, \$8 million grant to Pure Earth to support further research on the sources of lead exposure, as well as the cost-effectiveness of potential mitigation projects.[12]

While such individual mitigation projects may be cost-effective, policy and regulatory-level change is also required to address the major sources of lead exposure: lead-acid battery recycling; contaminated turmeric and other spices; leaded paint; and lead glazes used in ceramics. A major challenge in addressing these likely sources of exposure and mobilizing policy-level support for lead mitigation is the multi-disciplinary nature of the problem, requiring cooperation and shared responsibility between ministries for health, environment, education, trade, consumer protection, and land use, among others. Greater global attention to the burden of lead poisoning—paired with evidence-based strategies to reduce lead exposure—is needed to elevate local prioritization, motivate the requisite multi-sectoral cooperation, and address the issue. Within the US, the domestic salience of lead poisoning and the Biden Administration’s existing leadership position in domestic lead abatement may offer a window of opportunity for meaningful action.

Proposed Activities and Anticipated Impacts

CGD proposes a 2-year, \$1.2 million work program designed to: (1) produce rigorous evidence on the importance of lead poisoning as a human capital and global welfare issue; (2) generate actionable strategies and recommendations to better surveil and reduce the burden of global lead poisoning; and (3) increase the salience of lead poisoning and mobilize support for mitigation within the global health/international education/advocacy communities. The two-pronged work program would include: (1) empirical research on the links between lead exposure and adverse health, economic, education, and other welfare outcomes in an LMIC setting; and (2) a multi-stakeholder working group on lead abatement.

1. Empirical Research on Lead Exposure and Adverse Welfare Outcomes

The claims referenced above that lead exposure is responsible for, e.g., 900,000 deaths annually, or that phase-out of leaded gasoline yields \$2.5 trillion in economic benefits per year, rest on sparse data, much of it imputed, as well as fairly strong modeling assumptions. Anecdotal reports from researchers and policymakers suggest that despite the eye-popping magnitude of these figures, lack of confidence in their veracity remains one (clearly not the only) impediment to remedial policy action.

Our objective is to provide direct, rather than modeled, empirical estimates of the impact of lead exposure on adult life outcomes for children living in low- and lower-middle income countries.

Our reading of the literature suggest that whilst there is medical research on the pathological effects of lead poisoning which should transfer well across contexts, well-identified causal evidence on the effects of lead on social outcomes (such as education or crime) largely comes from high-income countries, and here effects *may not* transfer so well across contexts. We propose to start to fill this gap with original research, combining both desk-based analysis of existing data sets and primary data collection in lead ‘hot spots’.

Given the need to look at long-term effects of lead poisoning, our focus is on retrospective studies using natural experiments to identify causal effects. We propose three alternative study designs, which we hope to pursue in parallel - budget dependent, to provide complementary evidence using multiple techniques from multiple settings.

1. The effect of removing leaded gasoline in Africa. Most countries in Africa banned lead in gasoline only around 2005. Existing research from Sweden has shown significant effects of such bans on child development ([Gronqvist et al 2020](#)). We will merge spatial data on road networks with geographically

identified data on social outcomes. This will include LSMS-ISA household survey data from Burkina Faso, Ethiopia, Malawi, Mali, Niger, Nigeria, Tanzania, and Uganda (geocoded, with anthropometrics and labor market outcomes), as well as administrative data on national exam scores from schools across space and time.

Risk of bias: moderate

Cost: low

2. The effect of polluted sites and/or cleanup efforts. Here we plan to focus on a case study of one or more specific toxic waste exposure sites. Pure Earth's Toxic Sites Identification Program (<https://www.contaminatedsites.org/>) lists 1,490 sites across 54 developing countries where lead is the key pollutant. Our basic strategy here is similar to [Rau, Urzua, and Reyes \(2014\)](#) analysis of the Arica site in Chile, which found children living 1 kilometer further from the site had test scores 0.07 to 0.09 standard deviations higher. Among the Pure Earth list of toxic sites, we are seeking to identify those where it is possible to clearly distinguish exposed and unexposed populations (spatial variation) and exposed and unexposed birth cohorts (time-series variation) to enable a difference-in-differences analysis. The clean up of the Dong Mai site in Vietnam between 2013 and 2014 is one contender. We anticipate that bespoke survey data collection would be required to get sufficiently dense sample coverage in the vicinity of these sites, thus enabling us to credibly estimate the causal effect of the exposure and/or cleanup on later life outcomes, including cognitive skills, labor market earnings, health, etc.

Risk of bias: low

Cost: moderate (South Asia) to high (Africa or Latin America)

3. Longitudinal correlations between lead poisoning in early life (measured in existing studies), and later life outcomes (measured through new follow-up surveys). Neither of the first two approaches allow us to observe actual blood lead levels for the relevant sample population, and trace the mechanism of effects through lead poisoning per se. Thus we propose a third research strategy to trace a direct link from blood levels in early childhood to adult life outcomes, by doing long-term tracking of individuals who were sampled for blood lead testing in childhood. This kind of tracking exercise is increasingly common in development research, but expensive, and attrition rates can sometimes be high, complicating statistical inferences. Furthermore, the analysis would rely on simple regression analysis, without the benefit of a natural experiment for causal inference. The advantage of this approach, however, is that it allows us to more precisely quantify the change in adult life outcomes associated with a precise level of lead exposure.

Risk of bias: high

Cost: high

2. CGD Working Group

The aim of the working group is to generate actionable strategies and recommendations to better surveil and reduce the burden of global lead poisoning; and increase the salience of lead poisoning and mobilize support for mitigation within the DC global health/international education/advocacy communities.

CGD organizes working groups for a set period of time around a common effort to identify practical solutions to a specific problem. These groups draw strength from a diverse range of experts who share a common interest yet typically lack the opportunity to engage in problem-solving conversations and forge joint solutions. Members serve voluntarily and, except in special circumstances, in their individual capacity. Group members encourage one another's commitment to address a specific problem, for example, through changes in funding, policies, or program implementation. CGD working groups and commissions usually produce a report outlining the group's findings and recommendations, and members often continue to collaborate afterward to push for implementation.

CGD has an established and successful track record of using the working group model to achieve influence and impact in development and global health policy. CGD's policy impact from working groups includes adoption of a novel mechanism on advance market commitments used to launch pneumococcal vaccines, setting up the International Initiative for Impact Evaluation (3ie), motivating and establishing the International Decision Support Initiative to support country-led priority-setting for cost-effective health interventions, and encouraging the use of performance-based incentives adopted by multiple international agencies. In its first fifteen years of work, CGD has applied the working group approach in a variety of contexts to influence policies, choosing an important problem, developing a 'big idea', using the working group model and in-house secretariat to communicate with, convene, and consult with stakeholders, etc. Development Impact Bonds and Cash on Delivery (COD) Aid are recent examples of innovative funding strategies that were developed in CGD working groups and are currently being tested by global health funders such as the Global Fund, DFID and USAID.

In this particular case, CGD proposes to convene a working group to generate constructive recommendations to address the burden of lead poisoning in low- and middle-income countries. The working group would meet approximately three times over the 18-24 month period and each meeting would last one to three days. CGD would aim for at least one of those meetings to be in person, but is prepared to conduct the entirety of the working group virtually if required by the current epidemiological situation.

A first meeting would serve to introduce members to CGD and each other; define the working group's mandate and objective; and set an agenda for needed research and analysis. A second meeting, held about eight months later, would allow the working group to deliberate over emerging evidence and start sketching out findings and recommendations. A third meeting, held about six months thereafter, would allow members to review a draft report and approach consensus on the Group's findings and recommendations. As necessary/appropriate, CGD may also hold a fourth (final) working group to plan outreach and dissemination.

We propose to co-chair the working group with Pure Earth, the leading organization with relevant subject matter expertise in lead exposure and mitigation strategies, who have indicated their enthusiasm to do so. Via Pure Earth, the working group will benefit from evidence collection funded under the GiveWell grant on sources of lead exposure and the cost-effectiveness of mitigation strategies. CGD's original empirical research findings (described above) would directly inform the Group's deliberation. CGD will also strategically undertake and commission additional quantitative and qualitative research and analysis to support the working group, complementary to the Pure Earth research programme.

Working group members (20-30 people total) would be strategically selected to: (1) ensure the working group benefits from relevant expertise and experience; (2) increase the salience of lead poisoning among funders and other relevant organizations; and (3) increase the likelihood that the working group’s recommendations are ultimately adopted. While the precise composition of the working group remains tentative, an indicative membership list includes representatives from national governments in countries most affected by lead poisoning, experts from UNEP/Global Alliance to Eliminate Lead Paint, UNICEF, World Bank, USAID, SIDA, BRAC, interested philanthropic organisations and lead researchers.

All working group members would serve in their individual capacities and have the opportunity to review and comment on all working group products. The products – including the final report – would not necessarily be consensus documents, however, CGD would make sure they incorporate the perspectives of all members and clearly indicate areas of disagreement, where relevant.

At the conclusion of this project, CGD would issue a Final Report of the Working Group with findings and recommendations. CGD would use a variety of channels to disseminate the report and encourage uptake of the findings, with the goal of motivating concrete, trackable action from the Biden Administration and relevant international agencies. Channels of dissemination would likely include:

- Publication (online and in print) of the final report, including (1) targeted dissemination to key stakeholders via email and mail; and (2) broad dissemination to CGD’s health and education email lists.
- Public events (virtual and in-person, if possible) to share the report findings.
- Small-group meetings and roundtables with relevant stakeholders.
- Presentation or side-events at relevant international conferences and meetings, including those for education, health, and environment.
- Dissemination via social media, including Twitter, Facebook, and LinkedIn.
- Press releases and media outreach, with the goal of wide coverage in both the mainstream and development/effective altruism-focused press:
 - CGD has already had success featuring lead poisoning on Vox’s “The Weeds” podcast and expects wide media interest in the topic.
- Dedicated policy outreach to the Biden Administration and US Congress, leveraging the expertise of CGD’s Policy Outreach team.

Staffing

[REDACTED]

[REDACTED]

[REDACTED]




Budget

The total budget for this program of work is \$1.2 million. Funds allocated to this project will be used to partially cover the salaries of the personnel involved in the research (detailed above), direct research costs including data collection/surveys, and any future travel related and event costs. Finally, some funds will be reserved to cover the costs of a dissemination strategy that may include the development of webpages and dashboards, online resources, infographics, videos and/or other media. Per organizational policy, 15% of the total grant would be allocated to help cover CGD's indirect costs.

Organizational Qualifications

CGD is an independent, nonpartisan, and nonprofit think tank that works to reduce global poverty and improve lives by producing innovative economic research that, in turn, drives better policy and practice by the world's top decision makers. CGD has over [twenty years of experience](#) generating new ideas and actionable policy proposals and sparking critical global development conversations. CGD is the only think tank in Washington, DC with established presences in London, UK and a singular focus on international development, addressed through the multiple channels of [aid](#), [development finance](#), [migration](#), [global health](#), [education](#), and [technology](#).

Organizational Policies and Terms

CGD is an independent and nonpartisan research institution. As such, and as in the case of all donations to CGD, CGD retains total discretion regarding the use of funds, subject only to our commitment to use said funds for the programs or projects described in the enclosed proposal. There can be no conditions or limitations on CGD's independence in research, findings, conclusions, or resulting publications. Where appropriate, CGD may welcome and consider comments or views from donors, but CGD will retain total discretion and final decision-making authority regarding program and project research topics, speakers, and participants in activities, and on the contents of reports. CGD shall be the sole and exclusive owner of any and all products, services, processes, technologies, materials, software, data, files, lists, documents, computer records, research, compositions, works of authorship, computer programs, work product, know-how, algorithm, method, process, procedure, improvement, discovery, invention, other innovations, and intellectual property ("Work Product") made, conceived, reduced to practice, or

learned, either by CGD alone or jointly with other collaborators, as developed or acquired with donor support. Work Product shall immediately become and remain the exclusive property of CGD, regardless of whether such Work Product is patentable or copyrightable.

CGD will continue to ensure that its organizational culture, human resources policies and practices, and approach to research and partnerships adhere to [its stated commitment to diversity, inclusion, and equity](#). We will work to (1) increase the diversity of our staff; (2) promote a culture that emphasizes the diversity of backgrounds and perspectives; and (3) encourage other think tanks, research institutions, and peer organizations to self-reflect with humility, prioritize a diversity and inclusion agenda, and collaborate to share insights and accelerate progress. CGD has adopted employment policies in furtherance of these values and in compliance with all applicable laws, including but not limited to an equal employment opportunity and harassment policy, and expects its partners to do the same.

CGD's employees and agents shall not engage in federal lobbying contacts or federal lobbying activity, as such terms are defined in the Lobbying Disclosure Act of 1995, 2 U.S.C. § 1601, et. seq., as amended, on behalf of any donor, including making any oral or written communication, including electronic communication, to a covered federal executive or legislative branch official on behalf of any donor regarding: the formulation, modification, or adoption of federal legislation, rules, regulations, Executive orders, or other governmental programs, policies, or positions; the administration or execution of federal programs or policies, including the negotiation, administration, or award of contracts, loans, grants, permits or licenses; or the nomination or confirmation of a person subject to confirmation by the Senate. CGD shall not function directly or indirectly as a donor's representative or agent to the public at large. In carrying out the activities described in this proposal, CGD and its employees and agents shall not act as agents of any foreign principal as such terms are defined in the Foreign Agents Registration Act, 22 U.S.C. § 601 et. seq., as amended. Further, CGD shall not undertake activities on behalf of the donor that constitute "political activities" under the Foreign Agents Registration Act, including activities that are intended to in any way influence any agency or official of the Government of the United States or any section of the public within the United States with reference to formulating, adopting, or changing the domestic or foreign policies of the United States or with reference to the political or public interests, policies, or relations of a foreign government or foreign political party. For the avoidance of doubt, CGD's work shall not be directed by a foreign government or foreign political party and shall not directly promote the public or political interests of a foreign government or foreign political party.

CGD's tax identification number is 52-2351337. CGD Europe is established as a company limited by guarantee in the UK and as a registered UK charity (number 1157318).

[1] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4961898/>

[2] <https://pubmed.ncbi.nlm.nih.gov/8162884/>

[3] <https://www.elc-pa.org/wp-content/uploads/2016/02/ELC-Impact-of-Lead-on-Learning-Report-February-2016Rev-PDF.pdf>

[4] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4888135/>; https://www.nber.org/system/files/working_papers/w20366/w20366.pdf

[5] https://scholar.harvard.edu/files/jfeigenbaum/files/feigenbaum_muller_lead_crime.pdf

- [6] <https://www.nytimes.com/2021/08/10/us/politics/infrastructure-bill-passes.html>
- [7] <https://www.unicef.org/media/73246/file/The-toxic-truth-children%E2%80%99s-exposure-to-lead-pollution-2020.pdf>
- [8] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3764081/>
- [9] <http://ghdx.healthdata.org/gbd-results-tool>
- [10] https://www.researchgate.net/publication/288371618_Global_Benefits_From_the_Phaseout_of_Leaded_Fuel
- [11] <https://www.pureearth.org/wp-content/uploads/2020/11/Blacksmith-Institute-Inc-2019-form-990-tax-return-for-web.pdf>
- [12] <https://www.givewell.org/research/incubation-grants/Pure-Earth-lead-exposure-July-2021>
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[RS(1)]

Table 1: Indicative Working Group Membership

	Affiliation	Type
1	World Bank	International Organization/Funder
2	UNICEF	International Organization/Funder
3	World Health Organization	International Organization/Funder
4	UNEP/Global Alliance to Eliminate Lead Paint	International Organization/Funder
5	Asian Development Bank	International Organization/Funder
6	GiveWell	Interested Philanthropist
7	Bloomberg Foundation	Interested Philanthropist
8	Gates Foundation/CIFF	Interested Philanthropist
9	BRAC	Local NGO
10	Zambia Mining Environmental Remediation and Improvement Project (ZMERIP)	World Bank project
11	SIDA	Bilateral Donor
12	USAID	Bilateral Donor
13	PureEarth	Lead-Focused Organization
14	Global Alliance on Health & Pollution	Lead-Focused Organization
15	Vital Strategies	Lead-Focused Organization
16	Environmental Protection Agency	Lead-Focused Organization
17	TBD	Lead SME
18	TBD	Lead SME
19	TBD	Lead SME
20	India	LMIC Government
21	Nigeria	LMIC Government
22	Vietnam	LMIC Government
23	TBD	Education Organization

24		Education Organization
25	Center for Global Development	
26	Center for Global Development	
27	Center for Global Development	
28	Center for Global Development	