Water, Sanitation, and Hygiene in Outbreak Response

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We seek to reduce the burden of infectious diseases by investigating and evaluating the effectiveness of water and sanitation interventions in low-income and emergency contexts.
Evidence Synthesis

- Systematic Review
  - Many previous
    - Focused on impacts
    - Strict inclusion criteria
  - 15,000 documents
    - ½ peer-reviewed
    - ½ grey
  - Included outcomes, impacts, and qualitative

Slide credit: Travis Yates
WASH Evidence in Outbreaks

- Evidence base is thin
  - High in water treatment
  - Low in hygiene/sanitation
  - Low in emergency only interventions

Credit: Travis Yates
VBNC cells were detected after disinfection. Spraying appears more variable, less efficacious than pouring chlorine. The highest efficacy was achieved by pouring 2.0% chlorine for 1-10 minutes.
### Detection of culturable *V. cholerae* on surfaces

<table>
<thead>
<tr>
<th>Before</th>
<th>Surface</th>
<th>After: 30 Minutes</th>
<th>After: 24 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH01</td>
<td>HH02</td>
<td>HH03</td>
<td>HH04</td>
</tr>
<tr>
<td>HH05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kitchen/inside floor</td>
<td>Latrine floor</td>
<td>Patient's bed</td>
<td>Jerrycan</td>
</tr>
<tr>
<td>Wall</td>
<td>Furniture (table)</td>
<td>Curtains</td>
<td>Door</td>
</tr>
<tr>
<td>HH01</td>
<td>HH02</td>
<td>HH03</td>
<td>HH04</td>
</tr>
<tr>
<td>HH05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Below Table:

<table>
<thead>
<tr>
<th>Before</th>
<th>Surface</th>
<th>After: 30 Min</th>
<th>After: 24 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH06</td>
<td>HH07</td>
<td>HH08</td>
<td>HH09</td>
</tr>
<tr>
<td>HH10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient's bed</td>
<td>Kitchen floor</td>
<td>Latrine floor</td>
<td>Floor close to bed</td>
</tr>
<tr>
<td>Wall</td>
<td>Curtain</td>
<td>Jerrycan, container</td>
<td>Latrine door / wall</td>
</tr>
<tr>
<td>Entrance door</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- **Red** (>5000 CFU/100 cm²)
- **Orange** (200-5000 CFU/100 cm²)
- **Yellow** (<200 UCF/100 cm²)
- **Blue** (Not detected)
Results suggest that household spraying can be effective (Program #1). It is recommended sprayers follow a systematic protocol and spray surfaces until wet. Cases that do not reach care structures and asymptomatic cases are not covered. Chlorine dosage can be problematic and should be adjusted regularly.
Bucket Chlorination

Methods

- Program Staff
  - Key informant interview
  - Review records

- Chlorination Agents
  - Key informant interview
  - Observation & Review records
  - Sample chlorine solution (chlorine conc, pH)

- Beneficiaries
  - Initial household survey & water sampling
  - Follow-up household survey & water sampling
  - Focus groups

Local ethics approvals are secured in each context prior to commencing an evaluation.

Slide credit: Gabrielle String
Observations of Chlorination Points

- Two programs did not distribute umbrellas (or equivalent to shade agents and chlorine)
- PPE (gloves, mask, goggles) was frequently shared between agents resulting in missing pieces
- Only one program expected agents to test their own free chlorine residual (FCR)
### Bucket Chlorination - Solutions

<table>
<thead>
<tr>
<th>Program</th>
<th>Average Concentration [%]</th>
<th>Min. [%]</th>
<th>Max. [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program 1</td>
<td>3</td>
<td>1.3</td>
<td>7.2</td>
</tr>
<tr>
<td>Program 2</td>
<td>0.78</td>
<td>0.13</td>
<td>1.19</td>
</tr>
<tr>
<td>Program 3</td>
<td>0.18</td>
<td>0.07</td>
<td>0.34</td>
</tr>
<tr>
<td>Program 4</td>
<td>0.51</td>
<td>0.28</td>
<td>0.78</td>
</tr>
</tbody>
</table>

Examples of chlorine stock solution preparation, storage, and dosing.

Slide credit: Gabrielle String
Bucket Chlorination - Microbiological

Microbiological results 30 minutes after treatment

E. coli

Total Coliforms

% Household Samples

<1 1-10 10-100 100-1000 >1000

<1 1-10 10-100 100-1000 >1000

Program 1 Program 2 Program 3 Program 4

Tufts University School of Engineering

Slide credit: Gabrielle String
Next Steps

• Data collection, analysis and writing
• Recommendations

• Role of WASH
  – For prevention
  – In IPC in HCF
  – Who responsible?
Acknowledgements

- Travis Yates  
  - Systematic Review
- Karin Gallandat  
  - Household Spraying
- Gabrielle String  
  - Bucket Chlorination

r2hc  
Research for health in humanitarian crises  
elrha

USAID

Action Research on Common Under Researched WASH Interventions
Tufts University, in collaboration with response organizations

School of Engineering