



# Waterborne Disease Investigations

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# Objectives:

1. Describe the legal requirements for reporting and investigation of waterborne disease outbreaks.
2. Describe the investigation process for waterborne pathogens
3. Describe waterborne organisms of concern affecting municipal water and recreational water



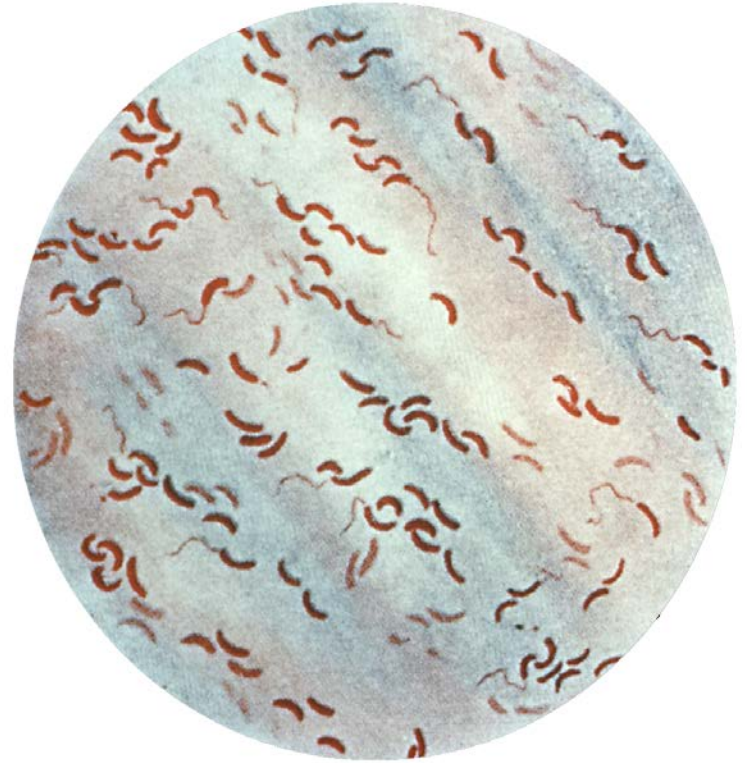
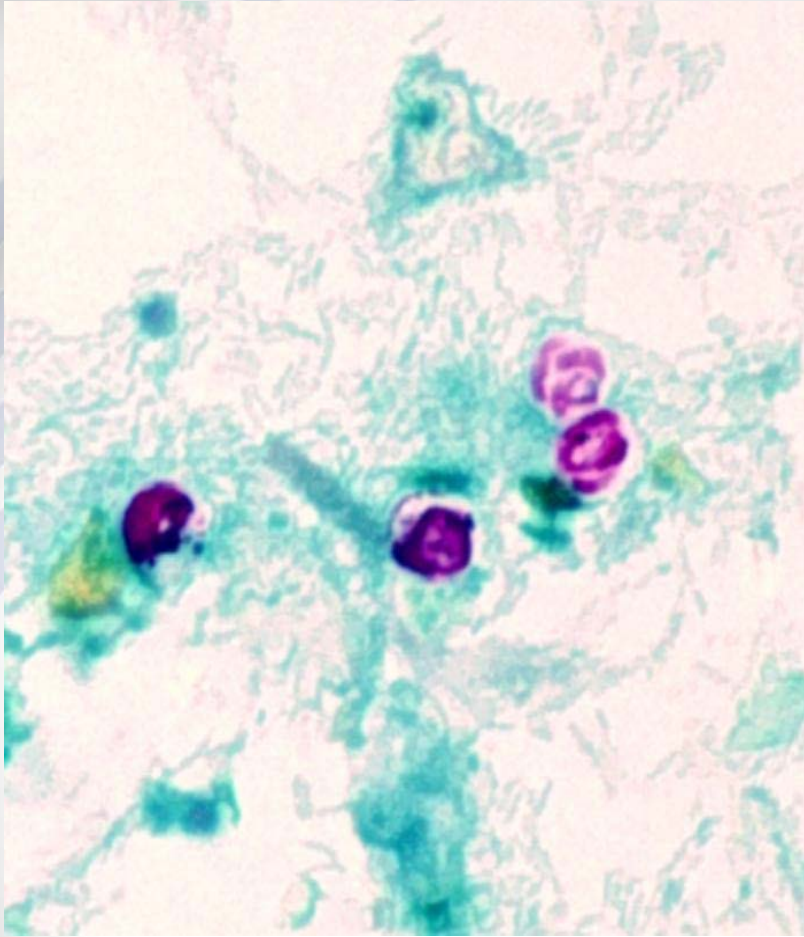
# What are waterborne diseases?

Waterborne diseases are illnesses associated with pathogens of concern that are transmitted to humans via water-whether it be via ingestion, by contact, or through inhaled droplets.

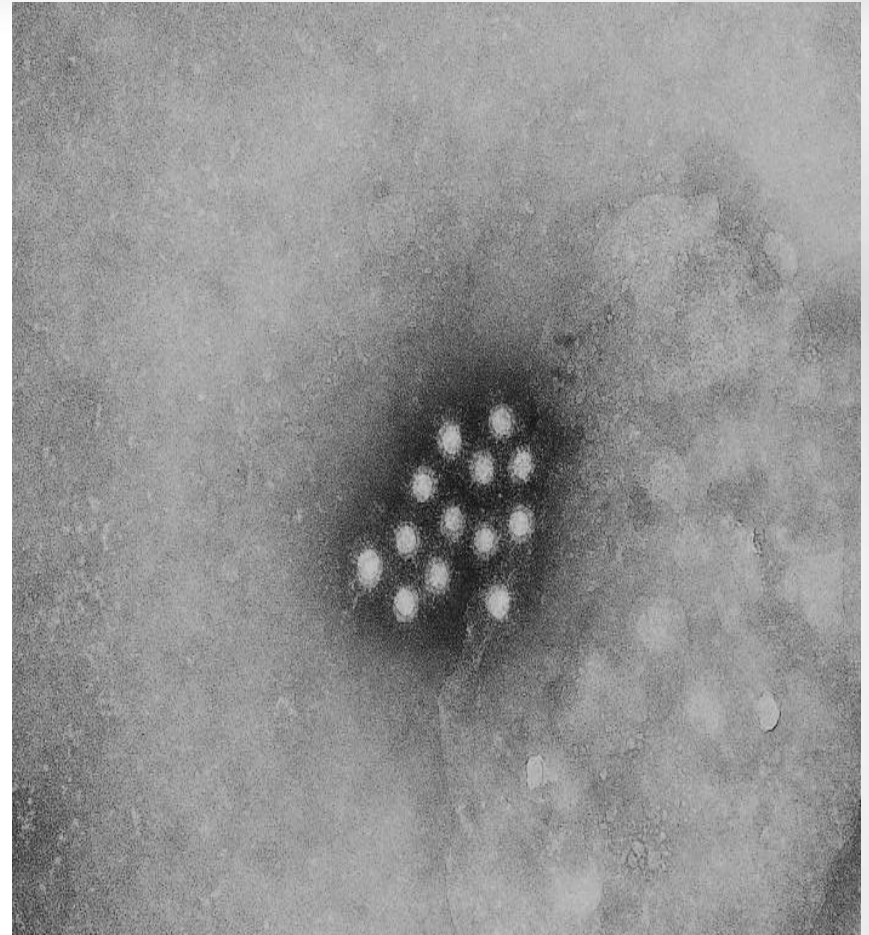
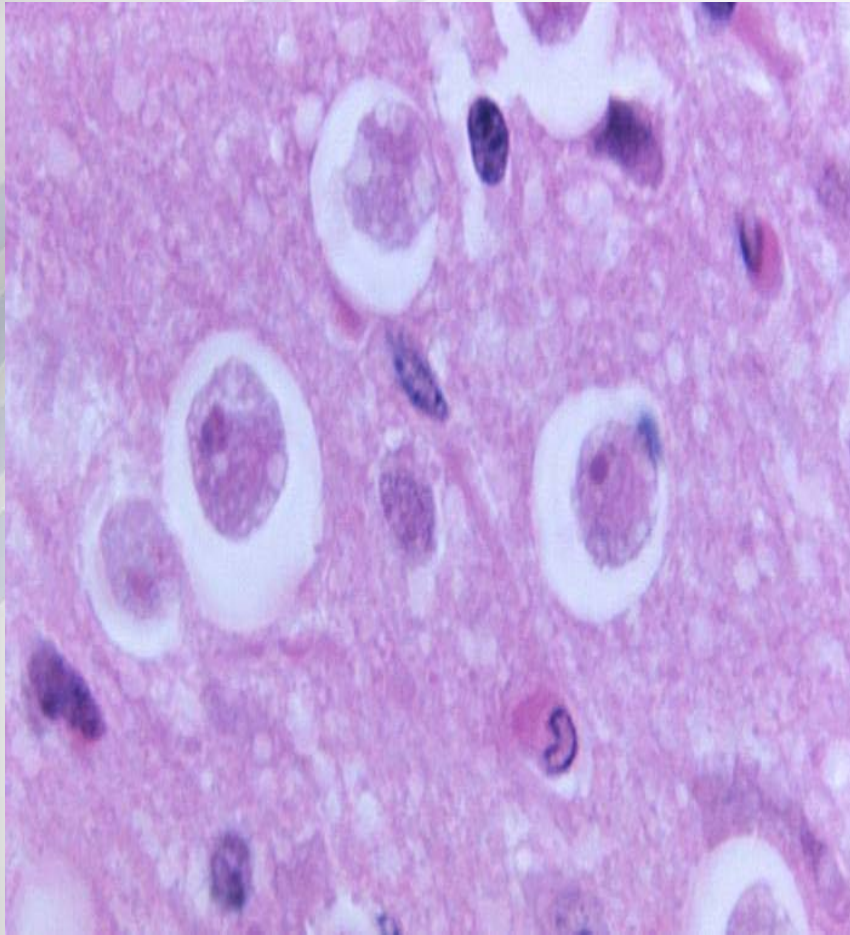




# A variety of organisms. . .



# ...and types!





## Neurologic infections

Echovirus, *Naegleria fowleri*

## Eye infections & irritation

*Acanthamoeba* keratitis, Adenoviruses, chemicals

## Ear infections

*Pseudomonas*

## Respiratory infections & irritation

*Legionella*, non-tuberculous mycobacteria, chemicals, cyanobacteria

## Hepatitis

HAV

## Urinary tract infections

*Pseudomonas*

## Acute gastroenteritis

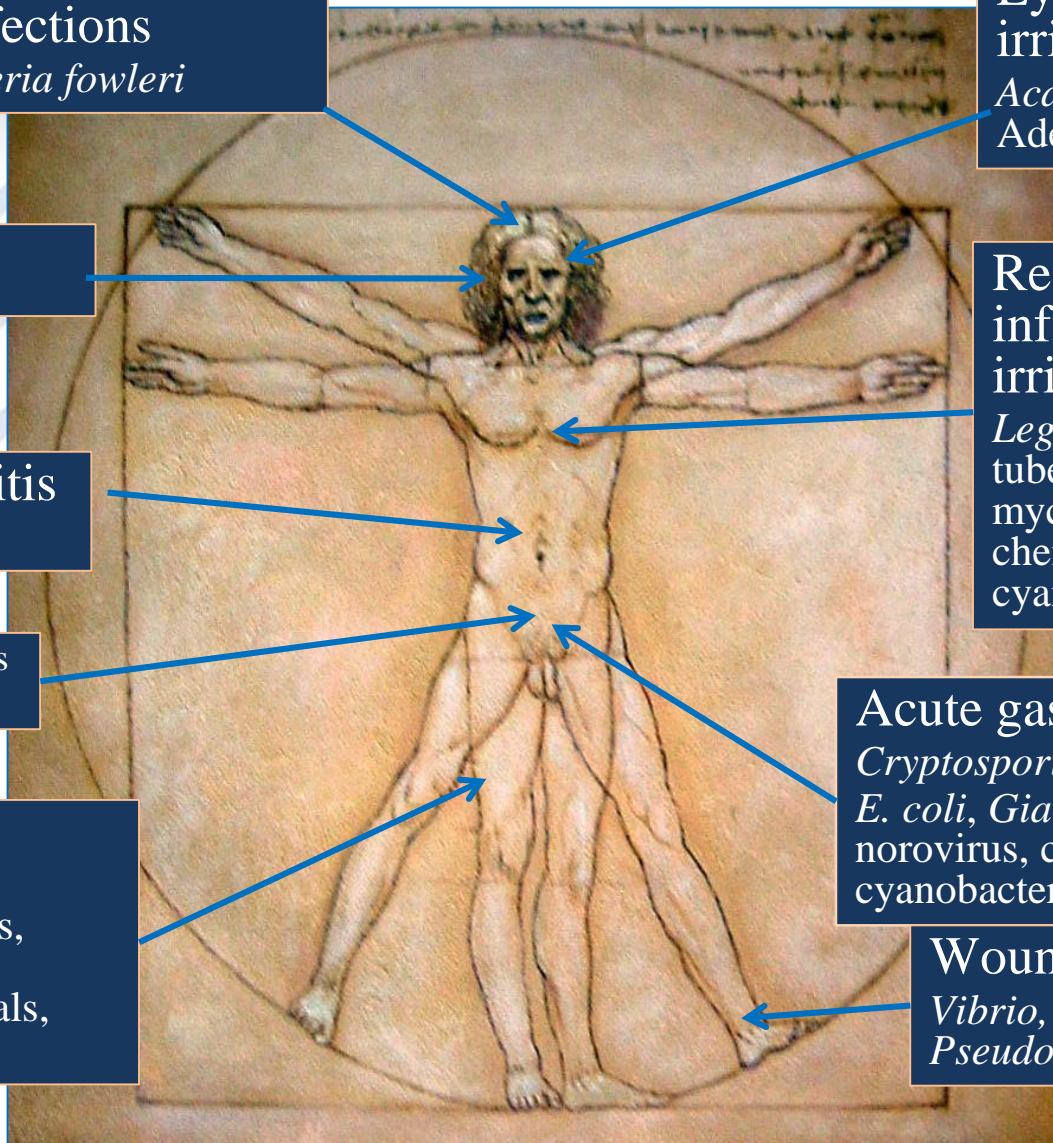
*Cryptosporidium*, toxigenic *E. coli*, *Giardia*, *Shigella*, norovirus, chemicals, cyanobacteria

## Skin infections

*Pseudomonas* dermatitis/folliculitis, fungal infections, schistosoma, chemicals, cyanobacteria

## Wound infections

*Vibrio*, *Aeromonas*, *Pseudomonas*





# **Legal Requirements for Waterborne Disease Outbreak Reporting in Ohio**



# Infectious disease reporting in Ohio

## Ohio Administrative code 3701-3-02

- Any individual case of reportable disease, whatever the cause
- For waterborne outbreaks, any 2 cases linked by epidemiological evidence pointing to exposure to the same water source



## **ORC 3709.22 Duties of Board of City or General Health District.**

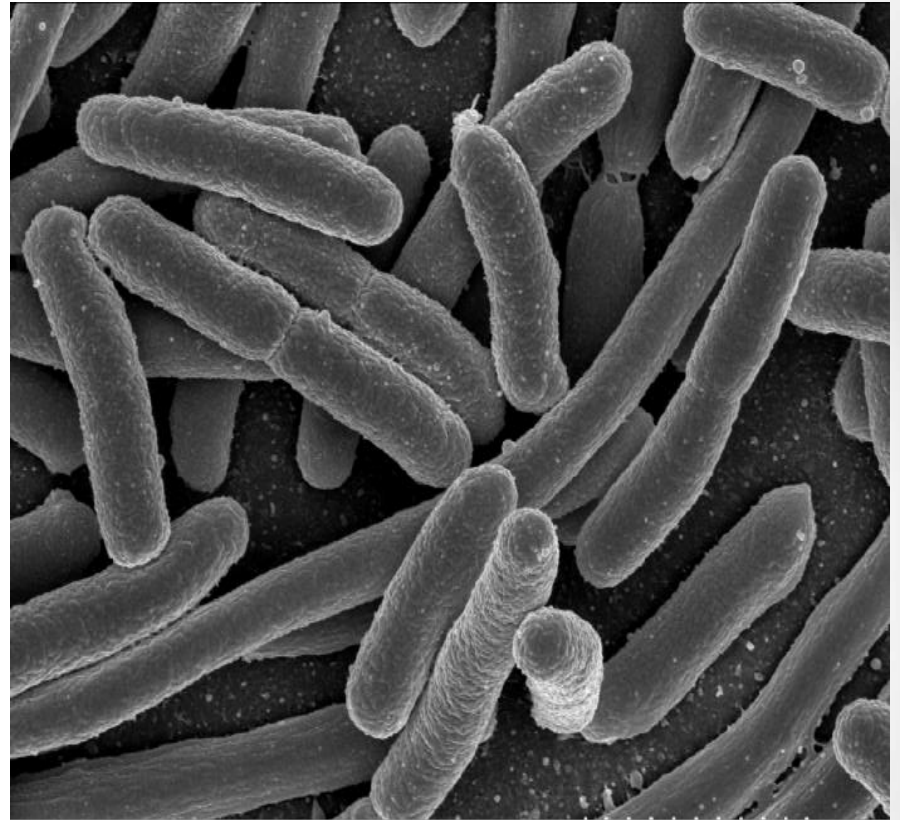
Each board of health of a city or general health district shall .... provide for the prompt diagnosis and control of communicable diseases. The board may also.... take such steps as are necessary to protect the public health and to prevent disease.





# Waterborne outbreak-Class C

All waterborne disease outbreak investigations are reportable under Class C criteria unless the specific pathogen is known and requires reporting under Class A or Class B criteria.



# Categories for waterborne outbreak disease reporting

Reports of waterborne disease outbreaks are divided into different categories based upon the type of water, the setting, and regulatory jurisdiction.

- Recreational Water, Treated
- Recreational water, Untreated
- Water intended for Drinking
- Water not Intended for Drinking or Water of Unknown Intent



# **Conducting a Waterborne Disease Outbreak Investigation**





# The call comes in. . .

- Someone calls you, complaining they are sick and they're sure it came from contact with water. What happens next?



# Gathering initial information

Sanitarians, epidemiologists, and public health nurses should be working together in the local health jurisdiction (and across jurisdictions, if necessitated by an investigation) to gather any information related to the complaint. Who? What? When? Where?



# Consult with ORBIT

- A suspected waterborne outbreak (Class C) must be reported to ODH ORBIT by the end of the next business day.
- An epidemiologist from ORBIT will be assigned to review the information with the local health jurisdiction and provide technical assistance in the event an investigation is necessary. They will provide you with an outbreak number (2016-XX-XXX).







# Investigating a Disease Outbreak

1. Interview cases, as well as possible cases and potentially even well people who may have had similar exposure.
2. Conduct environmental field visits with an environmental health specialist if necessary to investigate the potential sources of illness.
3. If specimens need to be collected for testing at the Ohio Department of Health Laboratory (ODHL), work with ORBIT, who will facilitate.



# Role of the sanitarian

Integral member of outbreak investigation team  
Close collaboration with lab and epi team

Outbreak Inspection: Not a standard inspection  
Begins with a blank sheet of paper  
Observes environment as a forensic investigator



# Outbreak inspections

Inspections focus on:

- Identifying potential hazards
- Identifying previously unrecognizable hazards
- Identifying unusual circumstances
- Identifying information that may prevent future outbreaks



# Gather everything necessary





# Investigating a disease outbreak, Continued

4. Implement public health prevention and control measures to prevent further spread.
5. Enter the outbreak into both the Ohio Disease Reporting System (ODRS) and National Outbreak Reporting System (NORS).



# Online Disease Reporting Systems

File Edit View Favorites Tools Help

Ohio Hospitals ODH Gateway NORS LHD IDOC IDCM Full IDCM Forms ODRS Test Site HAB Monitoring Waterborne

Ohio.gov Ohio Department of HEALTH ODRS

User: Brandi Lennett Home Disease Reporting Analysis Administration Logout Help

**Messages**

3/18/2016 ODRS Geocoder is Down  
ODRS Geocoder is down. You should still be able to save addresses however and they will geocode when services are restored. Thanks for your patience.

3/9/2016 Influenza Reporting  
Influenza A – Novel virus infection is a Class A infectious disease. This is an appropriate selection only when a PCR test cannot subtype a specimen as a seasonal influenza strain. Positive specimens tested by rapid influenza diagnostic tests (RIDT or "rapid flu test") and/or specimens for which a seasonal influenza subtype is confirmed (influenza A/H1N1 2009pdm, influenza A/H3N2, or influenza B) should only be reported if the patient is hospitalized and the specimen is collected within 9 days of admission. Specimens are reportable on "Influenza (nonseasonal) (noninfluenza)" or "Influenza (seasonal)".

**Queue Management**  
Queues pull data back 1 year from last modified or created date.

**Personal Queues**

Queue Name	Description	Last Run Date	View	Edit	Delete	Share?	Duplicate
1-New Queue Feb15	Provides a list of Br...	3/18/2016 4:47 PM	View	Edit	Delete	Submit	Duplicate
2 - Case Updates	Pulls updates to Bran...	3/17/2016 11:52 AM	View	Edit	Delete	Cancel	Duplicate
Marika's New Queue	Provides a list of Ma...	3/11/2016 12:58 PM	View	Edit	Delete	Submit	Duplicate
3 - Pending Queue	Provides a list of Br...	1/13/2016 11:26 AM	View	Edit	Delete	Cancel	Duplicate
5 - Katie Queue	Provides a list of Ka...	12/31/2015 4:55 PM	View	Edit	Delete	Submit	Duplicate
6 - Ellen Queue	Provides a list of El...	12/28/2015 10:49 AM	View	Edit	Delete	Submit	Duplicate
4 - Scott Queue	Provides a list of Sc...	12/23/2015 3:24 PM	View	Edit	Delete	Submit	Duplicate
8 Out of State	Pulls out of state cas...	11/9/2015 10:14 AM	View	Edit	Delete	Cancel	Duplicate
9 Data QC	Pulls cases with pote...	11/2/2015 11:42 AM	View	Edit	Delete	Cancel	Duplicate
Cyclosporins	Cyclo	9/24/2015 3:09 PM	View	Edit	Delete	Submit	Duplicate

Number of records per page: 10 1 to 10 (17) Go to page 1

**Favorite Public Queues**

Queue Name	Description	Created By	View	Favorites
FoodCORE	Salmonella=ODH case update status	Kevin Strobino	View	Remove
FoodCORE	Listeria=ODH case update status	Kevin Strobino	View	Remove
FoodCORE	E. coli=ODH case update status	Kevin Strobino	View	Remove

**Public Queues**

Build#: ODRS 7.5.2

**General**

## National Outbreak Reporting System

### Waterborne Disease Transmission

This form is used to report waterborne disease outbreaks. Pages 1-5 ask for the minimum or basic information about the outbreak investigation, epidemiol specimen and water test results. These are followed by sections specific to the type of water exposure. Only 1 of the 5 water exposure sections should be

Public reporting burden of this collection of information is estimated to average 20 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data n the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. Send comments regardir aspect of this collection of information, including suggestions for reducing this burden to CDC, Project Clearance Officer, 1600 Clifton Road, MS D-24, Atlanta, GA, 30333, ATTN: PRA (0920-0004) <DO NOT MAIL CASI

**CDC USE ONLY**

CDC Report ID State Report ID

**General Section**

**Primary Mode of Transmission (Check one)**

Food (Complete CDC 52.13) Person-to-person (Complete CDC 52.13)



# Forms for Specific organisms

[illegible]

CDC USE ONLY

Free Living Ameba Case Report

Date of Report: \_\_\_\_\_

**Demographics**

Patient's Last Name _____ _____ Ethnicity: <input type="checkbox"/> Hispanic <input type="checkbox"/> Unknown <input type="checkbox"/> Non-Hispanic	First _____ _____ Race: <input type="checkbox"/> White <input type="checkbox"/> Asian/Pacific Islander <input type="checkbox"/> Unknown <input type="checkbox"/> Black <input type="checkbox"/> American Indian <input type="checkbox"/> Other _____	M.I. _____ _____ County and State of Residence: _____ County and State of Treatment: _____	Age _____ _____ Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> Unknown
Immigrant? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown		Country of origin: _____	Date of immigration: _____ Occupation: _____

**Exposure History**

Country/State of Suspected Exposure: \_\_\_\_\_ / \_\_\_\_\_ Number of persons exposed (if known): \_\_\_\_\_

Source of possible exposure, if known: \_\_\_\_\_ (please check all that apply and provide best estimates of dates)

Recreational Water Exposures	Type:	Date(s):	Type:	Date(s):
<input type="checkbox"/> Canal	<input type="checkbox"/> Yes		<input type="checkbox"/> Private Club Pool	<input type="checkbox"/> Community Pool
<input type="checkbox"/> No	<input type="checkbox"/> Lake		<input type="checkbox"/> Private Home Pool	<input type="checkbox"/> Apartment Pool
<input type="checkbox"/> Unknown	<input type="checkbox"/> Pond		<input type="checkbox"/> Fill-and-Drain Pool	<input type="checkbox"/> Fountain
	<input type="checkbox"/> Ocean		<input type="checkbox"/> Hotel Pool	<input type="checkbox"/> Water park
	<input type="checkbox"/> River/Stream		<input type="checkbox"/> Spring (hot/cold)	
	<input type="checkbox"/> Well		<input type="checkbox"/> Spa/hot tub/whirlpool	
	<input type="checkbox"/> Other, specify _____			
		Date(s): _____		
Recreational Water Activities		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Snorkeling/scuba diving	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown
<input type="checkbox"/> Yes	<input type="checkbox"/> Diving into water	<input type="checkbox"/>	<input type="checkbox"/> Swimming	<input type="checkbox"/>
<input type="checkbox"/> No	<input type="checkbox"/> Jumped into water	<input type="checkbox"/>	<input type="checkbox"/> Water sports (sailing etc.)	<input type="checkbox"/>
<input type="checkbox"/> Unknown	<input type="checkbox"/> Swallowed water	<input type="checkbox"/>	<input type="checkbox"/> Wore nose clip or plugged nose when jumping/diving	<input type="checkbox"/>
	<input type="checkbox"/> Splashed water	<input type="checkbox"/>	<input type="checkbox"/> Other, specify _____	
		Date(s): _____		
Nasal Irrigation	Type:	Date(s):		
<input type="checkbox"/> Yes	<input type="checkbox"/> Net pot			
<input type="checkbox"/> No	<input type="checkbox"/> Squeeze bottle			
<input type="checkbox"/> Unknown	<input type="checkbox"/> Squeeze nozzle			
	<input type="checkbox"/> Other, specify _____			
		Date(s): _____		
Soil Exposures	Type:	Date(s):	Occupational Exposures	
<input type="checkbox"/> Yes	<input type="checkbox"/> Gardening		<input type="checkbox"/> Yes	<input type="checkbox"/> Farmer/rancher
<input type="checkbox"/> No	<input type="checkbox"/> Composting		<input type="checkbox"/> Yes	<input type="checkbox"/> Firefighter
<input type="checkbox"/> Unknown	<input type="checkbox"/> Farm/Ranch		<input type="checkbox"/> No	<input type="checkbox"/> Lifeguard/pool attendant
	<input type="checkbox"/> Other: _____		<input type="checkbox"/> Unknown	<input type="checkbox"/> Other, specify _____
	<input type="checkbox"/> specify _____		<input type="checkbox"/> Yes, please fill out specifics _____	

**Route of Entry if known:**

(please check all that apply) ☐ Inhalation ☐ Contact ☐ Other, specify: \_\_\_\_\_

**If Water Source, Please List Source Characteristics:**

Name of Water Exposure: _____ Size of Body Water: <input type="checkbox"/> < 10 acres <input type="checkbox"/> 10-100 acres <input type="checkbox"/> >100 acres <input type="checkbox"/> Unknown Ambient Air Temperature: _____ F/C	Geospatial Coordinates: _____ Water Turbidity: <input type="checkbox"/> Clear <input type="checkbox"/> Cloudy <input type="checkbox"/> Murky <input type="checkbox"/> Unknown Water Temperature: _____ F/C	Water Level: <input type="checkbox"/> Low <input type="checkbox"/> High <input type="checkbox"/> Normal <input type="checkbox"/> Flood Stage <input type="checkbox"/> Unknown Depth: _____ Thermally Polluted: <input type="checkbox"/> Y/N Flow Rate: <input type="checkbox"/> Slow <input type="checkbox"/> Normal <input type="checkbox"/> Fast <input type="checkbox"/> Unknown
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

1 of 9



# Final step for the LHD

6. When the outbreak investigation is complete, write the final outbreak report using the final outbreak report template and upload into ODRS and NORS within 90 days of reporting the outbreak to ODH.





# Final outbreak report

Title:  
Jurisdiction:  
Type of outbreak:  
ODRS ID:  
Outbreak ID:  
CDC NORS ID:

## Final Report

**Context / Background** – Information that helps to characterize the incident (population affected - e.g. estimated number of persons exposed and number of persons ill; location - e.g. setting or venue; geographical area(s) involved; suspected or known etiology).

**Initiation of Investigation** – Information regarding receipt of notification and initiation of the investigation (date and time initial notification was received by the agency; date and time investigation was initiated by the agency).

**Investigation Methods** – Epidemiological or other investigative methods employed (initial investigative activity - e.g. verified laboratory results; data collection and analysis methods - e.g. case-finding, cohort/case-control studies, environmental; tools that were relevant to the investigation - e.g. epidemic curves, attack rate tables, and questionnaires; case definitions - as applicable; exposure assessments and classification; review of reports developed by first responders, lab testing of environmental media, reviews of environmental testing records, industrial hygiene assessments, questionnaires).

**Investigation Findings/Results** – All pertinent investigation results (epidemiological results; laboratory results; clinical results; other analytic findings).

**Discussion and/or Conclusions** – Analysis and interpretation of the investigation results and/or any conclusions drawn as a result of performing the investigation (in certain instances, a conclusions section without a discussion section may be sufficient).

**Recommendations for Controlling Disease and/or Preventing/Mitigating Exposure** – Specific control measures or other interventions recommended for controlling the spread of disease or preventing future outbreaks and/or for preventing/mitigating the effects of an acute environmental exposure.

**Key investigators and/or report authors** – Names and titles are critical to ensure that lines of communication with partners, clinicians, and other stakeholders can be established.

**Submitted on** – mm/dd/yyyy

Updated: 12/07/2012



# Special circumstances

- If you are reporting a suspected HABS-related illness, this should be reported to the Bureau of Environmental Health at ODH at 1-866-OHIO BCH (1-866-644-6224).
- If you are reporting even one case of an illness with suspected Primary Amebic Meningoencephalopathy (PAM), contact ODH ORBIT immediately.



# **Selected Agents Often Implicated in Waterborne Disease Outbreaks**



# Top 5 agents in waterborne outbreaks

## Top 5 Causes - Drinking Water Outbreaks

- *Giardia*
- *Legionella*
- *Shigella*
- Norovirus
- *Campylobacter*

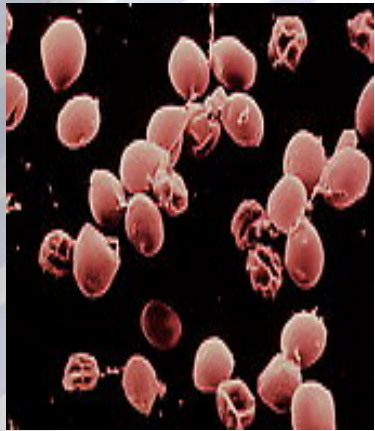
## Top 5 Causes - Recreational Water Outbreaks

- *Cryptosporidium*
- *Pseudomonas*
- *Shigella*
- *Legionella*
- Norovirus





# Cryptosporidium



**Source:** Humans, cattle, other domestic animals

**Incubation:** 1-12 days

**Duration:** 72 hours

**Transmission:** Person-to-person, contact with infected animals, environment

**Secondary Cases:** Yes

**Foods:** Drinking water, raw milk, unpasteurized cider

# Giardia



**Source:** Humans, animals

**Incubation:** 3-25 days

**Duration:** 2-6 weeks

**Transmission:** Person-to-person,  
contact with infected animals,  
environment

**Secondary Cases:** Yes

**Foods:** Raw foods

# Legionella

**Source:** Water

**Incubation:** 2-10 days

**Duration:** Variable

**Transmission:** Airborne, inhalation of aerosolized water

**Secondary Cases:** No

**Foods:** Water (not infective by ingestion)



# Shigella

**Source:** Humans

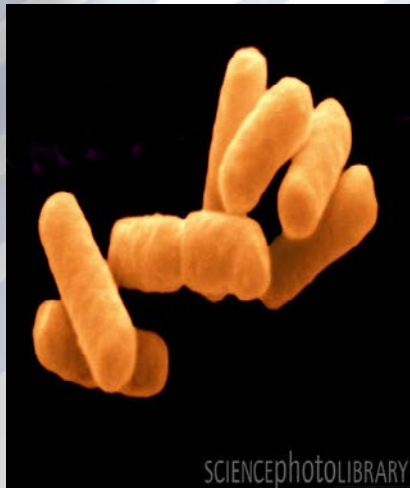
**Incubation:** 1-7 days

**Duration:** 7-10 days

**Transmission:** Direct from humans, or contaminated foods

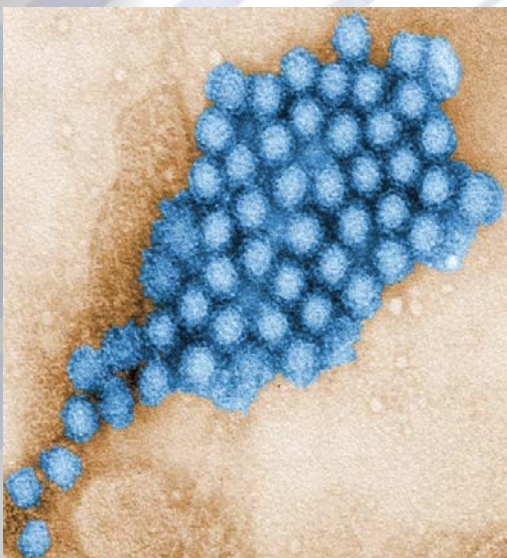
**Secondary Cases:** Yes

**Foods:** Raw foods





# Norovirus



**Source:** Humans

**Incubation:** 10-50 hours

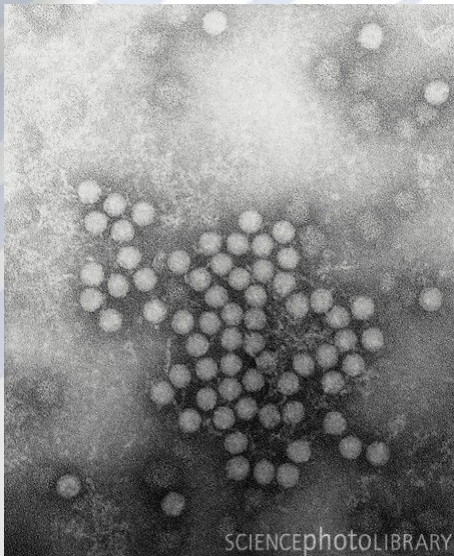
**Duration:** 24-48 hours

**Transmission:** Direct from contaminated food and/or water or person-to-person

**Secondary Cases:** Yes

**Foods:** Foods handled by an infected person or water that is sewage contaminated

# Hepatitis A



**Source:** Humans

**Incubation:** 15-50 days

**Duration:** Can be a few weeks

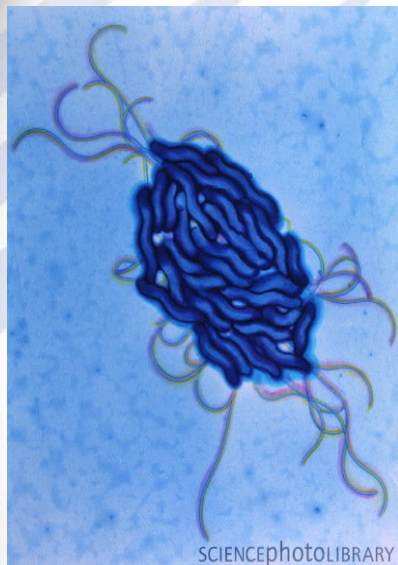
**Transmission:** Direct from contaminated food or person-to-person

**Secondary Cases:** Yes

**Foods:** Foods handled by an infected person or water that is sewage contaminated



# Campylobacter



**Source:** Cattle, poultry

**Incubation:** 1-10 days

**Duration:** 1-7 days

**Transmission:** Direct from animals or contaminated foods

**Secondary Cases:** Yes, but unusual

**Foods:** Raw milk, poultry

# Vibrio

**Source:** Water, shellfish

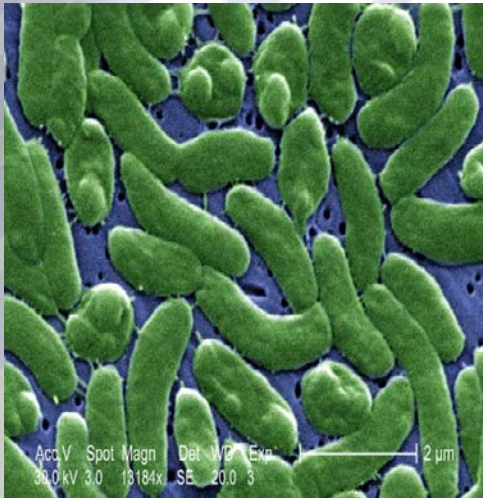
**Incubation:** 4-96 hours

**Duration:** 2 hours-10 days

**Transmission:** Direct from water or contaminated food (shellfish)

**Secondary Cases:** Yes, but unusual

**Foods:** Raw milk, poultry

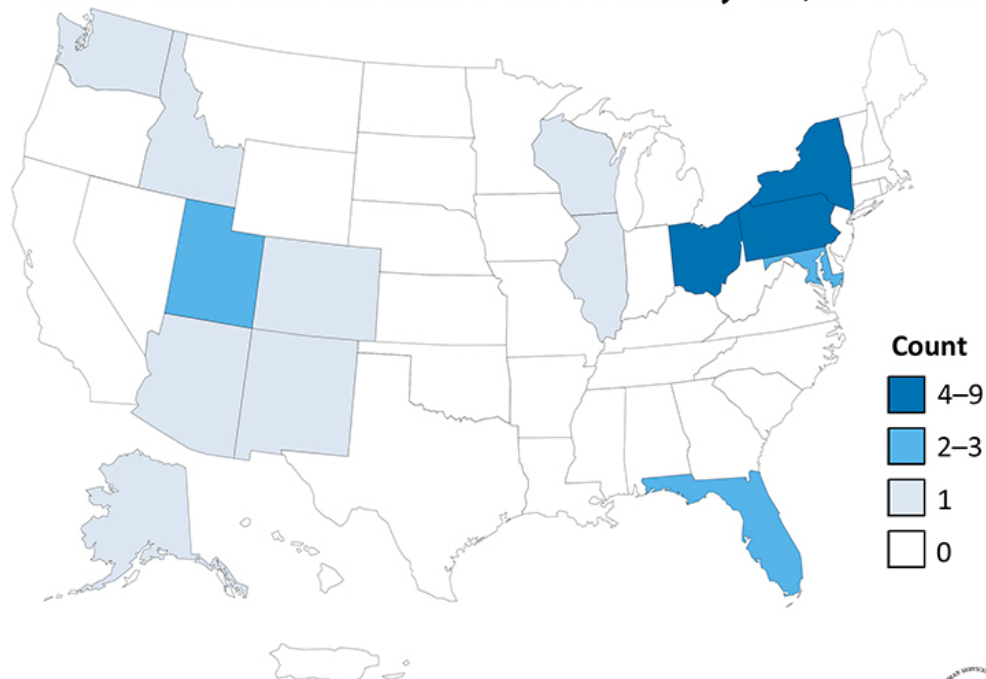




# **Selected Waterborne Disease Outbreaks in Ohio**



**Number of Waterborne-Disease Outbreaks Associated with Drinking Water\* —  
Waterborne Disease and Outbreak Surveillance System, 2011-2012**



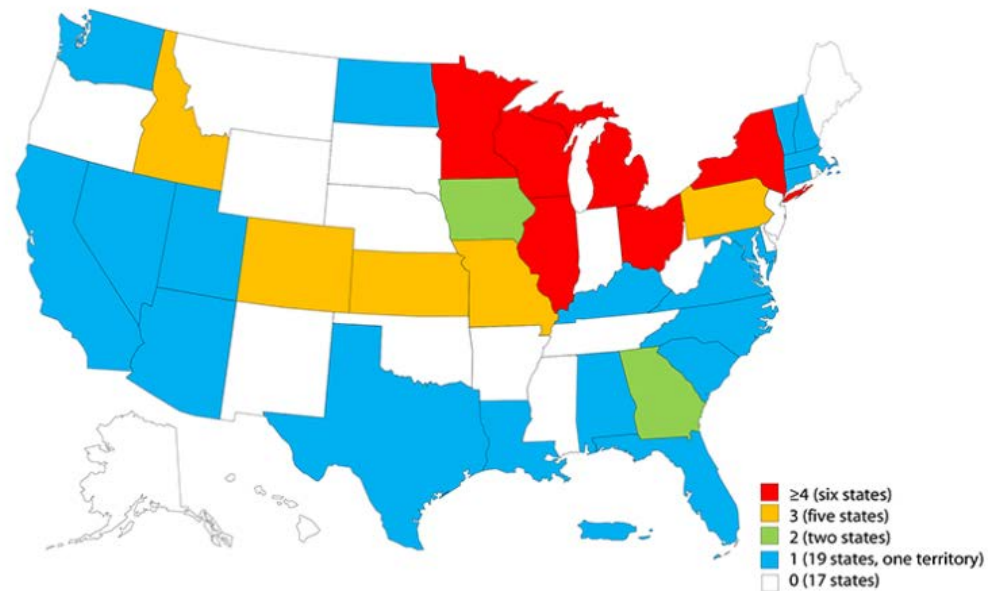
\* N=32. These numbers are largely dependent on reporting and surveillance activities in individual states, and do not necessarily indicate the true incidence of waterborne disease outbreaks in a given state.



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**FIGURE 1. Recreational Water-associated Outbreaks, by Jurisdiction of Exposure\* — United States, 2011–2012**



\*n=90; These numbers are largely dependent on surveillance and reporting activities in individual jurisdictions, and do not necessarily indicate the true occurrence in a given jurisdiction.



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**Table 5: Confirmed and Probable Waterborne Outbreaks, Ohio, 2013**

Month of Onset	Causative Agent	County	# Ill	Setting
November 2012	<i>Legionella pneumophila</i>	Franklin	7	Long-term care facility
December 2012	<i>Legionella pneumophila</i>	Franklin	2	Long-term care facility
December 2012	<i>Pseudomonas aeruginosa</i>	Huron	4	Hotel jacuzzi
March 2013	<i>Legionella pneumophila</i>	Cuyahoga	2	Hospital
April 2013	<i>Legionella pneumophila</i>	Holmes	2	Long-term care facility
April 2013	<i>Pseudomonas aeruginosa</i>	Franklin	5	Hotel hot tub
June 2013	<i>Legionella pneumophila</i>	Franklin	39	Retirement community
June 2013	<i>Legionella pneumophila</i>	Butler	11	Hot tub at private residence
June 2013	<i>Legionella pneumophila</i>	Franklin	4	Hospital
July 2013	<i>Legionella pneumophila</i>	Franklin	3	Hospital
July 2013	<i>Legionella pneumophila</i>	Auglaize	3	Manufacturing plant
July 2013	<i>Legionella pneumophila</i>	Franklin	2	Facility for developmentally disabled
September 2013	Microcystin	Ottawa	6	Township drinking water

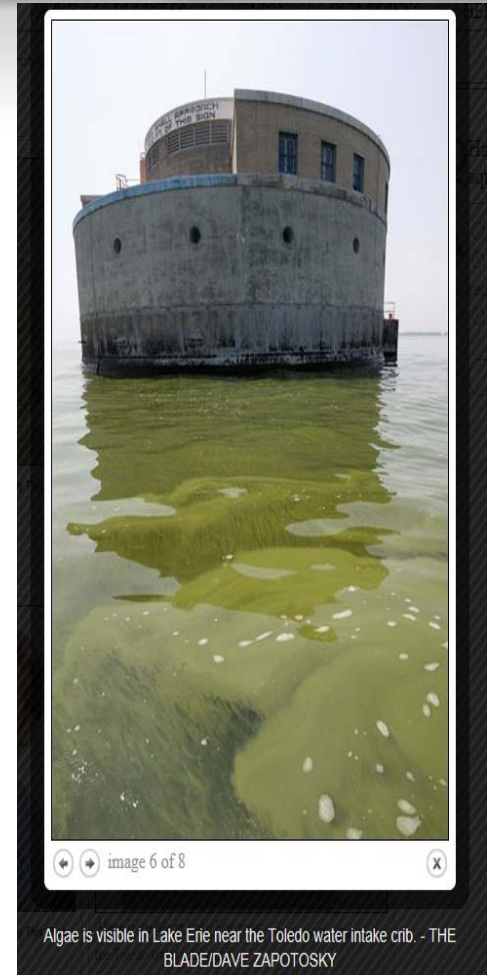
Source of outbreak data: Ohio Disease Reporting System.





# Toledo Water Event

- At 2:00 AM Saturday, August 2<sup>nd</sup>, 2014, a “Do Not Drink” notice was issued by the City of Toledo due to elevated microcystin levels in the municipal water supply.
- Contaminated water samples were collected and sent to various lab for confirmatory testing.
- An active Harmful Algal Bloom (HAB) was present in the Western Basin of Lake Erie, with algae visible near the water intake crib for the municipal water supply.



# *Cryptosporidium* Outbreak Investigation

- Wedding at an orchard  
October 2014
- 100 of 300 attendees ill





# Findings during the investigation

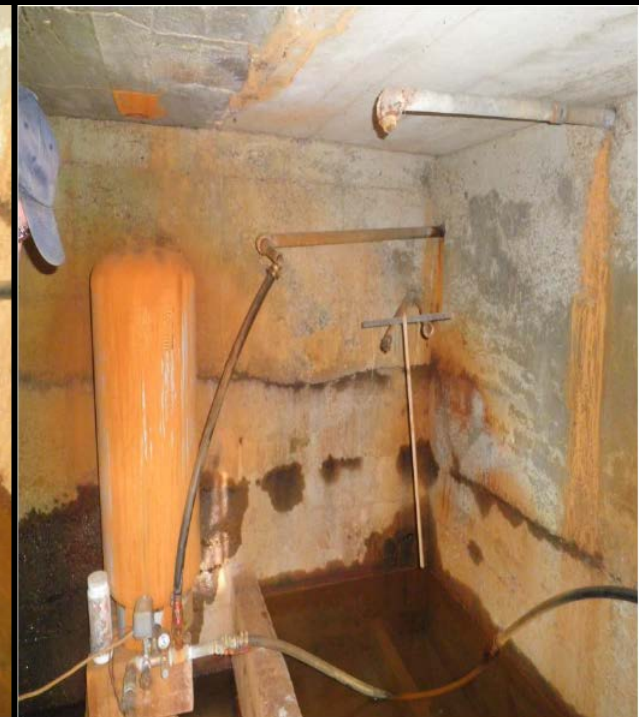
- Water supplying barn and bathrooms from a spring open on the side of a hill
- Inadequate sewage and septic systems for all buildings on property



Spring House



Concrete Water Trough Collecting Spring Water



Inside Spring House – Pressure Tank and Submersible Pump

# Outcome of the investigation

- Environmental health findings critical to investigation
  - Food inspection ruled out caterer
  - Multiple issues with sewage, septic systems, and spring at the site
  - Positive *Cryptosporidium parvum* in the water samples
- Venue closed to the public until improvements are made





# Mycobacterium chelonae

## Notes from the Field: *Mycobacterium chelonae* Eye Infections Associated with Humidifier Use in an Outpatient LASIK Clinic — Ohio, 2015

Please note: An erratum has been published for this article. To view the erratum, please click [here](#).

Weekly

October 23, 2015 / 64(41):1177

Chris Edens, PhD<sup>1,2</sup>; Lauren Liebich, MPH<sup>3</sup>; Allison Laufer Halpin, PhD<sup>1</sup>; Heather Moulton-Meissner, PhD<sup>1</sup>; Samantha Eitner, MPH-VPH<sup>3</sup>; Eric Zgodzinski, MPH<sup>3</sup>; Larry Vasko, MPH<sup>3</sup>; David Grossman, MD<sup>3</sup>; Joseph F. Perz, DrPH<sup>1</sup>; Marika C. Mohr, MS<sup>4</sup>

Laser-assisted in situ keratomileusis (LASIK) eye surgery is increasingly common, with approximately 600,000 procedures performed each year in the United States (1). LASIK eye surgery is typically performed in an outpatient setting and involves the use of a machine-guided laser to reshape the lens of the eye to correct vision irregularities (2). Clinic A is an ambulatory surgery center that performs this procedure on 1 day each month. On February 5, 2015, the Toledo-Lucas County Health Department (TLCHD) in Ohio was notified of eye infections in two of the six patients who had undergone LASIK procedures at clinic A on January 9, 2015. The two patients experienced eye pain after the procedures and received diagnoses of infection with *Mycobacterium chelonae*, an environmental organism found in soil and water.

TLCHD staff visited clinic A on February 12, 2015, to review procedures associated with LASIK surgery and identify possible routes of transmission. None were immediately identified. Clinic A subsequently performed 18 LASIK procedures on February 13, 2015. Two of these 18 patients experienced eye pain in early March 2015 and were determined to have laboratory-confirmed *M. chelonae*. These infections were reported to TLCHD, which prompted clinic A to suspend all further LASIK procedures.

Discussions between CDC, TLCHD, and the Ohio Department of Public Health focused on opportunities for water contamination during the procedures. Although TLCHD staff reported that they did not observe obvious lapses in medication preparation or hand hygiene, they did note that clinic A used two humidifiers to maintain the 40%–50% relative humidity recommended by the manufacturer of the laser device used in the LASIK procedures (3). These cold air, reservoir style, retail humidifiers were filled with tap water and located in the operating room close to where patients were situated during the procedures. Both humidifiers contained an internal reservoir that held water during use. One of these devices used an ultrasonic nebulizer to produce a mist, whereas the other passed dry inlet air over a saturated wick. The misting humidifier had been purchased in December 2014, and the evaporative device had been in use for multiple years. CDC recommended collecting environmental samples throughout the operating room, including from the water reservoir and air output vents on each of the humidifiers.

Laboratory testing performed by CDC isolated *M. chelonae* from the water reservoir of the misting humidifier. Pulsed-field gel electrophoresis results indicated that three of the four patient isolates and the humidifier isolate were indistinguishable; the isolate from the fourth patient was closely related (>95% similarity). After this investigation, clinic A disposed of both humidifiers and upgraded its centralized air handling system to control both temperature and humidity in the operating room environment. No further cases have been reported after the resumption of LASIK procedures in June 2015.

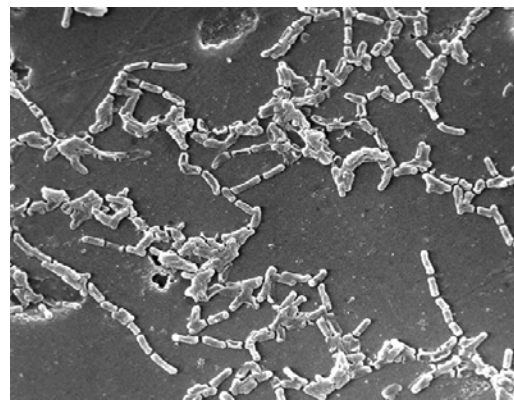
This outbreak was likely caused by the use of a consumer-grade misting humidifier that had been contaminated with *M. chelonae*. Because of the high level of humidity recommended by the manufacturers of the lasers used in LASIK procedures, it is possible that additional LASIK clinics employ similar humidifier systems. Current American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers/American Society for Healthcare Engineering (ANSI/ASHRAE/ASHE) ventilation guidelines state that humidifiers should be located within air handling units or ductwork, and that steam humidification should be used (4). Additionally, current CDC environmental infection control guidance states that use of reservoir style humidifiers is not permitted in health care facilities (5,6). This outbreak highlights the potential risk associated with the use of misting humidifiers in health care settings, and the need for diligent adherence to published recommendations for patient care during all procedures performed in outpatient settings.

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# Questions?

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