Welcome to the

CDC's Model Aquatic Health Code Network Webinar

Waterborne Infectious Disease Burden and Recreational Water-Associated Illness in the United States

12/4/23

2:00 PM ET

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This webinar is being recorded.

NACCHO
National Association of County & City Health Officials

Webinar Agenda

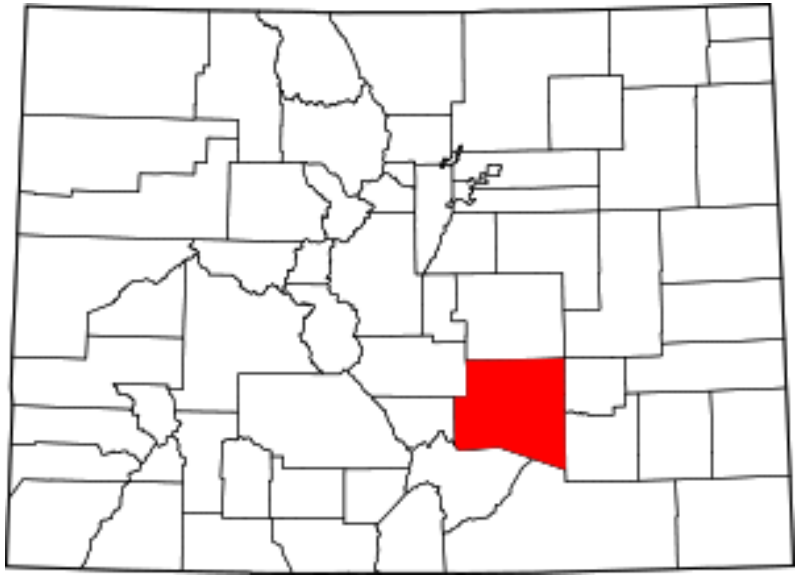
NACCHO
National Association of County & City Health Officials

- NACCHO Announcements
- Presentation: Waterborne Infectious Disease Burden and Recreational Water-Associated Illness in the United States
- **Questions & Answers**

NACCHO Announcements

New Resource: Pueblo County MAHC Implementation Resource Library

- Explore resources that one LHD used when fully adopting and implementing the MAHC, including:
  - Inspection reports
  - Surveys and forms
  - Draft code
  - Board of Health presentations
  - Stakeholder newsletters



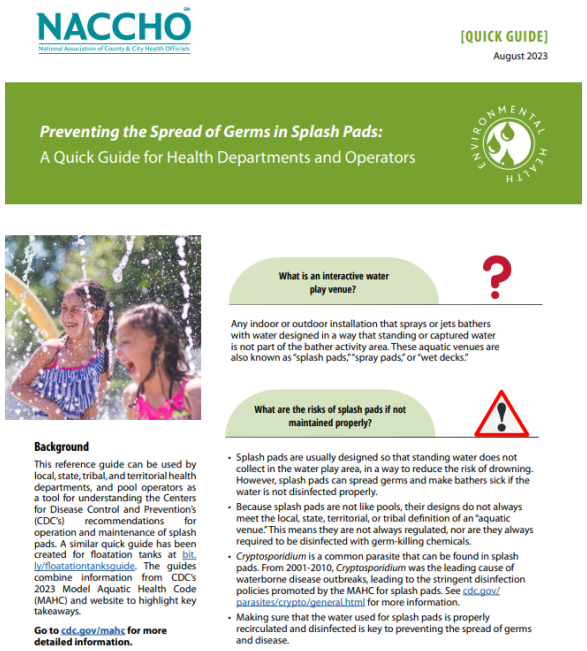
To access: Visit the NACCHO Toolbox at
https://toolbox.naccho.org/pages/tool-view.html?id=6014

Login or create a free MyNACCHO account to download as a ZIP file!

NACCHO Announcements

NACCHO
National Association of County & City Health Officials

New Resources: *MAHC Quick Guides* – Splash Pads and Floatation Tanks



NACCHO
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[QUICK GUIDE]
August 2023

Preventing the Spread of Germs in Splash Pads:
A Quick Guide for Health Departments and Operators

ENVIRONMENTAL HEALTH

Background

This reference guide can be used by local, state, tribal, and territorial health departments, and pool operators as a tool for understanding the Centers for Disease Control and Prevention's (CDC's) recommendations for operation and maintenance of splash pads. A similar quick guide has been created for floatation tanks at bit.ly/floatationtanksguide. The guides combine information from CDC's 2023 Model Aquatic Health Code (MAHC) and website to highlight key takeaways.

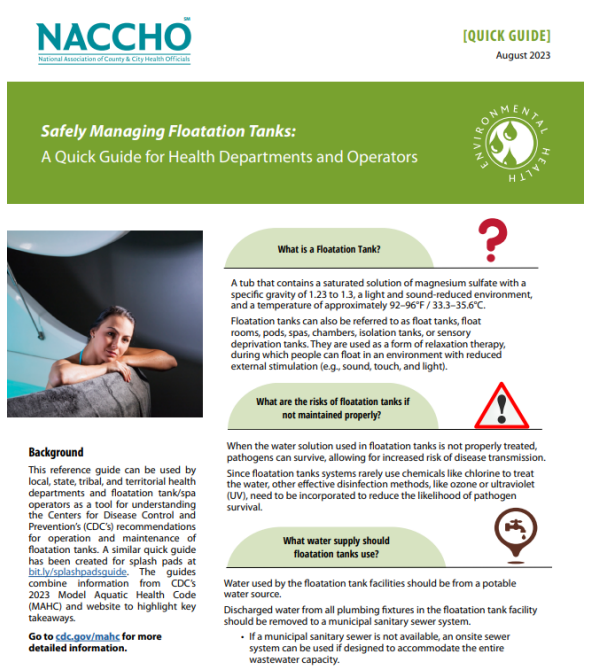
Go to cdc.gov/mahc for more detailed information.

What is an interactive water play venue?

Any indoor or outdoor installation that sprays or jets bathers with water designed in a way that standing or captured water is not part of the bather activity area. These aquatic venues are also known as "splash pads," "spray pads," or "wet decks."

What are the risks of splash pads if not maintained properly?

- Splash pads are usually designed so that standing water does not collect in the water play area, in a way to reduce the risk of drowning. However, splash pads can spread germs and make bathers sick if the water is not disinfected properly.
- Because splash pads are not like pools, their designs do not always meet the local, state, territorial, or tribal definition of an "aquatic venue." This means they are not always regulated, nor are they always required to be disinfected with germ-killing chemicals.
- *Cryptosporidium* is a common parasite that can be found in splash pads. From 2001-2010, *Cryptosporidium* was the leading cause of waterborne disease outbreaks, leading to the stringent disinfection policies promoted by the MAHC for splash pads. See cdc.gov/parasites/crypto/general.html for more information.
- Making sure that the water used for splash pads is properly recirculated and disinfected is key to preventing the spread of germs and disease.



NACCHO
National Association of County & City Health Officials

[QUICK GUIDE]
August 2023

Safely Managing Floatation Tanks:
A Quick Guide for Health Departments and Operators

ENVIRONMENTAL HEALTH

Background

This reference guide can be used by local, state, tribal, and territorial health departments and floatation tank/spa operators as a tool for understanding the Centers for Disease Control and Prevention's (CDC's) recommendations for operation and maintenance of floatation tanks. A similar quick guide has been created for splash pads at bit.ly/splashpadsguide. The guides combine information from CDC's 2023 Model Aquatic Health Code (MAHC) and website to highlight key takeaways.

Go to cdc.gov/mahc for more detailed information.

What is a Floatation Tank?

A tub that contains a saturated solution of magnesium sulfate with a specific gravity of 1.23 to 1.3, a light and sound-reduced environment, and a temperature of approximately 92–96°F / 33.3–35.6°C.

Floatation tanks can also be referred to as float tanks, float rooms, pods, spas, chambers, isolation tanks, or sensory deprivation tanks. They are used as a form of relaxation therapy, during which people can float in an environment with reduced external stimulation (e.g., sound, touch, and light).

What are the risks of floatation tanks if not maintained properly?

When the water solution used in floatation tanks is not properly treated, pathogens can survive, allowing for increased risk of disease transmission.

Since floatation tanks systems rarely use chemicals like chlorine to treat the water, other effective disinfection methods, like ozone or ultraviolet (UV), need to be incorporated to reduce the likelihood of pathogen survival.

What water supply should floatation tanks use?

Water used by the floatation tank facilities should be from a potable water source.

Discharged water from all plumbing fixtures in the floatation tank facility should be removed to a municipal sanitary sewer system.

- If a municipal sanitary sewer is not available, an onsite sewer system can be used if designed to accommodate the entire wastewater capacity.

Visit https://www.naccho.org/mahc to view and download!

VOTE using the Zoom poll for upcoming quick guide topics!

Today's Presenters

Shanna Miko, DNP, MPH
Epidemiologist, Outbreak Surveillance and Analytics Program Lead
Waterborne Disease Prevention Branch
Centers for Disease Control and Prevention (CDC)

Michele Hlavsa, RN, MPH
Epidemiologist, Healthy Swimming and Cryptosporidiosis
Waterborne Disease Prevention Branch
Centers for Disease Control and Prevention (CDC)

The Burden of Waterborne Infectious Disease by Exposure Route

Shanna Miko

NACCHO Model Aquatic Health Code Network Webinar: Waterborne Infectious Disease Burden and Recreational Water-Associated Illness in the United States

December 04, 2023

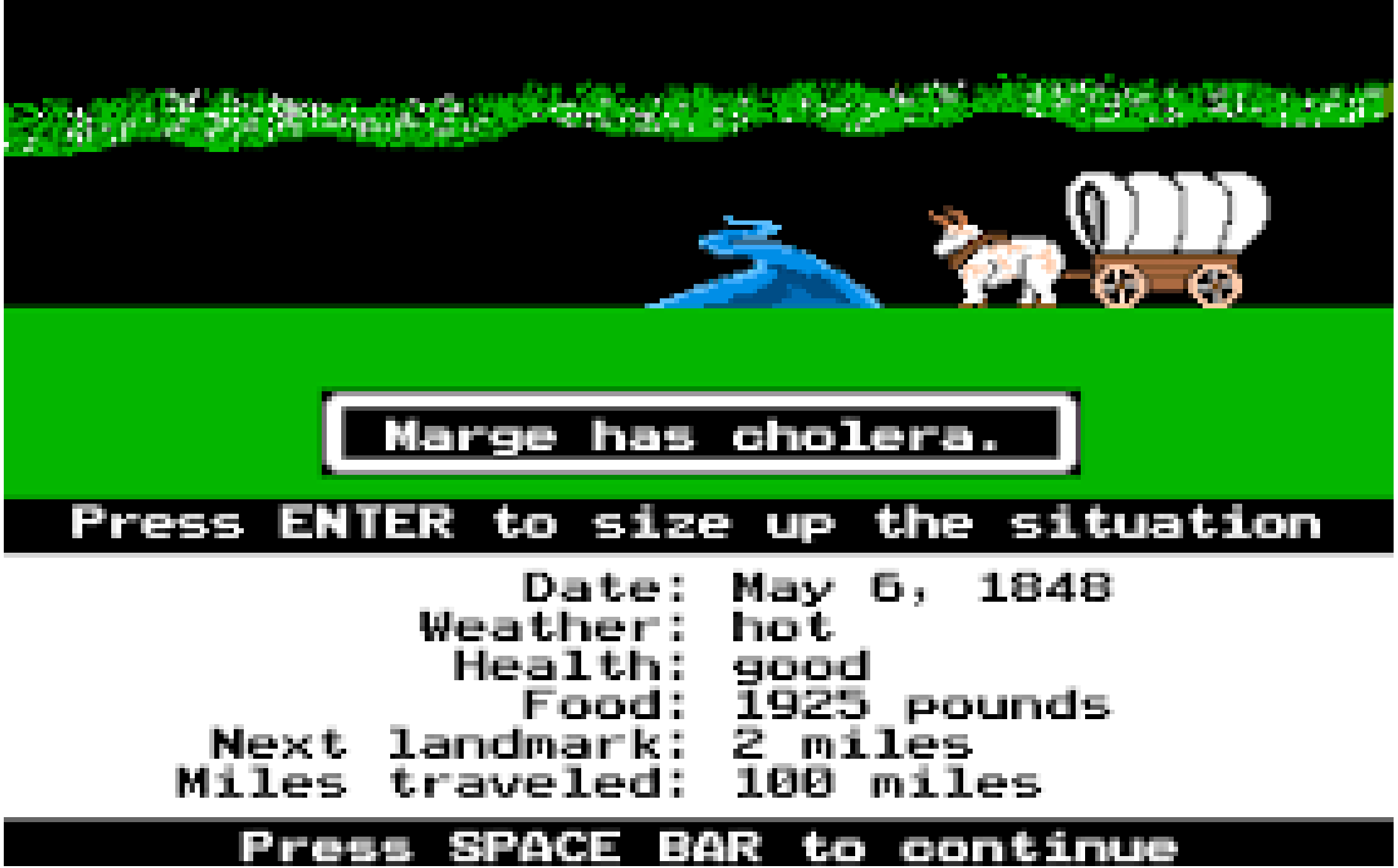
*The findings and conclusions in this presentation are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention

Outline

- ✓ Burden 1.0: Why?
- ✓ What did we find?
- ✓ Burden 2.0: Why?
- ✓ What did we find?
- ✓ What is next? (Spoiler: Burden 3.0)

Burden 1.0: Why?

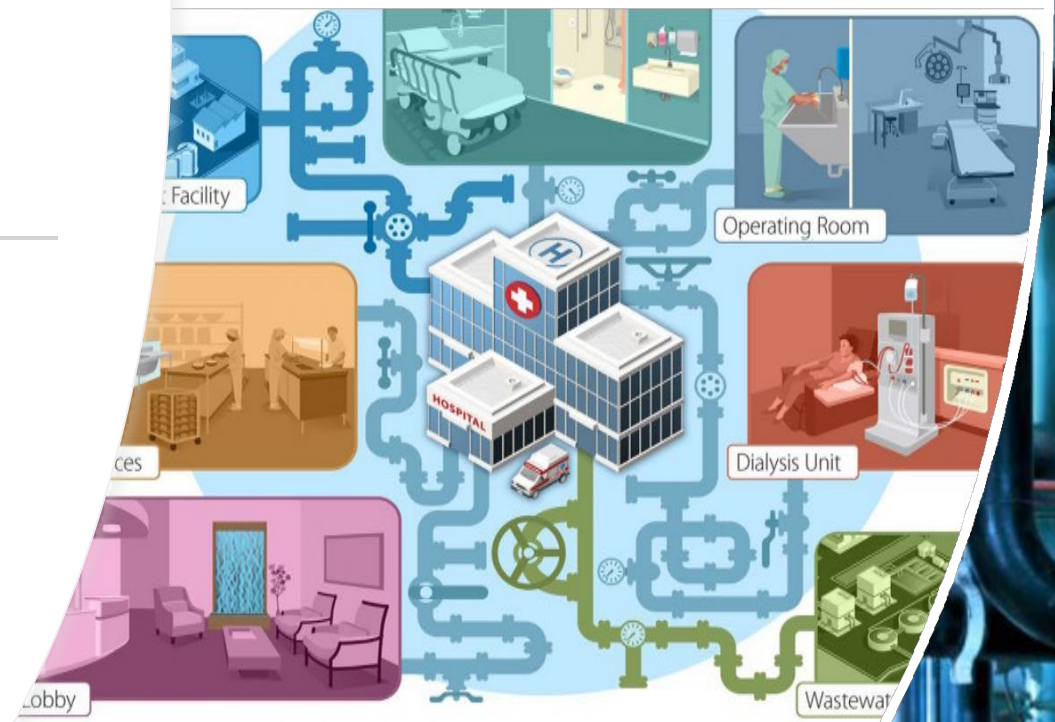
PROBLEM: outdated perception of waterborne disease



Slide courtesy of Sarah A Collier, CDC

Safe, reliable water supply leads to increasing use of water in complex ways

Complicated plumbing, heating and cooling systems in large buildings



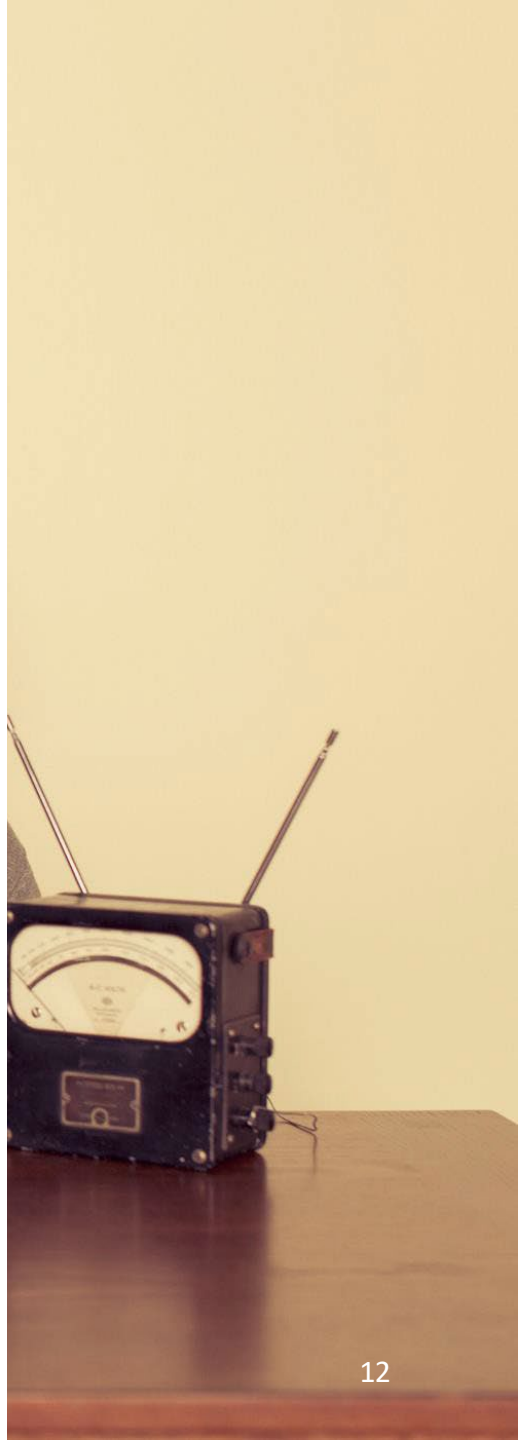
Food production

Medical uses

Water parks, splash pads and complex recreational water venues

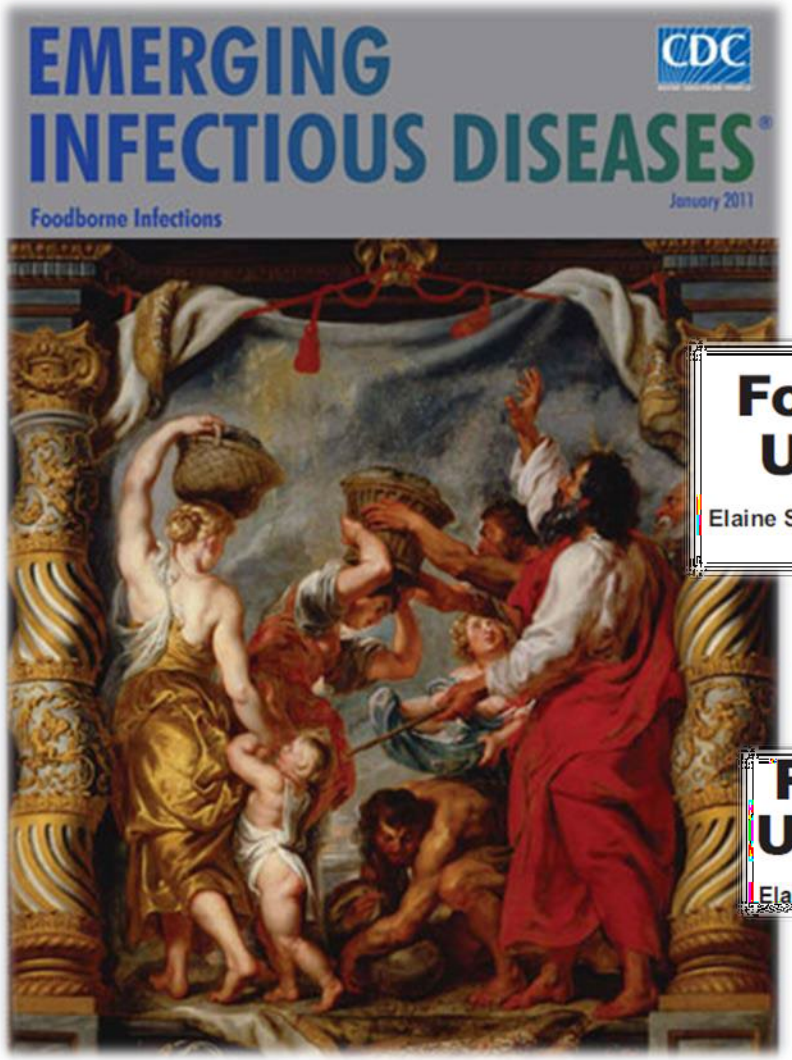
PROBLEM: outdated perception of waterborne disease

SOLUTION: estimate burden of waterborne disease



Burden 1.0: How?

2011



Foodborne Illness Acquired in the United States—Major Pathogens

Elaine Scallan,[1] Robert M. Hoekstra, Frederick J. Angulo, Robert V. Tauxe, Marc-Alain Widdowson, Sharon L. Roy, Jeffery L. Jones, and Patricia M. Griffin

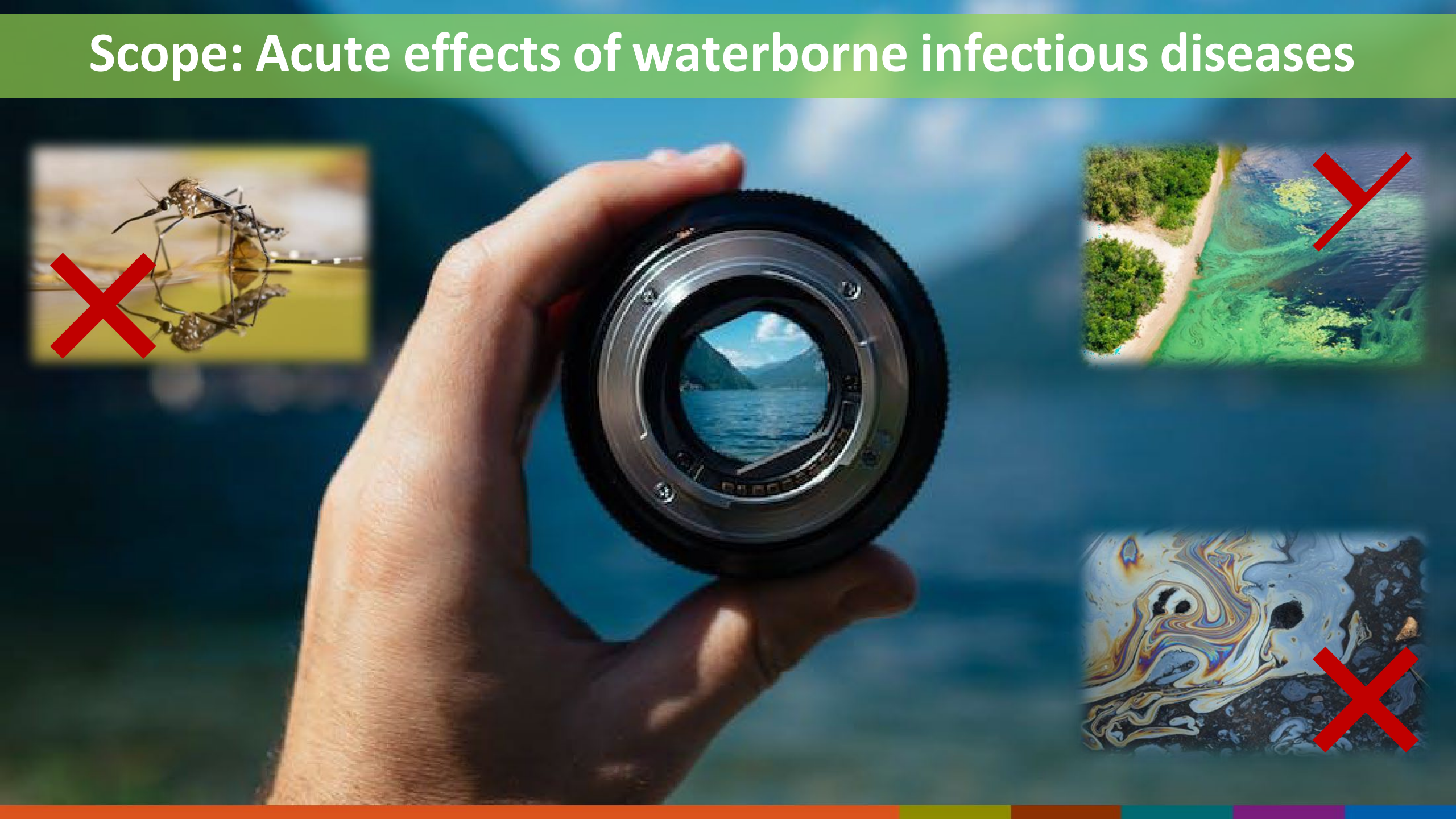
Foodborne Illness Acquired in the United States—Unspecified Agents

Elaine Scallan,[1] Patricia M. Griffin, Frederick J. Angulo, Robert V. Tauxe, and Robert M. Hoekstra

Slide courtesy of Sarah A Collier, CDC

Scope: Acute effects of waterborne infectious diseases

Scope: Acute effects of waterborne infectious diseases



17 selected diseases

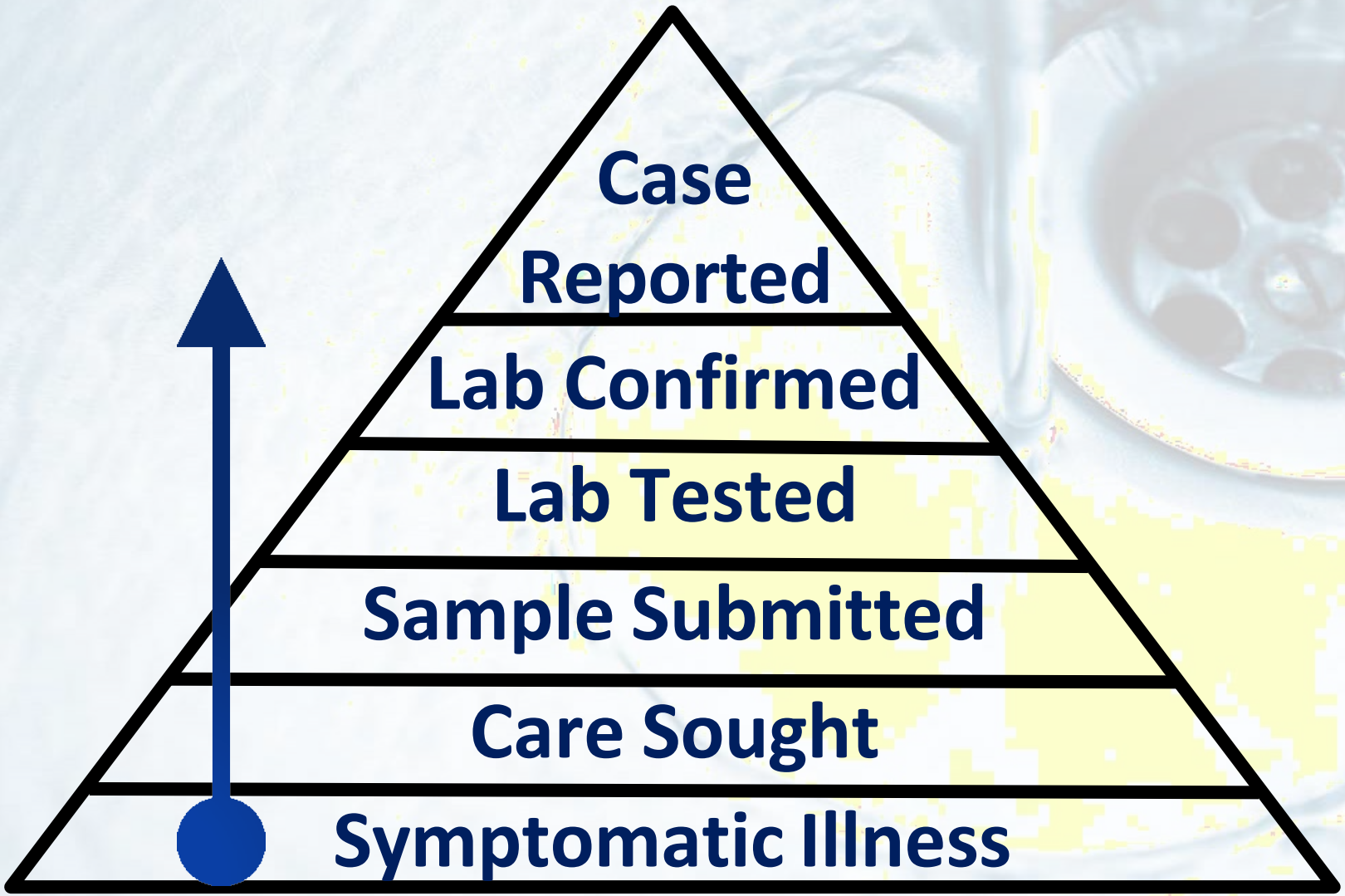
- Campylobacteriosis
- Cryptosporidiosis
- Giardiasis
- Legionnaires' disease
- Nontuberculous mycobacterial (NTM) infection
- Norovirus
- Otitis externa
- *Pseudomonas* pneumonia
- *Pseudomonas* septicemia
- STEC O157
- STEC non-O157
- Salmonellosis
- Shigellosis
- Vibriosis (*alginolyticus, parahaemolyticus, vulnific*

Waterborne burden outcomes

- Illnesses
- Emergency department (ED) visits
- Hospitalizations
- Deaths
- Cost

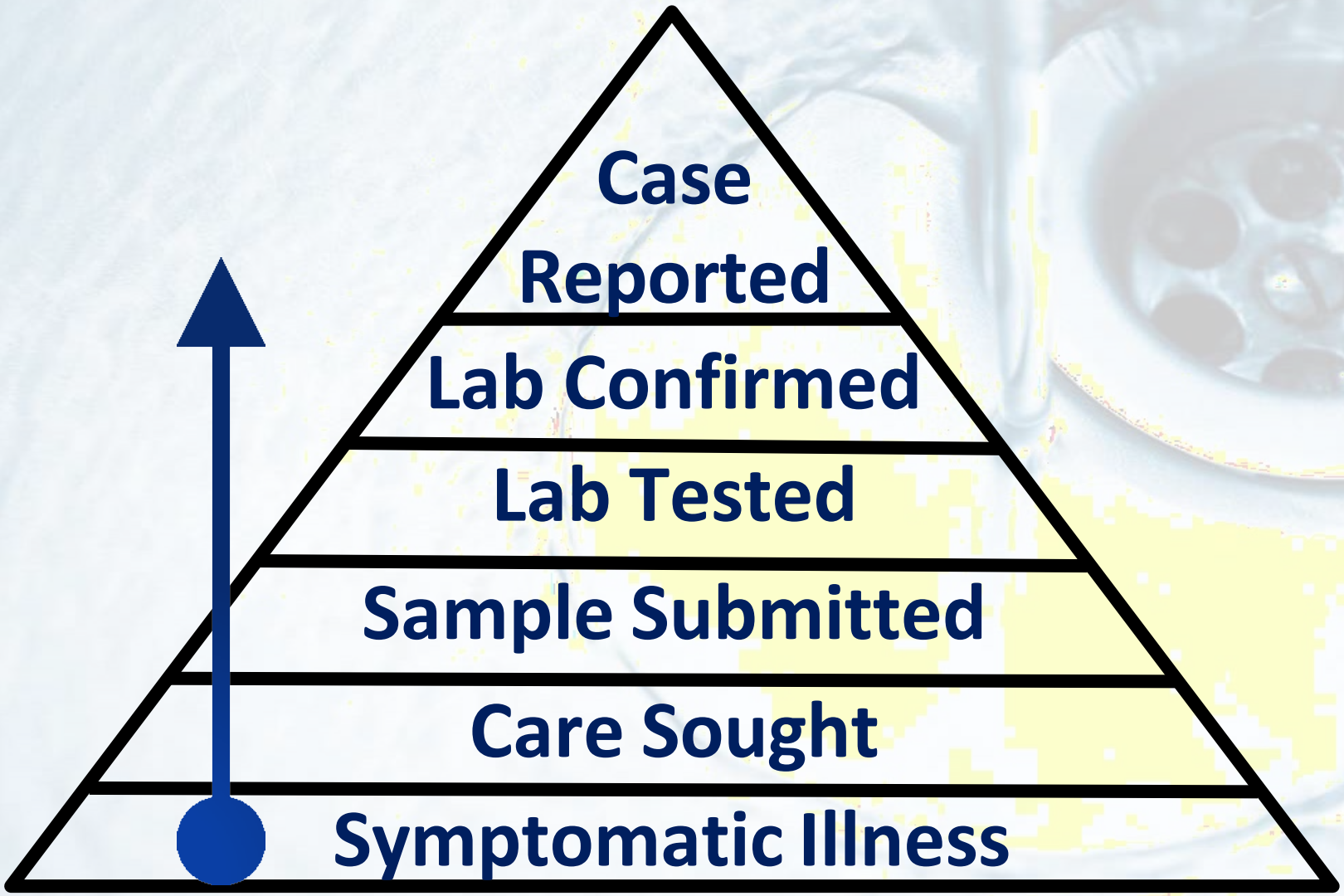
How to get from surveillance to overall number of cases?

Surveillance Pyramid (after Scallan, 2011)



Slide courtesy of Sarah A Collier, CDC

Example: Surveillance for mild campylobacteriosis



Slide courtesy of Sarah A Collier, CDC

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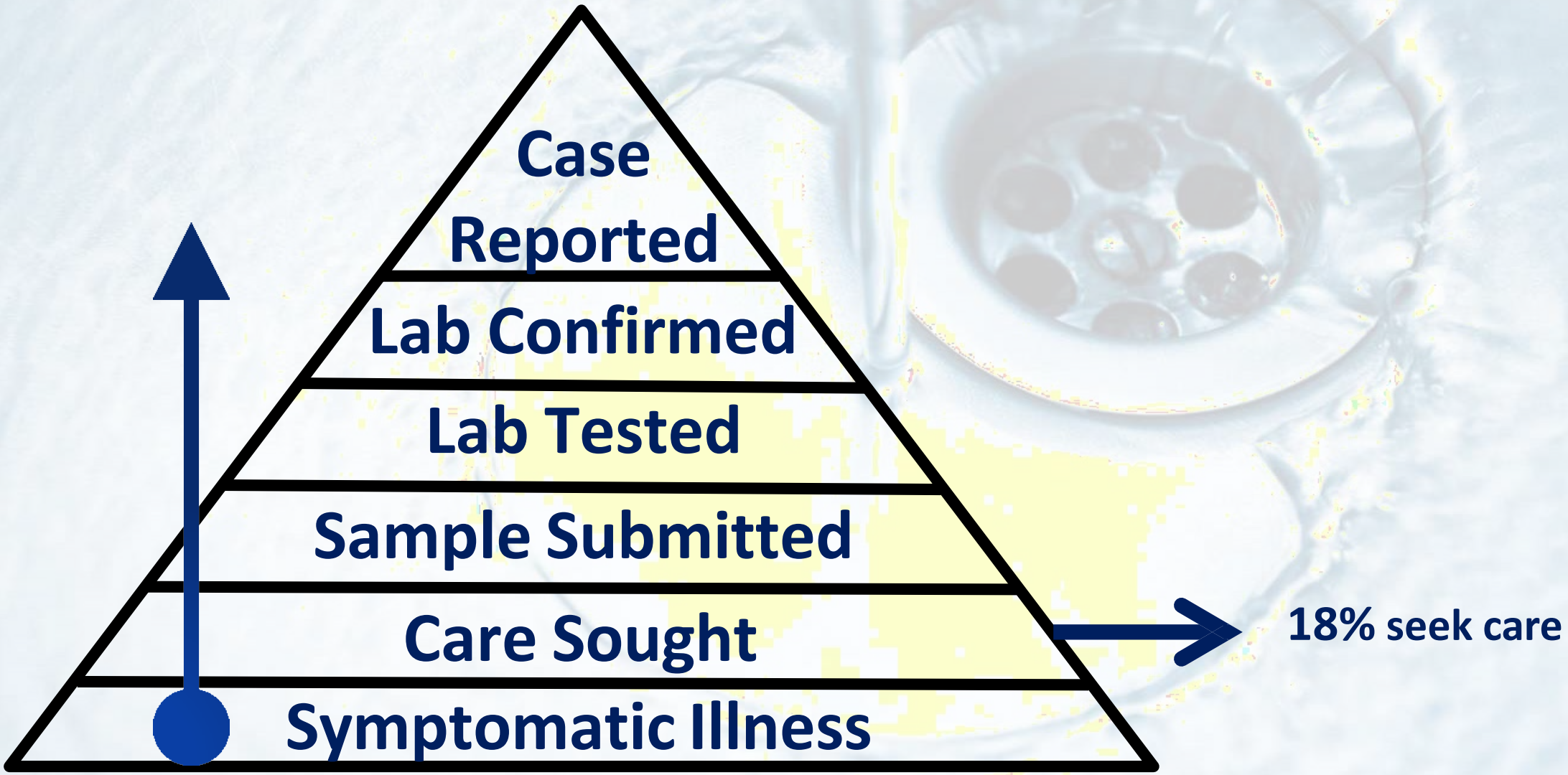

Slide courtesy of Sarah A Collier, CDC

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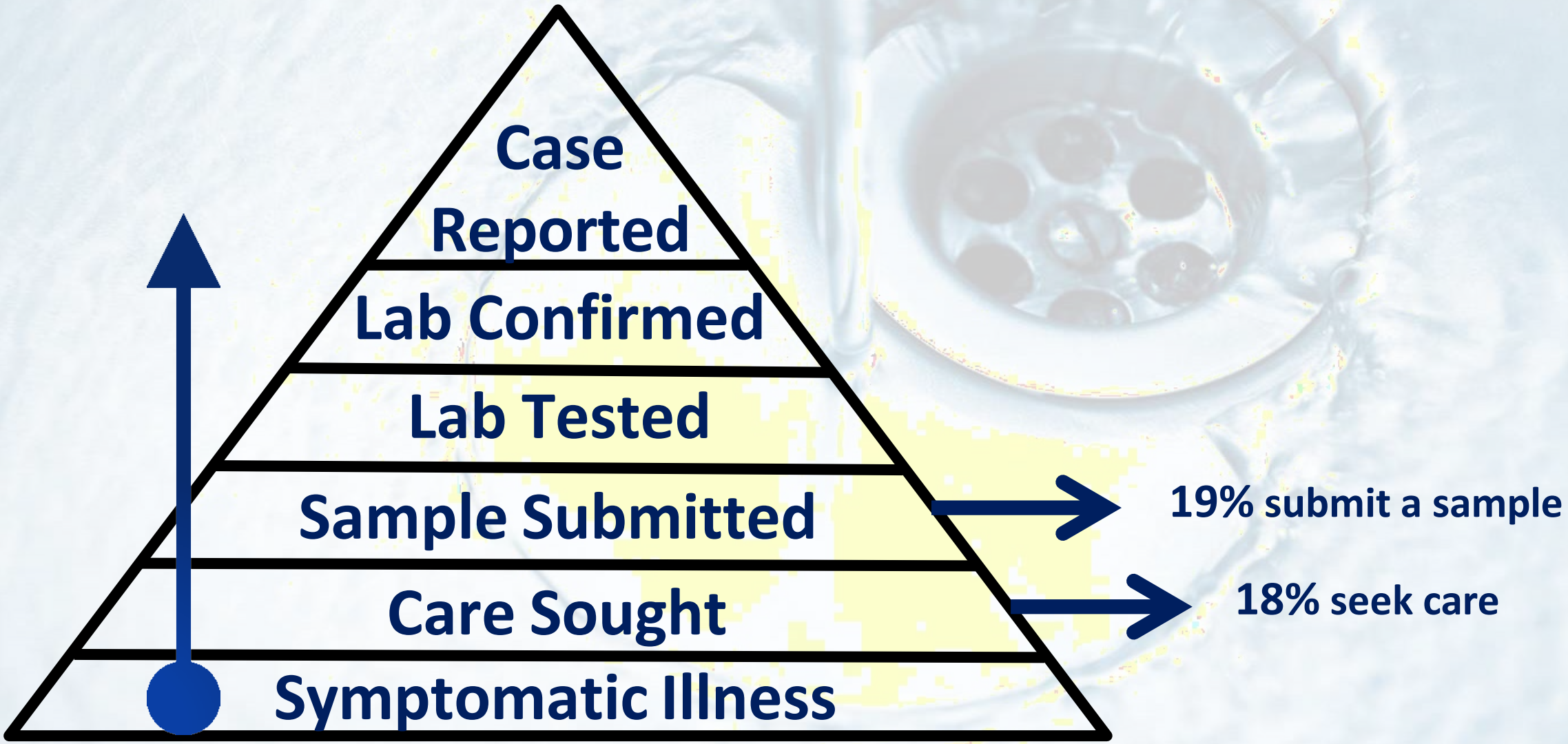

Slide courtesy of Sarah A Collier, CDC

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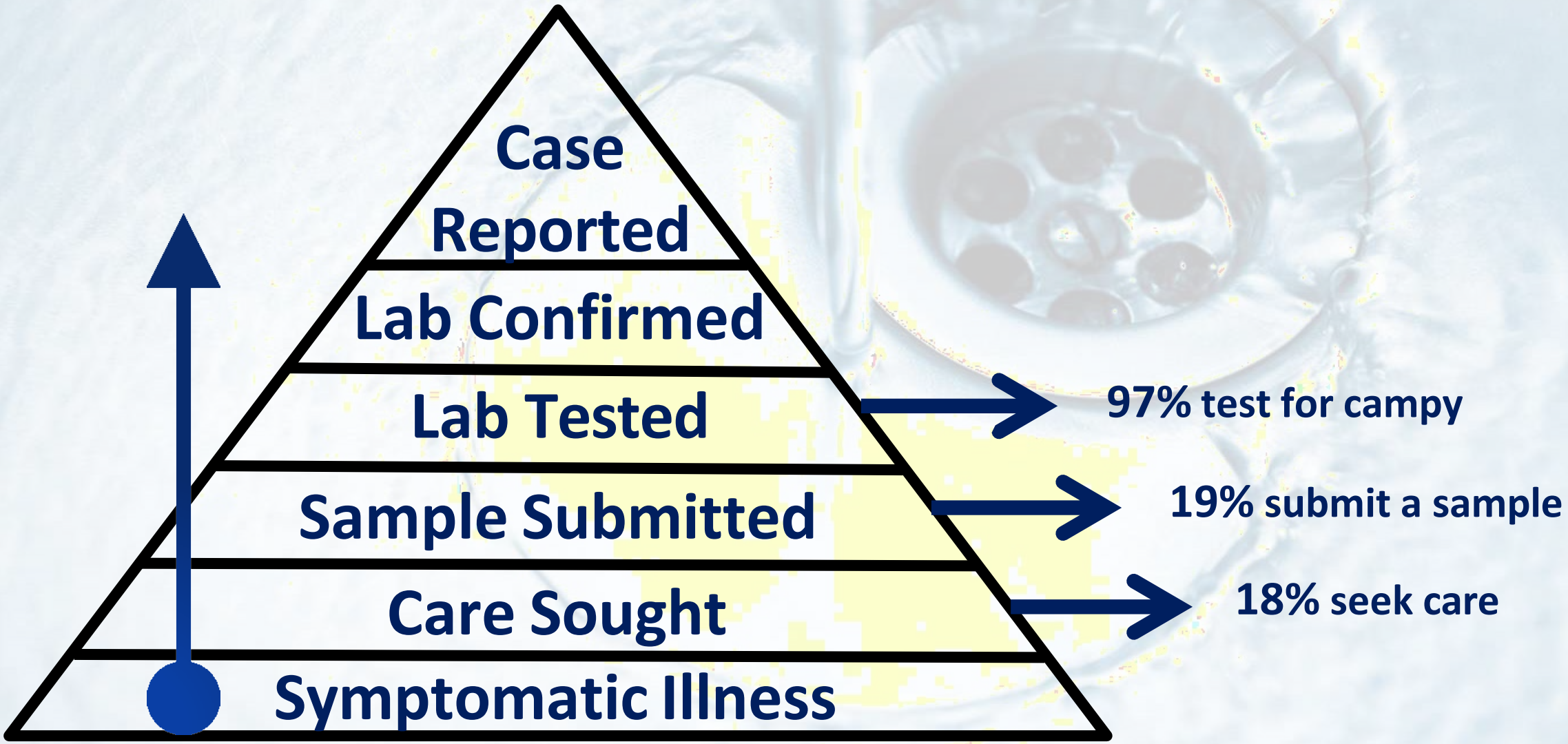

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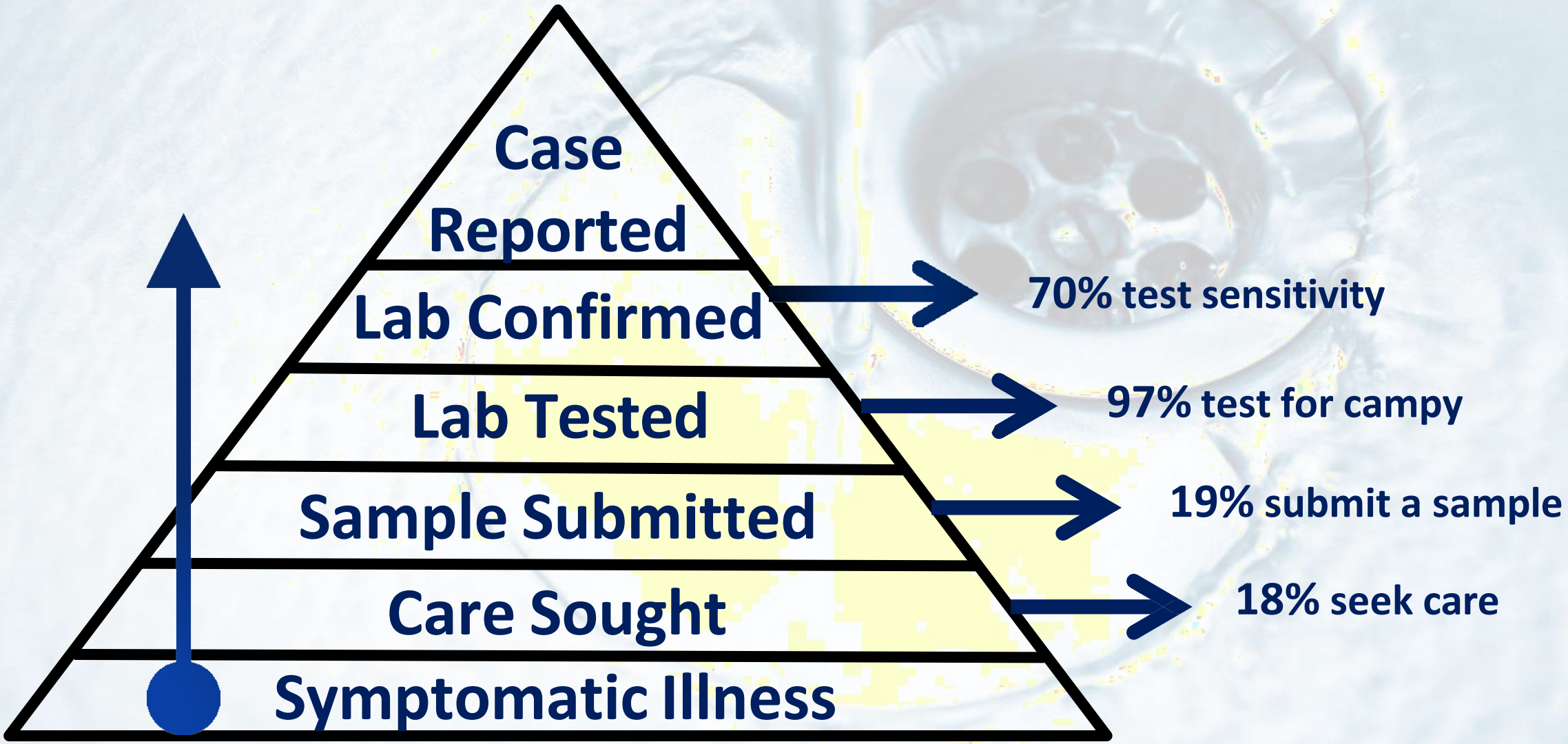

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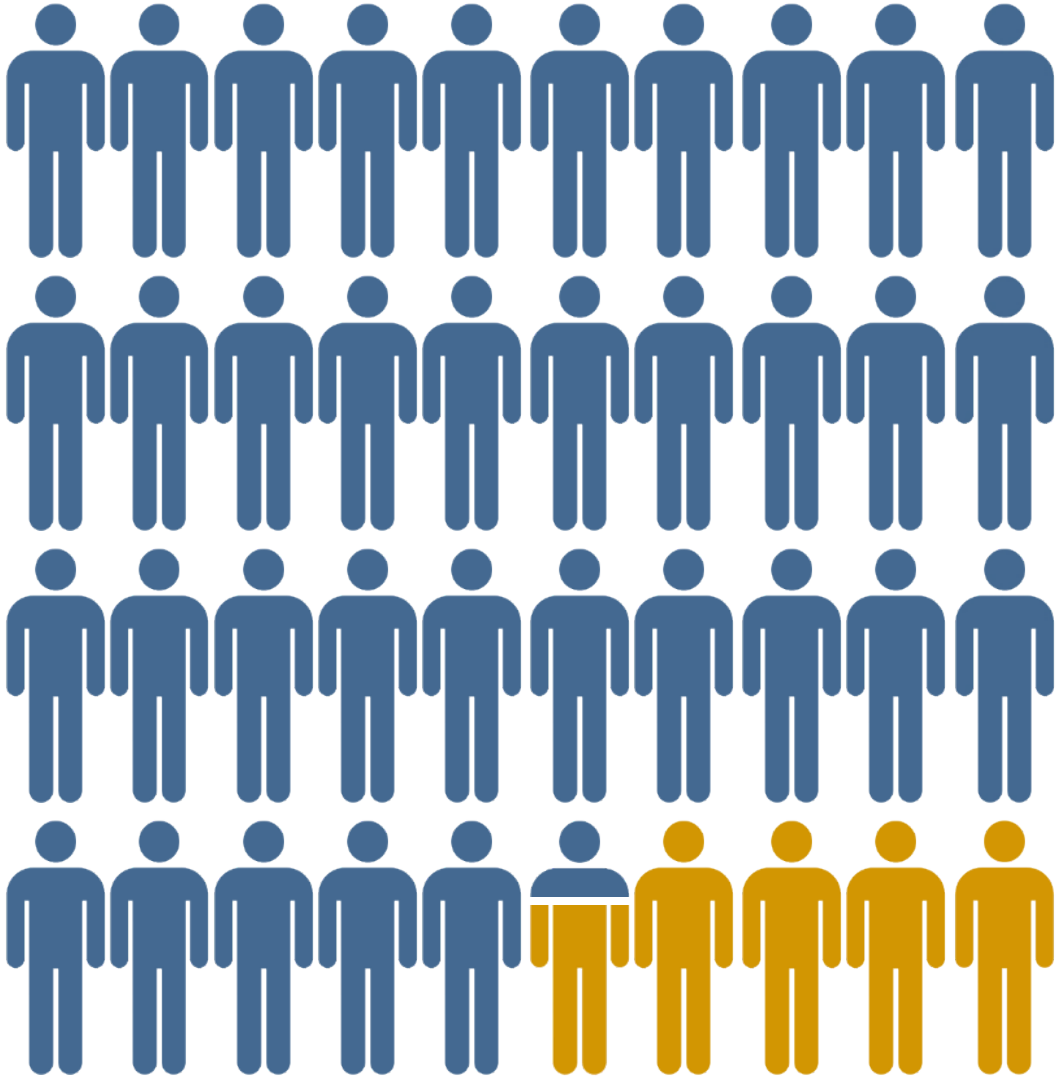
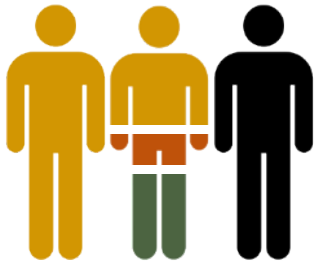




18% seek care
19% submit a sample
97% test for campy
70% test sensitivity
100% of positive tests reported as cases to FoodNet

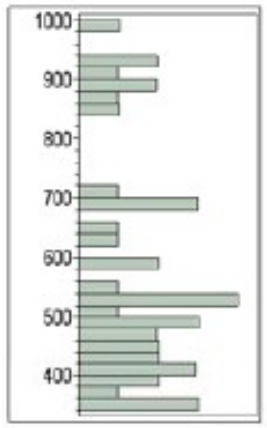
Every reported case represents

~43 total cases

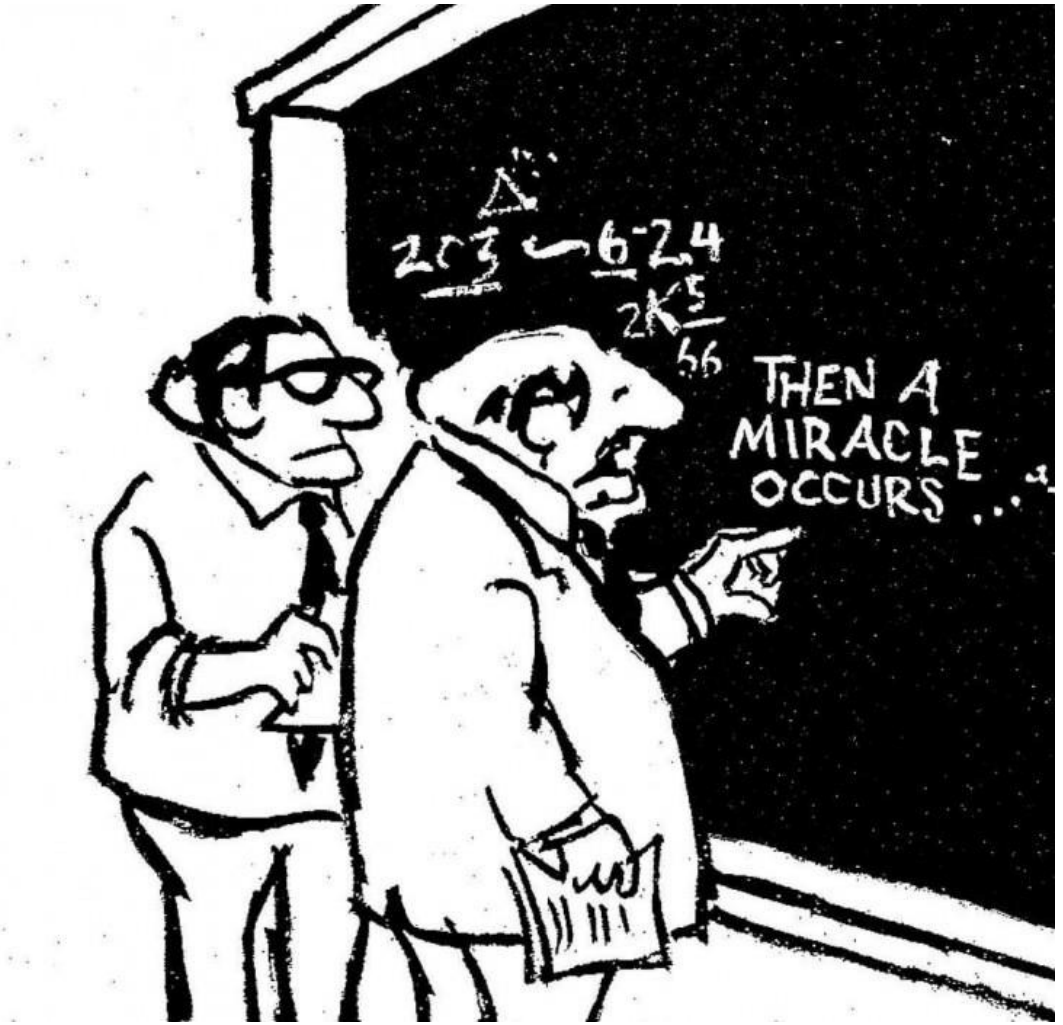
Slide courtesy of John Person, CDC

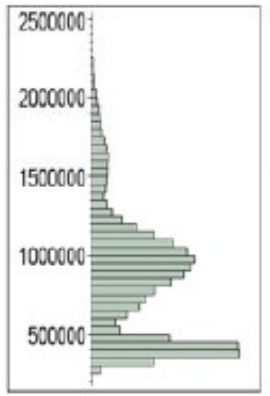
Modeling approach: Use distributions instead of point estimates

Figure 2: Model distributions for *Campyl*
counts from each of the 10 sites in the F



Observed laboratory-confirmed illnesses





Estimated annual domestically acquired foodborne illnesses
Mean: 850,000
90% CrI: 340,000 – 1,600,000

Slide courtesy of Sarah A Collier, CDC

Modeling approach: Use distributions instead of point est

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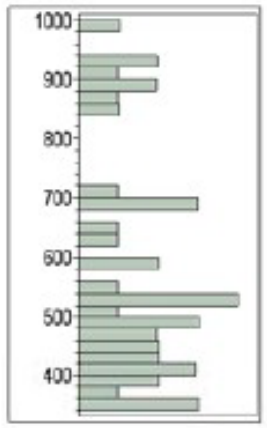
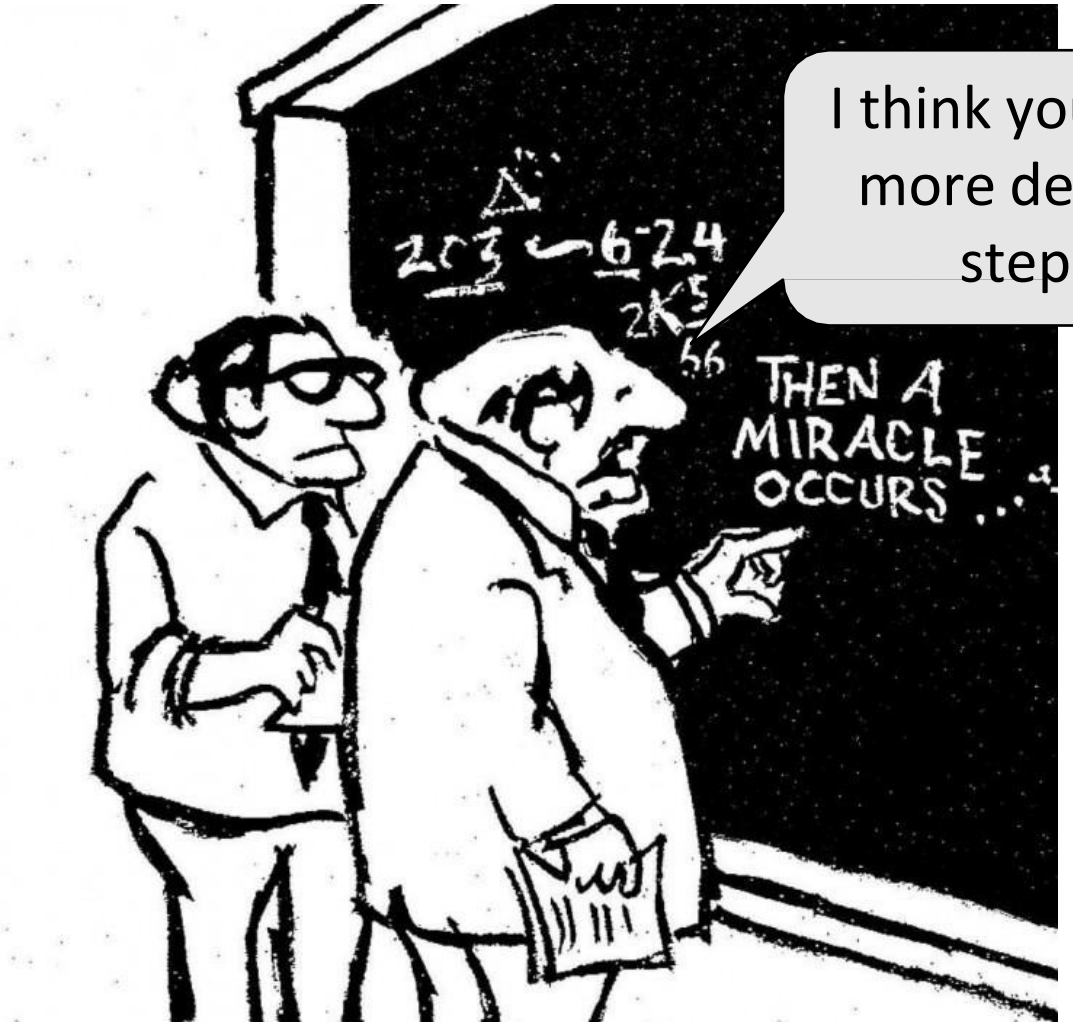
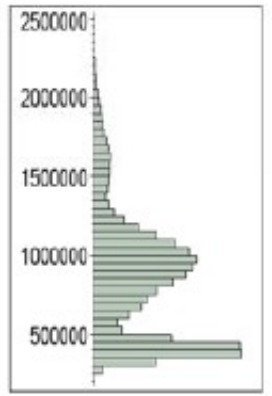
counts from each of the 10 sites in the F



Observed laboratory-confirmed illnesses





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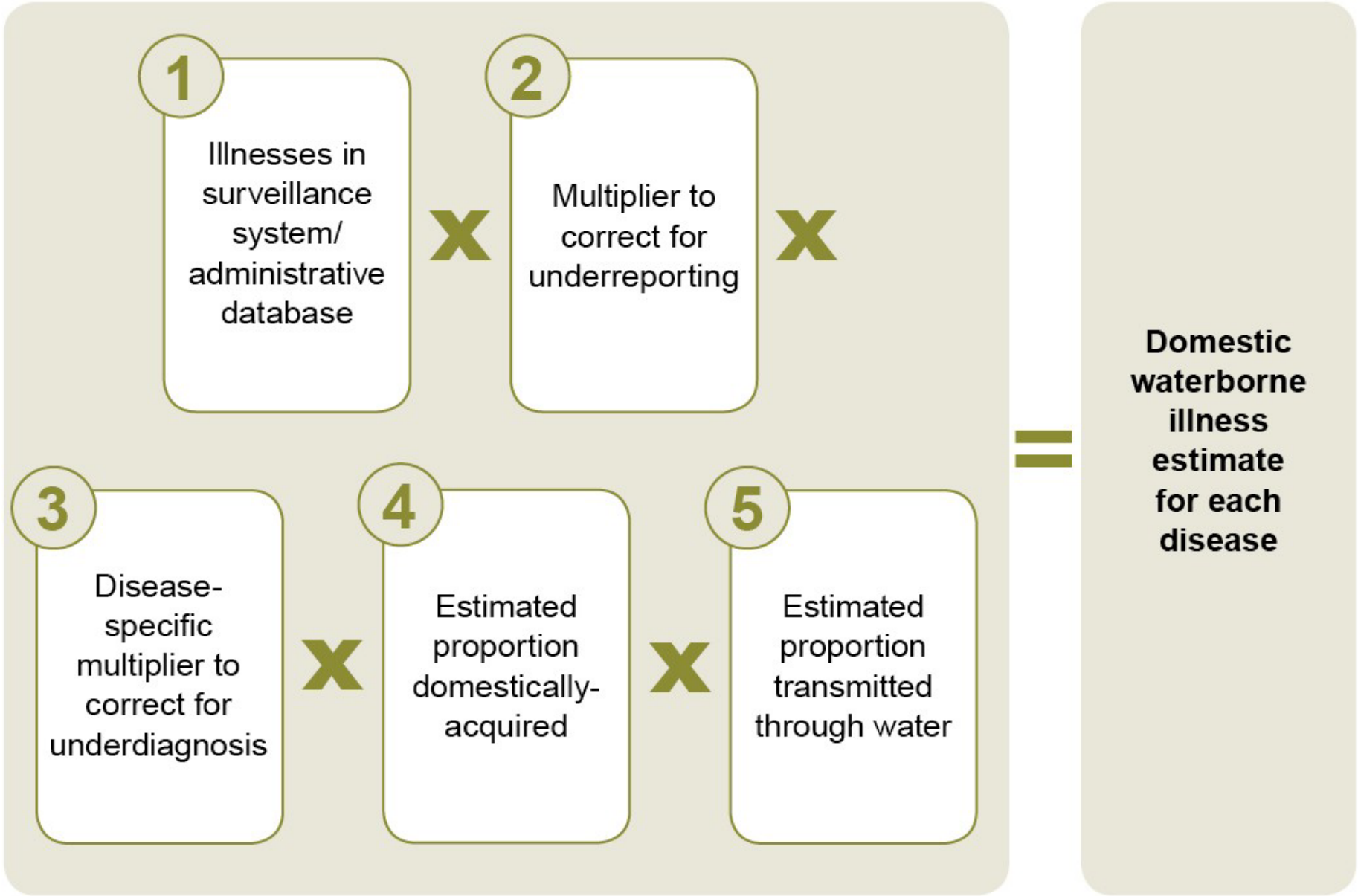
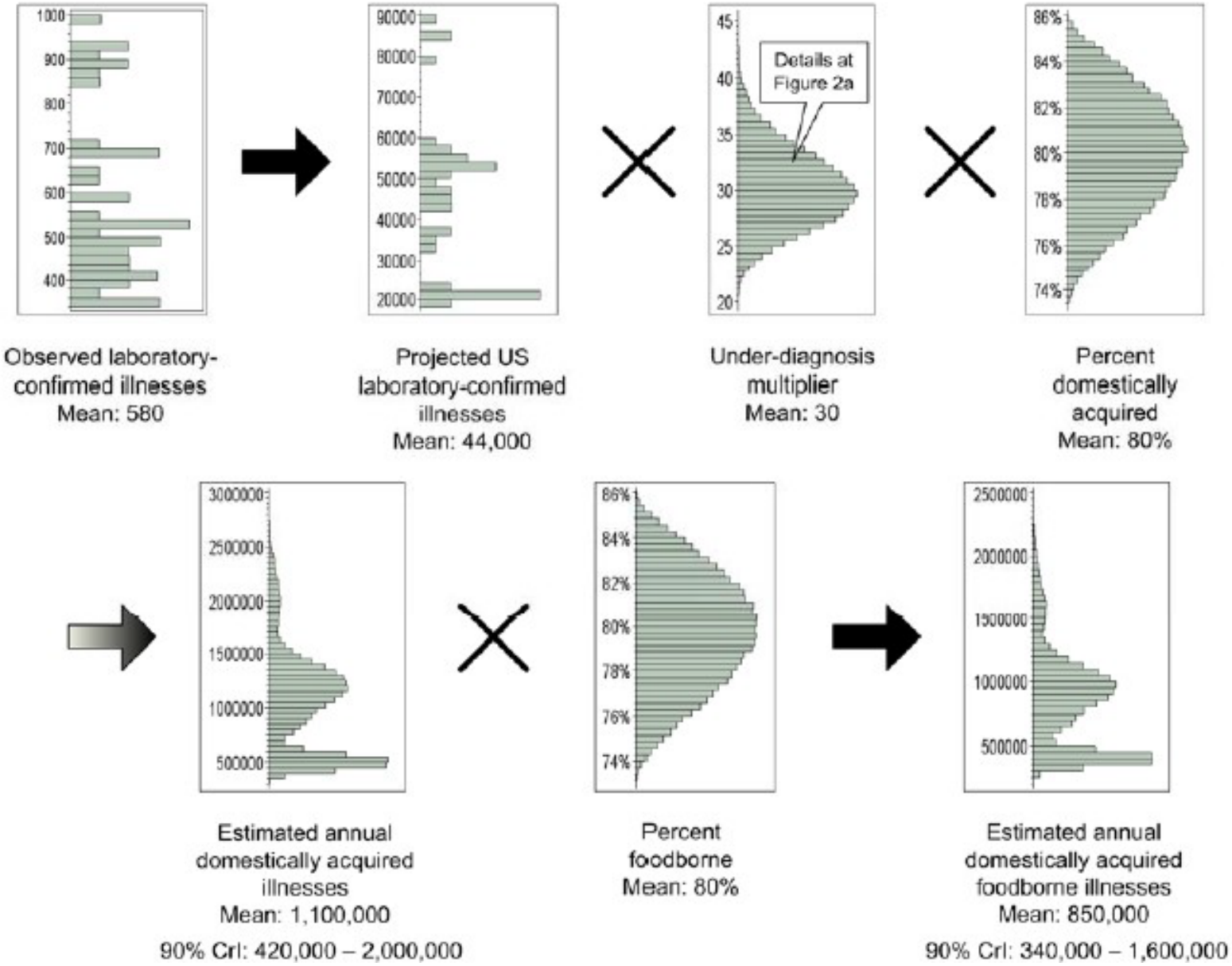


Slide courtesy of Sarah A Collier, CDC

Figure 2: Model distributions for *Campylobacter* illnesses. The histogram of observed laboratory-confirmed illnesses reflects annual counts from each of the 10 sites in the FoodNet catchment from 2005 to 2008.



Modeling approach: Use distributions instead of point estimates

Slide courtesy of Sarah A Collier, CDC

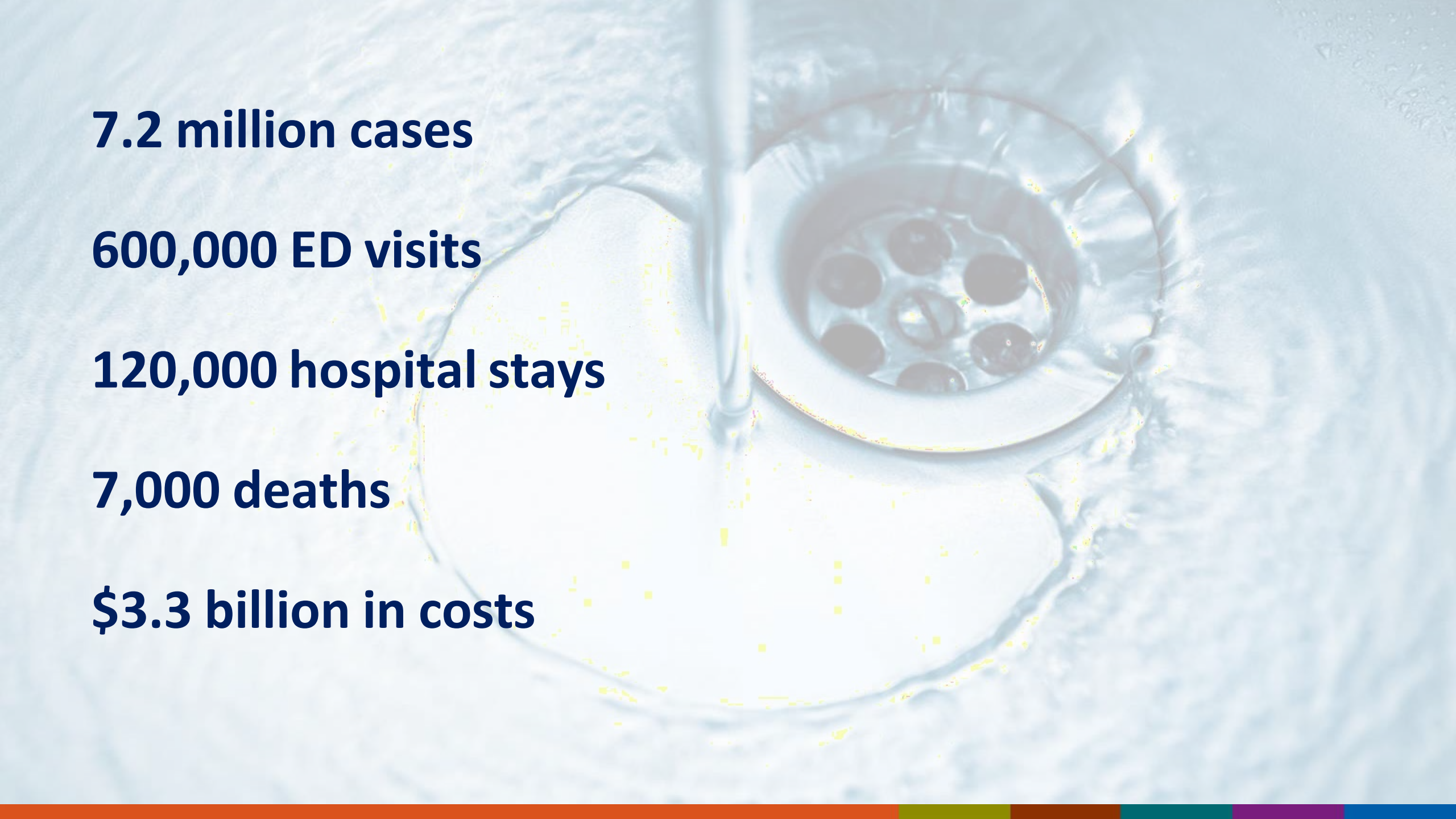

Shigellosis
Giardiasis
Salmonellosis
NTM
Noro
STEC
Crypto
Vibrio
Pseudomonas
LD
Otitis Externa
Campy

Estimate of Burden and Direct Healthcare Cost of Infectious Waterborne Disease in the United States

Sarah A. Collier, Li Deng, Elizabeth A. Adam, Katharine M. Benedict, Elizabeth M. Beshearse, Anna J. Blackstock, Beau B. Bruce, Gordana Derado, Chris Edens, Kathleen E. Fullerton, Julia W. Gargano, Aimee L. Geissler, Aron J. Hall, Arie H. Havelaar, Vincent R. Hill, Robert M. Hoekstra, Sujan C. Reddy, Elaine Scallan, Erin K. Stokes, Jonathan S. Yoder, Michael J. Beach

Emerging Infectious Diseases, 2021

Burden 1.0: Results?


7.2 million cases
600,000 ED visits
120,000 hospital stays
7,000 deaths
$3.3 billion in costs

7.2 million cases

600,000 ED visits

120,000 hospital stays

7,000 deaths

$3.3 billion in costs

due to waterborne disease every year

7.2 million cases

600,000 ED visits

120,000 hospital stays

7,000 deaths

$3.3 billion in costs

7.2M Cases

5 million otitis externa

1 million norovirus

400,000 giardiasis

300,000 cryptosporidiosis

Slide courtesy of Sarah A Collier, CDC

7.2M Cases

5 million otitis externa

1 million norovirus

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7.2M Cases

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Slide courtesy of Sarah A Collier, CDC


7.2 million cases
600,000 ED visits
120,000 hospital stays
7,000 deaths
$3.3 billion in costs

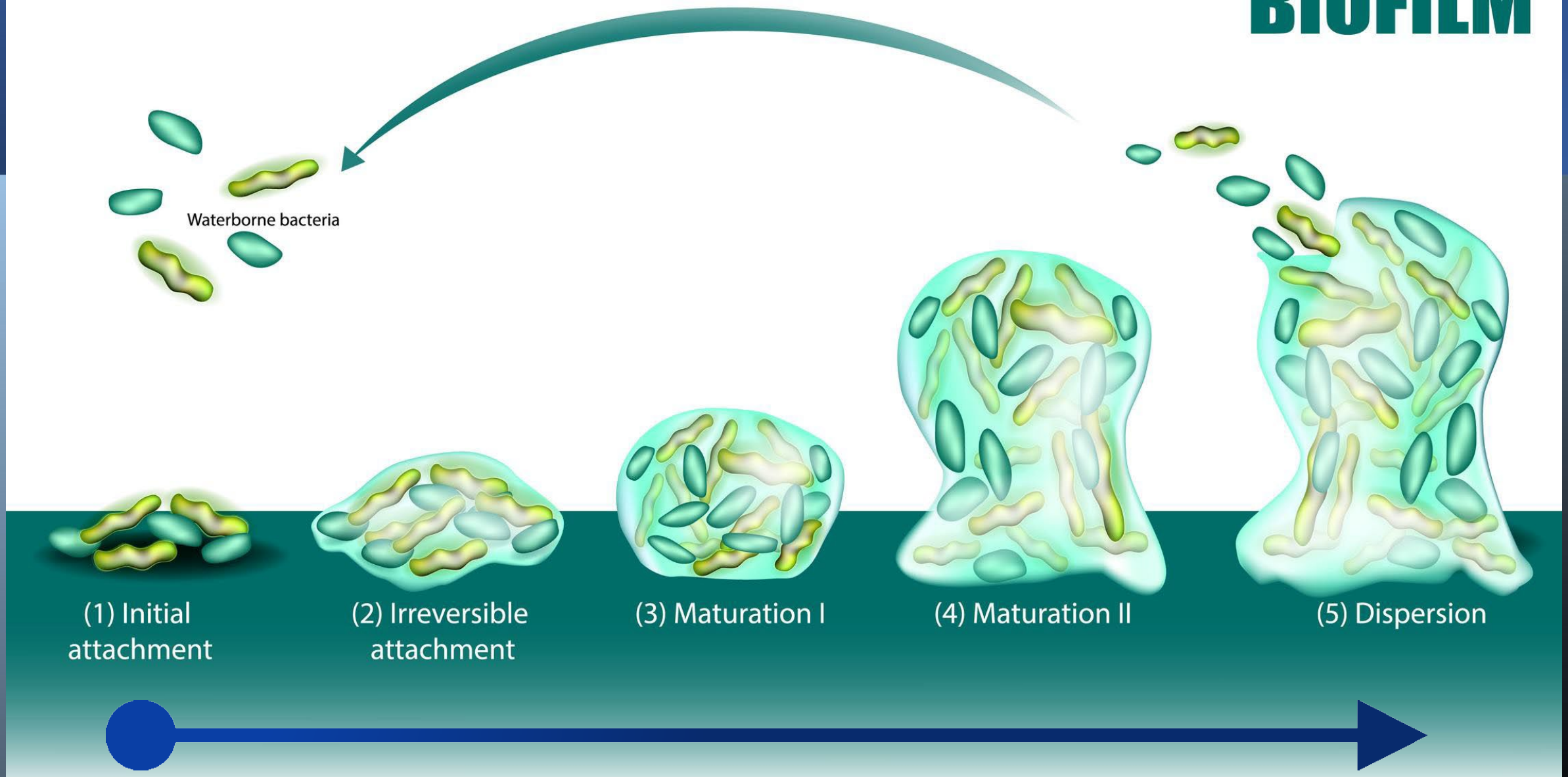
600K ED visits

570,000 otitis externa

Slide courtesy of Sarah A Collier, CDC

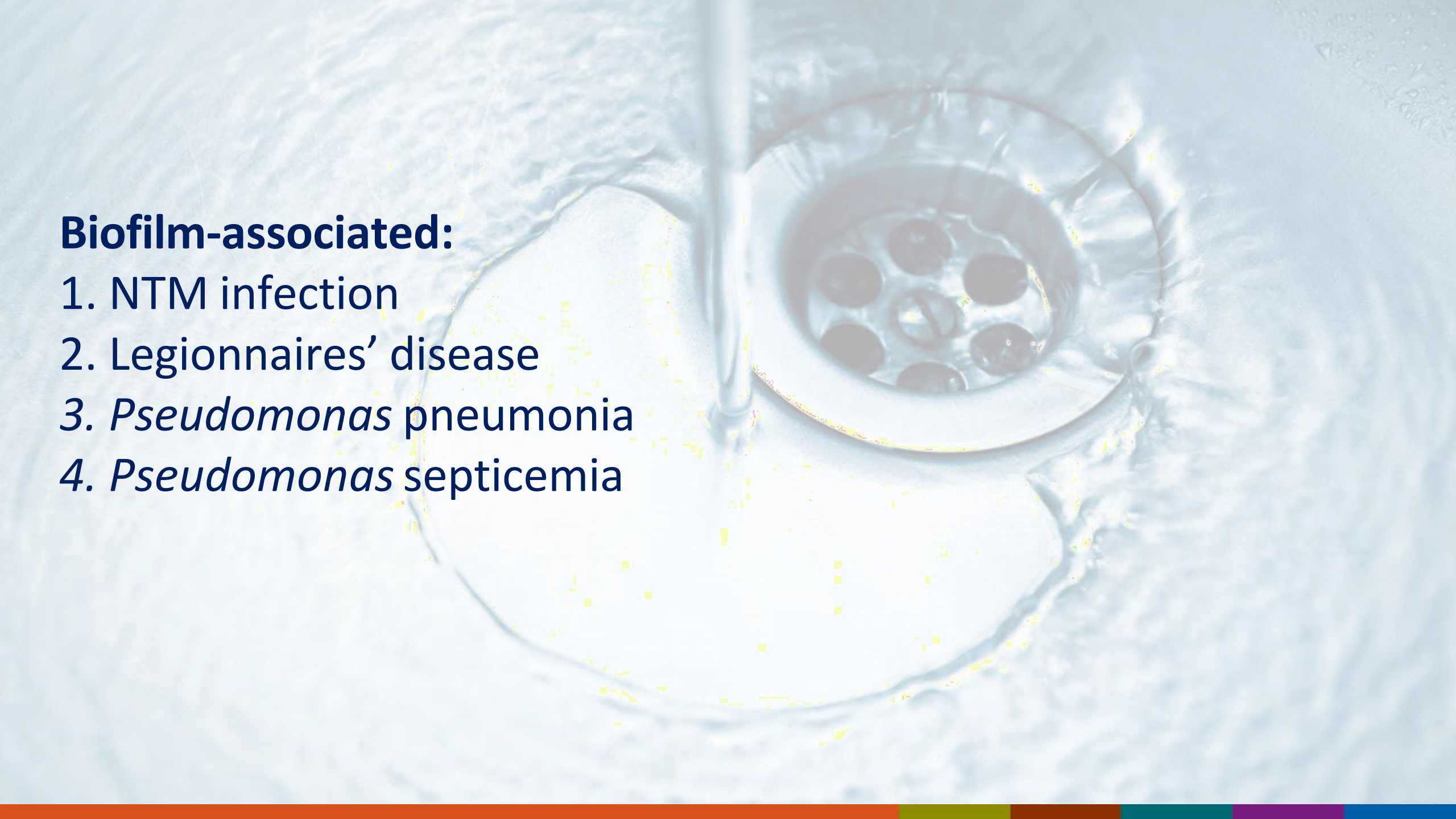

7.2 million cases
600,000 ED visits
120,000 hospital stays
7,000 deaths
$3.3 billion in costs

BIOFILM

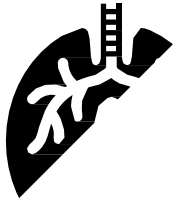

Waterborne bacteria
(1) Initial attachment
(2) Irreversible attachment
(3) Maturation I
(4) Maturation II
(5) Dispersion

Biofilm-associated:

1. NTM infection
2. Legionnaires' disease
3. *Pseudomonas* pneumonia
4. *Pseudomonas* septicemia

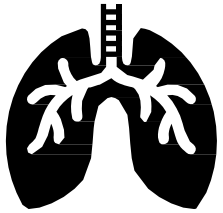


High Consequence Biofilm Associated Organisms



Nontuberculous mycobacteria (NTM) and Legionella

reactivation/reinfection in 25-50% of patients



Pseudomonas aeruginosa

can be multidrug-resistant

High Consequence Biofilm Associated Organisms

Naegleria fowleri

primary amebic meningoencephalitis (PAM)

97% case fatality rate

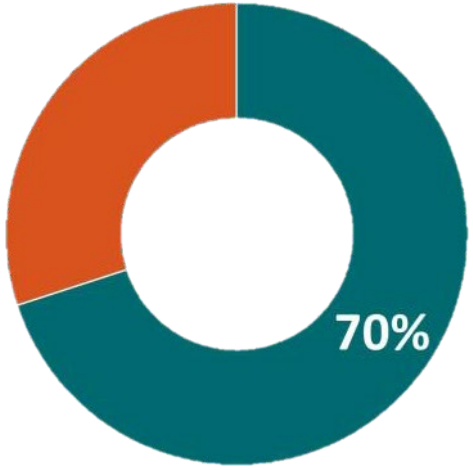
Acanthamoeba

granulomatous amebic encephalitis (GAE)

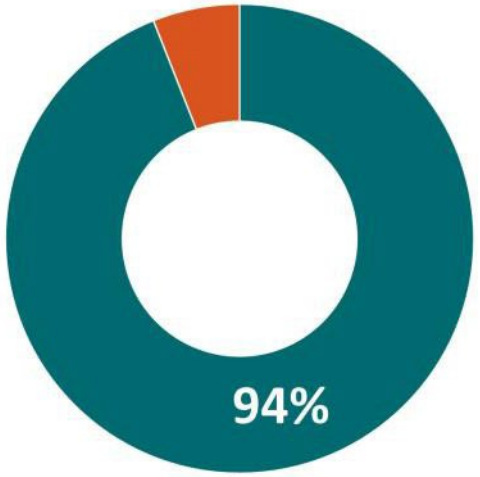
Acanthamoeba keratitis

vision loss or disseminated infection

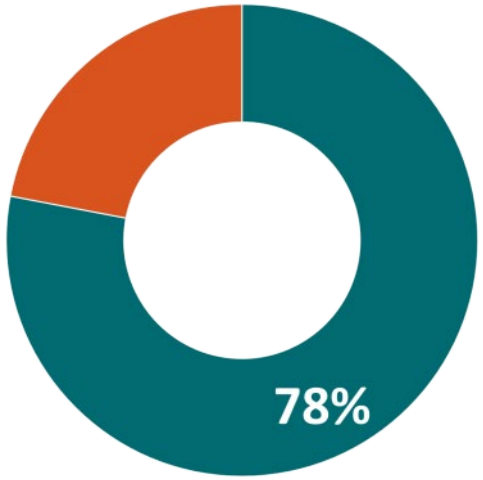
Biofilm-associated Waterborne Diseases Responsible for Majority of Hospitalizations, Deaths, and Healthcare Costs



120,000
hospitalizations



6,600
deaths



$3.3 billion

Burden 2.0: Why?

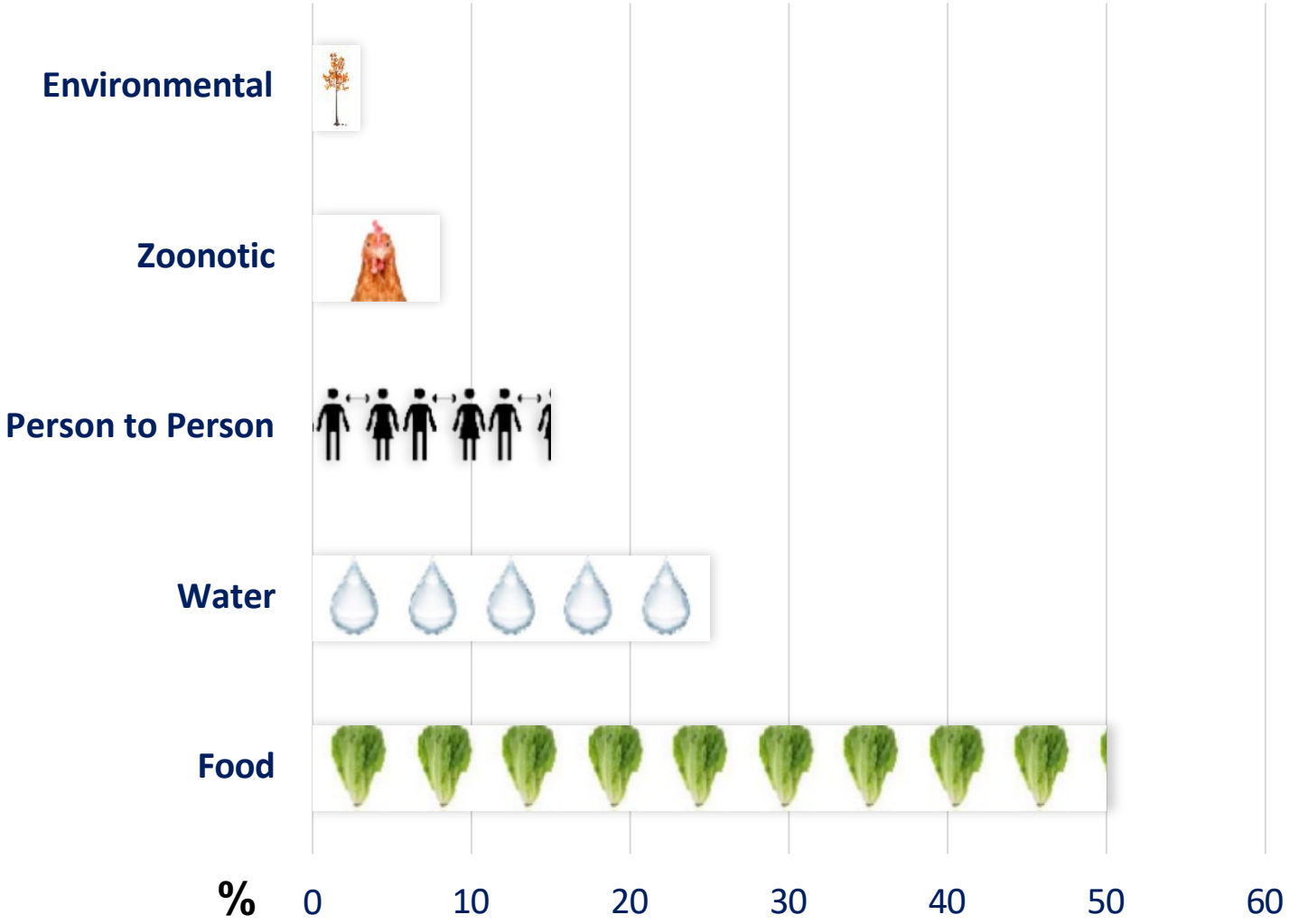
Burden 2.0: How?

Attribution of Illnesses Transmitted by Food and Water to Comprehensive Transmission Pathways Using Structured Expert Judgment, United States

Elizabeth Beshearse, Beau B. Bruce, Gabriela F. Nane, Roger M. Cooke, Willy Aspinall, Tine Hald, Stacy M. Crim, Patricia M. Griffin, Kathleen E. Fullerton, Sarah A. Collier, Katharine M. Benedict, Michael J. Beach, Aron J. Hall, Arie H. Havelaar

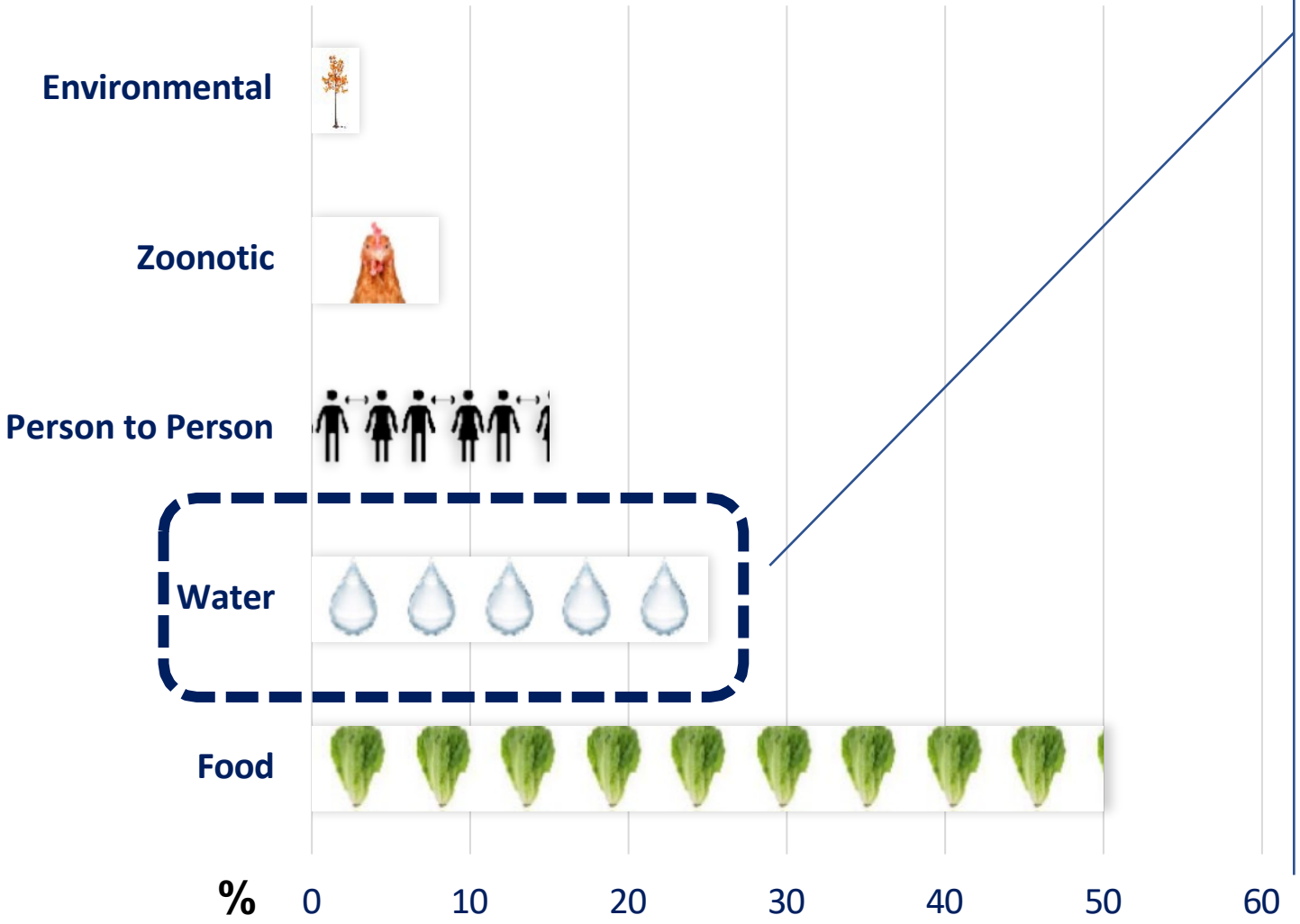
Attribution

PATHWAYS



Attribution

PATHWAYS



NRND

Drinking

Recreational

Recreational Water (treated and untreated)	Drinking Water	Non-recreational, Non-drinking Water
• Water that is used for recreational activities, such as in an aquatic facility or natural body of water. • Treated water has undergone a systematic disinfection process (e.g., chlorination and filtration) with the goal of maintaining good microbiologic quality for recreation; • Untreated water has not undergone a disinfection or treatment process to maintain good microbiological quality for recreation (e.g., lakes, rivers, oceans, and reservoirs).	• Water that is used primarily for drinking but including other domestic uses, such as washing or showering; can come from a public water system, a private well, or commercially bottled sources.	• Water that is used for purposes other than recreation or drinking (e.g., for agriculture, industry, medical treatment, backcountry streams or flood waters). • Agricultural water includes water that is used to grow fresh produce and sustain livestock. Industrial water includes water used during manufacturing or in cooling equipment. • Medical water includes any water used within medical devices or water used for washing surgical tools and equipment, and water used for hydrotherapy. • This category does not include transmission that can be accounted for by another major pathway, such as food or animals

Table 4. Source attribution results for major transmission pathways, structured expert judgment, United States, 2017*

Pathogen name	Mean % (95% uncertainty interval)				
	Foodborne	Waterborne	Person-to-person	Animal contact	Environmental
Bacteria					
Brucella spp.	45 (13–77)	10 (0–42)	Blocked	36 (10–73)	9 (0–32)
Campylobacter spp.	57 (30–80)	13 (1–31)	7 (0–23)	16 (3–35)	7 (0–30)
Enterotoxigenic *Escherichia coli*	69 (37– 91)	9 (0–38)	7 (0–38)	Blocked	15 (2–33)
STEC O157	60 (40–77)	5 (1–13)	16 (4–33)	12 (3–25)	7 (1–17)
STEC non-O157	50 (26–75)	6 (0–17)	15 (2–34)	21 (2–46)	8 (0–24)
E. coli, other diarrheagenic	55 (27–80)	9 (0–30)	16 (2–39)	9 (0–33)	12 (0–33)
Legionella spp.	Blocked	97 (67–100)	0 (0–1)	Blocked	2 (0–28)
Mycobacterium bovis	75 (36–98)	1 (0–9)	9 (0–39)	13 (0–50)	2 (0–12)
Nontuberculous *Mycobacterium* spp.	Blocked	72 (39–94)	4 (0–21)	2 (0–35)	22 (0–49)
Pseudomonas spp., otitis externa	Blocked	81 (67–95)	3 (0–13)	1 (0–4)	15 (1–,25)
Pseudomonas spp., septicemia	Blocked	22 (3–53)	2 (0–19)	2 (0–11)	74 (41–94)
Pseudomonas spp., pneumonia	Blocked	51 (14–80)	4 (1–32)	0 (0–2)	45 (15–80)
Salmonella enterica, nontyphoidal	66 (48–81)	6 (0–22)	7 (0–16)	11 (3–24)	9 (2–21)
S. enterica, nontyphoidal, age <5 y	46 (20–66)	7 (0–26)	18 (6–35)	13 (2–30)	16 (2–36)
S. enterica serotype Enteritidis	80 (63–92)	4 (0–11)	7 (1–16)	5 (0–19)	4 (1–14)
S. enterica serotype I 4,[5],12:i:-	66 (40–82)	6 (1–15)	8 (1–17)	12 (2–27)	7 (0–20)
S. enterica serotype Javiana	56 (29–76)	7 (1–20)	9 (2–22)	14 (3–33)	14 (2–29)
S. enterica serotype Newport	74 (50–86)	2 (0–9)	7 (1–16)	8 (1–19)	8 (2–18)
S. enterica serotype Typhimurium	59 (27–78)	7 (1–18)	8 (2–19)	14 (3–29)	13 (2–30)
S. enterica, all other serotypes group 1	60 (29–79)	6 (1–18)	9 (2–21)	12 (2–29)	12 (3–,29)
S. enterica, all other serotypes group 2	40 (10–65)	7 (1–24)	10 (2–26)	17 (1–40)	26 (6–51)
Shigella spp.	8 (1–36)	4 (1–21)	81 (48–93)	Blocked	6 (0–26)
Staphylococcus aureus	Blocked	75 (23–98)	18 (1–71)	1 (0–5)	5 (0–37)
Streptococcus spp., group A	4 (0–33)	1 (0–6)	92 (55–99)	1 (0–12)	2 (0–19)
Vibrio alginolyticus	60 (24–84)	37 (13–71)	0 (0–1)	1 (0–4)	2 (0–11)
V. alginolyticus, non-AGI	2 (0–17)	97 (79–100)	0 (0–1)	0 (0–2)	0 (0–2)
V. cholerae nontoxigenic	92 (61–100)	6 (0–30)	1 (0–3)	0 (0–4)	0 (0–3)
V. cholerae nontoxigenic, non-AGI	33 (8–59)	65 (39–90)	0 (0–1)	0 (0–1)	2 (0–13)
V. parahaemolyticus	74 (59–91)	24 (7–38)	0 (0–2)	0 (0–2)	1 (0 –5)
V. parahaemolyticus, non-AGI	8 (2–39)	90 (57–97)	0 (0–1)	0 (0–1)	2 (0–8)
V. vulnificus†	20 (7–54)	77 (40–91)	0 (0–3)	1 (0–9)	2 (0–12)
V. vulnificus, non-AGI	20 (9–34)	78 (58–89)	0 (0–1)	1 (0–16)	2 (0–9)
Vibrio spp., other AGI	96 (69–100)	2 (0–23)	0 (0–1)	0 (0–2)	1 (0–8)
Vibrio spp, other non-AGI	95 (58–100)	3 (0–27)	0 (0–1)	0 (0–2)	2 (0–15)
Yersinia enterocolitica	77 (44–100)	9 (0–37)	3 (0–17)	4 (0–16)	8 (0–33)
Protozoa					
Acanthamoeba spp.	Blocked	82 (46–100)	Blocked	0 (0–0)	18 (0–54)
Balamuthia mandrillaris	Blocked	54 (5–95)	Blocked	0 (0–0)	46 (5–95)
Cryptosporidium spp.	7 (0–25)	43 (17–73)	20 (2–49)	21 (4–48)	8 (0–34)
Cyclospora cayetanensis	83 (59–99)	6 (0–25)	3 (0–14)	1 (0–9)	7 (0–28)
Giardia spp.	10 (0–35)	44 (16–78)	27 (3–59)	10 (0–38)	8 (0–37)
Naegleria fowleri	Blocked	88 (61–100)	Blocked	Blocked	12 (0–38)
Toxoplasma gondii	28 (4–60)	5 (0–27)	Blocked	58 (24–86)	9 (0–29)
Viruses					
Astrovirus	15 (1–38)	6 (0–25)	73 (44–94)	Blocked	6 (0–18)
Hepatitis A virus	42 (9–78)	8 (0–33)	41 (8–77)	Blocked	8 (0–34)
Norovirus	19 (6–37)	6 (0–25)	70 (46–88)	Blocked	5 (0–18)
Rotavirus	5 (0–20)	7 (0–28)	81 (57–98)	Blocked	5 (0–21)
Sapovirus	13 (0–34)	8 (0–30)	75 (49–94)	Blocked	4 (0–16)

*Blocked indicates pathways blocked by study administrators. AGI, acute gastrointestinal disease; STEC, Shiga toxin–producing *Escherichia coli*.
†Clinical manifestations of interest for initial elicitation were bacteremia and wound infections.

Table 4. Source attribution results for major transmission pathways, structured expert judgment, United States, 2017*

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Enterotoxigenic *Escherichia coli*	69 (37– 91)	9 (0–38)	7 (0–38)	Blocked	15 (2–33)
STEC O157	60 (40–77)	5 (1–13)	16 (4–33)	12 (3–25)	7 (1–17)
STEC non-O157	50 (26–75)	6 (0–17)	15 (2–34)	21 (2–46)	8 (0–24)
E. coli, other diarrheagenic	55 (27–80)	9 (0–30)	16 (2–39)	9 (0–33)	12 (0–33)
Legionella spp.	Blocked	97 (67–100)	0 (0–1)	Blocked	2 (0–28)
Mycobacterium bovis	75 (36–98)	1 (0–9)	9 (0–39)	13 (0–50)	2 (0–12)
Nontuberculous *Mycobacterium* spp.	Blocked	72 (39–94)	4 (0–21)	2 (0–35)	22 (0–49)
Pseudomonas spp., otitis externa	Blocked	81 (67–95)	3 (0–13)	1 (0–4)	15 (1–,25)
Pseudomonas spp., septicemia	Blocked	22 (3–53)	2 (0–19)	2 (0–11)	74 (41–94)
Pseudomonas spp., pneumonia	Blocked	51 (14–80)	4 (1–32)	0 (0–2)	45 (15–80)
Salmonella enterica, nontyphoidal	66 (48–81)	6 (0–22)	7 (0–16)	11 (3–24)	9 (2–21)
S. enterica, nontyphoidal, age <5 y	46 (20–66)	7 (0–26)	18 (6–35)	13 (2–30)	16 (2–36)
S. enterica serotype Enteritidis	80 (63–92)	4 (0–11)	7 (1–16)	5 (0–19)	4 (1–14)
S. enterica serotype I 4,[5],12:i:-	66 (40–82)	6 (1–15)	8 (1–17)	12 (2–27)	7 (0–20)
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S. enterica serotype Typhimurium	59 (27–78)	7 (1–18)	8 (2–19)	14 (3–29)	13 (2–30)
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S. enterica, all other serotypes group 2	40 (10–65)	7 (1–24)	10 (2–26)	17 (1–40)	26 (6–51)
Shigella spp.	8 (1–36)	4 (1–21)	81 (48–93)	Blocked	6 (0–26)
Staphylococcus aureus	Blocked	75 (23–98)	18 (1–71)	1 (0–5)	5 (0–37)
Streptococcus spp., group A	4 (0–33)	1 (0–6)	92 (55–99)	1 (0–12)	2 (0–19)
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V. cholerae nontoxigenic	92 (61–100)	6 (0–30)	1 (0–3)	0 (0–4)	0 (0–3)
V. cholerae nontoxigenic, non-AGI	33 (8–59)	65 (39–90)	0 (0–1)	0 (0–1)	2 (0–13)
V. parahaemolyticus	74 (59–91)	24 (7–38)	0 (0–2)	0 (0–2)	1 (0 –5)
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V. vulnificus†	20 (7–54)	77 (40–91)	0 (0–3)	1 (0–9)	2 (0–12)
V. vulnificus, non-AGI	20 (9–34)	78 (58–89)	0 (0–1)	1 (0–16)	2 (0–9)
Vibrio spp., other AGI	96 (69–100)	2 (0–23)	0 (0–1)	0 (0–2)	1 (0–8)
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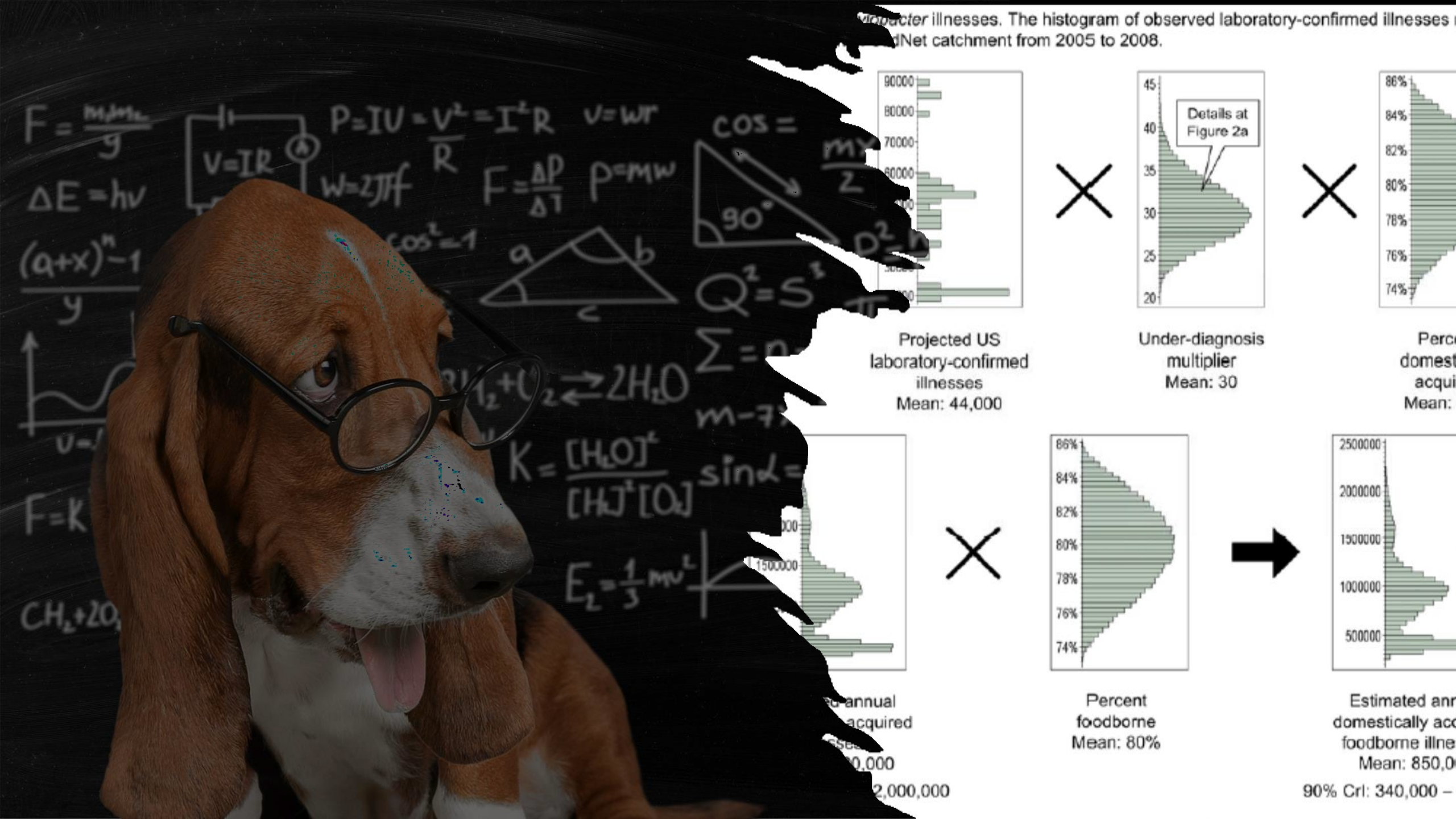
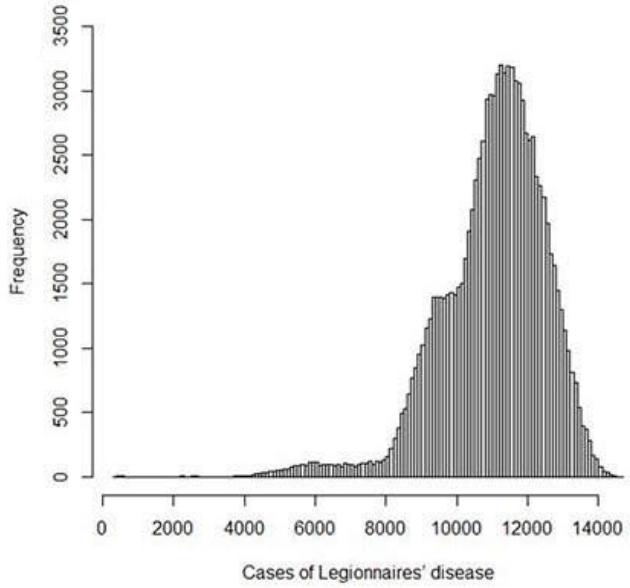
Viruses					
Astrovirus	15 (1–38)	6 (0–25)	73 (44–94)	Blocked	6 (0–18)
Hepatitis A virus	42 (9–78)	8 (0–33)	41 (8–77)	Blocked	8 (0–34)
Norovirus	19 (6–37)	6 (0–25)	70 (46–88)	Blocked	5 (0–18)
Rotavirus	5 (0–20)	7 (0–28)	81 (57–98)	Blocked	5 (0–21)
Sapovirus	13 (0–34)	8 (0–30)	75 (49–94)	Blocked	4 (0–16)

*Blocked indicates pathways blocked by study administrators. AGI, acute gastrointestinal disease; STEC, Shiga toxin–producing *Escherichia coli*.
†Clinical manifestations of interest for initial elicitation were bacteremia and wound infections.

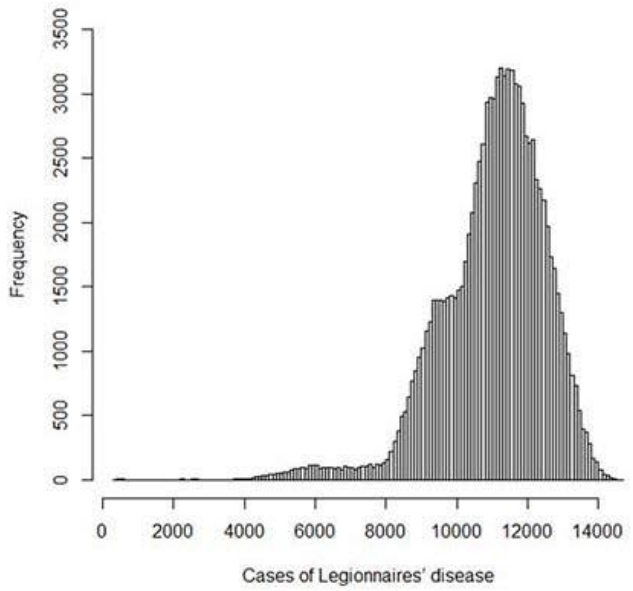

cter illnesses. The histogram of observed laboratory-confirmed illnesses
dNet catchment from 2005 to 2008.
90000
80000
70000
60000
45
40
35
30
25
20
Details at Figure 2a
86%
84%
82%
80%
78%
76%
74%
Projected US laboratory-confirmed illnesses
Mean: 44,000
Under-diagnosis multiplier
Mean: 30
Perc
domest
acqui
Mean:
1500000
annual
acquired
,000
2,000,000
86%
84%
82%
80%
78%
76%
74%
Percent foodborne
Mean: 80%
2500000
2000000
1500000
1000000
500000
Estimated ann
domestically acc
foodborne illne
Mean: 850,0
90% CrI: 340,000 –

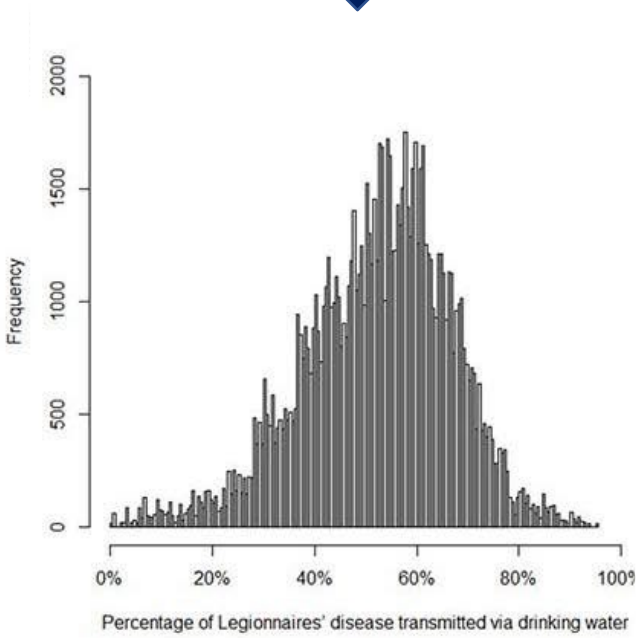
Burden 1.0
Collier, et al., 2021



Burden 1.0
Collier, et al., 2021

SEJ
Beshearse, et al., 2021

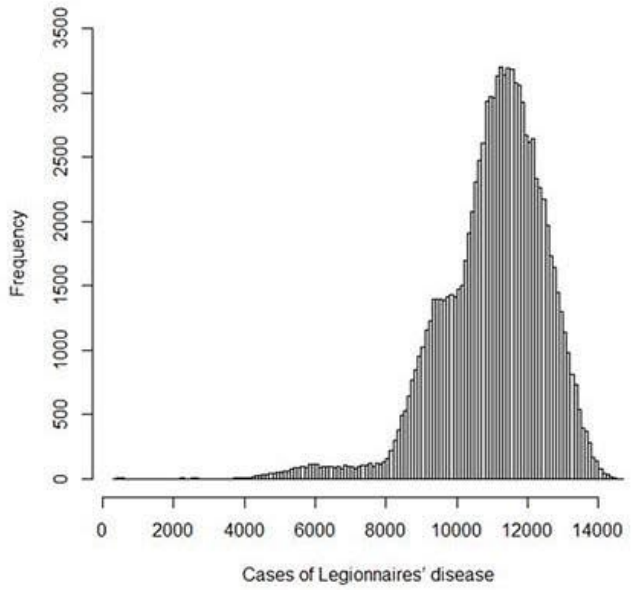


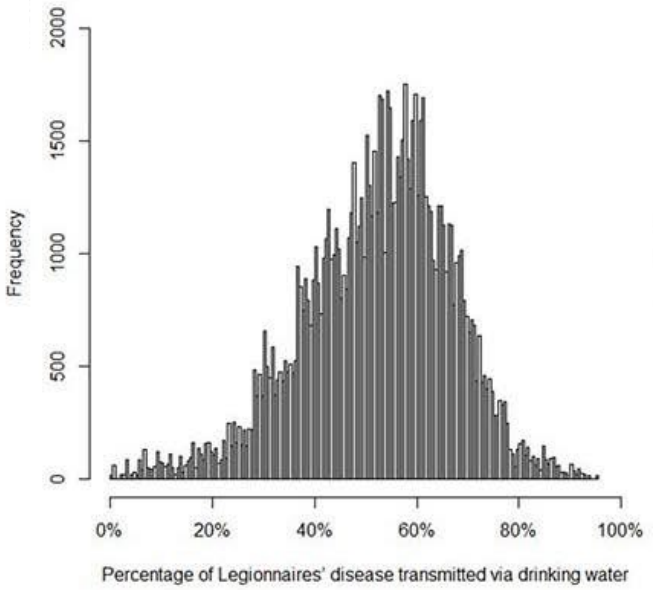


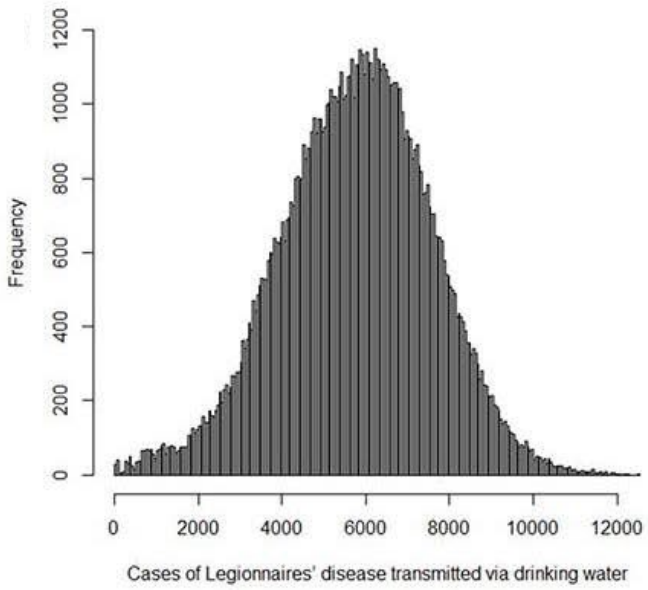
Burden 1.0
Collier, et al., 2021

SEJ
Beshearse, et al., 2021

Burden 2.0
Gerdes & Miko, et al., 2023







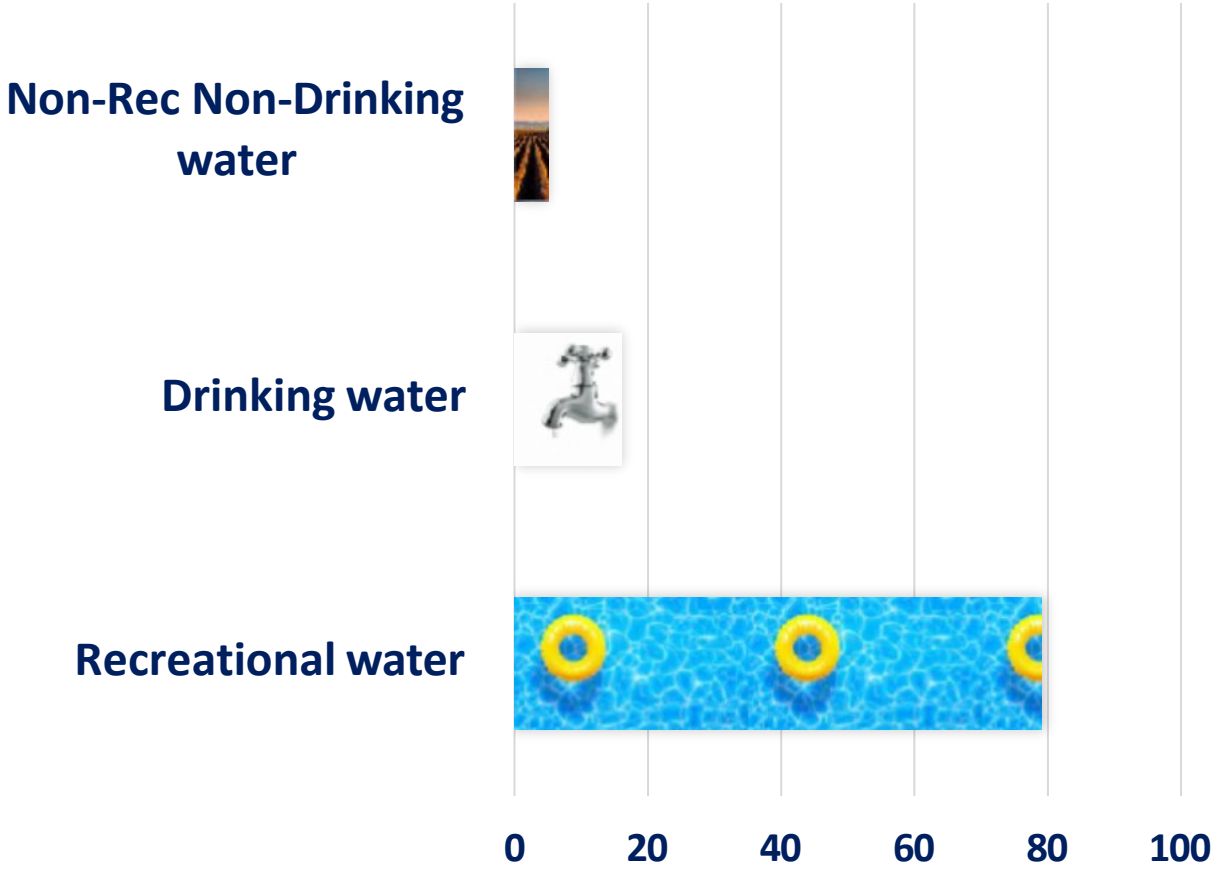
Estimating Waterborne Infectious Disease Burden by Exposure Route, United States, 2014

Megan E. Gerdes,[1] Shanna Miko,[1] Jasen M. Kunz, Elizabeth J. Hannapel, Michele C. Hlavsa, Michael J. Hughes, Matthew J. Stuckey, Louise K. Francois Watkins, Jennifer R. Cope, Jonathan S. Yoder, Vincent R. Hill, Sarah A. Collier

Burden 2.0: Results?

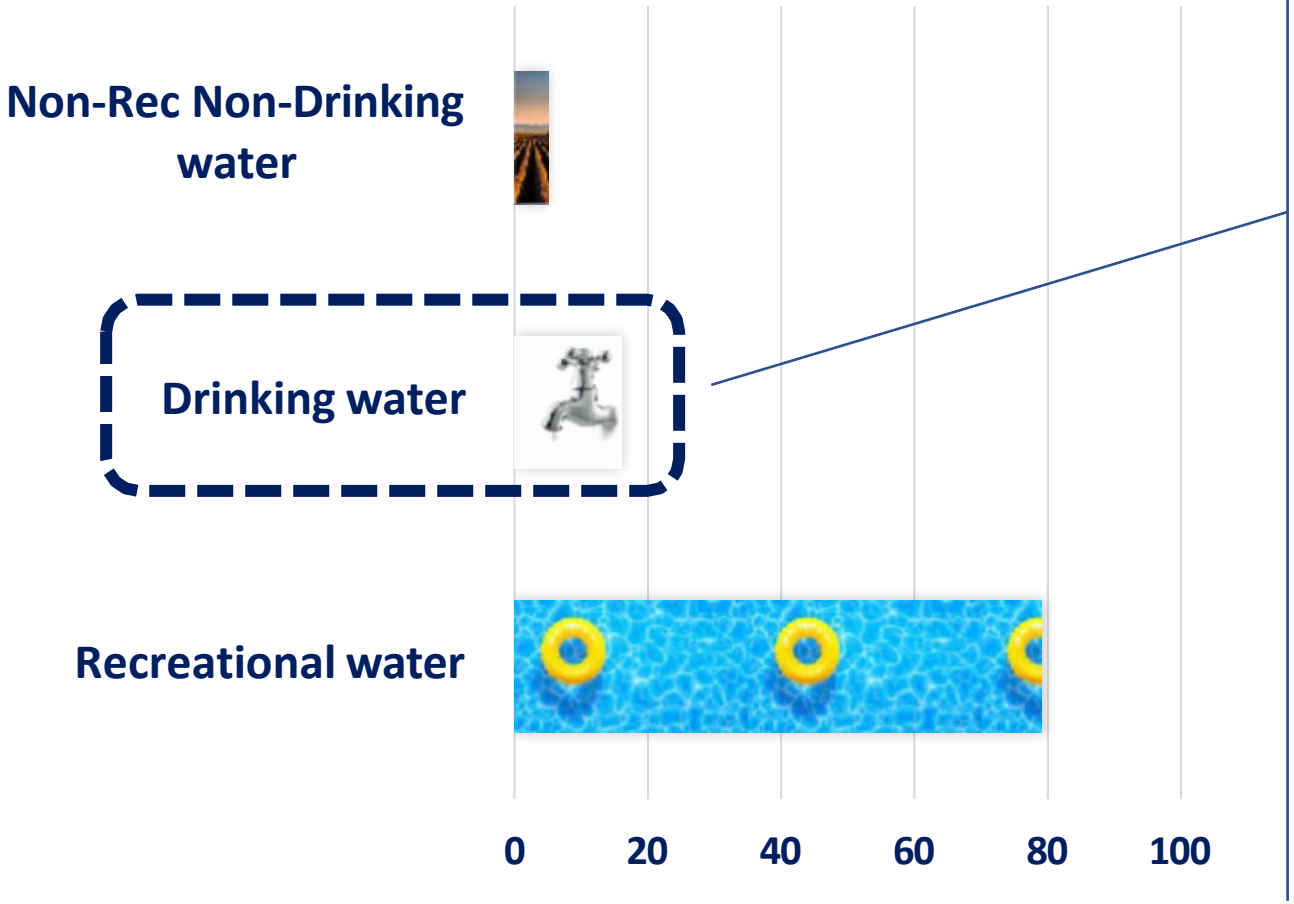
Total Illnesses

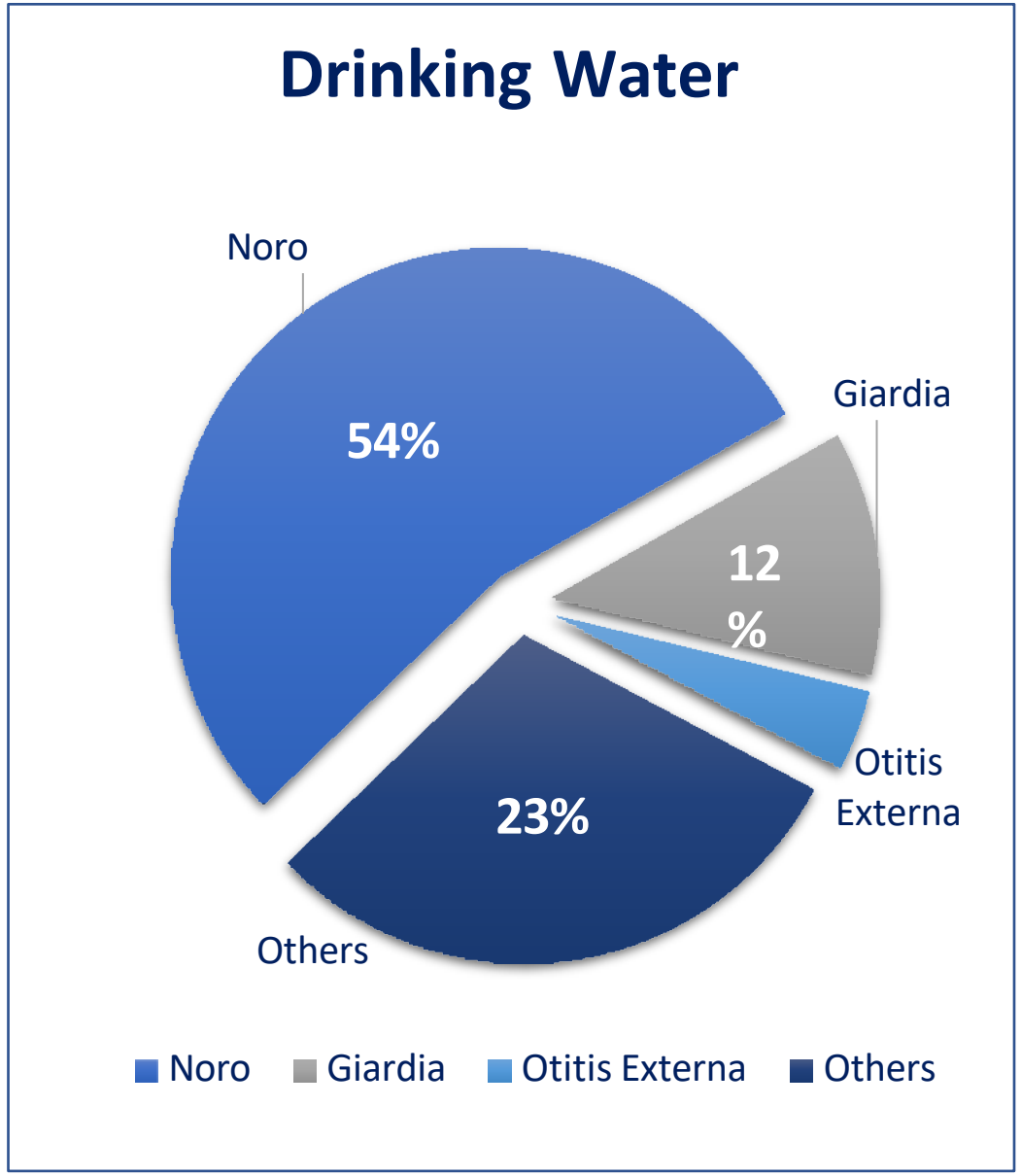
7.2M WATERBORNE INFECTIONS



Total Illnesses

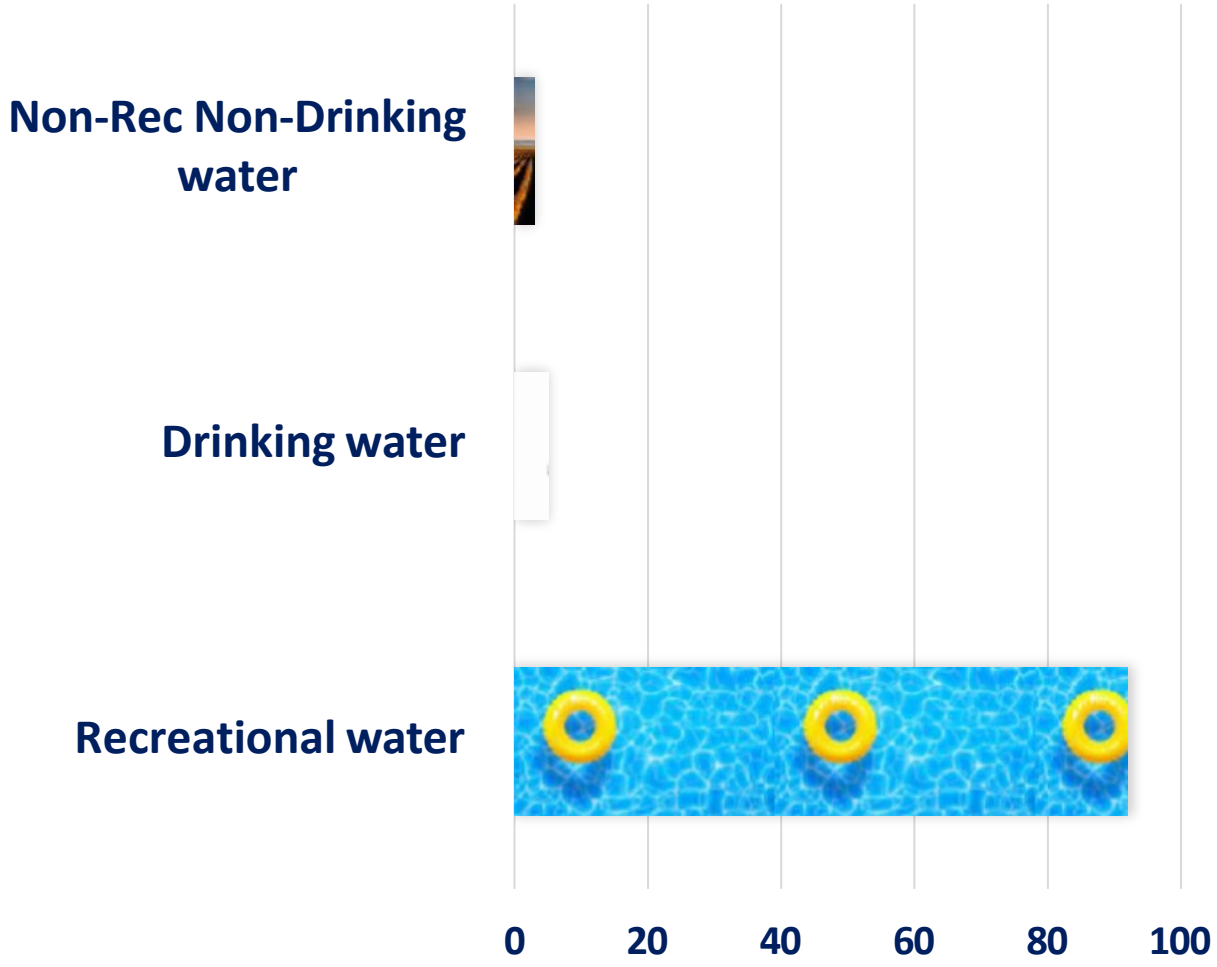
7.2M WATERBORNE INFECTIONS





ED Visits

600K WATERBORNE ED VISITS



ED Visits

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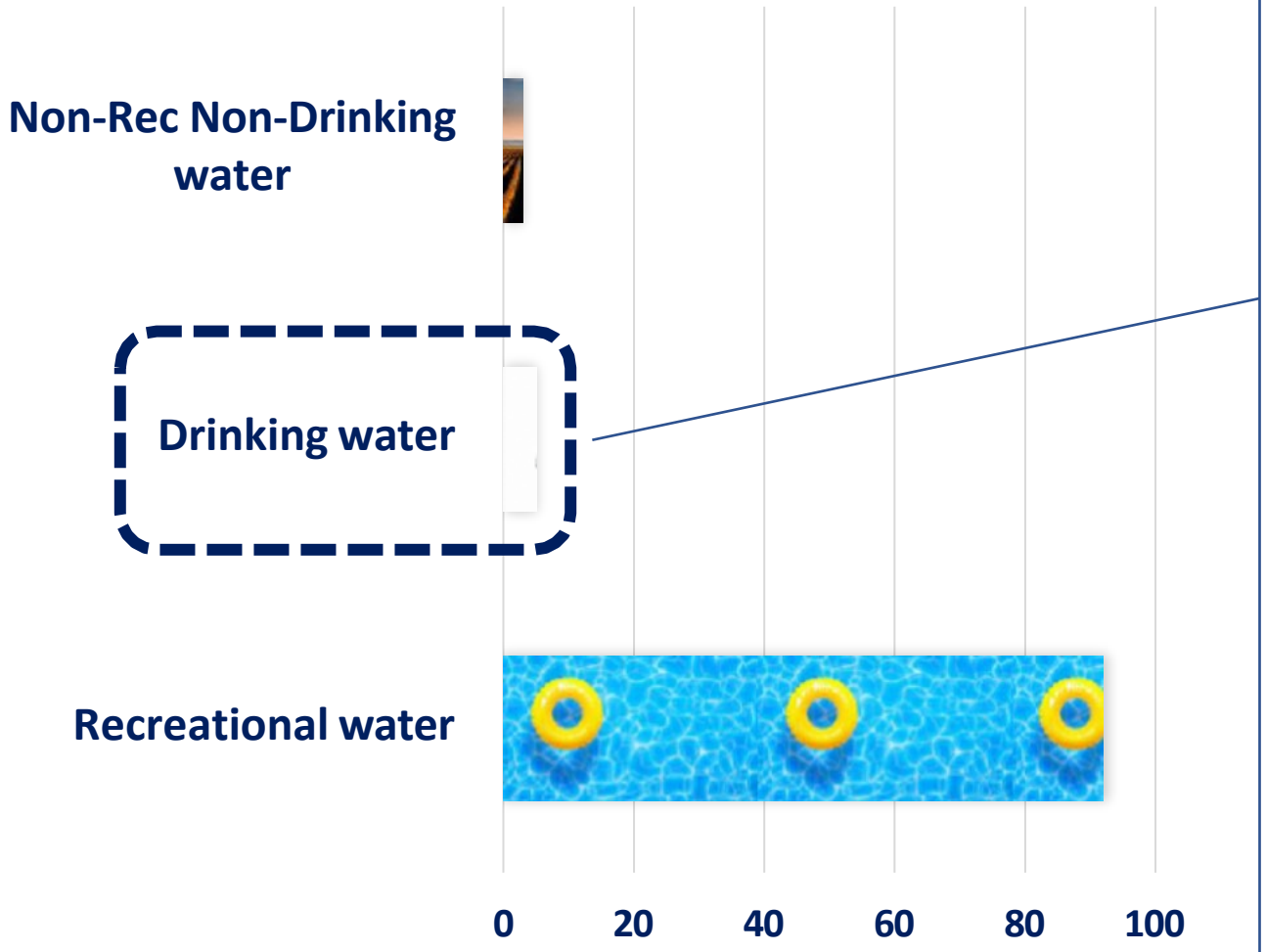
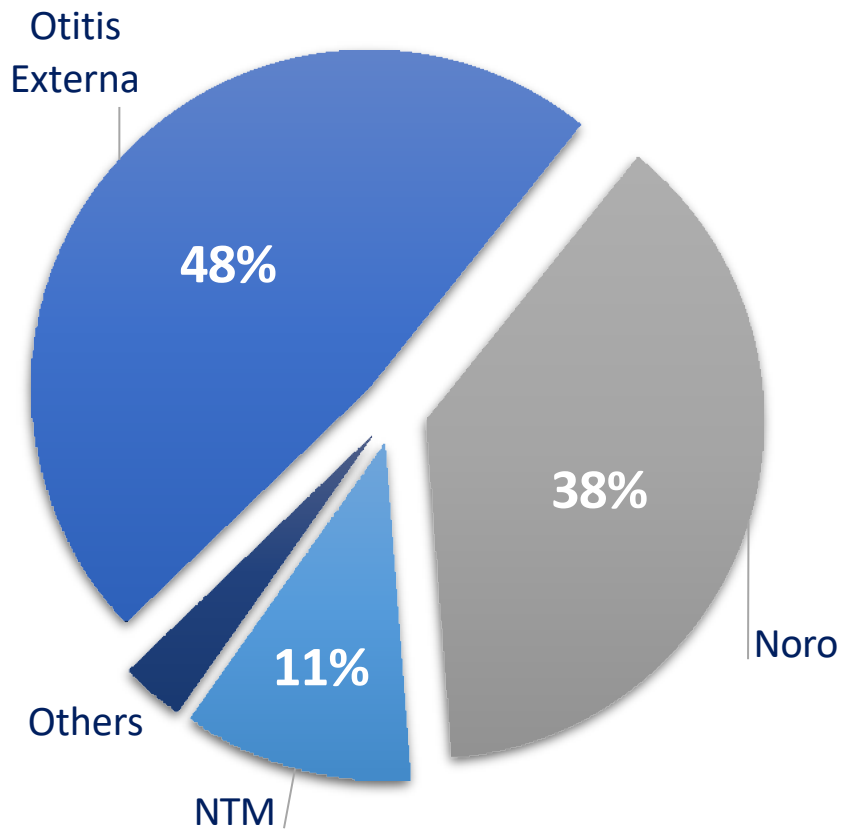
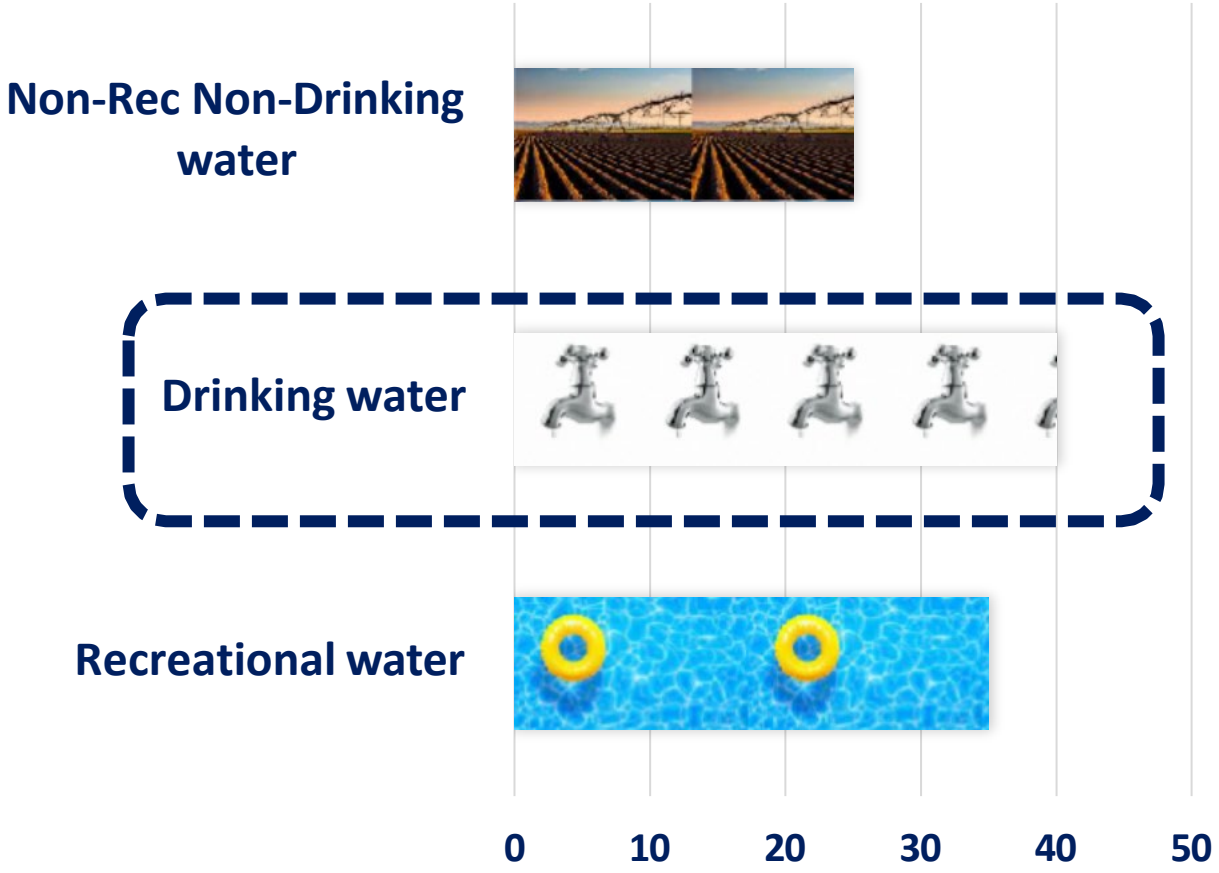


Drinking Water



Hospitalizations

120K WATERBORNE HOSPITALIZATIONS



Biofilms in Drinking Water Responsible for Large Portion of Hospitalizations, Deaths, and Healthcare Costs

40% of 120,000 Hospitalizations

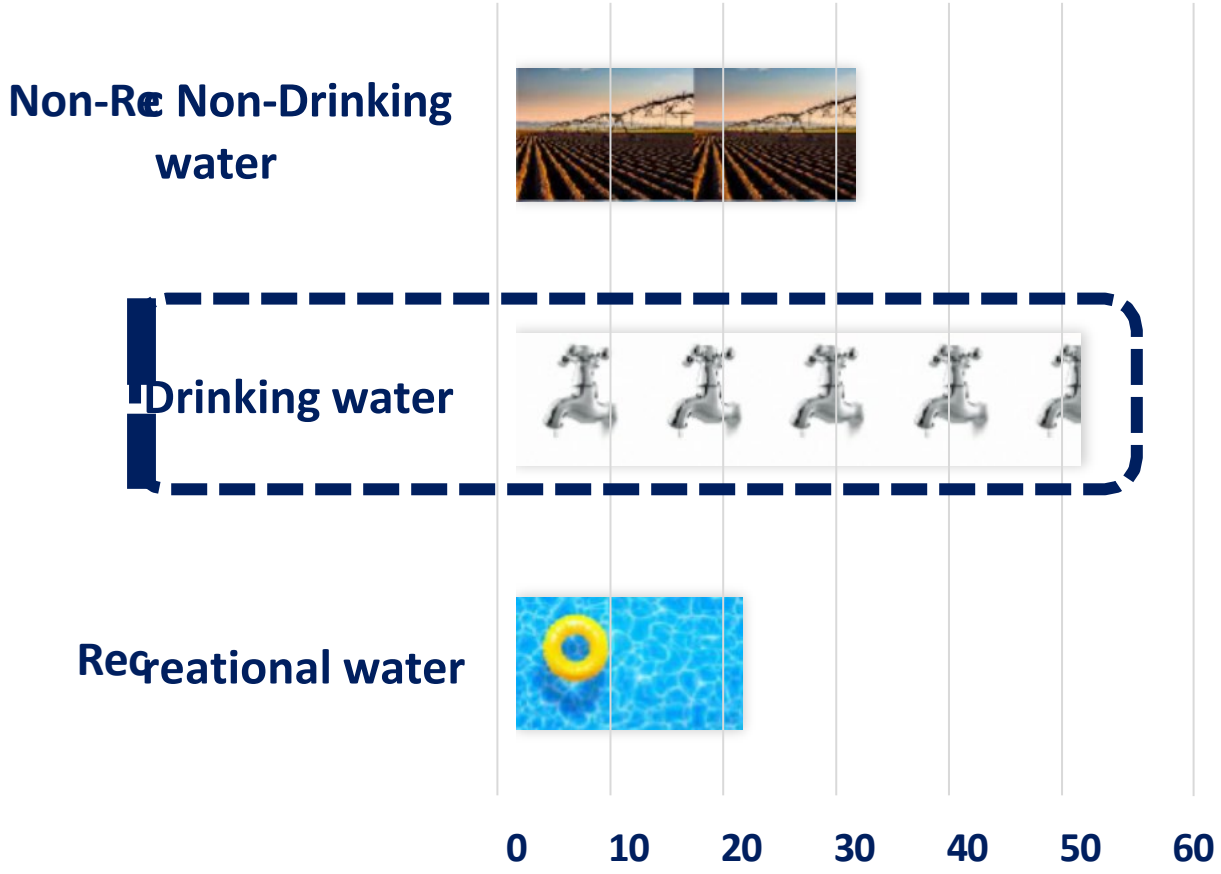
Biofilms in Drinking Water Responsible for Large Portion of Hospitalizations, Deaths, and Healthcare Costs

40% of 120,000 Hospitalizations

73% Drinking Water Hospitalizations from **Non-Tuberculous Mycobacterium**

Deaths

6,600 WATERBORNE INFECTION DEATHS



Biofilms in Drinking Water Responsible for Large Portion of Hospitalizations, Deaths, and Healthcare Costs

50% of
6,600 Deaths

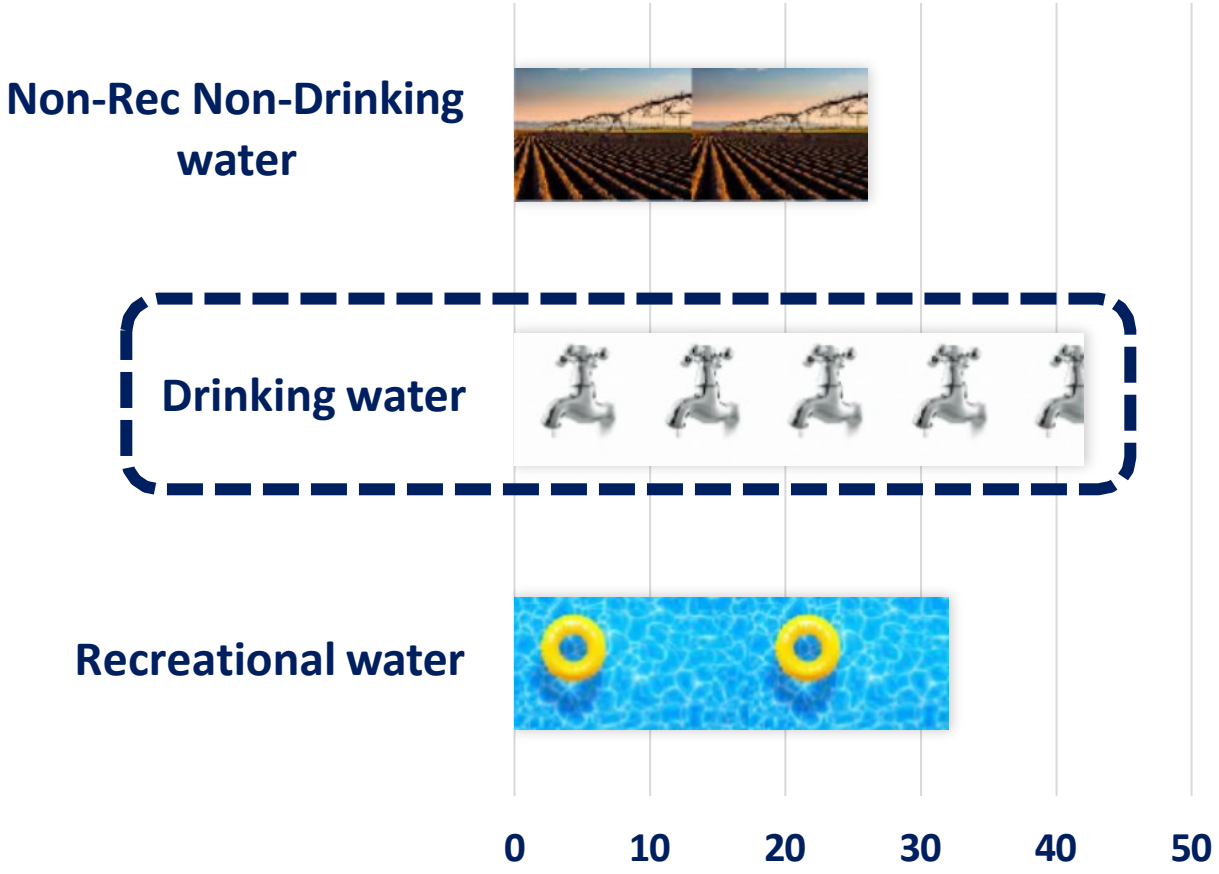
Biofilms in Drinking Water Responsible for Large Portion of Hospitalizations, Deaths, and Healthcare Costs

50% of
6,600 Deaths

78% Drinking Water Deaths from
Non-Tuberculous Mycobacterium

Direct Costs

$3B IN VISITS AND HOSPITALIZATIONS



Biofilms in Drinking Water Responsible for Large Portion of Hospitalizations, Deaths, and Healthcare Costs

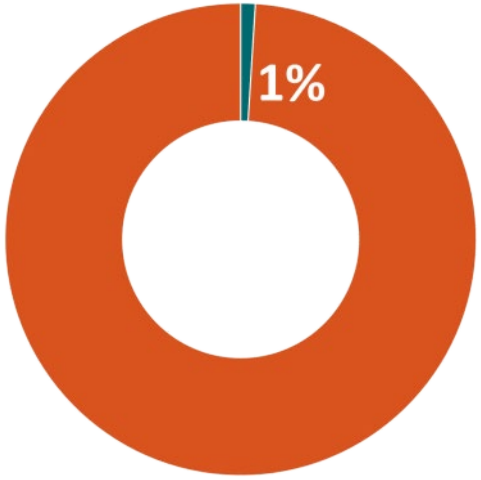
40% of
$3.3 billion

Biofilms in Drinking Water Responsible for Large Portion of Hospitalizations, Deaths, and Healthcare Costs

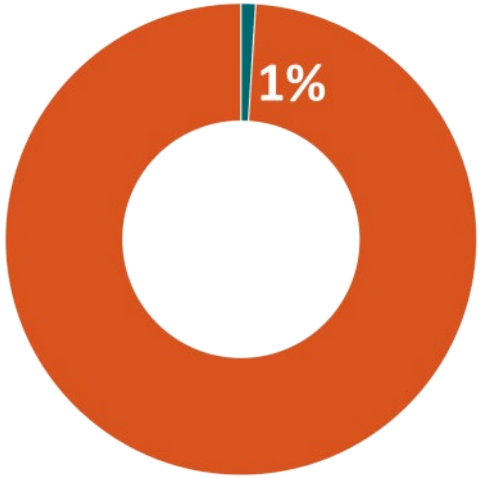
40% of
$3.3 billion

72% Drinking Water Costs: 4
Tuberculous Mycobacteriu
Pseudomonas pneumo
and 12% **legionellosi**

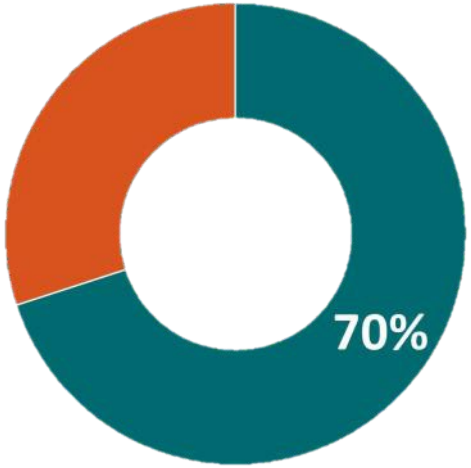
Infectious waterborne disease in the United States



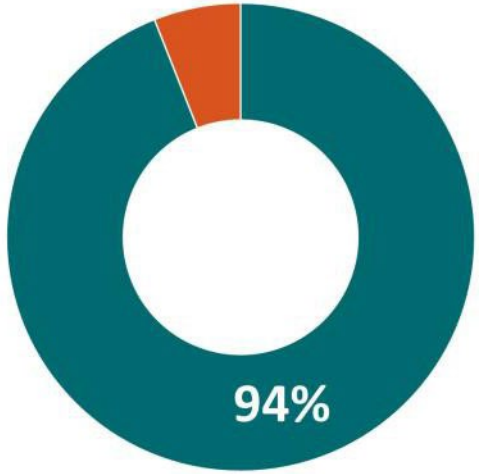
7.2 million illnesses



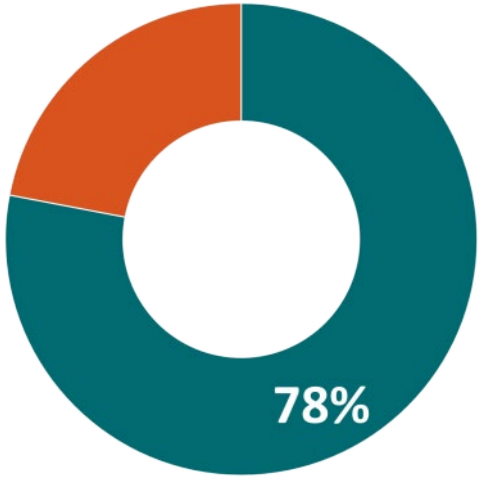
600,000 ED visits



120,000 hospitalizations



7,000 deaths

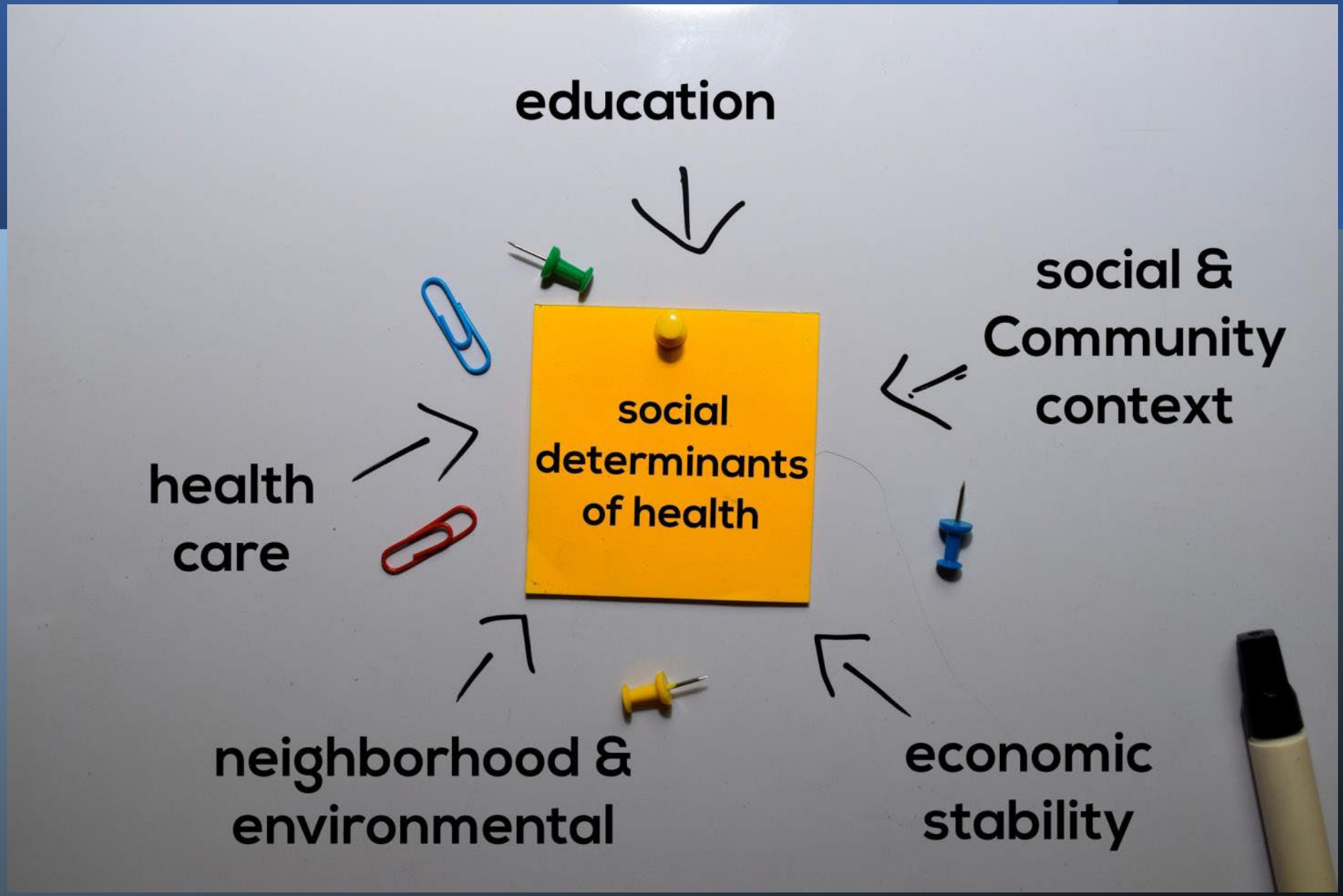


3.3 billion $US

% Biofilm-associated rises in more severe outcomes

Slide courtesy of Sarah A Collier, CDC

Burden 3.0?


education
social &
Community
context
social
determinants
of health
health
care
neighborhood &
environmental
economic
stability

Acknowledgements

Michael Beach
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Li Deng
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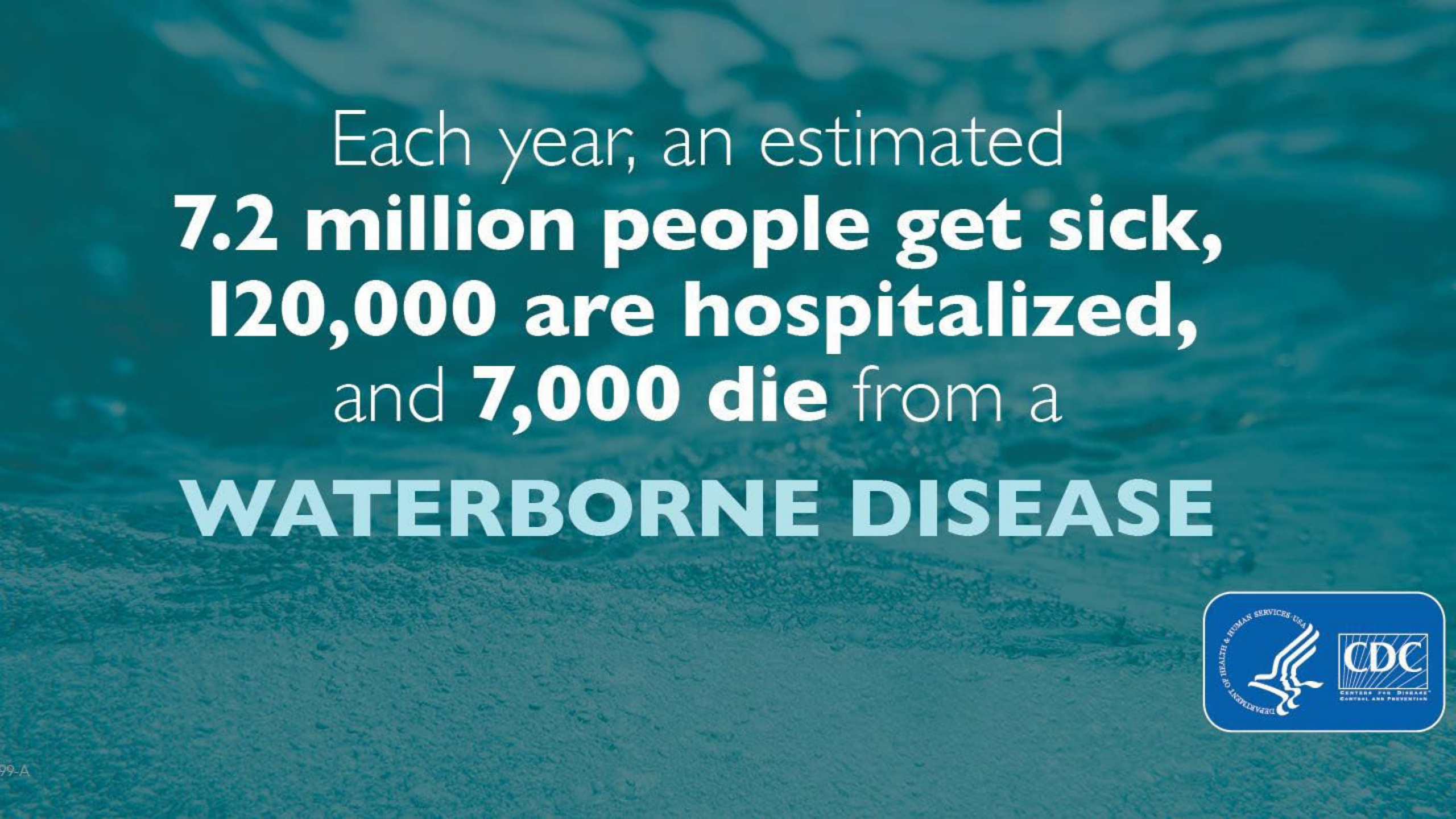
Mike Hoekstra
Patty Griffin
Beau Bruce
Aimee Geissler
Anna Blackstock
Gordana Derado
Chris Edens
Aron Hall
Sujan Reddy
Erin Stokes
Kakoli Roy
Madeleine Baker-Goering

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.


Each year, an estimated
7.2 million people get sick,
120,000 are hospitalized,
and 7,000 die from a
WATERBORNE DISEASE
DEPARTMENT OF HEALTH & HUMAN SERVICES USA
CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION
99-A

ANNEX SLIDES

For more information, contact CDC
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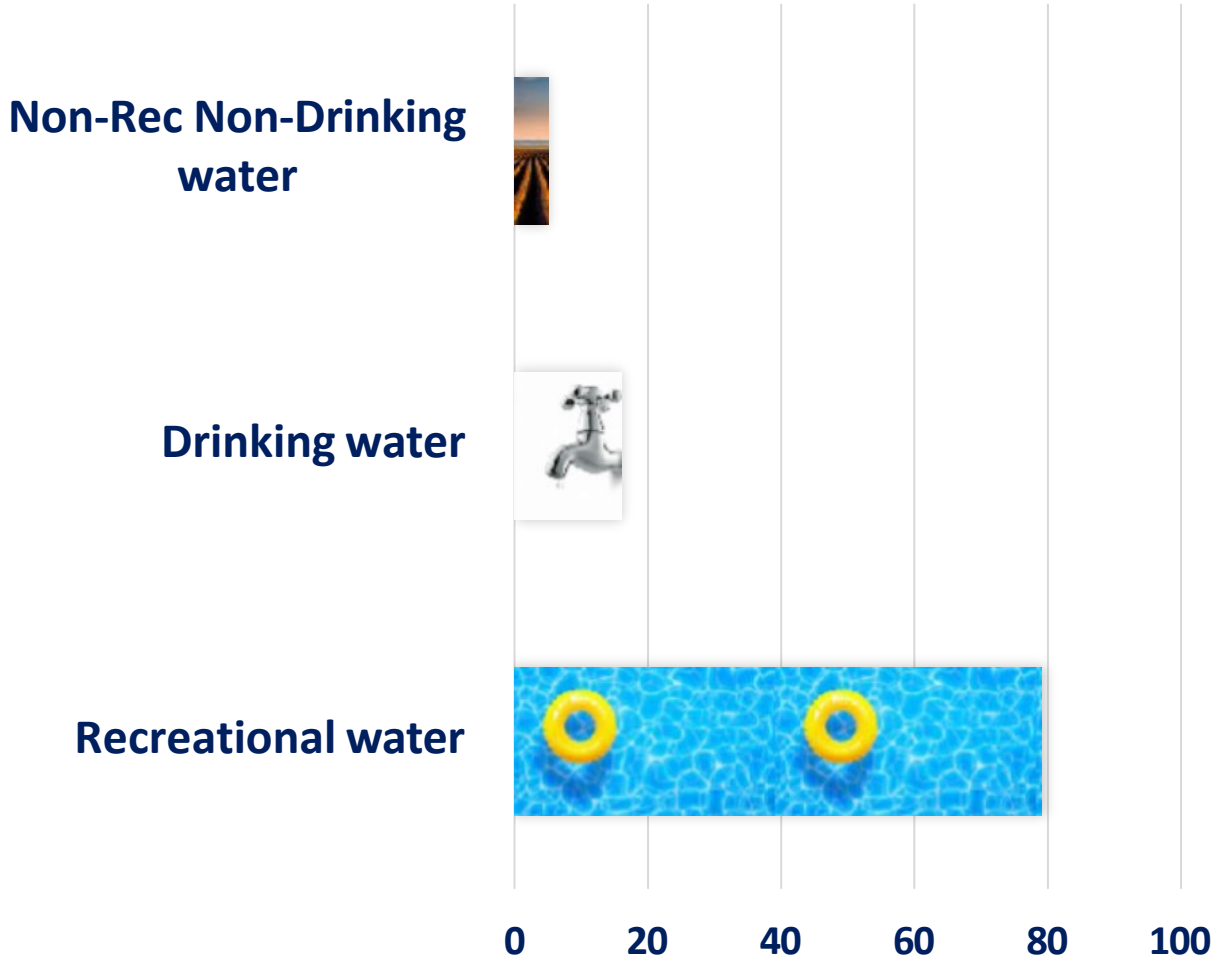
TTY: 1-888-232-6348 www.cdc.gov

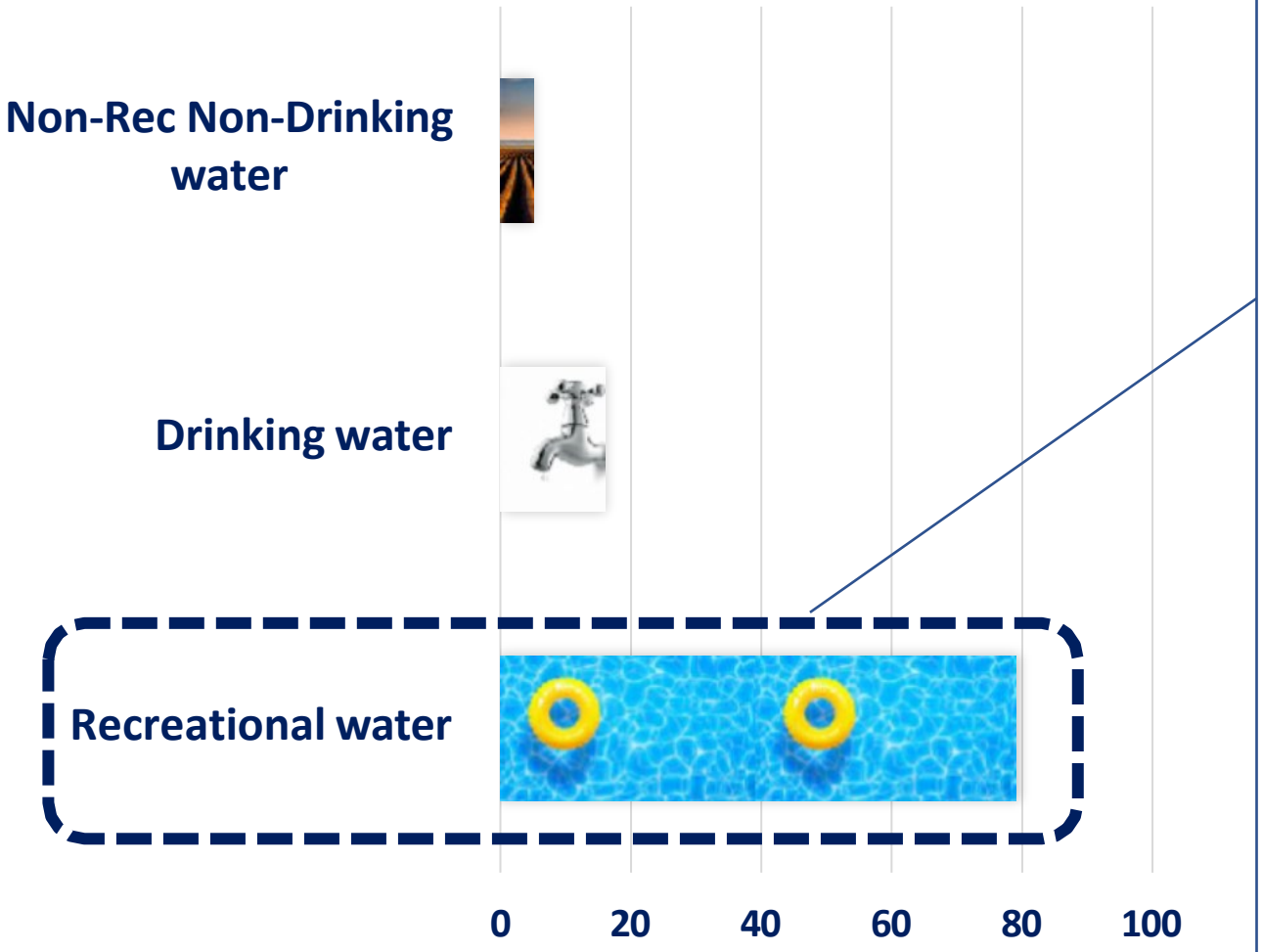
Total Illnesses

7M WATERBORNE INFECTIONS



Total Illnesses

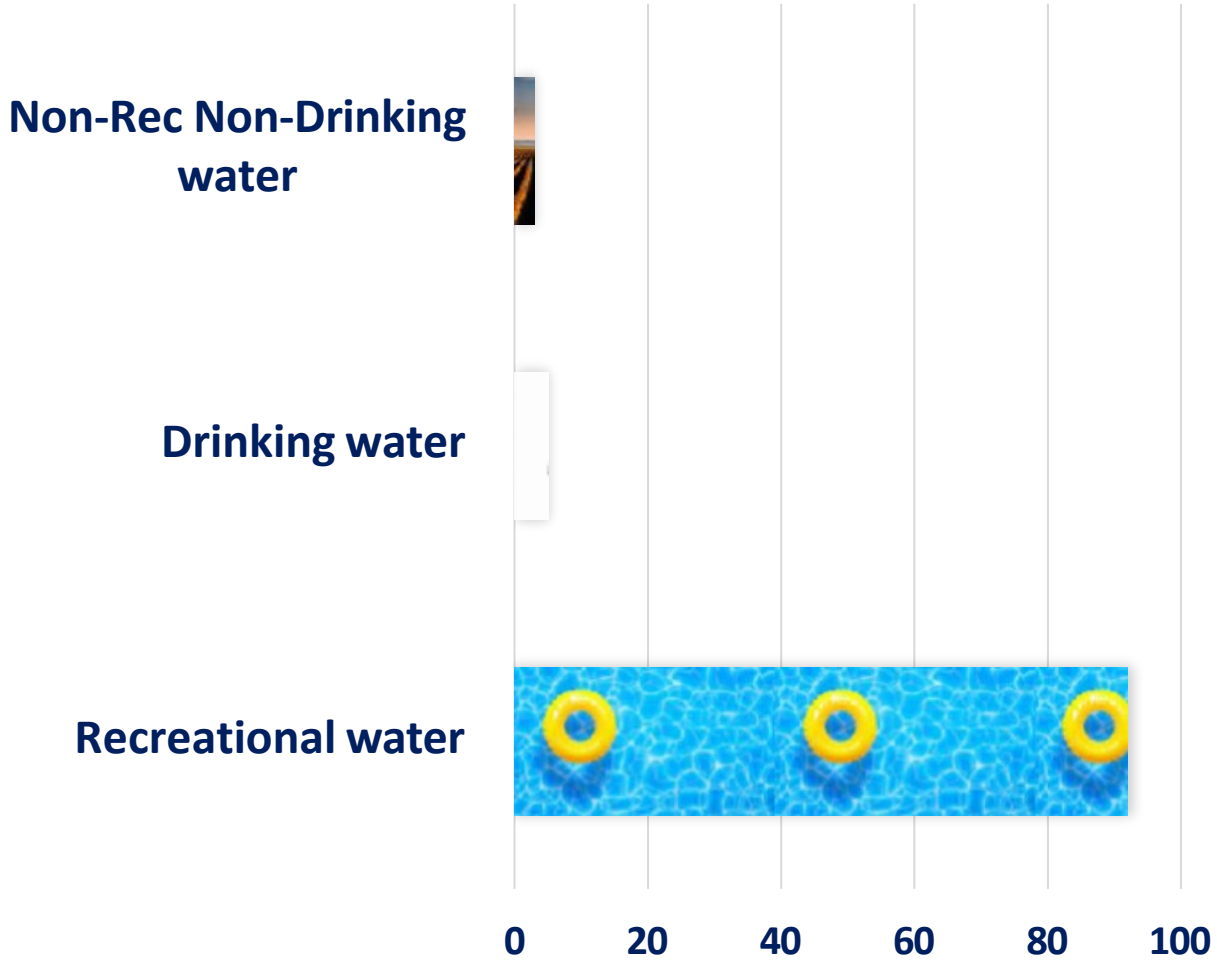
7M WATERBORNE INFECTIONS



Recreation Water

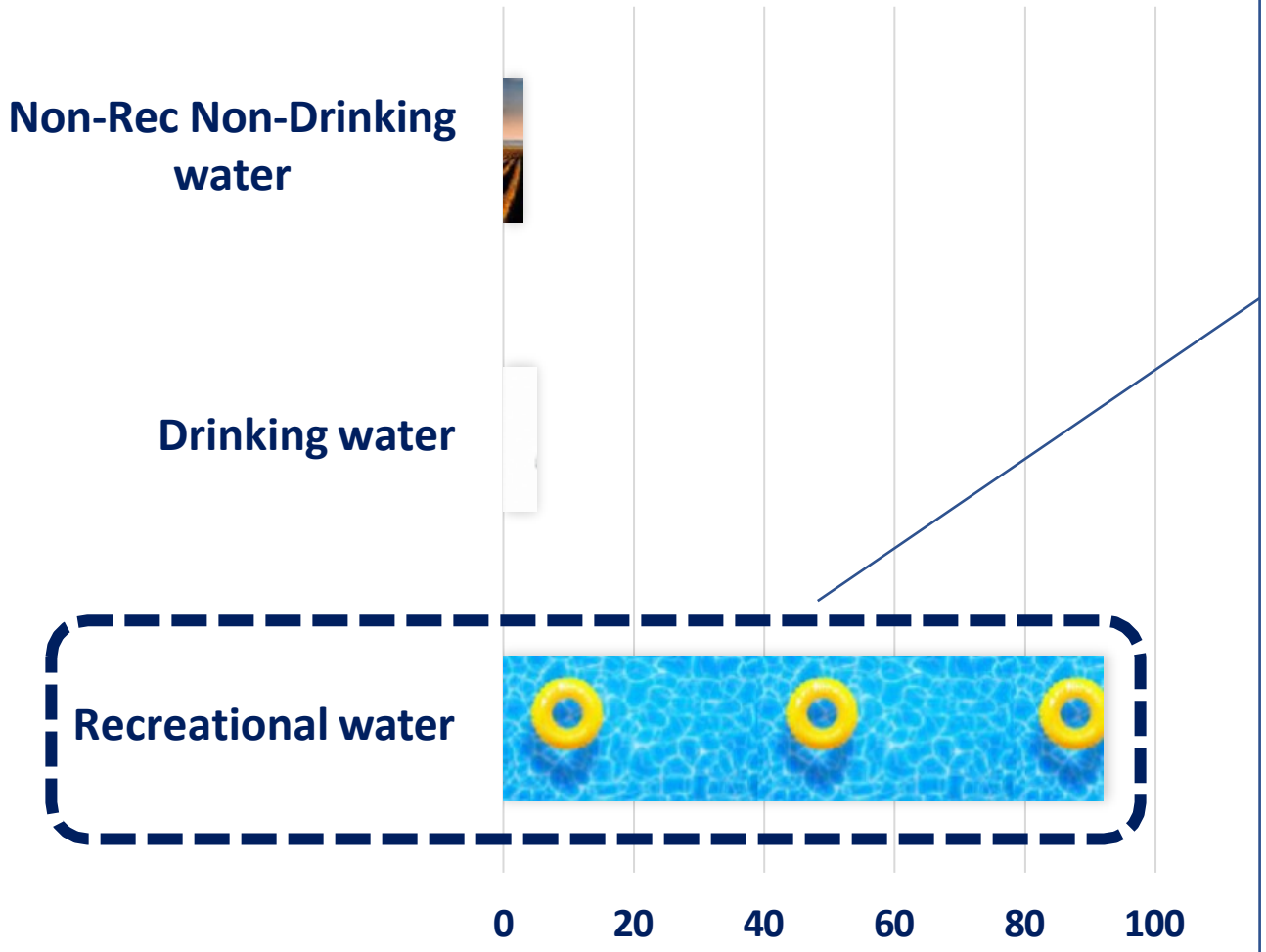
ED Visits

600K WATERBORNE ED VISITS

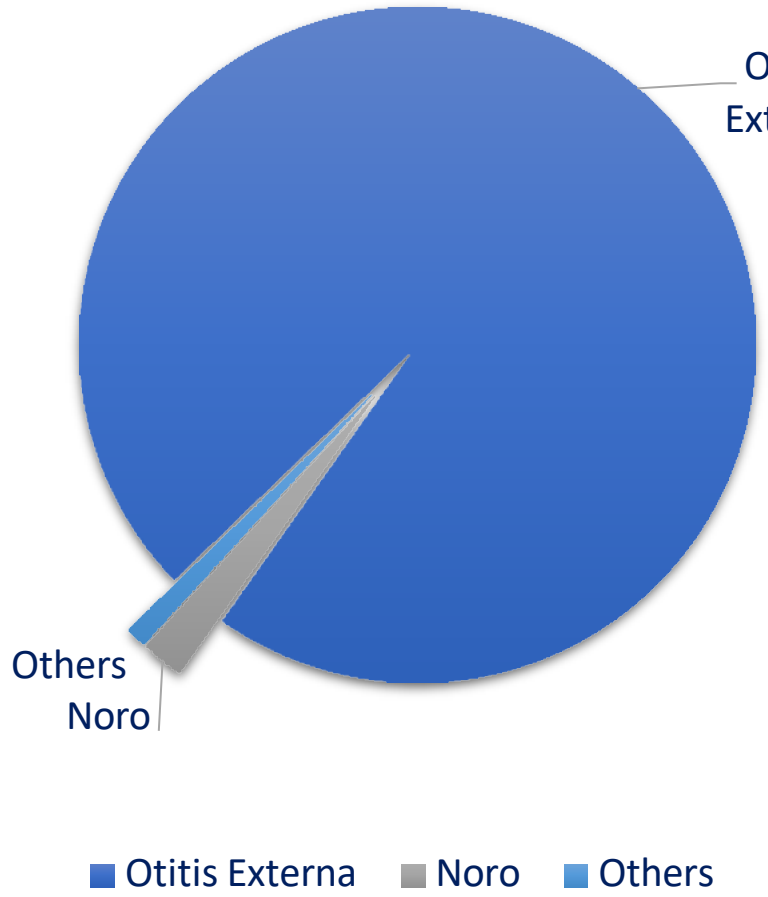


ED Visits

600K WATERBORNE ED VISITS

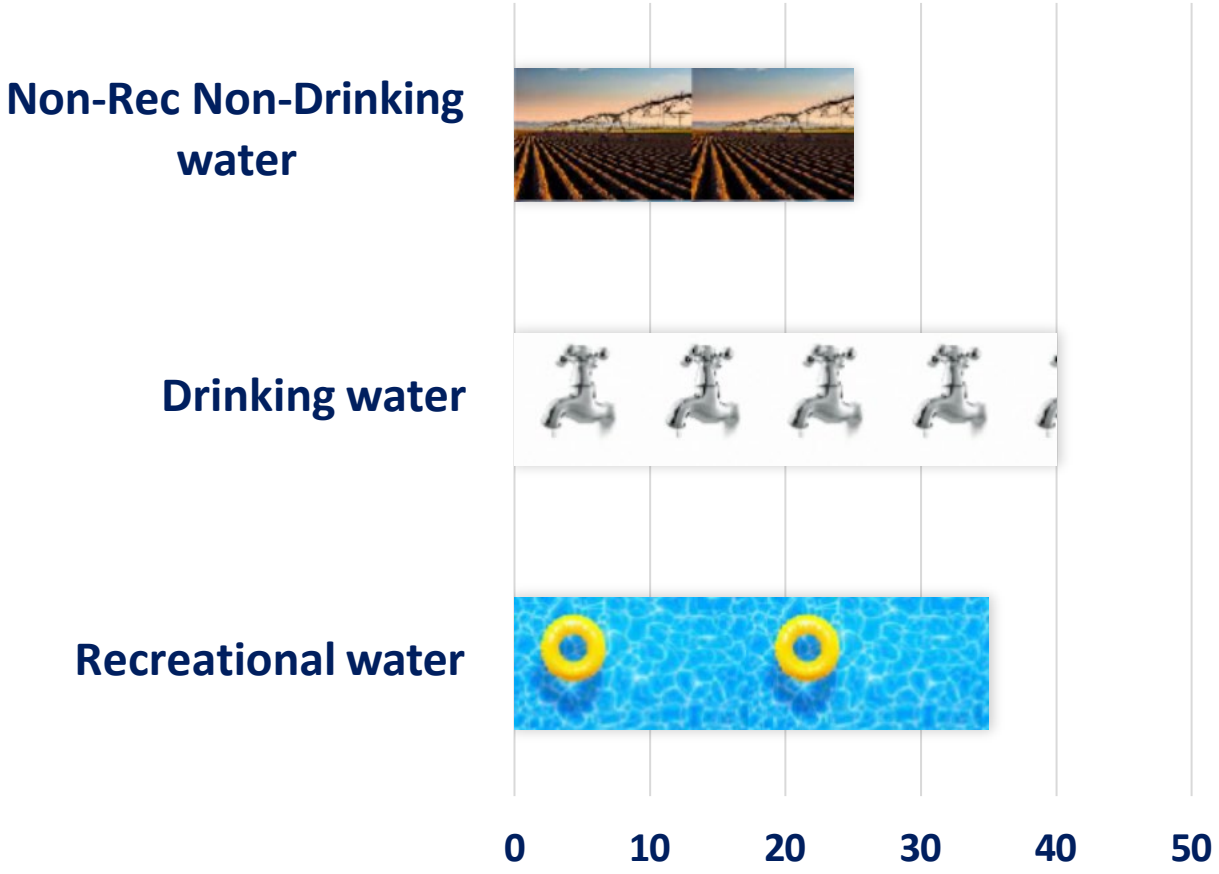


Recreation Water



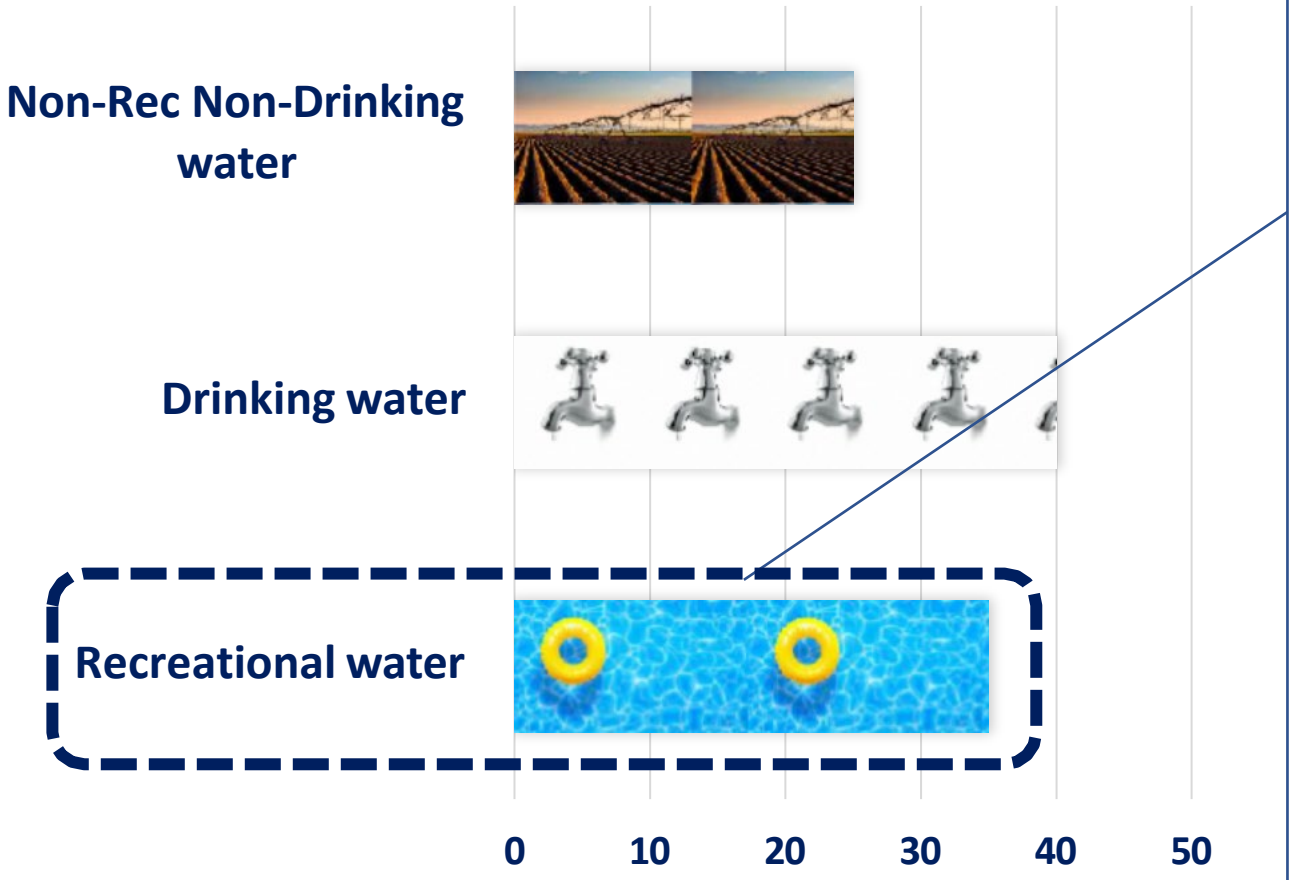
Hospitalizations

120K WATERBORNE HOSPITALIZATIONS

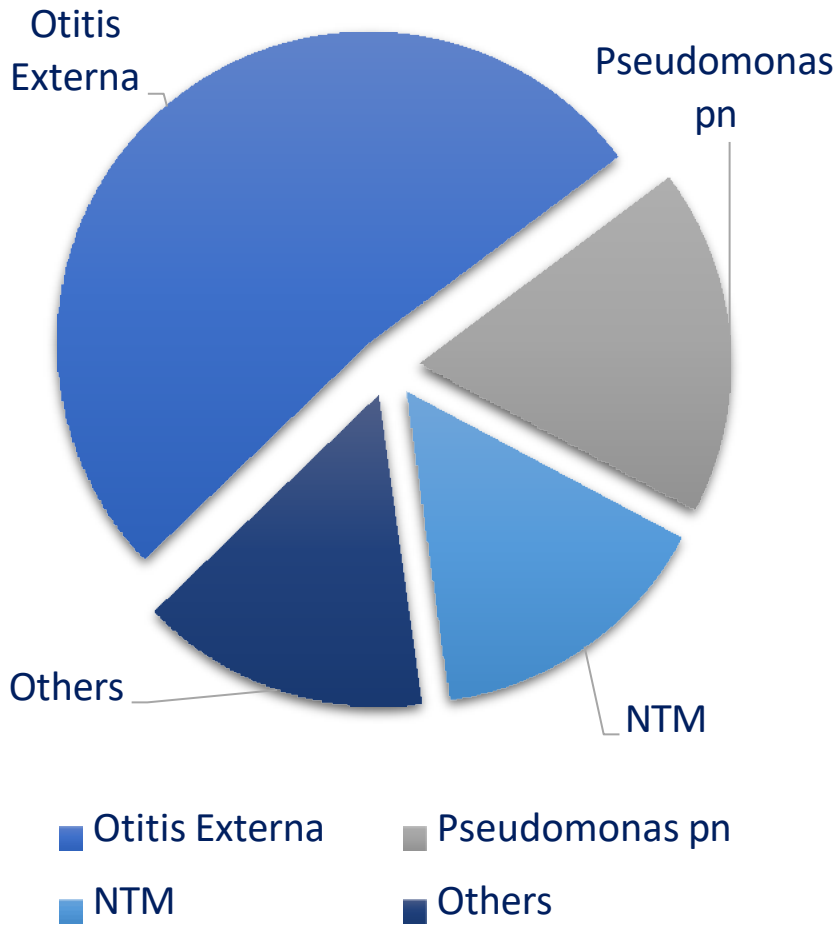


Hospitalizations

120K WATERBORNE HOSPITALIZATIONS

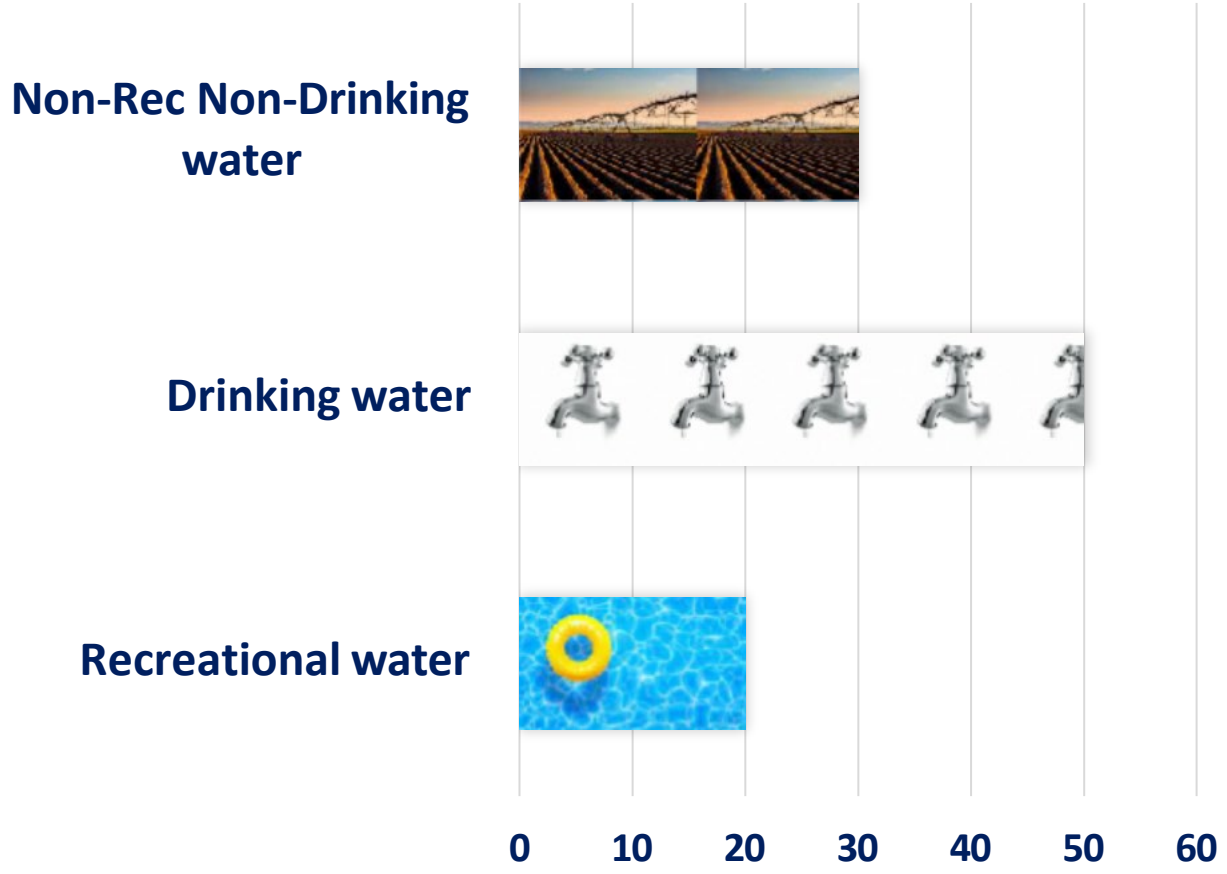


Recreation Water



Deaths

6,600 WATERBORNE INFECTION DEATHS



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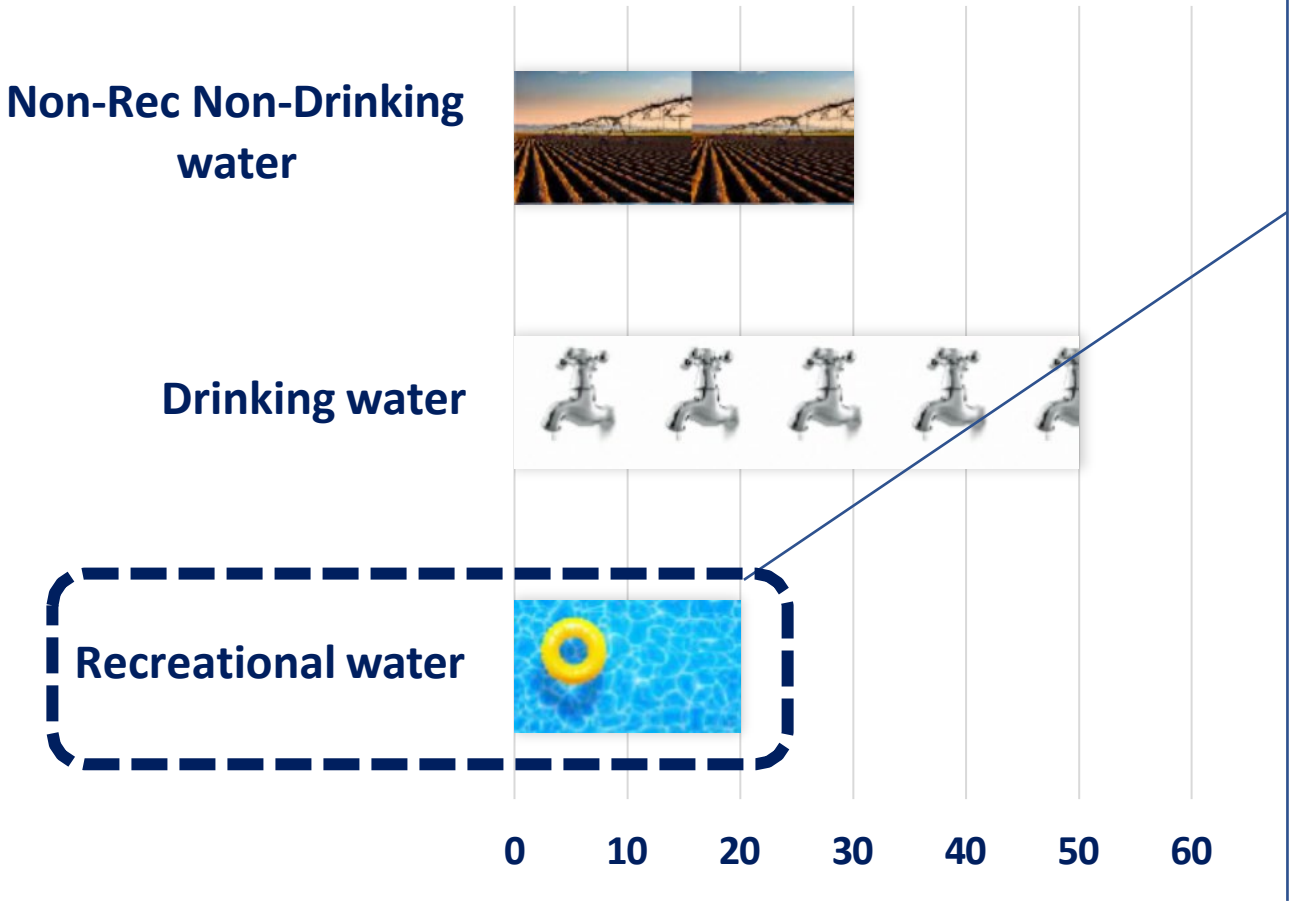
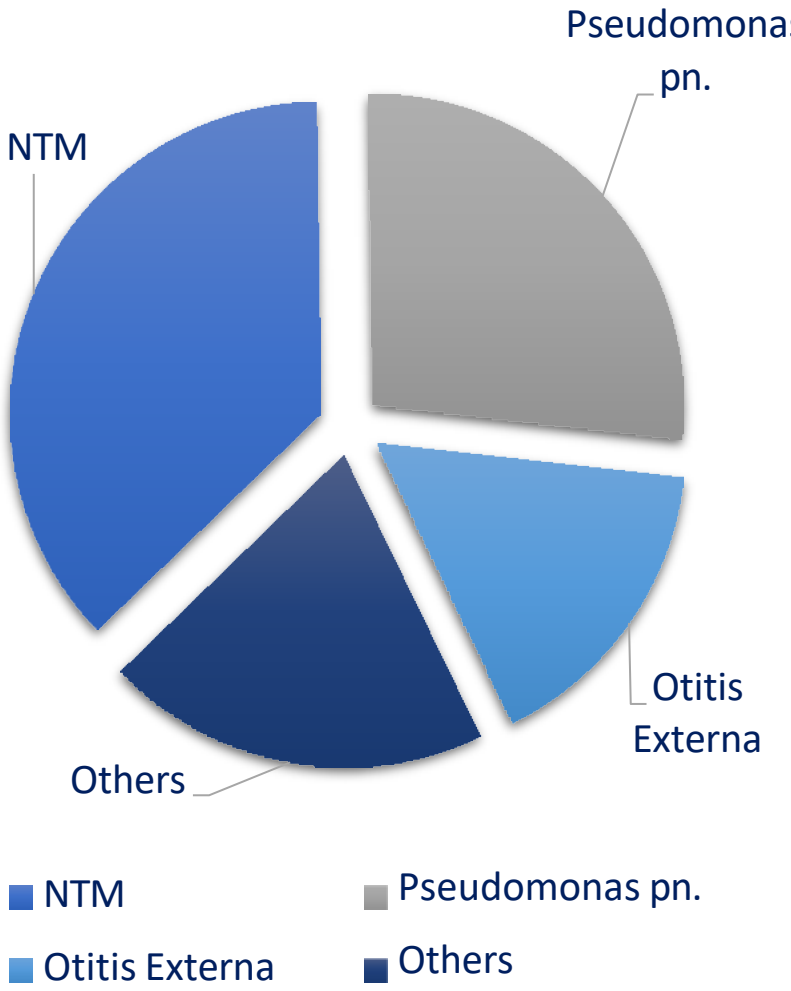
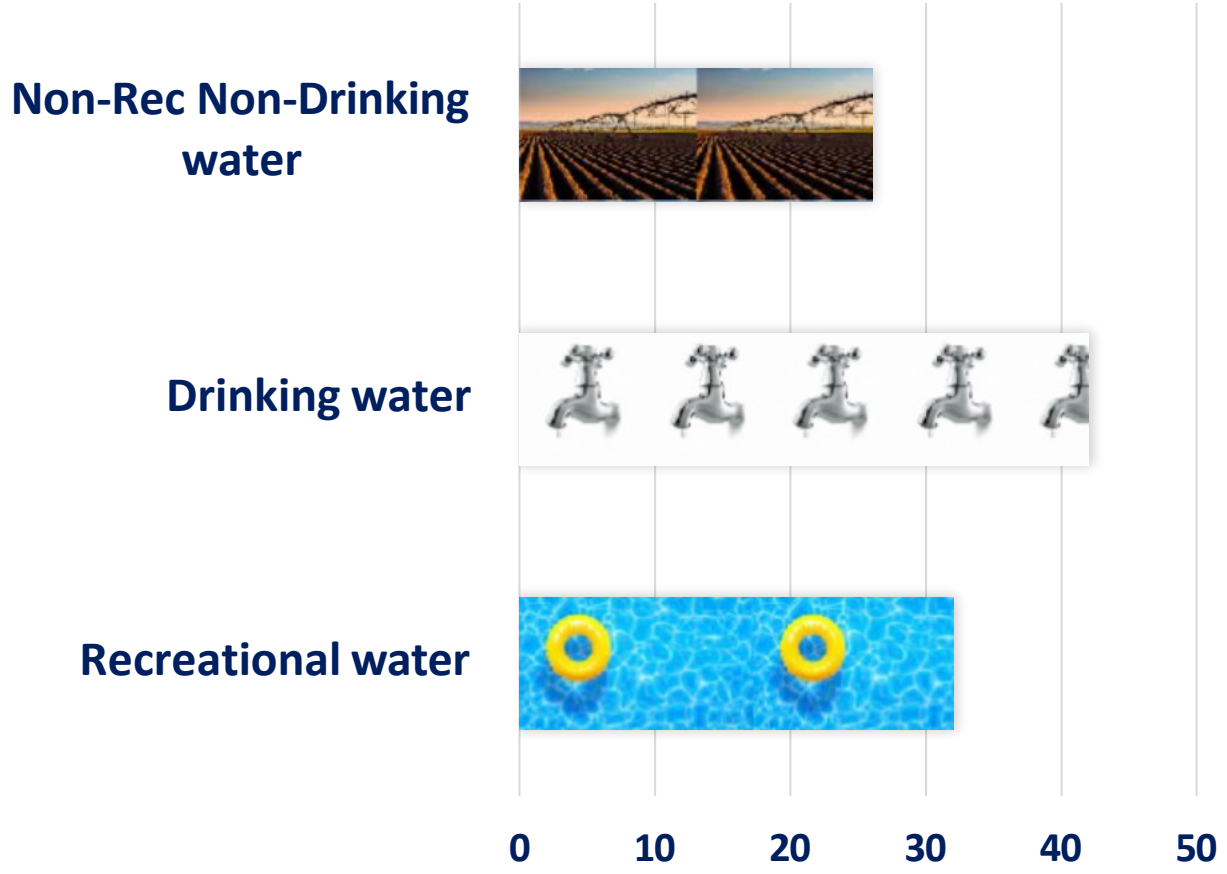


Recreation Water



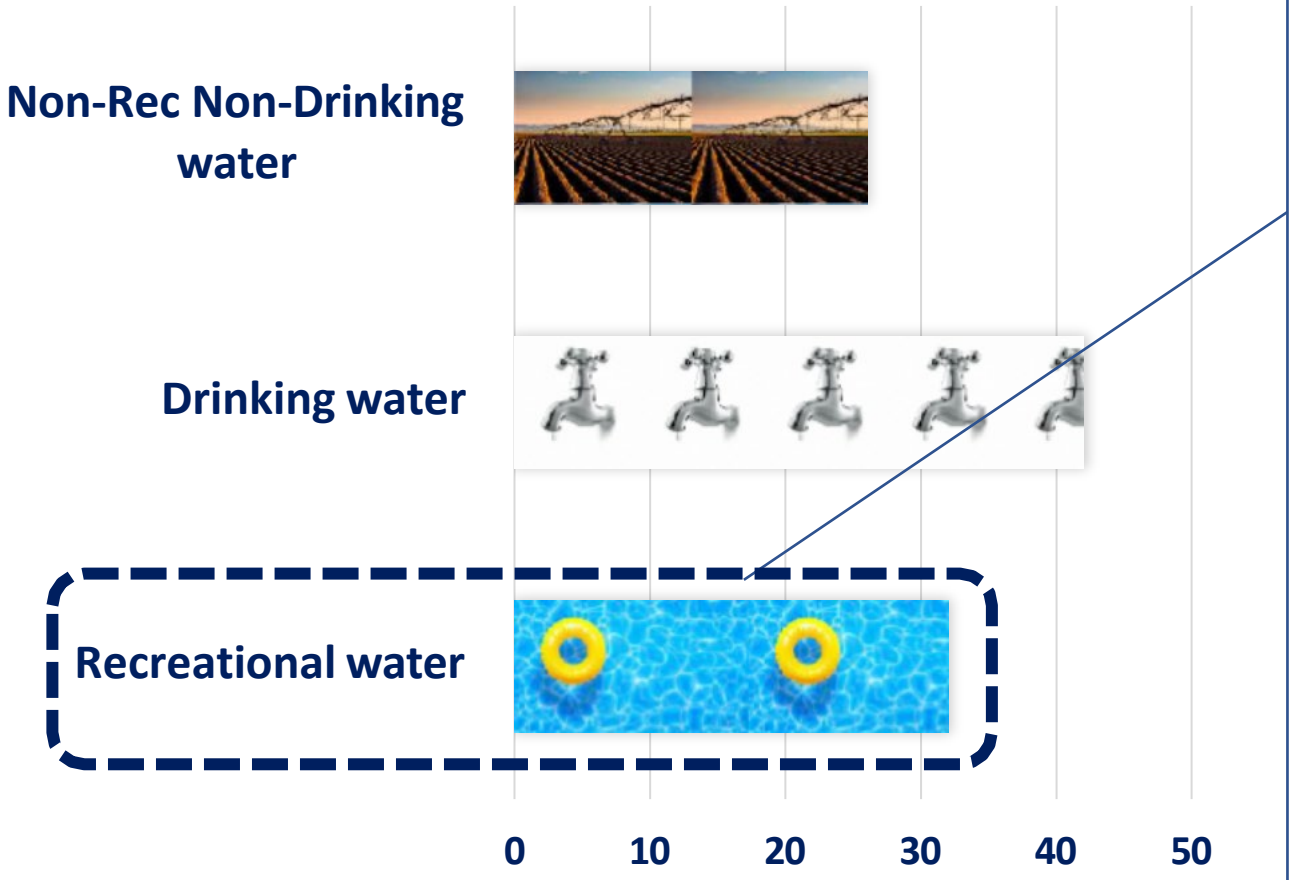
Direct Costs

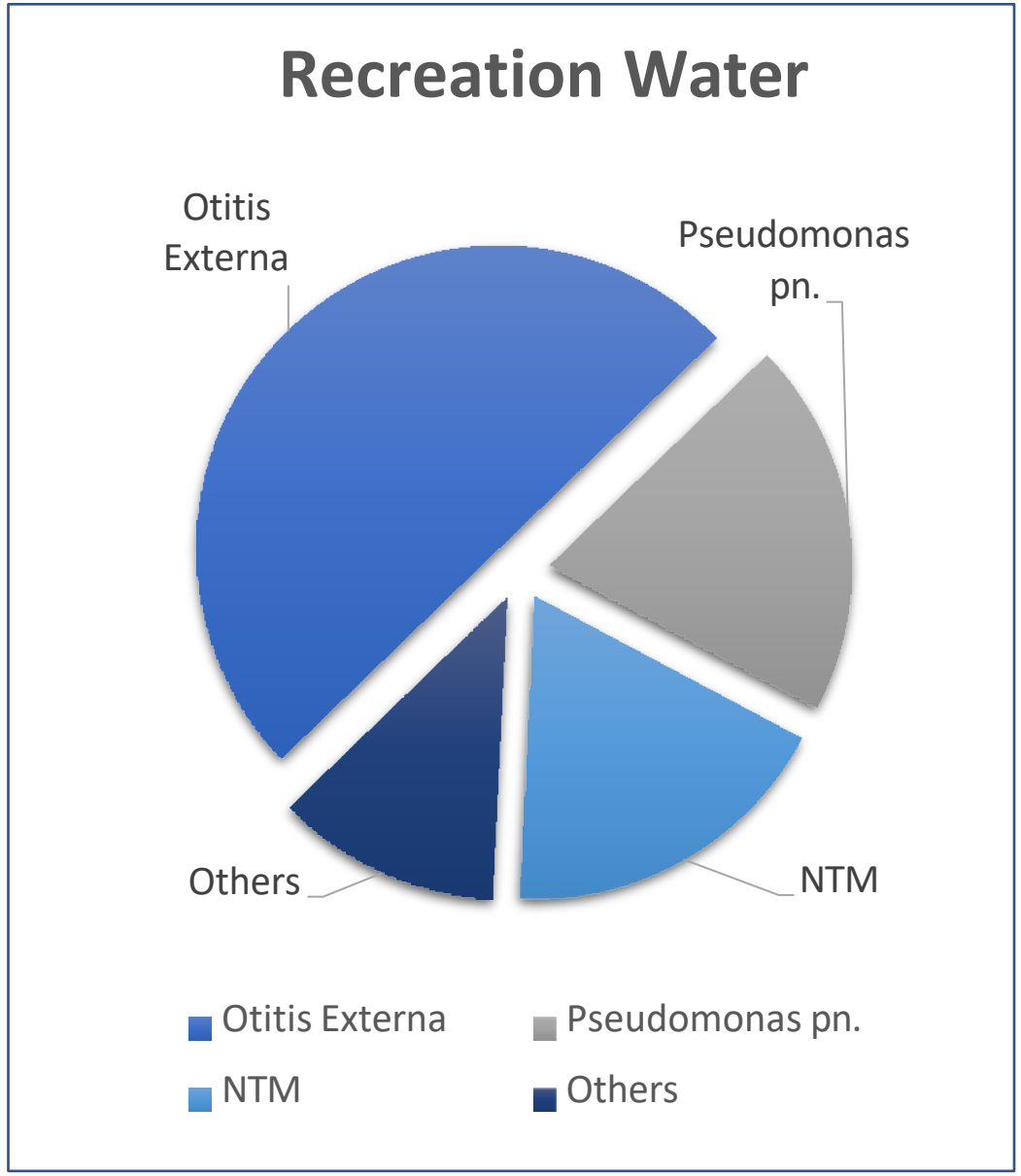
$3B IN VISITS AND HOSPITALIZATIONS



Direct Costs

$3B IN VISITS AND HOSPITALIZATIONS





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National Center for Emerging and Zoonotic Infectious Diseases

Estimates and Prevention of Recreational Water–Associated Infections in the United States

Michele Hlavsa, RN, MPH
Epidemiologist
Healthy Swimming, Cryptosporidiosis, and Model Aquatic Health Code

MAHC Network Webinar

December 4, 2023

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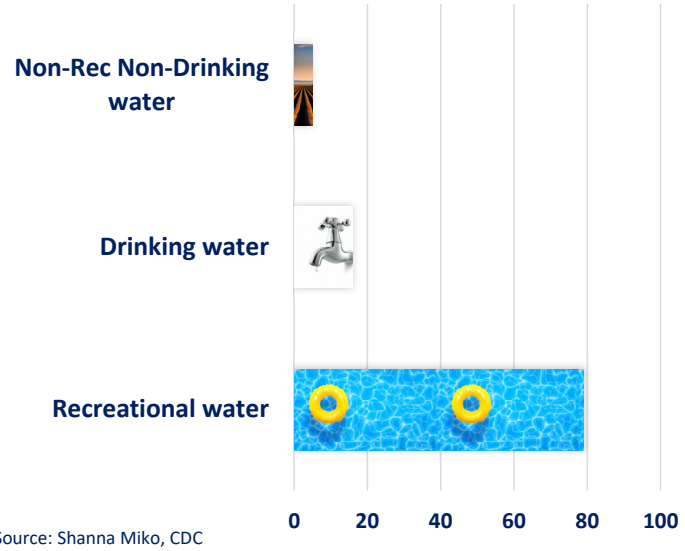
- Rebecca Rainey & Deise Galan
- Harmonization Committee
  - Model Aquatic Health Code (MAHC)
  - International Swimming Pool and Spa Code (ISPSC)

Recreational Water–Associated Infections

Waterborne Infections

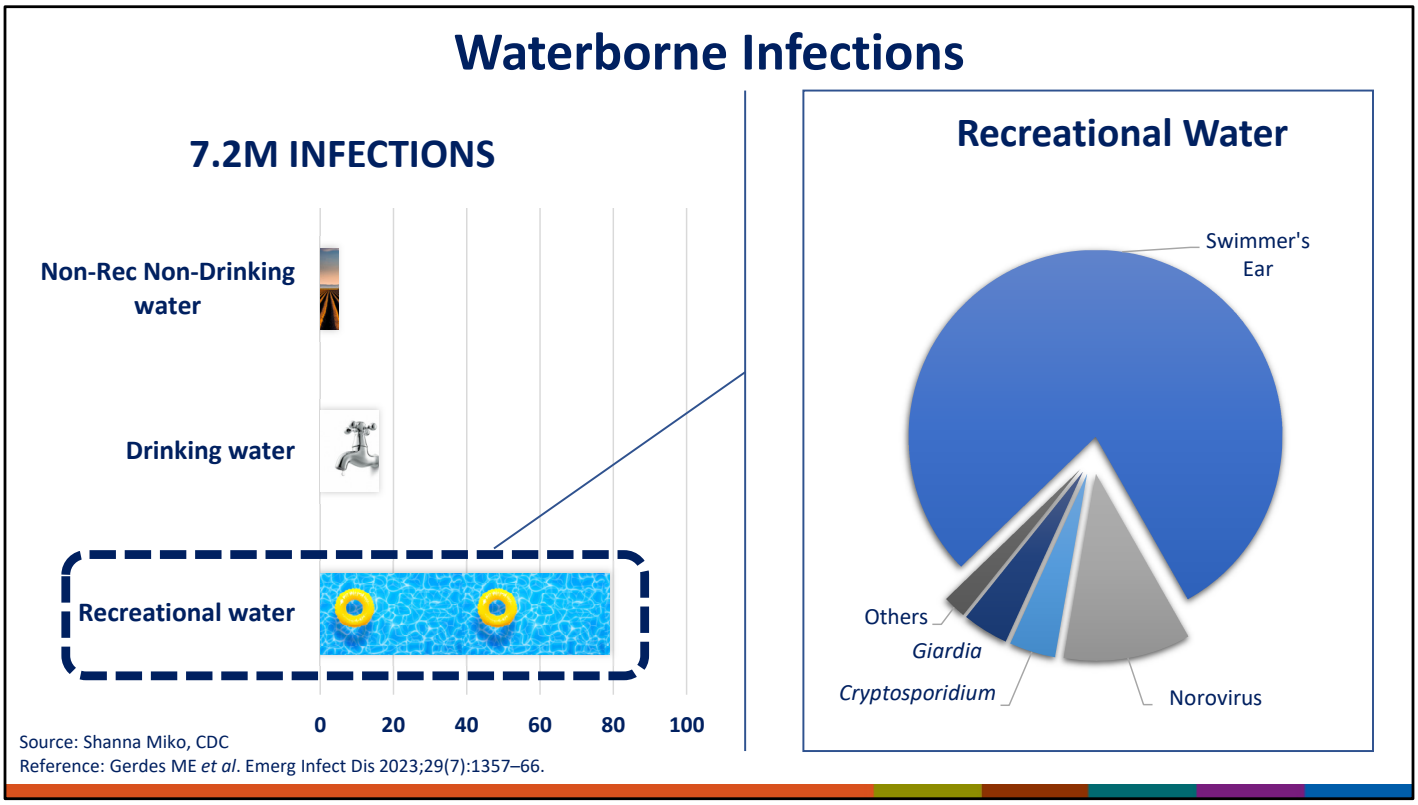
7.2M INFECTIONS



Source: Shanna Miko, CDC
Reference: Gerdes ME *et al*. Emerg Infect Dis 2023;29(7):1357–66.

7.2 M waterborne infections

almost 80% or 5.6 M rec water associated infections

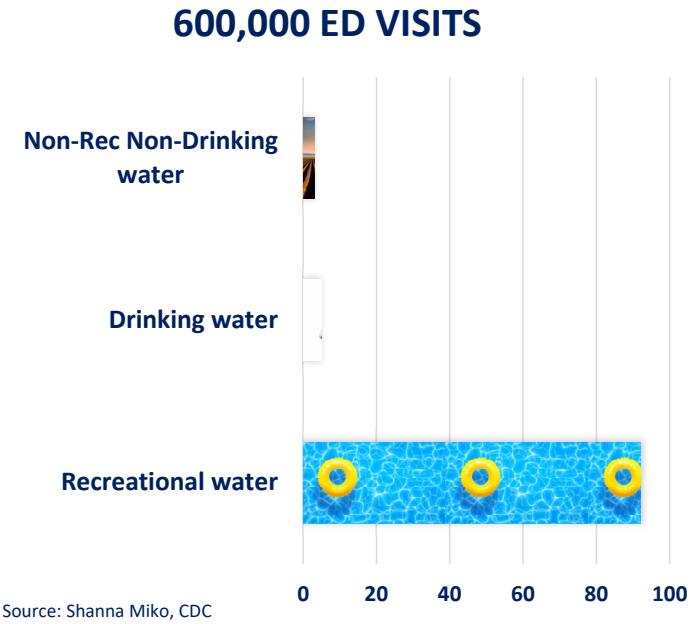


Almost 80% of rec water associated infections

4.4 M swimmer's ear associated with rec water

62% or almost two thirds of all waterborne infections

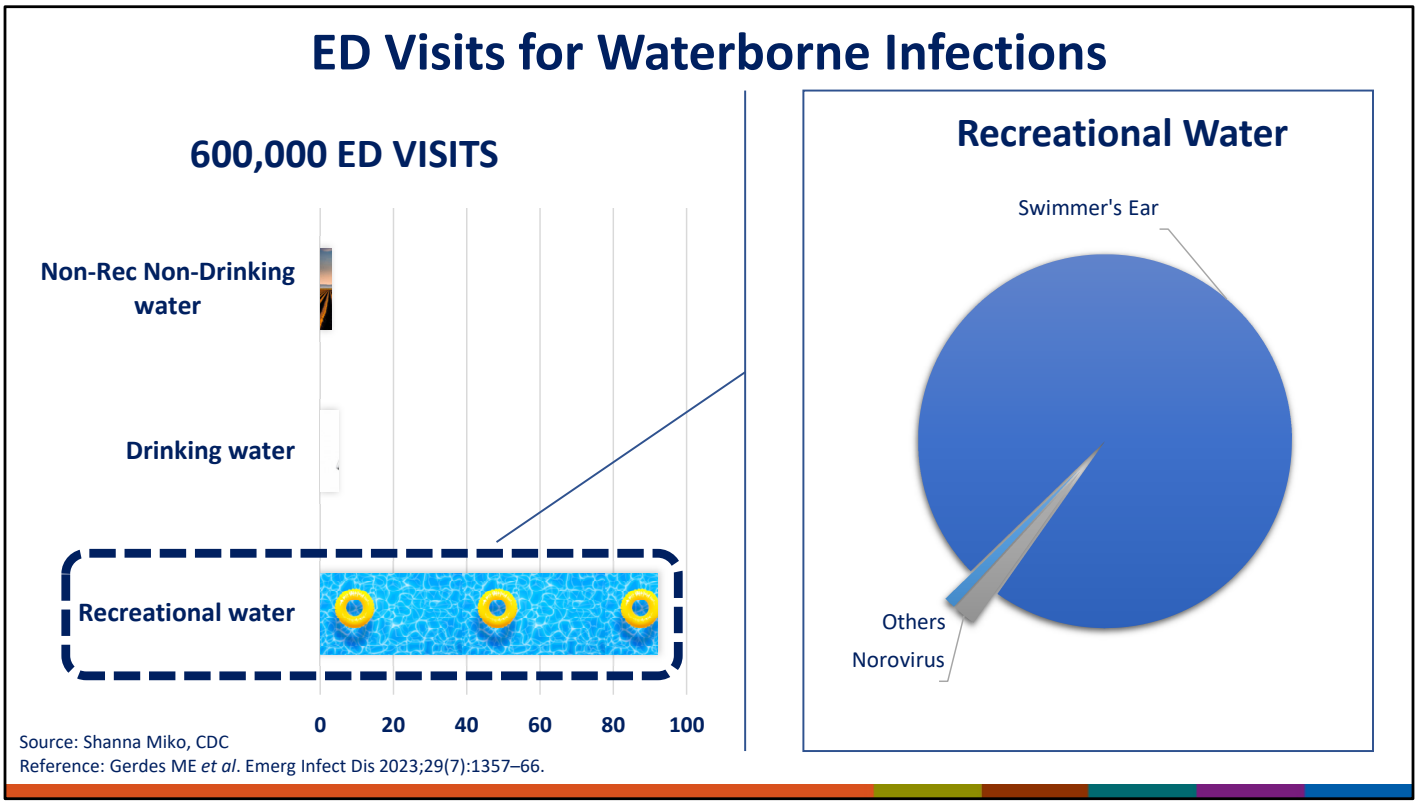
Emergency Department (ED) Visits for Waterborne Infections



Source: Shanna Miko, CDC
Reference: Gerdes ME *et al*. Emerg Infect Dis 2023;29(7):1357–66.

601,000 ED visits for waterborne infections

92% or 552,000 ED visits for rec water associated infections

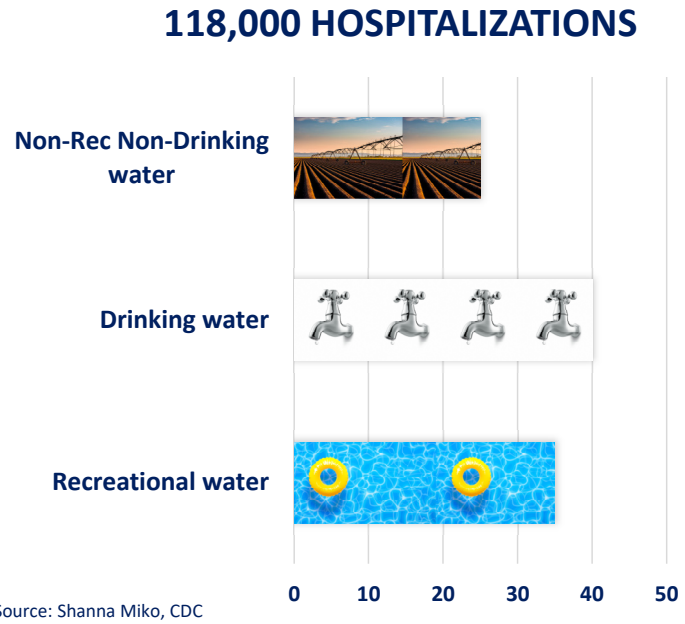


97% of ED visits for rec water associated infections

538,000 ED visits for swimmer's ear associated with rec water

90% of ED visits for all waterborne infections

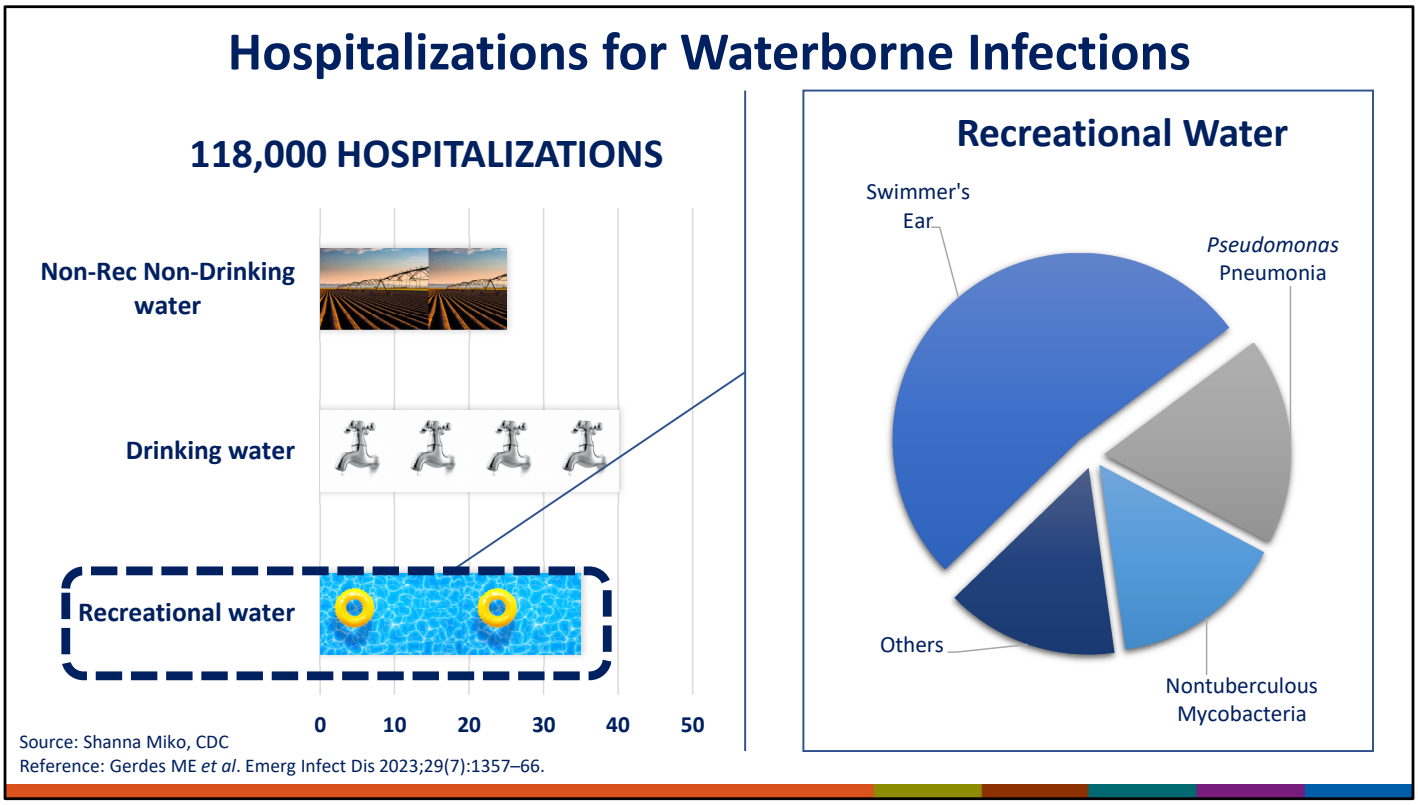
Hospitalizations for Waterborne Infections



Source: Shanna Miko, CDC
Reference: Gerdes ME *et al*. Emerg Infect Dis 2023;29(7):1357–66.

118,000 hospitalizations for waterborne infections

36% or 42,300 hospitalizations for rec water associated infections

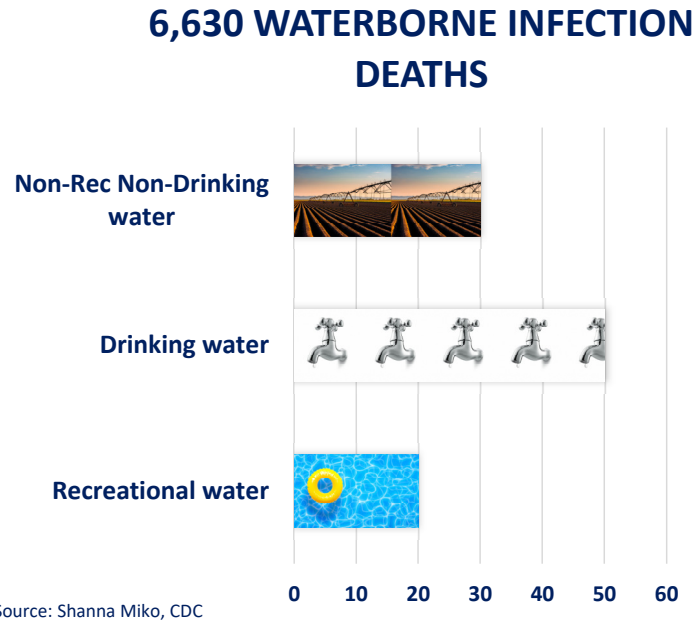


52% or just over half of hospitalizations for rec water associated infections

22,000 hospitalizations for swimmer's ear associated with rec water

Almost 20% hospitalizations for all waterborne infections

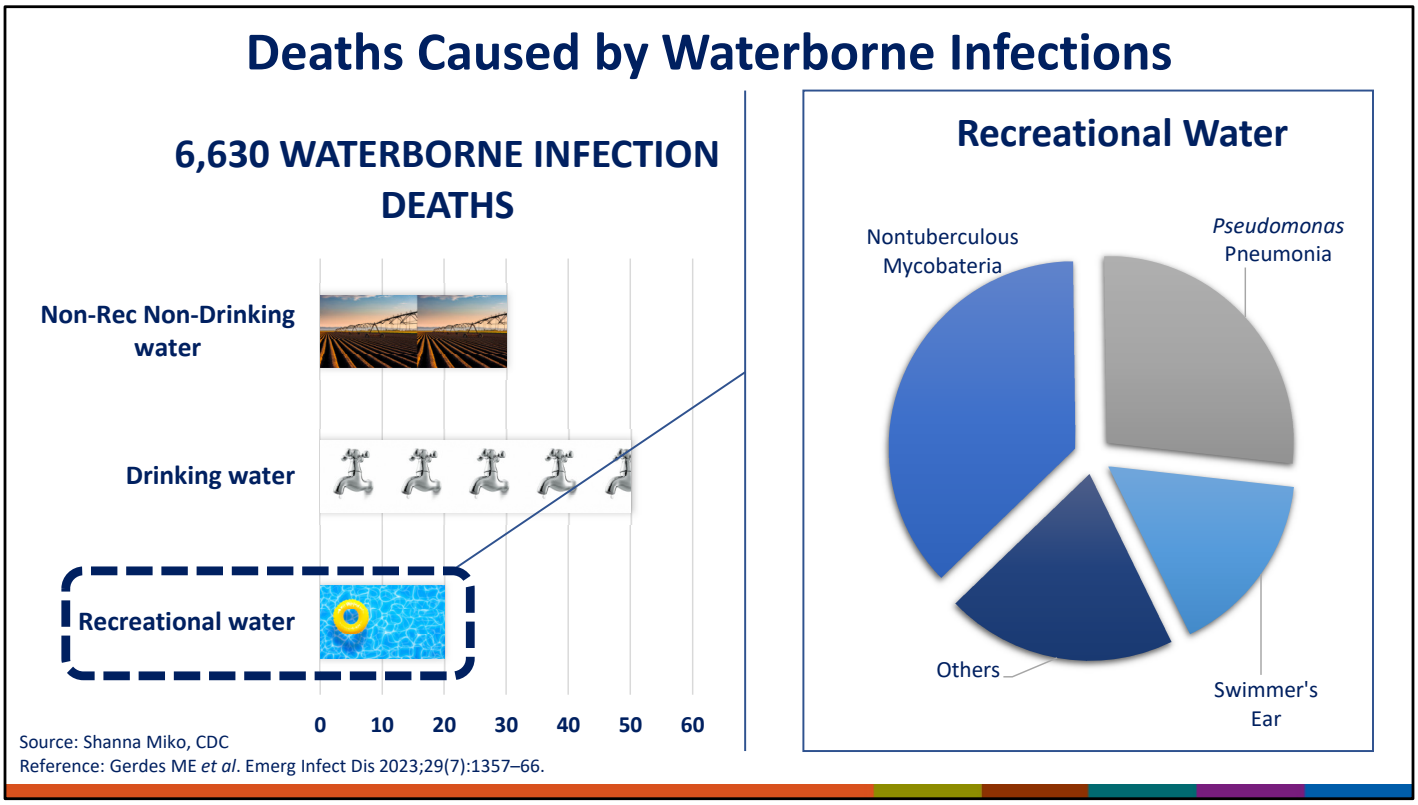
Deaths Caused by Waterborne Infections



Source: Shanna Miko, CDC
Reference: Gerdes ME *et al*. Emerg Infect Dis 2023;29(7):1357–66.

6,630 deaths caused by waterborne infections

Almost 20% or 1,290 caused by rec water associated infections



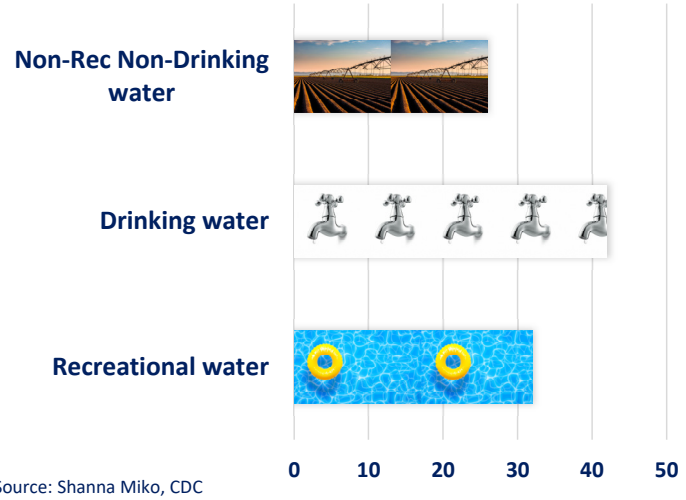
16% of deaths caused by rec water associated infections

208 deaths caused by swimmer's ear associated with rec water

3% of deaths caused by all waterborne infections

Direct Costs of Waterborne Infections

$3.3B IN ED VISITS AND HOSPITALIZATIONS

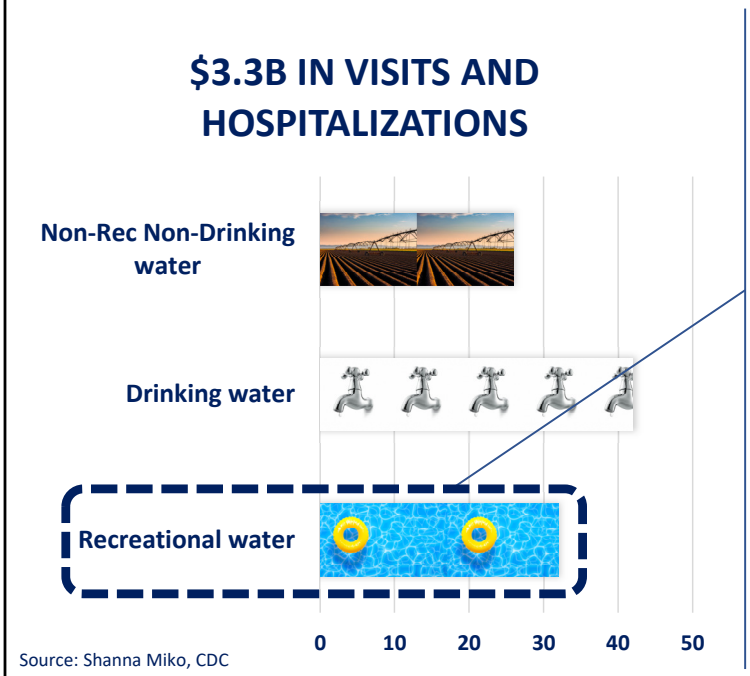


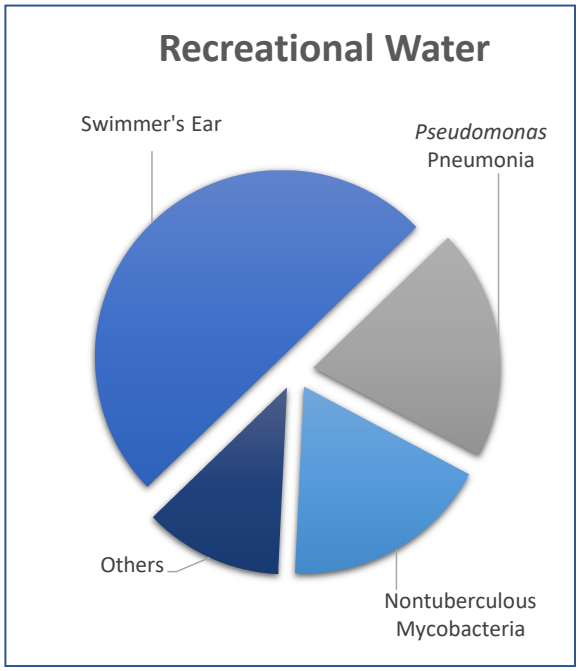
Source: Shanna Miko, CDC
Reference: Gerdes ME *et al*. Emerg Infect Dis 2023;29(7):1357–66.

$3.3B in direct costs for ED visits and hospitalizations for waterborne infections

Almost 33% or $1.07B in direct cost for ED visits and hospitalizations for rec water associated infections

Direct Costs of Waterborne Infections





Source: Shanna Miko, CDC
Reference: Gerdes ME *et al*. Emerg Infect Dis 2023;29(7):1357–66.

50% of direct costs for ED visits and hospitalizations associated with rec water associated infections

$536M in direct costs for ED visits and hospitalizations caused by swimmer's ear associated with rec water

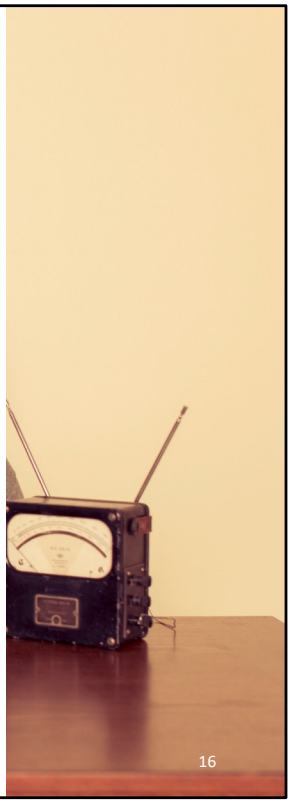
16% of direct costs for ED visits and hospitalizations associated with all waterborne infections

What is the Take Home Message?

Swimmer's ear =
Most important issue to
be addressed by aquatics

15

Sw[illegible] ear =
M[illegible] imp[illegible]nt is[illegible]e to
be[illegible]dresse[illegible]latics

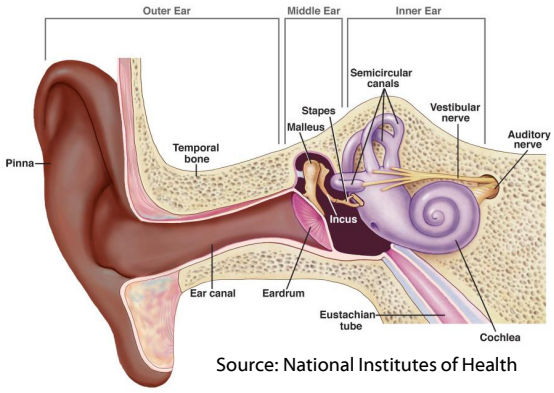


16

Pseudomonas

- Found in environment
- Transmitted through contact with contaminated water
- Also causes hot tub rash and hot hand-foot syndrome
- Inactivated readily by disinfectants
  - Maintaining minimum disinfectant concentration prevents transmission
  - Inadequately maintaining disinfectant concentration
    - *Pseudomonas* grows
    - Biofilm builds up and protects pathogens from disinfectants

Swimmer's Ear: Signs and Symptoms

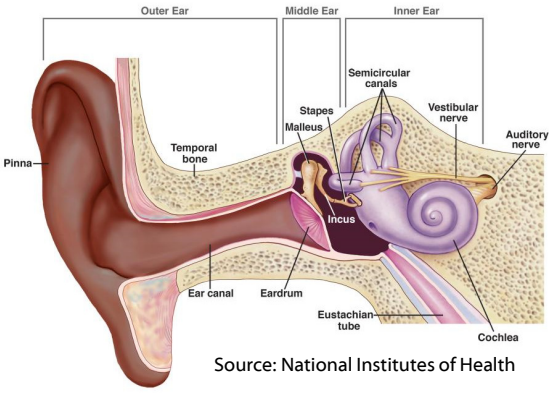


Source: National Institutes of Health

Source: https://www.cdc.gov/healthywater/swimming/swimmers/rwi/ear-infections.html

Swimmer's Ear: Signs and Symptoms

- Pain when
  - Outer ear tugged
  - Pressure put on part of outer ear that sticks out in front of the ear canal
- Itchiness inside ear
- Drainage from ear
- Redness and swelling in ear



Source: National Institutes of Health

Source: https://www.cdc.gov/healthywater/swimming/swimmers/rwi/ear-infections.html

Preventing Swimmer's Ear: The Basics

- Keep ears as dry as possible
  - Use bathing cap, ear plugs, or custom-fitted swim molds in water
- Dry ears thoroughly after being in water
- Use towel to dry ears well
  - Tilt head back and forth so that each ear faces down to allow water to escape ear canal
  - Pull earlobe in different directions when ear faces down to help water drain out
  - If there is still water in ear, consider using a hair dryer to move air within ear canal
    - Put hair dryer on lowest heat and speed/fan setting
    - Hold hair dryer several inches from ear

Source: https://www.cdc.gov/healthywater/swimming/swimmers/rwi/ear-infections.html

Preventing Swimmer's Ear: With Healthcare Provider

- Check with your healthcare provider about using ear-drying drops after being in water
  - **DON'T use these drops if you have ear tubes, punctured ear drums, swimmer's ear, or ear drainage**
- DON'T put objects in your ear canal (including cotton-tip swabs, pencils, paperclips, or keys)
- DON'T try to remove ear wax
  - If you think ear canal could be blocked by ear wax, check with your healthcare provider

Source: https://www.cdc.gov/healthywater/swimming/swimmers/rwi/ear-infections.html

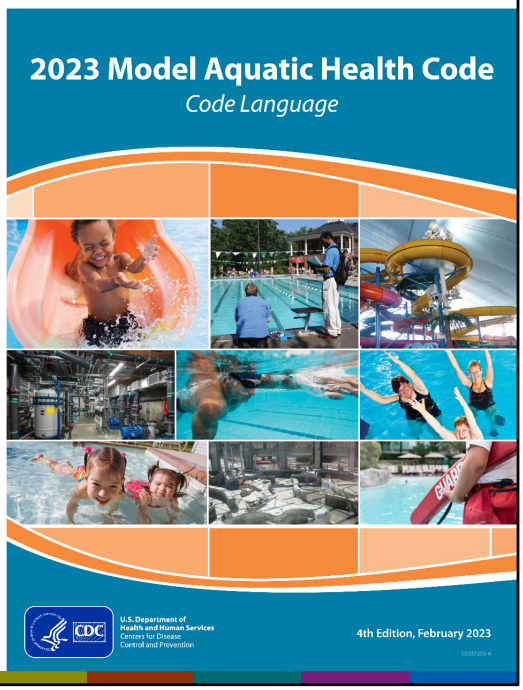
Treating Swimmer's Ear

- 2014 Clinical Practice Guidelines*
  - Prescribe drops or topical treatment
- Actual Practice†
  - Prescribe oral antimicrobials or systemic treatment
    - Can lead to antimicrobial resistance
    - % treating with oral antimicrobials varies with specialty

* Rosenfeld RM *et al*. Otolaryng Head Neck 2014; 150(1 Suppl):S1–S24.
† Collier SA *et al*. Otolaryng Head Neck 2013;148(1):128–34.

Swimmer's Ear Already Addressed in Codes

- MAHC 5.7.3.1 Primary Disinfectants
  - Maintain free chlorine
    - 1.0–10.0 ppm in most aquatic venues if not using cyanuric acid
    - 2.0–10.0 ppm in most aquatic venues if using cyanuric acid
    - 3.0–10.0 ppm in hot tubs
- MAHC 5.7.3.4 pH
  - Maintain pH at 7.0–7.8
- MAHC 6.1 Qualified Operator Training
- MAHC 6.4.1.3.1 Daily Inspection Items
  - Inspect for and, if needed, remove biofilm



What is the Take Home Message?

Public Health Needs to Lead Efforts to Address Swimmer's Ear

- Contribute to research
  - Estimated Burden of Acute Otitis Externa*
  - Coming late December 2023: *Pseudomonas* Infection Outbreak Associated with a Hotel Swimming Pool — Maine, March 2023
- Educate
  - Public about prevention
  - Healthcare providers about treatment
  - Aquatics about prevention
- Enforce codes for aquatic venues open to public

* CDC. MMWR Morb Mortal Wkly Rep 2011;60(19);605–9.

Limitations

- 2014 data
- Only 17 diseases
- Diagnoses for reimbursement from insurance companies
- Recreational water exposure not differentiated into treated and untreated

Reference: Gerdes ME *et al*. Emerg Infect Dis 2023;29(7):1357–66.

Michele Hlavsa
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404.718.4695

www.cdc.gov/healthyswimming
www.cdc.gov/mahc

For more information, contact CDC
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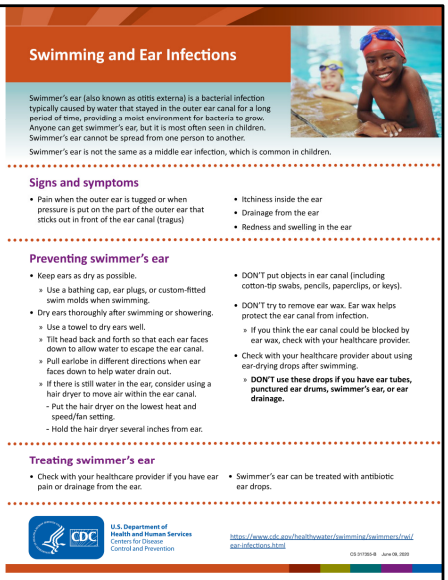

Swimming and Ear Infections

Swimmer's ear (also known as otitis externa) is a bacterial infection typically caused by water that stayed in the outer ear canal for a long period of time, providing a moist environment for bacteria to grow. Anyone can get swimmer's ear, but it is most often seen in children. Swimmer's ear cannot be spread from one person to another.

Swimmer's ear is not the same as a middle ear infection, which is common in children.

Signs and symptoms

- Pain when the outer ear is tugged or when pressure is put on the part of the outer ear that sticks out in front of the ear canal (tragus)
- Itchiness inside the ear
- Drainage from the ear
- Redness and swelling in the ear

Preventing swimmer's ear

- Keep ears as dry as possible.
  - » Use a bathing cap, ear plugs, or custom-fitted swim molds when swimming.
- Dry ears thoroughly after swimming or showering.
  - » Use a towel to dry ears well.
  - » Tilt head back and forth so that each ear faces down to allow water to escape the ear canal.
  - » Pull earlobe in different directions when ear faces down to help water drain out.
  - » If there is still water in the ear, consider using a hair dryer to move air within the ear canal.
    - Put the hair dryer on the lowest heat and speed/fan setting.
    - Hold the hair dryer several inches from ear.
- DON'T put objects in ear canal (including cotton-tip swabs, pencils, paperclips, or keys).
- DON'T try to remove ear wax. Ear wax helps protect the ear canal from infection.
  - » If you think the ear canal could be blocked by ear wax, check with your healthcare provider.
- Check with your healthcare provider about using ear-drying drops after swimming.
  - » **DON'T use these drops if you have ear tubes, punctured ear drums, swimmer's ear, or ear drainage.**

Treating swimmer's ear

- Check with your healthcare provider if you have ear pain or drainage from the ear.
- Swimmer's ear can be treated with antibiotic ear drops.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

https://www.cdc.gov/healthywater/swimming/swimmers/swi/ear-infections.html

CS 311355-B June 09, 2020

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.