Preventing Waterborne Disease

Professor Kristen Jellison
BioS 10
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Waterborne Disease – Global Statistics

- **748 million people** lack access to improved water supply
- **2.6 billion people** lack access to improved sanitation
- Between **1.085 to 2.187 million deaths** each year due to diarrheal diseases can be attributed to the ‘water, sanitation, and hygiene’ risk factor
  - 90% of these deaths are among children under age 5
Burden of Waterborne Disease

- Water-related disease is the 2\textsuperscript{nd} biggest killer of children worldwide (1\textsuperscript{st} = acute respiratory infections)

- At any one time:
  - half of the world’s hospital beds are occupied by patients suffering from water-related diseases (WaterAid, 2008)
  - half of the population of the developing world is suffering from one or more diseases associated with inadequate water and sanitation (WaterAid, 2008)
Burden of Waterborne Disease

- 443 million school days lost annually to water-related diseases

  - to reduce by half the proportion of people without access to safe water and sanitation by 2015
  - Drinking water target met in 2010 (although unequal progress among marginalized and vulnerable groups)
  - Sanitation goal unlikely to be met by 2015
The lowest levels of drinking water coverage are in sub-Saharan Africa

Fig. 3. Proportion of the population using improved drinking water sources in 2012
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**Ultimate goal:** Prevention of waterborne disease

- Water treatment technologies (emphasis on developing countries)
  - Biosand filtration
- Watershed management
  - Parasite fate and transport
Biosand Filtration

- Dimensions: 0.3m x 0.3m x 0.9m
- Weight: 170 lbs.
- Costs: $10-45 USD
Biosand Filtration

From spiked water tank

- 2 concrete BSFs
- 2 concrete BSFs modified with rusty nails
- 2 bucket (5-gal) BSFs
- 2 bucket (5-gal) BSFs modified with rusty nails
- 2 bucket (2-gal) BSFs
- 2 bucket (2-gal) BSFs modified with rusty nails
Biosand Filtration
Biosand Filtration

![Image showing biosand filtration setup with water samples in beakers]

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
<th>Avg</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent</td>
<td>4.82</td>
<td>61.37</td>
<td>30.17</td>
<td>18.40</td>
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<tr>
<td>Concrete</td>
<td>0.15</td>
<td>1.61</td>
<td>0.43</td>
<td>0.29</td>
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<tr>
<td>5gal buckets</td>
<td>0.15</td>
<td>1.60</td>
<td>0.46</td>
<td>0.31</td>
</tr>
<tr>
<td>2gal buckets</td>
<td>0.23</td>
<td>1.41</td>
<td>0.53</td>
<td>0.28</td>
</tr>
</tbody>
</table>
Biosand Filtration

**Total Coliforms Removal**

**E. coli Removal**

Log$_{10}$ Removal

- Concrete
- Concrete - Nails
- 5-gal bucket
- 5-gal bucket - Nails
- 2-gal bucket
- 2-gal bucket - Nails

- 1-hr
- 3-hr
- 6-hr
- 12-hr
- 24-hr
- 72-hr
Biosand Filtration

**Cryptosporidium Removal**

- Log_10 Removal
- Concrete, Concrete - Nails, 5-gal bucket, 5-gal bucket - Nails, 2-gal bucket, 2-gal bucket - Nails

**MS2 Virus Removal**

- Log_10 Removal
- Concrete, Concrete - Nails, 5-gal bucket, 5-gal bucket - Nails, 2-gal bucket, 2-gal bucket - Nails
Biosand Filtration

Conclusions:

- Biosand filtration can be effective with smaller units
  - The addition of nails to the diffuser basin enhanced virus removal
  - No appreciable correlation between bacterial and C. parvum removal and pause period was identified
  - Increasing the pause period increased virus removal for all filter sizes (this relationship was stronger for filters without nails)
Biosand Filtration

How does moving the filter impact performance?
Biosand Filtration

- How does moving the filter impact performance?
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Questions?
Contact Information

Prof. Kristen Jellison
Office: STEPS Room 344
Phone: x8-3555
Email: krj3@lehigh.edu