Module C.iv
Conducting environmental sampling

Content in this module was provided by the US Centers for Disease Control and Prevention
Outline

• Why include environmental lead sampling in lead prevalence studies?
• Examples of data that environmental lead sampling can provide
• How to do environmental lead sampling
Why do environmental sampling?

• Collection of air, water, soil and dust characterizes the sources of lead in the environment (e.g. paint may not be the only source)

• It can be a component of a lead exposure prevalence study

• It can allow comparison to local and international standards

  ▪ NB many of these standards (e.g. the US EPA action level for water of 15 ppb) are pragmatic, meaning they can be reached using good lead control techniques, rather than being health-based. A health-based standard would establish a ‘safe’ level of exposure and this has not been identified for lead.
Many sources of lead can contribute to blood lead levels

- Gasoline (no longer a major source in most countries)
- Battery recycling
- Consumer products
- Some traditional medicines
- Unregulated or cottage industries
- Electronic waste, child labor
- Localized sources such as mines/smelters
- Lead paint

(Reference 1)
What can environmental lead sampling tell you?

• Location of areas of lead contamination, enabling mapping of areas of high and low lead concentrations:
  ▪ Helps identify source(s) of exposure in population known to have high blood lead levels
  ▪ Identifies at-risk populations who should have blood lead levels checked
  ▪ Provides exposed populations with measures to reduce or stop exposure

• Data can be used to direct and evaluate remediation efforts.
Initial procedures: Outline

The next few slides describe the following issues:

• Important factors to consider
• Sampling form
• Labels
Important factors

• Talk to community members / heads of households to find out about likely areas of environmental contamination and of exposure – use this information to guide the sampling strategy.

• For a prevalence study there should be random selection of households / sampling sites
  ▪ Calculate the sample size needed and use a simple randomization strategy to select households / sites where environmental media will be collected
  ▪ See also Module C.iii
Important factors

• Be sure to take a global positioning system (GPS) reading at every participating household and wherever soil is sampled. Note the coordinates on the sampling form.
  • Provides data for mapping - helps to identify commonalities in geographic area of interest
• Ensure the person responsible for environmental sampling has the correct labels by household enrollment number and knows where to place labels and which sample collection containers to use.
Important factors

• Identify the areas to be sampled:
  ▪ painted surfaces e.g. walls, window frames
  ▪ dust wipe areas (near entrance to home, child’s play area, child’s sleeping area, window frames)
  ▪ water samples (water storage vessel, tap, well)
  ▪ soil sample (bare soil where child plays).

• Sample identification (ID No.) and any notes should be written on the sample collection form.
Sampling form – typical data fields

<table>
<thead>
<tr>
<th>Dust Samples</th>
<th>Water Sample</th>
<th>Soil Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor Near Front Door</td>
<td>Floor Where Child Plays</td>
<td>Bottle / Tap</td>
</tr>
<tr>
<td>Child’s Sleeping Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor Sample</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface (dirt, concrete, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor Sample Surface Area (cm²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Labels are essential

- Each data source has a corresponding label. It is very important to attach the appropriate label to the correct data source.

- A typical set of labels is as follows:
  - Consent-C
  - Child Questionnaire—CQ
  - Household Questionnaire—HQ
  - Dust Floor—DF-1 (Front Entrance)
  - Dust Floor—DF-1 (Child's Sleeping Area)
  - Dust Window—DW (Child’s Sleeping Area)
  - Blood Sample—B
  - Soil—SO
  - Water—W
  - Environmental Sampling Form—ES
  - Extra 1—X1
  - Extra 2—X2
Sample collection: Outline

The next few slides describe how to carry out the following procedures:

• Paint analysis
• Water sampling
• Dust wipe sampling
• Soil sampling
Paint analysis

• This can be done in-situ using portable x-ray fluorescence analyzer (XRF)

• Confirm XRF testing by sending duplicate samples (10-15% of total) to a laboratory with the necessary proficiencies

• Training in the use of XRF devices is essential

• For further details about paint analysis see Module C.ii
Water sampling: Supplies

- The following items are needed:
  - Gloves
  - Water ID label
  - 125 mL collection container
  - Environmental sampling form
Water sampling: Procedure

• If collecting multiple sample types collect the water sample first and use the same gloves for the dust and soil sampling
  ▪ levels of lead contamination in water are far lower than in dust/soil so cross-contamination is unlikely

• Take the sample from the source that the family is using for drinking/cooking

• Procedure:
  ▪ place label on sampling container
  ▪ put on gloves
  ▪ fill the sample container with water from source
  ▪ seal the container
Dust wipe sampling: Supplies

• The following items are needed:
  ▪ Gloves (use gloves from the water sampling effort)
  ▪ Dust ID labels
  ▪ Sampling wipes
  ▪ Ruler or template – can be reused for each sampling frame
  ▪ Sample container
  ▪ Baby wipe for dust sampling
  ▪ Rubbish bag
Dust wipe sampling: Getting started

• Keep gloves on from the water sampling effort
• Place ‘DUST’ label on sampling containers
• Identify floor location near the entrance and the floor area where the child plays. Identify window near to area where child sleeps
• Clear large debris from the sampling area before beginning the sampling, DO NOT clean the area prior to sampling
Dust wipe sampling: Floor wipe procedure

- If the entrance and play area locations are covered with fixed carpet/matting, choose an alternative area with a hard surface (e.g. wood floor, concrete, linoleum) and note location on the sampling form. If there is a door mat, remove the mat and sample under it.

- Measure 10 cm x 10 cm (100 cm²) space with ruler for each floor location.

- Remove wipe from packet and obtain the sample as indicated in ‘Wipe Schematic’ (see next slide) – use one wipe for the sample near the door and one wipe for the sample in the area where the child plays.

- Place each wipe into separate sample containers with separate labels.

- Fill in the sampling form.
Dust wipe sampling: Schematic

- The diagram below describes the procedure for taking a dust wipe sample. The procedure is the same regardless of the surface being sampled (floor, window etc.)

1. First Wipe
2. Second Wipe
3. Third Wipe

Whole pad

Half Pad

Quarter Pad

With each step, fold the exposed surface inward

4. Fold to put in bag/bottle

Bag or bottle
Label
Soil sampling: Supplies

• The following items are needed:
  ▪ Gloves
  ▪ Soil ID Label
  ▪ Sample scoop
  ▪ Large sealable bag e.g. 4 litres / 1 gallon
  ▪ Rubbish bag
Soil sampling: Getting started

• Identify the area outside where children play (ask the parent or guardian)

• Only sample from areas that are not covered by grass – the area should be bare soil

• Place soil sample label on sample bag

• Put on gloves (or keep on gloves from water and dust sampling)
Soil sampling: Procedure

• Take five discrete samples - take the sample from the top 1-1.5 cm (½ inch) of soil using the disposable scoop (see next slide for sampling schematic)

• Put all five samples in the sample bag, filling the bag by at least a third, and manipulate it to mix the samples

• Put the gloves in the rubbish bag

• Fill in the sample form, ensuring that the GPS location of the soil sample is noted
Soil sampling: Schematic

- Composite sampling example (taken in the middle of the play area; 2-3 metre distance between points):

Area where child plays:

✨ = sampling point
Air sample collection process

• General steps in collecting a particulate sample:
• Filter preparation – filter is equilibrated (conditioned) to a specified temperature and pressure and then weighed before being sent to the field for sampling (typically done by an environmental laboratory)
• Filter transported to site
• Filter placed in sampler inlet and sample is then run at specified date, time, and duration
• Filter is recovered from sampler, total flow of sample recorded from sampler, and sample is then transported to lab (or location to be weighed)
Air Sampling: Other issues to consider

- Filter preparation & laboratory liaison
- Impactor preparation
- Power outlets
- Ambient moisture
- Security of instrument
- Returning rented equipment
Final steps

• When completed, place all environmental samples together in one bag

• Remember to take and record GPS points at each home and each soil sampling location. Record these points on the sampling form

• Sample IDs and any notes should be recorded on the sampling form. Make sure to place a label on the sampling form as well

• Make sure all samples are appropriately labeled
Use of lead isotope ratios

- Four main isotopes of lead are 208, 206, 207, 204.
- Ratio of the isotopes varies by the source of the ore.
- Isotope ratio of soils represents mixing of lead from various ores used in gasoline, consumer products and smelting.
- If isotope ratio in a lead source and in blood can be characterized, then this can be useful ‘fingerprinting’ of environmental pollution.

(Reference 2)

Chart shows group of children exposed to the same source of lead and an individual exposed to a different source. (Reference 3)
Laboratory quality control considerations

• Important that analytical results are reliable

• Laboratory should have in place adequate quality assurance measures e.g.:
  ▪ standard operating procedures
  ▪ documented training and monitoring of staff performance
  ▪ use of certified reference standards
  ▪ internal quality control procedures – daily checks of analytical accuracy
  ▪ participation in external quality control programmes
Standard methods for sample analysis

• Water sample analysis

• Dust and soil sample analysis
Standard methods for sample analysis

• Air sample analysis
  - 40 CFR Appendix G to Part 50, Reference Method for the Determination of Lead in Total Suspended Particulate Matter (http://www.ecfr.gov/cgi-bin/text-idx?SID=e61b74afdf65ac8285dcb7c5fe874a06&mc=true&node=ap40.2.50_119.g&rgn=div9)
Conclusions

• Environmental investigation studies can:
  ▪ Complement blood lead prevalence studies
  ▪ Identify significant sources/new sources of lead in children’s environments
  ▪ Provide scientifically reliable estimates of environmental contamination (e.g. from lead paint) and blood lead levels
References


3. US Centers for Disease Control and Prevention, unpublished data
Additional sources


• National Environmental Methods Index [website] https://www.nemi.gov/home/
Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the US Centers for Disease Control and Prevention.
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