

Background

Each year, pathogens transmitted through water are estimated to cause 7.15 million cases of waterborne illness (95% credible interval [CrI], 3.9–12.0 million), 118,000 hospitalizations (95% CrI, 86,800–150,000) and 6,630 deaths (95% CrI, 4,520–8,870) in the United States (1). Summaries of waterborne disease outbreak data can inform prevention efforts for infectious and non-infectious etiologies.

Methods

For an event to be defined as a waterborne disease outbreak, two or more cases of similar illness must be epidemiologically linked by location and time of exposure to contaminated water, contaminated aerosols, or gases volatilized from water. Cases are defined as lab-confirmed or probable using outbreak-specific case definitions. The epidemiologic evidence must implicate water exposure as the outbreak source and can be strengthened by environmental health and laboratory data.

CDC has conducted national surveillance for waterborne disease outbreaks since 1971 via the Waterborne Disease and Outbreak Surveillance System (WBDOSS). Public health officials in U.S. jurisdictions (the 50 states, the District of Columbia, territories, and freely associated states) have voluntarily reported waterborne disease outbreaks through the web-based platform, National Outbreak Reporting System (NORS) (<https://www.cdc.gov/nors/about.html>) since 2009. WBDOSS has captured data regarding outbreaks associated with recreational water, drinking water, and other or unknown types of exposures to water. Water from an identified source other than a recreational venue or drinking water system is referred to as “other water” (e.g., industrial water, flood waters). An outbreak with insufficient data to link the outbreak to one specific source is reported as an unknown water exposure. Individual outbreaks associated with multiple types of water exposures are also reported as unknown.

Agencies use a standard form (https://www.cdc.gov/nors/pdf/NORS_CDC_5212-form.pdf) to report waterborne disease outbreaks. Data collected include the implicated outbreak water exposure (recreational, drinking, other, or unknown water); earliest illness onset date; etiology; implicated recreational water venue or drinking water system; the setting of exposure (e.g., a hotel, apartment complex, hospital); relevant epidemiologic data; and contributing factors. NORS data are available for download and visualization using the NORS Dashboard (<https://www.cdc.gov/nors/data/dashboard/index.html>), a web-based tool for searching and accessing outbreak data.

This summary includes waterborne disease outbreaks reported through NORS as of March 23, 2022, and for which the earliest illness onset was in 2015. Outbreak reports went through a standardized data cleaning process, a collaboration between CDC and reporting jurisdictions. Agencies can submit new outbreak reports and revise or delete reports as additional data become available. Thus, data reported in future analyses for 2015 might differ from the numbers presented here.

Findings

All Water Exposures

During 2015, 82 waterborne disease outbreaks were reported, resulting in at least 1,276 cases, 185 hospitalizations, and 27 deaths (Table 1). Recreational water was implicated in investigations of over half of outbreaks (57%, 47/82), resulting in nearly two-thirds of cases (62%, 787/1,276). Drinking water was implicated in investigations of about one-quarter of outbreaks (28%, 23/82), resulting in about one-third of cases (34%, 429/1,276) and most hospitalizations (67%, 124/185) and deaths (93%, 25/27). Other exposure to water was implicated for 7% (6/82) of outbreaks, resulting in 4% (47/1,276) of cases. In 7% of outbreaks (resulting in 1% of cases) the water outbreak source was unknown.

Table 1. Number and percentage* of reported waterborne disease outbreaks (N = 82) and associated cases, hospitalizations, and deaths, by outbreak exposure — Waterborne Disease and Outbreak Surveillance System, United States, 2015

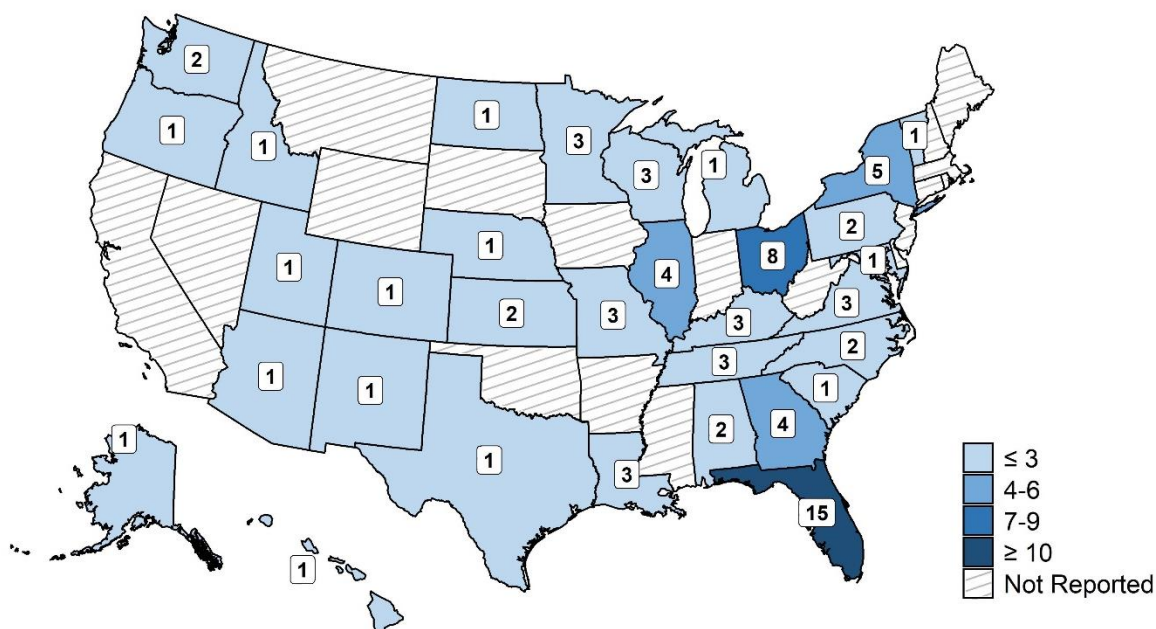
Outbreak Exposure	Outbreaks		Cases		Hospitalizations		Deaths	
	n	%	n	%	n	%	n	%
Recreational water	47	57	787	62	23	12	1	4
Drinking water	23	28	429	34	124	67	25	93
Other water [§]	6	7	47	4	27	15	1	4
Unknown water	6	7	13	1	11	6	0	0
Total	82	100	1,276	100	185	100	27	100

* Percentages might not sum to 100 due to rounding.

[§] Water from an identified source other than a recreational venue or drinking water system is referred to as “other water” (e.g., industrial water, flood waters).

For 2015, public health officials reported 82 waterborne outbreaks resulting from exposures in 32 states. (Figure 1). No outbreaks involving multi-state exposures were reported.

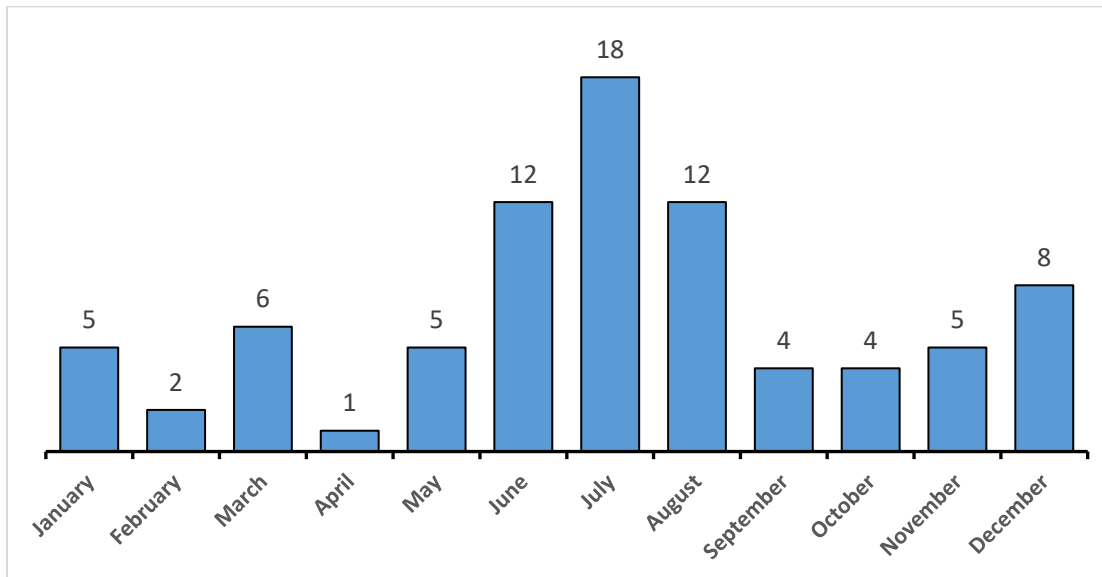
Figure 1. Frequency* of reported waterborne disease outbreaks (N = 82), by state of exposure — Waterborne Disease and Outbreak Surveillance System, United States, 2015



* These numbers are largely dependent on public health capacity and reporting requirements, which vary across jurisdictions, and do not necessarily indicate the true occurrence of outbreaks in each state.

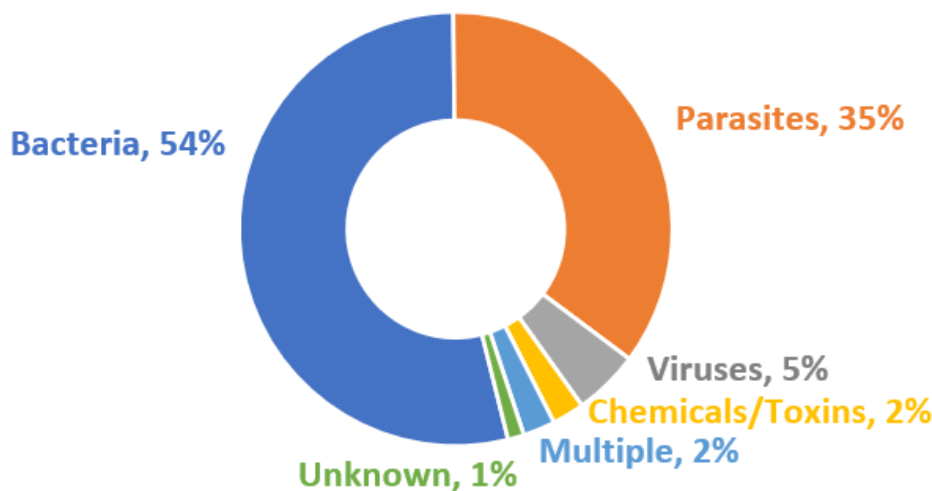
Outbreaks most frequently occurred June–August (51%, 42/82) (Figure 2).

Figure 2. Number of reported waterborne disease outbreaks (N = 82), by month of earliest illness onset — Waterborne Disease and Outbreak Surveillance System, United States, 2015



Bacteria were implicated in 54% (44/82) of outbreaks with a confirmed or suspected etiology; parasites were implicated in 35% (29/82) of outbreaks (Figure 3).

Figure 3. Percentage* of reported waterborne disease outbreaks (N = 82), by etiology type[§] — Waterborne Disease and Outbreak Surveillance System, United States, 2015



* Percentages do not sum to 100 due to rounding.

[§] Outbreaks of confirmed or suspected etiologies are summarized together. Multiple etiology outbreaks include one outbreak suspected to be caused by *Shigella sonnei*, *Campylobacter jejuni*, and norovirus; and one outbreak caused by *Campylobacter jejuni* and suspected to be caused by *Giardia duodenalis*.

At least one etiology was confirmed in 85% (70/82) of investigations of outbreaks (Table 2). Among outbreaks with a confirmed or suspected etiology, *Legionella* was most frequently reported, accounting for 43% (35/82) of outbreaks. This was followed by *Cryptosporidium*, which accounted for 28% (23/82) of outbreaks. *Cryptosporidium* caused 28% (362/1,276) of cases among outbreaks, followed by norovirus (21% [263]) and *Legionella* (18% [234]). *Legionella* accounted for 94% (174/185) of hospitalizations and all 27 deaths.

Table 2. Number* and percentage[§] of reported waterborne disease outbreaks (N = 82) and resulting cases, hospitalizations, and deaths, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Etiology	Outbreaks				Cases				Hospitalizations				Deaths			
	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected
<i>Legionella</i>	35	43	33	2	234	18	224	10	174	94	164	10	27	100	26	1
<i>Cryptosporidium</i>	23	28	22	1	362	28	355	7	6	3	6	0	0	0	0	0
<i>Giardia</i>	4	5	4	0	14	1	14	0	0	0	0	0	0	0	0	0
Norovirus	4	5	4	0	263	21	263	0	1	1	1	0	0	0	0	0
<i>Pseudomonas</i>	3	4	1	2	22	2	13	9	0	0	0	0	0	0	0	0
Chemicals/Toxins [¶]	2	2	0	2	51	4	0	51	1	1	0	1	0	0	0	0
<i>Escherichia</i>	2	2	2	0	15	1	15	0	2	1	2	0	0	0	0	0
<i>Mycobacterium</i>	2	2	1	1	13	1	9	4	0	0	0	0	0	0	0	0
<i>Acanthamoeba</i>	1	1	1	0	2	0	2	0	0	0	0	0	0	0	0	0
Avian schistosomes	1	1	0	1	22	2	0	22	0	0	0	0	0	0	0	0
<i>Campylobacter</i>	1	1	1	0	4	0	4	0	0	0	0	0	0	0	0	0
<i>Salmonella</i>	1	1	0	1	3	0	0	3	0	0	0	0	0	0	0	0
Multiple [†]	2	2	1	1	259	20	9	250	1	1	1	0	0	0	0	0
Unknown [‡]	1	1	--	--	12	1	--	--	0	0	--	--	0	0	--	--

* Confirmed and suspected totals might not sum to outbreak, case, or hospitalization count due to exclusion of unknown etiologies.

[§] Percentages might not sum to 100 due to rounding.

[¶] Chemical/toxin exposures include suspected chlorine and chloramine exposures.

[†] Multiple etiology outbreaks include one outbreak suspected to be caused by *Shigella*, *Campylobacter*, and norovirus and one outbreak caused by *Campylobacter* and suspected to be caused by *Giardia*.

[‡] Outbreaks of unknown etiology cannot be classified according to confirmed or suspected etiology for outbreak, cases, hospitalizations, or deaths. In 2015, there was one reported outbreak with an unknown etiology.

The most frequently reported outbreak settings were hotels or motels (22%, 18/82 outbreaks), outdoor recreational areas (10%, 8/82), hospitals or healthcare facilities (9%, 7/82), and communities or municipalities (7%, 6/82) (Table 3).

Table 3. Number and percentage* of reported waterborne disease outbreaks (N = 82) and resulting cases, by setting — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Water Setting	Outbreaks		Cases	
	n	%	n	%
Hotel/Motel	18	22	165	13
Outdoor Recreational Area	8	10	265	21
Hospital/Healthcare Facility [§]	7	9	65	5
Community/Municipality [¶]	6	7	283	22
Long Term Care Facility/Assisted Living	5	6	78	6
Camp/Cabin	4	5	108	8
Private Residence	4	5	19	1
Recreational Facility	3	4	45	4
Waterpark	3	4	61	5
Beach	2	2	18	1
Club (Requires Membership)	2	2	16	1
Resort	2	2	12	1
Multiple [†]	4	5	20	2
Other [‡]	7	9	45	4
Not Reported	4	5	21	2
Unknown	3	4	55	4
Total	82	100	1,276	100

* Percentages might not sum to 100 due to rounding.

[§] A healthcare institution providing inpatient medical or surgical treatment or nursing care for sick or injured persons, or a healthcare facility other than a long-term care or assisted-living facility.

[¶] Includes recreational water facilities owned by a community/municipality.

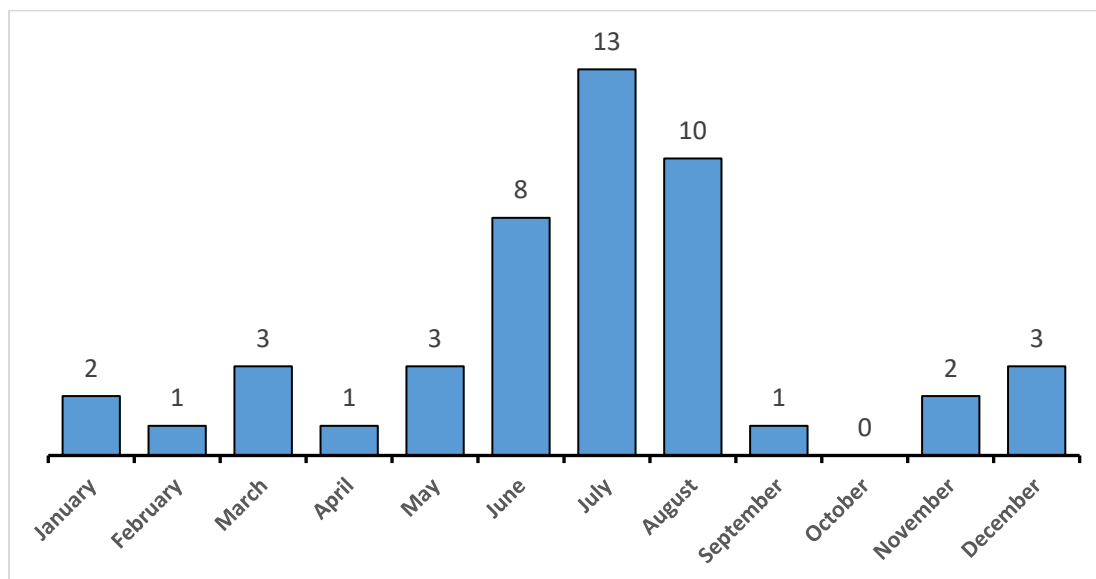
[†] Multiple setting includes: waterpark and child care/daycare center (1), hotel/motel and resort (1), outdoor recreational area and school/college/university (1), and multiple private residences (1).

[‡] Other setting includes: amusement park (1), casino (1), church/place of worship (1), factory/industrial facility (1), farm/agricultural setting (1), indoor workplace/office (1), and restaurant/cafeteria (1).

Recreational Water Exposures

Recreational water was the most frequently reported source of waterborne disease outbreaks, associated with 57% (47/82) of outbreaks, resulting in 62% (787/1,276) of reported cases (Table 1). Recreational water–associated outbreaks occurred year round but peaked during June–August (Figure 4). The seasonality of recreational water–associated outbreaks drove the seasonality of waterborne disease outbreaks overall.

Figure 4. Number of reported waterborne disease outbreaks associated with recreational water (n = 47), by month of earliest illness onset — Waterborne Disease and Outbreak Surveillance System, United States, 2015



Among recreational water outbreaks, 47% (22/47) were caused by *Cryptosporidium* and 19% (9/47) by *Legionella* (Table 4). Among 787 reported cases resulting from recreational water exposure and with a confirmed or suspected etiology, 46% (360/787) of cases were caused by *Cryptosporidium* and 33% (263/787) caused by norovirus. Over three quarters of 23 hospitalizations in those affected by recreational water–associated outbreaks were caused by *Legionella* (57%, 13/23) or *Cryptosporidium* (26%, 6/23). One death was reported for the 47 recreational water–associated outbreaks.

Table 4. Number* and percentage[§] of reported recreational water–associated disease outbreaks (n = 47) and resulting cases, hospitalizations, and deaths, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Etiology	Outbreaks				Cases				Hospitalizations				Deaths			
	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected
<i>Cryptosporidium</i>	22	47	21	1	360	46	353	7	6	26	6	0	0	0	0	0
<i>Legionella</i>	9	20	9	0	30	4	30	0	13	57	13	0	1	100	1	0
Norovirus	4	9	4	0	263	33	263	0	1	4	1	0	0	0	0	0
<i>Pseudomonas</i>	3	6	1	2	22	3	13	9	0	0	0	0	0	0	0	0
Chemicals/Toxins [¶]	2	4	0	2	51	7	0	51	1	4	0	1	0	0	0	0
<i>Acanthamoeba</i>	1	2	1	0	2	0	2	0	0	0	0	0	0	0	0	0
Avian schistosomes	1	2	0	1	22	3	0	22	0	0	0	0	0	0	0	0
<i>Campylobacter</i>	1	2	1	0	4	1	4	0	0	0	0	0	0	0	0	0
<i>Escherichia</i>	1	2	1	0	9	1	9	0	2	9	2	0	0	0	0	0
<i>Giardia</i>	1	2	1	0	3	0	3	0	0	0	0	0	0	0	0	0
<i>Mycobacterium</i>	1	2	1	0	9	1	9	0	0	0	0	0	0	0	0	0
Unknown [†]	1	2	--	--	12	2	--	--	0	0	--	--	0	0	--	--

* Confirmed and suspected totals might not sum to outbreak, case, or hospitalization count due to exclusion of unknown etiologies.

[§] Percentages might not sum to 100 due to rounding.

[¶] Chemical/toxin exposures include suspected chlorine and chloramine exposures.

[†] Outbreaks of unknown etiology cannot be classified according to confirmed or suspected etiology for outbreak, cases, hospitalizations, or deaths. In 2015, there was one reported outbreak with an unknown etiology.

Recreational water–associated outbreaks were most frequently associated with recreational water venues at hotels or motels (26%, 12/47), outdoor recreational areas (13%, 6/47), or communities or municipalities (11%, 5/47) (Table 5).

Table 5. Number and percentage* of reported recreational water–associated disease outbreaks (n = 47) and resulting cases, by setting — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Water Setting	Outbreaks		Cases	
	n	%	n	%
Hotel/Motel	12	26	150	19
Outdoor Recreational Area	6	13	258	33
Community/Municipality [§]	5	11	33	4
Camp/Cabin	3	6	104	13
Recreational Facility	3	6	45	6
Waterpark	3	6	61	8
Beach	2	4	18	2
Club (Requires Membership)	2	4	16	2
Private Residence	2	4	13	2
Resort	2	4	12	2
Amusement Park	1	2	7	1
Multiple [¶]	1	2	7	1
Not Reported	3	6	18	2
Unknown	2	4	45	6
Total	47	100	787	100

* Percentages do not sum to 100 due to rounding.

[§] A recreational water facility owned by a community/municipality.

[¶] Multiple setting includes: a waterpark and child care/daycare center.

Treated water (e.g., in pools, hot tubs, or splash pads) was associated with 85% (40/47) of these outbreaks, resulting in 62% (490/787) of cases; untreated recreational water was associated with 15% (7/47) of outbreaks, resulting in 38% (297/787) of cases (Table 6–7). Among the 40 treated recreational water–associated outbreaks, 45% (18/40) were associated with pools. Eight (20%, 8/40) outbreaks were associated with multiple venue types (Table 6). Nearly all untreated recreational water outbreak venues were associated with a lake or reservoir (86%, 6/7); the remaining outbreak was associated with a river or stream (Table 7).

Table 6. Number and percentage* of reported treated recreational water–associated disease outbreaks (n = 40) and resulting case, by venue — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Venue	Outbreaks		Cases	
	n	%	n	%
Pool	18	45	286	58
Hot Tub	6	15	30	6
Splash Pad	3	8	9	2
Inflatable or Plastic				
Pool/Temporary Water Slide	1	3	4	1
Multiple Venue Types [§]	8	20	120	24
Not Reported	3	8	18	4
Unknown	1	3	23	5
Total	40	100	490	100

* Percentages do not sum to 100 due to rounding.

[§] Multiple venue types includes: pool and hot tub (5); pool and splash pad (1); pool, inflatable or plastic kiddie/wading pool, and splash pad (1); pool, inflatable or plastic pool, and hot tub (1).

Table 7. Number and percentage of reported untreated recreational water–associated disease outbreaks (n = 7) and resulting cases, by venue — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Venue	Outbreaks		Cases	
	n	%	n	%
Lake/Reservoir	6	86	279	94
River/Stream	1	14	18	6
Total	7	100	297	100

Table 8. Reported treated recreational water–associated disease outbreaks (n = 40) and resulting cases, hospitalizations, and deaths — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Jurisdiction	Month	Etiology*	Cases	Hospitalizations [§]	Deaths	Water Venue(s) [§]	Water Setting(s) [§]
Alabama	January	<i>Cryptosporidium</i> sp.	7	0	0	Pool	Recreational Facility
Alabama	June	<i>Cryptosporidium</i> sp.	3	0	0	Pool	Waterpark
Alaska	February	Chlorine (S)	19	0	0	Pool	Community/Municipality
Colorado	March	<i>Legionella pneumophila</i> serogroup 1	2	2	1	Hot Tub	Hotel/Motel
Florida	June	<i>Legionella pneumophila</i>	2	2	0	Hot Tub	Resort
Florida	July	<i>Cryptosporidium parvum</i>	21	0	0	Pool	Waterpark
Florida	July	<i>Cryptosporidium</i> sp.	15	1	0	Pool	Hotel/Motel
Florida	July	<i>Cryptosporidium</i> sp.	7	0	0	Splash Pad, Pool	Child Care/Daycare Center, Waterpark
Florida	August	<i>Cryptosporidium hominis</i> IfA12G1	10	0	0	Hot Tub, Pool	Resort
Florida	August	<i>Cryptosporidium</i> sp.	4	0	0	Temporary Water Slide	Private Residence
Florida	December	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Hot Tub	Community/Municipality
Florida	December	<i>Legionella pneumophila</i> serogroup 1	2	1	0	Hot Tub	Hotel/Motel
Georgia	April	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Hot Tub, Pool	Club (Requires Membership)
Hawaii	July	<i>Cryptosporidium hominis</i> IgA20	7	0	0	Pool	Amusement Park
Illinois	June	<i>Pseudomonas</i> sp.	13	0	0	Hot Tub	Hotel/Motel
Kansas	December	<i>Cryptosporidium</i> sp.	2	0	0	Pool	Hotel/Motel
Kentucky	June	Norovirus Genogroup II	14	0	0	Pool	Club (Requires Membership)
Kentucky	July	<i>Cryptosporidium hominis</i>	11	2	0	Pool	Recreational Facility
Kentucky	August	<i>Legionella pneumophila</i>	3	2	0	Hot Tub, Inflatable or Plastic Kiddie/Wading Pool, Pool	Hotel/Motel
Louisiana	May	<i>Legionella pneumophila</i>	9	NR	0	NR	NR
Louisiana	June	<i>Legionella pneumophila</i>	6	1	0	NR	NR
Louisiana	June	<i>Giardia duodenalis</i>	3	0	0	NR	NR
Minnesota	March	<i>Pseudomonas</i> sp. (S)	2	0	0	Hot Tub, Pool	Hotel/Motel
Missouri	July	<i>Cryptosporidium</i> sp.	37	0	0	Pool	Waterpark
Nebraska	August	<i>Cryptosporidium</i> sp.	23	0	0	Unknown	Unknown
North Carolina	July	<i>Cryptosporidium</i> sp.	3	0	0	Pool	Community/Municipality
North Carolina	November	<i>Cryptosporidium</i> sp. (S)	7	0	0	Pool	Community/Municipality

North Dakota	September	<i>Legionella pneumophila</i> serogroup 1	2	1	0	Hot Tub, Pool	Hotel/Motel
Ohio	July	Chloramines (S)	32	1	0	Pool	Hotel/Motel
Ohio	August	<i>Cryptosporidium</i> sp.	27	0	0	Kiddie/Wading Pool	Recreational Facility
Ohio	August	<i>Cryptosporidium</i> sp.	3	0	0	Splash Pad	Community Park
Oregon	June	<i>Mycobacterium avium</i>	9	0	0	Hot Tub	Private Residence
South Carolina	November	<i>Acanthamoeba</i> sp.	2	0	0	Pool	Community/Municipality
Tennessee	January	Bacterial - Unknown (S)	12	0	0	Pool	Hotel/Motel
Tennessee	July	<i>Cryptosporidium hominis</i> IfA12G1	58	1	0	Pool	Hotel/Motel
Virginia	May	<i>Campylobacter jejuni</i>	4	0	0	Splash Pad	Community Park
Virginia	July	<i>Cryptosporidium hominis</i> IfA12G1	87	0	0	Inflatable or Plastic Kiddie/Wading Pool, Pool, Splash Pad	Camp/Cabin
Virginia	August	<i>Cryptosporidium</i> sp.	2	0	0	Splash Pad	Community Park
Wisconsin	March	<i>Pseudomonas aeruginosa</i> (S)	7	0	0	Hot Tub, Pool	Hotel/Motel
Wisconsin	August	<i>Cryptosporidium</i> sp.	9	0	0	Pool	Camp/Cabin

* (S) = Suspected Etiology.

§ NR = Not Reported.

Table 9. Reported untreated recreational water–associated disease outbreaks (n = 7) and resulting cases, hospitalizations, and deaths, by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2015

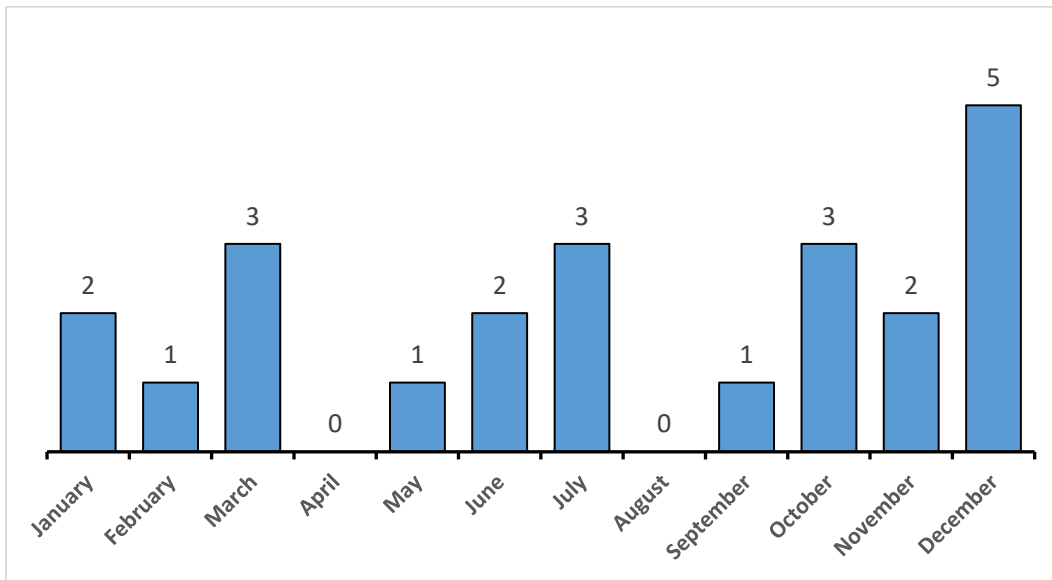
Jurisdiction	Month	Etiology*	Cases	Hospitalizations	Deaths	Water Venue	Water Setting
Idaho	May	Avian schistosomes (S)	22	0	0	Lake/Reservoir	Unknown
Minnesota	August	Norovirus Genogroup II GII.2	18	0	0	River/Stream	Outdoor Recreational Area
Missouri	July	<i>Cryptosporidium parvum</i>	8	0	0	Lake/Reservoir	Camp/Cabin
Ohio	July	<i>Escherichia coli</i> , Shiga toxin-producing	9	2	0	Lake/Reservoir	Beach
Pennsylvania	July	Norovirus unspecified	107	1	0	Lake/Reservoir	State Park
Tennessee	June	<i>Cryptosporidium</i> sp.	9	2	0	Lake/Reservoir	Beach
Vermont	August	Norovirus Genogroup II GII.6	124	0	0	Lake/Reservoir	State Park

* (S) = Suspected Etiology.

Drinking Water Exposures

Drinking water exposure was associated with 28% (23/82) of outbreaks, resulting in 34% (429/1,276) of reported cases, nearly 70% (124/185) of reported hospitalizations, and 93% of deaths (25/27) (Table 1). Drinking water–associated outbreaks did not display seasonality in when they occurred (Figure 5).

Figure 5. Number of reported waterborne disease outbreaks (n = 23) associated with drinking water exposure, by month of first illness onset — Waterborne Disease and Outbreak Surveillance System, United States, 2015



Among drinking water–associated outbreaks, 78% (18/23) of outbreaks were caused by *Legionella* (Table 10). Outbreaks with multiple etiologies accounted for 9% (2/23) of drinking water outbreaks. The remaining outbreaks were caused by *Escherichia*, *Giardia*, and *Mycobacterium*. Drinking water outbreaks associated with multiple etiologies caused 60% (259/429) of cases. *Legionella* caused 37% (157/429) of cases, 99% (123/124) of hospitalizations, and all drinking water–associated outbreak deaths.

Table 10. Number and percentage* of reported waterborne disease outbreaks (n = 23) and resulting cases and hospitalizations associated with drinking water exposure, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Etiology	Outbreaks				Cases				Hospitalizations				Deaths			
	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected
<i>Legionella</i>	18	78	16	2	157	37	146	10	123	99	113	10	25	100	24	1
<i>Escherichia</i>	1	4	1	0	6	1	6	0	0	0	0	0	0	0	0	0
<i>Giardia</i>	1	4	1	0	3	1	3	0	0	0	0	0	0	0	0	0
<i>Mycobacterium</i>	1	4	0	1	4	1	0	4	0	0	0	0	0	0	0	0
Multiple [§]	2	9	1	1	259	60	9	250	1	1	1	0	0	0	0	0
Total	23	100	19	4	429	100	165	264	124	100	114	10	25	100	24	1

* Percentages might not sum to 100 due to rounding.

[§] Multiple etiology outbreaks include one outbreak suspected to be caused by *Shigella*, *Campylobacter*, and norovirus and one outbreak caused by *Campylobacter* and suspected to be caused by *Giardia*.

Outbreaks associated with drinking water most frequently occurred in hospitals or healthcare facilities (30%, 7/23), long term care or assisted living facilities (17%, 4/23), and hotels or motels (13%, 3/23).

Table 11. Number and percentage* of reported waterborne disease outbreaks (n = 23) and cases associated with drinking water exposure by setting — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Water Setting	Outbreaks		Cases	
	n	%	n	%
Hospital/Healthcare Facility [§]	7	30	65	15
Long Term Care Facility/Assisted Living	4	17	72	17
Hotel/Motel	3	13	8	2
Private Residence	2	9	6	1
Community/Municipality [¶]	1	4	250	58
Multiple [†]	1	4	9	2
Other [‡]	4	17	16	4
Not Reported	1	4	3	1
Total	23	100	429	100

* Percentages might not sum to 100 due to rounding.

[§] A healthcare institution providing inpatient medical or surgical treatment and nursing care for sick or injured persons, or a healthcare facility other than a long-term care facility.

[¶] A city, town, or other settlement where a large group of people live and work served by a community or municipal water system.

[†] Multiple setting includes: a hotel/motel and resort.

[‡] Other setting includes: casino (1), factory/industrial facility (1), farm/agricultural setting (1), restaurant/cafeteria (1).

Among drinking water outbreaks, about 70% (16/23) were associated with community water systems. Individual or private water systems (e.g., private wells) accounted for four outbreaks (17%, 4/23). In 2015, there were no reported drinking water outbreaks associated with non-community water systems. By definition, a community water system is a public water system that supplies water to the same population year round; community, individual/private, and non-community water systems are mutually exclusive [\(3\)](#).

Table 12. Number and percentage of reported waterborne disease outbreaks (n = 23) and cases associated with drinking water exposure, by water system — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Water System	Outbreaks		Cases	
	n	%	n	%
Community	16	70	351	82
Individual/Private	4	17	69	16
Not Reported	1	4	3	1
Unknown	2	9	6	1
Total	23	100	429	100

Ground water was the reported source for 43% (10/23) of drinking water outbreaks, resulting in 65% (277/429) of cases, while surface water was associated with 17% (4/23) of outbreaks, resulting in 26% (110/429) of cases. Nine percent (2/23) of outbreaks were associated with both ground water and surface water, and 4% (1/23) of outbreaks were associated with ground water under the influence of surface water.

Table 13. Number and percentage* of reported waterborne disease outbreaks (n = 23) and cases associated with drinking water, by water source — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Water Source	Outbreaks		Cases	
	n	%	n	%
Ground Water	10	43	277	65
Surface Water	4	17	110	26
Ground & Surface Water	2	9	14	3
Ground Water Under Influence of Surface Water	1	4	6	1
Not Reported	2	9	7	2
Unknown	4	17	15	3
Total	23	100	429	100

* Percentages might not sum to 100 due to rounding.

Table 14. Reported waterborne disease outbreaks (n =23) associated with drinking water, by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Jurisdiction	Month	Etiology*	Cases	Hospitalizations [§]	Deaths	Water System [§]	Water Source Description [§]	Water Setting ^{§¶}
Arizona	October	<i>Campylobacter jejuni</i> (S), Norovirus unspecified (S), <i>Shigella sonnei</i> subgroup D (S)	250	0	0	Community	Well	Community/Municipality
Florida	February	<i>Legionella</i> sp.	3	1	0	Community	Unknown	Private Residence
Florida	June	<i>Legionella pneumophila</i> serogroup 1	7	7	2	Community	Unknown	Assisted Living Facility
Florida	September	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Community	Well	Hotel/Motel
Florida	November	<i>Legionella pneumophila</i>	5	4	0	Community	Unknown	Assisted Living Facility
Florida	November	<i>Legionella pneumophila</i>	2	2	1	Community	Well	Hospital/Healthcare Facility
Florida	December	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Community	Well	Hotel/Motel
Georgia	July	<i>Legionella pneumophila</i> serogroup 1	3	3	0	Community	NR	Hospital/Healthcare Facility
Georgia	December	<i>Legionella pneumophila</i> serogroup 1 (S)	6	6	0	Community	NR	Factory/Industrial Facility
Georgia	December	<i>Legionella pneumophila</i> (S)	4	4	1	Community	NR	Hospital/Healthcare Facility
Illinois	July	<i>Legionella pneumophila</i> serogroup 1	58	36	13	Individual/Private	River/Stream	Long Term Care Facility
Illinois	October	<i>Legionella pneumophila</i> serogroup 1	2	1	0	Unknown	NR	Long Term Care Facility
Maryland	October	<i>Legionella pneumophila</i> serogroup 1	4	1	0	Community	Well	Hotel/Motel
Michigan	May	<i>Legionella pneumophila</i> serogroup 1	43	43	5	Community	River/Stream	Hospital/Healthcare Facility
Minnesota	December	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Community	Unknown	Restaurant/Cafeteria
Missouri	March	<i>Legionella pneumophila</i> serogroup 1	3	NR	1	NR	NR	NR
New York	January	<i>Legionella pneumophila</i> serogroup 1 and 6	4	4	1	Community	Lake/Reservoir	Hospital/Healthcare Facility
New York	March	<i>Escherichia coli</i> , Shiga toxin-producing	6	0	0	Individual/Private	NR	Farm/Agricultural Setting
New York	March	<i>Legionella pneumophila</i> serogroup 1 and 4	5	3	1	Community	Lake/Reservoir	Hospital/Healthcare Facility
New York	December	<i>Giardia duodenalis</i>	3	0	0	Individual/Private	Well	Private Residence
Ohio	January	<i>Mycobacterium</i> sp. (S)	4	0	0	Unknown	NR	Hospital/Healthcare Facility
Pennsylvania	July	<i>Legionella pneumophila</i>	2	2	0	Individual/Private	Well	Casino
Utah	June	<i>Campylobacter jejuni</i> , <i>Giardia duodenalis</i> (S)	9	1	0	Community	Well, Other	Private Residence

* (S) = Suspected Etiology.

[§] NR = Not Reported.

¶ A Community/Municipality is a city, town, or other settlement where a large group of people live and work served by a community or municipal water system. A Hospital/Healthcare Facility is as a healthcare institution providing inpatient medical or surgical treatment and nursing care for sick or injured persons, or a healthcare facility other than a long-term care facility.

Other Exposures to Water

Non-drinking, non-recreational exposures to water (referred to as “other exposures to water”—e.g., industrial water exposures, flood waters) were associated with 7% (6/82) of outbreaks and 4% of cases (47/1,276) (Table 1).

Cooling devices were reported in half (3/6) of the other exposures to water outbreaks (Table 15). Untreated water consumed from river/streams (33%, 2/6) and a spring (17%, 1/7) were the remaining reported water exposure types.

Table 15. Number and percentage* of reported waterborne disease outbreaks (n = 6) associated with other exposures to water, by water type — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Water Type	Outbreaks		Cases	
	n	%	n	%
Cooling Device [§]	3	50	36	77
River/Stream	2	33	7	15
Spring	1	17	4	9
Total	6	100	47	100

* Percentages might not sum to 100 due to rounding.

[§] Cooling device includes: cooling tower (2) and evaporative condenser/air conditioner (1).

Legionella caused 50% (3/6) of other water-associated outbreaks, 77% (36/47) of cases, and all hospitalizations. There was one death caused by *Legionella*. The remaining outbreaks were caused by *Giardia* (33%, 2/6) and *Salmonella* (17%, 1/6).

Table 16. Number and percentage of reported waterborne disease outbreaks (n = 6) and resulting cases and hospitalizations associated with other exposures to water, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Etiology	Outbreaks				Cases				Hospitalizations				Deaths			
	n	%	Confirmed	Suspected	N	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected
<i>Legionella</i>	3	50	3	0	36	77	36	0	27	100	27	0	1	100	1	0
<i>Giardia</i>	2	33	2	0	8	17	8	0	0	0	0	0	0	0	0	0
<i>Salmonella</i>	1	17	0	1	3	6	0	3	0	0	0	0	0	0	0	0
Total	6	100	5	1	47	100	44	3	27	100	27	0	1	100	1	0

Table 17. Reported waterborne disease outbreaks (n = 6) associated with other exposures to water, by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Jurisdiction	Month	Etiology*	Cases	Hospitalizations	Deaths	Water Type	Setting
Kansas	September	<i>Salmonella enterica</i> Paratyphi B (S)	3	0	0	River/Stream	Outdoor Recreational Area
New Mexico	July	<i>Giardia duodenalis</i>	4	0	0	River/Stream	Camp/Cabin
New York	September	<i>Giardia duodenalis</i>	4	0	0	Spring	Outdoor Recreational Area
Ohio	May	<i>Legionella pneumophila</i> serogroup 5	20	11	0	Cooling Tower	Indoor Workplace/Office
Ohio	June	<i>Legionella pneumophila</i> serogroup 1	6	6	1	Evaporative Condenser/Air Conditioner	Assisted Living Facility
Washington	October	<i>Legionella pneumophila</i> serogroup 1	10	10	0	Cooling Tower	Unknown

* (S) = Suspected Etiology.

Unknown Exposures to Water

In 7% (6/82) of outbreaks and 1% of cases (13/1,276) the type of water exposure was unknown. Among the six outbreaks where the type of water exposure was unknown, 67% (4/6) had an unknown water exposure and 33% (2/6) had multiple water exposures (Table 18). Outbreaks involving unknown exposures to water most frequently occurred in hotels or other lodging facilities (67%, 4/6) (Table 20).

Table 18. Number and percentage of reported waterborne disease outbreaks (n = 6) associated with unknown exposures to water, by water type — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Water Type	Outbreaks		Cases	
	n	%	n	%
Multiple [*]	2	33	4	31
Unknown	4	67	9	69
Total	6	100	13	100

^{*} Multiple exposure outbreaks includes: Hot Tub and Well (1); Pool and River/Stream (1).

Among outbreaks with an unknown water exposure, 83% (5/6) were caused by *Legionella* and 17% (1/6) by *Cryptosporidium* (Table 19).

Table 19. Number and percentage of reported waterborne disease outbreaks (n = 6) and resulting cases and hospitalizations associated with unknown exposures to water, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Etiology	Outbreaks				Cases				Hospitalizations			
	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected	n	%	Confirmed	Suspected
<i>Legionella</i>	5	83	5	0	11	85	11	0	11	100	11	0
<i>Cryptosporidium</i>	1	17	1	0	2	15	2	0	0	0	0	0
Total	6	100	6	0	13	100	13	0	11	100	11	0

Table 20. Reported waterborne disease outbreaks (n = 6) associated with unknown exposures to water, by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2015

Jurisdiction	Month	Etiology	Cases	Hospitalizations	Deaths	Water Type	Water Setting
Florida	January	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Treated recreational and drinking water exposure*	Hotel/Motel, Resort
Illinois	July	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Unknown	Hotel/Motel
Ohio	August	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Unknown	Church/Place of Worship
Texas	November	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Unknown	Hotel/Motel
Washington	June	<i>Legionella pneumophila</i> serogroup 1	3	3	0	Unknown	Hotel/Motel
Wisconsin	August	<i>Cryptosporidium</i> sp.	2	0	0	Treated and untreated recreational water exposure*	Outdoor Recreational Area, School/College/University

* Illnesses could not be associated with a single type of water exposure.

Limitations

The findings in this summary are subject to at least three limitations. First, only a proportion of waterborne outbreaks are detected, investigated, and reported to the National Outbreak Reporting System (NORS). The counts here are an underestimate of the true burden of waterborne disease outbreaks in the United States and should not be used to estimate the actual number of outbreaks or cases of waterborne disease. Second, these numbers are largely dependent on public health capacity and reporting requirements, which vary across jurisdictions, and therefore do not necessarily indicate the true occurrence in each state. Third, data on outbreaks with a chemical/toxin etiology might be limited because of differences in how these outbreaks are detected and investigated compared with infectious disease outbreaks or characteristics of the contaminants (e.g., persistence in the environment).

Conclusions

Public health surveillance is key to understanding the epidemiology of waterborne disease and outbreaks. *Legionella* and *Cryptosporidium* were the most frequently reported outbreak etiologies of waterborne disease outbreaks for 2015. Filtration and disinfection of water have reduced (though not eliminated) the burden of waterborne disease outbreaks caused by disinfectant-sensitive pathogens. Much of the remaining burden is driven by pathogens that are resistant to disinfection, either through their affinity for biofilm (*Legionella* and *Pseudomonas*) or intrinsic structural resistance (*Cryptosporidium* oocysts are extremely chlorine tolerant due to their hard outer shell). Effective prevention strategies beyond traditional filtration and disinfection of water include developing and implementing water management programs (<https://www.cdc.gov/legionella/wmp/toolkit/index.html>) and adoption of CDC's Model Aquatic Health Code (<https://www.cdc.gov/mahc>).

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