Waterborne Disease Outbreaks

1. DISEASE REPORTING

A. Purpose of Reporting and Surveillance
   1. To prevent transmission from infected persons.
   2. To identify and correct sources of exposure for waterborne disease (WBD) outbreaks.
   3. To prevent further exposures to contaminated water and limit outbreaks.
   4. To expand current understanding of the transmission, pathogenesis and community impact of illness caused by known WBD agents.
   5. To identify new WBD agents, hazards, or gaps in the water safety system.

B. Legal Reporting Requirements
   1. Health care providers: Outbreaks immediately notifiable to local health jurisdiction
   2. Hospitals: Outbreaks immediately notifiable to local health jurisdiction
   3. Laboratories: No requirements for reporting WBD outbreaks; see disease-specific reporting requirements
   4. Local health jurisdictions: Outbreaks immediately notifiable to the Washington State Department of Health (DOH) Office of Communicable Disease Epidemiology (CDE)
      Note: there may be other reporting requirements for confirmed or probable cases of specific conditions.

C. Local Health Jurisdiction Investigation Responsibilities
   1. Immediately notify CDE when an outbreak is suspected. DOH epidemiologists and water quality specialists are available to assist local health jurisdictions with WBD outbreak investigations. CDE epidemiologists are responsible for coordinating the investigation of multi-county or multi-state WBD outbreaks involving Washington residents. Report suspected harmful algal blooms to (360) 236-3173.
   2. Perform an epidemiologic and if indicated an environmental investigations for outbreaks. If public health resources are limited, focus activities on investigating outbreaks that meet the following criteria: severe symptoms, large numbers affected, ongoing transmission, vulnerable population affected, or possible contaminated commercial product.
   3. Facilitate the transport of specimens to Public Health Laboratories to confirm an etiologic agent if necessary.
   4. Implement public health measures to prevent further spread.
   5. Report WBD outbreaks to CDE using the appropriate: optional DOH worksheet and DOH Waterborne Outbreak Reporting Form OR three CDC NORS forms: General outbreak form (outbreak timing, size, etc.) and General waterborne form (water exposure) and Specific water form (treated recreational, untreated recreational, drinking, or other water): http://www.cdc.gov/healthywater/statistics/wbdoss/nors/forms.html
2. THE EPIDEMIOLOGY OF WATERBORNE DISEASE OUTBREAKS

Waterborne disease (WBD) outbreaks can be categorized by etiologic agent (multiple agents rarely co-occur), type of water (drinking, recreation), and means of water contamination. If contaminated water in turn contaminates food (e.g., produce washed in bacteria-contaminated water, shellfish with *Vibrio*), the investigation is for a foodborne outbreak (see guidance: http://www.doh.wa.gov/Portals/1/Documents/5100/420-054-Guideline-FoodOutbreak.pdf).

A. Etiologic Agents, Descriptions of Illness and Incubation Periods

Etiologic agents of WBD outbreaks can be grouped into four general categories (see Appendix B for an overview of agents and symptoms):

1. **Bacteria** include *Shigella*, shiga toxin-producing *E. coli* [e.g., *E. coli* O157:H7], *Campylobacter*, *Salmonella*, typhoid, cholera, and other *Vibrio* species causing gastrointestinal symptoms as well as other uncommon agents such as *Francisella tularensis*, *Legionella*, *Leptospira*, *Mycobacterium* species, and *Pseudomonas*.

2. **Viruses** include hepatitis A virus and norovirus; historically poliovirus caused gastrointestinal symptoms.

3. **Parasites** include *Cryptosporidium* and *Giardia* causing gastrointestinal symptoms, invasive amoeba (e.g., *Naegleria* causing meningitis), *Schistosoma* (causing schistosomiasis), and endemic trematodes causing cercarial dermatitis (swimmer’s itch).

4. **Noninfectious agents** include cyanobacteria (blue green algae) toxins, copper, nitrates, and various chemicals that contaminate flood waters. Symptoms depend on the agent.

WBD agents may cause gastrointestinal, skin, or less commonly respiratory or systemic illness. As a result symptoms may include abdominal cramps, vomiting, diarrhea (bloody or non-bloody), hives, rashes, irritated eyes, sore throat, pneumonia, or systemic illness.

B. Waterborne Disease in Washington State

During recent years, Office of Communicable Disease Epidemiology has received 0 to 3 reports of WBD outbreaks yearly, involving a few to upwards of hundreds of ill persons. This is similar to the national rate of reported WBD outbreaks, although the true burden of WBD is likely many times higher. Known agents causing waterborne outbreaks in Washington include *Campylobacter*, *Cryptosporidium*, norovirus, shiga toxin-producing *E. coli*, *Giardia*, and hepatitis A. There were large outbreaks reported in 2003 (cross-contaminated drinking water lines causing campylobacteriosis) involving 110 people and in 1998 (suspect viral contamination of a swimming lake) involving 248 people.

C. Reservoirs

Humans are the reservoir of *Shigella* species, hepatitis A virus, typhoid, *Vibrio cholerae* (cholera), norovirus-like agents, and other viruses such as rotavirus and poliovirus.

Animals and birds are the primary reservoirs of *Campylobacter jejuni*, *Cryptosporidium*, shiga toxin-producing *E. coli*, *Francisella tularensis*, *Giardia*, leptospires, schistosomes, and *Salmonella* species, and can contaminate recreational water typically with feces. Wild or domestic animal carcasses can also contaminate water. Humans can also carry and have caused waterborne outbreaks due to *E. coli*, cryptosporidia and *Giardia*.
Drinking water systems can become contaminated if wells or pipes are breached and surface water enters. Human sewage can contaminate natural bodies of water, occurring more commonly in countries without developed sanitation infrastructure.

There are environmental reservoirs for *Legionella* species, non-cholera *Vibrio*, non-tuberculosis *Mycobacterium* species, schistosomes, amoeba, and algae. There may also be WBD due to an altered aquatic environment such as excess added chlorine, added copper sulfate, or altered water pH. Exposure may be through inhalation of aerosolized water or volatilized chemicals. Intentional water contamination could occur.

**D. Modes of Transmission**

By definition, WBD agents are transmitted through water, although many WBD agents are also transmitted through other routes, such as food, animal contact, or direct person-to-person. Typical route of entry is through ingestion or skin contact, less commonly by inhalation or intranasally. A WBD outbreak may initially be investigated as a foodborne outbreak until water exposure is recognized or vice versa. When reporting, the point of contamination separates foodborne from waterborne outbreaks (see Appendix C).

WBD outbreaks can be grouped into four general types of water exposure:

1. **Recreational water, treated** includes swimming pools, interactive fountains, water slides, spas, whirlpools, and hot tubs.
2. **Recreational water, untreated** includes lakes, rivers, streams, hot springs, and ocean beaches.
3. **Drinking water** (also used for showering or bathing) includes tap water, well water, bottled water, and contaminated water served as ice or in a beverage.
4. **Other water** includes decorative or display fountains, grocery store misting devices, cooling towers, and agricultural or industrial water.

**E. Periods of Communicability**


**F. Treatment**

Though treatment varies with the etiologic agent, most WBD diarrheal illnesses require only adequate hydration. Treatment recommendations for some specific WBD agents would be the same as for foodborne infections and can be found in:

Centers for Disease Control and Prevention. Diagnosis and Management of Foodborne Illnesses A Primer for Physicians and Other Health Care Professionals. MMWR 2004;53 (RR04):1–33. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5304a1.htm

**G. Susceptibility/Immunity**

There is general susceptibility to WBD agents. Vaccines are available for a few agents that have the potential to be waterborne (e.g., hepatitis A, cholera, typhoid, polio). Infants and persons with lowered gastric acidity may be infected with lower innocula of some
bacteria. Infants, the elderly, immunosuppressed persons, and sometimes persons with chronic medical conditions are more likely to suffer serious illness from diarrhea agents.

3. WATERBORNE OUTBREAK DEFINITIONS

A waterborne disease (WBD) outbreak is an incident in which 1) two or more epidemiologically-linked persons experience a similar illness after exposure to the same water source and 2) epidemiologic evidence implicates the water as the likely source of the illness.

Clinical Description
Depends upon etiologic agent (see Appendix B and individual disease guidelines).

Laboratory criteria for diagnosis
Depend upon etiologic agent (see Appendix B and individual disease guidelines).

Case classification (2010)
Confirmed: Any outbreak of an infectious disease, chemical poisoning or toxin-mediated illness where water is indicated as the source by an epidemiological investigation.

CDC Comment
The implicated water in a WBD outbreak may be drinking water, recreational water, water not intended for drinking (e.g., water used for agricultural purposes or in a cooling tower) or water of unknown intent. The route of exposure may be ingestion, inhalation, intranasal, or contact. The agent associated with the WBD outbreak may be a microbe, chemical, or toxin. Water testing to demonstrate contamination or identify the etiologic agent is preferred, but not required for inclusion as an outbreak. Chemicals (including disinfection byproducts) in drinking or recreational water that cause health effects either through water exposure or by volatilization leading to poor air quality are included.

Reports of WBD outbreaks received through the National Outbreak Reporting System (NORS) are captured in the Waterborne Disease and Outbreak Surveillance System (WBDOSS). Although not reported through NORS, the WBDOSS also accepts single cases of chemical exposure, wound infection (e.g., Vibrio skin infection) and other illnesses, (e.g., Naegleria infections) that are epidemiologically linked to water exposure as well as aquatic facility-related health events (e.g., chemical mixing accidents or air quality problems). However, these single cases or aquatic facility-related health events are not reported nor analyzed as WBD outbreaks.

http://wwwn.cdc.gov/NNDSS/script/casedef.aspx?CondYrID=898&DatePub=1/1/2010%2012:00:00%20AM%20

4. DIAGNOSIS AND LABORATORY SERVICES

A. Laboratory Diagnosis
Waterborne disease (WBD) outbreaks may or may not be laboratory confirmed. In general, confirming the specific etiologic agent in an outbreak requires detecting the agent in clinical specimens from at least two ill persons. Guidelines for confirming the
etiolologic agent of a WBD outbreak are available in Appendix C and for specific agents that can also cause foodborne outbreaks at:

B. Tests Available

1. Washington State Public Health Laboratories (PHL)

PHL have the capability to test clinical specimens from patients for many waterborne bacterial or parasitic agents and norovirus, to confirm bacterial and parasitic agents tested commercially, and to speciate or subtype isolates of *Salmonella*, *Legionella*, *Shigella*, and shiga toxin-producing *E. coli*. PHL will not test clinical specimens for hepatitis A but this test is widely available in commercial labs. In outbreak situations involving unusual agents, additional testing may be available through Centers for Disease Control and Prevention (CDC). Consult with Office of Communicable Disease Epidemiology (CDE) prior to collecting specimens to assure proper handling (206-418-5433). Different test kits are used for different agents (e.g., specimens for enteric bacteria are collected using transport medium while specimens for parasites are collected using preservative).

PHL also have the capability to test water specimens for many bacterial pathogens, when indicated in the context of an outbreak investigation. Collection of environmental samples must follow established protocols. PHL will not test water for norovirus or for parasites. Water testing for *Legionella* may be available with special arrangements.

For additional information regarding testing clinical and water specimens at PHL for pathogens also common as foodborne agents, see *Foodborne Disease and the Public Health Labs: A Foodborne Pathogen Quick Reference Guide for Food Sanitarians* available at:
http://www.doh.wa.gov/Portals/1/Documents/5200/FoodborneDiseaseforFoodSanitariansPHL.pdf

Note that PHL require all clinical specimens have two patient identifiers, a name and a second identifier (e.g., date of birth) both on the specimen label and on the submission form. Due to laboratory accreditation standards, specimens will be rejected for testing if not properly identified. Also include specimen source and collection date.

PHL have the capacity for limited chemical testing including lead or nitrates.

2. King County Environmental Laboratory (KCEL)

KCEL has the capability to test environmental samples from lakes and other water bodies for suspected freshwater biotoxins (HABs – harmful algae blooms). Analyses are available for microcystins, anatoxin-a, saxitoxins, and cylindrospermopsin. Washington State Department of Ecology’s Freshwater Algae Control Program funds the cost of toxicity tests while local agencies or lake managers pay for shipping. In situations where people have symptoms but tests for the four biotoxins are negative, additional testing may be available through CDC.

C. Specimen Collection

For instruction regarding collecting and shipping clinical and water specimens to PHL, see: http://www.doh.wa.gov/Portals/1/Documents/Pubs/301-016-PHLDirectoryServices.pdf
Collection of environmental samples must follow established protocols. Consult with Department of Ecology prior to collecting water samples to obtain a sample number and to assure proper handling. Most local health jurisdictions have sample kits available for use to test and ship for toxic cyanobacteria.

5. ROUTINE INVESTIGATION AND CONTROLLING FURTHER SPREAD

Waterborne disease (WBD) outbreaks can be detected through Notifiable Conditions reporting, bacterial isolate sub-typing and molecular analysis in the laboratory, consumer complaints, and syndromic surveillance systems. Investigations will vary greatly depending on the source: drinking water, building water system, treated recreational water, natural waters, etc. If public health resources are limited, focus activities on investigating outbreaks that meet the following criteria: severe symptoms, large numbers affected, ongoing transmission, vulnerable population affected, or possible contaminated commercial product (e.g., bottled water). Note there are special investigations for even single cases of legionellosis involving a healthcare facility (hospital, long term care) or travel.

A. Systematically collect information from cases to characterize the outbreak.

The optional Waterborne Disease Investigation Worksheet can assist with collecting preliminary information needed for the final DOH or NORS summary report form:

1. Demographics, including name, address, telephone number, age, sex, and other relevant factors such as occupation, residence, classroom, unit/wing/ward, cell block, etc.

2. Symptoms, including vomiting, diarrhea, bloody diarrhea, fever, abdominal cramps, jaundice, muscle aches, respiratory irritation, rash, systemic illness, as well as hospitalization status and medical care received.

3. Date and time of symptom onset and how long symptoms lasted (illness duration).

4. Common activities and water consumption history for a period of at least 72 hours before illness onset. Shared meals and food and drink consumption history for a period of at least 72 hours before illness onset may also be needed. Note that some agents have longer incubation periods and thus require collection of longer period of food history.

5. Travel including locations, water consumption, and recreational water exposures. Pertinent details for travel involving cruise ships or hotels/motels include dates, name of ship or hotel and room, and use of pools, spas, hot tubs, or other water recreational sites.

6. Names, addresses, phone numbers, and other locating information for anyone else who might be involved in the outbreak, both people who are sick and people who are not, and the name of the coordinator of a group activity, if applicable.

B. Attempt to identify additional cases, if indicated. Methods might include calling others potentially exposed to the suspected source (e.g. event attendees or others at the recreational site), sending provider alerts, requesting specimens from laboratories, or releasing a media alert.

C. Confirm the existence of an outbreak.

Local health jurisdictions should consider a number of questions, including the following:

[Note: These questions provide guidance and are not strict criteria.]
1. Are there persons from different households with illness following exposure to the same water or who visited the same recreational facility?
2. Are illness signs and symptoms, along with the incubation period and symptom duration, consistent with an illness resulting from the reported exposure?
3. Are all the illnesses similar and consistent with a WBD agent?
4. Is the number of illnesses more than what would be expected in this group of people and in the population as a whole?
5. Are there reports of potentially associated cases from related sources?
6. Are there common exposures other than water (e.g., food, personal or occupational contact) that could explain transmission?
7. Does the demographic information (age, ethnicity, etc.) suggest a common source?

D. Formulate a hypothesis about the illness agent and arrange for appropriate clinical laboratory testing, if indicated.

1. Refer ill persons for medical evaluation and testing if symptoms are severe, if bloody diarrhea is reported, or if the person is vulnerable to complications due to age or disability.
2. Collect fresh specimens for laboratory testing as soon as possible after onset of illness (See Section 4C for additional details regarding specimen collection.)
3. Collect specimens from as many people as possible. The criteria for confirming that an outbreak was caused by a specific agent usually depend on isolating the agent from at least two people involved in the outbreak.

E. Develop a preliminary case definition that includes time, place, and person.

An example of a case definition: Diarrhea with abrupt onset between July 25 and July 26, 2012 (time) in any person at least 2 years of age (person) who swam in Lake A on July 24, 2012 (place).

F. Implement an environmental field investigation based on the epidemiologic case data.

The goals of the joint epidemiologic and environmental outbreak investigation are to identify the infectious agent, the mode of transmission, the water source, and the source of the contamination. Consider the likely infectious agent based on symptoms and incubation period. Consider likely modes of transmission for that agent to focus the environmental investigation (See Section 2D). Source of exposure might also suggest an agent (e.g., fresh water organism or marine organism). As appropriate, obtain the following additional information:

1. Were there any unusual circumstances or practices operative just before the outbreak began that could have contaminated water? Power outages? Water back-ups? Other equipment failures?
2. Were there any unusual weather circumstances just before the outbreak began? Heavy rains? Floods?
3. Were any water recreation staff ill during the incubation period of the suspect WBD agent? When did they become ill? With which water sources did they work?

4. Do the staff involved with the water source ingest or have body contact with the water they work with?

G. Implement immediate control measures based on the likely WBD agent and source.

Depending on circumstances, immediate control measures may include a boil water order, posting warnings at a lake, closing a facility, recalling a commercial product like bottled water, or issuing a press release to advise citizens who may develop symptoms.

H. Consider testing hypotheses with an epidemiologic study. (i.e. case control or cohort)

1. Determine if initial interviews and the number of affected persons will support an epidemiologic study that compares groups of ill and well persons.

2. Get as complete a list as possible of all the people who likely shared exposure; lists can be obtained from an event organizer or from reservation lists.

3. Obtain information about the specific source of water (e.g., utility company).

4. Develop a questionnaire to systematically collect information on symptoms and exposures.

5. Administer the questionnaire to as many people as possible, both sick and well, as soon as possible after the first cases are reported. It is important to remember that people’s memories may become less reliable over time.

6. After finalizing a case definition, analyze the data to obtain the following:

   **Demographic profile:** the number of cases by age group and sex.

   **Symptom profile:** the percentage of cases who have vomiting, diarrhea, bloody diarrhea, fever, abdominal cramps, jaundice, respiratory symptoms, rash, and any other symptoms.

   **Epidemic curve:** the number of cases by time of onset of symptoms.

   ![Church 'A' supper attendees illness onset](chart.png)

   **Event attack rate:** the number of cases divided by the total number of people exposed. Event attack rate can only be calculated if the total number of people attending is known.

   **Median incubation period:** the time it takes 50% of the cases to get sick after exposure to the WBD agent. The median incubation period can only be calculated if the time of exposure is known.
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**Water-specific attack rate**: the percentage of people who became ill after specific water exposure (see table 1, column 4).

**Relative risks**: the percentage of people who became ill after a specific exposure, divided by the percentage of people who became ill without that exposure (table 1, column 8).

**P value**: The probability that the elevated relative risk is due only to chance. $P < 0.05$ means that chance is a very unlikely explanation for the difference in relative risks (less than 5 times out of a 100), and is the conventional cut-off to say the exposure is "statistically significantly associated with illness". However $P$ value is dependent on the number of persons included in the analysis and must be interpreted in that context.

**Table 1** is an example of data summary from an event-based cohort study.

<table>
<thead>
<tr>
<th>Water Item</th>
<th>DID HAVE Specific Exposure</th>
<th>DID NOT Have Specific Exposure</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number Sick</td>
<td>Number Well</td>
<td>Attack Rate</td>
</tr>
<tr>
<td>Wading pool</td>
<td>55</td>
<td>45</td>
<td>55%</td>
</tr>
<tr>
<td>Spray fountain</td>
<td>40</td>
<td>60</td>
<td>40%</td>
</tr>
<tr>
<td>Swimming pool</td>
<td>42</td>
<td>58</td>
<td>42%</td>
</tr>
<tr>
<td>City water</td>
<td>35</td>
<td>66</td>
<td>35%</td>
</tr>
<tr>
<td>Bottled water</td>
<td>30</td>
<td>70</td>
<td>3%</td>
</tr>
<tr>
<td>Formulas</td>
<td>A</td>
<td>B</td>
<td>$\frac{A}{A+B} = X%$</td>
</tr>
</tbody>
</table>

* Statistical programs, such as EpiInfo, SAS or SPSS are commonly used to calculate $P$ values.

Epi Info is a CDC-developed statistical software package available free of charge at: [http://wwwn.cdc.gov/epiinfo/](http://wwwn.cdc.gov/epiinfo/)

**I. Implement and evaluate further control measures**

Control measures specified in Section 5G may need to be initiated or expanded and may also include pool maintenance training or notifying state or federal regulatory agencies.

With a diarrheal agent, patients and contacts should be told not to swim until recovered and should be instructed in good hand washing and food-handling practices. Persons with vomiting or diarrhea should not handle or prepare food to be eaten by others. More specific follow-up of cases and contacts varies with the etiologic agent. Please refer to disease-specific Surveillance and Reporting Guidelines ([http://www.doh.wa.gov/PublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions.aspx](http://www.doh.wa.gov/PublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions.aspx)) for guidance on reportable diseases.

**J. Report findings to DOH**

Report even single cases of unusual WBD agents, such as *Naegleria* meningitis, to Office of Communicable Disease Epidemiology (CDE) at 206-418-5500.

Report all WBD outbreaks to CDE using the DOH Waterborne Outbreak Form: [DOH Waterborne Outbreak Reporting Form](http://www.doh.wa.gov/PublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions.aspx). Alternatively, a set of three NORS forms can be completed for a confirmed WBD outbreak:
The NORS General Section obtains information about investigation methods, dates of onsets and exposures, geographic location, demographic characteristics of primary cases, incubation and duration of illnesses, major symptoms, presence of secondary cases, and identified commercial products associated with the outbreak.

The NORS General Waterborne form obtains information about the type of water exposure, associated events, route of entry, results of case-control or cohort investigations, and laboratory test results for cases.

The NORS specific water forms are designed for treated recreational water, untreated recreational water, drinking water, and other water. Each of these forms includes a description, laboratory test results for the water, and factors contributing to contamination. Only one of the four is used for a given investigation.

NORS forms are at: http://www.cdc.gov/healthywater/statistics/wbdoss/nors/forms.html. CDC toolkits for waterborne outbreak investigation include extensive case/control interview forms, sample case tracking line lists (add columns for symptoms reported), environmental health outbreak investigation surveys for swimming pools, and sample notification letters. See: http://www.cdc.gov/healthywater/emergency/toolkit/#guides

6. CONTROLLING FURTHER SPREAD

Patients with diarrhea should not swim in public areas. The patients and their close contacts should be instructed in good hand washing and food-handling practices. More specific follow-up of cases and contacts varies with the etiologic agent. Please refer to the Surveillance and Reporting Guidelines (http://www.doh.wa.gov/PublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions.aspx) for guidance on individual notifiable diseases. Consult with Office of Communicable Disease Epidemiology for any other conditions (206-418-5433).

7. ROUTINE PREVENTION

For overview recommendations see: http://www.cdc.gov/healthywater/.

Use only safe sources for drinking water including during recreational activities. If water quality is uncertain, boil or chemically treat water before using it for drinking, rinsing uncooked foods, or brushing teeth.

Wash hands after using the toilet or changing diapers. Shower with soap before swimming in pools. Do not enter swimming areas when ill with vomiting or diarrhea. Do not let children ill with vomiting or diarrhea enter swimming areas even if they have special swim diapers or swim pants.

Children in diapers should have frequent diaper changes. During an outbreak, some jurisdictions have excluded diapered children from water recreation facilities. Generally, a more aggressive public media campaign has shown improved success where local park and pool managers, day care institutions, and other common areas of congregation work to inform the public of potential problems and educate the public to not enter the water for two weeks after any incidents of diarrhea.

ACKNOWLEDGEMENTS

We would like to acknowledge the Oregon Department of Human Services for developing the format of this document.
**UPDATES**

New guideline first posted February 2011.
Guideline updated May 2012, minor wording.
Guideline updated December 2012, eliminating section for Managing Special Situations.
**APPENDIX A: WATERBORNE DISEASE OUTBREAK DEFINITIONS**

A waterborne disease (WBD) outbreak is defined as an incident in which 1) two or more persons experience a similar illness after exposure to the same water source and 2) epidemiologic evidence implicates the water as the likely source of the illness. Single cases of some agents are also reportable (e.g., *Naegleria*).

**Laboratory-confirmed**: An outbreak of WBD with laboratory evidence confirming the outbreak etiology.

**Probable**: An outbreak of WBD with observational evidence and contributing factors without laboratory evidence.

**Suspected**: A group of cases linked by time or place (also known as a cluster) but without evidence linking illnesses to a common water exposure. Suspected outbreaks of WBD may lead to public health activities, including heightened oversight of a facility, but do not require submission of a summary report to DOH.

**Types of epidemiologic evidence**

Types of evidence gained by epidemiologic and environmental investigation

- Illnesses are consistent with exposure to a waterborne agent AND illness onsets are consistent with exposure to a common water source AND exposure cannot be explained by another transmission route (e.g. person-to-person, food or zoonotic) or other exposures.
- Contributing factors are identified that are consistent with the epidemiological and/or laboratory evidence
- Analytic epidemiological study with statistically significant association between illness and exposure to a common water source

**Types of laboratory evidence**

- Detection of a common agent in human cases with descriptive evidence of a common water exposure
- Detection of an agent in a water source and illnesses compatible with the agent in outbreak cases
- Detection of a common agent in human cases and in a water source

**Additional Definitions**

**Case-patient (abbreviated as Case)**: A person in the population or study group identified as having the particular disease or condition under investigation.

**Agent**: A pathogen or toxin considered to be the cause of the outbreak of waterborne disease.

**Common Water Source**: Documentation that cases were exposed to or consumed the same water at an identified facility or group gathering; or cases consumed a water product distributed from an identified common source.

**Contributing Factor**: A fault or circumstance that singly or in combination led to an outbreak of waterborne disease. Contributing factors may include water management practices which led to contamination; and/or the proliferation, amplification and/or survival of an agent.
## APPENDIX B: COMMON AGENTS OF WATERBORNE DISEASE OUTBREAKS

### Incubation Periods and Symptoms of Common Waterborne Disease Agents*

<table>
<thead>
<tr>
<th>Agent</th>
<th>Incubation Period</th>
<th>Duration / Communicable to others</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diarrhea</td>
<td>Bloody diarrhea</td>
</tr>
<tr>
<td>Blue-green algae (liver toxins)</td>
<td>30 minutes to 24 hours (generally slower acting)</td>
<td>unknown / not communicable</td>
<td>+</td>
</tr>
<tr>
<td>Blue-green algae (neurotoxins)</td>
<td>few minutes to 24 hours (generally fast acting)</td>
<td>unknown / not communicable</td>
<td>+</td>
</tr>
<tr>
<td>Swimmer’s itch</td>
<td>1-48 hours</td>
<td>7 days / not communicable</td>
<td></td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>0.3-5 days</td>
<td>to 5 days / not communicable</td>
<td></td>
</tr>
<tr>
<td>Vibrio (skin)</td>
<td>3-72 hours</td>
<td>varies / not communicable</td>
<td>++</td>
</tr>
<tr>
<td>Norovirus-type agents</td>
<td>0.5-2 days</td>
<td>1-2 days / communicable</td>
<td>+++</td>
</tr>
<tr>
<td>Salmonella and typhoid</td>
<td>0.5-5 days</td>
<td>3-7 days / communicable</td>
<td>+++</td>
</tr>
<tr>
<td>Shigella</td>
<td>1-7 days</td>
<td>4-7 days / communicable</td>
<td>+++</td>
</tr>
<tr>
<td>E. coli O157:H7</td>
<td>1-8 days</td>
<td>5-10 days / communicable</td>
<td>+++</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>1-10 days</td>
<td>2-5 days</td>
<td>+++</td>
</tr>
<tr>
<td>Legionella / Pontiac fever</td>
<td>2-10 days – pneumonia</td>
<td>varies / not communicable</td>
<td>+</td>
</tr>
<tr>
<td>Leptospira</td>
<td>2-30 days (typ. 5-14)</td>
<td>varies / not communicable</td>
<td>+++</td>
</tr>
<tr>
<td>Cryptosporidium</td>
<td>1-12 days</td>
<td>2+ weeks / communicable</td>
<td>+++</td>
</tr>
<tr>
<td>Francisella tularensis</td>
<td>1-14 days (typ. 3-5)</td>
<td>varies / not communicable</td>
<td>+++</td>
</tr>
<tr>
<td>Giardia</td>
<td>3-25 days</td>
<td>1-4 weeks / communicable</td>
<td>+++</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>15-50 days</td>
<td>1-2+ weeks / communicable</td>
<td>++</td>
</tr>
</tbody>
</table>

*These are only guidelines; incubation periods and symptoms reported by patients affected by these agents may be outside of the ranges listed above. Communicable indicated person-to-person transmission. A good reference is Control of Communicable Diseases Manual published by the American Public Health Association.*
## APPENDIX C: CRITERIA FOR CONFIRMATION OF WATERBORNE OUTBREAKS

The Centers for Disease Control and Prevention have established criteria for confirming the etiology when a foodborne outbreak has been identified which have been adapted. Original criteria can be found at [http://www.cdc.gov/outbreaknet/references_resources/guide_confiming_diagnosis.html](http://www.cdc.gov/outbreaknet/references_resources/guide_confiming_diagnosis.html)

<table>
<thead>
<tr>
<th>Etiologic agent</th>
<th>Confirmation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacterial</strong></td>
<td>Note that ill persons would have a shared exposure.</td>
</tr>
<tr>
<td></td>
<td>*Tests Available at WA State Public Health Laboratories are indicated by an asterisk</td>
</tr>
<tr>
<td></td>
<td><strong>1. Campylobacter jejuni/coli</strong></td>
</tr>
<tr>
<td></td>
<td>*Isolation of organism from clinical specimens from two or more ill persons OR</td>
</tr>
<tr>
<td></td>
<td>Isolation of organism from epidemiologically implicated water</td>
</tr>
<tr>
<td></td>
<td><strong>2. Escherichia coli</strong></td>
</tr>
<tr>
<td><strong>a. Enterohemorrhagic (E. coli O157:H7 and others)</strong></td>
<td>*Isolation of E. coli O157:H7 or other Shiga-like toxin-producing E. coli of same PFGE pattern from clinical specimen from two or more ill persons OR Isolation of E. coli O157:H7 or other Shiga-like toxin-producing E. coli of same PFGE pattern from epidemiologically implicated water</td>
</tr>
<tr>
<td><strong>b. Enterotoxigenic (ETEC)</strong></td>
<td>Isolation of organism of same serotype, demonstrated to produce heat-stable (ST) and/or heat-labile (LT) enterotoxin, from stool of two or more ill persons</td>
</tr>
<tr>
<td><strong>c. Enteropathogenic (EPEC)</strong></td>
<td>Isolation of organism of same enteropathogenic serotype from stool of two or more ill persons</td>
</tr>
<tr>
<td><strong>d. Enteroinvasive (EIEC)</strong></td>
<td>Isolation of same enteroinvasive serotype from stool of two or more ill persons</td>
</tr>
<tr>
<td><strong>3. Francisella tularensis</strong></td>
<td>*Isolation of organism from clinical specimens from two or more ill persons OR</td>
</tr>
<tr>
<td></td>
<td>Fourfold titer increase in two or more ill persons (presumptive: elevated without increase)</td>
</tr>
<tr>
<td><strong>4. Leptospirosis</strong></td>
<td>Fourfold titer increase in two or more ill persons (presumptive: elevated without increase) OR Demonstration of Leptospira by immunofluorescence in clinical specimens from two or more ill persons OR Isolation of organism from clinical specimens from two or more ill persons</td>
</tr>
<tr>
<td><strong>5. Pseudomonas</strong></td>
<td>Isolation of organism from clinical specimens from two or more ill persons</td>
</tr>
<tr>
<td><strong>6. Mycobacterium balnei or marinum</strong></td>
<td>*Isolation of organism from clinical specimens from two or more ill persons</td>
</tr>
<tr>
<td><strong>7. Mycobacterium avium</strong></td>
<td>*Isolation of organism from clinical specimens from two or more ill persons</td>
</tr>
<tr>
<td><strong>8. Salmonella, nontyphoidal</strong></td>
<td>*Isolation of organism of same serotype from clinical specimens from two or more ill persons OR Isolation of organism from epidemiologically implicated water</td>
</tr>
<tr>
<td><strong>9. Salmonella Typhi</strong></td>
<td>*Isolation of organism from clinical specimens from two or more ill persons OR</td>
</tr>
<tr>
<td></td>
<td>Isolation of organism from epidemiologically implicated water</td>
</tr>
</tbody>
</table>
### Waterborne Disease Outbreaks

#### Surveillance and Reporting Guidelines

10. **Shigella spp.**
   - *Isolation of organism of same PFGE pattern from clinical specimens from two or more ill persons*
   - OR
   - *Isolation of organism of same PFGE pattern from epidemiologically implicated water*

11. Naturally occurring Harmful Algal Blooms (blue-green algae/toxic cyanobacteria)

   **Anatoxin-a:**
   - History of swimming, head immersion and/or accidental swallowing of bloom water AND either demonstration of algal cells in feces or toxin demonstrated in blood (or other tissues and body fluids at autopsy such as liver and vitreous fluid). Note: False positive detection of phenylalanine, which has the same MW as anatoxin-a, in tissues and body fluids may confound the diagnosis.

   **Cylindrospermopsin:**
   - Acute gastrointestinal illness with abnormal liver function tests AND confirmed exposure (ingestion or immersion) to water with confirmed blue-green bloom of cyanobacterial species capable of cylindrospermopsin production.

   **Microcystins:**
   - Suspect case
     - Gastrointestinal illness and ingested water or contaminated food from water with cyanobacterial bloom
     - OR
     - Dermal symptoms and skin contact to water with a cyanobacterial bloom
     - OR
     - Jaundice, visual disturbances, abdominal pain, nausea, vomiting, bad taste in mouth and routine dialysis with water source with a cyanobacterial bloom
   - Confirmed case
     - Meets suspect case definition and positive assay in clinical specimen and/or vector
   - Confirmation testing of cyanotoxin in blood serum may be available through coordination with CDC.
     - A microtiter plate format ELISA kit for human, dog and cattle serum is available from ABRAXIS.

12. **Vibrio including V. cholerae**
   - *Isolation of organism from clinical specimens from two or more ill persons*
   - OR
   - *For Vibrio cholerae, Isolation of organism from epidemiologically implicated water*

### Chemicals

#### 1. Cnidarians

- **Suspect:** Likely exposure to nematocysts (stinging cells of jellyfish)

#### 2. Chemical hazards, inorganic: pH, hydrogen sulfide, nitrogen trichloride, any contaminant that is recognized in drinking water standards

- When contaminants exceed maximum contaminant levels for drinking water, a screening approach is recommended with a general guide of ten times the levels set in drinking water levels as a concentration to begin further evaluation. It will take specific evaluation of the contaminant and the potential routes of exposure through swimming.
  - e.g., inorganic levels of nitrogen trichloride in excess of 0.05 ppm (WHO) in the atmosphere

#### 3. Chemical hazards, organic: gasoline additives, chlorine byproducts, lipophilic organic contaminants, chlorinated biphenyls, chloroform volatile organics (THM, haloacetic acids, other organic fractions)

- Demonstration of high levels of volatile disinfection byproducts in epidemiologically implicated water. When contaminants exceed maximum contaminant levels for drinking water, a screening approach is recommended with a general guide of ten times the levels set in drinking water levels as a concentration to begin further evaluation. It will take specific evaluation of the contaminant and the potential routes of exposure through swimming.

### Parasitic

#### 1. **Cryptosporidium spp.**

- *Demonstration of oocysts in stool or in small-bowel biopsy of two or more ill persons*
- OR
  - Demonstration of organism in epidemiologically implicated water
<table>
<thead>
<tr>
<th>Disease</th>
<th>Diagnostic Criteria</th>
</tr>
</thead>
</table>
| **2. Cyclospora cayetanensis** | *Demonstration of the parasite by microscopy or molecular methods in stool or in intestinal aspirate or biopsy specimens from two or more ill persons  
OR Demonstration of the parasite in epidemiologically implicated water |
| **3. Giardia intestinalis**   | *Demonstration of the parasite in stool or small-bowel biopsy specimen of two or more ill persons          |
| **4. Swimmer’s itch**               | No specific tests                                                                                       |
| **Viral**                  |                                                                                                          |
| **1. Hepatitis A**        | Detection of immunoglobulin M antibody to hepatitis A virus (IgM anti-HAV) in serum from two or more persons who consumed epidemiologically implicated water |
| **2. Norovirus (NoV)**    | *Detection of viral RNA in at least two bulk stool or vomitus specimens by real-time or conventional reverse transcriptase-polymerase chain reaction (RT-PCR)  
OR Visualization of viruses (NoV) with characteristic morphology by electron microscopy in at least two or more bulk stool or vomitus specimens  
OR Two or more stools positive by commercial enzyme immunoassay (EIA) |
| **3. Astrovirus**         | Detection of viral RNA in at least two bulk stool or vomitus specimens by real-time or conventional reverse transcriptase-polymerase chain reaction (RT-PCR)  
OR Visualization of viruses (NoV) with characteristic morphology by electron microscopy in at least two or more bulk stool or vomitus specimens  
OR Two or more stools positive by commercial enzyme immunoassay (EIA) |
## APPENDIX D: REPORTING OF WATERBORNE OUTBREAKS THROUGH NORS

Use to determine if an outbreak is Waterborne or Foodborne for NORS reporting.

<table>
<thead>
<tr>
<th>Source of Outbreak (Known or Suspected)</th>
<th>Reporting Guidelines for NORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food</strong></td>
<td>▪ If contaminated food goes in the mouth – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If food is produced or prepared using contaminated water and then the contaminated food is consumed – Foodborne</td>
</tr>
<tr>
<td><strong>Water (drinking, recreational [untreated, treated], other)</strong></td>
<td>▪ If contaminated water goes in the mouth, is breathed in (swimming in a pool, shower or other aerosol, while sitting in a hot-tub or jet spa), or there is contact with the body in another way – Waterborne</td>
</tr>
<tr>
<td></td>
<td>▪ If small children are sitting in the water assume ingestion – Waterborne</td>
</tr>
<tr>
<td><strong>Ice</strong></td>
<td>▪ If ice is made with contaminated water – Waterborne</td>
</tr>
<tr>
<td></td>
<td>▪ If ice is made with contaminated water and then added to a beverage (e.g. ice was made with contaminated water and only people who consume drinks containing ice became ill) – Waterborne</td>
</tr>
<tr>
<td></td>
<td>▪ If ice is made with contaminated water and is used to cool a food product – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If ice is already made and then becomes contaminated through handling – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If it is unknown how the ice became contaminated – Foodborne</td>
</tr>
<tr>
<td><strong>Beverages Prepared with Water</strong></td>
<td>▪ If the beverage is made with contaminated water – Waterborne</td>
</tr>
<tr>
<td></td>
<td>▪ If the beverage is already made and then becomes contaminated through handling – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If the flavoring (e.g., frozen orange juice concentrate) is contaminated – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If it is unknown how the beverage became contaminated – Foodborne</td>
</tr>
<tr>
<td><strong>Drink Mix/Soda Machines</strong></td>
<td>▪ If the water entering the machine is contaminated or if there is a problem with the internal plumbing of the machine resulting in contamination (e.g., cross-connections, backflow of carbonated water resulting in copper leaching) – Waterborne</td>
</tr>
<tr>
<td></td>
<td>▪ If the drink is contaminated through handling after it is dispensed or contamination of the spout on the machine – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If the flavoring is contaminated before it is put into the machine – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If it is unknown how the beverage became contaminated – Foodborne</td>
</tr>
<tr>
<td><strong>Bottled Water</strong></td>
<td>▪ If bottled water is contaminated anywhere in the chain from source water through production, storage, transportation, distribution, and point of use – Waterborne</td>
</tr>
<tr>
<td><strong>Flavored Drinks (note: flavoring does not include carbonation)</strong></td>
<td>▪ If flavoring is added to bottled water and then it becomes contaminated or if the flavoring is contaminated – Foodborne</td>
</tr>
<tr>
<td></td>
<td>▪ If the water is contaminated before the flavoring is added – Waterborne</td>
</tr>
<tr>
<td></td>
<td>▪ If it is unknown how the flavored bottled water became contaminated – Foodborne</td>
</tr>
</tbody>
</table>