Serological Monitoring of Pathogen Occurrence

Floyd Frost
Gunther Craun
Twila Kunde
Pathogen Detection in Drinking Water

• Detection of a pathogen in water (e.g. Cryptosporidium or Giardia) is commonly used by water utilities to monitor source and treated water quality.

• This was the purpose of the Information Collection Rule (ICR).
The ICR – successes and failures

• The ICR documented widespread occurrence of *Giardia* cysts and *Cryptosporidium* oocysts in raw and treated drinking water.

• The problem is ‘So what?’ How has this expensive set of data been used to improve water treatment, water quality or public health?
What went wrong?

• Pathogen detection is unreliable – even in a laboratory setting.

• Detection of something that looks like a pathogen does not mean that people are at risk of infection or disease from ingesting that organism.

• Pathogen detection is expensive
What is the alternative?

• The immune system constantly monitors even minor infections by organisms.
• An immune response will occur even when there is no illness.
• Pathogens in the body will come and go but an immune response is detectable after the infection has been cleared.
Limitations

- An assay is needed that can detect immune responses to the pathogen of interest and not general responses to large classes of organisms.
- For some viruses, general assays may be useful because there are few antigens and less of a chance of misclassification.
Limitations

• For parasites, the organism has a large number of potential antigens.
• Many of these antigens are shared with other organisms.
• Unless one selects antigens that are specific for that pathogen, misclassification can be a major problem.
Detectable NHANES Responses

- Site (n) +17-kDa +27-kDa
- SW1 (107) 50.5% 49.5%
- SW2 (502) 45.2% 47.6%
- SW3 (186) 72.6% 81.2%
- GW1 (51) 47.1% 58.8%
- GW2 (503) 26.0% 35.6%
- GW3 (120) 39.2% 65.8%
# Paired City Studies

<table>
<thead>
<tr>
<th>Site</th>
<th>15/17-</th>
<th>27-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuquerque (GW)</td>
<td>36.3%</td>
<td>50.8%</td>
</tr>
<tr>
<td>Las Vegas (SW)</td>
<td>49.8%</td>
<td>55.2%</td>
</tr>
<tr>
<td>MW 1 (GW)</td>
<td>25.6%</td>
<td>36.0%</td>
</tr>
<tr>
<td>MW 2 (SW)</td>
<td>53.9%</td>
<td>38.8%</td>
</tr>
<tr>
<td>MW 3 (GW)</td>
<td>52.4%</td>
<td>72.5%</td>
</tr>
<tr>
<td>MW 4 (SW)</td>
<td>72.3%</td>
<td>82.6%</td>
</tr>
</tbody>
</table>
International Studies

- Site 15/17- 27-kDa
- Russia (sw) 67.6% 88.9%
- Italy (sw) 84.0% 69.3%
- Sydney (sw-AU) 56.7% 60.6%
- Melbourne (sw-AU) 61.5% 65.4%
- Payment (sw-CA) 81.8% 83.1%
- BC (sw-CA) 30.4% 35.6%
Riverbank Filtration

Compared to well water users, users of riverbank filtered water in Hungary more frequently had responses to *Cryptosporidium* antigens.

• But they less frequently had responses than users of surface water that was conventionally filtered.
Serological Response ≥30% of Positive Control – 15/17-kDa

- Water source  pos/N  p=
- Riverbank     16/50  0.02
- Surface filtered  25/54  --
- Deep wells     10/49  0.006
Serological Response ≥30% of Positive Control – 15/17-kDa

<table>
<thead>
<tr>
<th>Source</th>
<th>Pos/N</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverbank</td>
<td>9/50</td>
<td>0.02</td>
</tr>
<tr>
<td>Surface filtered</td>
<td>20/54</td>
<td>--</td>
</tr>
<tr>
<td>Deep wells</td>
<td>6/49</td>
<td>0.006</td>
</tr>
</tbody>
</table>
So what is next?

• We are conducting one riverbank filtration study in Nebraska under the STAR grant
• We need to replicate the riverbank filtration studies in North America
• We would like to do more international studies – e.g. Europe