



HOME-BASED SOURCE ASSESSMENT PROTOCOL

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Acronyms

AAS	Atomic absorption spectroscopy
ASTM	American Society for Testing and Materials
BLL	Blood lead level
GPS	Global Positioning System
HBA	Home-based assessment
ICP-MS	Inductively coupled plasma mass spectrometry
XRF	X-ray fluorescence analyzer

1 Introduction

The main purpose of home-based assessments is to identify sources of lead and pathways of exposure, particularly among children.

When a child with an elevated level of lead in their blood (typically $>5 \mu\text{g}/\text{dL}$) is identified, it is important to understand what factors are contributing to the burden of lead in their body. Investigating the contributing sources is needed to design an effective intervention for that specific child and his or her family, but it also allows for the identification of trends to inform larger interventions at the community, regional, or even national level.

A home-based assessment (HBA) is typically carried out after the blood lead level (BLL) of a child has been analyzed and it is necessary to assess and quantify different sources of exposure. In the process, investigators analyze aspects of the home environment, including soil, paint, indoor dust, water, foods, toys, and other consumer products. It should be noted that this assessment focus specifically on the child's primary place of residence. Children may be exposed to lead in other locations that they frequent, including playgrounds, daycare or school facilities, or relatives' homes.

This guidance is intended to be used by field personnel conducting such assessments. It contains guidance for planning and administering the study, conducting environmental sampling, and administering a questionnaire on potential risk factors.

The sampling approach draws on the elements laid out in "Small Area Surveillance to Estimate Prevalence of Childhood Blood and Environmental Lead Levels: A Technical Guide"¹ (from the US Centers for Disease Control) and incorporates additional potential lead exposure sources common in low- and middle-income countries.

2 Study Design

2.1 Study Components

There are three primary components of data needed to complete an effective assessment of the underlying drivers of lead exposure:

1. The blood lead level (BLL) of the child (discussed in greater detail in the following section) to understand the severity of the exposure.
2. A home-based assessment (HBA) to understand potential routes of exposure. This data is obtained through two primary means. The first is through a

¹ Hodge, J., Nielsen, J., Dignam, T., and M.J. Brown. Small Area Surveillance to Estimate Prevalence of Childhood Blood and Environmental Lead Levels: A Technical Guide." US CDC.

- portable X-ray fluorescence analyzer (XRF), which provides immediate readings on lead concentrations in a variety of media. The second is through samples collected and submitted to a laboratory for analysis. Laboratory analysis is used for media that cannot be assessed with an XRF and for validation of XRF results.
3. A questionnaire to collect data on behavioral and environmental factors that may put a child at higher risk for lead exposure.

2.2 Participant Selection

It is recommended that HBAs be carried out following the collection of BLL data. This BLL data may be collected through routine health surveillance testing, convenience sampling at specific clinics, or as part of a randomized population-based study.

From this larger collection of children, a subset can be selected for detailed home-based investigations. Children with the highest BLLs should be prioritized to identify the major contributing source(s) and provide targeted feedback to the family and stakeholders. Including a smaller proportion of children with average and low BLLs provides useful comparison groups and can help narrow down possible interventions.

Another scenario which may warrant the implementation of HBAs is around known point sources (such as a smelter or battery recycling site). In this case, the aim would be to assess the impact of the known point source and identify what (if any) other lead sources may be affecting the community prior to a remediation or other risk reduction activity. Children should be selected from within a specified radius of the point source. In order to demonstrate that the point source is a major factor contributing to the children's BLLs, a comparison group of children should also be selected from a control site which does not have a lead point source but is otherwise similar in terms of socioeconomic and demographic factors.

A study-specific sample size calculation will need to be done to determine the number of participants required to identify a statistically significant association between environmental exposures and BLLs². This must be done **before** the study begins. This calculation should also consider response rate. Response rate is the proportion of people that participate in the study compared to those that were asked to participate. The sample size should account for the anticipated rate of refusal to participate³.

When selecting potential participants, the following eligibility criteria should also be considered:

² Hodge, J., Nielsen, J., Dignam, T., and M.J. Brown. Small Area Surveillance to Estimate Prevalence of Childhood Blood and Environmental Lead Levels: A Technical Guide." US CDC.

³ Ibid.

- It is recommended to select participants through age 6 years (up to 72 months).
- Children must have lived in the identified household for at least 6 months.

2.3 Partners

It is key to identify and involve relevant authorities, primarily in the public health sector. Depending on the country, this can range from the national to local level (e.g. health authority, environmental authority, mayor's office). Involvement of a governmental authority can be an important factor in gaining community acceptance of a study, and also provides the opportunity for capacity building. The details of such partnerships should be established beforehand through Memoranda of Understanding (MOUs) or data use agreements to clarify any questions related to data access and publication.

Including local health professionals, like public health nurses, or community leaders as part of the sampling team can help build trust and rapport with participants. Civil society organizations with close ties to the community can also have an important role during the study design and implementation by providing information on potential lead sources (such as what products are commonly used or how families typically obtain water in the study area) and liaising with participants.

2.4 Ethical Clearance and Informed Consent

Ethical clearance and informed consent are critical elements of HBA studies. The HBA can be included in the study design for BLL testing and submitted for ethical clearance from an Institutional Review Board (IRB). If this is not the case, then IRB approval should be obtained separately from the appropriate authority. The IRB will be able to provide or direct you to an appropriate format for the submission.

Ensuring informed consent is received from each participating household before any data is collected is **critical**. The form to obtain written informed consent should be included during the ethics review. Note that a parent or guardian must provide such consent for a minor participating in the study. The institution granting the IRB approval may have more specific guidance for the content of the informed consent but in the absence of such guidance, include the elements outlined by the US

Department of Health and Human Services:

<https://www.hhs.gov/ohrp/regulations-and-policy/guidance/checklists/index.html>

It is common to provide a small gift (such as a toy or books) as compensation for participation in a study. The nature and approximate value of this gift should be outlined in the IRB. Follow any national guidelines, but typically small compensation

as an incentive for completion of a study is permitted so long as such incentive is not coercive.

An example of an informed consent statement that includes BLL collection, environmental sampling in the household, and the administration of a questionnaire is included in Appendix A. The exact wording should be adapted to the particulars of the study. However, in order to incorporate the BLL findings into an international, anonymized database, include language in the IRB that the data will be centrally held for research purposes. The consent form should indicate that the participants “agree to use data, appropriately anonymized, for research”.

Informed consent documents should be provided to potential participants in the appropriate local language. Final versions of the final informed consent document should be maintained in English and in the appropriate local language for the field.

If photos are taken during the course of the assessment, a release is not required as long as the photos do not include people (for example, the child and family members).

3 Study Planning

Preparation for the study should include ensuring that all team members are familiar and comfortable with the study plan, and that all necessary services and supplies are in order.

3.1 Identify Laboratories and Obtain Equipment

Obtaining reliable laboratory results is key to ensuring the accuracy of the study results. One or more labs may be needed to cover the different environmental media included in the HBA.

- Use certified laboratories, if such a certification program exists in your country. If such a certification does not exist, contact local health or environmental authorities, scientific institutions or universities to identify a suitable laboratory in the study region.
- The US CDC offers a no-cost proficiency testing program for blood lead analysis. See <https://www.cdc.gov/labstandards/lamp> for more details.
- Discuss the list of parameters to be tested, as well as the prices for analyses with the laboratory.
- Ensure the labs are familiar with the recommended methods and have the necessary equipment (see Appendix B).

Be sure to build in time to acquire needed equipment and supplies. Some may be available locally while other may need to be ordered from abroad. A list of recommended equipment is included in Appendix C.

3.2 Health and Safety

During the study planning phase, prepare a complete Health and Safety plan. This plan should lay out any risks to the study team, how to mitigate those risks, and how the study team will react to an emergency in the field. It should identify emergency numbers and locate the nearest health care facilities. Refer to the Health and Safety Guidelines included as Appendix D.

Furthermore, to ensure the safety and comfort of staff in the field:

- Clothing should be professional and appropriate to the local context. Clothing should be comfortable and provide adequate protection from the elements (e.g. heat, rain, insects, etc.).
- Ensure all staff have adequate access throughout the day to water, food, and restrooms.
- Generate name tags or badges for study team members so you are readily identifiable to the community.
- Discuss and address any other personal health and safety concerns raised by team members.
- Alert local authorities that the study teams will be in the area.

3.3 Team Roles

To efficiently and effectively carry out the home source investigation, a coordinated team is needed. Below is a recommended division of tasks:

- Spokesperson/Surveyor: Acts as the spokesperson with the household and obtains consent; speaks with household about water source and items to sample; identifies locations for dust wipe samples; sketches the house.
- XRF Tester: Operates the XRF to take readings of soil, paint, and items in the house.
- Recorder: Remains with the XRF tester and ensure all readings and observations are written down.
- Sampler: Collects and labels all physical samples (including water and dust); helps collect samples for XRF testing (e.g. puts spice samples in plastic bags).

If the questionnaire is being administered at the same time as the HBA, consider merging two of the roles above and adding an interviewer to keep the study team to four or fewer individuals. The interviewer should administer the questionnaire to the parent or guardian who provided consent for the study, in their native language.

These roles can be adapted to the specific needs of the study. Carry out the HBAs with the minimum number of individuals so as not to overwhelm the family or draw

excessive attention within the community. Consider if team members will rotate positions or remain in a single role over the course of the investigation. This will depend on the goals of the partners and/or staff involved.

Depending on the number of tasks that need to be completed at a particular household (e.g. if blood draws or the administration of a questionnaire need to be done in addition to environmental sampling), it may be most efficient to sub-divide the team. In this case, develop a plan to communicate and coordinate among the teams (such as a WhatsApp group) and arrange check-in times and meeting places.

The step-by-step guide for environmental sample collection in Appendix E lays out a suggested division of labor among team members.

3.4 Training

Training for the HBA study should be completed prior to study implementation. Training for the study should include both a classroom component and hands-on practice.

Classroom training should include the following elements:

- Study objectives
- Background on lead as an environmental health threat
- Obtaining ethical clearance and informed consent
- Administering the questionnaire
- Data sheets and data entry
- Detailed sampling protocols
- Detailed Health and Safety protocols
- How results will be returned to participants
- Privacy concerns

The hands-on element of the training should include:

- Practice operating the XRF on different media
- Collection of dust wipe samples
- Collection of water samples
- Collection of other media samples (e.g. spices)
- Sample labelling, preservation, chain of custody
- Practice administering the questionnaire
- Quality assurance and control measures

If possible, carry out a complete practice assessment at a home (for example, at the home of a study team member or volunteer). If this is not possible, simulate a complete assessment from start to finish in the classroom.

4 Sampling Approach

Data should be collected and recorded in a consistent and accurate manner throughout implementation of the study.

4.1 Recording Data

Accurately and completely recording data is **critical**. Data can be recorded on paper or electronically. There are benefits and drawbacks to both. Even if electronic forms are selected, be sure to bring paper versions of the data entry sheets to ensure sampling can continue if you encounter an issue with the device or software.

Paper form:

- Readily available in the field with no maintenance or troubleshooting
- Requires manual data entry at the end of the day or sampling session (must be done carefully to avoid introducing errors during transcription)
- Researchers have physical backup

Electronic data collection:

- Requires tablet or cellphone with adequate battery life and connectivity
- Must ensure entries are being uploaded to a cloud or backed-up regularly to a hard drive to prevent losing data
- Can be designed with specific data entry formats and/or controls to ensure all questions are answered

There are multiple options for secure, accessible data collection software programs, which can be selected based on the experience or specific needs of the study team. One such software is SurveyCTO, which includes all the required functions to conduct a survey and store the collected data. The survey form is programmed by the team. Both tablets and mobile phones can be used for data collection in the field using SurveyCTO. To start the data entry, the person collecting the data opens a new form on the device, by tapping 'Fill Blank Form' in the SurveyCTO Collect app. Then the investigator enters the answers to the questions and submits the finalized questionnaire. The completed survey forms are stored in a database, which is used for data quality checks and data analysis. The database needs to be password protected.

Another tool that can be used is the ODK application, which is very versatile and can be adapted to field needs. It can collect data online or offline (<https://getodk.org/>).

A free option is EpiInfo. Guidance for the use of EpiInfo is provided by the US Centers for Disease Control.

4.2 Household IDs

Each household must be assigned a unique and confidential identification number (for example 001, 002, 003, etc.). This ID should be used consistently across the environmental samples, data entry sheets, and the questionnaire, and should also be linked with the BLL result. If all children already have unique identifiers from the BLL sample collection, this number can be used for the HBA.

4.3 Sampling Best Practices

As part of the HBA, environmental data will be collected in two ways – in real-time via the XRF and by obtaining samples to the lab for analysis.

For samples that are collected for lab analysis, follow the guidelines outlined below:

- Labelling of samples:
 - Each sample label should have three components:
 - The sample type. Each type of sample must be assigned a text identifier (for example, dust sample - D, water sample – W, soil sample – S, etc.)
 - The unique household ID (e.g. 001)
 - A sample number
 - For example, D-001-01 would be the first dust wipe sample from household 001. D-001-02 would be the second dust wipe from household 001.
 - Recommended coding and formatting are laid out in the Sample Collection Log (Appendix F).
- Avoiding contamination during sampling:
 - Wash your hands thoroughly or use disposable gloves.
 - Do not drink or eat while sampling.
 - Use designated containers/bags for sampling.
 - Do not use metal sampling devices if the samples will be tested for metal concentrations.
 - Avoid external contamination of the sample container/bag.
 - Avoid any internal contamination of the sample/bag; open the container/bag right before sampling.
 - Do not place foreign objects in the sample container/bag.
 - After sampling, ensure that all containers/bags are tightly closed.
- Sample transportation:
 - All the samples transportation instructions must be obtained from the laboratory in advance, including the samples delivery time, storage conditions (e.g. temperature), etc.
 - The samples must be protected from external influence (e.g. precipitation, heat, freezing, or cross-contamination) during transportation.

4.4 XRF Use

The portable XRF is used to analyze the concentration of lead and other elements in real-time.

- Be sure to review the health and safety recommendations for the specific XRF to be used in the study, but the following general precautions should be taken:
 - Never aim the device at yourself or others when the x-ray is on.
 - Never hold samples during analysis.
 - If sampling at a table, ensure that no body parts are in the line of the x-ray under the table.
- Follow the detailed guidelines for XRF operation laid out in Appendix G.
- For each reading, record:
 - Reading sequence number (generated by the XRF)
 - Sample type (what type item is being sample)
 - XRF mode
 - Lead concentration. If no lead is detected, be sure to record the reading as “ND”
 - Description of item
- Refer to Appendix H for a recommended format for a XRF Reading Log to record results in the field.
- Download and retain the raw data file from the XRF. This file acts as a back-up and can also provide information on other elements (such as arsenic) detected in the item.

5 Study Implementation

Once the team is fully trained and familiar with the study’s protocol, and all needed equipment and supplies have been obtained, implementation can begin.

5.1 Key Steps for Field Preparation

- Ensure the study team is familiar with the study area and the Health and Safety plan.
- Create and disseminate to the team a plan for which households will be visited and in what order.
- Confirm you have an adequate supply of all required equipment and supplies (see Appendix C).
- Coordinate with the laboratory the dates for delivering samples. Follow the laboratory’s specific handling, labeling and packaging instructions while collecting and transporting samples. Use appropriate sampling containers

(e.g. bags, bottles or other containers for sampling). Find out about the requirements for the minimum amounts/weights of samples.

- Print out enough sample labels on adhesive paper. Make sure to generate all unique participant and sample IDs in advance. Carry blank labels and permanent markers with you in case additional labels have to be generated in the field.

5.2 Approaching the Household

When approaching the household, be sure to introduce yourself and the project, including the partners involved and the objectives. Speak clearly and directly in the local language and engage with the family in a friendly manner.

- Ensure you have identified the individual in the household that is legally able to provide consent (most likely the parent or legal guardian of the child who's BLL was or will be collected). This will be outlined in the IRB.
- Once you have identified the correct individual, provide an oral summary of the informed consent (this should be a pre-established script), which will include what data will be gathered and how it will be used. Inform people that the information they share will be kept confidential. Be polite and answer questions.
- If the parent/legal guardian agrees to participate, obtain their signature on the informed consent form in the local language.
- If the parent/legal guardian does not agree to participate, record that the individual declined to participate. If the individual offered a reason for declining to participate, make a note of why.

Once you have obtained consent:

- Ensure the household has been assigned a unique identifier.
- Collect a GPS point for the household (at the front door if possible).
- Ensure the parent/guardian has enough time to allow the assessment and questionnaire to be completed.
 - The anticipated time will depend on which components are included (HBA, questionnaire and BLL), and the experience of the team. However, a rough estimate is 30-45 minutes per household.
 - If it is not a convenient time for the parent/legal guardian, schedule another time to return.
- At this stage, you can begin sampling and, if applicable, administering a questionnaire.

5.3 Questionnaire

A questionnaire designed to gather sociodemographic and lead risk factors should be administered at each household to the parent/legal guardian. If a BLL has already been collected, the questionnaire may have already been administered at that time.

If not or if additional questions are warranted, the questionnaire should be administered at the time of the HBA (and included in the informed consent) to the parent/guardian.

Major elements of the questionnaire should include:

- Age and gender
- Demographic and socioeconomic information. NOTE: If possible replicate metrics used in national studies such as Demographic and Health Surveys or UNICEF Multiple Indicator Cluster Surveys. This can facilitate comparisons or integration with larger datasets.
- Housing characteristics
 - Housing type and quality (stand-alone house, apartment, hut, etc.). The terminology should reflect local norms.
 - Flooring type
 - Cleaning practices
- Occupations or hobbies of household members that may involve lead.
 - Capture whether these activities are occurring in the home, or if the household member may be bringing lead home on their clothes
- Diet
 - Provides insight into general nutritional status and household socioeconomic information,
 - Can capture the frequency of consumption of suspected lead-containing foods or spices (such as turmeric).
- Behaviors which may pose an increased risk of lead exposure
 - Where the child is spending their day
 - Frequency of handwashing
 - Mouthing toys, biting nails, etc.
- Use of specific products associated with increased risk of lead exposure
 - For example, traditional medicines, glazed pottery, etc.

An example questionnaire is included in Appendix I. The exact questions may be tailored to the local context. The questionnaire should be translated into the local language, and the terms used should be clear and simple to avoid confusion or misunderstandings by the respondent.

Follow the recommendations below for effective interviewing:

- The interviewer should know the local language and be familiar with local customs.
- At the beginning of the interview, introduce yourself and your organization, explain the purpose of the interview to the participant, ask permission to ask questions.
- Administer the questionnaire in a private area, if possible.
- Speak clearly, slowly, and confidently; be attentive and polite.

- Try to generate an atmosphere of trust. Indicate that you keep the information obtained confidential and reiterate that their responses will not be used for any other purposes than those stated at the beginning of the interview.
- Emphasize that the information requested is very important for data analysis. Show interest in the respondent's answers.
- At the end of the interview, make sure that the interviewee answered all the questions.
- Ask the participant if he/she has any additional information on the topic which you did not discuss.
- Explain how the results of the HBA will be returned.
- Thank the participant.

6 Environmental Sampling Components

The sampling protocol contains the following elements – a sketch of the home; XRF readings of soil surrounding the home, painted surfaces, spices (if applicable), toys, cookware, and other consumer products; dust sample collection; and water sample collection.

Depending on local regulations or norms for environmental assessment, you can consider additional data collection methodologies, several of which are outlined in Appendix J.

This protocol emphasizes the child's home environment. However, the principles can be applied to other areas the child spends a significant amount of time (e.g. playground, daycare, school), if resources allow.

Before sampling, ensure you are familiar with the guidance in Section 4: Sampling Approach, and Appendices E through H.

6.1 Sketch Home Layout

Materials needed:

- Blank paper
- Pen
- Handheld GPS unit

Draw a quick sketch of the floor plan or layout of the home (Figure 1). This allows the team to mark where particular samples were collected (mainly dust wipe samples), and can also be referred back to if questions arise about the characteristics of the house.

The study team may already have a GPS point for the household (for example, if the BLL was collected during an earlier sampling effort). If not, record a GPS point at the front door of the household.

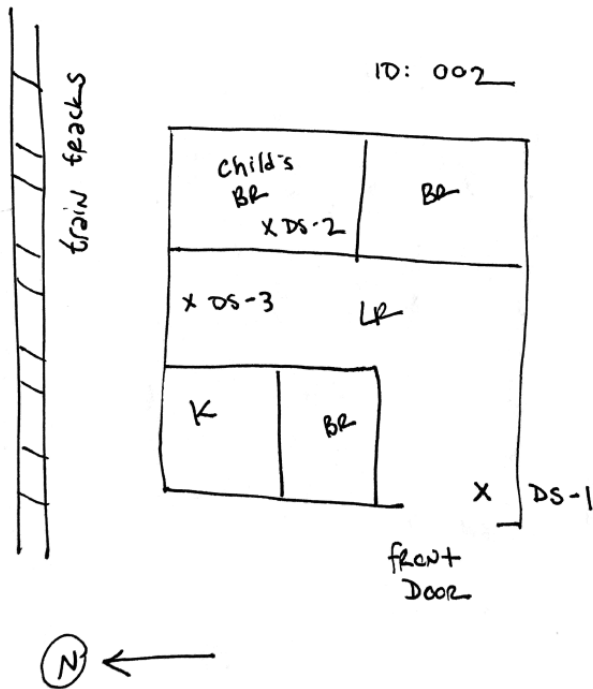


Figure 1. Example of household sketch.

6.2 Soil outside home

Materials needed:

- Portable XRF
- Handheld GPS unit
- Polyethylene/thin plastic bags
- Plastic scoop/spoon/spatula
- Sample collection bags/containers
- Sample labels
- XRF Reading Log
- Sample Collection Log

Collect XRF readings from locations surrounding the home, including:

- Identify 3-5 evenly distributed locations outside the house. These readings should capture areas where a child might play or spend time such as a yard.
- Try to sample bare dirt where possible, avoiding grass, sticks, rocks, or pavement.
- Ideally, XRF readings of soil should be taken while the ground is dry. If this is not possible, make a note on the XRF Reading Log of any readings that were

taken of wet soil. Alternatively, wet soil samples may be collected, dried and tested at a later date.

- Place a polyethylene bag (such as a thin sandwich bag) on the ground where you will sample to protect the XRF window. Change this bag at least after each household to avoid cross-contamination (more often if it visible soiled).
- Measure in *SOIL* mode.
- Record the GPS reading at each XRF reading location.
- Include a brief description of the location (e.g. courtyard used for play)
- Reference levels: 400 ppm soil in residential areas; 1200 ppm soil in industrial areas (US EPA)

If the selected household is on an upper floor, ask the parent or guardian if the child spends time in the area around the base of the building. If so, take readings as explained above.

If the assessment is being carried out in an urban environment or in an area that is all paved, there may not be much ground with exposed soil. In this case, dirt or dust can be sampled in areas where it has accumulated in cracks between bricks or along the sidewalk or road. The investigators can also scrape together dirt with a clean scoop, collect this dirt in a sample bag, and XRF the bag. Mark paved areas on the household sketch. If there are no areas with substantial dirt that can be sampled, make a note as to why in the XRF Reading Log and/or household sketch.

At a subset of homes (10-20% depending on the sample size), collect a composite sample for analysis in the lab.

- Collect soil from all locations where XRF readings were taken.
- Use a plastic scoop, spoon or spatula to collect the sample. Use a different scoop for each household.
- Try to take only the surface of the soil (top 1 cm).
- Combine them in one sample bag and close securely. Mix the sample well within the bag to homogenize it.
- Collect at least 3 XRF readings of the well-mixed soil in the bag.
- Confirm the required amount of soil with the lab (likely at least 100 grams).
- Ensure there is a sample label adhered to the outside of the sample bag and add the sample information to the Sample Collection Log.

6.3 Paint

Materials needed:

- Portable XRF
- Sample collection bags/containers
- XRF Reading Log
- Sample Collection Log

Identify painted surfaces throughout the home. Pay particular attention to surfaces with enamel paint. These types of paints are typically applied to surfaces that are subject to abrasion, such as window frames, doors, door frames, furniture, and children's play equipment. Please note that brightly colored paints, in particular yellow, orange, and red, may be more likely to contain lead.

- Record the color of the paint and what state it is in – for example, intact, chipping, or peeling. Record the location of the paint in the house. If possible, ask the parent/guardian when the walls were painted (walls painted within the past 10 years are less likely to have lead).
- Take a reading for each different paint that you see in the home. Measure in *PAINT* mode (for a reading in mg/cm² or µg/cm²).
- If there is no paint in the house, make a note on the data collection sheet.
- Reference level: 1.0 mg/cm² or 1000 µg/cm² (US HUD)

Look for flaking or peeling paint. If present, collect a sample of the flaking paint chips in a sampling bag or container.

6.4 Products

Materials needed:

- Portable XRF
- Polyethylene/thin plastic bags
- Plastic sampling spoons
- Sample collection bags
- Sample labels
- XRF Reading Log
- Sample Collection Log

Using the XRF, readings can also be taken of products that may contain lead. This section can be customized based on the local context. Speak with homeowner about products used in the home, particularly those with an exposure route to the child. Some categories to consider are listed below but this list should not be considered exhaustive. Ask permission to sample these items with the XRF.

Identify a hard surface, such as a table, to gather and analyze the products. **Before taking readings on the products, use the XRF to test the table to ensure there is no lead that would interfere with the readings.**

6.4.1 Spices and Religious Powders

Lead has been identified as an adulterant in spices, primarily in South and Central Asia. High levels of contamination have been identified particularly in yellow spices, like turmeric and curry (from South Asia) and kviteli kvavili, also known as yellow flower (from Georgia), although red spices such as chili powder and paprika have also been found to contain lead.

- Consult with the parent/guardian on the most common spices they use in their cooking, with a particular emphasis on red, yellow, or orange spices. Aim to sample 3-5 spices per household (although this number can be adjusted up or down depending on the region).
- If the spices being assessed are in thin, clear plastic bags, you may test the spices in that bag. If the spices are in a different container, use a disposable spoon or scoop to place a sample (30-50g) in a small, thin plastic bag (Figure 2).
- The sample should be ~1 cm thick in the plastic bag.
- Measure in *SOIL* mode.
- Record the type of spice.
- Speak with the respondent to gather and record additional information on the brand (if any), if it was packaged or bought in bulk, if it was purchased whole or ground, and where it was purchased (e.g. turmeric, unbranded, bought loose at local market).
- Use a clean spoon and plastic bag for each sample.
- Spices without a detectable level of lead can generally be returned to the family.
- For spices where lead is detected, ask the family if you can keep the sample. Some or all of these samples may be sent for lab analysis to confirm the concentration and/or determine the particular lead compound in the product (e.g. lead chromate).
- Reference level: 2 ppm (EU), local regulations may vary

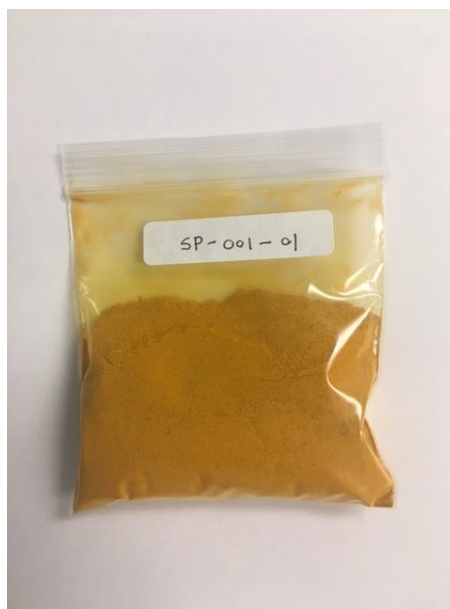


Figure 2. Spice in sample bag.

6.4.2 Cosmetics

Lead has been identified in very high concentrations in traditional eyeliner (kohl/kajal/surma). Elevated lead levels have also been found in a wide range of cosmetic products, including face and eye powders, lipsticks, and nail polish. This section also applies to religious or cultural powders like kumkum and sindoor.

- Transfer the cosmetic product to a clear plastic bag, removing it from any packaging or metal trays.
- Shift the sample within the plastic bag to make it as thick as possible (ideally ~1 cm).
- Measure in *TEST ALL* mode.
- Reference level: 2 ppm (EU/Germany)

6.4.3 Traditional Medicines

If the parent/guardian indicates that a child regularly or recently took a traditional medicine, ask if you can collect a sample of it. Samples of these medicines should be submitted to the lab. Confirm the amount of sample required by the lab, but a rough guideline is 10 to 20 grams.

If the parent/guardian is not willing or able to provide a sample to be taken to the lab, try taking a reading with the XRF.

- Place the medication in a plastic bag.
- Measure using *TEST ALL* mode.
- Reference level: 10 ppm (WHO)

6.4.4 Metal Cookware

Some metal cookware – particularly low-cost, locally manufactured aluminum-based cookware – has been found to leach lead. This appears to be a very widespread issue, and such cookware has been identified in countries spanning Sub-Saharan Africa, Central America, and across Asia. Some examples include pots, pans, woks, pressure cookers, stewpots, and Dutch ovens.

- Consult with the parent/guardian on the most common items they use for cooking. Aim to sample at least 3 items per household (although this number can be adjusted up or down depending on the region).
- Record what type of cookware - the local term can be used.
- Record if there is a coating on the pot, such as non-stick.
- Record any available information on where it was manufactured or purchased.
- Take at least 3 XRF readings on each item. If possible, take readings on the inside of the item (the cooking surface). Also include readings of any rivets or solder points (e.g. for handles) or fixtures on tops (e.g. valves for pressure cookers).
- Measure in *TEST ALL* mode.
- If budget allows, consider collecting cookware from a subset of households. This will require additional compensation for the family. Collecting the cookware would allow leachate testing in the laboratory. Prioritize items with high lead readings, however collecting some items with low and medium concentrations can also provide useful information. Carefully label the item and add the information to the Sample Collection Log.
- Reference value: There are no internationally recognized reference values for total lead in metal cookware. Based on Pure Earth research on leaching, 100 ppm can be used as a guidance value.

6.4.5 Ceramics

Lead has been detected in low-temperature pottery with glazes, such as cookware or cups/mugs. Leaching of lead from ceramics is of particular concern when the food/drink is hot and/or acidic.

- Consult with the parent/guardian on the most common items they use for cooking. Aim to sample 3-5 items per household (although this number can be adjusted up or down depending on the region).
- Record a brief description of the ceramic, and any available information on where the item was manufactured or purchased.
- Take at least 3 XRF readings. If possible, take readings on the inside of the item (the cooking surface).
- Measure in *TEST ALL* mode.

- If budget and time allow, use sodium rhodizonate swabs (such as 3M LeadCheck) to test for leachable lead. See Appendix J. Record whether or not you observe a color change on the swab.
- If budget allows, consider collecting cookware from a subset of households. This will require additional compensation for the family. Prioritize items with high lead readings, however collecting some items with low and medium concentrations can also provide useful information. Collecting the ceramic will allow leachate testing in the laboratory. Carefully label the item and add the information to the Sample Collection Log.
- Reference value: There are no reference values for total lead. Leachate testing would be required to assess actual lead exposure through food or liquids.

6.4.6 Toys

Lead can be present in children's toys, such as plastic or painted items. This is particularly of concern when children are at the age of chewing or mouthing toys. The XRF can be used on hard toys (plastic, wood, or metal), but not on soft/fabric toys or dolls.

- Record a brief description of the toy – what it is made out of, if it's painted or not.
- Measure in *TEST ALL* mode.
- If the toy is painted in different colors, collect at least one reading of each color of paint.
- Reference value: 100 ppm (US CPSC) or 90 ppm for painted items

6.4.7 Jewelry or Amulets

If a child wears and mouths a piece of metal jewelry or an amulet, first ask if the parent or legal guardian can remove the item.

- Record a brief description of the item.
- Measure in *TEST ALL* mode.
- Reference value: 100 ppm for children's jewelry (US CPSC); 500 ppm for adult jewelry (EU)

6.4.8 Fabric products

While the XRF is typically used for hard surfaces, it can be used as a semi-quantitative screening method for fabrics. Lead-containing dust can accumulate in everyday fabric materials, which can act as an exposure source, especially for children. Some of these products are children's clothing (t-shirts, pants, etc.), adult clothing (particularly if there is suspected occupational exposure), and mattresses.

- Record a brief description of the fabric product.
- For clothing measurements, fold the clothing three times before taking the XRF reading (this ensures the material is adequately thick).
- For mattresses, avoid metal components such as springs.
- Measure in *TEST ALL* mode.
- Reference value: XRF results for fabrics should be considered semi-quantitative, unless additional analyses are conducted.

6.5 Dust wipes

Materials needed:

- Gloves
- GhostWipes or equivalent
- Dust sampling templates (optional)
- Masking tape
- Ruler/tape measure
- Sample collection bags/containers
- Sample labels
- Sample Collection Log
- Garbage bag

Household dust is generated from external and internal sources. Up to 85% of household dust can come from an external source brought in by shoes and pets. Dust wipes measure the total amount of lead dust on a given surface area. This measurement is called "lead load" and is a good indicator of the amount of lead a child is taking in. Laboratories report the amount of lead found in a dust wipe in micrograms (μg) per wipe. This number is then divided by the area of the sample taken in $\mu\text{g}/\text{ft}^2$ or m^2 . Therefore, it is very important that the sample area is accurately measured.

Dust wipe samples should be collected from 2-3 locations in the home. If the home is very small (for example, 1 room), it may only be feasible to take one sample.

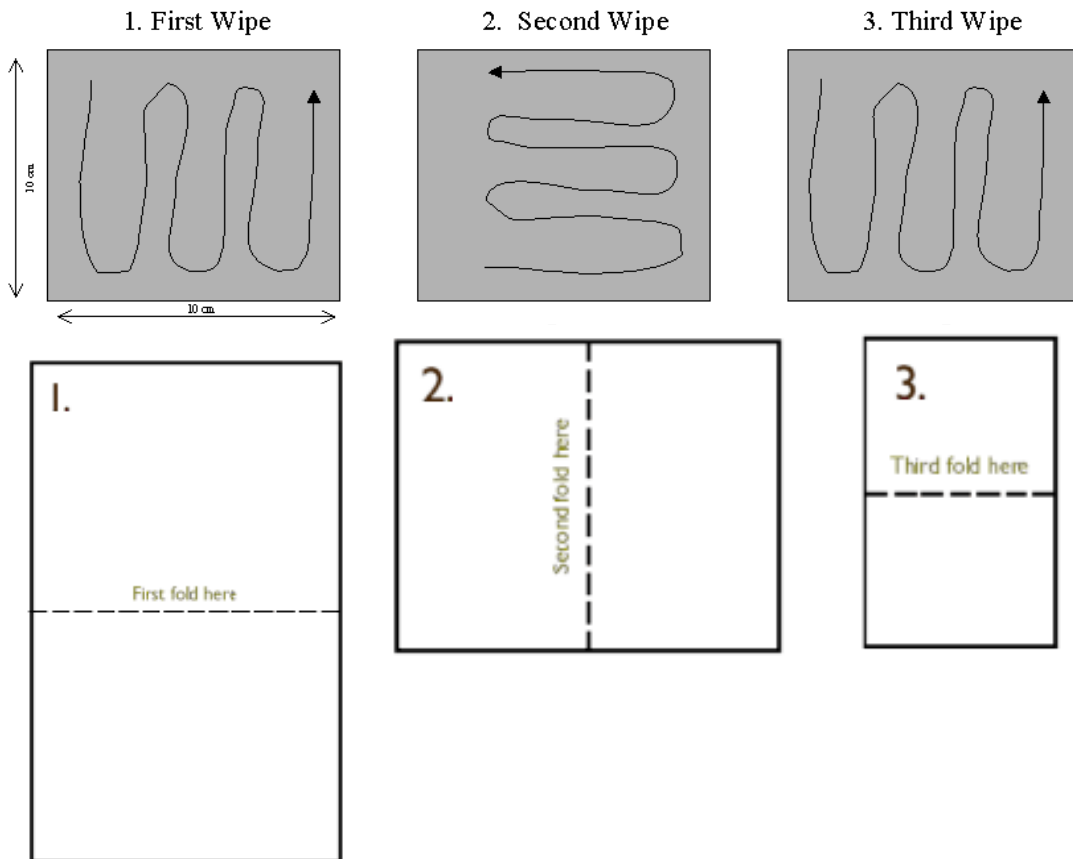
Select an area near the front door and in the child's play area. Other areas you can sample are the child's bedroom or sleeping area, living room, and kitchen. If possible, take the sample on the floor. Dust wipes require a solid surface, so you will not be able to collect a sample using this method if there is a dirt floor or carpet. Alternatively, you can take a sample from a windowsill, a shelf, or a piece of furniture (for example, the top of a cupboard or cabinet) where dust has accumulated. In the case of a dirt floor, use the XRF to take a soil reading inside the home.

The dust wipe sample should be taken using Environmental Express GhostWipes (SC4200 Moist Wipe) or an equivalent which meets ASTM E1792 specifications. The area sampled may need to be adjusted depending on the amount of household dust

expected to be found in the homes and the laboratory capabilities. The area sampled should be 100cm², in which case a 10 cm x 10 cm template (Environmental Express C1010 Dust Sampling Template) can be used, or 625cm² (25 cm x 25 cm), which can be marked out with masking tape. Each sample will need a wipe, a template/tape, and a sample container or bag.

- Wear gloves while collecting dust wipe samples.
- Locate three appropriate places to take dust samples as described above.
- Place a disposable template on the floor at each sample location and tape it down with masking tape, or mark out area with masking tape if a larger area is being sampled.
- NOTE: Clear any large debris from the sampling area before sampling but DO NOT clean the area prior to sampling. Make sure the parents or guardians, or others in the home, did NOT dust the area earlier in the day! Otherwise, it is better to either come another day, or take samples from the place where the dust was not removed.
- If you are sampling a windowsill or other surface where the 10cmx10cm template does not fit, you can also mark out a rectangle using a tape measure or ruler and masking tape. Sample an area that is at least 100cm².

Remove wipe from packet. Sample collection is performed by firmly pressing the wipe in an S-shape, repeating the wiping procedure three times, each time folding the wipe and changing the direction of the wipe by 90° (see





- Figure 3):
 - First pass: Open the wipe fully and start in an upper corner of the template. In a side-to-side “S” motion, wipe back and forth firmly, making your way from the top of the template to the bottom. Wipe the entire sample area up to the template but do not wipe the surface outside of the template.
 - Second pass: Fold the wipe in half so that the dirty side is touching itself. With the folded wipe, wipe the whole area of the template again, but this time, move the wipe in a top-to-bottom motion across the template from left to right.
 - Third pass: Fold the wipe again with the dirty side in. You should now have a quarter wipe. Wipe the area one more time, concentrating on collecting dust from the edges and corners of the sample area.
- Fold the wipe once more and put the wipe into the sample container. This can be a plastic tube or bag. Establish what container you will use with the lab beforehand. Each wipe should have a separate sample container.
 - NOTE: If screening the wipe with the XRF, fold a total of 5 times and place the folded wipe into a 1.5in x 2in bag.
- Make sure the sample is labeled and add the sample to the Sample Collection Log. Record the area sampled (for example, 10cmx10cm). This is important as dust results are reported as an amount of lead per area.
- Mark the location of the sample and ID on your drawing of the house.
- Dispose of the template and masking tape.
- Use a new template and wipe for each location.
- Prepare a field blank sample. Collect a dust wipe field blank at every 20th household, or 1 per sampling day. Remove a wipe from the package with a new glove, shake the wipe open, refold it in a manner similar to that used during the actual wipe sampling procedure, and then insert it into a sampling container without touching any other surface or object.
- Reference level: 10 µg/ft² for floor dust, 100 µg/ft² for window sill dust (US EPA)

Additional details about this sampling method are available through the US Environmental Protection Agency’s Lead Dust Sampling Training Course (http://www2.epa.gov/sites/production/files/documents/ldst-instructor_manual-2011-10-12.pdf).

To screen the dust wipe using an XRF, take four readings on each side of the wipe. Use PLASTICS mode. If all readings on the first side of the wipe are non-detect for lead, you do not need to measure the other side.

In communities where the use of vacuum cleaners is common, XRF readings of the dust accumulated in the vacuum bag can be taken (see Appendix J).

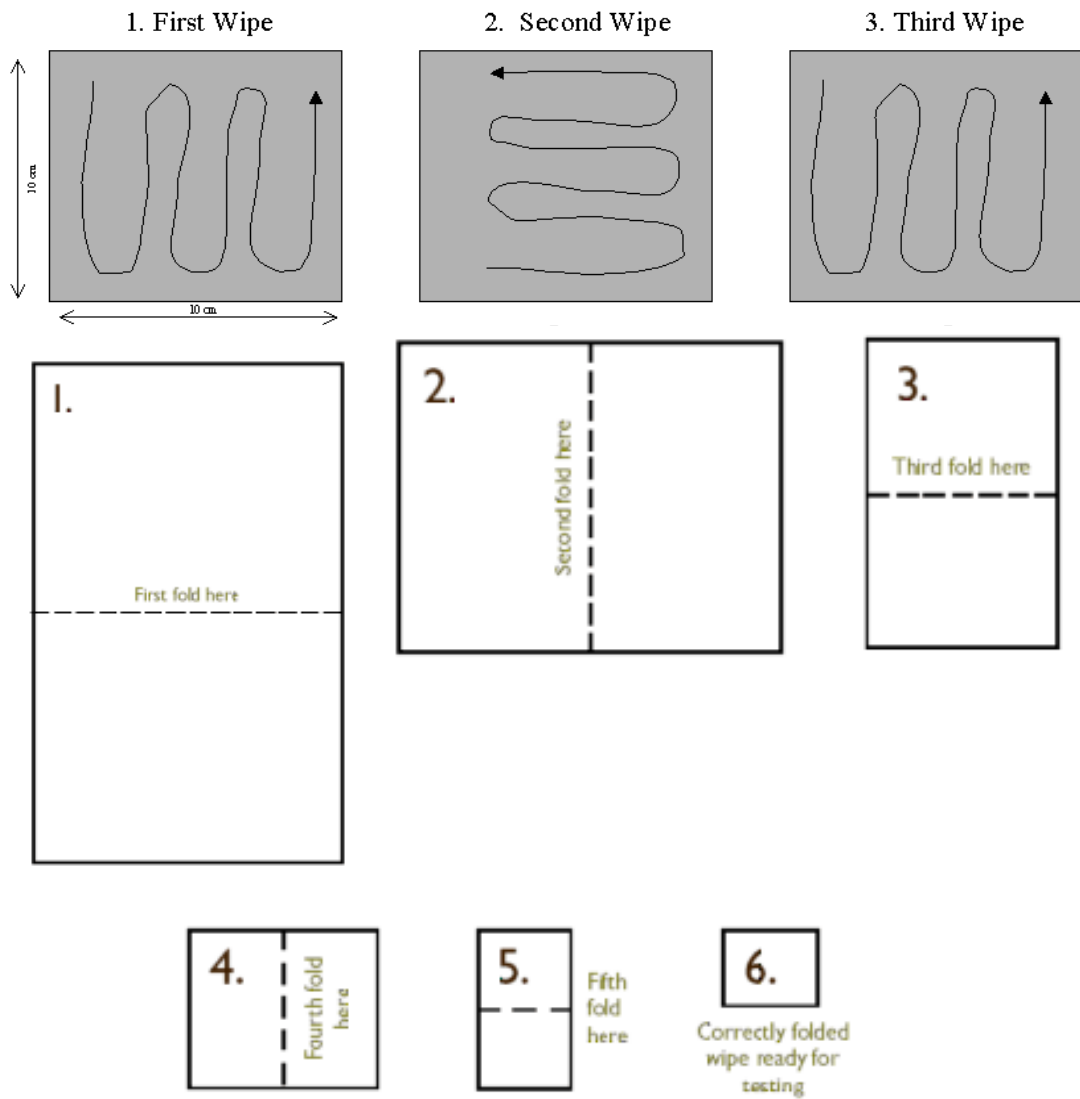
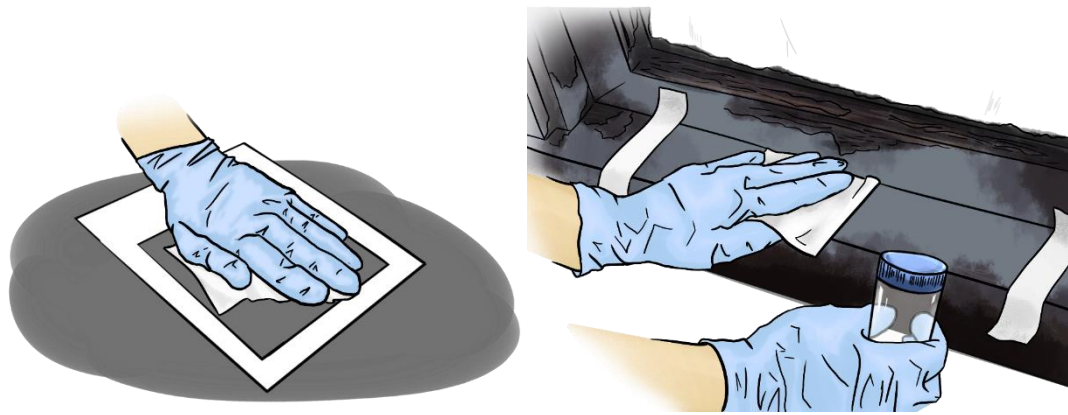


Figure 3. Dust wipe sampling schematic (adapted from Hodge et al)

6.6 Water

- Gloves
- Handheld GPS unit
- Sample collection containers
- Sample labels
- Sample Collection Log

Water samples should be taken from all of the homes in the study or from a subsample which is representative of a variety of water sources. The exact number will be determined by the scale and geographic scope of the study. There are a number of household water sources that you may encounter and several factors to consider:

- A house may have tap water or city supply water, which is distributed from a central source or treatment center, or the family may access water through a well.
- Even if all homes in the study area are connected to a central supply, it is possible that there would be differences in lead exposure due to different supply lines or pump components.
 - Newer homes (e.g. less than 20 years old) are less likely to have lead pipes or copper pipes with lead solder.
 - In lower income areas, piping systems are frequently made from plastic (PVC), which presents a low risk for lead.
 - If plastic is prevalent, a representative sample of water from the common (city) supply is all that is needed, not a sample from each house.
 - If old metal pipes are present, sampling the water from each household is advised.
- Other homes access water through wells. You may find that each home has its own well or you may multiple families living in the same area use a communal well.
 - Such wells commonly fall into two categories:
 - Shallow or dug (<10m)
 - Deep/borewell (>10m)
 - If there are several similar wells providing water to households in a neighborhood, all of similar depth and construction, one or two samples will be sufficient to determine if lead is in the aquifer being used.

Ideally, you will be able to collect enough samples to characterize each unique water source. Depending on the anticipated number of samples, consider if you will use a lab or a field testing option (such as a portable colorimeter). Use the appropriate sampling container and storage based on the selected method and/or the lab's recommendations.

- Speak with the respondent about how their water is supplied. Ask the respondent about the age of the house, and the material (e.g. plastic PVC or metal) and age of the plumbing, if known.
- If the house has more than one faucet/spigot, prioritize the one in the kitchen or the one that is used for cooking or preparing meals.
- Mark the location on your drawing of the house. If the water source is outside of the household (such as a communal well) record the GPS location.
- Wear gloves.
- Label the sample container while it is dry.
- Put the sample container under the faucet, fill and cap. **Do not run the water prior to sampling.**
- Fill in the sampling form with the water source, well depth, and faucet location.
- Add the sample to the Sample Collection Log.
- Follow the specific instructions from the lab for sample preservation (such as the addition of nitric acid) and storage (refrigeration).
- Prepare a drinking water blank at every 20th household, or 1 per sampling day. Fill the supplied sampling container with distilled water and store and transport in the same manner as the field samples.
- Reference value: 10µg/L (10 ppb)

6.7 After Sampling

After taking XRF readings and collecting samples, reconvene briefly as a team to ensure all steps are complete, all samples are properly labeled, and all data is correctly recorded. Be sure that all items that were sampled are returned the family. Remove all trash (for example, dust wipe packaging). Communicate clearly with the household how and when results will be returned and be sure to thank the family for their time and cooperation.

If lead concentrations of concern were identified during the assessment (through XRF readings for example), this can be communicated to the family at the time of assessment, but provide a full summary once all results (including laboratory analyses) are compiled.

7 Results

Once the data has been collected, condensed and reviewed for errors, it is very important that the findings are communicated clearly first with study participants, and then subsequently with a wider audience. The household source studies are designed to identify major drivers of elevated blood lead levels and provide actionable information for governments and other stakeholders.

7.1 Mapping Results

Visualizing the results of the HBA on maps is important for recognizing patterns and interpreting findings. Use the GPS location of the household and soil XRF readings to aggregate results for each of environmental media sampled (for example, all drinking water results on a single map, soil results on a separate map). An example is included below (Figure 4).

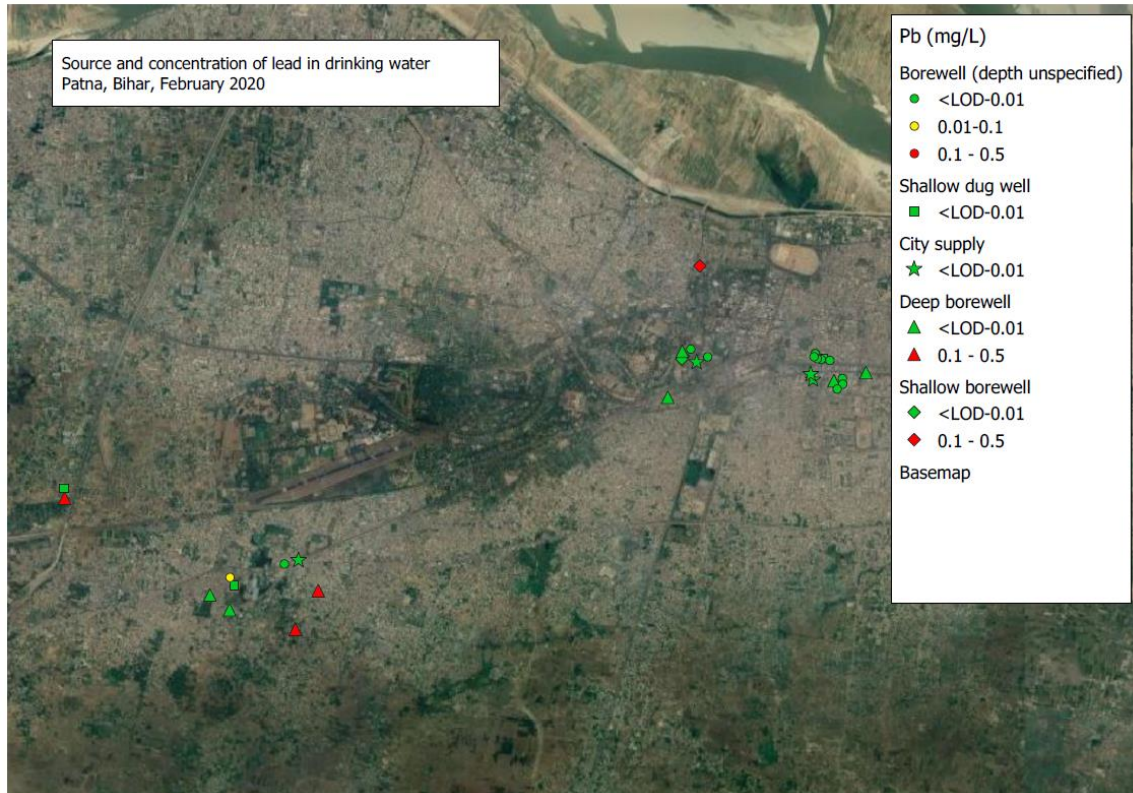


Figure 4. Example map of drinking water results.

7.2 Returning Results to Participants

It is crucial that participants receive the results of the study in a clear and timely manner. Exactly how and when sample results will be returned to families should be outlined in the IRB; some recommendations are presented below:

- Condense the findings into a handout or packet.
- Develop text and graphics that are appropriate for the local context; be sensitive to factors like literacy levels.
- Consider presenting the results in one or both of the following ways, either graphically or in text:
 - In comparison to national or international standards, for example:

- The turmeric used in your home has lead levels 3 times the government's limit.
 - In relation to the rest of the study population
 - The concentration of lead in the soil surrounding your home was higher than 75% of the other homes in the study.
- Include educational material about the risks of lead and recommendations to reduce exposures from any identified sources. Share this information with residents and recommend that they share it with friends, neighbors, acquaintances. Environmental education plays an important role in reducing the risk of lead poisoning in children and adults.
- Have the respondent sign a form indicating that they have received the results. This form should also be signed by a study team member. One copy of this form should be kept by the respondent and one by the study team. Specifics on the storage and management of these forms should be laid out in the documentation approved by the IRB.

Example infographics are included in Appendix K.

7.3 Disseminating Findings

Once the household-level results have been conveyed to the participating families, there are two primary routes to consider in disseminating the findings more widely.

The data should be fully de-identified to ensure the privacy of the participants. Refer to national rules about health data privacy, but in general de-identification means that no names, birthdates, contact information, or exact locations of individuals in the study can be shared.

Capturing the study's results in a peer-reviewed journal article allows for dissemination of the study's findings to research institutions and may encourage greater government interest and action.

In parallel to pursuing a peer-reviewed publication, summarize the study results for policy makers, community groups and other stakeholders. A policy brief can be generated that highlights the sources identified and recommends next steps, including proposed interventions or additional research.

List of Appendices

A - Informed Consent Example

B - Recommended Laboratory Methods

C - Equipment List

D - Health and Safety Guidelines

E - Step-by-Step Environmental Sampling Guide

F - Sample Collection Log

G - XRF Operation

H - XRF Reading Log

I - Questionnaire

J - Optional Sample Collection

K - Return Results Form Example

Appendix A – Informed Consent Example

The following example includes venous blood collection, environmental sample collection, and the administration of a questionnaire. The text can be modified to reflect the risks and benefits of the particular study.

INFORMED CONSENT

Title of the Study/Project

(INSERT LOCATION) *Childhood Lead Exposure and Source Identification Study*
(INSERT STUDY PARTNERS) are conducting a public health study about the possible lead poisoning of young children in **(INSERT LOCATION)**. We are doing this because lead can harm children’s ability to think, grow, and hear. Also, lead can cause problems with your child’s blood, which can make them feel weaker. However, it is possible to keep your children safe by taking steps to decrease the amount of lead in their surroundings. We want to learn if your child is lead poisoned. There is medical treatment for children with high amounts of lead in their blood. We expect to have **(INSERT SAMPLE SIZE)** children join this study.

Aims and methods of the research

We want to find out how common childhood lead poisoning is and sources contribute to the lead poisoning of children here. This will help us learn how severe the problem is and what steps need to be taken to ensure children are not poisoned by lead. To learn more about these problems, we will visit homes to test children below 6 years of age, to find out the amounts of lead in their blood and study their surroundings for possible sources of lead. To find these sources, we will check dust, soil, water, paint, food, and consumer products.

What do you and your child have to do?

- The study worker will ask you some questions, which should take 45 minutes of your time. The questions are your house, basic information about yourself and your child, and possible risks for lead poisoning.
- We will ask you for the name of each of your children aged 6 years or younger, and will randomly select one child to provide us with a blood sample. This child will represent all children in your family. Your child will have a small amount (up to 1 teaspoon) of blood taken from a vein in their arm. **(NOTE: the local interpreter may translate the volume to an appropriate comparison to improve comprehension).**
- **We will also collect the names and fairly detailed histories of the parents/household members of the children.**
- You will be informed of your child’s blood lead results by **(INSERT RESPONSIBLE PARTNER HERE)**.

Benefits

The benefit to you is that you will learn whether your child has been exposed to lead so that you can seek appropriate medical treatment. You will not be charged any money for the testing. You will receive the results of your child's lead test. A person from **(INSERT RESPONSIBLE PARTNER HERE)** will come to your household to tell you the results of your child's test. You will also be informed of potential sources of lead exposure in your household and provided with recommendations to reduce exposure to these sources.

Risk

There is little risk to your child from the blood test. Your child will feel a slight pinch, slight pain, or possible dizziness when the blood is drawn from an arm. Children may develop a slight bruise or infection following the venous blood test. **(IF CAPILLARY TESTING IS BEING USED, MODIFY THIS SECTION)**

Confidentiality of records

The results of your child's test will be kept private and secure to the extent permitted by law in your country. The answers to our questions and your child's blood sample will be identified by using numbers instead of their names. The anonymized data will be centrally held for research.

However, if your child needs urgent medical care, **(INSERT RESPONSIBLE PARTNER)** will keep a master list of names to make sure all children receive medical care. After the study, this master list of names will be destroyed.

Freedom of individual to participate and to withdraw from study

You may also choose to leave the study at any point of time and your data will not be used.

Contact Information

If you have questions at any time about this study, you may contact the researcher whose contact information is provided below.

INSERT CONTACT INFORMATION

Consent

I voluntarily agree to take part in the above study and agree to use data, appropriately anonymized, for research. Participating children will receive a **goodie bag, containing fruit juice and an educational toy or book, valued at no more than XX. (MODIFY WITH LOCALLY APPROPRIATE COMPENSATION)**

Signature (or Thumb impression) of the Subject:

Date: ____/____/____

Signatory's Name: _____

Signature of Impartial Witness /Legally Acceptable Representative:

Date: ____/____/____

Signatory's Name: _____

Signature of the Authority/Investigator:

Date: ____/____/____

Name of the Authority: _____

Appendix B – Recommended Laboratory Methods

Sample Type	Method	Notes
Dust wipe	US EPA SW-6020 or an equivalent analytical method	Results should be reported as $\mu\text{g}/\text{ft}^2$ or mg/m^2
Drinking water	ICP-MS; ICP-AES; Atomic absorption spectroscopy graphite furnace	Limit of detection should be at or below 10ppb
Soil	US EPA SW-846 Method 3050 or an equivalent analytical method	

Appendix C – Equipment List

- Informed consent sheets
- Printed brief of the project (local authorities or residents may ask you to share information about the project)
- Printed version of protocol
- Printed versions of questionnaire (even if using a digital collection system)
- Printed version of Step-by-step Environmental Sampling Guide (Appendix E)
- Sample Collection Log
- XRF Reading Log
- Copy of Health and Safety Plan
- Any necessary maps of the study area

- Name tags
- Gloves
- If taking blood samples: D-Wipe (<https://esca-tech.com/product/d-wipe-towels/>) or comparable disposable wipe for skin
- Any other required PPE (as laid out in the Health and Safety Plan)

- Blank paper for sketching homes and for notes
- Pens
- Permanent markers
- Sample labels (bring blank labels even if you have pre-printed labels)

- Portable XRF analyzer and at least one extra battery and necessary standards
- Handheld GPS unit (preferred over phones with integrated GPS) and extra batteries
- Camera

- Sampling bags – small (for spices/powders) and “sandwich”-size for soil samples

- Sampling containers for water (as requested or provided by the lab)
- Sampling containers for dust (as requested or provided by the lab)
- Small disposable plastic spoons for powders
- Disposable plastic scoops/scrapers/spoons for soil collection
- GhostWipes or ASTM E1792-certified equivalent for dust wipe sampling
- Dust wipe sampling template - 10cmx10cm (C1010 Dust Sampling Template or validated local alternative)
- Masking tape
- Ruler/measuring tape
- Garbage bags

- LeadCheck swabs (optional)

Appendix D – Health and Safety Guidelines

Introduction

Home-based assessments must be conducted in a safe manner. This document provides an overview of the health and safety guidelines team members should follow before, during and after the home-based assessments.

Responsibilities

Safety is an ongoing priority in any situation that team members encounter. Team members are expected to understand that safety policies, procedures, or training cannot predict all potentially dangerous situations; therefore, they must use their judgment at all times to stay safe.

Team members must do their best to protect their safety. Ultimately it is the individual's responsibility to be aware of his or her safety needs and react accordingly. Team members are expected to take adequate safety precautions such as: 1) refuse to be involved in situations that pose a high risk, 2) ask a colleague to accompany them on a visit, 3) abandon a situation because they believe they are in danger, or 4) proceed in a limited fashion due to safety concerns.

The study coordinator should ensure that all members of the study team have been informed of general health and safety requirements and will support them in obtaining any data or measurements needed to address risks posed by specific work during home-based assessment.

Preparing for a visit

1. Perform a risk screening

Before conducting a home-based assessment, investigators must identify the potential hazards that they may encounter during their visits. In general, these hazards are fairly common for any dwellings and are described in a table below.

Type of hazard	Examples	Notes
Chemical hazard	<ul style="list-style-type: none">- Lead contaminated materials- Other chemical pollutants present at home / yards	Since this assessment is aimed at finding sources of lead contamination at dwellings, an investigator should be alert to potentially lead-contaminated objects: soil, dust, paint, dishes, food, tap water, cosmetics, etc. However, the potential exposure to other toxic substances should not be overlooked.

Physical hazard	<ul style="list-style-type: none"> - Radiation - Electricity - High exposure to sunlight / ultraviolet rays - Temperature extremes – hot and cold weather 	Attention should be paid to expected local weather when working outdoor in summer- or wintertime to avoid heat stroke or syncope, sunburn, or hypothermia or frostbite. Bare wires or electrical appliances at homes may present a risk of electric shock. The radiation hazard comes from the XRF, which employs radioactive material.
Biological hazard	<ul style="list-style-type: none"> - Fungi/mold - Bacteria, viruses, parasites - Insects and other animals bites 	If blood tests will be conducted see “Bio-safety” below (this will be carried out by highly trained team members only). COVID-19 precautions must be followed. Be aware of dogs or other animals which may pose a risk in or around the house..
Safety hazard	<ul style="list-style-type: none"> - Slips, trips, falls - Car accident 	Working in dwellings and yards will pose slip, trip, and fall hazards due to uneven or slippery surfaces that may be wet from washing, rain or ice. Dust sampling from high surfaces is associated with the risk of falling. Safety precautions must be followed while driving to place that should be assessed.
Violence hazard	<p>Aggressive behavior by homeowners, including:</p> <ul style="list-style-type: none"> - pushing, grabbing - verbal threats - robbery - sexual abuse - assault with knives, guns, clubs or any kind of weapon 	Such behavior by homeowners is unlikely, but the possibility must be considered.

Reproductive hazards:

IMPORTANT! Women who are pregnant or who are planning on becoming pregnant SHOULD NOT take part in home-based assessments due to potential risk of lead and radiation exposure.

Once hazards have been identified, team members must assess the risk to their health to decide whether or not their exposure is significant, and what precautions are needed to protect their health.

Next, the team member must determine what measures he/she must take to reduce the probability that the exposure to these hazards will cause injury or endanger his/her wellbeing (such as wearing personal protective equipment, etc.). Additionally, the team member should evaluate any security concerns (such as risks posed by violence, crime, etc.) and take appropriate measurements to address those as well.

Following the items listed below is mandatory when preparing for a home-based assessment:

- All team members should be trained in safety procedures and should carry with them a set of safety instructions and the phone number of the study coordinator and/or team leader.
- The team members should carry out the home-based assessment with at least one partner. Each team member should let someone else know where he/she is, when he/she intends to return, and what to do if he/she does not come back at the appointed time.
- Before visiting homes, team members should be supplied with information on the nearest medical center and directions on how to get this medical center.
- Listen to weather reports. Never drive and never do sampling outside if severe weather is predicted or if a storm occurs while at the location where you plan to visit.
- Contact local authorities or police and notify them where the study teams will be each day.

2. Get personal protective equipment (PPE) ready

Team members must have access to essential personal protective equipment and must identify and use the appropriate PPE during the home visits. The important point to keep in mind is that lead can enter the body through ingestion, which occurs as a result of routine hand-to-mouth activities such as eating, drinking, and smoking. Therefore, team members should refrain from hand-to-mouth activities during the home visits and adequately clean their hands (with soap and water or with wipes designed to remove lead from skin, such as D-Wipe) before engaging in these activities. On a windy day, team members may need to use face masks to avoid breathing airborne lead-contaminated dust when working at dry, dusty places. Generally, the observance of basic personal hygiene practices will minimize team members' exposure to lead before, during and after home-based assessments.

Basic equipment includes:

- Comfortable shoes or boots - no open-toe shoes or sandals
- Clothing that cover the body and fits snugly at the neck, wrists and ankles
- N-95 Respirator (i.e. basic dusk mask): Dusk mask must be worn whenever there is potential exposure to hazardous dust. However, masks may not be necessary if there is no reason to believe significant dust exposure risks are present. These respirators should only be used once (they should NOT be cleaned or washed and/or reused).
- Goggles or safety glasses: must be worn whenever there is the presence of particles in the air that may damage the eyes (for example, significant amounts of dust) or when there is the risk of splash or splatter of contaminated substances.
- Disposable nitrile gloves for sample collection.
- D-Wipe (<https://esca-tech.com/product/d-wipe-towels/>) or comparable disposable wipe

Additional equipment includes:

- Medical mask
- Sunscreen
- Insect repellent
- Cap or sun hat

PPE should be inspected before every visit and it should be cleaned, repaired or replaced if needed.

The home visit:

1. Traveling to and from the site:

- Vehicles used to travel to and from the site must comply with local regulations (up to date inspections if required, etc.)
- The number of occupants must not exceed the number of people that can be seated.
- Seat belts, if available, must be used by those riding in the front of the vehicle or in all seats if required by local regulations
- Drivers must adhere to speed limits, signs and all other traffic norms
- Vehicles must never be driven by anyone under the influence of alcohol.

2. Car Safety

- Vehicles used to travel to and from the site must comply with local regulations (up to date inspections if required, etc.)
- Carry an emergency flat tire repair kit with you and learn how to use it.
- Before travelling insure the fuel tank is full.
- The number of occupants must not exceed the number of people that can be seated.

- Seat belts, if available, must be used by those riding in the front of the vehicle or in all seats if required by local regulations
- Drivers must adhere to speed limits, signs and all other traffic norms
- Vehicles must never be driven by anyone under the influence of alcohol.
- Don't leave equipment, cell phones, packages or bags visible inside your car. Place all valuables in the trunk and out of sight of passersby.
- Check an up-to-date weather report before driving to your visit, especially if you are driving a significant distance.
- Carry an Emergency Car Kit that contains flairs, first aid supplies, water and a thermal blanket.
- Park in a safe location. Be sure your car doesn't pose a hazard to other drivers and that you don't block traffic.
- If someone bumps you from behind or is following you, don't stop in a remote area. Drive to a well-lighted public place with other people. Stay in your car and dial police.

3. During visiting home:

- Never enter private property without the permission of the house owner.
- Wear appropriate PPE if he/she considers it is necessary (see above).
- Must NOT - under ANY circumstance - enter confined areas. These are areas large enough for a person to enter but with limited ventilation and/or limited or restricted means of entry or exit (for example wells, tanks, pits, vessels, sewer systems, pipelines, etc.)
- Be cautious in areas that may be slippery due to water, mud, steep slopes, etc.
- Be cautious if using ladders or stairways that may be unsafe
- Avoid contact with your face and mouth, as well as with food, drinks, and eating and drinking utensils.
- Do not use cosmetics.
- Do not smoke.
- Bring your own water from home.
- Team member should not eat in the homes where he/she conducts the assessment. If meal is offered, then politely decline.
- Be aware that hazardous material and toxic contamination may look innocuous –take precautions anyway. Do not assume that because people (e.g. local community members) are living in the area without any protection or without presenting any obvious adverse health symptoms that there is no hazard.

Be aware of dogs

- Any dog may bite.
- Before visiting the site, ask if there are any animals you need to be aware of. Upon arrival, look for signs of a dog before entering the yard or house.
- Do not surprise a dog – call out or tap on a gate if present.

- If a dog is unleashed within a fenced yard, do not attempt to enter the yard. Return to your car and call the owner to notify them that you are at the site; ask them to confine the dog in a safe place.

Bio-safety

Biological agents such as bacteria, viruses, parasites can be present in human and animal fluids and waste such as blood, feces and urine. Touching or any contact with human and animal fluids and waste, or dead animals, should be avoided during investigations.

Collection of human fluid samples, such as urine or blood samples, should only be done by persons with specific responsibility and training for such sample collection, and must be done following protective protocols. Good practice in such situations includes:

- Wearing disposable gloves and safety glasses at all times
- Good handling and disposal practices for needles, vials, tubes or other materials used in the sampling process
- Protective clothes, such as a lab coat or uniform must be worn during sample collection, and should be removed before entering in contact with other people, especially children and pregnant women.

COVID safety measures, such as wearing a medical mask when communicating with other people, frequent use of antiseptics to wipe hands and devices should not be neglected. If any team members or family members in the dwelling have respiratory symptoms or other symptoms of coronavirus infection, the visit should be rescheduled.

Radiation Safety

The radioactive hazard comes from the XRF, which employs radioactive material. Portable XRF tools are used for lead assessments in different types of materials. XRF devices contain radioactive isotopes that emit x-rays and gamma radiation. Proper training and handling of these instruments is needed to protect the instrument operator and any other persons in the immediate vicinity during XRF usage. **Always follow the manufacturer's instructions.** XRF tools used in accordance with manufacturer's instructions will not cause significant exposure to ionizing radiation. According to NRC rules, a radiation dose to an individual in any unrestricted area must not exceed 2 millirems per hour. Generally, an XRF operator conducting inspections according to manufacturer's instructions would be exposed to radiation well below the regulatory level.

- The XRF instrument should be in the operator's possession at all times.
- The operator should never defeat or override any safety mechanisms of XRF equipment.

- The instrument's shutter should never be pointed at anyone, even if the shutter is closed.
- The operator's hand should not be placed on the end plate during a measurement.
- No people should be near the other side of a wall, floor, ceiling or other surface being tested. The operator should verify that this is indeed the case prior to initiating XRF testing activities, and check on it during testing.
- The effectiveness of the instrument's radiation shielding should be assessed every six months through a leak test. The XRF manufacturer or owner's manual can be consulted to obtain vendors of leak test kits.

If these practices are observed, the risk of excessive exposure to ionizing radiation is extremely low and will not endanger any inspectors or occupants present in the dwelling. Refer to Appendix G for further information on operation of the XRF.

After the site screening

Before lunch and at the end of the day, team members should wash their hands and faces and clean off their work shoes.

Investigators who potentially were exposed to lead should follow these procedures at the end of home based assessment:

- Wash hands and face before eating anything.
- Change into clean clothes and shoes.
- Place contaminated clothes, including work shoes and personal protective equipment to be cleaned, laundered, or disposed of, in a special package.
- Take showers and wash hair before entering into close contact with other people, particularly pregnant women and/or children.
- Clean shoes to remove any mud or soil on them, wearing gloves during the cleaning and making sure that the removed soil is collected and disposed of properly or is left at the site. Soiled material or scraping from shoes must not be left on floors, in cars or around door entrances or other places where people gather.
- If any safety related incidents occurred during the visit, these must be communicated to the study coordinator.
- If there are any lessons learned during the visit that can be shared with other team members to prevent future incidents, these also should be communicated to the study coordinator who can disseminate that information.

Further health and safety information can be found at:

- US Center for Disease Control and Prevention – Workplace safety and health topics (<http://www.cdc.gov/niosh/topics/chemical.html>).
- US Occupational Safety and Health Administration (OSHA)– Health and safety topics (<http://www.osha.gov/SLTC/>).

Further information on toxic pollutants can be found at:

- Agency for Toxic Substances and Disease Registry – Case studies in Environmental Medicine (<http://www.atsdr.cdc.gov/csem/csem.html>).

Appendix E – Step-by-step Environmental Sampling Guide

LEAD STUDY ENVIRONMENTAL & HOUSE SAMPLE SEQUENCE

Step No.	Surveyor	XRF Tester	Recorder	Sampler	Activity
1	X	X	X	X	Confirm household location with survey/blood collection teams
1A	X				- Pass on observations, concerns
2	X	X	X	X	Prepare material for efficient testing and sampling; calibrate XRF if needed
3	Any	Any	Any	Any	Talk to owner, reaffirm consent to enter and test
4	X				Asks about water sources – well or city. If the water comes from a well, ask: where is it, type, depth
4A	X			X	<ul style="list-style-type: none"> - If well present, collect water sample - If water comes from the city, take samples from a subset of households (~total of 5 city water samples per community)
5	X				Sketches house
6	X			X	Surveys house to find up to 3 good dust sampling locations. Surveyor notes agreed locations on sketch, with sample numbers
7		X	X		XRF Test of soils and/or road dust outside house
7A				X	At approximately every 5 houses, take composite soil sample from play area or road dust
8	X				Looks for items to sample – spice, toys, metals, etc. Asks questions of home owner
9				X	Takes up to 3 dust samples
10		X	X		Enters house, surveys to find painted walls or furniture to test
11		X	X		0-3 XRF tests of walls or furniture for paint
12	X				Collects, spices, foods, toys, cosmetics, jewelry or metal objects for testing to a central location (usually kitchen table)
13				X	Helps collect items to sample, puts powder samples into small plastic bags for XRF testing
14		X	X		XRF testing of samples in correct mode
15				X	If high lead found in spice or food, bag and label sample
					– If low lead, return sample to homeowner and say it was OK
17	X	X	X	X	Assure all waste is collected, items put back
18	X	X	X	X	Home owner is thanked, teams leaves

Important Points:

- Assure proper labelling of all samples, recording of results and samples on forms
- Use gloves when taking any samples (not needed when using XRF)

It is also helpful to have a list of reference values on hand, to understand how XRF readings of items in the home compare to relevant standards. They can also be useful for answering questions from household members. These can be updated with any national regulations.

Lead Exposure Standards:

Residential Soil - 400 ppm
Paint -90 ppm or 1 mg/cm²
Spices - 5 ppm (USFDA)
Toys - 100 ppm (US CPSC)
Cosmetics - 10 ppm (USFDA)

Water - 10 ug/L
Floor dust - 10 ug/sq. ft.
Window sill dust - 100 ug/sq.ft.

Appendix F – Sample Collection Log

Coding	Sample Type	Description to include
D	Dust	- Location of sample (which room) - Area sampled (e.g. 10cm x 10cm)
W	Water	- Type of water source (e.g. tap in house, shared borewell, etc)
SL	Soil	- Location of sample (e.g. front yard, or play area)
SP	Spice	- Name of spice (e.g. turmeric) - Bought whole or ground? - Bought loose/in bulk or in a package? - Branded or no brand? - Location purchased (e.g. local market)
CS	Cosmetic/Religious powder	- Type of cosmetic/religious powder (e.g. kohl, surma, kumkum) - Location purchased
M	Traditional medicine	- Name of traditional remedy - What is it used to treat?
CE	Ceramics/pottery	- Type of item - Location purchased/manufactured
CW	Metal cookware	- Type of item - Location purchased/manufactured
Add others as needed		

Examples:

D-001-01 (first dust wipe sample from household 001), Description = Living room floor, 10cm x 10cm

D-001-02 (second dust wipe sample from household 001), Description = Bedroom windowsill, 5cm x 20cm

If the sample which is being collected has also been analyzed with the XRF (such as spices or soil samples), indicate the XRF reading number(s) in the Sample Collection Log. This allows us to compare the XRF results with the lab result for quality control.

If multiple pages of the Sample Collection Log are needed for the same household, fill in “Page X of X” to ensure that all data for that household are kept together

Appendix G – Detailed XRF Guidance

Correct operation of the XRF is critical for keeping investigators safe and for collecting accurate data.

All investigators operating the XRF should be familiar with the safety information presented in *Chapter 2: Using your analyzer* of [Niton XL3 Analyzer User's Guide](#).

XRF (X-ray fluorescence) is a non-destructive analytical technique used to determine the elemental composition of materials. XRF analyzers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source. Each of the elements present in a sample produces a set of characteristic fluorescent X-rays (“a fingerprint”) that is unique for that specific element. If you are interested in reading more about how the XRF works, read ThermoFisher’s [XRF Technology in the Field](#).

Health and Safety

Primary radiation is radiation that is produced by the analyzer and emitted out through the measurement window.

- **Always treat radiation with respect.**
- **Do not hold your analyzer near the measurement window during testing. Never point your analyzer at yourself or anyone else when the shutter is open**
- There should always be a sample in contact with the measurement window when the x-ray tube is on.
- The sample will absorb most of the primary-beam radiation unless it is smaller than the instrument's measurement window or of low density and/or thickness. Caution should be taken when analyzing samples that are small, thin, and/or low in density as they may allow much more of the primary beam to escape.

The primary beam is a directed beam out of the front of the analyzer that can have high dose rates. The secondary beam, or scattered beam, has much lower dose rates.

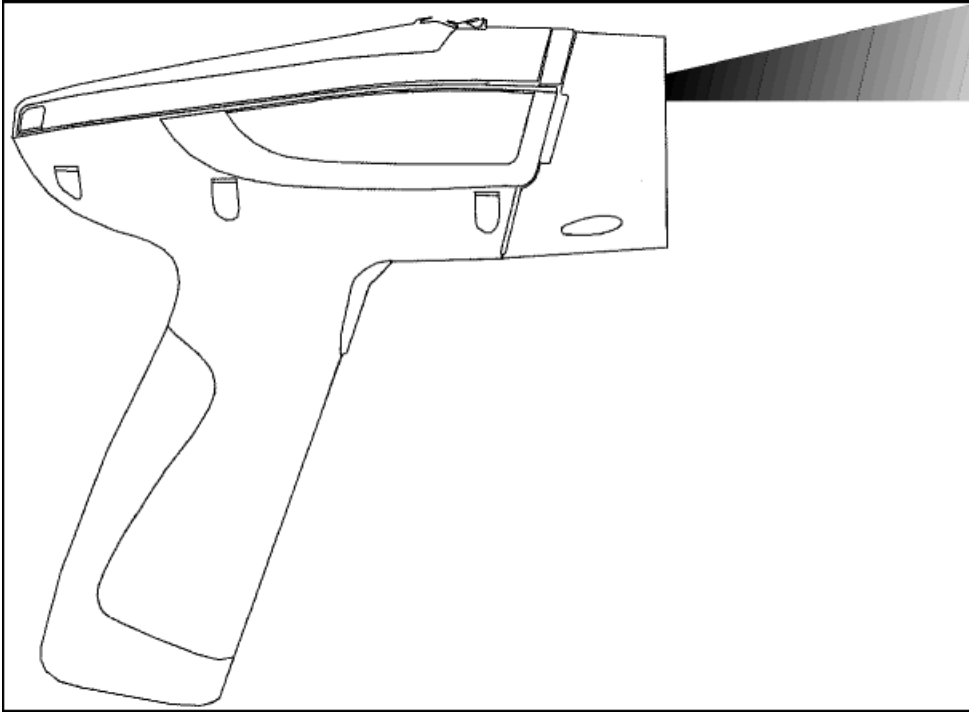


Figure 5. Primary beam

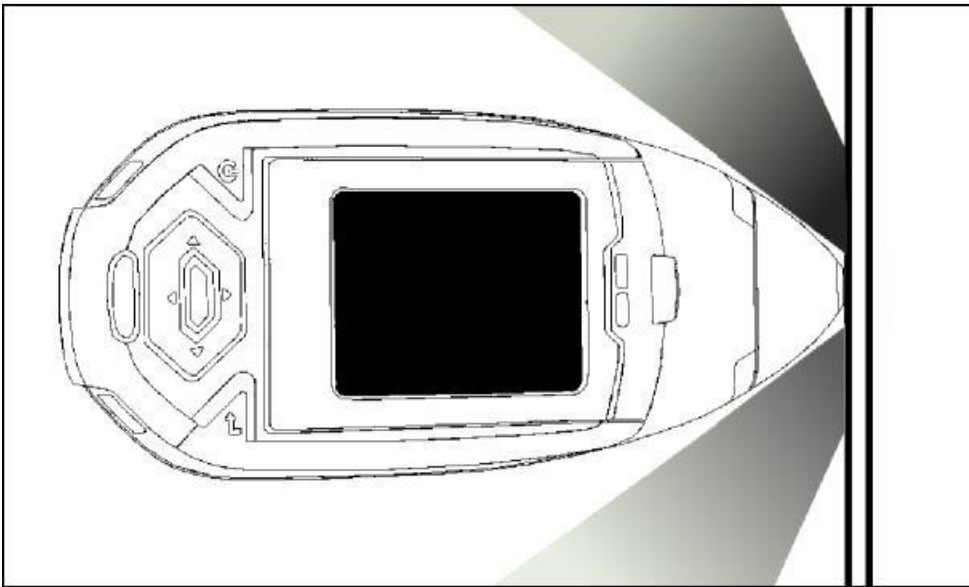


Figure 6. Secondary (scattered) beam

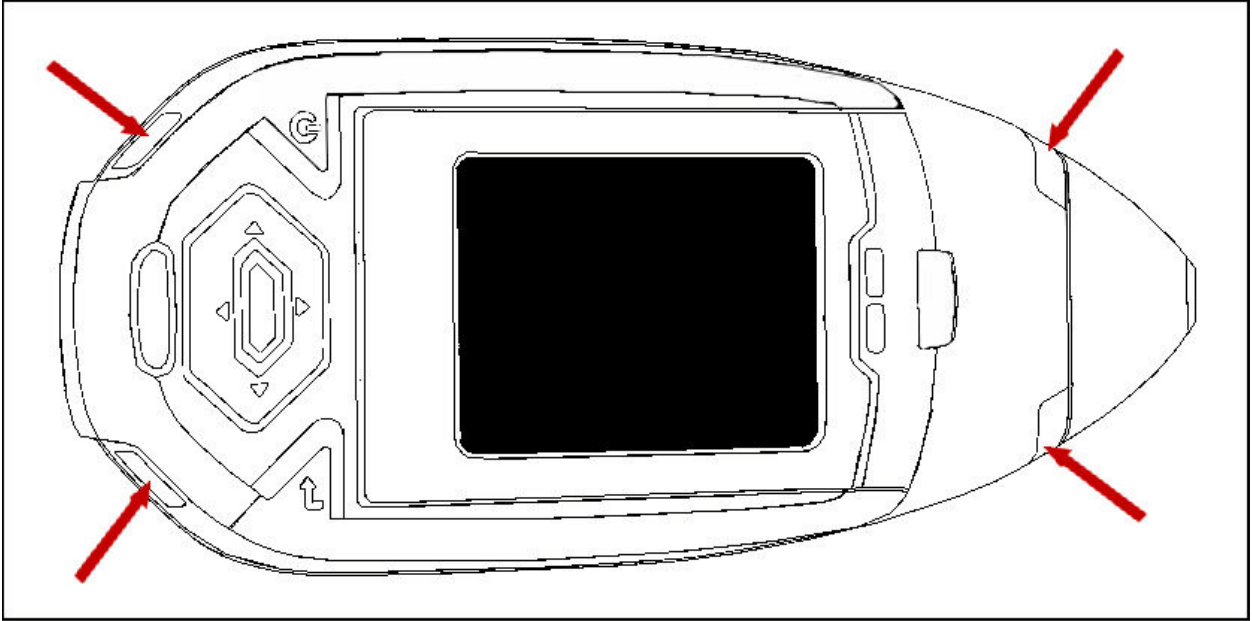


Figure 7. X-ray beam indicator lights

XRF Instrument Preparation

- Inspect the measurement window for damage (rips) or dirt/debris – circled in red below. Replace if needed (contact HQ).



- Each week, select the icon for “System Check”. This allows the instrument to run an internal check – no further interaction is required by the operator. If you receive a failure error, contact the study coordinator and/or team leader.
- At the beginning of the day or anytime the instrument has been off for 30 minutes, conduct a calibration verification. Select the appropriate standard for the sample type or matrix you will be analyzing.
- Record lead reading result for each calibration standard used.
 - If reading is outside of acceptable range, restart XRF and try again. If still outside range for one or more sample types, contact HQ prior to collecting additional measurements for that mode.
- The calibration verification should also be done at the end of the session.

Sample Preparation

Please see the body of the protocol for sample specific guidance for different materials.

- For loose items like powders, use thin plastic bags (thicker bags may reduce the XRF’s signal).
 - Collect “blank” measurement of empty bag to ensure lead is below detectable levels. Record this measurement.
- Mix the sample well to make it more uniform/homogeneous before analyzing.
- For loose items like powders, try to ensure the sample in the bag is ~1cm thick. Denser materials like metal may only need a few millimeters.
- For curved or irregularly shaped items, try to analyze the flattest surfaces.
- Retain all samples (properly labelled and secured) for possible additional screening or laboratory testing.

XRF Operation

- Samples should be placed on a hard surface, not held in your hand when analyzing.
- Take an XRF reading of the table or surface you will be using to analyze the samples to ensure it does not contain lead, as this could interfere with the readings. If lead is detected, find a new surface.
- Ensure XRF is in the appropriate mode for the sample type. We will primarily be using *Test All*.
- XRF readings should be about 30 seconds long.

Data Back-up

- At the end of each day when XRF readings are taken, download and retain raw data file as .csv or .xls.

- **NOTE:** Make sure that each XRF reading in the data file is well correlated to each sample reading through the XRF Reading Log; otherwise, the data file is not useful.
- In the file name, include the date that the samples were analyzed as DD-MM-YYYY.

Appendix H - XRF Reading Log

Short codes should be used to record the type of item being analyzed with the XRF, as well as the XRF mode being used. This list should be provided to team members to reference while in the field. Sample type codes can be added if needed or removed if they are not applicable in the local context. Similarly, the XRF modes can be changed to reflect the particular analyzer in use for the study.

Sample type coding:

SL	=	Soil
SP	=	Spice
PNT	=	Painted surface
T	=	Toy
CW	=	Metal cookware
CE	=	Ceramics/Pottery
CS	=	Cosmetic/Religious powder
J	=	Jewelry
M	=	Traditional medicine
CCL	=	Children Clothes (Folded)
ACL	=	Adult Clothes (Folded)
MA	=	Mattresses
O	=	Other (include description)

XRF mode coding:

SL	=	Soil
TA	=	Test All
PNT	=	Paint/Painted Products

Notes:

For any XRF readings taken outside of the home, such as soil readings surrounding the household or in play areas, record the location with a GPS coordinate. The first two digits of the GPS coordinate can be pre-filled, so that the study team is only responsible for recording the 6 trailing digits.

If multiple pages of the XRF Reading Log are needed for the same household, fill in "Page X of X" to ensure that all data for that household are kept together.

Appendix I - Questionnaire

Childhood Lead Exposure Risk Assessment Questionnaire

Possible responses should be adapted to local circumstances and norms. Add any additional products/routes of concern for the study population. Questions can be removed if the particular products are not commonly used.

If possible replicate metrics used in national studies such as Demographic and Health Surveys or UNICEF Multiple Indicator Cluster Surveys. This can facilitate comparisons or integration with larger datasets.

Date of interview: ___/___/___ Interviewer's name:.....

Consent obtained by parent or guardian?

Yes No - IF CONSENT NOT GRANTED, DO NOT START THIS INTERVIEW

Name of interviewee:

Relationship to children in the household:

- a. Parent (indicate mother or father)
- b. Child's guardian
- c. Add other options if applicable in your country, but note that this individual must be able to act as a legal representative of the child

Child (Name) _____ Birthdate _____ ID# _____

Mother _____

Father _____

Phone number _____

Location (city, village) _____

Street Address _____

GPS Coordinates: Lat: Long:

Family Demographic Information:

Home many adults are living in your household (include yourself)? ____

How many children AGE X TO X living in the household?

Education of the respondent:

- | | |
|---|--|
| <input type="checkbox"/> Illiterate | <input type="checkbox"/> Under Graduate |
| <input type="checkbox"/> Literate but no formal education | <input type="checkbox"/> Graduate/Post Graduate (General) |
| <input type="checkbox"/> School up to 5 years (Class1-5) | <input type="checkbox"/> Professional (Doctor, Engg, LLB, MBA) |
| <input type="checkbox"/> School up to 6-9 years (Class 6-9) | <input type="checkbox"/> Technical (Diploma/IT) |
| <input type="checkbox"/> SSC/HSC | <input type="checkbox"/> Other (Specify): _____ |

Occupation of respondent:

- | | |
|---|--|
| <input type="checkbox"/> Farmer | <input type="checkbox"/> Service-private |
| <input type="checkbox"/> Skills Worker | <input type="checkbox"/> Homemaker |
| <input type="checkbox"/> Daily Wage Labor | <input type="checkbox"/> Student |
| <input type="checkbox"/> Self-employed | <input type="checkbox"/> Unemployed |
| <input type="checkbox"/> Service-Government | <input type="checkbox"/> Other (Specify) : _____ |

Household Information:

Type of Home:

Adapt to local housing categories

- Hut Semi-Pucca Pucca Apartment Independent House

How many stories in building:

Which story is the selected household located in:

Number of rooms in the selected household:

Home ownership status:

- Owned Rented

Type of flooring (Please check one)

- | | |
|---|--|
| <input type="checkbox"/> Dirt floor | <input type="checkbox"/> Wood |
| <input type="checkbox"/> Concrete floor | <input type="checkbox"/> Other (Specify) : _____ |
| <input type="checkbox"/> Tile/Stone | |

What cleaning methods do you usually use for your floors? Check all that apply

- | | | |
|------------------------|------------------------------|-----------------------------|
| Vacuum | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Broom | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Wet mop | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Other (Specify): _____ | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

In the last 6 months, have you or anyone living in this household worked at a job:

-
- | | | | |
|--|------------------------------|-----------------------------|-------------------------------------|
| Removing paint (including sandblasting, scraping, sanding, or using a heat gun or torch) | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|--|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|---|------------------------------|-----------------------------|-------------------------------------|
| Remodeling, repairing or renovating houses or buildings | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|---|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|---|------------------------------|-----------------------------|-------------------------------------|
| Tearing down buildings or metal structures (demolition) | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|---|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|---------------------|------------------------------|-----------------------------|-------------------------------------|
| Doing plumbing work | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|---------------------|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|--|------------------------------|-----------------------------|-------------------------------------|
| Doing auto body work, repairing/rebuilding automobile engines or radiators | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|--|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|------------------------------------|------------------------------|-----------------------------|-------------------------------------|
| Melting metal for reuse (smelting) | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|------------------------------------|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|---|------------------------------|-----------------------------|-------------------------------------|
| Welding, burning, cutting or torch work | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|---|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|-------------------------------------|------------------------------|-----------------------------|-------------------------------------|
| Pouring molten metal (foundry work) | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|-------------------------------------|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|--|------------------------------|-----------------------------|-------------------------------------|
| Making paint or pigments (paint/pigment manufacturing) | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|--|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|------------------------------------|------------------------------|-----------------------------|-------------------------------------|
| Salvaging metal or scrapyards work | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|------------------------------------|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|---|------------------------------|-----------------------------|-------------------------------------|
| Splicing cable, soldering, electronics repair | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|---|------------------------------|-----------------------------|-------------------------------------|
-
- | | | | |
|-----------------------------|------------------------------|-----------------------------|-------------------------------------|
| Making or repairing jewelry | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
|-----------------------------|------------------------------|-----------------------------|-------------------------------------|

Working in a chemical plant Yes No Don't know

Working in a glass factory Yes No Don't know

Making pottery/ceramics Yes No Don't know

Working where batteries are manufactured, recycled, repaired or reconditioned Yes No Don't know

If yes to any activities above, please answer the following two questions.

How often do you or anyone in this household wear or bring their work clothes home?

- All of the time
- Some of the time
- None of the time

Do you usually wash or clean these work clothes here at home?

- All of the time
- Some of the time
- None of the time

In the last 6 months, have you or anyone living in this household done the following activities in the home:

Remodel, repair, or renovate this home Yes No Don't know

Remove paint or varnish from furniture at this home Yes No Don't know

Strip and/or paint bicycles, cars, or boats at this home Yes No Don't know

Solder pipes or metal at this home Yes No Don't know

Work on a car near this home Yes No Don't know

Solder electronic parts or jewelry at this home Yes No Don't know

Use artist paint for pictures or jewelry at this home Yes No Don't know

Apply glaze to pottery or ceramic objects at this home Yes No Don't know

Recycle or recondition batteries Yes No Don't know

Melt lead for fishing sinkers or bullets at this home Yes No Don't know

Do anything else at this home which might involve using lead Yes No Don't know
Please specify: _____

Do you have a battery back-up electrical power system/inverter in your house?

Yes No Don't know

From where do you get drinking water? Check all that apply. **Indicate primary source with an asterisk (*) if more than one source** selected.

- | | |
|--|--|
| <input type="checkbox"/> Tap | <input type="checkbox"/> Community well/borewell |
| <input type="checkbox"/> Stream | <input type="checkbox"/> Pond |
| <input type="checkbox"/> Household bore well | <input type="checkbox"/> Other: _____ |

Do you grow vegetables/fruit/grain/herbs for your own use?

Yes No Don't know

If yes, what vegetables/fruit/grain/herbs do you grow for your own use? (Check all that apply)

(INSERT common local produce/grains)

Which of the following cookware are used in your household?

Metal ware

- Clay pots
- Glass
- Other, please specify: _____
- Don't know

Which of the following food containers are used in your household?

- Ceramic dishes, bowls, pitchers
- Metal dishes, bowls, pitchers
- Glass
- Plastic
- Other, please specify: _____
- Don't know

Which of the following spices/herbs do you use in cooking at least once a week?

- Turmeric
- Chili powder
- Mixed spices/sambar masala/rasam masala
- Coriander powder
- Don't know

For each of the spices selected above, from where do you purchase your spices?

- Loose spices from the local shops
- Branded and packed spices available nationally
- Packed spices sold by the local brands
- Other, please specify: _____
- Don't know

Does anyone in the household smoke cigarettes?

- Yes No Don't know

Child's Health

Has the child selected to participate in the study been sick in the past 6 months?

Yes No Don't know

If yes, please identify the illness(es) for the participating child: *Interviewer Note: Record date as dd/mm/yyyy*

	Yes	No	Date of onset
Vomiting	<input type="checkbox"/>	<input type="checkbox"/>	
Abdominal pain (colicky)	<input type="checkbox"/>	<input type="checkbox"/>	
Fever	<input type="checkbox"/>	<input type="checkbox"/>	
Numbness	<input type="checkbox"/>	<input type="checkbox"/>	
Lethargy	<input type="checkbox"/>	<input type="checkbox"/>	
Hyperactivity	<input type="checkbox"/>	<input type="checkbox"/>	
Weakness	<input type="checkbox"/>	<input type="checkbox"/>	
Excessive crying	<input type="checkbox"/>	<input type="checkbox"/>	
Restlessness	<input type="checkbox"/>	<input type="checkbox"/>	
Balance problems or dizziness (ataxia)	<input type="checkbox"/>	<input type="checkbox"/>	
Headache	<input type="checkbox"/>	<input type="checkbox"/>	
Convulsion	<input type="checkbox"/>	<input type="checkbox"/>	

Does (child's name) experience any of the following behavioral or developmental problems?

	Yes	No	Year of onset
Aggression	<input type="checkbox"/>	<input type="checkbox"/>	
Hyperactivity	<input type="checkbox"/>	<input type="checkbox"/>	

Attention deficit	<input type="checkbox"/>	<input type="checkbox"/>	
School problems	<input type="checkbox"/>	<input type="checkbox"/>	
Learning disabilities	<input type="checkbox"/>	<input type="checkbox"/>	
Growth delays	<input type="checkbox"/>	<input type="checkbox"/>	
Speech or language delays	<input type="checkbox"/>	<input type="checkbox"/>	
Hearing loss	<input type="checkbox"/>	<input type="checkbox"/>	

Does (child's name) take breast milk? (Please check one)

- Yes, breast milk only, no other foods
- Yes, & other foods
- No breast milk at all

Where does (child's name) spend most of his/her day? Please select one.

- Inside the house
- Right outside the house/in the household yard
- At school. Please specify: _____
- Somewhere else in the village. Please specify: _____
- Outside the village. Please specify: _____
- Don't know

Is (child's name) currently taking any medicines prescribed by a medic, community health worker, doctor, or government institution?

- Yes
- No
- Don't know

If YES, what is the prescribed medicine and what condition is the medicine treating? _____

How often does (child's name) put her/his fingers in her/his mouth or bite her/his nails?

- Less than once a week or never
- Several times a week
- Several times a day or more
- Don't know

Does your child eat, put things in his/her mouth, or chew on things that aren't food? Examples include toys (metal, plastic, or painted wood), amulets/jewelry, paint chips, dirt/sand, chalk)

- Yes
- No
- Don't know

If YES, please explain (open ended) – what object, how often

How often does (child's name) wash his/her hands before eating?

- Never
- Rarely
- Sometimes
- Often
- Always
- Don't know

-----END-----

Appendix J - Optional Sample Collection

Depending on local regulations or norms for environmental assessment, you can consider additional data collection methodologies.

LeadCheck

LeadCheck is an inexpensive method for determining Lead without involvement of special laboratory equipment and specialists. The LeadCheck method is based on the reaction of lead with certain chemicals. When LeadCheck test swab reagents react with lead, they turn pink within 30 seconds. LeadCheck can be used for both direct testing (quickly determine the presence of lead in contact with the surface) and indirect testing (without direct contact of test surfaces with the reagent). LeadCheck is highly sensitive to even a small lead content, does not destroy or damage the tested surfaces, and allows you to test even small items for the presence of lead. It has an unlimited shelf life of unreacted chemicals. After activating the chemicals contained in each swab, the lead-reactive component is active for 90 seconds. An introductory video on working with LeadCheck is available on the manufacturer's official channel:



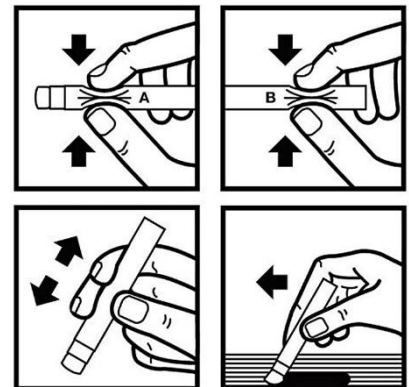
<https://www.youtube.com/watch?v=BWgxU9BSBng>

LeadChecks can be used for painted surfaces. Measurements based on the XRF may be influenced by the substrate underlying the paint, whereas LeadChecks are not. Spot tests can be done using the LeadCheck systems.

LeadChecks can also be used for glassware and ceramic cookware to indicate the presence of lead paint or glaze.

LeadCheck swab activation:

- Squeeze the swab to crush the front glass vial inside.
- Squeeze the swab to crush the rear glass vial inside.
- Shake the pencil to mix the reagents.
- Squeezing the swab, rub the surface to be tested for approximately 30 seconds. Within one minute, the swab will become stained if lead is present.



Direct Testing Procedure:

- 1) For cooking items, ask residents to show you the items they use. With their permission find and collect a few suitable objects for sampling: ceramic plates, glazed jugs, etc. If assessing painted walls, select
- 2) Put on gloves. Wipe the area to be tested with the activated brush tip of the LeadCheck® swab.

- 3) Activate the LeadCheck® swab as outlined above. Shake it lightly. Click on the tester swab to saturate the brush tip with reagent. Once LeadCheck® is activated, the reagent must be light brown. Otherwise, activate a new swab.
- 4) Rub the tip of the LeadCheck® swab brush onto the surface to be tested. If the surface contains lead, the tip of the swab brush will turn red.
- 5) Warning: The residue of the reagent may affect the performance of the tested component in the future. After testing, it must be cleaned of the reagent, or to avoid contact with the reagent, use an indirect testing method (below).



Indirect Testing Procedure:

The indirect testing method is used to test any areas, including those sensitive to chemical reaction. The advantage of the indirect testing method is the absence of direct contact with the reagent and the possibility of repeated use. Conducting indirect testing in the future does not affect the operation of the tested component.

- 1) Ask a parent or guardian to show children's toys and things that children often play with. With their permission, find and collect a few suitable items for testing: children's favorite toys, especially those covered with paint or plastic items made in China.
- 2) Wear gloves. Clean and degrease the surfaces to be tested.
- 3) Wipe the area to be tested with the cotton tip of one of the probes from LeadCheck® kit. The tip diameter is 0.3 mm. Use a new probe to test each new area.
- 4) Squeeze a drop of the reagent from the LeadCheck® swab into the cell on the test pad.
- 5) Dip the cotton tip of the probe that has been in contact with the surface to be tested into the reagent squeezed out of the swab into the cell of the test pad.
- 6) If the surface being tested contains lead, the cotton tip of the probe will turn pink or red when contacted with the reagent. If the surface being tested was lead-free, no change of color will



occur. The intensity of the staining of the LeadCheck tip varies depending on the concentration of lead in the sample (Figure 8).

- 7) With the indirect method, you may test several samples at once, taken from different surfaces. This saves time and reagent. Maximum efficiency of LeadCheck® Reagent is maintained for up to two minutes after mixing.



Figure 8. Variation in staining intensity of LeadCheck due to difference in the lead concentration.

Vacuum cleaner dust sampling procedure

Prepare the necessary equipment:

- a. gloves (use gloves when sampling)
 - b. sampling log/protocol and ID labels
 - c. bags or containers for samples
 - d. garbage bags
- 1) Wear gloves.
 - 2) Obtain consent to take house dust samples from a vacuum cleaner. Ask to open the vacuum cleaner and carefully collect a sample of dust (free of fibers and other waste) from the bottom of the dust bag. Scoop up the free-flowing dust fraction with a sampling spoon, or scoop with your hand. The sample volume is half a teaspoon (2.5 cm³, 5 g). Pour the sample into a plastic bag and close the bag tightly so that the dust does not spill out. If the bag of the vacuum cleaner does not allow you to scoop up the dust, pour the contents of the bag into a clean garbage bag, and scoop the sample from there. You can also prepare a surface, spread clean paper, oilcloth or a large clean bag on it, then pour the contents of the vacuum cleaner bag on top. Separate and discard various waste, fibers, everything that has nothing to do with dust. The dust remaining afterwards is collected, ensuring the capture of the entire thickness of the layer, and placed in a prepared sampling container or bag.

- 3) Samples can be analyzed in the same way as soil samples. There are three widely used analytical methods for dust analysis: XRF, flame Atomic absorption spectroscopy (AAS) and Inductively coupled plasma (ICP). All three methods have acceptable detection limits and sensitivities.

Sampling procedure of lead-based paints for testing in the laboratory

If there is a need to assess paint samples in the laboratory, guidance on paint sample collection is provided below.

Prepare the necessary equipment:

- a. knife, clerical knife, scalpel
 - b. sample bag or container
-
- 1) Wear gloves. Cut off the dry paint samples from the surface avoiding contamination. Remember that old dried paint is fragile.
 - 2) Clean the knife after each sample to prevent transfer of paint particles between the samples.
 - 3) Use AAS to test the samples in the laboratory.

Lead content in food

The assessment of dietary lead can constitute an entire study in itself. However, an investigation into certain contributors to dietary lead can be incorporated into the HBA. All analysis of food should be done in a laboratory as concentrations are likely to be lower than the level of detection of the XRF.

- Consider limiting the sampling to specific, commonly consumed staple that are eaten regularly and in large quantities.
- Consider asking the family (with compensation) to prepare a typical meal using their usual ingredients and cookware. This would provide information on potential exposure sources from foods, spices, and cookware.

Appendix K – Return Results Form Example

Signature sheet:

पटना लीड अध्ययन के परिणाम

Household ID 000

नमूना लेने की तिथि _____

मुझे _____ पर ये परिणाम मिले

माता - पिता के हस्ताक्षर

प्योर-अर्थ स्टाफ का हस्ताक्षर

Patna Lead Study Results

Household ID 000

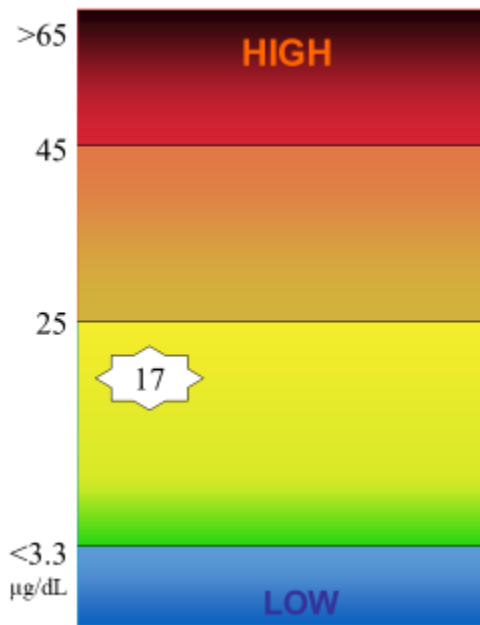
Taken on (add date samples collected)

I received these results on (date of visit)

Signature of Parent

Signature of Pure Earth Staff

Infographics:



रक्त लीड स्तर

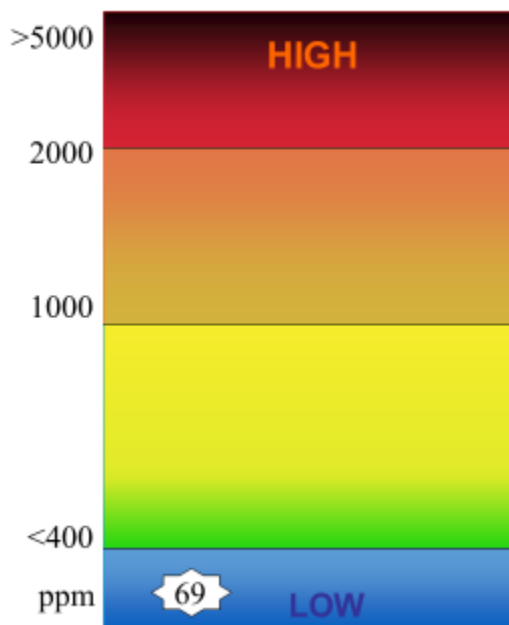
जब अध्ययन दल ने नमूने लिए मेरे बच्चे के रक्त के स्तर को दिखाता है।

एक तरह से मैं अपने बच्चे को स्वस्थ रख सकता हूँ, वह है हाथों और खिलौनों को बार-बार धोना।

Blood Lead Levels

The star shows my child's blood lead level when the study team took samples.

One way I can keep my child healthy is to wash hands and toys frequently.



मिट्टी के नमूने में लीड-स्तर

जब अध्ययन दल ने नमूने लिए, तो स्टार मेरे घर के आसपास की औसत मिट्टी के स्तर को दिखाता है।

एक तरह से मैं अपने बच्चे को स्वस्थ रख सकता हूँ, वह है प्रवेश द्वार पर पायदान बिछा क

Soil Lead Levels

The star shows the average soil lead level around my house when the study team took samples.

One way I can keep my child healthy is to put a floor mat at the entry door.