Children and Waterborne Disease: What Are the Risks?

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One in nine people worldwide lack access to “safe” drinking water

Worldwide, more than 800,000 people die each year due to diarrhea related to lack of quality water (that’s 2,300 people/day)

(Prüss-Ustün, 2014; WHO and UNICEF, 2014)
What is the risk of health problems in an exposed population?
Zero Risk Does Not Exist
Hazard vs. Risk

Hazard = Agent that may initiate an adverse response

Risk = Probability that something will happen
Risk Assessment Steps

- Hazard Identification
- Dose-Response Assessment
- Exposure Assessment

Risk Characterization
Hazard Identification

Identify All Possible Hazards

http://melbel.hubpages.com/hub/Sources-of-Water-Pollution-List
Waterborne Hazards

**MICROBIALS**
- Bacteria
- Viruses
- Protozoa

**CHEMICALS**
- Arsenic
- DBPs
- Lead

Chemical structures of arsenic and lead.
What are the health problems at different exposures?

Is there a threshold effect?
Threshold and Linear Effects

Response vs. Dose

- Threshold effect: Response increases linearly with dose above a certain threshold.
- Linear effect: Response increases linearly with dose without a threshold.
Which fits the dose-response data better?

Haas et al., 1999
Who is exposed?
How are they exposed?
How often are they exposed?
Exposures
Source

Route of Exposure

Population Exposed

Air

Tap/Lake/River/Pool

Food

Inhalation

Ingestion

Dermal

Population Exposed
Risk Factors for Waterborne Disease Among Children

- Immature immune defense mechanisms
- Higher water ingestion rate
- Potentially greater exposure to waterborne hazards
## Risk Assessment Parameters and Impact on Risk Estimate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Change</th>
<th>Risk Effect</th>
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<tbody>
<tr>
<td>Water Intake (liters)</td>
<td>![↑]</td>
<td>![↑]</td>
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<tr>
<td>Amount of Hazard in Exposure</td>
<td>![↑]</td>
<td>![↑]</td>
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<tr>
<td>Microbe Virulence</td>
<td>![↑]</td>
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<tr>
<td>Immunity</td>
<td>![↓]</td>
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<tr>
<td>Exposure Frequency and Duration</td>
<td>![↑]</td>
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<tr>
<td># Exposure Pathways</td>
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Risk Characterization

Interprets information learned through first three steps

Lists assumptions and uncertainties

Estimates human health effects resulting from exposure
Risk Assessment

Hazard Identification

Dose-Response Assessment

Exposure Assessment

Risk Characterization

Evaluation of Options

Decisions and Actions
Normal Life Stages

Should certain subpopulations . . .

. . . not drink tap water?
Risk Communication

*Helping patients understand risk
Future Approaches Addressing Children and Waterborne Disease

- Database development
- Epidemiological studies
- Clinical studies
- Informed risk assessments