Health Risks of Recreation on the Chicago Area Waterways System: Results of CHEERS

MWRDGC Research Seminar
October 29, 2010
Samuel Dorevitch, MD, MPH
Overview

- Why the study was done
- How the study was done
- Findings: Water quality
- Findings: Health risks of CAWS recreation
- Findings: Clinical microbiology
- Next steps
Overall purpose of the study

To characterize, under current conditions, the health risks of CAWS limited contact recreation
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Canoeing, fishing, kayaking, Motor boating, rowing
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- GI, respiratory, eye, ear, skin
- Canoeing, fishing, kayaking, Motor boating, rowing
Overall purpose of the study

To characterize, under current conditions, the health risks of CAWS limited contact recreation.

Secondary treatment, no disinfection; storm water, CSOs

GI, respiratory, eye, ear, skin

Canoeing, fishing, kayaking, motor boating, rowing
Overall purpose of the study

Through direct observation

Secondary treatment, no disinfection; storm water, CSOs

To characterize, under current conditions, the health risks of CAWS limited contact recreation

GI, respiratory, eye, ear, skin

Canoeing, fishing, kayaking, Motor boating, rowing
Why characterize the health risks?

- Clean Water Act goal: Recreation in and on the water ("swimmable and fishable" where attainable)
- Use Attainability Analysis
- Proposed effluent standards
Is an epidemiologic study the only approach?

• Existing literature focuses on studies of swimming at beaches
• Microbial risk assessment has been done
• US EPA has established ambient water quality criteria using epidemiologic data
Specific study objectives

1. To estimate health risks attributable to CAWS recreation
2. To evaluate the relationship between microbial measures of water quality and health risk
3. To identify pathogens responsible for illness
Study design

• “Prospective cohort”
  – Enroll people free of disease
  – People have varying exposure
  – Evaluate development of disease in relation to exposure
What is CHEERS?

Chicago Health, Environmental Exposure, and Recreation Study
Enroll groups with and without the factor of interest, in this case, exposure to CAWS water.

- Unexposed recreators
- General use recreators
- CAWS recreators
Sources of risk, by group

Unexposed  General Use  CAWS
Data collection
Water sampling

• Indicators by culture (q 2 hours)
  – E. coli
  – Enterococci
  – Somatic coliphages
  – F+ coliphages

• Pathogens (q 6 hrs)
  – Giardia
  – Cryptosporidium
Evaluate by phone on days 2, 5 and 21

- Acute GI illness
- Acute respiratory illness
- Dermatitis

- Eye infection
- Ear infection
- Culture of clinical specimens
Data analysis

• Multivariate logistic regression: odds of illness occurring
• Takes into account potentially important differences between groups
• Calculation of attributable risk differences
Data analysis approach:
For each health endpoint...

1. Develop conceptual model
2. Define time windows of interest
3. Bivariate analysis
4. Multivariate logistic regression
5. Attributable risk calculation
6. Evaluate model assumptions and alternative approaches
Peer Review

- Water Environment Research Foundation (WERF)
- National and international authorities
- EPA, CDC, utility, academia, consulting
- Protocol review
- Data quality review
- Data analysis methods
- Report
Results: Microbes

Graph showing Enterococci concentration by location group.
## Study participants

<table>
<thead>
<tr>
<th>Year</th>
<th>CAWS</th>
<th>(%)</th>
<th>GUW</th>
<th>(%)</th>
<th>UNX</th>
<th>(%)</th>
<th>Total</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>342</td>
<td>8.6</td>
<td>127</td>
<td>3.4</td>
<td>323</td>
<td>9.0</td>
<td></td>
<td>792</td>
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<tr>
<td>2008</td>
<td>2,426</td>
<td>61.2</td>
<td>2,110</td>
<td>56.4</td>
<td>2,080</td>
<td>58.0</td>
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<td>6,616</td>
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<td>2009</td>
<td>1,198</td>
<td>30.2</td>
<td>1,507</td>
<td>40.2</td>
<td>1,184</td>
<td>33.0</td>
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<td>3,889</td>
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<tr>
<td>Total</td>
<td>3,966</td>
<td>100.0</td>
<td>3,744</td>
<td>100.0</td>
<td>3,587</td>
<td>100.0</td>
<td></td>
<td>11,297</td>
</tr>
</tbody>
</table>
### Water recreation activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>CAWS</th>
<th>GUW</th>
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</thead>
<tbody>
<tr>
<td>Motor boating</td>
<td>16.7%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Canoeing</td>
<td>22.3%</td>
<td>32.1%</td>
</tr>
<tr>
<td>Fishing</td>
<td>10.7%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Kayaking</td>
<td>34.2%</td>
<td>32.0%</td>
</tr>
<tr>
<td>Rowing</td>
<td>16.1%</td>
<td>6.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
Self-reported head/face immersion, by water recreation activity and study group

Canoe, Kayak, Row, Fish, Motor boat

Percent

CAWS

GUW
Cases of gastrointestinal Illness attributable to water recreation, per 1,000 uses

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CAWS</td>
<td>45.4</td>
</tr>
<tr>
<td>UNX</td>
<td>32.9</td>
</tr>
<tr>
<td>Difference</td>
<td>12.5</td>
</tr>
</tbody>
</table>


Cases of gastrointestinal Illness attributable to water recreation, per 1,000 uses

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<tbody>
<tr>
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<td>46.3</td>
<td></td>
</tr>
<tr>
<td>UNX</td>
<td>32.9</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>13.4</td>
<td></td>
</tr>
</tbody>
</table>
Cases of gastrointestinal Illness attributable to water recreation, per 1,000 uses*

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>CAWS</td>
<td>43.6</td>
</tr>
<tr>
<td>GUW</td>
<td>-43.0</td>
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<tr>
<td>Difference</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*Takes into account differences in recreational activities and water exposure*
CAWS – Unexposed Differences

![Graph showing cases per 1,000 uses with labels for AGI, ARI, Eye, Skin, and Ear.]
GUW – Unexposed Differences

Cases per 1,000 uses

-30.0  -20.0  -10.0   0.0    10.0    20.0    30.0

AGi  ARI  Eye  Skin  Ear
CAW – GUW Differences

![Graph showing differences in cases per 1,000 uses across various locations (AGI, ARI, Eye, Skin, Ear). The graph indicates variations in cases with 95% confidence intervals.]
Severity – Any AGI

![Chart showing the percentage of participants in different severity levels for CAWS, GUW, and UNX groups. The chart includes categories such as None, OTC, Productivity lost, Sought healthcare, Prescription, and ER/Hospital.](chart.png)
Illness Severity: AGI only

Percentage of participants

CAWS N=57
GUW N=58
UNX N=37
Illness severity: eye symptoms, all
Illness severity: eye symptoms only
Study Objective #3: Pathogens

11,297 participants
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10,998 (97.4%) had no baseline GI symptoms
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11,297 participants

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2,467 (22.4%) developed GI symptoms*

745 (30.2%) provided stool sample

76 (10.2%) tested positive for a pathogen
Breakdown of pathogens: all participants

- Virus
- Bacteria
- Protozoa
- Rotavirus
- Norovirus
- Echovirus type 11
- Adenovirus
Pathogen positive stool samples, by study group

<table>
<thead>
<tr>
<th>Group</th>
<th>% positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAWS</td>
<td>8.6</td>
</tr>
<tr>
<td>GUW</td>
<td>10.5</td>
</tr>
<tr>
<td>UNX</td>
<td>11.3</td>
</tr>
<tr>
<td>Total</td>
<td>10.2</td>
</tr>
</tbody>
</table>
What we didn’t find

- Salmonella
- Shigella
- *E. coli* O157:H7
- Cryptosporidium
Ongoing analysis: Study objective #2
### Ongoing analysis (example)

<table>
<thead>
<tr>
<th>Excess Cases per 1,000</th>
<th>Microbe concentration per 100mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>20</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Many thanks

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Questions?