Recreational Waterborne Outbreaks

Waterborne outbreaks may be due to water that is intended for drinking, recreational water, or other water (e.g., agricultural, industrial, ornamental). While outbreaks due to contaminated drinking water were well recognized historically, outbreaks involving recreational water illnesses have typically been less well recognized.

Public Health Discussion Points

The answers are contained in the text and given at the end of the issue.

1. Are waterborne outbreaks always due to infectious agents?
2. Are reported waterborne outbreaks currently more likely to be associated with drinking water or with recreational water?
3. What are possible explanations for an increase in reports of waterborne outbreaks over time?

Recreational Waterborne Outbreaks

The national case definition for a waterborne outbreak for surveillance purposes has two categories:

Two or more persons epidemiologically linked to recreational water by location of exposure, time, and illness

OR

Single case of unusual waterborne illness, e.g., *Naegleria* meningitis

Recreational waterborne outbreaks may involve treated water (e.g., pool, interactive fountain, spa) or untreated water (e.g., lake, river, hot spring, ocean). Waterborne agents may include microorganisms which may come from the environment, animals, the case patient, other bathers, or sewage as well as natural or synthetic chemicals either in or volatilized from the water.
A large number of agents can cause recreational waterborne outbreaks. Common agents include:

- **Viral**: norovirus
- **Bacterial**: *Pseudomonas*, Shiga toxin-producing *E. coli* (STEC), *Shigella*, other enteric bacteria, *Vibrio*, and leptospires
- **Parasitic**: *Cryptosporidium*, *Giardia*, and cercaria (swimmer’s itch)
- **Chemical**: toxins from harmful algal blooms (cyanobacteria), water treatment chemicals, and pollutants

Rare recreational waterborne outbreaks occur with more than one agent implicated.

The clinical presentation of recreational waterborne outbreak cases depends on the agent involved and the route of exposure to water. Direct water contact can cause rashes, hives, and infections of the skin, ear or wounds. Water ingestion can produce gastrointestinal illness. Mucous membrane exposure may generate irritation or infection. Inhalation of water or aerosols can result in pneumonia or asthma. Cyanobacterial toxins cause neurologic symptoms such as numb lips, tingling fingers and toes, and dizziness, as well as gastrointestinal symptoms like diarrhea. There can be systemic illness like fever or hepatitis. One type of rare but severe illness is meningitis resulting from intranasal exposure to *Naegleria* (fresh water amoeba).

### Recreational Waterborne Surveillance

Centers for Disease Control and Prevention (CDC) provide four decades of surveillance data for waterborne outbreaks. Although recreational water sources were not initially reported separately from other waterborne outbreaks, in 1974 there were 39 confirmed cases of shigellosis exposed in a swimming area of the Mississippi River in Iowa contaminated by sewage (http://www.cdc.gov/healthywater/statistics/wbdoss/surveillance.html).

Likely reflecting increased surveillance efforts, more recreational waterborne outbreaks are being reported annually in the United States, particularly from treated venues. During 2005-2006 there were 20 drinking water outbreaks in 11 states resulting in 612 illnesses. In the same period there were 78 recreational water outbreaks in 31 states resulting in 4412 illnesses; of these 94% involved gastrointestinal illnesses with the most commonly identified agent as *Cryptosporidium* (65% of gastrointestinal outbreaks). Other identified agents were *Shigella*, STEC, and norovirus. About three-quarters of the outbreaks involved treated recreational water. There are rare marine water outbreaks, mainly outbreaks of rashes due to trematode (cercarial) larvae (Connecticut and Delaware) and sea-anemones or jelly fish (cnidarial) larvae (Florida and Long Island). See: http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5709a1.htm
There is a recent large increase in cryptosporidiosis waterborne outbreaks, many associated with splash parks where young children play in sprays and fountains (Figure). Cryptosporidium and to a lesser extent Giardia are particular concerns due to high chlorine resistance compared to other microbial agents causing waterborne illnesses.

![Figure](image-url) Figure. Number* of outbreaks of cryptosporidiosis associated with water, by water type, 1988–2008

In Washington State few recreational water outbreaks are reported although such reporting is mandated. Most reported outbreaks involve small numbers of cases; one smaller outbreak involved STEC and resulted severe illnesses. Local health jurisdictions have identified and investigated several large outbreaks. A norovirus outbreak in 1993 and a suspected viral outbreak in 1998, both involving exposures from swimming lakes, each had hundreds of cases (Table).


<table>
<thead>
<tr>
<th>Year</th>
<th>Agent</th>
<th>Cases</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>Giardia</td>
<td>4</td>
<td>Swimming lake</td>
</tr>
<tr>
<td>1993</td>
<td>Norovirus</td>
<td>604</td>
<td>Swimming lake</td>
</tr>
<tr>
<td>1993</td>
<td>Cryptosporidium</td>
<td>7</td>
<td>River</td>
</tr>
<tr>
<td>1994</td>
<td>Cryptosporidium</td>
<td>4</td>
<td>River</td>
</tr>
<tr>
<td>1998</td>
<td>Suspected viral</td>
<td>248</td>
<td>Swimming lake</td>
</tr>
<tr>
<td>1999</td>
<td><em>E. coli</em> O157:H7</td>
<td>36</td>
<td>Swimming lake</td>
</tr>
<tr>
<td>2007</td>
<td>Cryptosporidium</td>
<td>14</td>
<td>Public pool</td>
</tr>
<tr>
<td>2007</td>
<td>Giardia</td>
<td>4</td>
<td>Swimming lake</td>
</tr>
</tbody>
</table>

* N = 172.
1 Water that has undergone a treatment process (e.g., chlorination and filtration) to make it safe for recreation.
2 Data for 2007 and 2008 are provisional.
Waterborne outbreaks may be difficult to recognize. Most of the agents have many potential routes of exposure and recreational waterborne outbreak cases may be geographically scattered. As a result, the initial report may not recognize that exposure occurred through recreational water exposure. Since many of the agents are more likely to be transmitted person-to-person or through food, the water exposure may not be evident. As a result, local health jurisdictions do not receive many reports that specify likely or suspected waterborne outbreaks. The report of only a single case of a notifiable condition such as STEC is usually difficult to associate with recreational water exposure even if swimming was the route of exposure.

The investigation itself has additional challenges once a recreational waterborne outbreak is suspected. A group of swimmers reporting illness may share additional exposures in addition to the water such as food, drinking water, and person-to-person contact.

Waterborne Outbreak Investigations

The Department of Health (DOH) notifiable conditions website includes links to legal reporting requirements, reporting forms, and investigation guidelines. As with foodborne investigations, waterborne outbreak investigations are modeled on CDC’s NORS (National Outbreak Reporting System), with collaboration by communicable disease and environmental health investigators. The investigator first characterizes the agent and the cases, and determines likely exposures. Any appropriate clinical laboratory testing should be done for suspected cases; during outbreaks, testing may be available at Washington State Public Health Laboratories. Other public health laboratories test for unusual agents such as those associated with harmful algal blooms.

DOH Communicable Disease Epidemiology can assist local health jurisdictions with recreational waterborne outbreak investigations. Forms available from the DOH’s website (see Resources) can guide a local health jurisdiction’s waterborne investigation. The waterborne outbreak forms are similar to foodborne outbreak investigation forms. The forms collect case information such as demographics, range of symptoms, and exposures as well as epidemiologic data to characterize the type of water implicated in the outbreak, dates of exposure, number of persons affected, severity of illnesses, and potential factors contributing to water contamination.
Reports of outbreaks are sent by local health jurisdictions to Communicable Disease Epidemiology. Summaries of reported waterborne outbreaks are forwarded for inclusion in surveillance conducted by Centers for Disease Control and Prevention.

Although recreational waterborne outbreaks can be challenging to recognize and confirm, investigation of such outbreaks is important for identifying and mitigating sources of exposure. Timely reporting and investigation of waterborne outbreaks are needed for public health interventions. Reporting also contributes to national surveillance to better characterize recreational waterborne outbreaks.

**Answers to Public Health Discussion Points**

1. Both biological and chemical agents can cause waterborne infections.
2. Recently there have been more reported outbreaks and cases of illness nationally due to recreational waterborne outbreaks than drinking water outbreaks.
3. Reports of waterborne outbreaks may increase due to many factors including a true increase in outbreaks, increased surveillance efforts to identify outbreaks, and increased testing for specific agents.

**Resources**

Local health jurisdictions should report any communicable disease waterborne outbreaks to (206) 418-5500 and illnesses from harmful algal blooms to (360) 236-3173.

- [http://www.doh.wa.gov/notify/forms/](http://www.doh.wa.gov/notify/forms/) includes links to legal reporting requirements and individual notifiable conditions
- [http://www.doh.wa.gov/ehp/algae/default.htm](http://www.doh.wa.gov/ehp/algae/default.htm) covers cyanobacteria (harmful algal bloom)

If you have any questions or comments specifically about this article, please contact author Marcia Goldoft, MD, MPH, at Communicable Disease Epidemiology Section (206) 418-5500, Washington State Department of Health.