

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. Health care facilities: **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: Individual confirmed or probable cases of specific conditions may have other specific reporting requirements; refer to disease-specific guidelines.

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. Single or multiple cases of illnesses associated with harmful algal blooms should also be reported to CDE.
2. Perform an epidemiologic investigation. This ideally includes an environmental health component to identify causes and preventive measures. If public health resources are limited, focus on investigating outbreaks that involve severe clinical manifestations, large case numbers, ongoing transmission, vulnerable populations, or a possibly contaminated commercial product. CDE can also provide surge capacity for local health jurisdictions.
3. Facilitate 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 [Waterborne Outbreak Reporting Form](#). This combines a DOH-specific cover sheet with the CDC National Outbreak Reporting System (NORS) Form. (Additional guidance at <https://www.cdc.gov/nors/forms.html>.)

2. EPIDEMIOLOGY OF WATERBORNE DISEASE OUTBREAKS

Waterborne disease (WBD) outbreaks can be categorized by etiologic agent/s (multiple agents can co-occur in a single outbreak), routes of entry (e.g., ingestion, inhalation, intranasal, or skin contact), clinical manifestations (e.g., gastrointestinal, dermatologic, respiratory, neurologic, systemic), or types of water (drinking, recreational, other).

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 (<http://www.doh.wa.gov/Portals/1/Documents/5100/420-054-Guideline-FoodOutbreak.pdf>).

A. Etiologic Agents and Descriptions of Illness

Etiologic agents of WBD outbreaks can be grouped into four general categories (Table 1). Clinical manifestations depend on the agent and route of entry and may include abdominal cramps, vomiting, diarrhea (bloody or non-bloody), hives, rashes, irritated eyes, sore throat, pneumonia, or systemic illness (see Appendix B for details).

CATEGORY	EXAMPLES OF WATERBORNE DISEASE AGENTS
Virus	Hepatitis A virus Norovirus Poliovirus
Bacterium	Enteric <i>Campylobacter</i> spp. <i>Salmonella</i> (<i>S. Typhi</i> and non-typhoidal <i>Salmonella</i> spp.) Shiga toxin-producing <i>E. coli</i> <i>Shigella</i> spp. <i>Vibrio cholera</i> Other <i>Francisella tularensis</i> <i>Legionella</i> spp. <i>Leptospira</i> spp. <i>Mycobacterium</i> spp. <i>Pseudomonas</i> spp. Non-cholerae <i>Vibrio</i> species that cause wound infections
Protozoa and Trematodes	Parasitic protozoa <i>Cryptosporidium</i> spp. <i>Giardia</i> spp. <i>Cyclospora cayetanensis</i> Free-living amoeba <i>Naeglaria fowleri</i> (causes meningoencephalitis) <i>Balamuthia mandrillaris</i> , <i>Acanthamoeba</i> spp. (causes granulomatous amebic encephalitis or disseminated or cutaneous infections) <i>Schistosoma</i> flatworms Cause of cercarial dermatitis, or swimmer's itch, locally Cause of schistosomiasis in tropical countries
Noninfectious	Cyanobacteria (blue-green algae) toxins Copper, nitrates, and various chemicals that contaminate flood waters

Table 1. Examples of waterborne disease agents, by category.

B. Waterborne Disease Outbreaks in Washington State

From 1996 through 2015, 24 WBD outbreaks were reported to the Washington State Department of Health (DOH) Office of Communicable Disease Epidemiology (CDE), with a median of 1 (range, 0 to 3) outbreaks per year and a median of 11 cases (range, 3-260) per outbreak. The true burden of WBD outbreaks is likely many times higher.

During these two decades, the most common WBD outbreak etiology was norovirus or unknown viral cause of gastroenteritis (N = 6); other causes included *Pseudomonas* (4), *Legionella* (3), *Cryptosporidium* (2), *E. coli* (2), harmful algal bloom (2), *Campylobacter* (1), *Shigella* (1), and unidentified agents (3). Additional causes of reported WBD outbreaks in Washington prior to 1996 included *Giardia*, hepatitis A, *Mycobacterium*, *Salmonella*, and *Staphylococcus*.

The three largest WBD outbreaks in the two-decade period of 1996-2015 were gastrointestinal and included a norovirus outbreak associated with lake swimming in 2014 (approximately 260 cases), a campylobacteriosis outbreak associated with cross-contaminated drinking water lines in 2003 (110 cases), and suspected viral illness associated with a swimming lake in 1998 (248 cases).

Of the 25 reported WBD outbreaks during 1996-2015, 15 (60%) were due to exposure to recreational water (6 from treated water and 9 from untreated water), 9 (36%) were due to drinking water, and 1 (4%) was due to unknown water sources. The median number of cases in drinking water outbreaks was 18 (range, 3-110), 50 percent higher than the median number of 12 (range, 3-260) cases in recreational water outbreaks.

C. Reservoirs

Animals. Animals, including birds for some pathogens, are the primary reservoirs of *Campylobacter jejuni*, *Cryptosporidium*, Shiga toxin-producing *E. coli*, *Francisella tularensis*, *Giardia*, *Leptospira*, schistosomes, and non-typhoid *Salmonella* species. These wild or domestic animal reservoirs can contaminate recreational water with feces, although contamination from animal carcasses can also occur. Some of these organisms, e.g., *E. coli*, *Cryptosporidium*, and *Giardia*, can also contaminate water through shedding from infected humans.

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

Environment. Some WBD pathogens can be maintained in soil, water, or other environmental reservoirs; these pathogens include *Legionella* species, non-cholera *Vibrio*, non-tuberculosis *Mycobacterium* species, schistosomes, and free-living amoeba.

D. Modes of Transmission

By definition, WBD agents are transmitted through water, although some WBD agents can also be transmitted through other routes, such as food, animal contact, or directly from person-to-person. Particularly for enteric pathogens and gastrointestinal illnesses, an outbreak might initially be investigated as foodborne (or zoonotic, person-to-person, or environmental) until water exposure is recognized, or vice versa. When reporting, the point of contamination separates foodborne from waterborne outbreaks (see Appendix C).

Route of Entry. Depending on the etiologic agent, typical route of entry is through ingestion or skin contact. Exposure to some agents can occur through inhalation of aerosolized water (e.g., for *Legionella*) or volatilized chemicals. Intranasal exposure (e.g., for *Naegleria fowleri*) can also occur.

WBD outbreaks can be grouped into five general types of exposure, by the intended water use (Table 2). For any of these types of water exposures, intentional water contamination could occur.

WATER USE	EXAMPLES	CONTRIBUTING FACTORS (examples)
Recreational Water, Treated	<ul style="list-style-type: none"> -Swimming pool -Interactive fountain -Spray pad -Water slides -Kiddie or wading pools -Spa/whirlpool/hot tub 	<p>People (e.g., exceeding maximum bather load, fecal/vomitus accident, patrons swimming when ill with diarrhea)</p> <p>Facility design (e.g., cross-connection with wastewater, inadequate hygiene facilities)</p> <p>Maintenance (e.g., malfunctioning or inadequate disinfectant, pH control, or filtration system)</p> <p>Policy and management (e.g., untrained staff, absent/inadequate chemical handling policies, lack of shock/hyperchlorination policy)</p>
Recreational Water, Untreated	<ul style="list-style-type: none"> -Lakes, rivers, streams -Hot springs -Ocean beaches 	<p>People (e.g., exceeding maximum bather load, fecal/vomitus accident, patrons swimming when ill with diarrhea)</p> <p>Swim area design (e.g., inadequate hygiene facilities, malfunctioning/inadequate on-site wastewater treatment system, stagnant/poorly circulating water in swim area)</p> <p>Water quality (e.g., domestic or wild animal contamination, sewer line break, nearby human/animal waste application)</p> <p>Policy and management (e.g., inadequate water quality monitoring, untrained staff)</p>

Table 2. Types of waterborne disease exposure, by intended water use. Continued, next page.

WATER USE <i>(cont.)</i>	EXAMPLES <i>(cont.)</i>	CONTRIBUTING FACTORS (examples) <i>(cont.)</i>
<p>Drinking Water</p> <p><i>Includes</i> exposures to drinking water even when route of entry was not from ingestion (e.g., through showering or bathing).</p> <p><i>Excludes</i> water consumed from back-country streams or other sources that are not public/individual water systems.</p>	<ul style="list-style-type: none"> -Public or individual water systems -Bottled water -Beverage containing contaminated water or ice 	<p>Source water (e.g., cracked well casing leading to mixing of ground and surface water, wildlife contamination, human sewage entering natural bodies of water)</p> <p>Water treatment prior to entry into a house or building (e.g., inadequate disinfection or filtration)</p> <p>Distribution systems (e.g., backflow of nonpotable water into cross-connected potable water pipes)</p> <p>At other points (e.g., contamination at faucet tap)</p>
<p>Other</p> <p><i>Includes</i> water consumed from back-country streams or other sources that are not public/individual water systems.</p>	<ul style="list-style-type: none"> -Decorative or display fountains -Grocery store misting devices -Cooling towers -Agricultural or industrial water 	<p>Cooling tower or evaporative condenser problems (e.g., lack of maintenance program)</p> <p>Ornamental fountain problems (e.g., inadequate disinfection/filtration or presence of debris)</p> <p>Broken or damaged sewer pipe</p> <p>Recycling of water</p>
<p>Unknown</p> <p>Type of water could not be determined or the intended purpose or use of the water is unknown.</p>	<p>Legionellosis or other outbreaks in which cases share a common venue (e.g., hotel), but exact source of contaminated water cannot be determined (e.g., hot tub water vs. lobby fountain vs. drinking water used for showers).</p>	

Table 2 (continued). Types of waterborne disease exposure, by intended water type.

E. Periods of Communicability

The communicable period of those infected with bacteria, viruses or parasites varies. See Appendix B and DOH agent-specific guidelines (<http://www.doh.wa.gov/PublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions.aspx>).

F. Treatment

Although disease 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 (<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 develop illness from infections 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

Per the 2010 Council for State and Territorial Epidemiologists (CSTE) national surveillance case definition, a waterborne disease (WBD) outbreak is an incident in which both of the following criteria are met:

- (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 (<https://www.cdc.gov/nndss/conditions/waterborne-disease-outbreak/case-definition/2010/>):

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 (WBD OSS). Although not reported through NORS, the WBD OSS 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.

4. DIAGNOSIS AND LABORATORY SERVICES

A. Laboratory Diagnosis

Confirming the specific etiologic agent in a WBD outbreak requires detecting the agent in water specimens or in clinical specimens from at least two cases; see Appendices A and C for details. Guidelines for agents that also cause foodborne outbreaks are also at http://www.cdc.gov/foodsafety/outbreaks/investigating-outbreaks/confirming_diagnosis.html

B. Tests Available

1. **Water specimens** (Table 3)

LABORATORY AND AVAILABLE TESTS	NOTES
Washington State Public Health Laboratories (PHL)	
Infectious agents <u>Legionella</u> : May be available with special arrangements. <u>Many other bacterial pathogens</u> : When indicated in the context of an outbreak investigation <u>Norovirus, protozoa</u> : No water testing For pathogens that are also foodborne, also see http://www.doh.wa.gov/Portals/1/Documents/5200/FoodborneDiseaseforFoodSanitariansPHL.pdf	Collection of environmental samples must follow established protocols (e.g., in instructions sent out with PHL collection kits). Before collecting or shipping water specimens to PHL for pathogen testing, contact CDE at 206-418-5500 to discuss.
Chemicals Limited, but can include lead and nitrates	
King County Environmental Laboratory (KCEL)	
Harmful algal bloom (HAB) toxins Environmental samples from lakes and other water bodies for suspected freshwater biotoxins associated with harmful algal blooms (HABs): microcystins, anatoxin-a, saxitoxins, and cylindrospermopsin.	WA Department of Ecology’s Freshwater Algae Control Program funds cost of toxicity tests; local agencies or lake managers pay for shipping.
Centers for Disease Control and Prevention (CDC)	
Infectious agents May provide additional testing for outbreaks involving unusual agents.	Consult with CDE (206-418-5500) before specimen collection or submission.
HAB toxins May assist in situations with symptomatic cases but negative water findings for the four biotoxins.	

Table 3. Available water testing by laboratory.

2. Clinical specimens (Table 4)

LABORATORY AND AVAILABLE TESTS	NOTES
<p data-bbox="298 302 954 329">Washington State Public Health Laboratories (PHL)</p> <p data-bbox="334 352 537 380">Infectious agents</p> <p data-bbox="428 388 1032 548">Norovirus and many waterborne bacteria and parasites. This includes confirming bacterial and parasitic agents tested commercially and speciating or subtyping isolates of <i>Salmonella</i>, <i>Legionella</i>, <i>Shigella</i>, and Shiga toxin-producing <i>E. coli</i>.</p> <p data-bbox="428 573 1055 735">The PHL Microbiology Laboratory Test Menu lists pathogen-specific testing availability and details (http://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/PublicHealthLaboratories/MicrobiologyLabTestMenu).</p> <p data-bbox="428 760 1055 856">For pathogens that are also foodborne, also see http://www.doh.wa.gov/Portals/1/Documents/5200/FoodborneDiseaseforFoodSanitariansPHL.pdf.</p>	<p data-bbox="1084 352 1468 716">To ensure proper handling, consult with Office of Communicable Disease Epidemiology (CDE) (206-418-5500) prior to specimen collection. Different test kits are used for different agents (e.g., specimens for enteric bacteria require transport media, while specimens for parasites require preservative).</p> <p data-bbox="1084 741 1468 1136">All clinical specimens must 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. Because of laboratory accreditation standards, specimens will be rejected for testing if not properly identified. Also include specimen source and collection date.</p>
<p data-bbox="298 1178 623 1205">Commercial Laboratories</p> <p data-bbox="334 1230 537 1257">Infectious agents</p> <p data-bbox="428 1266 1019 1325">Hepatitis A virus: Widely available at commercial labs (not available at PHL)</p>	
<p data-bbox="298 1362 935 1390">Centers for Disease Control and Prevention (CDC)</p> <p data-bbox="334 1415 537 1442">Infectious agents</p> <p data-bbox="428 1451 954 1509">May provide additional testing for outbreaks involving unusual agents.</p> <p data-bbox="334 1535 748 1562">Harmful algal bloom (HAB) toxins</p> <p data-bbox="428 1570 1019 1696">Saxitoxin, neosaxitoxin, gonyautoxins, and tetrodotoxin in urine. As of summer 2016, CDC is working on expanding its repertoire to address microcystins and domoic acid.</p>	<p data-bbox="1084 1415 1468 1509">Consult with CDE (206-418-5500) before specimen collection or submission.</p>

Table 4. Available clinical specimen testing by laboratory.

C. Specimen Collection

1. General

Collection of environmental samples must follow established protocols. For instruction on collecting and shipping clinical and water specimens to PHL, see either of the following:

- <http://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/PublicHealthLaboratories/MicrobiologyLabTestMenu>
- <http://www.doh.wa.gov/Portals/1/Documents/Pubs/301-016-PHLDirectoryServices.pdf>.

2. Harmful algal bloom (HAB) investigations

Clinical specimens (human): Consult with CDE at 206-418-5500.

Clinical specimens (animal): Consult with DOH Environmental Public Health Sciences at 360-236-3385.

Water specimens: Consult with Department of Ecology (360-407-6938), King County Environmental Health Lab (206-684-2300), or your local health jurisdiction prior to collecting water samples, to obtain a sample number and to ensure proper handling.

Most local health jurisdictions have sample kits available for use to test and ship for toxic cyanobacteria.

More information on HABs is available at the following sources:

- www.nwtoxicalgae.org
- <http://www.doh.wa.gov/CommunityandEnvironment/Contaminants/BlueGreenAlgae>
- <http://www.cdc.gov/habs/>

5. ROUTINE INVESTIGATION AND CONTROLLING FURTHER SPREAD

Overview

Detection. Waterborne disease (WBD) outbreaks can be detected through routine Notifiable Conditions reporting, bacterial isolate sub-typing and molecular analysis in the laboratory, consumer complaints, and syndromic surveillance systems.

Investigation. Investigations will vary greatly depending on the water type (e.g., private well water, municipal drinking water, or treated/untreated recreational water), pathogen, type of illness, and the setting and timing of exposure (e.g., discrete event versus prolonged exposure).

Prioritization. If public health resources are limited, focus activities on investigating outbreaks involving severe clinical manifestations, large numbers of affected persons, ongoing transmission, vulnerable populations, or possible contaminated commercial product (e.g., bottled water).

Legionellosis. Special investigations may be necessary for even single legionellosis cases involving a healthcare facility (hospital, long term care) or travel.

CDC toolkits. In addition to the guidance in this guideline, additional guidance is available in CDC toolkits for waterborne outbreak investigation, including extensive case/control interview forms, sample case tracking line lists, environmental health outbreak investigation surveys for swimming pools, and sample notification letters. For more information, see <http://www.cdc.gov/healthywater/emergency/preparedness-resources/outbreak-response.html> and the specific pages below.

- Drinking water: <http://www.cdc.gov/healthywater/emergency/preparedness-resources/drinking-water-outbreak-toolkit.html>
- Recreational water: <http://www.cdc.gov/healthywater/emergency/preparedness-resources/rec-water-outbreak-toolkit.html>
- Legionellosis: <http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/index.html>

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:

- **Demographics:** Name, address, telephone number, age, sex, and other relevant factors such as occupation, residence, classroom, unit/wing/ward, cell block, etc.
- **Clinical data:** Illness onset and duration, signs/symptoms, hospitalization status, and medical care received.
- **Common activities and water consumption history:** For a period of at least 72 hours before illness onset. Of note:
 - a. Some agents have longer incubation periods and thus require collection of longer period of food history
 - b. Shared meals and food and drink consumption history for a period of at least 72 hours before illness onset may also be needed, since many waterborne pathogens (especially enteric pathogens) can also be transmitted by the foodborne route
 - c. Record any travel exposures, 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.

- **Other information:** 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 issuing a media alert.

C. Confirm the existence of an outbreak

Local health jurisdictions should consider a number of questions, including the following (for guidance only; not strict criteria):

1. Are there ill persons from different households who had 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 illness burden more than what would be expected in this group of people and in the population as a whole (i.e., greater than expected background incidence?)
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 person, place, and time

Example: 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

Goals. The goals of the joint epidemiologic and environmental outbreak investigation are to identify the following:

Infectious agent. Consider based on symptoms and incubation period. Exposure source might also suggest an agent (e.g., freshwater organism or marine organism).

Mode of transmission. Consider likely modes of transmission for that agent, to help focus the environmental investigation (See Section 2D)

Water source.

Source of the contamination: How the agent got into the water.

Environmental data collection. As part of the environmental investigation, work with environmental health staff to complete as much as possible or as is relevant from the second half of CDC's NORS WBD outbreak forms (beginning on page 5 of the forms). Separate forms for drinking, recreational water, and other/unknown water sources are at <http://www.cdc.gov/nors/forms.html>. Ideally, collected information will include:

1. Water testing information, including: descriptors such disinfectant levels, pH, and turbidity; water quality indicators such as fecal coliform; and microbiology or chemical/toxin analysis
2. Detailed description of the drinking water system or the recreational water venue, including the usual type of water treatment, if any
3. Recent compliance with regulations
4. Factors contributing to contamination or increased exposure

To help in this environmental investigation, some general questions to ask could include:

- Were any unusual circumstances or practices operative just before the outbreak began that could have contaminated water? Power outages? Water back-ups? Other equipment failures?
- Did any unusual weather circumstances occur just before the outbreak began? Heavy rains? Floods?
- 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?

- 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

Identification of control measures may be aided by considering potential contributing factors listed in CDC's NORS WBD outbreak report forms (<http://www.cdc.gov/nors/forms.html>).

In most instances, consult with environmental health staff, who can provide situation-specific guidance and assist an owner/operator in treating water and cleaning the facility as needed. Depending on circumstances, immediate control measures could include (but are not limited to) the following, with guidance from environmental health staff:

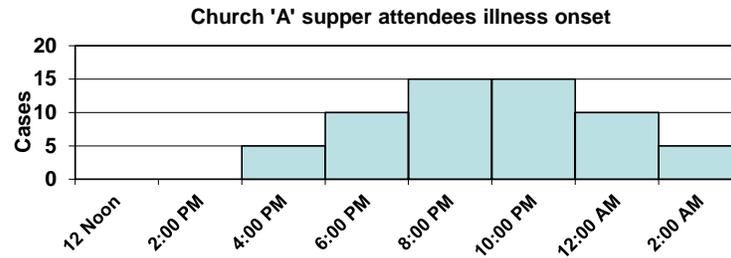
- Drinking water: Issuing a boil water order, recalling a commercial product like bottled water
- Recreational water: Closing a facility or beach, posting warning at a lake, super-chlorinating the water, backwashing the filter, draining the water, sanitizing the bathrooms or other likely-contaminated areas, cleaning the entire facility, and refilling the water and treating the water as required or feasible (for treated water facilities)
- Any water source: Issuing a press release to advise citizens who may develop illness

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

1. Determine whether initial interviews and the number of affected persons will support an epidemiologic study that compares groups of ill and well persons.
2. Obtain 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 ill 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 (see 5E), analyze the data for the following:

Descriptive Epidemiology

- **Demographic profile:** Median (with range) or proportion of cases by age (or age group), sex, or other variables of potential relevance (e.g., race/ethnicity)
- **Illness profile:** Percentage of cases who had vomiting, diarrhea, bloody diarrhea, fever, abdominal cramps, jaundice, respiratory symptoms, rash, etc.
- **Epidemic curve:** Number of cases by time of onset of symptoms



- **Event attack rate:** Number of cases divided by total number of people exposed. Can only be calculated if the total number of people attending is known, as well as the ill/well status for each attendee.
- **Median incubation period:** Time it takes for 50 percent of the cases to experience illness onset after exposure to the WBD agent. Can only be calculated if the time of exposure is known (easier when the exposure occurred during a discrete event, such as a visit to a recreational swimming venue). Medians should generally be provided along with some measurement of spread, often the range (minimum and maximum).

Water-Specific Attack Rate

Percentage of people with a specific water exposure who subsequently became ill (see table 1, column 4). Water-specific attack rate can only be calculated if the total number of people with the given water exposure is known, as well as the ill/well status for each of those exposed persons.

Measures of Association

- **Relative risk (RR):** Percentage of exposed people who became ill, divided by percentage of unexposed people who became ill (table 1, column 8). RR is computed cohort studies, when the total number of exposed persons and their illness status is known. An RR of 1.0 indicates that the two percentages are the same, i.e., that the risk for illness was equal in exposed and unexposed persons. An RR >1.0 (plus a confidence interval that does not contain 1.0) indicates that exposed persons had a greater risk of becoming ill than did non-exposed persons.
- **Exposure odds ratio (OR):** This is generally computed in the context of a case-control study, when the entire cohort of exposed persons was not or could not be

assessed for illness status. Instead, a subset of cases and controls are identified and their exposures determined; then, the odds of cases having had a specific exposure is compared to the odds of controls having the exposure. An OR of 1.0 indicates that the exposed:unexposed ratios are equal in cases and controls. An OR >1.0 (plus a confidence interval that does not contain 1.0) indicates that cases had a greater odds of experiencing the exposure than did controls.

- **Note:** Some situations may warrant an individually-matched case-control study design, in which each case is matched to one or more controls based on potentially confounding variables, such as age or sex. As this involves a more complex analytical approach than an unmatched study, it can be helpful to seek guidance from epidemiologists experienced in this procedure.

Tests for Statistical Significance

Confidence intervals and/or p-values should be provided along with RRs and ORs. Of note, these tests will agree with each other if paired correctly (i.e., a 95% CI and a p-value with a significance level of $\alpha = 0.05$; or a 90% CI and a p-value with $\alpha = 0.10$).

- **Confidence interval (CI):** Given as a lower and upper bound, this estimates the precision (i.e., level of certainty) of an RR or OR; a tight CI indicates a precise RR or OR estimate, whereas a wide CI indicates an imprecise RR or OR. It is often computed as a 95% CI, which the investigator can think of as “I am 95 percent confident that the true population RR (or OR) falls between these two values.” An RR or OR greater than 1.0 has greater credibility if its CI does not overlap 1.0.

For example, in a case-control study examining various water exposures among people attending a lake party:

- Lake swimming OR = 5.0 (95% CI, 2.5-8.0). This indicates that cases had five times greater odds of having gone swimming than did the well controls. Since the OR does not contain 1.0, this association can be stated with relative confidence, and investigators may wish to examine this exposure further.
- Drinking at the water fountain OR = 1.2 (95% CI, 0.2-2.2). Indicates that cases had 1.2 times the odds of drinking bottled water than did controls; however, the CI contains 1.0, which limits the confidence in this estimate. Investigators would likely focus on other exposures.

- P-value:** The probability that the given RR or OR is due only to chance. $P < 0.05$ indicates that chance is a very unlikely explanation for the observed RR or OR (less than 5 times out of 100 if the population were sampled repeatedly) and is the conventional cut-off for stating the exposure is "statistically significantly associated with illness" if the RR or OR that is >1.0 . However, decisions about associations should not be made on the p-value alone, as it is only a measure of statistical significance (not of the strength of association), and it is dependent on the number of persons included in the analysis.

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

Water Item	DID HAVE Specific Exposure			DID NOT Have Specific Exposure			Statistics	
	Number Sick	Number Well	Attack Rate	Number Sick	Number Well	Attack Rate	Relative Risk	P value
Wading pool	55	45	55%	5	95	5%	11	<.001
Spray fountain	40	60	40%	20	80	20%	2	.004
Swimming pool	42	58	42%	18	82	18%	2.3	.005
City water	35	65	35%	25	75	25%	1.4	0.1
Bottled water	30	70	3%	30	70	3%	1	1
Formulas	A	B	$A / (A+B)$ = X%	C	D	$C / (C+D)$ = Y%	X% / Y %	*

*Statistical programs, such as EpiInfo, SAS, or SPSS are commonly used to calculate confidence intervals and p-values. Epi Info is a CDC-developed statistical software package available free of charge at: <http://www.cdc.gov/epiinfo/index.html>. Epi Info is also available as a free app for mobile phones.

I. Implement and evaluate further control measures

Control measures specified in Section 5G may need to be initiated or expanded and might 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. For specific notifiable diseases, refer to DOH Surveillance and Reporting Guidelines (<http://www.doh.wa.gov/PublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions.aspx>).

J. Report findings to DOH

Single reports of rare or severe WBDs. Report even single cases of unusual or particularly severe WBDs, such as primary amebic meningoencephalitis from *Naegleria fowleri*, to the Office of Communicable Disease Epidemiology (CDE) at 206-418-5500.

Single cases of harmful algal bloom (HAB)-associated illness in humans should also be reported to CDE.

Outset of investigation. Immediately report all suspected WBD outbreaks to CDE (206-418-5500).

Completion of investigation. After the investigation into a confirmed WBD outbreak is concluded, provide a report to DOH using the following:

- (1) [Waterborne Outbreak Reporting Form](#). This combines a DOH-specific cover sheet with CDC's NORS Waterborne Disease Transmission form (www.cdc.gov/nors/forms.html).

Separate sections are used for treated recreational water, untreated recreational water, drinking water in public or individual water systems, or other/unknown water use (see Section 2D for descriptions).

Each NORS WBD form contains the following sections:

- **General** (same for all water types): Investigation methods, dates of onsets and exposures, geographic location, demographic characteristics, incubation and duration of illnesses, major signs/symptoms, presence of secondary cases, and identified commercial products associated with the outbreak
- **Water-General** (same for all water types): Type of water exposure, associated events, route of entry, results of case-control or cohort study, and laboratory tests results for both clinical and water specimens
- **Water Type-Specific** (specific to the water type): Description of water system/venue/intended use, violations/regulatory compliance, and factors contributing to contamination or increased exposure to contaminated water

Additional guidance on the NORS form is at <https://www.cdc.gov/nors/forms.html>.

- (2) *Optional*: The optional [Waterborne Disease Investigation Worksheet](#) can assist with collecting preliminary information needed for the final CDC-NORS or DOH form. See Section 5A for details.

Harmful algal blooms (HABs)

WHAT	REPORT TO	REPORT FORM
Human cases (single cases or outbreaks)	CDE, 206-418-5500	http://www.cdc.gov/habs/pdf/ohhabs-fillable-human-form.pdf
Animal cases	DOH Environmental Public Health Sciences – Public Health Veterinarian, 360-236-3369	http://www.cdc.gov/habs/pdf/ohhabs-fillable-animal-form.pdf
Blooms only	Department of Ecology, 360-407-6938 BEACH Program, 360-480-4868 Shellfish Program, 360-407-6938 (if marine water/shellfish involved)	http://www.cdc.gov/habs/pdf/ohhabs-fillable-environmental-form.pdf

6. CONTROLLING FURTHER SPREAD

Disease-specific guidance (notifiable conditions). More specific follow-up of cases and contacts varies with the etiologic agent. Guidance on individual notifiable diseases is available in the Surveillance and Reporting Guidelines (<http://www.doh.wa.gov/PublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions.aspx>)

Diarrheal illness. Patients with diarrhea should not swim in public areas. For certain infections (e.g., *Cryptosporidium*, *Giardia*, *Shigella*, and STEC), WADOH’s disease-specific guidelines extend this exclusion to 2 weeks after resolution of diarrhea or other symptoms (see disease-specific guidelines). The patients and their close contacts should be instructed in good hand washing and food-handling practices.

The Model Aquatic Health Code (MAHC) provides detailed, science-based guidance on healthier and safer swimming and other water activities (<http://www.cdc.gov/mahc/>).

Other conditions. Consult with Office of Communicable Disease Epidemiology for any other conditions (206-418-5500).

7. ROUTINE PREVENTION

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

General. Wash hands after using the toilet or changing diapers.

Drinking water. 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.

Recreational water. 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 when 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

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UPDATES

New guideline first posted February 2011.

Updated May 2012: Minor wording.

Updated December 2012: Eliminating section for Managing Special Situations.

Updated August 2016: Minor wording and clarifications; additional details about harmful algal blooms.

Updated June 2016: Updated outbreak reporting form description and link; updated contact for reporting HAB animal cases.

RESOURCES

CDC

- Recreational water illnesses: <http://www.cdc.gov/healthywater/swimming/swimmers/rwi.html>
- Responding to fecal incident in recreational water: <http://www.cdc.gov/healthywater/swimming/pdf/fecal-incident-response-guidelines.pdf>
- Model Aquatic Health Code, updated 2016 (guidance for government agencies and aquatic sector to reduce risk for outbreaks, drowning, and chemical injuries at swimming pools and spas): <http://www.cdc.gov/mahc/>
- Harmful algal bloom (HAB)-associated illness: <http://www.cdc.gov/habs/>
- HAB partner toolkit (communication resources): <http://www.cdc.gov/habs/materials/toolkit.html>

APPENDIX A: WATERBORNE DISEASE OUTBREAK DEFINITIONS

A waterborne disease (WBD) outbreak is defined as 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.

Single cases of some agents are also reportable (e.g., *Naegleria*).

Categorization of outbreak status:

- **Confirmed:** Any outbreak of an infectious disease, chemical poisoning, or toxin-mediated illness where water is indicated as the source by an epidemiological investigation (CSTE definition), and in which *clinical or water specimens have laboratory evidence for the etiologic agent*, as appropriate for the given agent (DOH addition); Agent specific details in Appendix C
- **Probable:** An outbreak of an *apparent* infectious disease, chemical poisoning, or toxin-mediated illness where water is indicated as the source by an epidemiological investigation, but in which *neither clinical nor water specimens have laboratory evidence for the suspected etiologic agent* (DOH definition)
- **Suspected:** A group of cases linked by time or place (also known as a cluster) but without evidence that the common water exposure is a more likely cause than other common exposures. 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 that are consistent with exposure to a waterborne agent AND illness onsets that are consistent with exposure to a common water source AND exposure that cannot be explained by another transmission route (e.g. person-to-person, food or zoonotic) or other exposures
- Contributing factors 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, chemical, 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; examples include but are not limited to management practices, facility design, distribution system, people’s behaviors, and known contamination.

APPENDIX B: CLINICAL CHARACTERISTICS OF COMMON AGENTS OF WATERBORNE DISEASE OUTBREAKS

Agent	Incubation Period	Duration	Person-to-Person Transmission	Signs and Symptoms (+ occasionally occurs; ++ sometimes occurs; +++ often occurs)					
				Diarrhea	Bloody diarrhea	Vomiting	Fever	Rash, Skin	Other
Cyanobacteria (blue-green algae): Liver toxins	30 minutes to 24 hours (generally slower acting)	Unknown	No	+		+++		++	jaundice, abdominal pain, shock
Cyanobacteria (blue-green algae): Neurotoxins	few minutes to 24 hours (generally fast acting)	Unknown	No	+				++	gasping, tingling, weakness, convulsions
Campylobacter	1-10 days	2-5 days	Yes	+++	+	+	+++		cramps
Cryptosporidium	1-12 days	2+ weeks	Yes	+++			+		
E. coli O157:H7	1-8 days	5-10 days	Yes	+++	++	+			cramps, HUS
Francisella tularensis	1-14 days (typ. 3-5)	Varies	No				+++	may be ulcer	highly variable
Giardia	3-25 days	1-4 weeks	Yes	+++					greasy stool, weight loss
Hepatitis A	15-50 days	1-2+ weeks	Yes	++		+	+++		jaundice, fatigue
Legionella / Pontiac fever	2-10 days – pneumonia	Varies	No	+			+++		pneumonia
Leptospira	2-30 days (typ. 5-14)	Varies	No				+++	++	systemic, highly variable
Norovirus-type agents	0.5-2 days	1-2 days	Yes	+++		+++	+		aching, headache
Pseudomonas	0.3-5 days	Up to 5 days	No					itchy folliculitis	
Salmonella (including typhoid)	0.5-5 days	3-7 days	Yes	+++	+	+	+++		cramps
Shigella	1-7 days	4-7 days	Yes	+++	+	+	+++		cramps
Swimmer’s itch	1-48 hours	7 days	No					itchy red papules	
Vibrio (skin)	3-72 hours	Varies	No				++	ulcer	cellulitis

These are guidelines only. For any given case, clinical characteristics may be outside of the ranges listed above. More information is available in DOH Guidelines for individual diseases (<http://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/NotifiableConditions/ListofNotifiableConditions>) or the American Public Health Association *Control of Communicable Diseases Manual* (<https://www.apha.org/ccdm>).

APPENDIX C: CRITERIA FOR CONFIRMATION OF WATERBORNE OUTBREAKS

Adapted from Centers for Disease Control and Prevention criteria for confirming the etiology of a foodborne disease outbreak (http://www.cdc.gov/foodsafety/outbreaks/investigating-outbreaks/confirming_diagnosis.html).

Etiologic agent	Criteria for Confirmed Waterborne Disease Outbreak
Bacterial	<p>Note that ill persons would have a shared exposure.</p> <p>*Tests Available at WA State Public Health Laboratories are indicated by an asterisk</p>
1. <i>Campylobacter jejuni/coli</i>	<p>*Isolation of organism from clinical specimens from two or more ill persons <u>OR</u> Isolation of organism from epidemiologically implicated water</p>
2. <i>Escherichia coli</i>	
a. Enterohemorrhagic (<i>E. coli</i> O157:H7 and others); also known as Shiga toxin-producing <i>E. coli</i> (STEC)	<p>*Isolation of <i>E. coli</i> O157:H7 or other Shiga-like toxin-producing <i>E. coli</i> of same PFGE pattern from clinical specimen from two or more ill persons <u>OR</u> Isolation of <i>E. coli</i> O157:H7 or other Shiga-like toxin-producing <i>E. coli</i> of same PFGE pattern from epidemiologically implicated water</p>
b. Enterotoxigenic (ETEC)	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
c. Enteropathogenic (EPEC)	Isolation of organism of same enteropathogenic serotype from stool of two or more ill persons
d. Enteroinvasive (EIEC)	Isolation of same enteroinvasive serotype from stool of two or more ill persons
3. <i>Francisella tularensis</i>	<p>*Isolation of organism from clinical specimens from two or more ill persons <u>OR</u> Fourfold or greater change in serum titer for two or more ill persons</p> <p><i>Probable</i> outbreak: Elevated serum antibody titer (without 4-fold or greater change) in two or more patients without histories of tularemia vaccination <u>OR</u> Detection by fluorescent assay in clinical specimens from two or more ill persons</p>
4. Leptospirosis	<p>Isolation of organism from clinical specimens from two or more ill persons <u>OR</u> Fourfold or greater increase in titer for two or more ill persons (presumptive: elevated without increase) <u>OR</u> Demonstration of <i>Leptospira</i> by immunofluorescence in clinical specimens from two or more ill persons <u>OR</u></p>
5. <i>Pseudomonas</i>	Isolation of organism from clinical specimens from two or more ill persons
6. <i>Mycobacterium balnei</i> or <i>marinum</i>	*Isolation of organism from clinical specimens from two or more ill persons

7. <i>Mycobacterium avium</i>	*Isolation of organism from clinical specimens from two or more ill persons
8. <i>Salmonella</i>, nontyphoidal	*Isolation of organism of same serotype from clinical specimens from two or more ill persons <u>OR</u> *Isolation of organism from epidemiologically implicated water
9. <i>Salmonella</i> Typhi	*Isolation of organism from clinical specimens from two or more ill persons <u>OR</u> *Isolation of organism from epidemiologically implicated water
10. <i>Shigella</i> spp.	*Isolation of organism of same PFGE pattern from clinical specimens from two or more ill persons <u>OR</u> *Isolation of organism of same PFGE pattern from epidemiologically implicated water
12. <i>Vibrio</i>, including <i>V. cholerae</i>	*Isolation of organism from clinical specimens from two or more ill persons <u>OR</u> For <i>Vibrio cholera</i> O1 or O139: Significant rise in vibriocidal, bacterial-agglutinating, or antitoxin antibodies in acute- and early convalescent-phase sera among persons not recently immunized) <u>OR</u> *For <i>Vibrio cholera</i> : Isolation of organism from epidemiologically implicated water
Parasitic	
1. <i>Cryptosporidium</i> spp.	*Demonstration of oocysts in stool or in small-bowel biopsy of two or more ill persons <u>OR</u> Demonstration of organism in epidemiologically implicated water
2. <i>Cyclospora cayetanensis</i>	*Demonstration of the parasite by microscopy or molecular methods in stool or in intestinal aspirate or biopsy specimens from two or more ill persons <u>OR</u> Demonstration of the parasite in epidemiologically implicated water
3. <i>Giardia intestinalis</i>	*Demonstration of the parasite in stool or small-bowel biopsy specimen of two or more ill persons
4. Swimmer's itch (cercarial dermatitis)	No specific tests for clinical specimens
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) <u>OR</u> Visualization of viruses (NoV) with characteristic morphology by electron microscopy in at least two or more bulk stool or vomitus specimens <u>OR</u> Two or more stools positive by commercial enzyme immunoassay (EIA)

<p>3. Astrovirus</p>	<p>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)</p> <p><u>OR</u></p> <p>Visualization of viruses (NoV) with characteristic morphology by electron microscopy in at least two or more bulk stool or vomitus specimens</p> <p><u>OR</u></p> <p>Two or more stools positive by commercial enzyme immunoassay (EIA)</p>
<p>Chemicals/Toxins</p>	
<p>1. Cnidarians</p>	<p>Suspect: Likely exposure to nematocysts (stinging cells of jellyfish)</p>
<p>2. Chemical hazards, inorganic: pH, hydrogen sulfide, nitrogen trichloride, any contaminant that is recognized in drinking water standards</p>	<p>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.</p> <p>e.g., inorganic levels of nitrogen trichloride in excess of 0.05 ppm (WHO) in the atmosphere</p>
<p>3. Chemical hazards, organic: gasoline additives, chlorine byproducts, lipophilic organic contaminants, chlorinated biphenyls, chloroform volatile organics (THM, [haloacetic acids], other organic fractions)</p>	<p>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 contaminate and the potential routes of exposure through swimming</p>
<p>11. Harmful Algal Blooms (blue-green algae/ toxic cyanobacteria)</p>	<p><u>Anatoxin-a:</u> 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.</p> <p><u>Cylindrospermopsin:</u> 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 .</p> <p><u>Microcystins:</u> <i>Suspect case</i> Gastrointestinal illness and ingested water or contaminated food from water with cyanoHAB bloom <u>OR</u> Dermal symptoms and skin contact to water with a cyanoHAB bloom <u>OR</u> Jaundice, visual disturbances, abdominal pain, nausea, vomiting, bad taste in mouth and routine dialysis with water source with a cyanoHAB bloom <i>Confirmed case</i> Meets suspect case definition and positive assay in clinical specimen and/or vector</p> <p>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.</p> <p>As of July 2016, definitions for reporting HAB-associated cases to CDC are available at http://www.cdc.gov/habs/pdf/ohhabs-case-and-event-definitions-table.pdf.</p>

APPENDIX D: REPORTING OF WATERBORNE OUTBREAKS THROUGH NORS

Use to determine if an outbreak is Waterborne or Foodborne for reporting to CDC via the National Outbreak Reporting System (NORS).

Source of Outbreak**(Known or Suspected)****Reporting Guidelines for NORS**

Food	<ul style="list-style-type: none"> ▪ If contaminated food goes in the mouth – Foodborne ▪ If food is produced or prepared using contaminated water and then the contaminated food is consumed – Foodborne
Water (drinking, recreational [untreated, treated], other)	<ul style="list-style-type: none"> ▪ 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 ▪ If small children are sitting in the water, assume ingestion – Waterborne
Ice	<ul style="list-style-type: none"> ▪ If ice is made with contaminated water – Waterborne ▪ 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 ▪ If ice is made with contaminated water and is used to cool a food product – Foodborne ▪ If ice is already made and then becomes contaminated through handling – Foodborne ▪ If it is unknown how the ice became contaminated – Foodborne
Beverages Prepared with Water	<ul style="list-style-type: none"> ▪ If the beverage is made with contaminated water – Waterborne ▪ If the beverage is already made and then becomes contaminated through handling – Foodborne ▪ If the flavoring (e.g., frozen orange juice concentrate) is contaminated – Foodborne ▪ If it is unknown how the beverage became contaminated – Foodborne
Drink Mix/Soda Machines	<ul style="list-style-type: none"> ▪ 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 ▪ If the drink is contaminated through handling after it is dispensed or contamination of the spout on the machine – Foodborne ▪ If the flavoring is contaminated before it is put into the machine – Foodborne ▪ If it is unknown how the beverage became contaminated – Foodborne
Bottled Water	<ul style="list-style-type: none"> ▪ If bottled water is contaminated anywhere in the chain from source water through production, storage, transportation, distribution, and point of use – Waterborne
Flavored Drinks (note: flavoring does not include carbonation)	<ul style="list-style-type: none"> ▪ If flavoring is added to bottled water and then it becomes contaminated or if the flavoring is contaminated – Foodborne ▪ If the water is contaminated before the flavoring is added – Waterborne ▪ If it is unknown how the flavored bottled water became contaminated – Foodborne

APPENDIX E: REPORTING OF HARMFUL ALGAL BLOOM CASES OR EVENTS USING OHHABS

As of Summer 2016, harmful algal bloom events (blooms) and HAB-associated illnesses in humans or animals can be reported to CDC using the One Health Harmful Algal Bloom System (OHHABS) (<http://www.cdc.gov/habs/ohhabs.htm>). Contact CDE for additional reporting information.

Definitions of HAB events and human/animal case definitions are available at <http://www.cdc.gov/habs/pdf/ohhabs-case-and-event-definitions-table.pdf>.