

Background

Each year, 17 pathogens transmitted through water cause an estimated 7.2 million cases of waterborne illness (95% credible interval [CrI], 3.9–12.0 million), 120,000 hospitalizations (95% CrI, 86,800–150,000) and 6,600 deaths (95% CrI, 4,520–8,870) in the United States (1). Summaries of reported waterborne disease outbreak data help characterize waterborne disease epidemiology.

Methods

For an event to be defined as a waterborne disease outbreak, two or more cases of similar illness must be epidemiologically linked by time, location of exposure to water, and type of illness, and this epidemiologic evidence must implicate water as the probable source of illness. Cases are categorized as laboratory-confirmed or probable using case definitions specific to each outbreak. The epidemiologic evidence must implicate exposure to water or gas volatilized from the water 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) (<https://www.cdc.gov/healthywater/surveillance/index.html>). Public health officials in U.S. jurisdictions (the 50 states, the District of Columbia, U.S. 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/index.html>) since 2009. WBDOSS captures outbreak data associated with recreational water, drinking water, other, and unknown types of exposures to water. Water from an identified outbreak source other than a recreational water venue or drinking water system is referred to as “other” water exposure (e.g., industrial water, flood water, agriculture, or medical treatments). If there are insufficient data to link the outbreak to a specific water source, the outbreak is reported to be associated with an unknown water exposure. Individual outbreaks associated with multiple types of water sources are also reported to be associated with an unknown water exposure.

Jurisdictions used a standard form ([National Outbreak Reporting System, CDC 52.12](#))¹ to report waterborne disease outbreaks. In addition to water exposure data, data on the following are collected: earliest illness onset date; etiology; implicated recreational water venue, drinking water system, etc.; the setting of exposure (e.g., a hotel/motel, hospital/healthcare facility, beach); and outbreak case, hospitalization, and death counts. Outbreaks of suspected and confirmed etiologies were summarized together. NORS data are available for visualization and download 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 voluntarily reported through NORS as of January 19, 2023, and for which the earliest illness onset date was in 2021. Outbreak reports went through a standardized data cleaning process, a collaboration between CDC and reporting jurisdictions that increases data quality. Jurisdictions can submit new outbreak reports and revise or delete reports as additional data become available. Thus, 2021 NORS data reported in future analyses might differ from the numbers presented here.

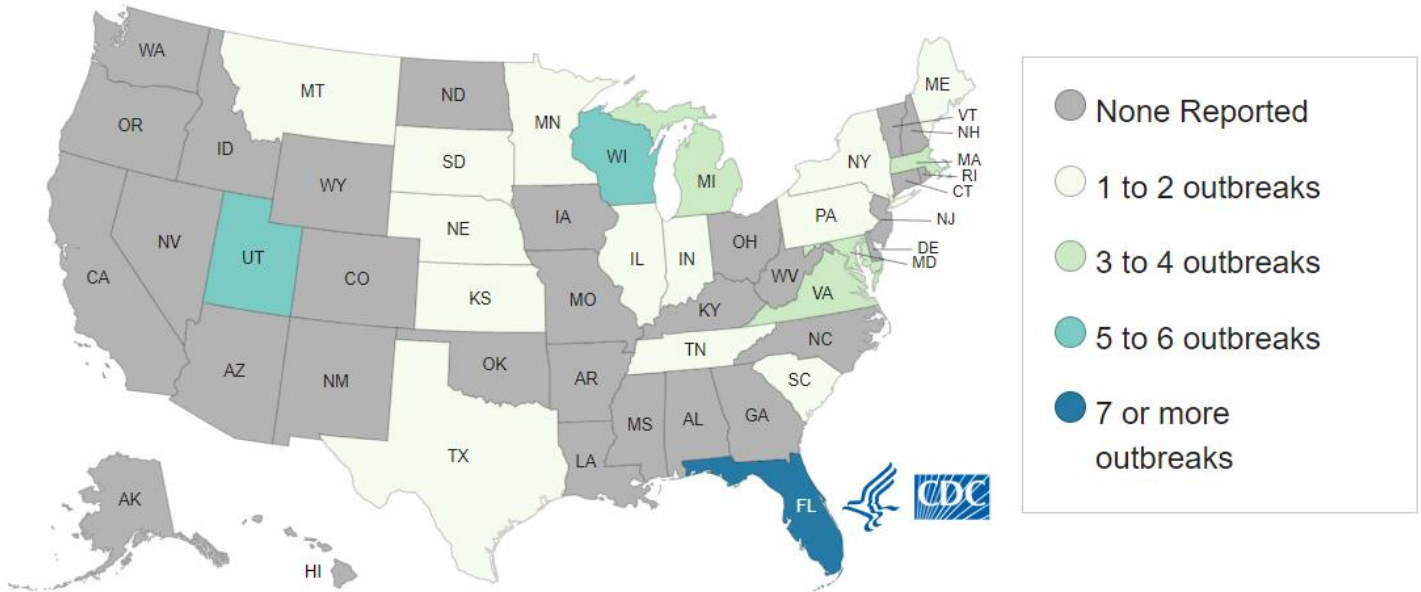
¹An updated NORS reporting form ([CDC 52.14](#)) was released in January 2023 and combines reporting for all modes of transmission. The previous form was used during 2017–January 2023 (including for this report) and was specific to waterborne disease outbreaks.

Findings

All Water Exposures

During 2021, public health officials reported 52 waterborne disease outbreaks associated with exposures in 20 states (Figure 1). No outbreaks involving multi-state exposures were reported.

Figure 1. Frequency* of reported waterborne disease outbreaks (N = 52), by state of exposure — Waterborne Disease and Outbreak Surveillance System, United States, 2021



*These numbers are dependent on public health capacity and reporting requirements, which vary across individual jurisdictions. Thus, these numbers do not necessarily indicate the actual occurrence of outbreaks in each jurisdiction.

The 52 reported outbreaks were associated with at least 511 cases, 104 hospitalizations, and 10 deaths (Table 1). Recreational water was implicated in investigations of almost two thirds of these outbreaks (62%, 32/52) and associated with over half of cases (56%, 284/511), over one third of hospitalizations (36%, 37/104), and one death. Drinking water was implicated in investigations of almost one third of outbreaks (29%, 15/52) and associated with over one third of cases (42%, 214/511), over half of hospitalizations (54%, 56/104), and seven deaths. Other exposure to water was implicated for 2% (1/52) of outbreaks; unknown water exposure was implicated for 8% (4/52) of outbreaks.

Table 1. Number and percentage* of reported waterborne disease outbreaks (N = 52) and associated cases, hospitalizations, and deaths, by type of water exposure — Waterborne Disease and Outbreak Surveillance System, United States, 2021

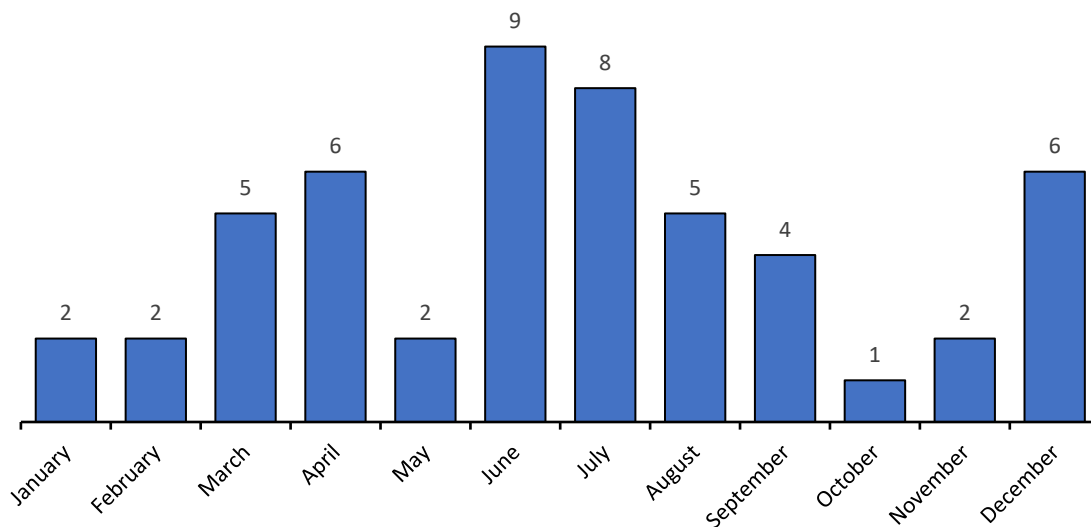
	Outbreaks	Cases	Hospitalizations	Deaths
Water Exposure	N (%)	N (%)	N (%)	N (%)
Recreational	32 (62)	284 (56)	37 (36)	1 (10)
Drinking	15 (29)	214 (42)	56 (54)	7 (70)
Other†	1 (2)	2 (0)	2 (2)	0
Unknown	4 (8)	11 (2)	9 (9)	2 (20)
Total	52 (100)	511 (100)	104 (100)	10 (100)

*Percentages might not sum to 100 due to rounding.

†Water from an identified outbreak source other than a recreational venue or drinking water system is referred to as “other” water exposure (e.g., agriculture, industrial water, flood water, or medical treatments).

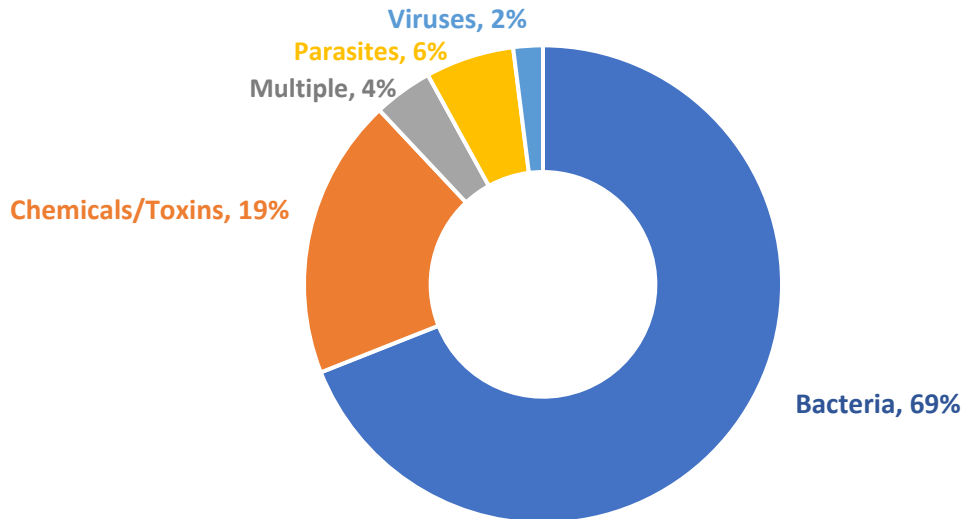
Almost one third (33%, 17/52) of outbreaks started in June or July (Figure 2).

Figure 2. Number of reported waterborne disease outbreaks (N = 52), by month of earliest illness onset — Waterborne Disease and Outbreak Surveillance System, United States, 2021



Bacteria were implicated in 69% (36/52) of outbreaks with a confirmed or suspected etiology; chemicals were implicated in 19% (10) of outbreaks (Figure 3).

Figure 3. Percentage of reported waterborne disease outbreaks (N = 52), by etiology type* — Waterborne Disease and Outbreak Surveillance System, United States, 2021



*Multiple etiology type outbreaks include one outbreak suspected to be caused by *Pseudomonas aeruginosa* and chlorine and one outbreak suspected to be caused by *Campylobacter* and norovirus.

At least one etiology was confirmed in 73% (38/52) of investigations of outbreaks and 14 outbreaks (27%) had suspected etiologies (Table 2). *Legionella* was the most frequently reported etiology, confirmed or suspected to have caused 50% (26/52) of outbreaks. Outbreaks caused by *Legionella* were associated with 20% (103/511) of cases but 63% (65/104) of hospitalizations and six deaths. Harmful algal bloom (HAB) associated etiologies caused 15% (8/52) of outbreaks and 11% (58/511) of cases. These outbreaks, referred to throughout the report as cyanobacterial species/toxins, included cyanotoxin, *Microcystis*, and anatoxin-a.

Table 2. Number and percentage* of reported waterborne disease outbreaks (N = 52) and associated cases, hospitalizations, and deaths, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Etiology Genus	Outbreaks		Cases	Hospitalizations	Deaths
	N (%)	Confirmed [†] , Suspected	N (%)	N (%)	N (%)
<i>Legionella</i>	26 (50)	23, 3	103 (20)	65 (63)	6 (60)
Cyanobacterial species/toxins [‡]	8 (15)	1, 7	58 (11)	1 (1)	0
<i>Campylobacter</i>	3 (6)	2, 1	72 (14)	7 (7)	0
<i>Cryptosporidium</i>	3 (6)	3, 0	64 (13)	0	0
<i>Pseudomonas</i>	3 (6)	2, 1	35 (7)	12 (12)	4 (40)
Chlorine Gas	2 (4)	2, 0	32 (6)	7 (7)	0
<i>Escherichia</i>	2 (4)	2, 0	12 (2)	4 (4)	0
Norovirus	1 (2)	1, 0	20 (4)	0	0
<i>Salmonella</i>	1 (2)	1, 0	3 (1)	0	0
Multiple [§]	3 (6)	1, 2	112 (22)	8 (8)	0
Total	52 (100)	38, 14	511 (100)	104 (100)	10 (100)

*Percentages might not sum to 100 due to rounding.

†An outbreak is considered to have a confirmed etiology if there are two or more lab-confirmed cases, or for certain chemicals/toxins, if there are at least two cases (lab-confirmed or probable cases) with signs and symptoms meeting the clinical confirmation criteria.

‡Cyanobacterial species/toxins included cyanotoxin, *Microcystis* (a cyanobacteria that can produce cyanotoxins), and anatoxin-a (a type of cyanotoxin).

§Multiple etiology outbreaks include one outbreak caused by *Escherichia coli* (confirmed) and *Clostridium difficile* (suspected); one outbreak suspected to be caused by *Pseudomonas aeruginosa* and/or chlorine; and one outbreak suspected to be caused by *Campylobacter* and norovirus.

The most frequently reported outbreak setting was hotel/motel (25%, 13/52 outbreaks), followed by hospital/healthcare facility (17%, 9 outbreaks), and outdoor recreational area (12%, 6 outbreaks) (Table 3).

Table 3. Number and percentage* of reported waterborne disease outbreaks (N = 52) and associated cases, by setting — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Setting	Outbreaks	Cases
	N (%)	N (%)
Hotel/Motel	13 (25)	116 (23)
Hospital/Healthcare Facility [†]	9 (17)	38 (7)
Outdoor Recreational Area	6 (12)	64 (13)
Beach	5 (10)	23 (5)
Apartment/Condo	4 (8)	31 (6)
Club (Requires Membership)	3 (6)	12 (2)
Camp/Cabin Setting	2 (4)	99 (19)
Community/Municipality [‡]	2 (4)	68 (13)
School/College/University	2 (4)	32 (6)
Subdivision/Neighborhood	2 (4)	13 (3)
Unknown [§]	2 (4)	6 (1)
Private Residence	1 (2)	5 (1)
Ship/Boat	1 (2)	4 (1)
Total	52 (100)	511 (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.

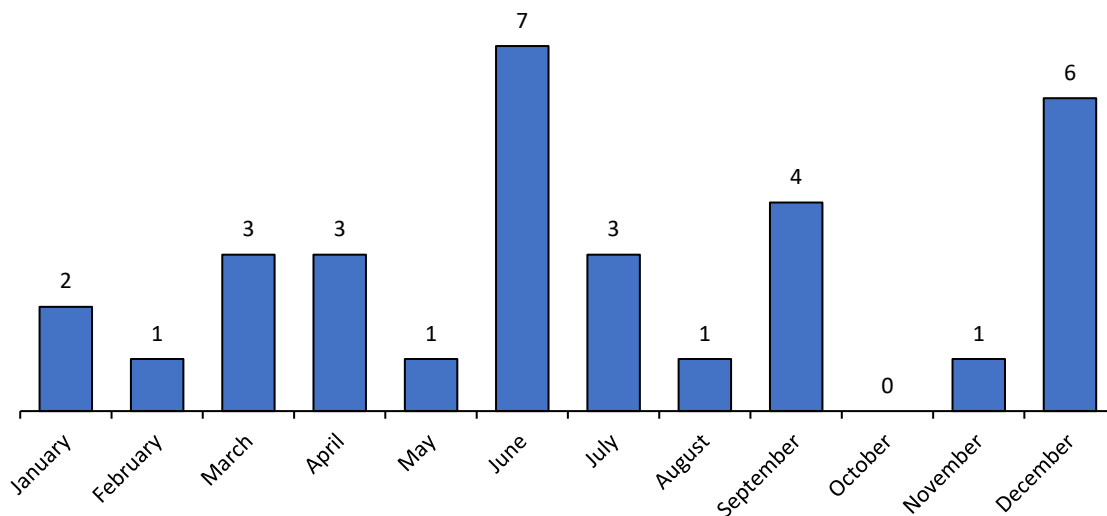
[‡]A city, town, or other settlement where a large group of people live and work.

[§]Setting was reported as unknown by reporting site.

Recreational Water Exposures

Recreational water was the most frequent exposure for reported waterborne disease outbreaks, associated with 62% (32/52) of outbreaks, which were associated with 56% (284/511) of cases, 36% (37/104) of hospitalizations, and one death (Table 1). Recreational water–associated outbreaks occurred year-round, but 31% (10/32) started in June or July (Figure 4). This seasonality of recreational water–associated outbreaks helped drive the seasonality of waterborne disease outbreaks overall. Notably, there were six outbreaks (19%) that occurred in December. These outbreaks were not similar across geography, etiology, or water setting.

Figure 4. Number of reported waterborne disease outbreaks associated with recreational water (N = 32), by month of earliest illness onset — Waterborne Disease and Outbreak Surveillance System, United States, 2021



Among recreational water outbreaks, 38% (12/32) were confirmed or suspected to be caused by *Legionella* (Table 4). These 12 outbreaks were associated with 19% (53/284) of cases but 51% (19/37) of hospitalizations and the only death. Cyanobacterial species/toxins resulted in 8 (25%) outbreaks, 20% (58/284) of cases and one hospitalization.

Table 4. Number and percentage* of reported recreational water–associated disease outbreaks (N = 32) and associated cases, hospitalizations, and deaths, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Etiology Genus	Outbreaks		Cases	Hospitalizations	Deaths
	N (%)	Confirmed, Suspected	N (%)	N (%)	N (%)
<i>Legionella</i>	12 (38)	10, 2	53 (19)	19 (51)	1 (100)
Cyanobacterial species/toxins [†]	8 (25)	1, 7	58 (20)	1 (3)	0
<i>Cryptosporidium</i>	2 (6)	2, 0	62 (22)	0	0
Chlorine Gas	2 (6)	2, 0	32 (11)	7 (19)	0
<i>Pseudomonas</i>	2 (6)	1, 1	23 (8)	0	0
<i>Escherichia</i>	2 (6)	2, 0	12 (4)	4 (11)	0
Norovirus	1 (3)	1, 0	20 (7)	0	0
<i>Salmonella</i>	1 (3)	1, 0	3 (1)	0	0
Multiple [‡]	2 (6)	1, 1	21 (7)	6 (16)	0
Total	32 (100)	21, 11	284 (100)	37 (100)	1 (100)

*Percentages might not sum to 100 due to rounding.

[†]Cyanobacterial species/toxins included cyanotoxin, *Microcystis* (a cyanobacteria that can produce cyanotoxins), and anatoxin-a (a type of cyanotoxin).

[‡]Multiple etiology outbreaks include one outbreak caused by *Escherichia coli* (confirmed) and *Clostridium difficile* (suspected) and one outbreak suspected to be caused by *Pseudomonas aeruginosa* and/or chlorine.

Treated recreational water (e.g., in pools, hot tubs, or splash pads) was associated with 69% (22) of the 32 outbreaks and 77% (219) of the 284 cases; untreated recreational water (e.g., in lakes, rivers, oceans) was associated with 30% (10) of outbreaks and 23% (65) of cases (Tables 5–6). Among the 22 treated recreational water–associated outbreaks, 45% (10) were associated with hot tubs and 27% (6) with pools. Among 10 untreated recreational water outbreaks, 80% were associated with a lake or reservoir.

Table 5. Number and percentage of reported treated recreational water–associated disease outbreaks (N = 22) and associated cases, by venue — Waterborne Disease and Outbreak Surveillance System, United States, 2021

	Outbreaks	Cases
Venue	N (%)	N (%)
Hot Tub	10 (45)	51 (23)
Pool	6 (27)	105 (48)
Splash pad	1 (5)	22 (10)
Multiple*	5 (23)	41 (19)
Total	22 (100)	219 (100)

*Multiple includes the following combinations of venues implicated in outbreak investigations: hot tub and pool (for three outbreaks); kiddie/wading pool and pool (for one); and hot tub, kidding/wading pool, and pool (for one).

Table 6. Number and percentage of reported untreated recreational water–associated disease outbreaks (N = 10) and associated cases, by venue — Waterborne Disease and Outbreak Surveillance System, United States, 2021

	Outbreaks	Cases
Venue	N (%)	N (%)
Lake/Reservoir	8 (80)	34 (52)
Ocean	1 (10)	3 (5)
River/Stream	1 (10)	28 (43)
Total	10 (100)	65 (100)

The most frequently reported setting for recreational water–associated outbreaks was hotel/motel (34%, 11/32), followed by beach (16%, 5/32) and outdoor recreational area (16%, 5/32) (Table 7).

Table 7. Number and percentage* of reported recreational water–associated disease outbreaks (N = 33) and associated cases, by setting — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Setting	Outbreaks	Cases
	N (%)	N (%)
Hotel/Motel	11 (34)	112 (39)
Beach	5 (16)	23 (8)
Outdoor Recreational Area	5 (16)	60 (21)
Apartment/Condo	2 (6)	26 (9)
School/College/University	2 (6)	32 (11)
Club (Requires Membership)	2 (6)	8 (3)
Camp/Cabin Setting	1 (3)	8 (3)
Community/Municipality†	1 (3)	4 (1)
Private Residence	1 (3)	5 (2)
Ship/Boat	1 (3)	4 (1)
Subdivision/Neighborhood	1 (3)	2 (1)
Total	32 (100)	284 (100)

*Percentages might not sum to 100 due to rounding.

†A city, town, or other settlement where a large group of people live and work.

The 22 treated recreational water-associated outbreaks were associated with 219 cases, 33 hospitalizations, and one death (Table 8). Among these outbreaks, 26% (6) were confirmed or suspected to be caused by *Legionella* and associated with hotel/motel hot tubs. One outbreak caused by *Cryptosporidium* resulted in 18% (40/219) of cases.

Table 8. Reported treated recreational water–associated disease outbreaks (N = 22), by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Jurisdiction	Month	Etiology Status	Etiology	Cases	Hospitalizations	Deaths	Water Venue(s)	Water Setting
Florida	March	Confirmed	<i>Legionella pneumophila</i>	2	1	0	Hot Tub	Subdivision/Neighborhood
Florida	April	Confirmed	<i>Legionella pneumophila</i> serogroup 1	3	0	0	Hot Tub	Hotel/Motel
Florida	June	Confirmed	<i>Legionella pneumophila</i> serogroup 1	3	2	0	Hot Tub	Hotel/Motel
Florida	November	Confirmed	<i>Legionella pneumophila</i> serogroup 1	4	4	0	Hot Tub	Community/Municipality
Florida	December	Confirmed	<i>Legionella pneumophila</i> serogroup 1	11	2	0	Hot Tub	Apartment/Condo
Florida	December	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Hot Tub	Club (Requires Membership)
Florida	December	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	1	0	Hot Tub	Hotel/Motel
Illinois	March	Suspected	<i>Pseudomonas</i> sp.	12	0	0	Pool	Hotel/Motel
Indiana	March	Confirmed	<i>Legionella</i> sp.	6	5	0	Pool	Other – Gym/aquatics
Indiana	July	Confirmed	<i>Escherichia coli</i> , <i>Shiga</i> toxin-producing O121	8	1	0	Kiddie/Wading Pool, Pool	Camp/Cabin Setting
Michigan	May	Suspected	<i>Legionella pneumophila</i> serogroup 1	2	1	1	Hot Tub, Pool	Hotel/Motel
Minnesota	December	Confirmed	Chlorine Gas	15	0	0	Pool	School/College/University
Minnesota	December	Suspected	Chlorine, <i>Pseudomonas aeruginosa</i>	6	0	0	Hot Tub, Kiddie/Wading Pool, Pool	Hotel/Motel
Montana	April	Confirmed	<i>Legionella pneumophila</i> serogroup 1	10	0	0	Hot Tub	Hotel/Motel
Pennsylvania	June	Suspected	<i>Clostridium difficile</i> , <i>Escherichia coli</i> , <i>Shiga</i> toxin-producing O157:H7	15	6	0	Pool	Apartment/Condo
South Carolina	September	Suspected	<i>Legionella pneumophila</i> serogroup 1	5	1	0	Hot Tub, Pool	Private Residence

Jurisdiction	Month	Etiology Status	Etiology	Cases	Hospitalizations	Deaths	Water Venue(s)	Water Setting
South Dakota	January	Confirmed	<i>Cryptosporidium</i> sp.	40	0	0	Pool	Hotel/Motel
Tennessee	June	Confirmed	<i>Cryptosporidium</i> hominis, <i>Cryptosporidium</i> parvum	22	0	0	Splash Pad	Outdoor Recreational Area
Virginia	April	Confirmed	<i>Legionella pneumophila</i> serogroup 1	3	0	0	Hot Tub	Hotel/Motel
Wisconsin	January	Confirmed	<i>Pseudomonas aeruginosa</i>	11	0	0	Hot Tub	Hotel/Motel
Wisconsin	June	Confirmed	Norovirus GI.5[P4]	20	0	0	Hot Tub, Pool	Hotel/Motel
Wisconsin	December	Confirmed	Chlorine Gas	17	7	0	Pool	School/College/University

The 10 untreated recreational water-associated outbreaks were associated with 65 cases and four hospitalizations; 50% were associated with a beach setting (Table 9). All but one outbreak started during June–September, and eight outbreaks were confirmed or suspected to be caused by cyanobacterial species/toxins, including cyanotoxin, anatoxin-a, or *Microcystis*.

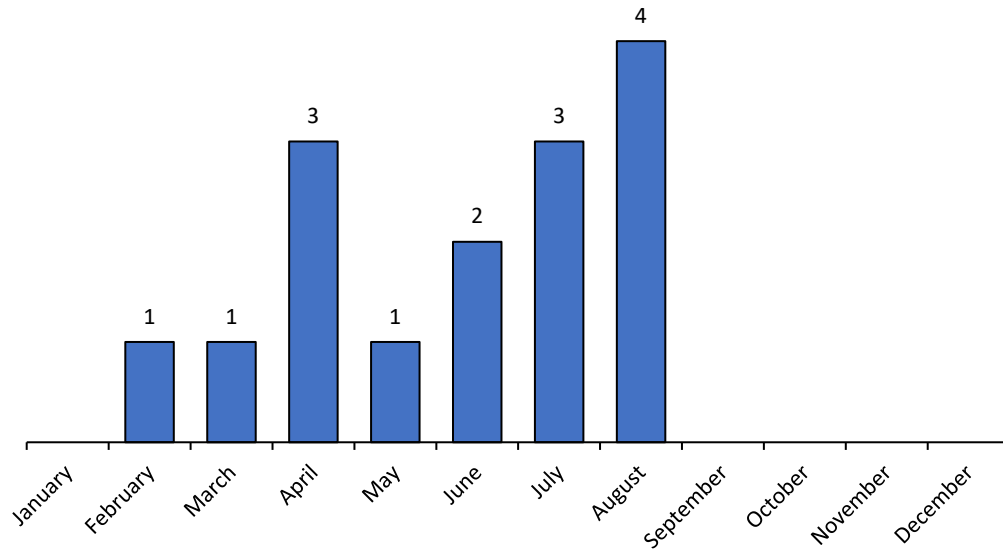
Table 9. Reported untreated recreational water–associated disease outbreaks (N = 10), by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Jurisdiction	Month	Etiology Status	Etiology	Cases	Hospitalizations	Deaths	Water Venue	Water Setting
Florida	June	Confirmed	<i>Salmonella</i>	3	0	0	Ocean	Beach
Kansas	September	Confirmed	<i>Escherichia coli, Shiga toxin-producing O157</i>	4	3	0	Lake/Reservoir	State Park
Michigan	September	Confirmed	Cyanotoxin	4	0	0	Lake/Reservoir	Ship/Boat
Utah	February	Suspected	Anatoxin-a	28	1	0	River/Stream	National Park
Utah	June	Suspected	<i>Microcystis</i>	8	0	0	Lake/Reservoir	Beach
Utah	June	Suspected	Cyanotoxin	3	0	0	Lake/Reservoir	State Park
Utah	July	Suspected	Cyanotoxin	5	0	0	Lake/Reservoir	Beach
Utah	August	Suspected	Cyanotoxin	4	0	0	Lake/Reservoir	Beach
Utah	September	Suspected	Cyanotoxin	3	0	0	Lake/Reservoir	Beach
Virginia	July	Suspected	Cyanotoxin	3	0	0	Lake/Reservoir	Outdoor Recreational Area

Drinking Water Exposures

Drinking water exposure was associated with 29% (15/52) of reported waterborne disease outbreaks, which were associated with 42% (214/511) of cases, 54% (56/104) of hospitalizations, and seven deaths (Table 1). Drinking water-associated outbreaks most frequently started in August, followed by July and April (Figure 5). None of the reported outbreaks started in January or September–December.

Figure 5. Number of reported drinking water–associated disease outbreaks (N = 15), by month of earliest illness onset — Waterborne Disease and Outbreak Surveillance System, United States, 2021



Among the drinking water–associated outbreaks, 67% (10/15) of outbreaks were confirmed or suspected to be caused by *Legionella* (Table 10). Another 20% (3/15) of outbreaks were confirmed or suspected to be caused by *Campylobacter*. Of the remaining two outbreaks, one was caused by *Pseudomonas* and the other was suspected to be caused by multiple etiologies, including *Campylobacter* and norovirus. The latter resulted in 43% (91/214) of cases. Outbreaks confirmed or suspected to be caused by *Legionella* were associated with 18% (39/214) of cases but 63% (35/56) of hospitalizations and 43% (3/7) of deaths. The outbreak caused by *Pseudomonas* was associated with the other 57% (4) of deaths.

Table 10. Number and percentage* of reported drinking water–associated outbreaks (N = 15) and associated cases, hospitalizations, and deaths, by etiology — Waterborne Disease and Outbreak Surveillance System, United States, 2021

	Outbreaks	Cases	Hospitalizations	Deaths
Etiology Genus	N (%)	N (%)	N (%)	N (%)
<i>Legionella</i>	10 (67)	39 (18)	35 (63)	3 (43)
<i>Campylobacter</i>	3 (20)	72 (34)	7 (13)	0
<i>Pseudomonas</i>	1 (7)	12 (6)	12 (21)	4 (57)
Multiple†	1 (7)	91 (43)	2 (4)	0
Total	15 (100)	214 (100)	56 (100)	7 (100)

*Percentages might not sum to 100 due to rounding.

†Multiple includes one outbreak suspected to be caused by multiple etiologies, *Campylobacter* and norovirus.

By definition, a public water system is a system that supplies water to the same population year-round; the categories of public water systems, community and non-community (which includes transient and non-transient), are mutually exclusive (2). Among drinking water–associated outbreaks, about 60% (9/15) were associated with community water systems (Table 11). Individual/private water systems (e.g., private wells) were associated with two outbreaks (13%, 2/15).

Table 11. Number and percentage of reported drinking water–associated outbreaks (N = 15) and associated cases, by water system — Waterborne Disease and Outbreak Surveillance System, United States, 2021

	Outbreaks	Cases
System	N (%)	N (%)
Community	9 (60)	106 (50)
Unknown*	3 (20)	97 (45)
Individual/Private	2 (13)	7 (3)
Commercially Bottled	1 (7)	4 (2)
Total	15 (100)	214 (100)

*Water system was reported as unknown by reporting site.

An unknown water source was associated with 40% (6/15) of drinking water–associated outbreaks, resulting in 50% (106/214) of cases, while surface water was reported for 27% (4/15) of outbreaks, resulting in 15% (33/214) of cases. Ground water was reported for 20% (3/15) of outbreaks, resulting in 32% (68/214) of cases (Table 12).

Table 12. Number and percentage* of reported drinking water–associated outbreaks (N = 15) and associated cases and hospitalizations, by water source — Waterborne Disease and Outbreak Surveillance System, United States, 2021

	Outbreaks	Cases	Hospitalizations
Water Source	N (%)	N (%)	N (%)
Unknown†	6 (40)	106 (50)	12 (21)
Surface Water	4 (27)	33 (15)	30 (54)
Ground Water	3 (20)	68 (32)	11 (20)
Ground Water & Surface Water	1 (7)	3 (1)	3 (5)
Ground Water Under Influence of Surface Water	1 (7)	4 (2)	0
Total	15 (100)	214 (100)	56 (100)

*Percentages might not sum to 100 due to rounding.

†Water source was reported as unknown by reporting site.

The most frequently reported setting for drinking water–associated outbreaks was hospital/healthcare facility (47%, 7/15). One outbreak associated with a camp/cabin setting resulted in 43% (91/214) of cases and another outbreak associated with a community/municipality resulted in 30% (64/214) of cases (Table 13).

Table 13. Number and percentage* of reported drinking water–associated outbreaks (N = 15) and associated cases, by setting — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Setting	Outbreaks	Cases
	N (%)	N (%)
Hospital/Healthcare Facility [†]	7 (47)	33 (15)
Apartment/Condo	2 (13)	5 (2)
Camp/Cabin	1 (7)	91 (43)
Community/Municipality [‡]	1 (7)	64 (30)
Hotel/Motel	1 (7)	2 (1)
Outdoor Recreational Area	1 (7)	4 (2)
Subdivision/Neighborhood	1 (7)	11 (5)
Unknown [§]	1 (7)	4 (2)
Total	15 (100)	214 (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 facility.

[‡]A city, town, or other settlement where a large group of people live and work.

[§]Water setting was reported as unknown by reporting site.

Most outbreaks were caused by *Legionella* (10/15) and occurred in a hospital/healthcare facility (Table 14). One *Campylobacter* outbreak was responsible for 30% (64/214) of cases and occurred in a community/municipality setting using ground water supplied by a well that was reported to be chlorinated for about two weeks twice per year as part of routine maintenance. Another outbreak suspected to be caused by *Campylobacter* and norovirus resulted in 43% (91/214) of cases and occurred in a camp/cabin setting with an unknown water system.

Table 14. Reported waterborne disease outbreaks (N =15) associated with drinking water, by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Jurisdiction	Month	Etiology Status	Etiology	Cases	Hospitalizations	Deaths	Water System	Water Source Description*	Water Setting
Florida	March	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	2	2	Community	Other - Aquifer	Hospital/Healthcare Facility†
Florida	May	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Community	Not Reported	Hospital/Healthcare Facility
Maine	July	Suspected, Suspected	<i>Campylobacter</i> , <i>Norovirus GII</i>	91	2	0	Unknown	Not Reported	Camp/Cabin Setting
Maine	August	Confirmed	<i>Campylobacter jejuni</i>	4	0	0	Individual/Private	Well (Dug)	Outdoor Recreational Area
Maryland	April	Confirmed	<i>Pseudomonas aeruginosa</i>	12	12	4	Community	Lake/Reservoir	Hospital/Healthcare Facility
Maryland	July	Confirmed	<i>Legionella pneumophila</i> serogroup 1	8	8	0	Community	Lake/Reservoir	Hospital/Healthcare Facility
Maryland	August	Confirmed	<i>Legionella pneumophila</i> serogroup 1	11	8	1	Community	River/Stream	Subdivision/Neighborhood
Massachusetts	April	Confirmed	<i>Legionella pneumophila</i>	4	4	0	Unknown	Not Reported	Hospital/Healthcare Facility
Massachusetts	June	Confirmed	<i>Legionella pneumophila</i> serogroup 1	3	2	0	Individual/Private	Not Reported	Apartment/Condo
Massachusetts	August	Suspected	<i>Legionella pneumophila</i>	2	2	0	Unknown	Not Reported	Hospital/Healthcare Facility

Jurisdiction	Month	Etiology Status	Etiology	Cases	Hospitalizations	Deaths	Water System	Water Source Description*	Water Setting
Nebraska	August	Confirmed	<i>Campylobacter jejuni</i>	64	7	0	Community	Well (Drilled)	Community/Municipality [‡]
Texas	April	Suspected	<i>Campylobacter</i>	4	0	0	Commercially Bottled	Not Reported	Unknown
Virginia	July	Confirmed	<i>Legionella sp.</i>	3	3	0	Community	River/Stream & Well	Hospital/Healthcare Facility
Wisconsin	February	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Community	Well (Unknown)	Hotel/Motel
Wisconsin	June	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Community	Unknown	Apartment/Condo

*Water source description further classifies water sources listed in Table 13, as reported in NORS. Other – aquifer, well (drilled), and well (unknown) are types of ground water sources. Lake/reservoir/impoundment and river/stream are types of surface water sources. Well (dug) is a type of ground water under the influence of surface water source.

[†]A Hospital/Healthcare Facility is as 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 facility.

[‡]A Community/Municipality is a city, town, or other settlement where a large group of people live and work.

Other Exposures to Water

Non-drinking, non-recreational exposure to water, referred to as “other exposure to water” (e.g., industrial water exposure, flood water), was associated with one (2%) of the reported waterborne disease outbreaks (Table 1). The outbreak was associated with less than 1% (2/511) of cases, 2% (2/104) of hospitalizations, and no deaths. This outbreak was also associated with an ornamental fountain in a hotel/motel setting (Table 15).

Table 15. Reported waterborne disease outbreaks (N = 1) associated with other (non-drinking, non-recreational) exposure to water, by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Jurisdiction	Month	Etiology Status	Etiology	Cases	Hospitalizations	Deaths	Water Type	Water Setting
Florida	July	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	2	0	Fountain - Ornamental	Hotel/Motel

Unknown Exposures to Water

Unknown water exposure was associated with 8% (4/52) of reported waterborne disease outbreaks (Table 1). The four outbreaks were associated with 2% (11/511) of cases, 9% (9/104) of hospitalizations, and two deaths. *Legionella* was confirmed to cause 75% (3) of the outbreaks, two of which were associated with a hospital/healthcare facility (Table 16).

Table 16. Reported waterborne disease outbreaks (N = 4) associated with unknown exposure to water, by jurisdiction — Waterborne Disease and Outbreak Surveillance System, United States, 2021

Jurisdiction	Month	Etiology Status	Etiology	Cases	Hospitalizations	Deaths	Water Type	Water Setting
Maryland	November	Confirmed	<i>Legionella pneumophila</i> serogroup 1	4	4	0	Unknown	Other – Fitness club
Michigan	March	Confirmed	<i>Legionella pneumophila</i> serogroup 1	2	2	2	Unknown	Hospital/Healthcare Facility*
New York	July	Confirmed	<i>Legionella pneumophila</i> serogroup 1	3	3	0	Other – Aerosols	Hospital/Healthcare Facility
Texas	October	Confirmed	<i>Cryptosporidium</i> sp.	2	0	0	Unknown	Unknown

*A Hospital/Healthcare Facility is as 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 facility

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 actual occurrence in each jurisdiction. Furthermore, the COVID-19 pandemic likely contributed to changes in reporting from states due to limited resources and other factors. 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* was the most frequent outbreak etiology of reported waterborne disease outbreaks for 2021. Of the 26 *Legionella* outbreaks, 35% (9) were associated with a hospital/healthcare facility (seven outbreaks associated with drinking water exposure and two with unknown water exposure) and 23% (6) were associated with a hotel/motel hot tub. In contrast, only three reported outbreaks were caused by *Cryptosporidium*, the historic leading etiology of reported waterborne disease outbreaks in past years. The findings could be due to a change in reporting by jurisdictions during the COVID-19 pandemic. Jurisdictions might have prioritized detecting, investigating, and reporting outbreaks of diseases (e.g., Legionnaires' disease) of increased severity (e.g., associated with hospitalization and death) because of resources being diverted to the pandemic response. Additionally, the pandemic might have led to conditions that promoted replication and transmission of *Legionella* (e.g., water quality not being maintained in hot tubs during low to no hotel/motel occupancy). For 2021, eight outbreaks were confirmed or suspected to be associated with exposures to cyanobacterial species or toxins. This too could be pandemic-related and reflect the public choosing to participate in outdoor activities, such as using untreated recreational water venues. Alternatively, reporting of outbreaks of illness caused by *Legionella* or by harmful algal blooms could reflect increased occurrence or CDC support for jurisdictions' surveillance activities for the respective illnesses.

Over the past 100 years, filtration and disinfection of water have reduced (though not eliminated) the burden of waterborne disease outbreaks in the United States caused by disinfectant-susceptible pathogens. Much of the remaining burden is driven by pathogens that are resistant to disinfection (e.g., *Cryptosporidium*, whose oocysts are chlorine tolerant due to their hard outer shell) or challenging to control due to their growth in biofilm (e.g., *Legionella*, nontuberculous mycobacteria, and *Pseudomonas*). Effective prevention strategies beyond traditional filtration and disinfection of water include developing and implementing water management programs at the state or local level by building owners and managers (<https://www.cdc.gov/legionella/wmp/toolkit/index.html>) and implementing treated recreational water venue guidelines identified in CDC's Model Aquatic Health Code (<https://www.cdc.gov/mahc>).

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