Webinar on Safe Water, Sanitation and Health for all during and post COVID-19

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Topic of Presentation: SaniPath exposure Assessment of Faecal Contamination in Urban Residential Environments
SaniPath Exposure Assessment of Faecal Contamination in Urban Residential Environments

CSE Webinar 7 July 2020: Safe Water, Sanitation, and Health for all during and post COVID-19

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Overview

1. Why are exposure assessments useful and what information can they tell us?
2. Overview of the SaniPath Tool objectives and methods
3. Key findings from Dhaka, Bangladesh
4. How can SaniPath results inform municipal and national policies and programming?
Sanitary Flows Analyses show that Fecal Sludge is NOT Contained – Many Reservoirs in Urban Environment

What are the public health risks from this fecal sludge in the environment?

What information does local government need in order to address this?

Inadequate sanitation leads to multiple fecal exposure pathways

Pathogen Source

- Human Excreta
- Animal Excreta

Environment

- Flies
- Soil
- Surface Water
- Ground Water

Vehicle

- Hands
- Food
- Drinking Water

Humans

Adapted from Pruss et al 2002.
Pathways of Exposure to Fecal Contamination

- Floodwater
- Public latrines
- Open drains
- Ocean Water
- Street Food
- Drinking water
- Bathing water
- Wastewater-irrigated produce
- Soil
- Surface Water
- Fomites

PC: Julia Rosenbaum
Urban environments have multiple exposure routes with different risks....

Which exposures pose the greatest risk?
Figure 1: Maximizing Public Health Impact by Targeting Sanitation Interventions toward Dominant Fecal Exposure Pathways

Four pathways of exposure to fecal contamination are shown below. The size of the arrows indicates the relative magnitude of population-level exposure to fecal contamination for the given pathway.

- Pathway A
- Pathway B
- Pathway C
- Pathway D

An intervention on Pathway A reduces cumulative exposure but not enough to result in a reduction in enteric disease (below).

An intervention on Pathway B sufficiently reduces cumulative exposure to result in a reduction in enteric disease (below).

Dominant Pathway(s)

By identifying the all fecal exposure pathways in a specific setting and measuring the magnitude of exposure, we can better understand which pathways are the most important or "dominant pathways.

The dominant pathway(s) is defined as the pathway(s) that make the greatest contribution(s) to the total fecal exposure.
Provide evidence for urban sanitation advocacy and investment decisions

- Identify and assess public health risks related to poor sanitation and FSM
- Raise awareness about these risks among stakeholders
- Help prioritize sanitation investments and policies based on the exposures that have the greatest public health impact.
How can we measure exposure to fecal contamination?

• Exposure = Environmental Contamination + Behavior
  • Where in the environment is there fecal contamination and what is the magnitude of contamination?
    • Collect environmental samples
    • Measuring pathogens in environmental samples is expensive and requires advanced lab capacity
    • Measuring fecal indicator bacteria (E. coli) is feasible by simple field methods
  • How do people come into contact with fecal contamination?
    • Who? Adults or children? Male or Female?
    • What type of behavior?
      • Deliberate ingestion of raw vegetables, street food, drinking water, soil
      • Accidental ingestion of surface water, bathing water, animal feces
      • Contact with drain water, flood water, soil, latrine surfaces
    • How often?
The Exposure Mindset – Opportunities for Action

- For disease to occur, there must first be exposure to the pathogen that causes infection and disease.
- Exposure is determined by the environment (presence of pathogens, contamination, etc.) and behaviour (actions that bring contact with the environment).
- To change disease outcomes you must change exposure by altering the environment or behaviour.

Slide courtesy of Dr. Rebecca Sindall, UKZN
Data Collection Methods

Primary Data Collection

• **Exposure Behavior**
  • Reported frequency of behavior of adults and children that may lead to exposure to fecal contamination
  • Household, School, and Community surveys

• **Fecal Contamination**
  • Collect environmental samples from relevant exposure pathways
  • Analyze for *E. coli* as an indicator of fecal contamination
Estimating Exposure to Fecal Contamination

Behavior Frequency

- Never: 47.2%
- 1-5 times: 13.4%
- 6-10 times: 6.5%
- 11-15 times: 6.5%
- 16 times: 1.1%
- >16 times: 1.1%
- can't know: 11.6%

Environmental Contamination

The mean dose and proportion of the population exposed are summarized from simulated distributions and displayed in risk profiles.

Tool uses Bayesian analysis to estimate the distribution of environmental contamination and frequency of exposure.

Results are presented in a normalized and comparable unit – Dose as MPN E. coli ingested per month.

Other parameters: intake volumes, duration of exposure, etc.
A Cloud-Based Platform To Do It All

Visit tool.sanipath.org to try out the tool!
Outputs of the Tool

**Pie Charts**

**Histograms**

**People Plots**

**Automated Report**

**Dhaka, Bangladesh**

**Exposure Assessment Report**

Patrick

30 July, 2018

**Executive Summary**

Sanitation quality and access to improved sanitation facilities play an important role in the health of a community. Those communities with inadequate sanitation systems and little to no access carry the greatest disease burden from poor sanitation. To better prioritize sanitation investments and guide intervention strategies to reduce the risk of enteric disease, it is important to assess the contribution that various environmental pathways have on exposure to fecal contamination.

To quantitatively evaluate fecal contamination exposure pathways in urban communities in Dhaka, Bangladesh, the SanPath Exposure Assessment Tool (Georgia University, Atlanta, USA) was deployed from 2017-04-08 to 2018-01-07. The exposure pathways of fecal contamination presented in this
The Tool can help identify trends... 

Municipal Drinking Water – 6 neighborhoods in Dhaka

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Percent Exposed = 79 %, Log10 Dose= 3.85</td>
<td>Percent Exposed = 84 %, Log10 Dose= 4.76</td>
<td>Percent Exposed = 28 %, Log10 Dose= 3.36</td>
<td>Percent Exposed = 96 %, Log10 Dose= 8.23</td>
<td>Percent Exposed = 82 %, Log10 Dose= 8.57</td>
<td>Percent Exposed = 82 %, Log10 Dose= 8.52</td>
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</table>

....across neighborhoods
....across pathways in a single neighborhood
...the contribution of specific pathways to total fecal exposure – 10 neighborhoods in Dhaka, Bangladesh
Pathogen Analyses in One Dhaka Study Neighborhood

*5 target pathogens (norovirus, *V. cholera*, *Shigellae*, *S. Typhi*, Giardia)
*3 types of samples (open drains, canals, flood water)
*High frequency of pathogen detection in almost all locations and sample types

UF= Ultrafiltration of large volume (20 L) samples
*Samples that are marked as UF were concentrated using an ultrafiltration methods. All others were 400 ml grab samples.*
Almost all sample types also had high pathogen concentrations

Log_{10} concentration per 100mL

Photo credit: Juliet Willetts
Comparison of Child Exposure Data from 10 Cities
## Strengths and Limitations

### Strengths
- Innovative quantitative analytical approach
- Considers multiple pathways
- Uses primary data
- Training materials freely available online
- Customizable and open source
- Web-based tools for management and analysis of results
- Simple graphics make results easy to interpret and communicate to decision makers
- Relatively rapid process with real-time results and reporting

### Limitations/Challenges
- Does not account for changes over time
- Relies on self-reported behavior
- Hygiene, food preparation, and risk mitigating behaviors are not considered in model
- Current model is for urban environment, but ongoing adaptation for rural contexts
- Requires basic laboratory and survey capacity
- Requires community cooperation
SaniPath Value: From Evidence to Action

SaniPath approach for assessing exposure to fecal contamination in the environment provides valuable evidence:
* for advocacy
* to guide intervention investments, and
* to highlight information gaps

Risk profiles show how exposure to fecal contamination varies across pathways in a single neighborhood, varies across neighborhoods in a single city and across pathways for different cities.

Public Health programs can use information on geographic differences and pathway differences to target intervention and investments to areas/pathways of greatest risk.
Ghana: How are we moving from Evidence to Action?

• Creating Demand and Awareness
  • Media and Institutional engagement

• Generating Evidence in collaboration with Local Authorities for Ownership of Results
  • Involve environmental health officers and local utilities in data collection

• Using Evidence Generated to Inform Decision Making and Action

• Planning Sanitation Investments using Evidence from SaniPath Results

Photo credit: Habib Yakubu
Influencing Policy in Ghana

- The SaniPath Tool is now recommended as a public health risk tool in the urban sanitation strategy
- National steering committee formed to encourage the use of the Tool for urban sanitation planning
- New Ministry of Sanitation and Water committed to using evidence to improve urban sanitation
- President dedicated to making change. Declared that he wants Accra to be the cleanest city in Africa.

Photo credits: Habib Yakubu
Influencing Policy in Ghana: Food Safety

- Results from the SaniPath deployments in Accra, Ghana are being used to influence policy change.
- The national urban sanitation strategy being developed will now address the risks associated with wastewater-irrigated produce.
- The Kumasi Metropolitan Authority Sanitation Plan for 2020 includes guidance for vendors, public education campaigns, and inspections to promote safety of street food.

- Influencing sanitation policy and investments takes years!
Using SaniPath Evidence to Guide Public Health Response to COVID-19 in Ghana

About 40% of households in Accra (pop. 2.47 million) rely on public toilet facilities.

National and municipal authorities developed 4 key messages to help keep these facilities clean and safe during the COVID-19 pandemic.
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Makerere School of Public Health
Kampala Capital City Authority
Kumasi Metropolitan Authority
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For more information visit SaniPath.org

Thank You

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View Tool tutorials on YouTube!

Connect with us on Twitter!

@SaniPath
Supplemental Slides
## Types of Data Collected

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Sample Type</th>
<th>We ask target population about:</th>
</tr>
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| Ingestion of drinking water    | Municipal Drinking Water | How frequently do they drink municipal water (# days per week)?  
                               |                      | Any household treatment?                                                                       |
| Ingestion of produce           | Produce rinse        | Is produce irrigated with wastewater?  
                               |                      | What types of produce are eaten raw?  
                               |                      | How frequently is raw produce eaten (# days per week)?                                         |
| Ingestion of bathing water     | Water used for bathing | Assume bathing happens daily                                                                 |
| Contact with public latrines   | Swab of latrine surfaces | Use of public latrines?  
                               |                      | How frequently (# times per month)?                                                           |
| Contact with drainage system   | Drain water          | Any contact with open drains?  
                               |                      | How frequently (# times per month)?                                                          |
| Contact with surface waters    | Surface Water        | Any contact with surface waters?  
                               |                      | How frequently (# times per month)?                                                          |
| Contact with flood waters      | Flood Water          | Any contact with flood water?  
                               |                      | How frequently (# times per month)?                                                          |
People plots show the percent of a population that is exposed to fecal contamination, as measured by *E. coli*, and the dose of exposure per month.

- The grey people represent the population that have no exposure to fecal contamination via a specific pathway in a given month.
- The red people represent the population that does have exposure to fecal contamination via a pathway - whether it be 1 time or 10 times.
- The intensity of the red represents the dose on a log scale, the average fecal contamination ingested per month.

Higher percent exposed indicated by more red people

Higher dose indicated by higher intensity red color
Multi-City Comparisons: Municipal Drinking Water
Using SaniPath Evidence to Inform Decision Making and Action

• Immediate Actions Taken
  • Water Utility was engaged to understand water quality concerns
  • Hygiene behavior change education at local schools
  • Public toilet shut down due to illegal direct desludging connection to local river

• Long Term Action-Planning and Policy Interventions
  • Developed proposals for intervention and investment based on SaniPath Findings
  • KMA won a £400,000 UK Grant from DFID Sanitation Challenge grant based on SaniPath activities and other sanitation-related efforts
  • SaniPath local partner (TREND) won $10,000 “Innovation Prize for Capacity Building Initiative”
  • Using prize money to fund action plans from SaniPath results – Food Safety and Quality Compliance
  • SaniPath recommended as a sanitation planning tool by Ministry of Sanitation and Water Resources