Water, Sanitation, and Hygiene in Cholera Response

Daniele Lantagne, Ph.D., P.E.
Associate Professor, Tufts University
WASH Evidence in Outbreaks (Cholera)

- Systematic Review
  - 15,000 documents
  - Outcomes, impacts

- Evidence base is thin
  - High in water treatment
  - Low in hygiene/sanitation
  - Low in emergency only interventions
  - “CISUR”
Recent Research – Filling in Gaps

LAB
• Efficacy of bucket chlorination (R2HC)
• Efficacy of households spraying/wiping and household disinfection kits (R2HC)
• Cleaning jerricans cans and taps / biofilm (OFDA, Kohler)
• Fouling in membrane filters (Tufts)

FIELD
• Effectiveness of
  – Water trucking (OFDA)
  – Bucket chlorination (OFDA, R2HC)
  – Household spraying and household disinfection kits (R2HC)
  – Hygiene kits, cash transfers, shared latrines (UNICEF/Myanmar)

POLICY
• Chlorine tablet selection and alignment (OFDA)
• Impacts of coordination, quality in response (Cluster, Oxfam/SI)
## Spraying/Wiping – Lab Efficacy Study Design

<table>
<thead>
<tr>
<th>Surfaces</th>
<th>Chlorine Concentration</th>
<th>Chlorine Type</th>
<th>Exposure Time</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>0.2 %</td>
<td>Sodium hypochlorite (NaOCl)</td>
<td>1 min</td>
<td>Spray</td>
</tr>
<tr>
<td>HDPE Plastic</td>
<td>2.0 %</td>
<td>High-test hypochlorite (HTH)</td>
<td>10 min</td>
<td>Wipe</td>
</tr>
<tr>
<td>Ceramic</td>
<td></td>
<td>Sodium dichloroisocyanurate (NaDCC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrile</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarp</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terracotta</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Matrix sampled in duplicate with + / - controls
- Surfaces inoculated with 2 mL of *V. cholerae* culture.
- Chlorine concentration confirmed within +/- 10%
- Surface carriers neutralized in sodium thiosulfate.
Preliminary takeaway: Spraying until a surface is wet with 0.2% or 2.0% chlorine is efficacious to reduce *V. cholerae* as is wiping with 2% chlorine on most surfaces (notably not on dirt).
Field - Household Spraying - Protocol

Field program coordinator

Key informant interview

Field program staff / sprayers

Key informant interview

Observation (HDK training / spraying)

Test spraying solution (chlorine conc., pH)*

Beneficiaries

Household survey

Surfaces, drinking water, and hands sampling

*For household spraying only.

Slide credit: Karin Gallandat
## 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>Kitchen / inside floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH02</td>
<td>Latrine floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH03</td>
<td>Patient's bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH04</td>
<td>Jerrycan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH05</td>
<td>Wall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH06</td>
<td>Furniture (table)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH07</td>
<td>Curtains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH08</td>
<td>Door</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Legend
- **High** (>5000 CFU/100 cm²)
- **Intermediate** (200-5000 CFU/100 cm²)
- **Low** (<200 CFU/100 cm²)
- **Not detected**
### Conclusions

#### Key results

- Spraying can reduce contamination on HH surfaces if implemented properly
- Intervention coverage is limited (asymptomatic & community cases)
- Challenge: identification of HH
- VBNC *V. cholerae* not detected in this work; their relevance remains unclear

#### Recommendations (if HH spraying is implemented)

- Systematic procedure to ensure complete coverage
  - Spray until surface is wet
  - Kitchen area is critical (2.0%)
- Prioritize approaches that increase community coverage
- Use HH spraying opportunities for hygiene promotion
- Travel w/ patient’s relative and give sprayers phones/radio
Acknowledgements

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