



LEGIONELLA... The Silent Killer

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No disclosures



OBJECTIVES

- Review the history of legionella
- Discuss characteristics, transmission, treatment and prevention strategies
- Identify industry standards and regulations of Water Management Programs.
- Review case reporting, investigation, and controls measures
- Discuss the role of the Infection Preventionist in water management & legionella prevention
- Review the history of legionella in the United States and CT
- Examine the seasonal pattern of legionella
- Discuss the global burden and recent outbreaks

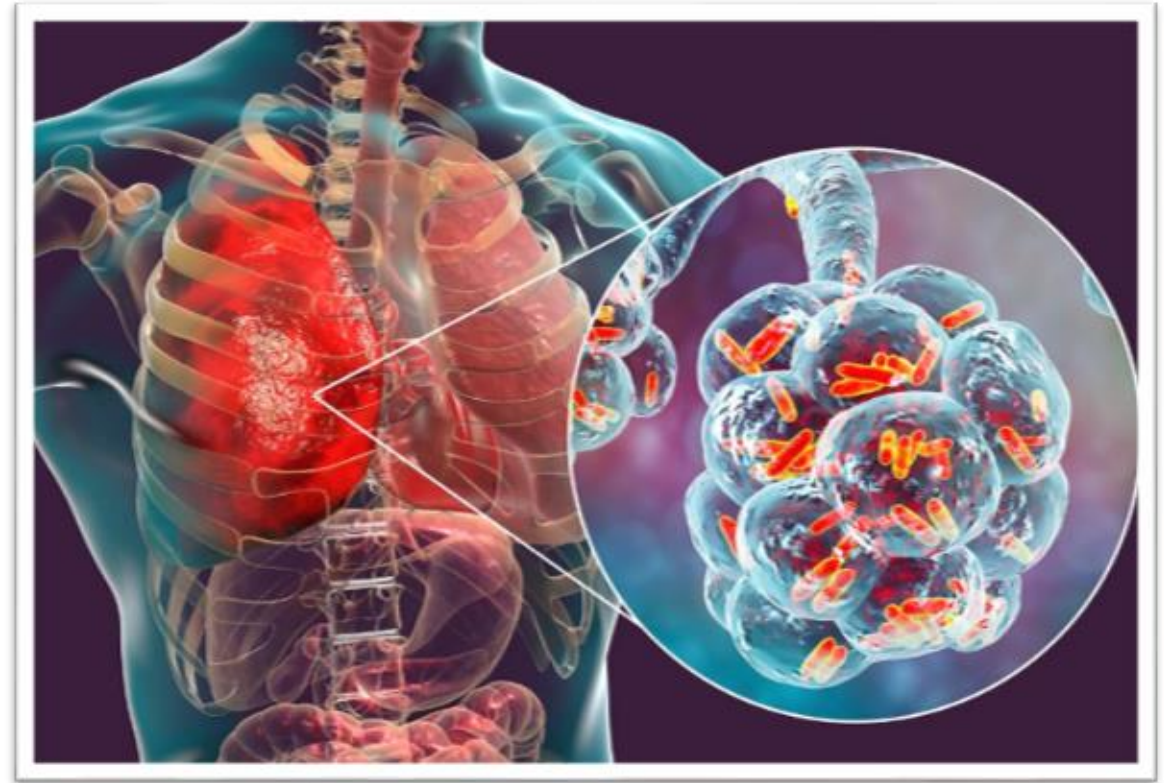


Figure 1. [Legionnaires' disease], (2021)

A word cloud centered around the word "legionella" in large, bold, dark blue letters. The word "disease" is also prominent in a lighter blue color. Other words include "infection", "research", "medicine", "fever", "lung", "patient", "micro", "care", "medical", "organism", "diseased", "tablets", "biology", "drug", "exam", "health", "bacteria", "test", "assessment", "syringe", "pharmacy", "pneumonia", "legionnaires", "microbiology", "therapy", "legionellosis", "flu", "hygiene", "experiment", "antibiotic", "virus", "sickness", "cdc", "scientific", "lab", "recipe", "pills", "malady", "examine", "infectious", "pharmacist", "biological", "epidemic", "doctor", "diarrhea", "illness", "blood", "remedy", "ill", "healthy", "food", "capsule", "analyzing", "researcher", "laboratory", "pharmaceutical", "hospital", "hematology", "immunology", "treats", "physician", "sick", "science". The background features a hand holding a white pill.

legionella

disease

infection

research

medicine

fever

lung

patient

micro

care

medical

organism

diseased

tablets

biology

drug

exam

health

bacteria

test

assessment

syringe

pharmacy

pneumonia

legionnaires

microbiology

therapy

legionellosis

flu

hygiene

experiment

antibiotic

virus

sickness

cdc

scientific

lab

recipe

pills

malady

examine

infectious

pharmacist

biological

epidemic

doctor

diarrhea

illness

blood

remedy

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healthy

food

capsule

analyzing

researcher

laboratory

pharmaceutical

hospital

hematology

immunology

treats

physician

sick

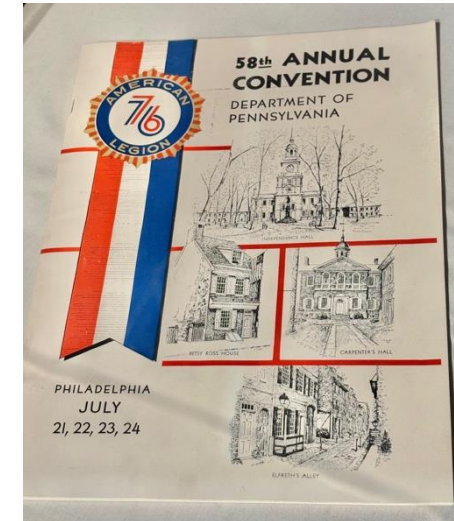
science

Figure 1 ([Legionella disease], n.d.)



The Bellevue-Stratford Hotel





BELLEVUE WELCOME PACKET FOR MEMBERS OF THE PENNSYLVANIA LEGION

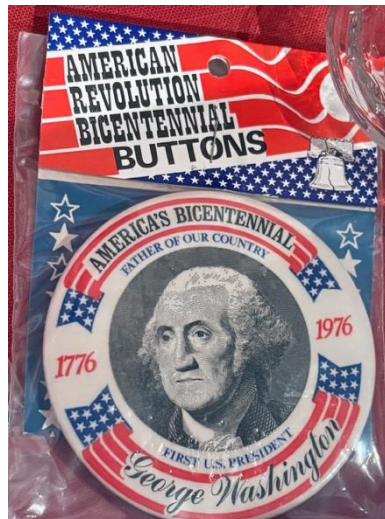




Figure 1 (Leonard, 2025)

1976 Legionnaires' disease outbreak



Figure 2 (Wolfman-Arent, 2021)

-when cold air kills



Figure 3(Hingston,2016)



Within days of returning home, some of the veterans developed pneumonia and fatal respiratory infections.

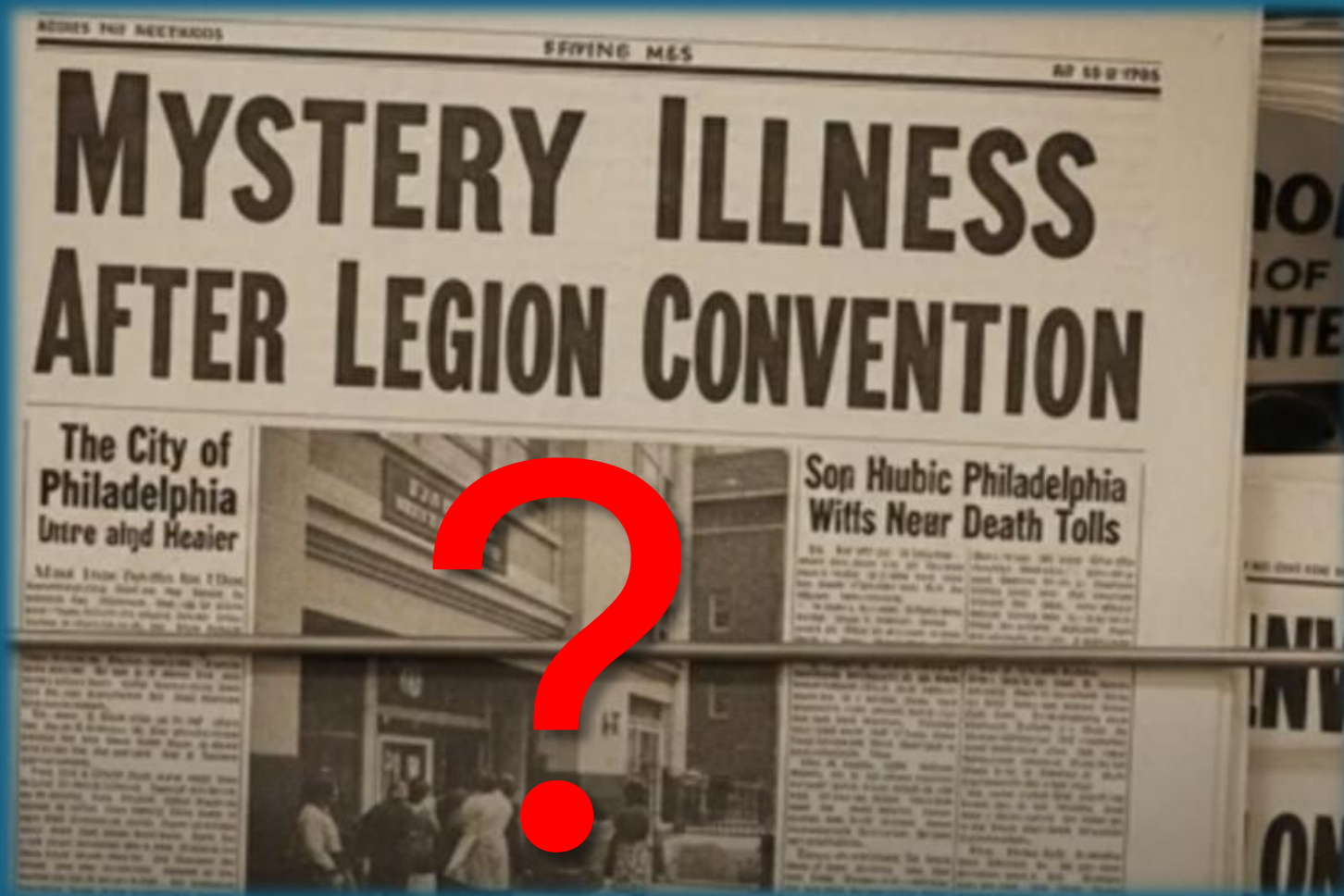


Figure 1(The Lost Hotels, 2026)

Casualties

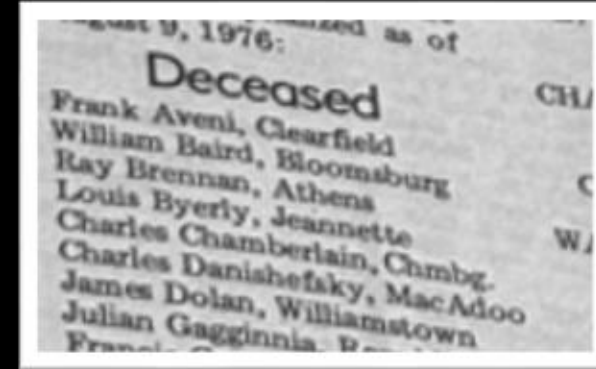


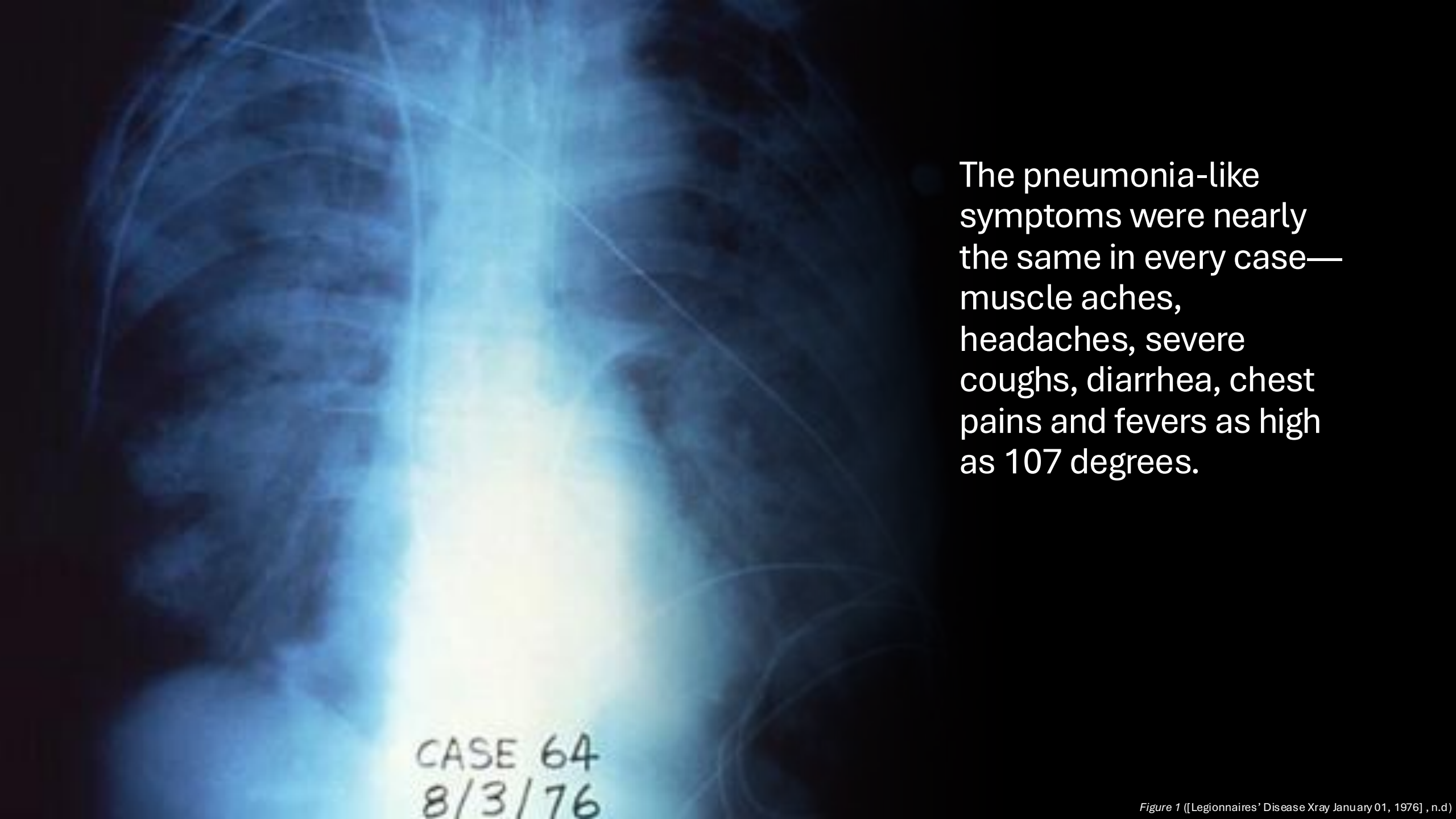
Figure 1 (The Philly Killer exhibit at the Mutter Museum, Philadelphia, PA, 2026)



Figure 2 (Altman 2001)



Figure 3 (The Philadelphia Legionnaires' Outbreak, 2023)



The pneumonia-like symptoms were nearly the same in every case—muscle aches, headaches, severe coughs, diarrhea, chest pains and fevers as high as 107 degrees.

CASE 64
8/3/76

...are, they deemed
...ause, apparently few of the victims
...hibited gastrointestinal symptoms. Campbell
**Same rooms,
same meals
and a question**
...Street, were not registered to go to
...the convention. But, Hamberg re
...counted yesterday, "we heard about
...and decided to drop
...Nedmann





Investigators Daily Meeting, Philadelphia, 1976

Figure 1 (Geothermal, 2020)

Investigative Team

- Epidemiologists
- State health workers
- Laboratories
- Medical staff in hospitals
- Investigators

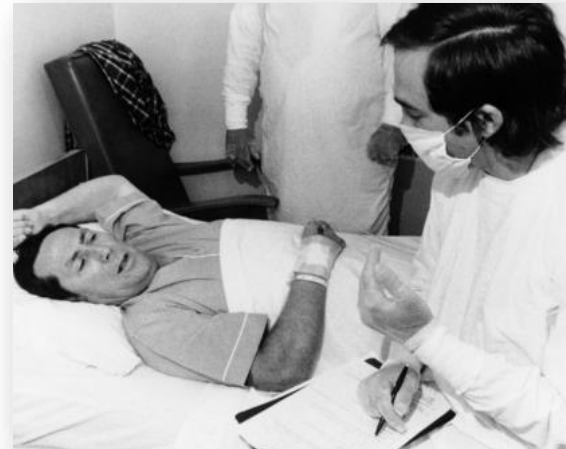


Figure 2 (Deher, 2015)

Data Collection

2

V. Receptions (Continued)

For National Executive Committeeman	J	Yes	_____	No	_____
	K		_____		_____
For Alternate National Executive Committeeman	L		_____		_____
	M		_____		_____

For Finance Committeeman

For other hospitality rooms (i.e., Post)--Specify (Dates, rooms, food and alcohol consumed)

VI. Did you obtain food or liquor from any of the following sources (# of times if possible)?

<u>SOURCE</u>	<u>FOOD</u>	<u>LIQUOR</u>
Hotel A	_____	_____
Dining rooms	_____	_____
Coffee shop	_____	_____
Room service	_____	_____
Brought into hotel (state source)	_____	_____
Havey House	_____	_____
Eagle II	_____	_____
Bain's	_____	_____
Horn & Hardart	_____	_____
Red Oak	_____	_____
Bellevue Lounge	_____	_____
Nick's Roast Beef	_____	_____
L & H Sandwich Shop	_____	_____
Colonado	_____	_____
Mitchell's	_____	_____
American Flame	_____	_____
Red Onion	_____	_____
19th Hole	_____	_____
Dewey's	_____	_____
Poor Richard's Club	_____	_____
Hickory Lounge	_____	_____
Bookbinder's	_____	_____
The Office	_____	_____
H. A. Winston	_____	_____
Frank Clements Tavern	_____	_____
Top of the Tooz	_____	_____
Paper Plate	_____	_____
Other Bars on Locust Street	_____	_____
Other (specify)	_____	_____

VII. Food eaten at Keystone "Go-Getter's Breakfast," Friday, July 23rd, 7:30 to 9:00 am at Hotel A, 18th Floor, Roof Garden

EPIDEMIOLOGIC QUESTIONNAIRE

Informant _____
Phone # _____

I. Guest Name _____ Address _____
Town _____ County _____ State _____
Sex _____ Race _____ Age _____
Marital Status _____ Other _____ DOB _____

II. Date of arrival in Philadelphia _____ Date of Departure _____
Hotel of Residence: Name _____ Dates _____ Room _____
Name _____ Dates _____ Room _____
Attended Convention: Yes _____ No _____ Purpose of Visit: _____
Status: Delegate _____ Family Member _____
Other _____

III. Clinical

Have you been ill recently? Yes _____ No _____ Date of onset _____
What were your first symptoms? _____ Name _____
Did you see a doctor? Yes _____ No _____ Phone _____
If yes, when _____
Admitted to the hospital? Yes _____ No _____ Location _____
If yes, what _____

LEGIONNAIRE CENSUS

1. Name _____ 2. Age _____ 3. Sex: ☐ Male ☐ Female

4. Address _____ 5. Phone _____ 6. Post # _____

7. Convention Status: (check only one) 8. Check the hotel where you stayed: 9. Check which days you were in Phila. for the convention: yes no

Delegate _____ Hotel A _____ Room # _____
 Auxiliary _____ E _____
 Family member _____ D _____
 (not auxiliary) _____ F _____
 Non-delegate _____ G _____
 Other _____ Home _____
 _____ Other _____ Specify _____
 _____ Did not go to Phila. _____

10. How many hours did you spend in Hotel A each day? 11. How many hours did you spend in Hotel D each day?

Wednesday, 21st _____ hours Wednesday, 21st _____ hours
 Thursday, 22nd _____ hours Thursday, 22nd _____ hours
 Friday, 23rd _____ hours Friday, 23rd _____ hours
 Saturday, 24th _____ hours Saturday, 24th _____ hours

12. Indicate below how much time you spent in Hotel A or on the sidewalk around Hotel A on Friday, July 23. Check all boxes corresponding to the time(s) you were there:

Morning:	Midnight to 2 AM	2 AM to 4 AM	4 AM to 6 AM	6 AM to 8 AM	8 AM to 10 AM	10 AM to Noon
Afternoon and Evening:	Noon to 2 PM	2 PM to 4 PM	4 PM to 6 PM	6 PM to 8 PM	8 PM to 10 PM	10 PM to Midnight

13. Indicate below how much time you spent in Hotel D or on the sidewalk around Hotel D on Friday, July 23. Check all boxes corresponding to the times you were there:

Morning:	Midnight to 2 AM	2 AM to 4 AM	4 AM to 6 AM	6 AM to 8 AM	8 AM to 10 AM	10 AM to Noon
Afternoon and Evening:	Noon to 2 PM	2 PM to 4 PM	4 PM to 6 PM	6 PM to 8 PM	8 PM to 10 PM	10 PM to Midnight

14. Check below the activities which you attended:

	Yes	No	Don't Know
Wednesday, July 21, 8 PM Joint Auxiliary and Legion meeting, Grand Ballroom in Hotel A	_____	_____	_____
Thursday, July 22, 10 AM, Grand Ballroom of Hotel A	_____	_____	_____
Thursday, July 22, 7 PM, Testimonial Dinner, Ballroom of Hotel D	_____	_____	_____
Friday, July 23, 7:30 AM, Keystone "Go-Getter's Breakfast" 18th floor, Roof Garden of Hotel A	_____	_____	_____
Friday, July 23, 10 AM, 58th Dept. Convention Session Ballroom of Hotel A	_____	_____	_____

LEGIONNAIRE CENSUS

1. Name _____ 2. Age _____ 3. Sex: ☐ Male ☐ Female

4. Address _____ 5. Phone _____ 6. Post # _____

7. Convention Status: (check only one) 8. Check the hotel where you stayed: 9. Check which days you were in Phila. for the convention: yes no

Delegate _____ Hotel A _____ Room # _____
 Auxiliary _____ E _____
 Family member _____ D _____
 (not auxiliary) _____ F _____
 Non-delegate _____ G _____
 Other _____ Home _____
 _____ Other _____ Specify _____
 _____ Did not go to Phila. _____

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Figure 1(The Philly Killer exhibit at the Mutter Museum, Philadelphia, PA, 2026)

Hospitality Room Survey
Hotel A

Informant: _____

I. Hospitality Room - Name: _____ Room No. _____ Post: _____

Street: _____ Home Phone: _____

Town: _____ County: _____ State: _____

Age: _____ Sex: _____

Occupation: _____ Legion
District: _____

II. Stay in Hotel A:

From _____ To _____

Day Reception Held in Room: _____ No. People
Attended
Reception

Time: From: _____ To: _____ Do You Have a Guest List? _____

Other Days Receptions Held: _____

Dates:

No. People Attended
(Approximate No.)

Time:

1. _____
2. _____
3. _____
4. _____

From _____ To _____
From _____ To _____
From _____ To _____
From _____ To _____

Bartender, Hotel Exec Show Symptoms

APPENDIX D

EMPLOYEE QUESTIONNAIRE - OUTBREAK SURVEILLANCE - CITY OF PHILA.

Name _____ Age _____ Sex _____

Home Phone _____ Hotel Job _____ Shift _____

Days absent for July _____ Were you in Hotel July 23, 1976? Yes _____ No _____

Symptoms: Date of Onset _____ Fever _____ °F

Cough _____ Chest X ray _____

A case consists of A+ chest film (pneumonia) and any fever, or fever > 102°F, and cough. If these are present, continue.

What door do you use to enter or leave? _____

Legionnaire contact: _____ Frequent (e.i., room service, front desk, maid, waitress)

_____ Occasional (kitchen, clerical)

Average visits per day to Legionnaires' rooms? _____

Do you regularly eat hotel food? Yes _____ No _____

Did you have food or beverage in Legionnaire's room? Yes _____ No _____

Date if known _____ Type of food _____ Room No. _____

Did you smoke free cigarettes given out at convention? Yes _____ No _____

Physician _____ Address _____ Phone # _____

Interviewed by _____ Date _____

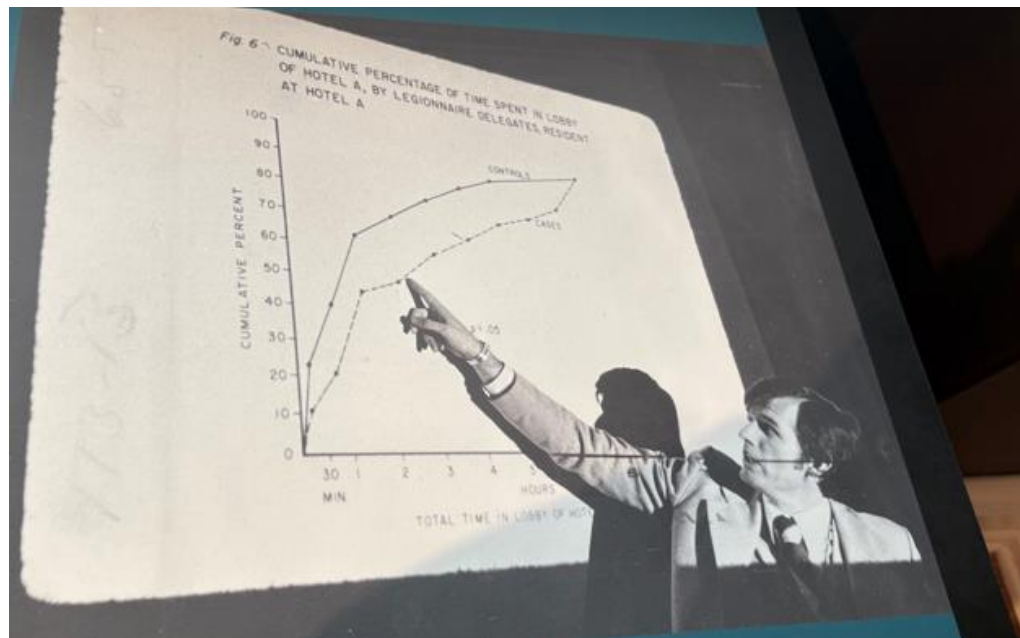
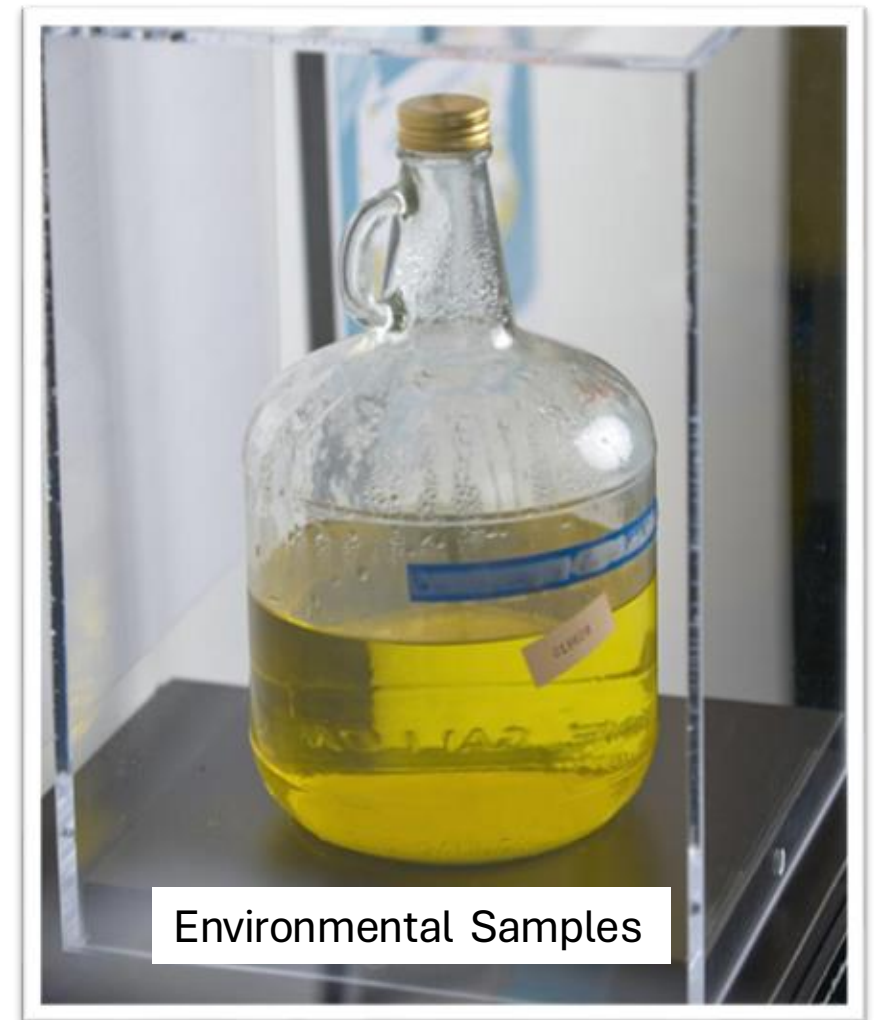


Figure 1 ([Graph at the Legionnaire's Disease Symposium], n.d)



Figure 2 (Leonard, 2025)



David J Sencer CDC Museum: Legionnaires Exhibit



Figure 1 (Norman, 2025)

San Francisco Chronicle
The Largest Daily Circulation in Northern California

112th Year No. 173 ★★★★★ WEDNESDAY, AUGUST 4, 1976 777-1111 20 CENTS

Fear Among the Legionnaires

Williamsport, Pa. — Richard M. Snyder has been locking his forehead all day.

His best friend, William J. Hartman, 45, was in critical condition at Williamsport Hospital with the mysterious illness that has stricken American Legion members all over Pennsylvania.

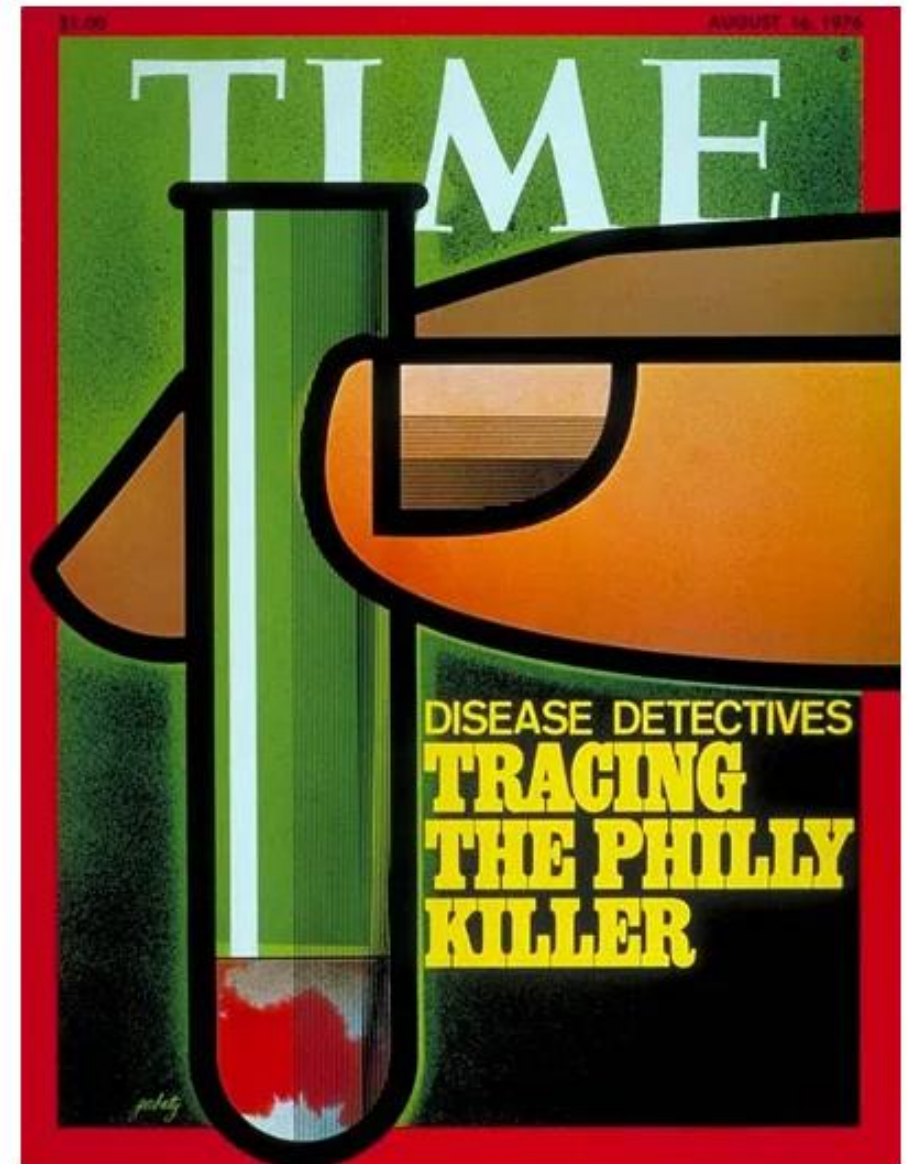
Another friend, Charles Roberts, 40, was ill last Monday night when Snyder called him. Roberts entered the hospital yesterday afternoon, with the same fever and headache that has stricken the illness in other legionnaires who

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Legion Mystery

Disease Toll Rising—Doctors Still Baffled

Figure 2 (O' Rourke, 2016)



The Aug. 16, 1976, cover of TIME TIME

Figure 3 (Disease Detectives Tracing the Philly Killer, 1976)



MEDIA FRENZY!





THE CLOSURE OF GROUND ZERO



All images (The Lost Hotels, 2026)

The Bellevue-Stratford Hotel

Theories & Speculation

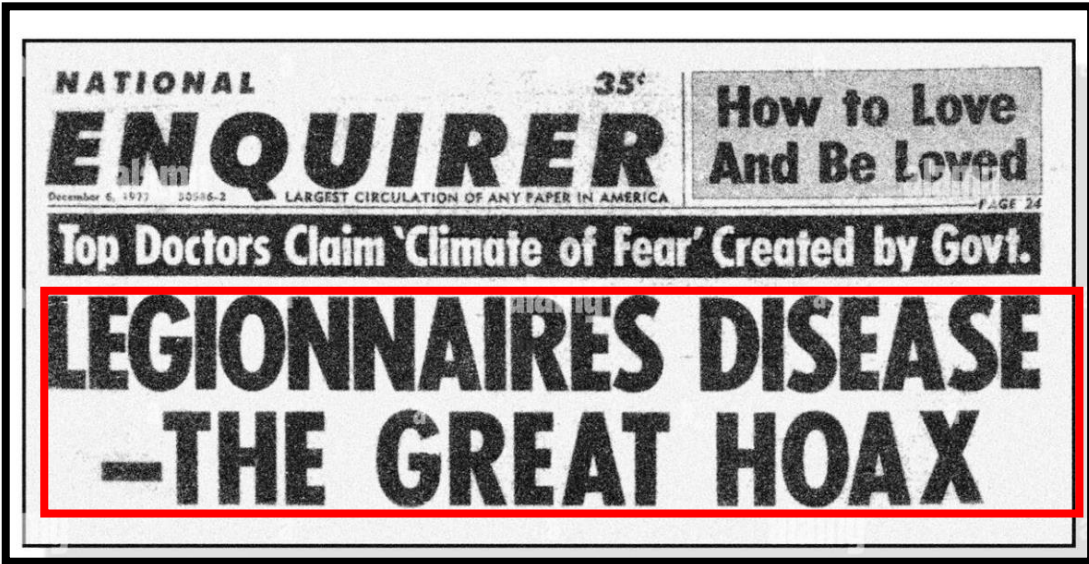
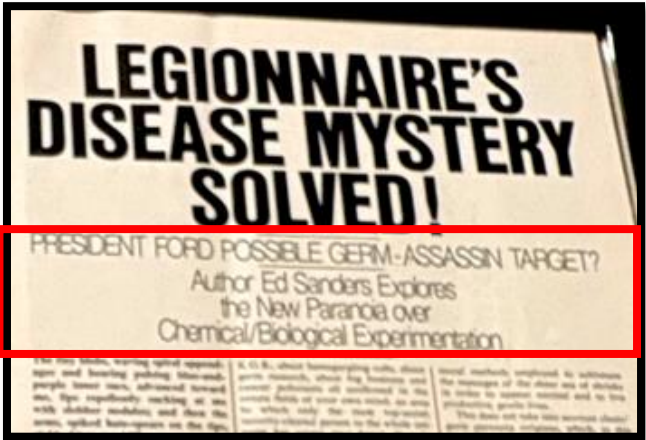
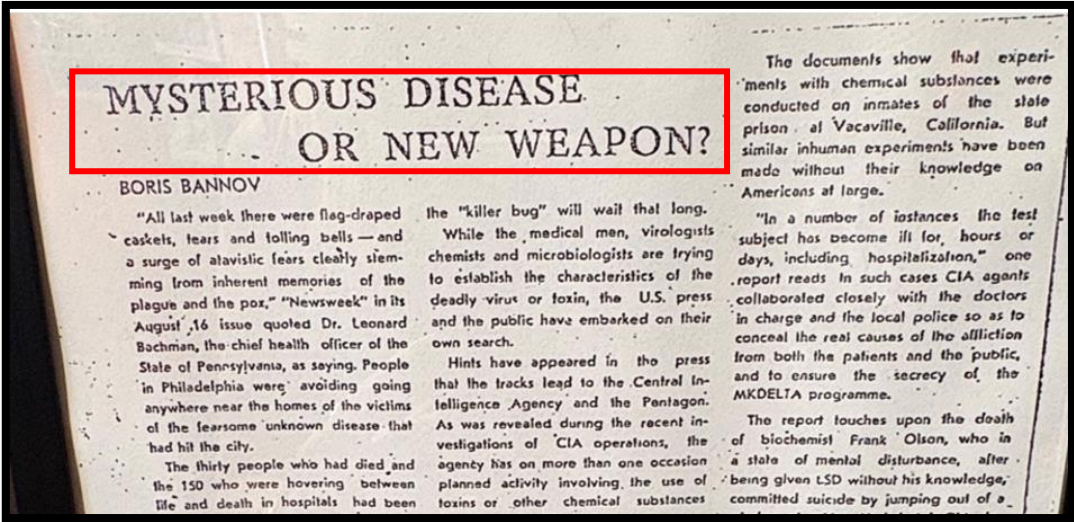


Figure 3 ([Legionnaires Disease-The Great Hoax, 2020])



Some members of the American Legion believed that the fatal sickness that struck down their comrades was the result of targeted foul play.
Courtesy of the Special Collections Research Center, Temple University Libraries, Philadelphia, PA.



Figure 1 (The Philly Killer exhibit at the Mütter Museum, Philadelphia, PA, 2026)

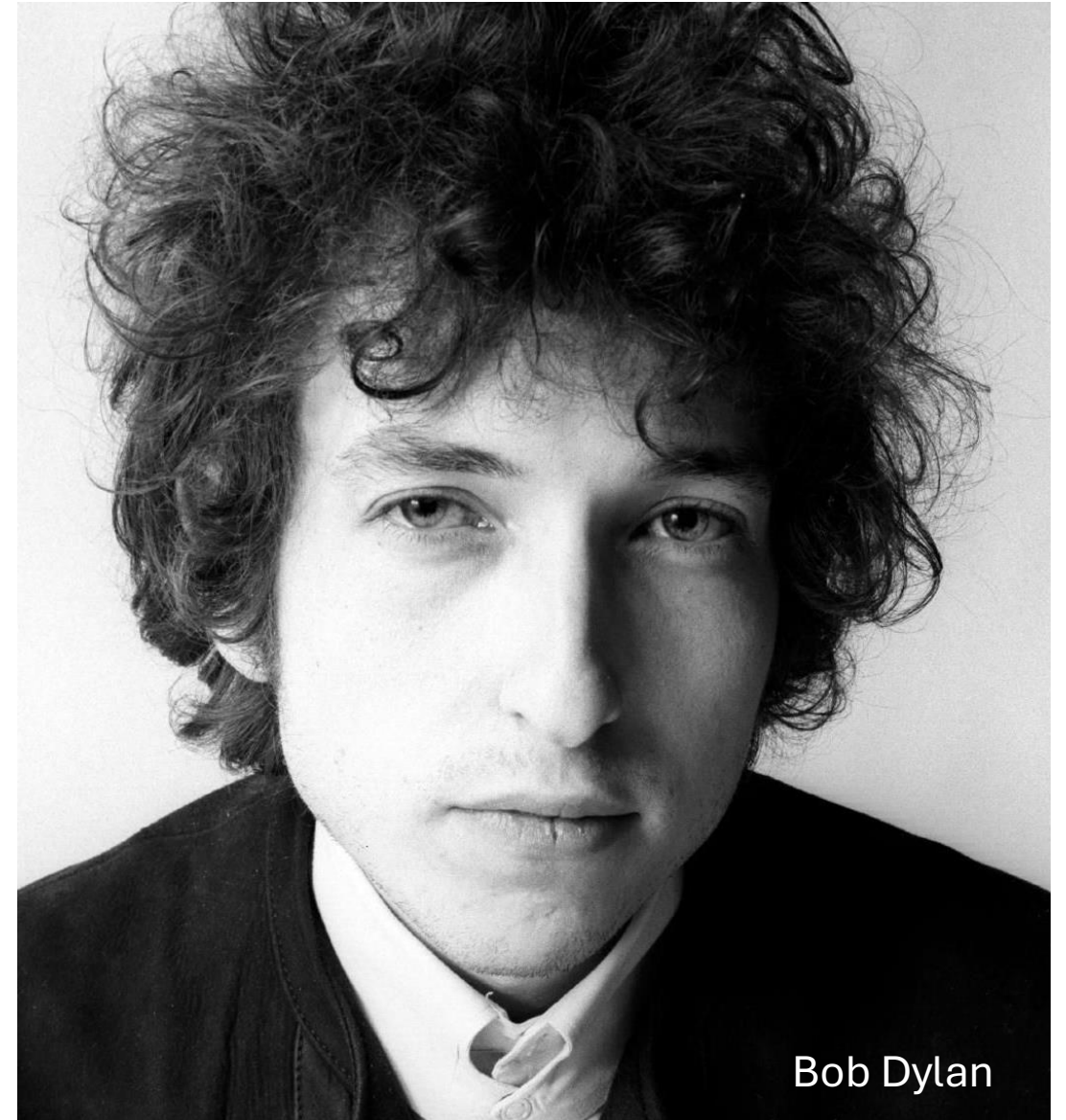
A D E A D
 Some say it was radiation, some said: acid on the microphone
 A D E
 And some say it was a combination of things that turned their heart
 D E
 But whatever it was, it drove them to their knees
 E7 |: A . . . D . . . E . . . | :|
 Oh, that Legionnaire's disease

I wish I had a dollar for everyone that died within that year
 Got 'em grabbed by the collar, and plenty a maiden shed a tear
 Now beneath my heart, it sure put on a squeeze,
 Oh, that Legionnaire's disease
 It was Legionnaire's disease

Granddad fought in a revolutionary war, father in the War of 1812
 Uncle fought down in Vietnam and then he fought a war all by himself
 But whatever it was, it hit him like a tree
 Oh, that Legionnaire's disease
 It was Legionnaire's disease
 It was Legionnaire's disease
 It was Legionnaire's disease

Figure 1 (Dylan, 1978)

[Bing Videos](#)



Bob Dylan

Figure 2 (Davison, M., Fishel, P, 2023)

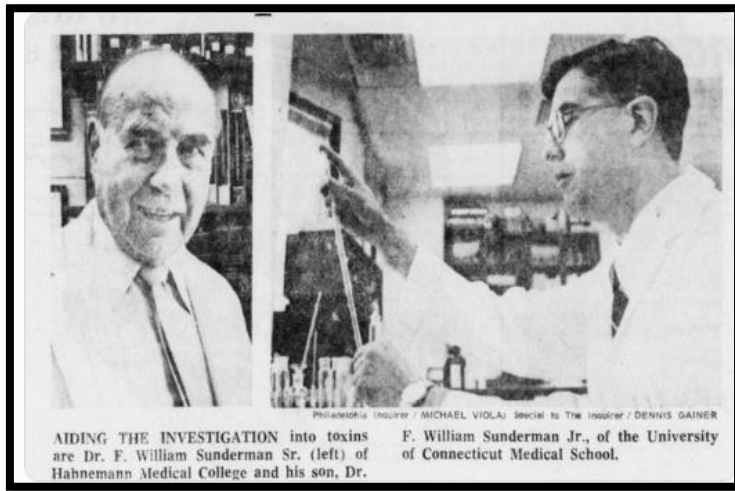


Figure 1(Wolfman-Arent, 2021)



Figure 2 (LaGarde, 1996)

Above-Normal Nickel Found in Legionnaires

Farmington, Conn. — (AP) — Scientists today found higher than normal nickel levels in tissue from victims of the mysterious legionnaires' disease.

They cautioned against premature conclusions in that high levels of nickel also were found in tissue from other humans.

The researchers are looking into the possibility that the Legion illness was caused by poisoning from nickel carbonyl.

After an American Legion convention July 21-24 in Philadelphia, 27 persons died and 128 others became ill, and their symptoms were similar to those of nickel carbonyl poisoning.

Dr. F. William Sunderman, who heads the University of Connecticut research team, said today nickel carbonyl is "one of the most toxic gases known." But he said he didn't know where it would have come from at the

Sunderman said he has asked for more tissue samples and added it would take several days to reach a conclusion. He said the tissue from the victims and the normal tissue were sent in the same container to Connecticut, raising the possibility of contamination.

When the tests are done, results will be sent from the UConn Health Center to the Center for Disease Control in Atlanta, Ga.

Doctors at the health center examined tissues from the lungs, brains and other organs of the victims. The symptoms of the 155 persons stricken with the illness "are very, very close to the classic description of nickel carbonyl poisoning," Sunderman said.

Allegheny County Coroner Cyril Wecht said yesterday in Pittsburgh that concentrations of crystals found in the kidneys of two victims indicate

Figure 3 (Wolfman-Arent, 2021)



Figure 4 (LaGarde, 1996)

17 Metals Dropped In Tests for Cause Of Legion Disease

By LAWRENCE K. ALTMAN

Special to The New York Times

HARRISBURG, Pa., Aug. 12

—The Center for Disease Control in Atlanta said today that 17 metals had been excluded as possible causes of the mysterious legionnaires' disease that has killed 27 persons in Pennsylvania.

Figure 5 (Altman 1996)

CDC Microbiologist Joseph McDade

“It’s like looking for a contact lens on a basketball court with your eyes four inches above the ground,”

-New York Times interview with John McDade

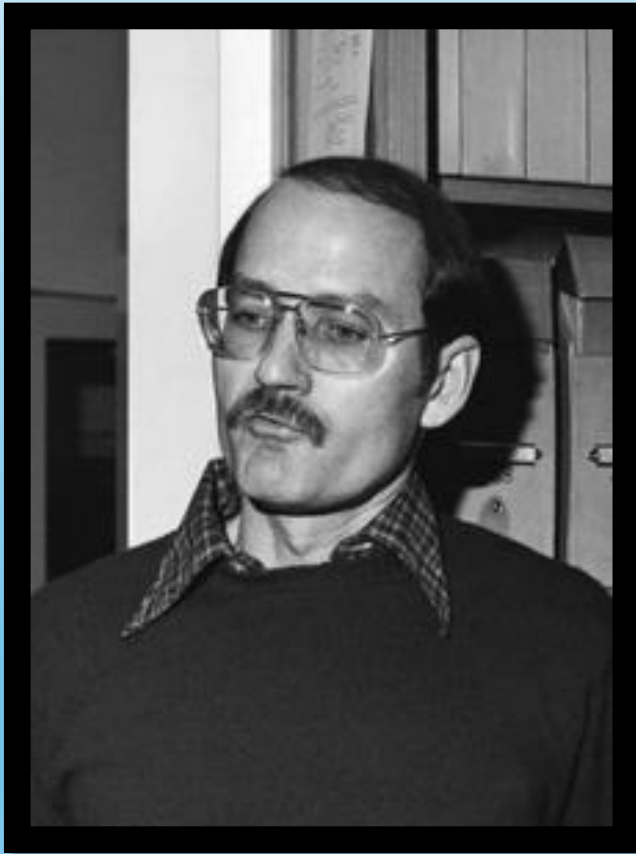


Figure 1 (Center for Disease Control and Prevention, n.d.)



Figure 2 (Bouscher, 2023)

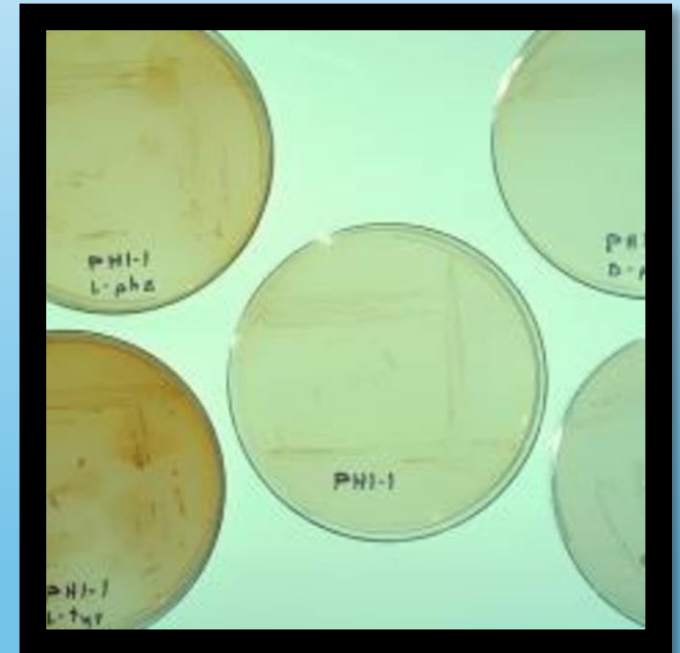


Figure 3 (Klein, 2006)



THE TURNING POINT: Christmas

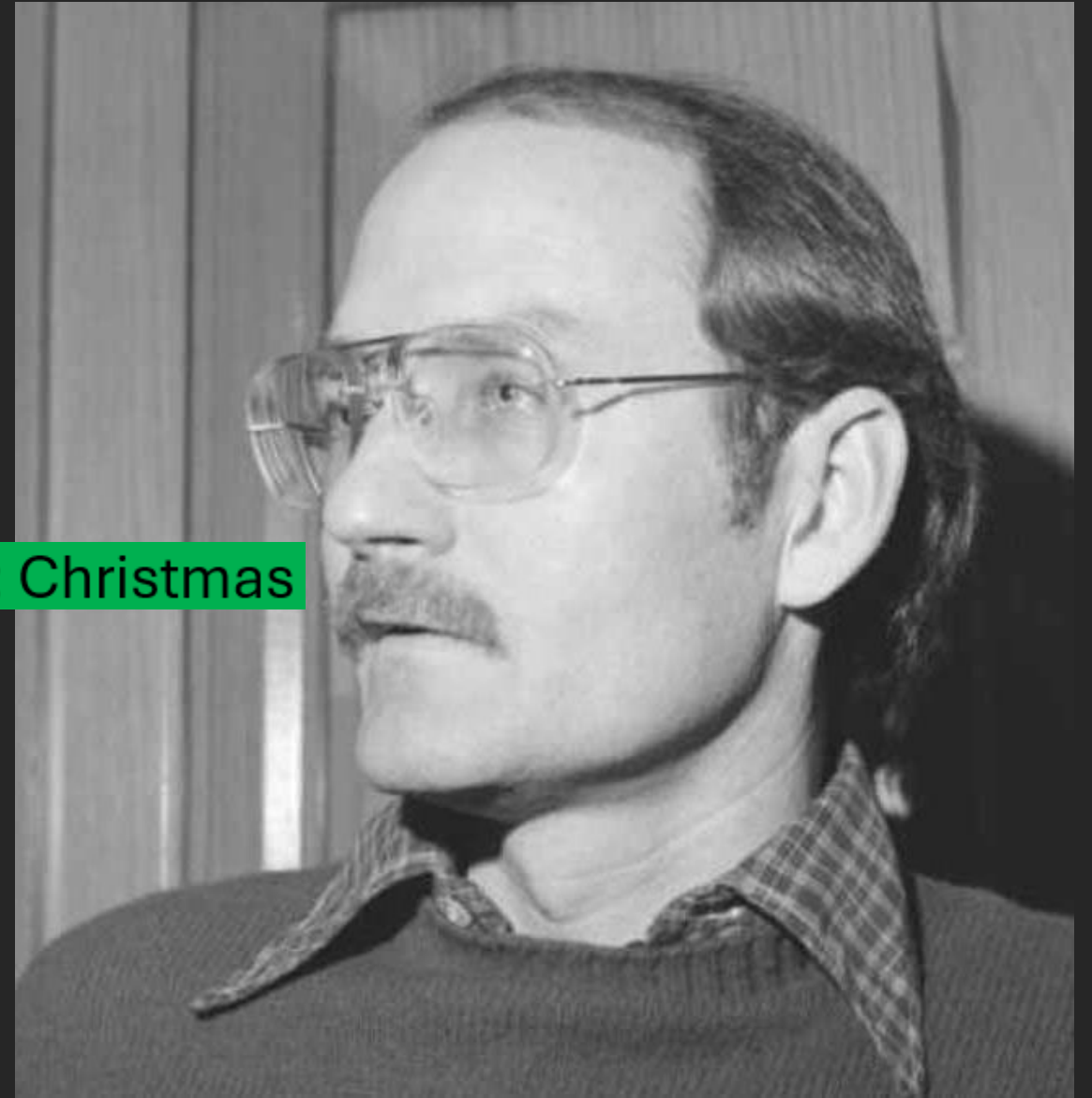
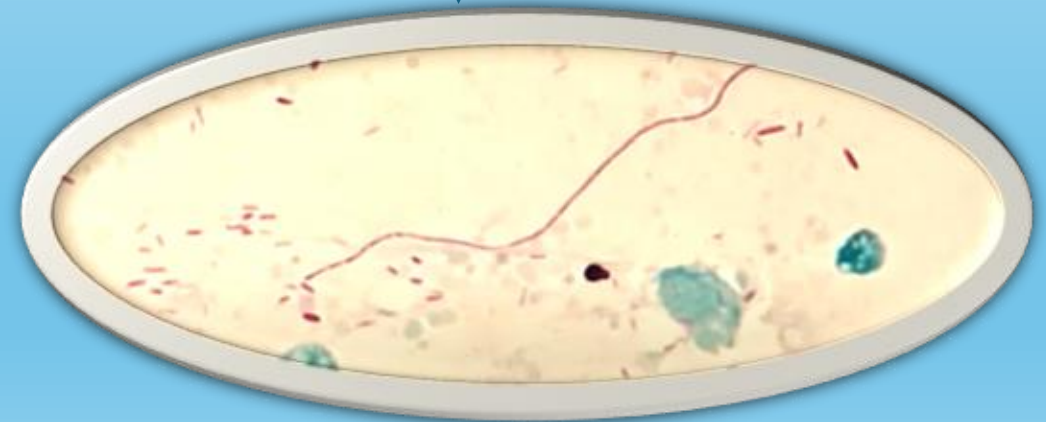
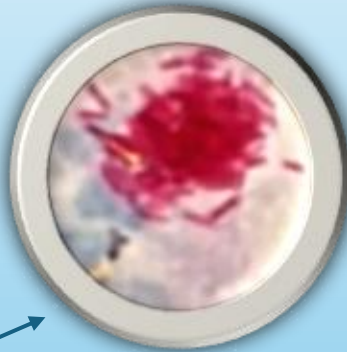


Figure 1 ([Christmas tree 1978], 1978)

Figure 2 (Gordan, 2016)

The discovery: January 18, 1977



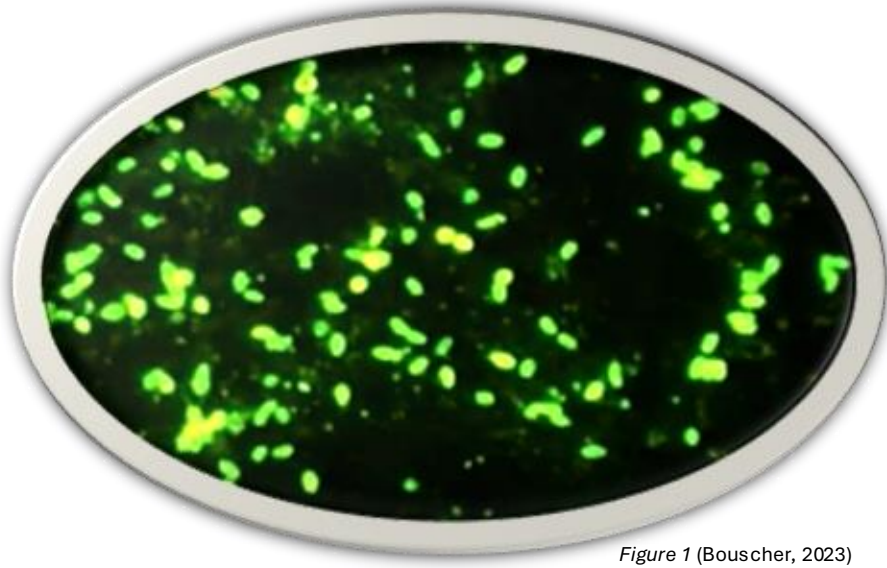


Figure 1 (Bouscher, 2023)

“As we broke the code and found out that they were falling into this particular pattern, I can still remember the hair raising up on the back of my neck.”

FORMER CDC MICROBIOLOGIST JOSEPH MCDADE

Figure 3 (LaGarde,1996)



Figure 2 (LaGarde,1996)

Feeley Gorman Agar

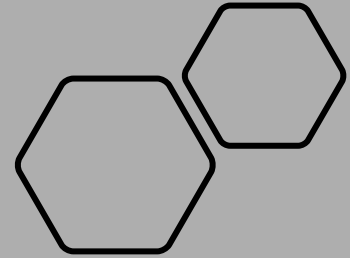


Figure 1 (Bouscher, 2023)

HOW WAS LEGIONELLA MISSED?

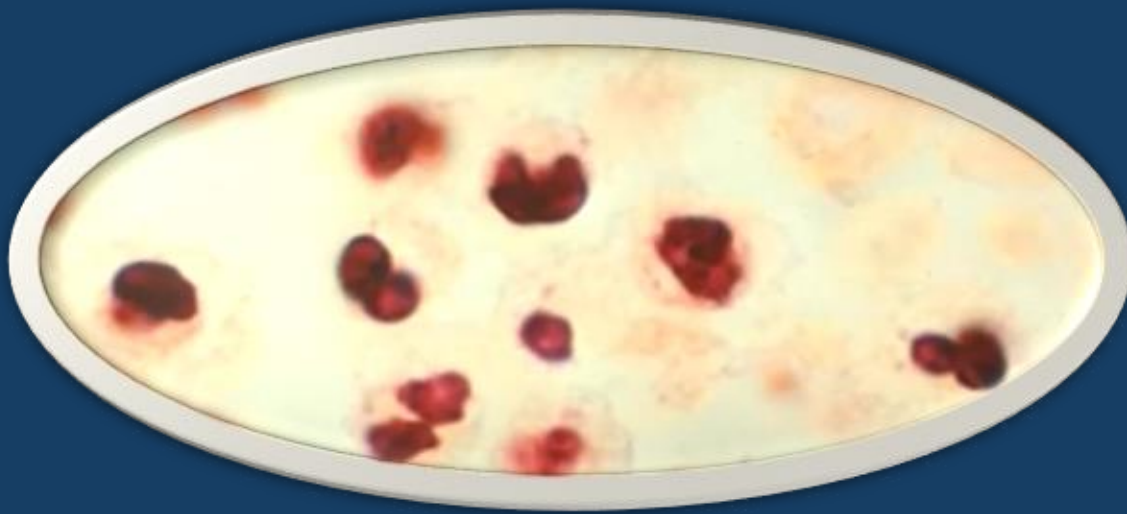




Figure 1 (LaGarde, 1996)



Figure 3 (LaGarde, 1996)



Figure 2 ([Erythromycin], n.d)



Figure 1 (Washington Post, 2019)



Figure 2 ([Pontiac Michigan], n.d)

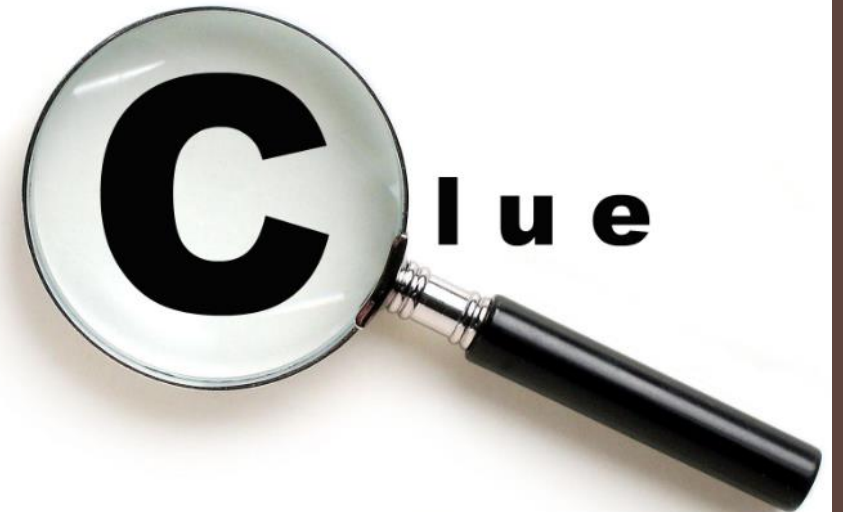


Figure 3 ([Clue], n.d.)

**ST. ELIZABETHS MENTAL
HOSPITAL 1965
&
PONTIAC FEVER
MICHIGAN 1968**

Legionella linked to cooling tower



Figure 1 (The Philly Killer exhibit at the Mütter Museum, Philadelphia, PA, 2026)

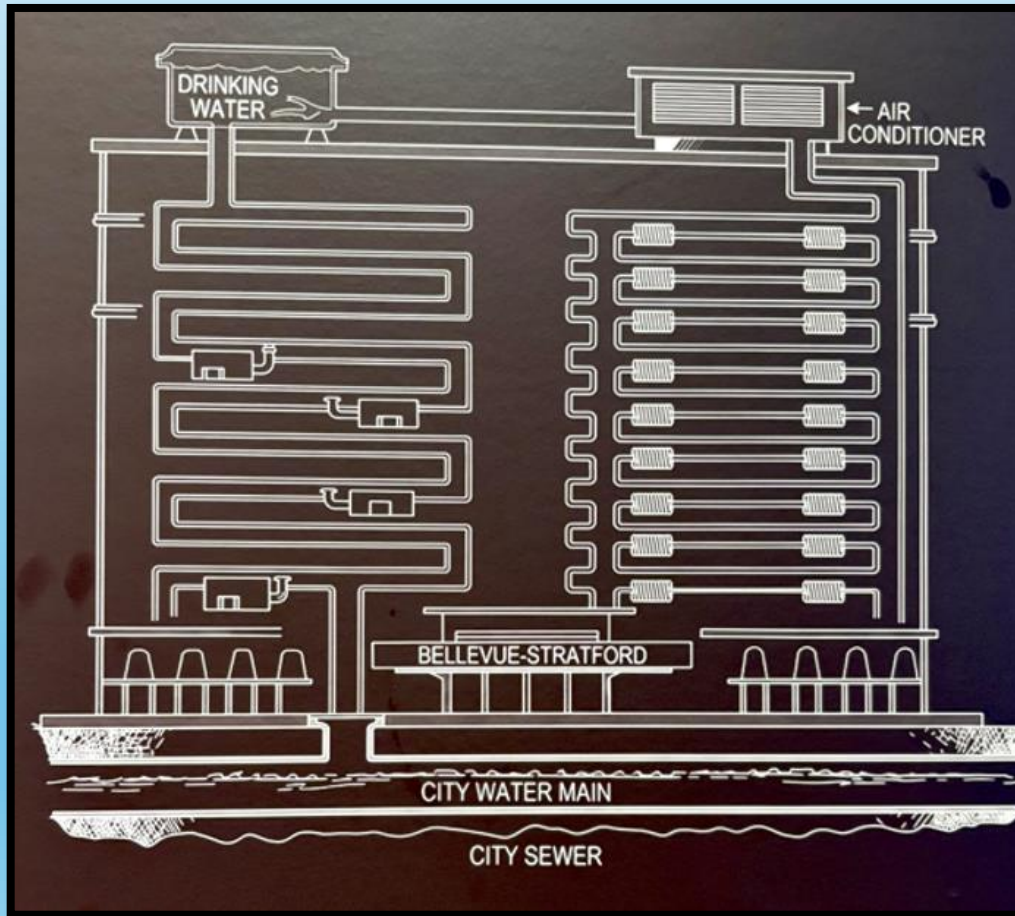


Figure 2 [(The Philly Killer special exhibition), 2026]

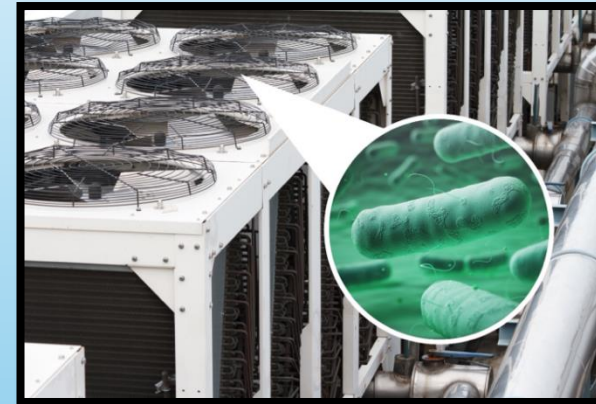


Figure 3 (Arsenault, 2017)

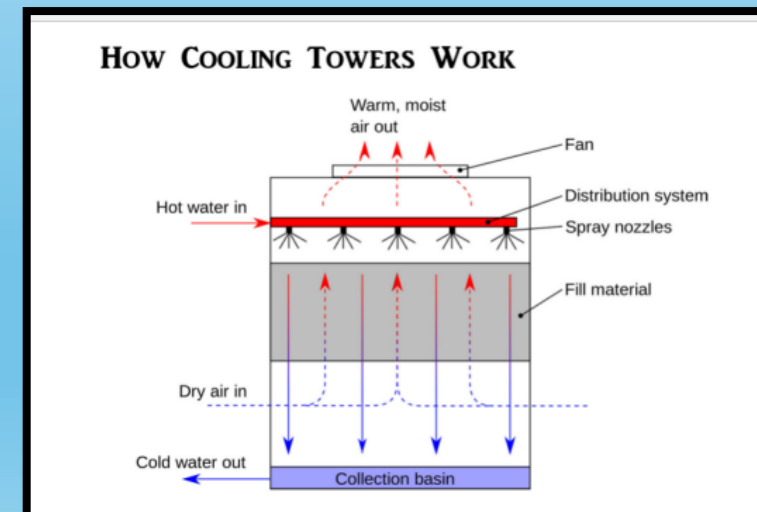


Figure 4 ([How cooling towers work], n.d.)



Burlington VT Hospital Outbreak 1977

Bloomington Indiana Outbreak 1978

- Campus of Indiana University: 36,000 students centered around Indiana memorial union that houses students & clubs & hotel for visitors
- March 1978-Aug 1978
- 39 cases of legionella
- 3 deaths
- CDC investigated water tower and found legionella



Figure 1 ([Campus of Indiana University Memorial Union] , n.d.)

Memphis TN Hospital Outbreak 1978

- Baptist Hospital
- 44 cases, 0 deaths
- 2 samples water from air conditioning cooling tower were positive legionella



Figure 1 ([Baptist Memorial Hospital Memphis TN] n.d.)



Figure 1 ([Oxford Churchill Hospital] n.d.)

Oxford outbreak 1979

- Churchill hospital in Oxford
- Kidney transplant unit
- 2 cases of legionella, 6 months apart staying in the same room
- Legionella found in the shower head, from the facet head and the side arms of the shower head.

Legionella species are Gram-negative bacilli.



Figure 1 ([Legionella on petri dish] , 2013)



Figure 2 ([Lake].n.d)

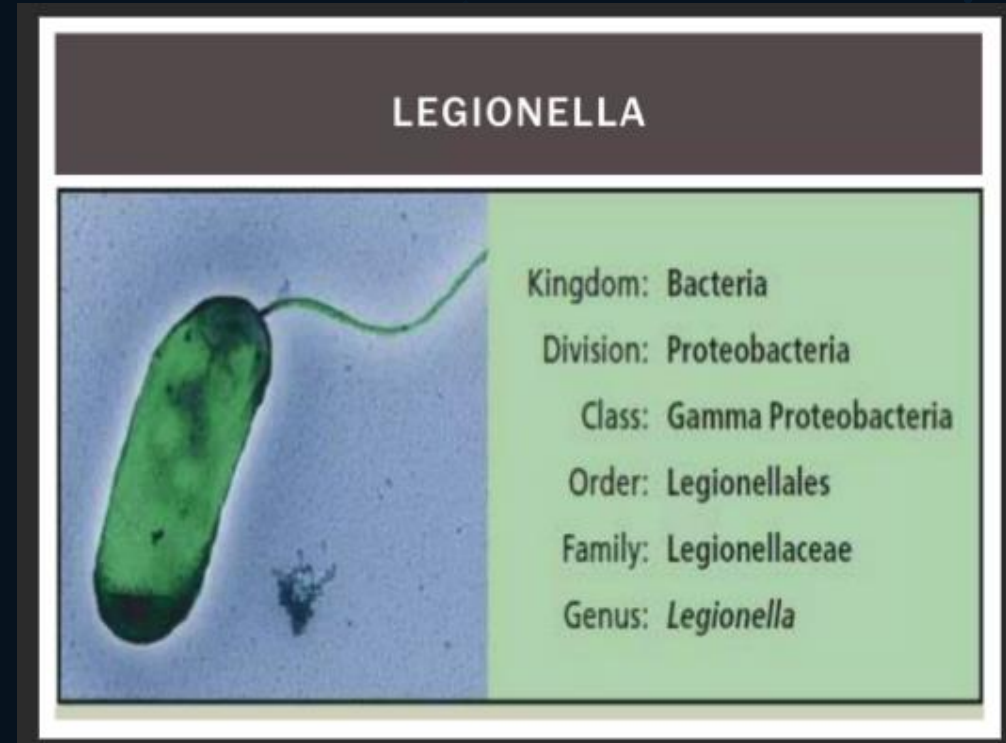


Figure 3 ([Legionella class] n.d)

Legionnaires disease (legionellosis)

a lung infection caused by the
bacterium *Legionella*

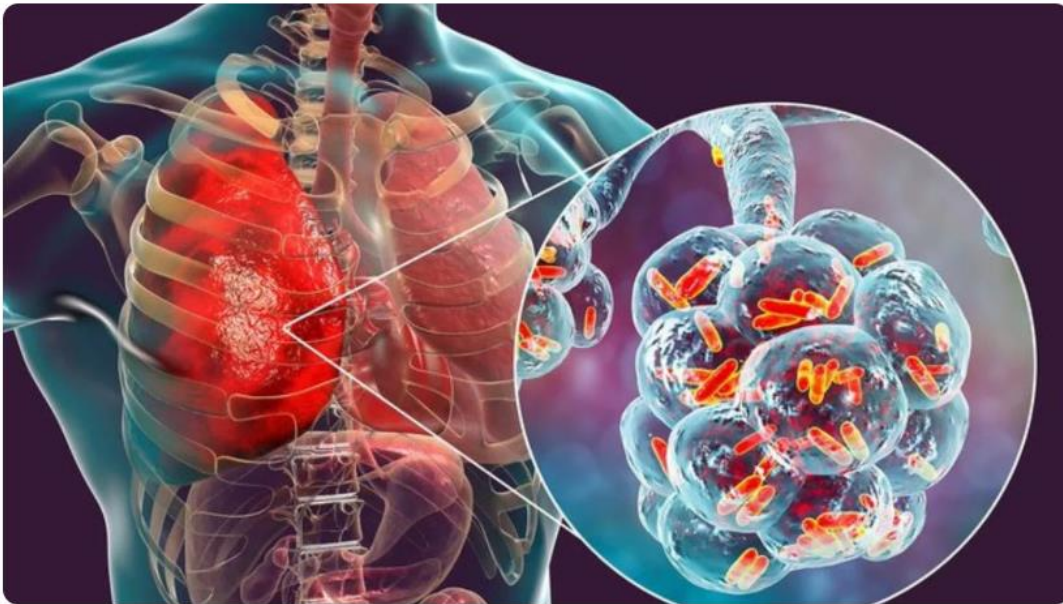
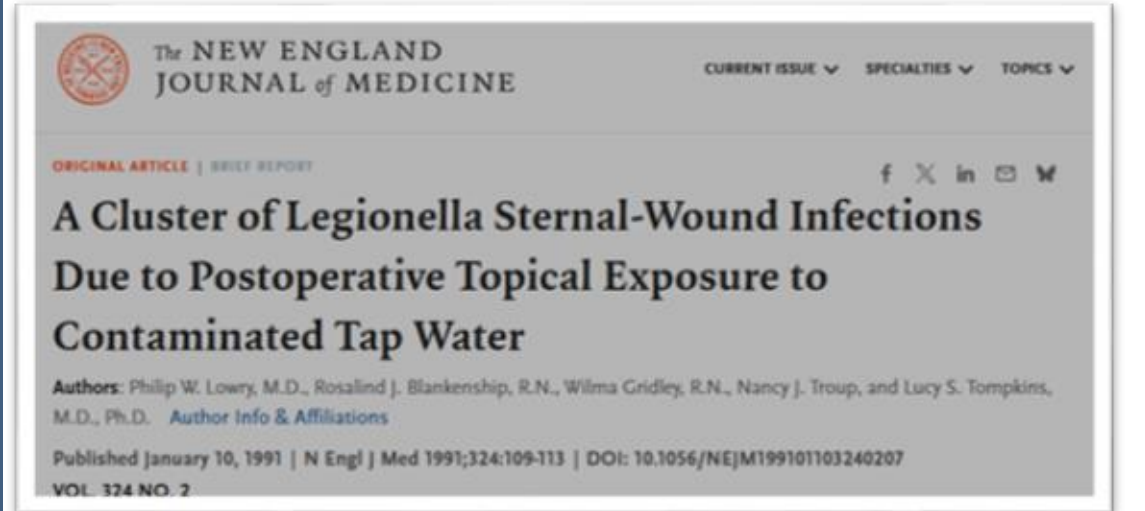


Figure 1[(*Legionella* lung infection] n.d.)



Figures 2 & 3 (Lowry et al, 1991)

Symptoms



Figure 1 ([Coughing], n.d.)

- ▶ Cough
- ▶ Shortness of breath
- ▶ Muscle aches
- ▶ Headache
- ▶ Fever

Risk Factors



Figure 2 ([Sick elderly], n.d.)

- ▶ Elderly (50 years and older)
- ▶ Smokers (current or former)
- ▶ Specific health issues/conditions:
 - ▶ Cancer
 - ▶ Chronic lung disease
 - ▶ Diabetes
 - ▶ Kidney & liver failure
 - ▶ Weak immune system

Modes of transmission

- Breathing in mist & water containing *Legionella*
- Swallowing water into the lungs, and aspiration of drinking water/ice chips containing *Legionella*

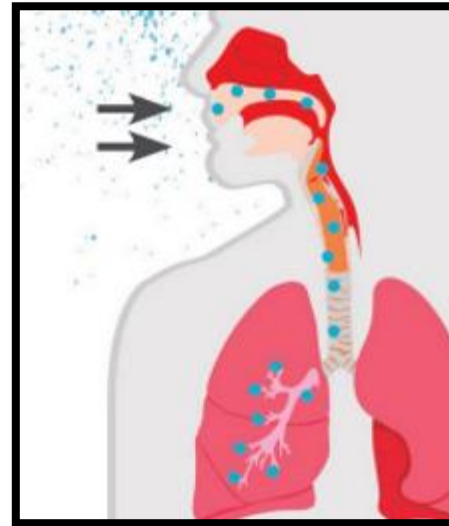


Figure 1 (CDC, 2025)

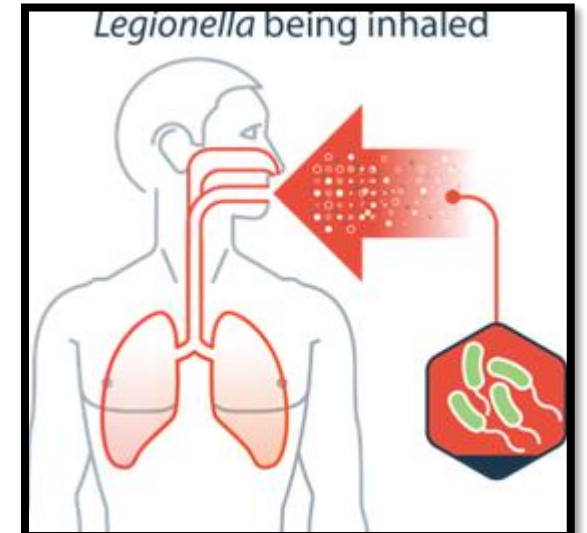


Figure 2 (CDC, 2025.)

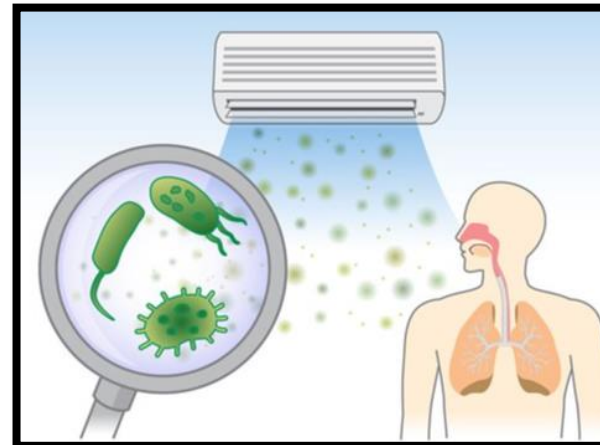


Figure 3 (Legionnaires' Disease: What You Need to know, 2018)

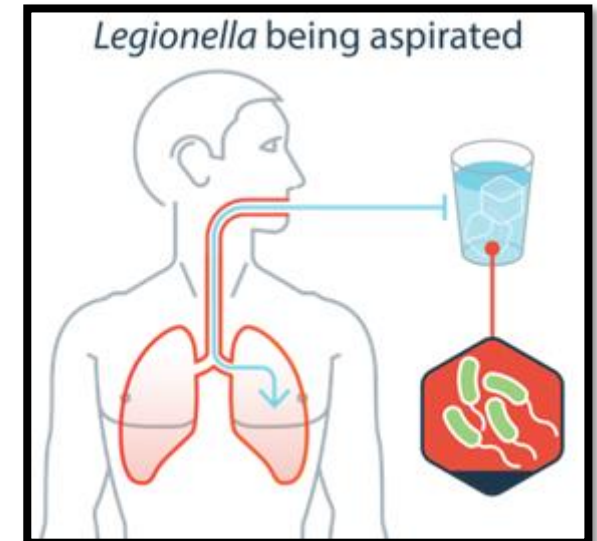


Figure 4 (CDC, 2025.)

Sources of infection

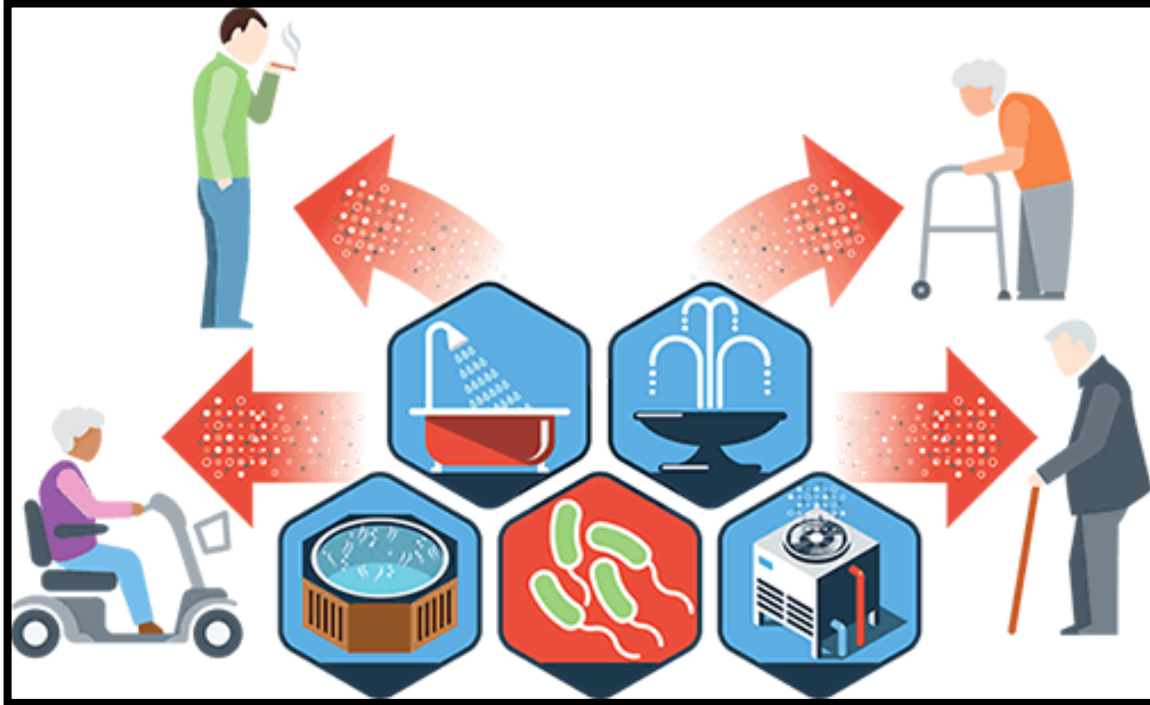


Figure 1 (CDC, 2024.)

Respiratory
equipment

Car washes

Misting
devices

Street
cleaning
machines

Soil

Showerheads
and sink
faucets

Hot tubs

Decorative
fountains and
water features

Plumbing
systems

Contaminated
water or ice

Cooling
towers

Hot water
heaters

Humidifiers

Hospital
dishwashers

Diagnosing

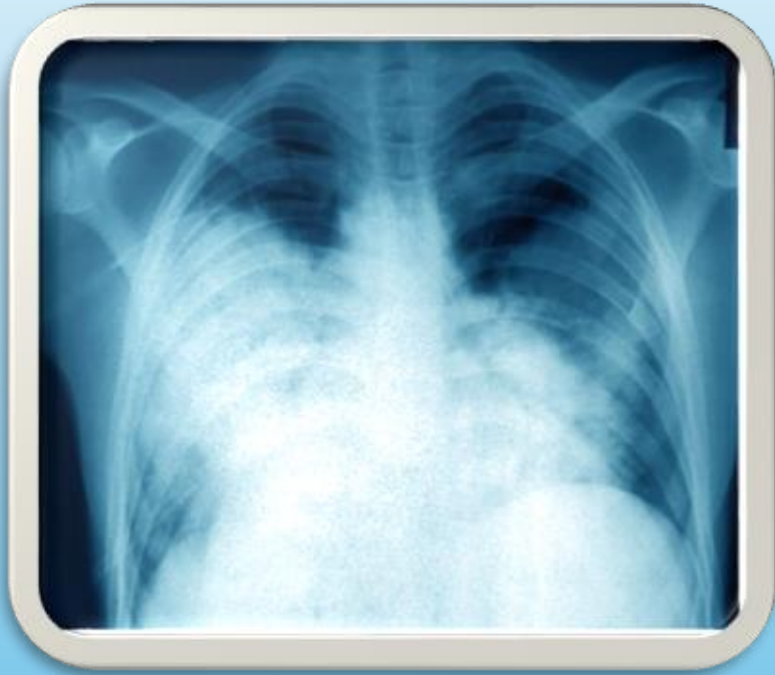


Figure 1 ([Legionnaires' disease Xray], n.d.)

This frontal chest radiograph shows acute bilateral pneumonia (legionnaires' disease caused by *Legionella pneumophila*)



Figure 2 ([Legionella urine test], n.d.)



Figure 4 ([Legionella blood test], n.d.)

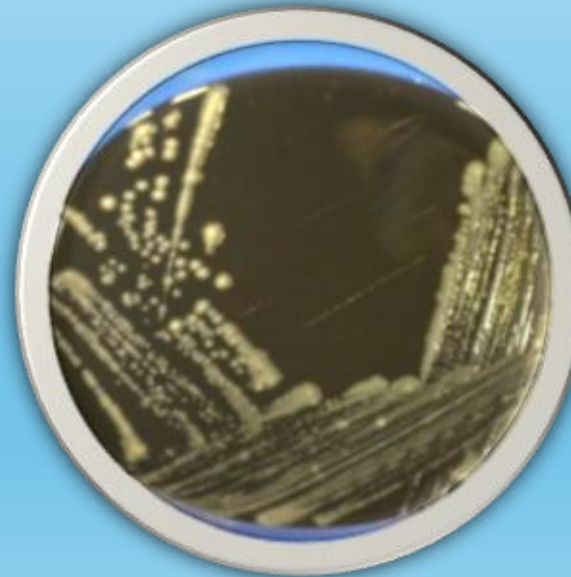


Figure 3 [Legionella] culture test], n.d.)



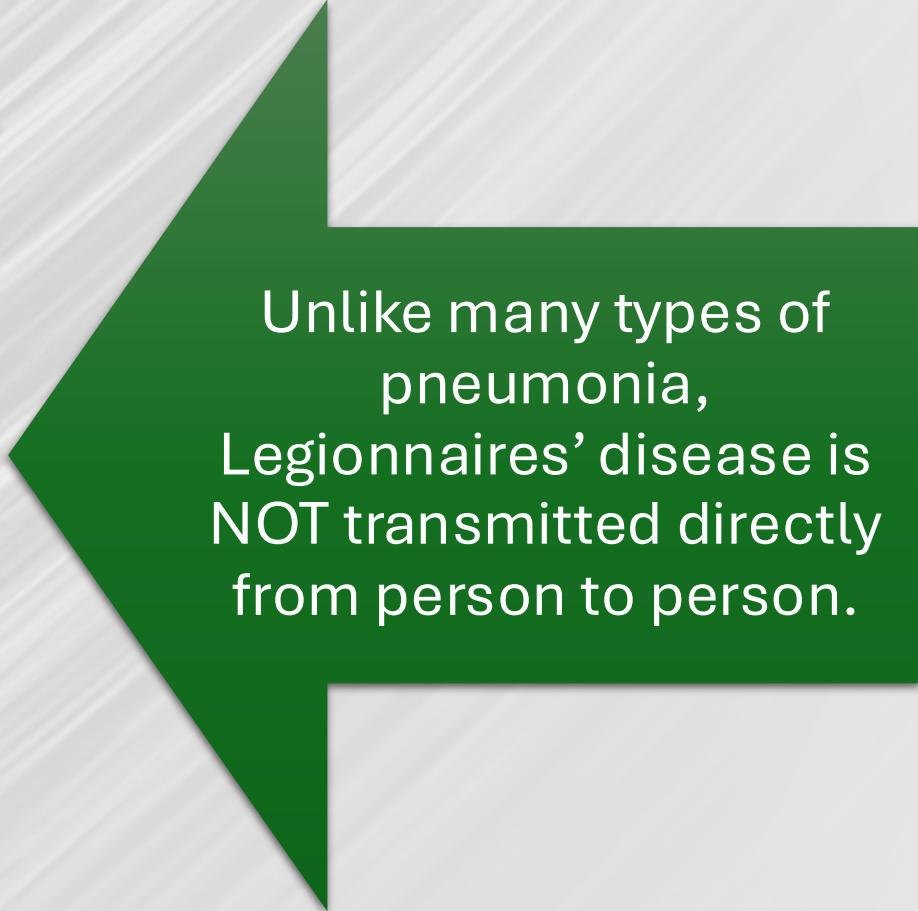
Figure 5 ([Legionella PCR], n.d)

Is Legionnaires' disease contagious?



Legionnaires' disease is
NOT contagious.

NO!



Unlike many types of
pneumonia,
Legionnaires' disease is
NOT transmitted directly
from person to person.

Patients with confirmed or suspected Legionella infection do not require isolation or contact precautions

Treatment & Prognosis

- Antibiotics: Azithromycin, Clarithromycin, or Levofloxacin.
- For individuals who contract the disease in health care settings, the case-fatality rate is as high as 25%.
- 1 out of 10 people who get Legionnaires' disease will die from the infection.

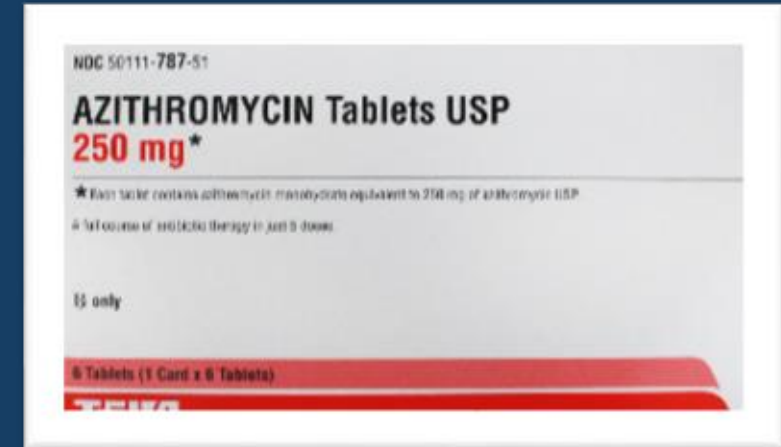


Figure 1 ([Azithromycin], n.d.)



Figure 2 ([Levaquin], n.d)

Focus on plumbing and biofilm



Figure 1 ([Biofilm in pipe],n.d.)

CONCERNS:

- Age of piping
- Scale build up
- Biofilm buildup
- Dead legs
- Water stagnation

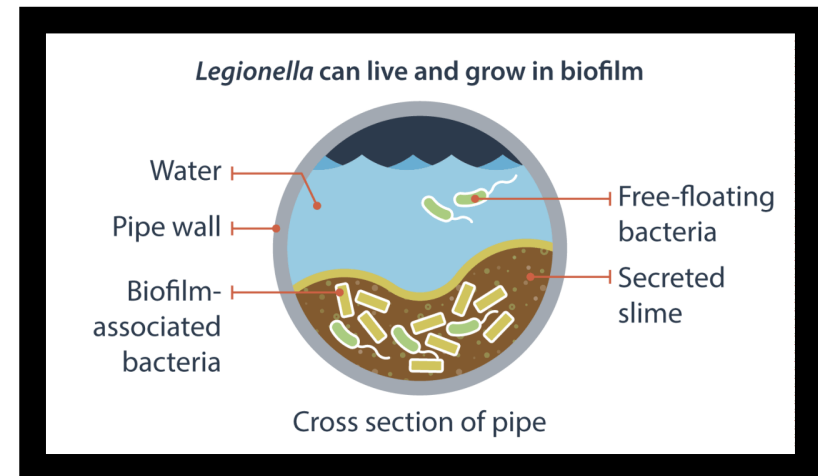


Figure 2 (CDC, 2025)

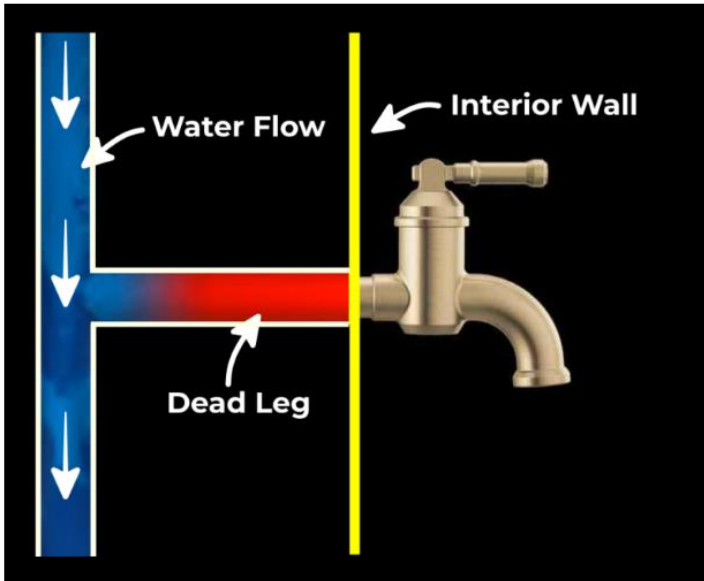


Figure 1 ([Dead leg], n.d)

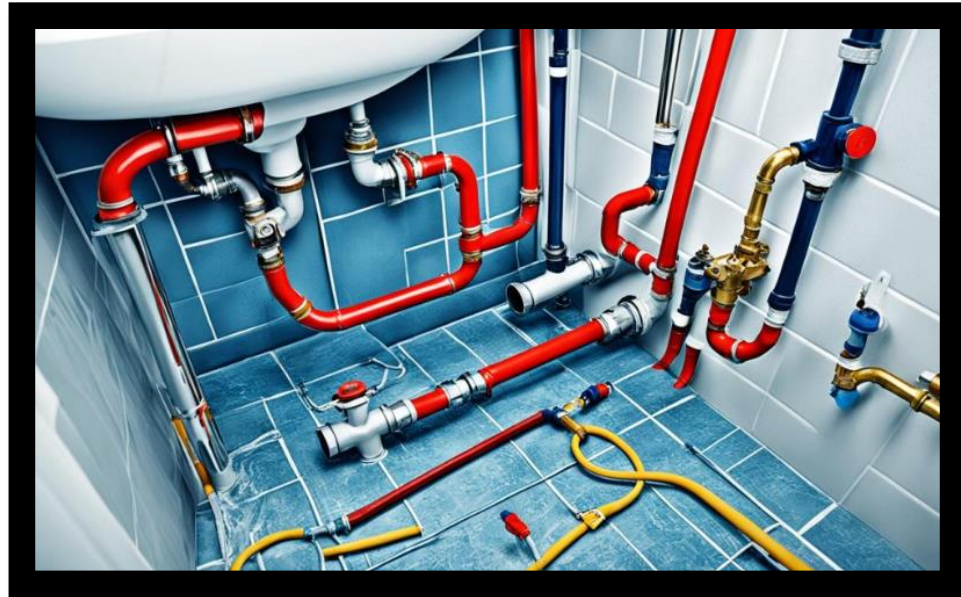


Figure 2 ([Dead leg], n.d.)

Dead Legs

A **dead leg** in a plumbing system refers to a section of piping that receives no or infrequent water flow.

Because the water in a dead leg **never moves**, it allows biofilms to develop rapidly.

Water Management Industry Standards

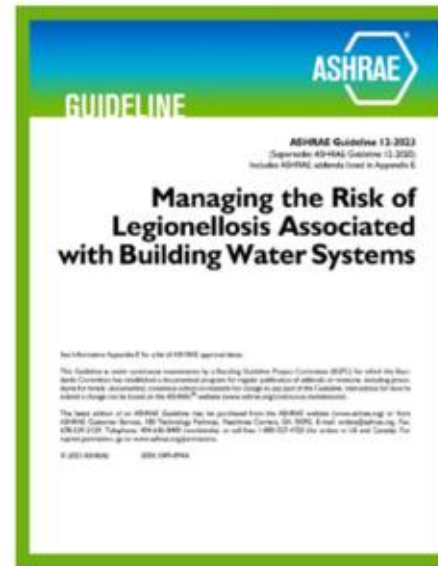
- Industry standard
 - ASHRAE Standard (2015, 2018)
- Health care
 - VHA Directive 1061 (2014)
 - CMS requirement (2017)
 - The Joint Commission
- Regulations
 - State & local



ASHRAE STANDARD 514



ASHRAE STANDARD 188



ASHRAE GUIDELINE 12





Figure 1 ([Drinking water], n.d.)

What is the OSHA Standard for Legionella bacteria in water?

Raw/Non-potable: not safe for human consumption and must be treated to remove impurities and contaminants.

Tap/potable water: water safe for drinking and meeting safety standards

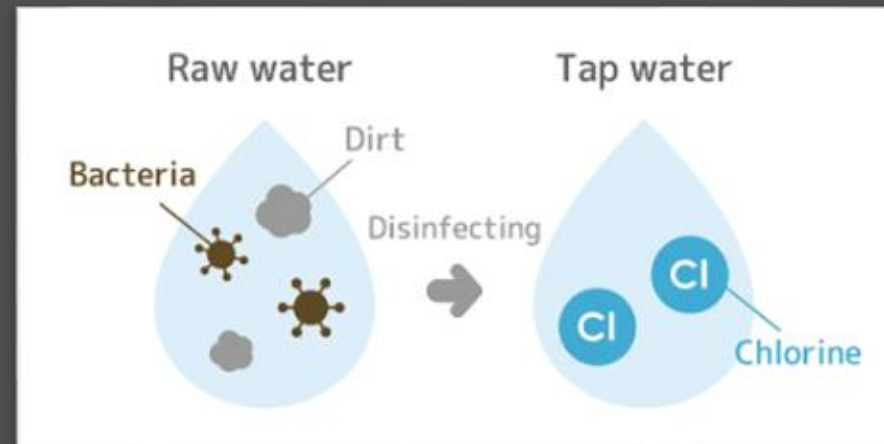


Figure 2 ([Chlorine in water disinfection], n.d.)

Figure 1. Routine *Legionella* testing: A multifactorial approach to performance indicator interpretation*^o^Δ

Concentration indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
≥10 CFU/mL [†] in potable water	1.0–9.9 CFU/mL in potable water	Detectable to 0.9 CFU/mL in potable water	No <i>Legionella</i> detected in a single round of testing	No <i>Legionella</i> detected in multiple rounds of testing	No <i>Legionella</i> detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any <i>Legionella</i> species
OR ≥100 CFU/mL in cooling towers	OR 10–99 CFU/mL in cooling towers	OR Detectable to 9 CFU/mL in cooling towers			

Change in concentration over time indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
100-fold or greater increase in concentration (e.g., 0.05 to 5 CFU/mL)	10-fold increase in concentration (e.g., 0.05 to 0.5 CFU/mL)	<i>Legionella</i> concentration steady (e.g., 0.5 CFU/mL for two consecutive sampling rounds)	No <i>Legionella</i> detected in a single round of testing	No <i>Legionella</i> detected in multiple rounds of testing	No <i>Legionella</i> detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any <i>Legionella</i> species

Extent indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
Detection in multiple locations AND a common source location [‡]	Detection in a common source location that serves multiple areas	Detection in a few of many tested locations within a water system	No <i>Legionella</i> detected in a single round of testing	No <i>Legionella</i> detected in multiple rounds of testing	No <i>Legionella</i> detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any <i>Legionella</i> species
OR Detection across many locations within a water system	OR Detection in more than one location within a water system				

Type[¶] of *Legionella* (species and serogroup) associated with Legionnaires' disease:

Highly Associated	Less Associated
<i>L. pneumophila</i> serogroup 1; Non-Lp1 <i>L. pneumophila</i> ; Presence of multiple different <i>Legionella</i> species or serogroups	Any non- <i>pneumophila</i> <i>Legionella</i> species including "blue-white" fluorescent <i>Legionella</i>

* This figure is intended for use during routine testing of potable water and cooling towers only. Due to their ability to rapidly grow and spread *Legionella*, any detection of viable *Legionella* in a hot tub or decorative fountain should prompt a response, including a review of the water management program and corrective actions. Test results are performance indicators and are not a measure of risk of human illness. This figure is not intended for use if a building or device is associated with Legionnaires' disease (LD) cases or an outbreak.

^o See "Routine testing for *Legionella*" for guidance regarding suggested response activities. Comparable results may lead to different suggested response activities when other factors are considered (e.g., if there is evidence of poorly controlled growth at a healthcare facility).

^Δ Considering the type of *Legionella* identified along with other *Legionella* testing performance indicators provides a clearer picture of water system control than the results of any single indicator. For example, facility owners and operators may consider implementing immediate interventions for a healthcare facility with: A. detectable but <10 colony-forming units per milliliter (CFU/mL), B. non-Lp1 *Legionella pneumophila*, C. observed at steady concentrations, but D. detected at multiple distal locations including a central water heater.

[†] Concentrations expressed as CFU/mL are for test results generated by traditional spread plate culture methods. If other test methods are used, consult testing lab or manufacturer instructions for appropriate interpretation.

[‡] Common source location examples include water heaters, hot water returns, storage tanks, and cooling tower basins.

[¶] If a facility has a history of associated LD cases, then sequencing isolates obtained during routine testing may provide performance indicators regarding outbreak strain persistence (if that strain is detected).



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CDC Legionella Water Management Program Toolkit

- It is a step-by-step guide on how to create a water management plan
- Translates ASHRAE Standard 188 into plain language for wider audiences

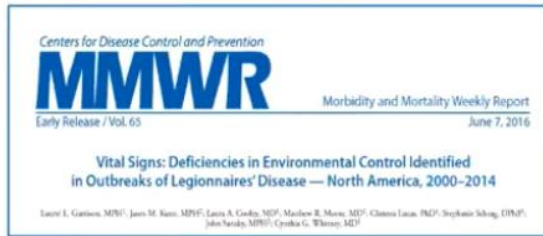


Figure 1(CDC, 2025)

Waterborne Management Program: The Healthcare Statistics: 2022

- 25% of hospitals **do NOT** have a water management program
- 77% of hospitals **have NOT** implemented their water management program

Inadequate water management leads to increased risk of LD



Communication

A Methodology for Classifying Root Causes of Outbreaks of Legionnaires' Disease: Deficiencies in Environmental Control and Water Management

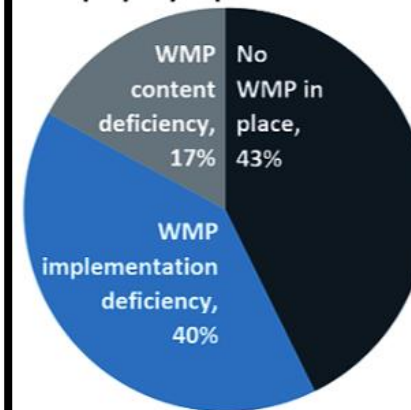
Benjamin R. Clopper^{1,2,*}, Jason M. Kuntz^{1,2}, Simone W. Salandy², Jessica C. Smith³, Brian C. Hubbard² and John P. Szilagyi²

CDC investigations show 9 out of 10 outbreaks were caused by problems preventable with more effective water management

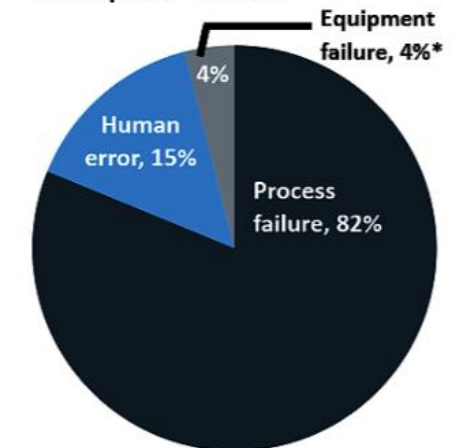
¹ Garrison LE et al. *MMWR*. 2016;65(22):557–61.

² Clopper BR et al. *Microorganisms*. 2021;9(1):89.

Most WMP deficiencies associated with outbreaks were due to missing or improperly implemented WMPs.



Most environmental deficiencies were due to process failure.



All the deficiencies associated with outbreaks could have been prevented by comprehensive, properly implemented water management programs.



Figure 1: (CDC 2024)



Partnership is the key & requires the efforts of:

- Environmental health
- Epidemiology
- Laboratory science

UConn Water Management Team



Figure 1: (Walker, 2022)

- Director of **Facilities** Engineering
- Director of **Epidemiology**
- **Infection prevention**
- Program Director of **Bone Marrow Transplant**
- Clinical Program Coordinator BMT
- **Central Sterile**
- Supervisor **Plumbing**
- Associate Prof of **Pathology & Lab Medicine**
- Supervisor **HVAC**
- Clinical Lab Supervisor of **Microbiology**
- Associate Director of Clinical Laboratory
- Accreditation and **Regulatory Affairs**
- Safety and Quality Office School of Dental
- Director of **Environmental Health and Safety**
- **Clinical Engineering**
- Director of **Physical Environment**
- Supervisor of Engineering Control Center
- **Regulatory Compliance** Office
- **Infectious Disease/Epidemiology** MD
- **MDC Water Company**

Joint Commission PE.04.01.05



Effective Jan 1, 2026

- Water Management Team
- Flow Diagram
- Risk & Hazard Analysis
- Required Control Measures
- Monitoring, Limits, and Corrective Actions
- Annual Water Management Program Review

Elements of Compliance Standard IC.04/01.01, EP2

- Communication and collaboration with all components of the hospital involved in infection prevention and control activities, including but not limited to the antibiotic stewardship program, sterile processing department, and the water management program.

COMPLIANCE WITH CMS

DEPARTMENT OF HEALTH & HUMAN SERVICES
Centers for Medicare & Medicaid Services
7500 Security Boulevard, Mail Stop C2-21-16
Baltimore, Maryland 21244-1850



Center for Clinical Standards and Quality/Quality, Safety and Oversight Group

Ref: ~~QSO~~-17-30- Hospitals/CAHs/NHs
REVISED 07.06.2018

DATE: June 02, 2017

TO: State Survey Agency Directors

FROM: Director
Quality, Safety and Oversight Group (*formerly Survey & Certification Group*)

SUBJECT: Requirement to Reduce *Legionella* Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD)

JOHN DEMPSEY HOSPITAL UCONN HEALTH CAMPUS FARMINGTON, CT



MAIN BUILDING



UNIVERSITY TOWER

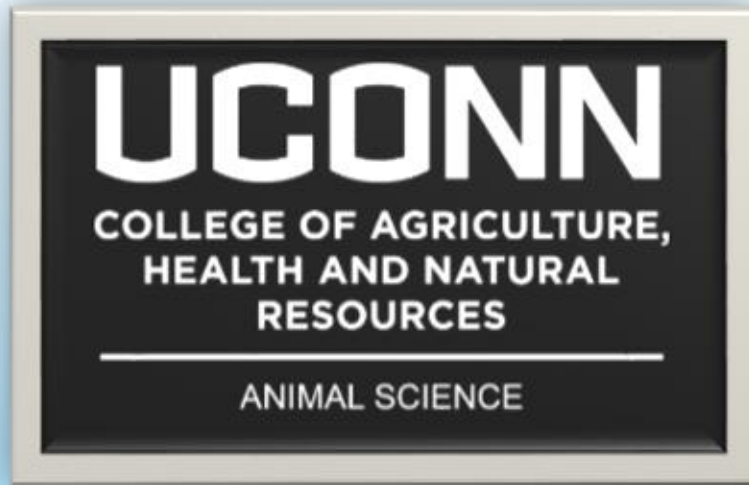


OUTPATIENT PAVILLION



JACKSON LABORATORY





- Animal genetics/genomics
- Breeding
- Biotechnology (genetic engineering & stem cells)
- Animal reproduction
- Embryology
- Growth biology & endocrinology
- Food microbiology & safety
- Dairy technology & safety
- Equine science
- Dairy production & management
- Meat chemistry
- Laboratory animal science
- Diversified livestock





Figure 1 ([UConn Today, 2011])



Figure 2 (Walker, 2023)



Figure 3 (Pennington, 2017)

- **79,000 patient visits a year**

- **186 Dental Units**

2023 Water line Problem 🚰

Water Management / Risk Assessment Process ASHRAE 188 Chapter 5

Table 5.1 BUILDING(S) RISK CHARACTERIZATION
COOLING TOWERS/EVAPORATIVE CONDENSERS

RISK CHARACTERIZATION OF THE BUILDING
Does the building have one or more Cooling Towers and/or Evaporative Condensers that provide cooling and/refrigeration for the HVAC&R system (Y/N)
Does the building have any whirlpools and/or spas in the building or onsite (Y/N)
Does the building have water-based devices that, by design, release aerosols? This includes, but its not limited to certain types of ornamental fountains, misters, atomizers, air washers or humidifiers in the building or onsite (Y/N)

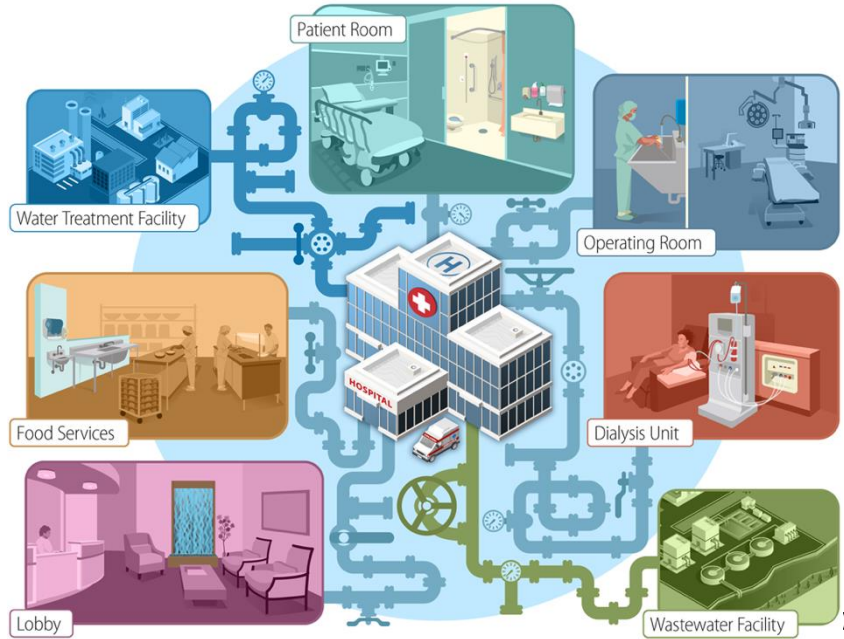
Table 5.2 BUILDING(S) RISK CHARACTERIZATION

RISK CHARACTERIZATION OF THE BUILDING
Includes multiple housing units with 1 or more centralized potable heather water systems (Y/N)
Is more than 10 stories high(include any levels below grade) (Y/N)
The building contains one or more areas for the purpose of housing or treating occupants receiving treatment for burns, chemotherapy for cancer, or solid organ transplantation or bone marrow transplantation (Y/N)
The building contains one or more area for the purpose of housing or treating occupants that are immunocompromised, at-risk, are taking drugs that weekend the immune system, have renal disease, have diabetes or have chronic lung disease (Y/N)
The building is identified by the owner as being for purpose of housing occupants over the age of 65 years (Y/N)

Table 5.3 DETERMINING PREVENTIVE MEASURES REQUIRED FOR EACH BUILDING(

Section 5 Survey Results	Preventive Measures	Code
No to all of Section 5.1 & 5.2	A survey of the building shall be done at least annually	A
Yes to any part of Section 5.1 & no to Section 5.2	A WMP shall be implemented for equipment and devices listed in 5.1	B
No to all of Section 5.1 but Yes to section 5.2	A WMP shall be implemented for building water systems listed in 5.2	C
Yes to section 5.1 & 5.2	A WMP shall be implemented to manage the risk of legionellosis and include a systematic analysis of hazardous condition in the building water systems, determine where control measures ae required, establishing control limits and corrective actions, monitor, document, and confirm program implementation	D

Water Management Plan: Assessing Building Risks



Potential Sources of Contamination

- Cooling towers and evaporative condensers
- Dialysis water and equipment
- Hydrotherapy tanks and pools
- Heating and cooling equipment
- Equipment that is connected to main water systems (such as endoscope reprocessors and dental unit water lines)

Currently Owned and Occupied on or near Farmington Campus

Building/ Area ID	Description	Gross SF	Interior SF	Address	City, ST Zip Code	Owned/ Leased	Condition	Year Built / Acq	Primary Usage	Cooling Towers	Whirlpools	Ornamental Fixtures	Multiple housing with cent hw	> 10 Stories	24/7 Health care	Burn unit, Chemo, Cancer, Organ trans	Weekend Immun	Housing for 64 and older	Action Code
1	MAIN BUILDING	1,773,403	1,557,071	263 FARMINGTON AVE	FARMINGTON, CT 06030	OWNED/OCC													
Area AA	ACADEMIC ADDITION	32,029	14,656				EXCELLENT	2016	EDUCATION	N	N	N	N	N	N	N	N	N	A
Area A	ACADEMIC	168,591	151,129				GOOD	1972	EDUCATION	N	N	N	N	N	N	N	N	N	A
Area B	CENTER FOR COMPARATIVE MEDICINE	54,068	45,923				EXCELLENT	1972	RESEARCH SUPPORT	Y	N	N	N	N	N	N	N	N	B
Area C	CLINIC	335,935	304,034				GOOD	1975	CLINIC	N	N	Y	N	N	N	N	N	N	A
Area F	CANZONETTI	96,391	86,257				GOOD	1993	HOSPITAL	Y	N	N	Y	N	N	N	N	N	D
Area H	CONNECTICUT TOWER	190,093	167,786				FAIR	1975	HOSPITAL	N	N	N	Y	N	Y	N	Y	Y	C
Area L	BLDG L	476,138	414,417				GOOD	1972	RESEARCH	N	N	N	N	N	N	N	N	N	A
Area T	UNIVERSITY TOWER	420,158	372,869				EXCELLENT	2016	HOSPITAL	Y	N	N	Y	Y	Y	Y	Y	Y	D

Action Code	5.1	5.2	Action
A	No Y	No Y	Review if conditions change
B	1+	No Y	Treatment plan for areas of concerns
C	No Y	1+	Treatment and management plan
D	1+	1+	Include in management plan

Buildings with Cooling Towers: 10

ASHE: Risk groups for Legionella in hospital

Low risk:

- Office areas
- Common areas

Medium risk:

- Outpatient care areas
- Outpatient surgery, PACU
- Behavioral Health
- Food & nutrition
- Cardiac Cath Lab
- Radiation Therapy
- Pharmacy
- Laboratories
- Echocardiography
- Endoscopy
- Nuclear Medicine
- PT & RT

High risk:

- Medical inpatient areas
- Surgical inpatient areas
- MICU, SICU, NICU, CCU
- L&D and newborn nurseries
- Pediatrics
- Skilled nursing facilities
- Long term acute care ventilator units

Highest risk:

- Special units caring for immunocompromised patients
- Burn units
- Oncology units
- Transplant units

Risk Assessment



UNIVERSITY TOWER			CONNECTICUT TOWER		
		MECHANICAL	N/A	MECHANICAL	
P	N/A				
7	N/A	Info Tech - Offices	LOW	7: Med/Surg/Pt Obs	
6	High	Oncology / BMT	LOW	6: Out Pat Infussion/ Sleep	
5	MED	ORTHO/SURGE	MED	5: DOC UNIT	
4	MED	MEDICAL SURVIVAL	LOW	4: Out Pat Sickle Cell	
3	MED	MEDICAL SURGICAL DIALYSIS	LOW	3: Out Pt - Neuro	
2	MED	INTERMEDIATE CARE	LOW	2: ON-CALL/OFFICES	
1	HIGH	ICU	LOW	1: PSYCH	
M	LOW	SURGERY SUPPORT/IMAGING/CAFE	LOW	M: RADIOLOGY	
G	HIGH	SURGERY	HIGH	G: NICU/MATERINTY	
B	LOW	EMERGENCY/CS	LOW	B:GI/ENDO/CT	Vacant ORs
LB	N/A	MECHANICAL	N/A	SB: MECH	

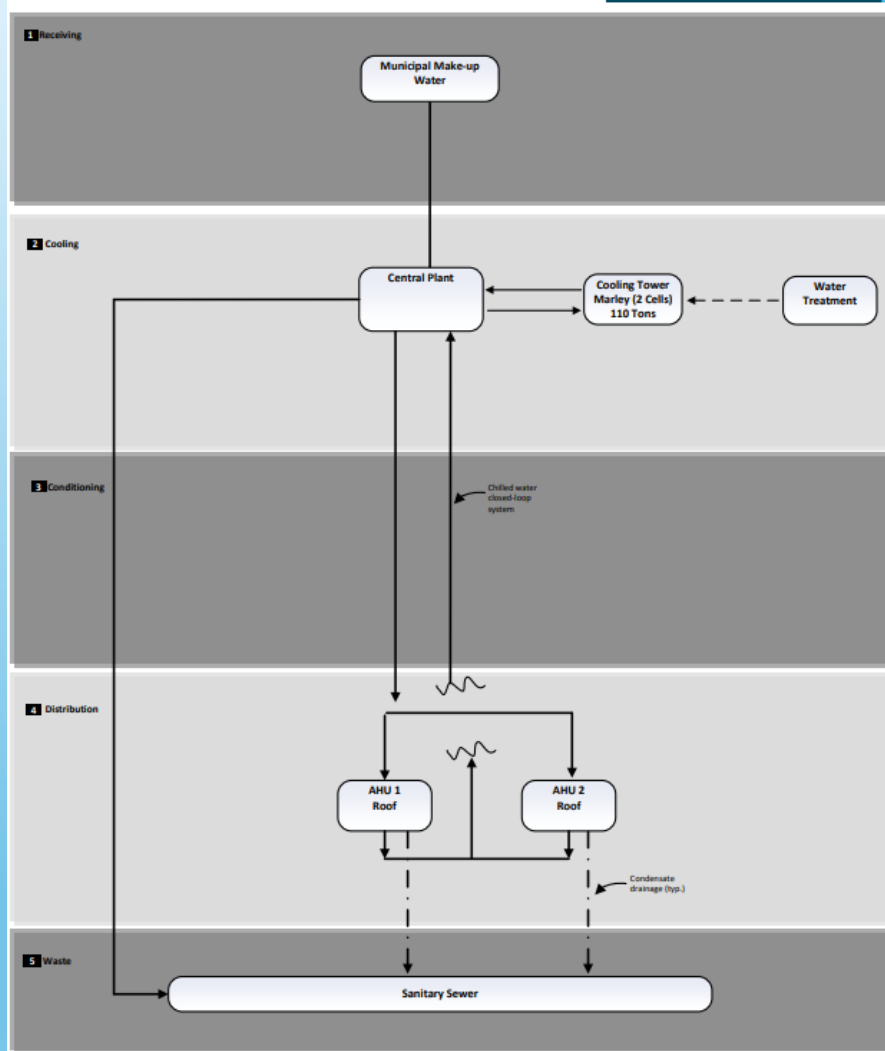
UConn John Dempsey Hospital
 Legionella Risk Assessment
 April 2026

Other Uconn Health Facilities:
 OP – Cancer Center and Radiation
 Oncology = Med/High
 MSI Ors= High
 All other areas reviewed and
 considered Low

Water Management Diagram-University Tower

NON-POTABLE WATER SYSTEM FLOW DIAGRAM

UConn Health T Building- University Tower



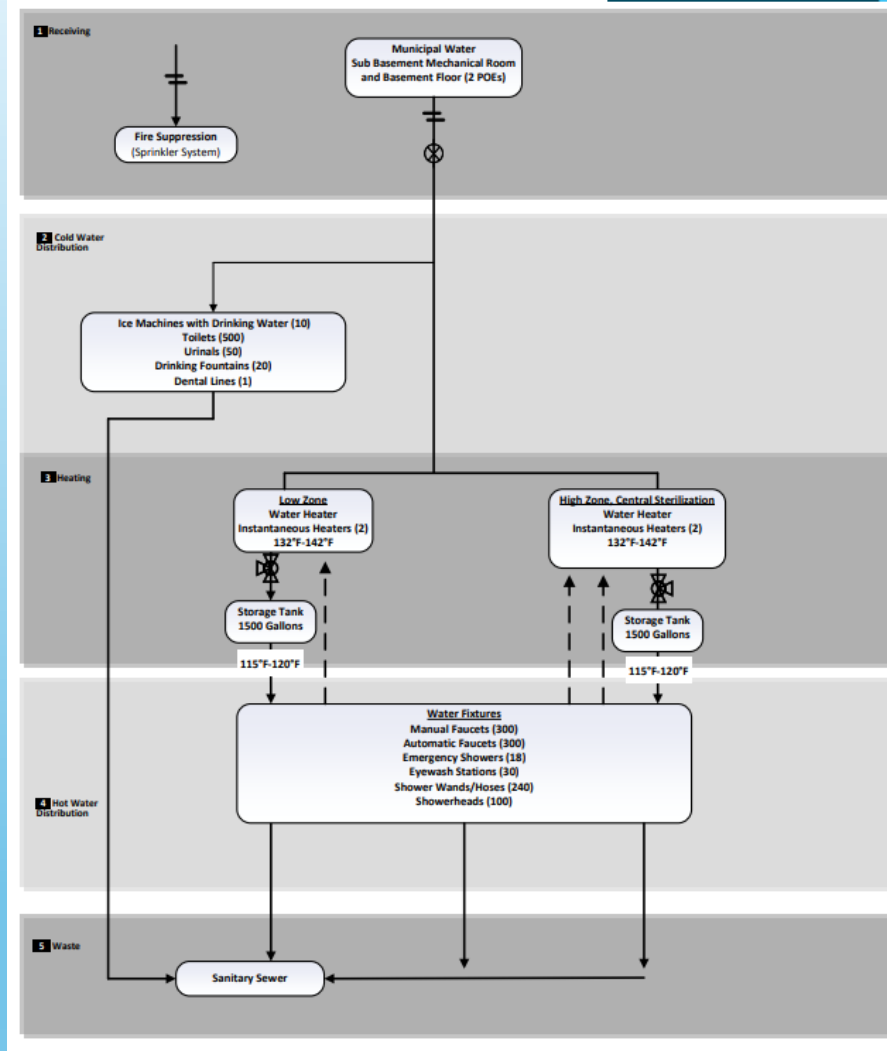
Key: Backflow Preventer, Condensate Drainage, Chilled-Water Closed Loop System

* Blue Asterisk indicates validation Legionella testing location

Non-Potable Water System Flow Diagram

POTABLE WATER SYSTEM FLOW DIAGRAM

UConn Health T Building- University Tower



Key: Backflow Preventer, Water Flow, Recirculating Return Flow, Mixing Valve, Booster Pump

* Blue Asterisk indicates validation Legionella testing location

Potable Water System Flow Diagram

Control Measures-Hot Water

Water temperature is tested monthly in the control towers

Pros:

- Effective at killing Legionella
- Works quickly to kill Legionella
- ASHRAE 188 recommended

Cons

- Scalding is a concern
- Equipment longevity (scale, corrosion)
- Does not penetrate biofilm

How Water Temperature Affects Legionella

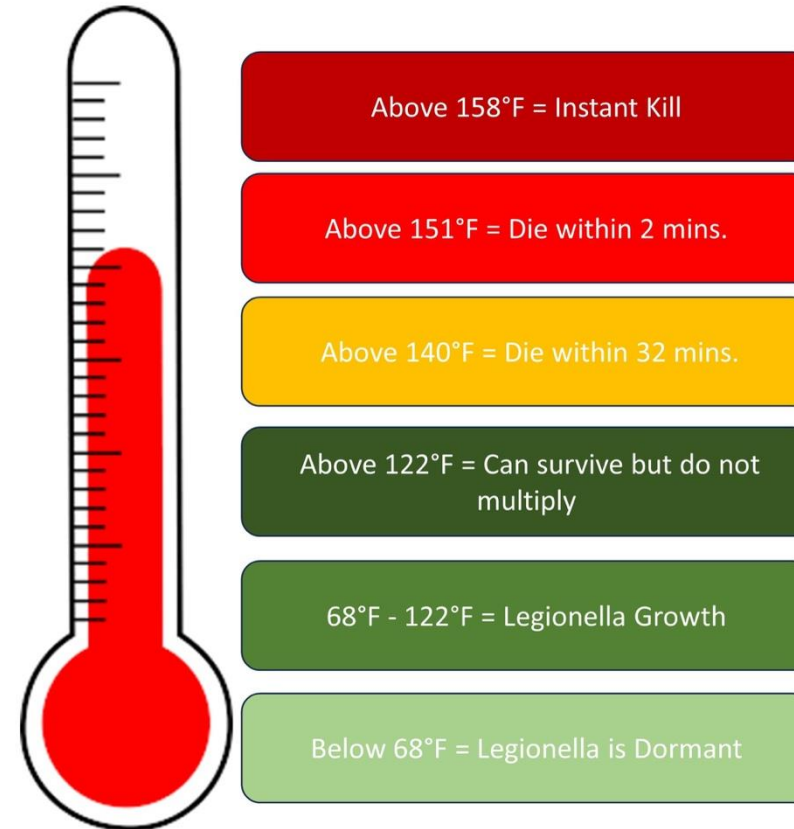


Figure 1: (Legionella in Our Water, 2023)

LEGIONELLA TESTING –performed semi annually (only on BMT unit)

Date/ Time Collected: 02/03/2026 10:45 am – 11:00 am

Collection Site: UCONN HC BMT, 263 Farmington Ave

Sample Temp. at Receipt: 13-16°C

Collected By: Matthew Dalton

Collection Source: Municipal

Treatment: N/A

Chilling Process:

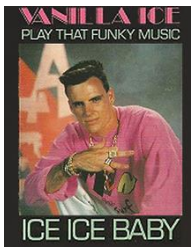
☒ Started ☐ Not Started

Holding Times:

☒ Met ☐ Not Met

ID	Sample Description	<i>Legionella Pneumophila</i>	Date Tested
01	P-Sink 625	Not Detected*	02/04/2026
02	BR-Sink 625	Not Detected*	02/04/2026
03	Shower 625	Not Detected*	02/04/2026
04	P-Sink 626	Not Detected*	02/04/2026
05	BR-Sink 626	Not Detected*	02/04/2026
06	Shower 626	Not Detected*	02/04/2026
07	P-Sink 624	Not Detected*	02/04/2026
08	P-Sink 627	Not Detected*	02/04/2026
09	P-Sink 628	Not Detected*	02/04/2026
10	Main Water Supply	Not Detected*	02/04/2026

CFU = Colony Forming Units



ICE, ICE, ~~BABY~~ DEADLY

Bacteria in UPMC Ice Machine Contributed to Patient Death

Figure 1 (Staff, 2014)

HEALTH NEWS

Legionella bacteria at Syracuse hospital found in two patient sinks, ice machine

Figure 3 (Mudler, 2015)

Ice maker, sinks linked to UW Medical Center Legionnaires' outbreak; 2 dead

Figure 4 (Staff, 2016)



Figure 2 ([Dirty ice machine legionella], n.d.)



Figure 5 (Sinnerton, 2016)

Water Management External Factors:



Changes in municipal water quality



Changes in water pressure



Water main breaks



Construction

Hospital construction & renovation risk to hospitalized patients



Figure 1 (Lin et al., 2011)

- In Ohio, 11 cases of hospital-acquired Legionnaires disease were identified in patients moved to a newly constructed 12-story addition in a hospital, and 1 of those died.
- 407 cases of legionella linked to soil intensive activities resulting in 48 deaths from 2000-2014 according to a recent CDC investigation



Water Problems: WATER MAIN BREAKS

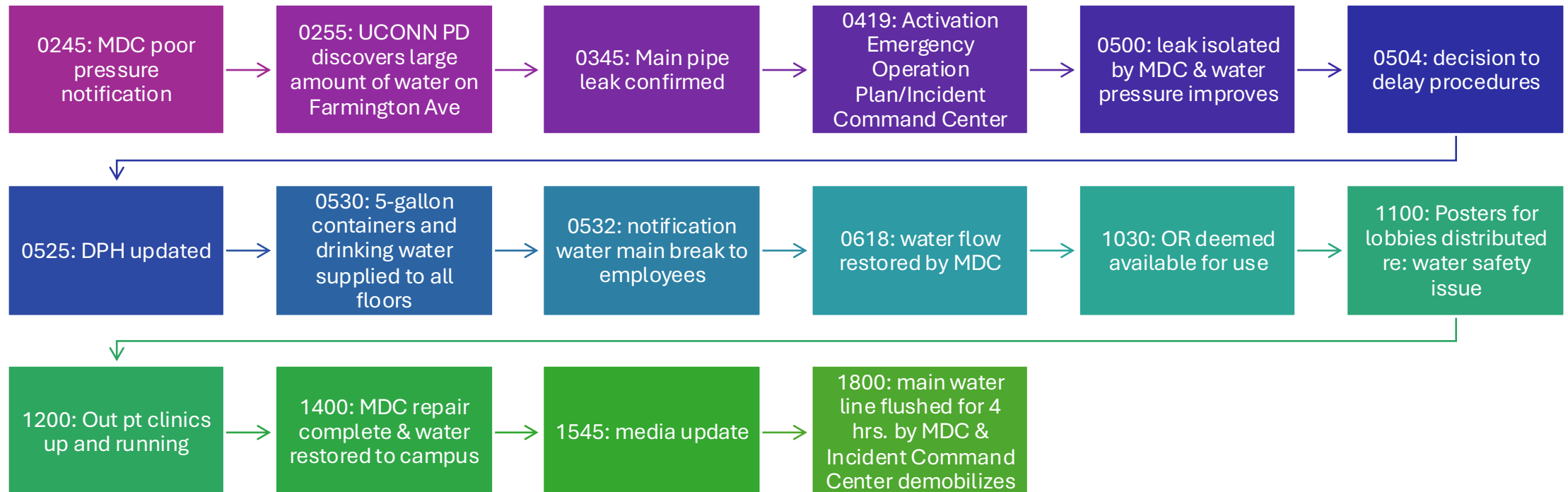
2016 & 2019

Water Problems:

MDC Water pressure: 2019



Figure 1 (Fox Plumbing, 2023)



Water problems: Legionella in BMT unit (prior to the grand opening of the unit)

Legionella Detection - ID, Enumeration, & Serotyping of *L. pneumophila* plus 10 other Legionella species by ISO 11731:2017 Culture Method (EMSL Test Code M343 & Method MICRO-SOP-105)

Client Sample ID/Sample Location Lab Sample Number	Sample Type	Volume Submitted (mL)	Volume Filtered (mL)	Method Processed	Identification	Volume Examined (mL)	Limit of Detection (CFU/mL)	Final Results (CFU/mL)
COLD-SINK 1 - PATIENT ROOM SINK 242304588-0001	Potable	1000	1000	Concentrated	None Detected	20	0.05	ND
COLD-SINK 2 - PATIENT ROOM SINK 242304588-0002	Potable	1000	1000	Concentrated	None Detected	20	0.05	ND
HOT-SINK 1 - PATIENT ROOM SINK 242304588-0003	Potable	1000	1000	Concentrated	<i>Legionella pneumophila</i> (sero 1)	20	0.05	0.10
HOT-SINK 2 - PATIENT ROOM SINK 242304588-0004	Potable	1000	1000	Concentrated	<i>Legionella pneumophila</i> (sero 1)	20	0.05	0.05
BATH-SINK 1 - BATH-SINK 242304588-0005	Potable	1000	1000	Concentrated (Acid)	<i>Legionella pneumophila</i> (sero 1)	2	0.50	7.50
BATH-SINK 2 - BATH-SINK 242304588-0006	Potable	1000	1000	Concentrated (Acid)	<i>Legionella pneumophila</i> (sero 1)	2	0.50	0.50
SHOWER-1 - SHOWER 242304588-0007	Potable	1000	1000	Concentrated (Acid)	<i>Legionella pneumophila</i> (sero 1)	2	0.50	1.00
SHOWER-2 - SHOWER 242304588-0008	Potable	1000	1000	Concentrated (Heat)	<i>Legionella pneumophila</i> (sero 1)	20	0.05	0.15
NURSE-SINK 1 - NURSE STATION 242304588-0009	Potable	1000	1000	Concentrated	None Detected	20	0.05	ND
NURSE-SINK 2 - NURSE STATION 242304588-0010	Potable	1000	1000	Concentrated	<i>Legionella pneumophila</i> (sero 1)	20	0.05	0.05

Figure 1. Routine *Legionella* testing: A multifactorial approach to performance indicator interpretation*^o^Δ

Concentration indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
≥10 CFU/mL [†] in potable water	1.0–9.9 CFU/mL in potable water	Detectable to 0.9 CFU/mL in potable water	No <i>Legionella</i> detected in a single round of testing	No <i>Legionella</i> detected in multiple rounds of testing	No <i>Legionella</i> detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any <i>Legionella</i> species
OR ≥100 CFU/mL in cooling towers	OR 10–99 CFU/mL in cooling towers	OR Detectable to 9 CFU/mL in cooling towers			

Change in concentration over time indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
100-fold or greater increase in concentration (e.g., 0.05 to 5 CFU/mL)	10-fold increase in concentration (e.g., 0.05 to 0.5 CFU/mL)	<i>Legionella</i> concentration steady (e.g., 0.5 CFU/mL for two consecutive sampling rounds)	No <i>Legionella</i> detected in a single round of testing	No <i>Legionella</i> detected in multiple rounds of testing	No <i>Legionella</i> detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any <i>Legionella</i> species

Extent indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
Detection in multiple locations AND a common source location [‡]	Detection in a common source location that serves multiple areas	Detection in a few of many tested locations within a water system	No <i>Legionella</i> detected in a single round of testing	No <i>Legionella</i> detected in multiple rounds of testing	No <i>Legionella</i> detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any <i>Legionella</i> species
OR Detection across many locations within a water system	OR Detection in more than one location within a water system				

Type[¥] of *Legionella* (species and serogroup) associated with Legionnaires' disease:

Highly Associated	Less Associated
<i>L. pneumophila</i> serogroup 1; Non-Lp1 <i>L. pneumophila</i> ; Presence of multiple different <i>Legionella</i> species or serogroups	Any non- <i>pneumophila</i> <i>Legionella</i> species including "blue-white" fluorescent <i>Legionella</i>

* This figure is intended for use during routine testing of potable water and cooling towers only. Due to their ability to rapidly grow and spread *Legionella*, any detection of viable *Legionella* in a hot tub or decorative fountain should prompt a response, including a review of the water management program and corrective actions. Test results are performance indicators and are not a measure of risk of human illness. This figure is not intended for use if a building or device is associated with Legionnaires' disease (LD) cases or an outbreak.

^o See "Routine testing for *Legionella*" for guidance regarding suggested response activities. Comparable results may lead to different suggested response activities when other factors are considered (e.g., if there is evidence of poorly controlled growth at a healthcare facility).

^Δ Considering the type of *Legionella* identified along with other *Legionella* testing performance indicators provides a clearer picture of water system control than the results of any single indicator. For example, facility owners and operators may consider implementing immediate interventions for a healthcare facility with: A. detectable but <10 colony-forming units per milliliter (CFU/mL), B. non-Lp1 *Legionella pneumophila*, C. observed at steady concentrations, but D. detected at multiple distal locations including a central water heater.

[†] Concentrations expressed as CFU/mL are for test results generated by traditional spread plate culture methods. If other test methods are used, consult testing lab or manufacturer instructions for appropriate interpretation.

[‡] Common source location examples include water heaters, hot water returns, storage tanks, and cooling tower basins.

[¥] If a facility has a history of associated LD cases, then sequencing isolates obtained during routine testing may provide performance indicators regarding outbreak strain persistence (if that strain is detected).



321985-G

Infection Preventionist Role

- Basic knowledge of the components of water systems
- Identify sources and modes of transmission of water borne illness
- Help develop and monitor water management plans to align with industry standards
- Invite facilities to IPC Committee to discuss water management program
- Become a member of Water Management team
- Monitor ICRA (infection control risk assessment)-
- Reporting cases to DPH cases
- Provide education and training to staff on proper water management practices to reduce the risk.



Case Definition & Reporting

- The CT DPH uses the national surveillance case definition to determine case status.
- Is reportable to the CT DPH & is a nationally notifiable disease.



Figure 1: (DPH, n.d)

CDC's role

CDC monitors Legionellosis cases using two surveillance systems at the national level:

- National Notifiable Disease Surveillance System (NNDSS)
- Supplemental Legionnaires' Disease Surveillance System (SLDSS)

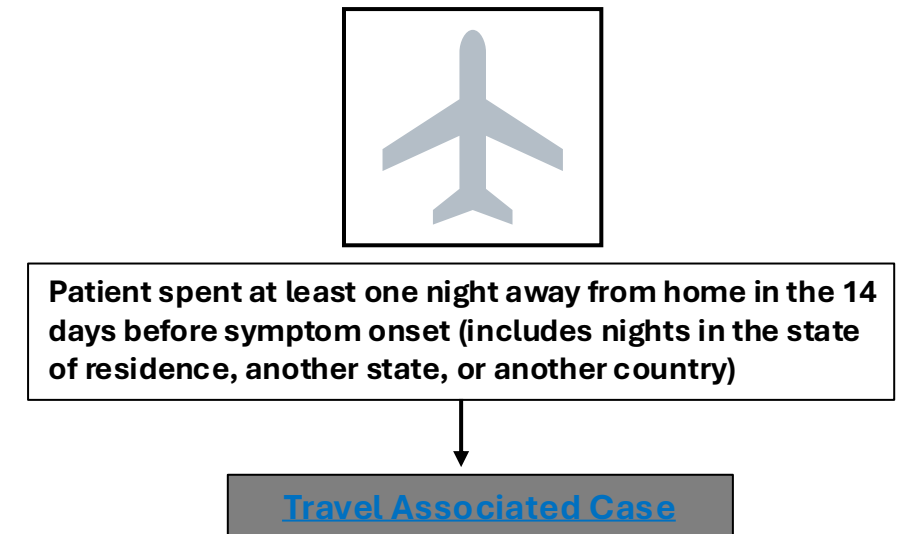
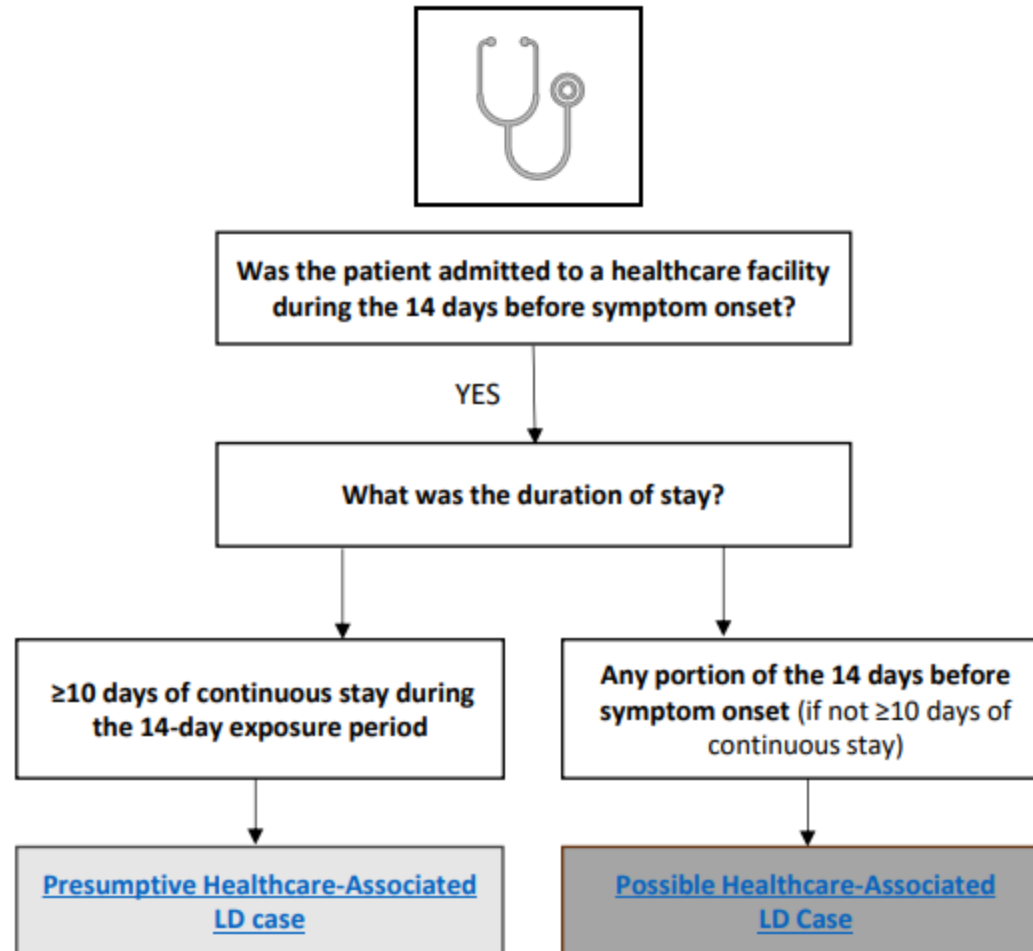


Figure 1 (CDC, n.d)



Figure 2 ([Epidemiology . Health danger risk spread laboratory], 2019)

Exposure Categories Definitions





Outbreaks of Legionnaires' disease can be difficult to detect

Figure 1 (Smith, 2024)



INVESTIGATION

Criteria for a full investigation

- 1 or more cases of presumptive health-care associated legionnaire's disease at any time at the same healthcare facility
- 2 or more cases of possible healthcare-associated Legionnaire's disease within 12 months of each other at the same healthcare facility.
- When a statically significant increase in Legionnaires has been found in a defined geographic area compared against a historical background for the same geographic area

Investigations are Important for Linking Cases and Identifying Likely Sources

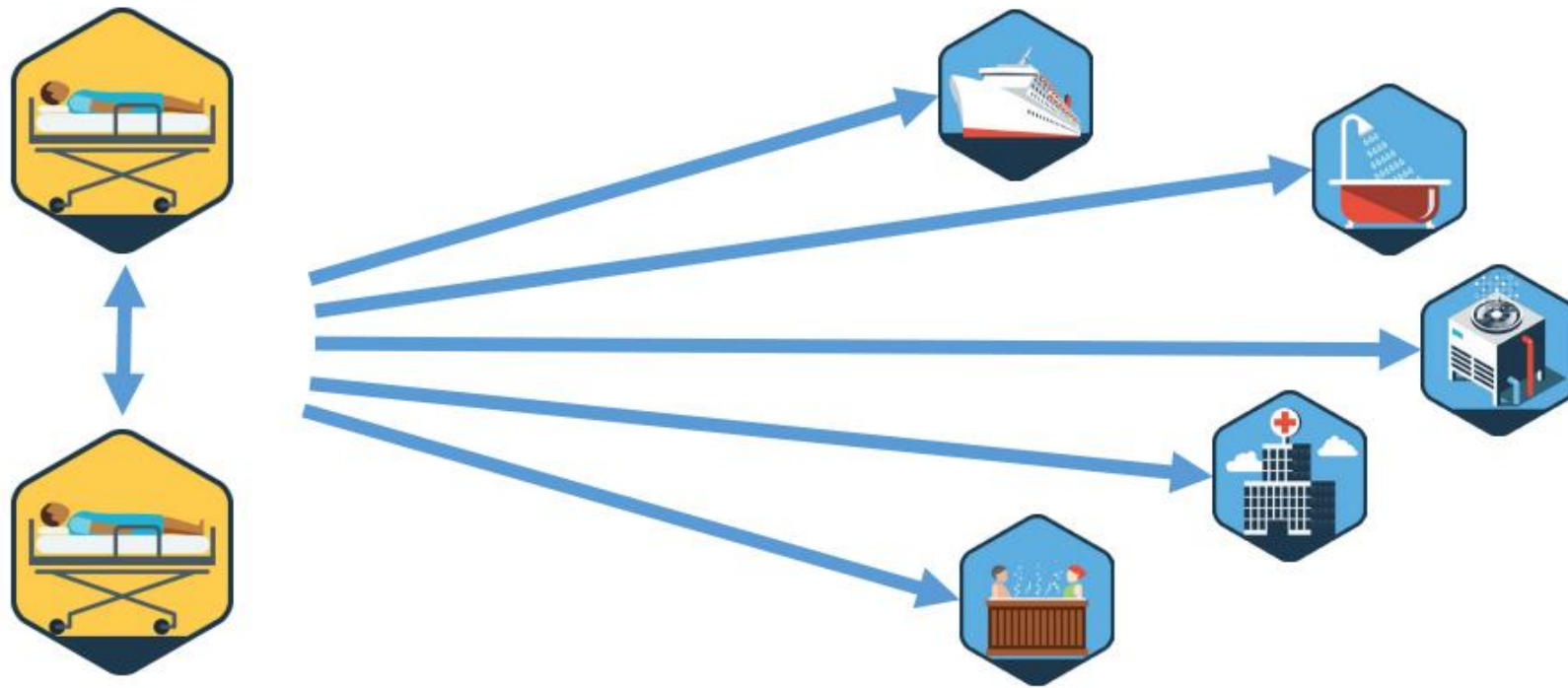




Figure 1 ([Adorable scared baby in a white onsie in a cozy living room], 2024)

HOSPITAL OUTBREAK..

When risk becomes
reality

Initial steps



Confirm diagnosis & contact the local health department



Interview case-patient to determine the exposure



Environmental assessments: changes in water quality and water sampling



Implement water restrictions: no using ice machines,
no showering, no tap water-use bottled water

DPH-Enhanced surveillance plan



Instruct clinicians at the facility to evaluate patients with respiratory symptoms for pneumonia.



Order chest X-rays to confirm pneumonia.



Coordinate appropriate testing



Create and maintain line list for patients with any respiratory illness and results of any relevant testing (i.e., testing for other pathogens that may cause respiratory illness).



Maintain surveillance for at least 6 months from the time of last facility-associated case.

Implement Controls to Prevent Additional Exposure

Controlling	Controlling exposure to Legionella during an outbreak might not require facility shutdown. Temporary provisions to isolate the affected water system can allow work to continue, and may include:
Supplying	Supplying bottled water for drinking instead of drinking from the domestic cold-water system.
Shutting	Shutting down water heaters to eliminate access to hot water in the domestic system.
Using	Using temporary cooling towers.
Utilizing	Utilizing portable heaters, air conditioners, and fans instead of the contaminated HVAC system

Water Treatment for Legionella

- Chlorine as a disinfectant
- Monochloramine
- Chlorine Dioxide
- Copper-Silver Ionization
- Ozone
- Ultraviolet Light Disinfection

Treatment will alter water quality

- >lead, copper, nitrate, nitrites, chlorite (to name a few)
- Corrosion to medical devices & equipment

When is an Outbreak Investigation Over

No new cases
following
implementation of
long-term legionella
control strategies

No detection of
legionella during
post-remediation
environmental
monitoring



Figure 1 ([Magic book], n.d.)

Although the medical case
had been solved,
Legionnaires' disease has
not been confined to the
history books

BURDEN



Figure 1 (Baker-Goering, et. al, 2021)

The CDC estimates that the U.S. economic burden from Legionnaires' disease is likely more than US\$1 billion per year.



Figure 2 ([Dollar sign], n.d.)



Figure32 ([Danger], n.d.)

Legionnaires' disease is on the rise

A line graph with a green line showing an upward trend. The x-axis represents years with labels for 2000, 2005, 2010, 2015, and 2018. The y-axis is not explicitly labeled but represents the rate of disease. The line starts at a low point in 2000 and rises steadily, with a slight dip around 2010, before reaching its peak in 2018. A large green arrow points upwards from the 2018 data point, emphasizing the increase. Text next to the 2018 point states 'Rates increased 9-fold since 2000'.

Year	Rate (relative to 2000)
2000	1.0
2005	~1.5
2010	~1.2
2015	~3.0
2018	9.0

Rates increased 9-fold since 2000

Quick Stats - Current Filters	
Outbreaks	Illnesses
98	375
Hospitalizations	Deaths
281	34

Source: CDC

Legionnaires' disease in the United States, 2000-2022

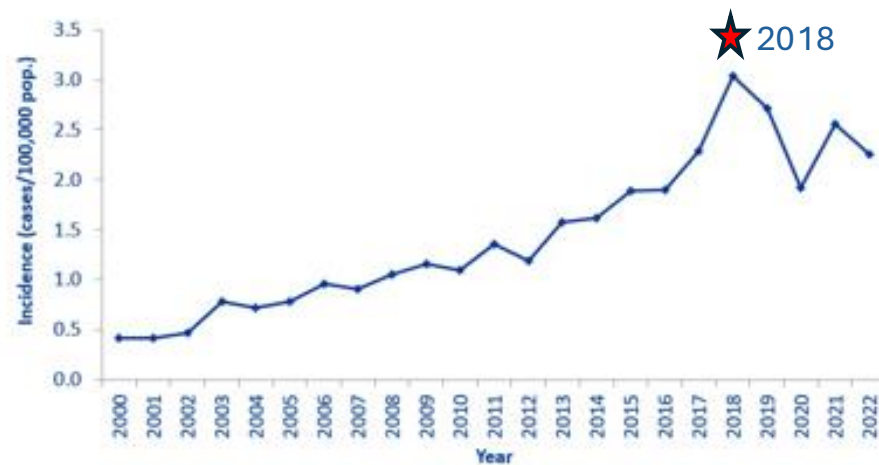
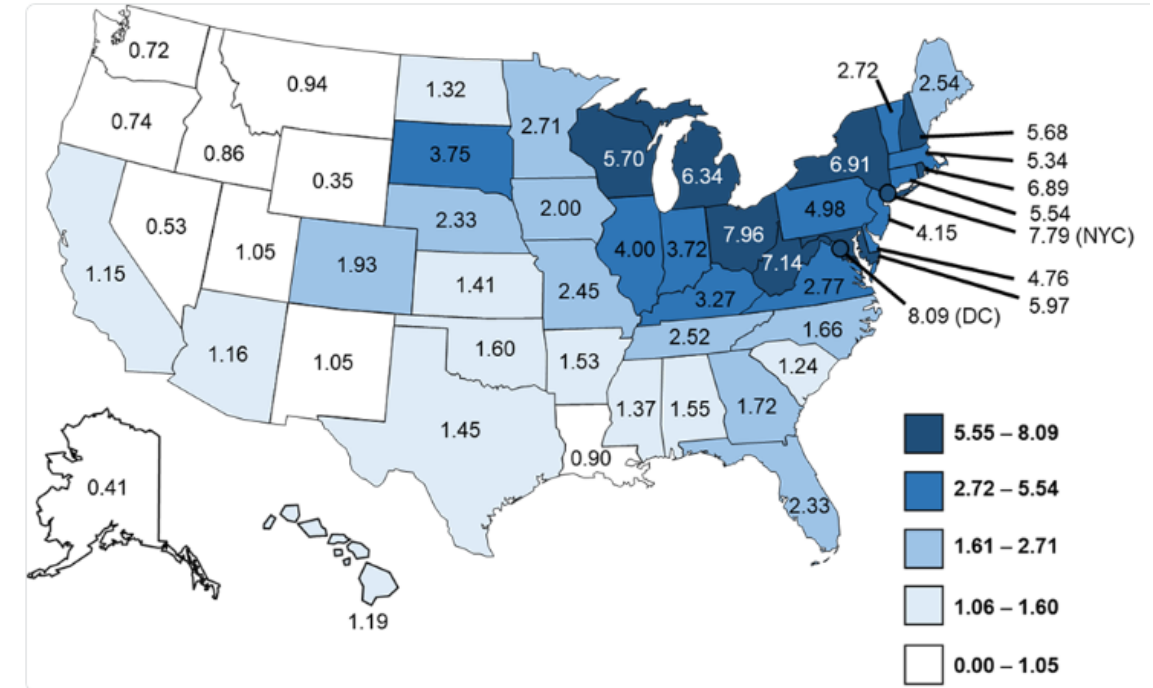


Figure 3a. Crude incidence^a rates of reported confirmed cases of Legionnaires' disease^b by jurisdiction of residence^c—NNDSS,^d United States, 2018.^{e,f}



^aCrude incidence of cases per 100,000 population (number of confirmed Legionnaires' disease cases reported that year divided by postcensal resident jurisdiction population estimate for that year times 100,000 population).

Figure 6a. Number of reported confirmed cases and deaths of Legionnaires' disease by exposure category^a—SLDSS,^b complete reporting jurisdictions,^c 2018.^d

	Cases		Deaths	
	N	%	N	CFR ^e
Exposure category	(Total = 8,764)		(Total= 719)	
Any Healthcare	1,584	18.1	156	9.8
Definite Healthcare	204	2.3	53	26.0
Possible Healthcare	1,380	15.7	103	7.5
Any Travel	1,279	14.6	35	2.7
Any Assisted or senior living	326	3.7	30	9.2
None of these	5,886	67.2	342	5.8

Figure 1 (CDC, 2025)

Seasonal pattern of Legionella in 2018 in USA

Figure 2. Number of reported confirmed cases of Legionnaires' disease^a by month^b and year^c—NNDSS,^d United States, 2018 and 2019.

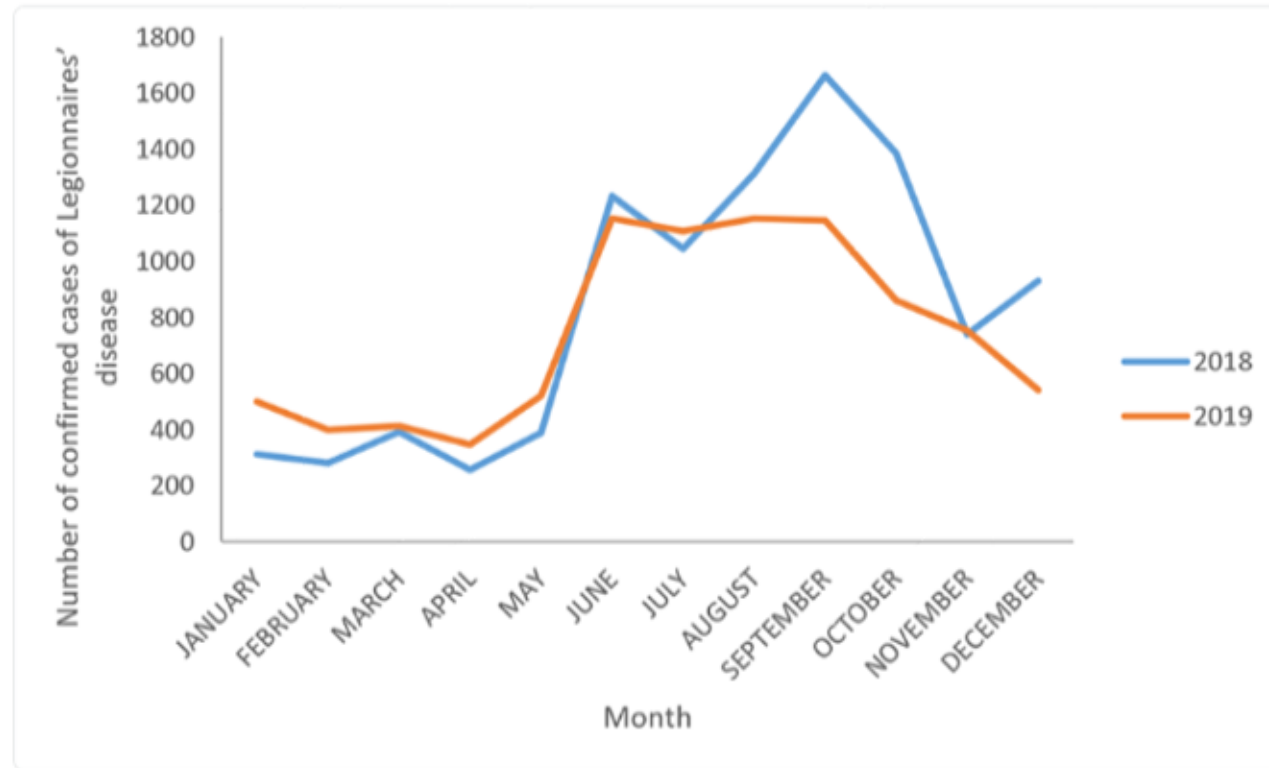


Figure 1 (CDC, 2025.)



Figure 2 ([Cold drink on high temperature], n.d.)

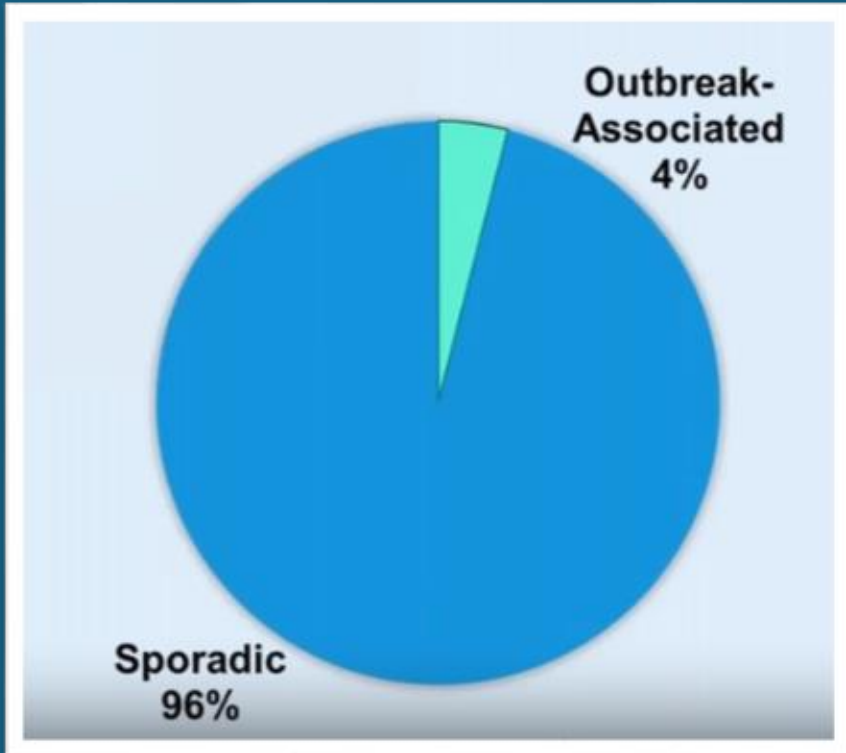


Figure 1 Moffa et al., 2023)

Most legionella cases are sporadic

► Epidemiol Infect. 2023 Jul 28;151:e133. doi: [10.1017/S0950268823001206](https://doi.org/10.1017/S0950268823001206)

Legionellosis on the rise: A scoping review of sporadic, community-acquired incidence in the United States

[Michelle A Moffa](#)¹, [Clare Rock](#)^{2,3}, [Panagis Galiatsatos](#)^{4,5}, [Shantini D Gamage](#)^{6,7}, [Kellogg J Schwab](#)⁸, [Natalie G Exum](#)⁸,✉

Legionella in CT 1980-1997

(prior to the surveillance era)

Nosocomial Legionnaires Disease Associated with Exposure to Respiratory Therapy Equipment, Connecticut

ELLEN JONES, PATRICIA CHECKO, ANECIA DALTON, JOHN COPE, JAMES BARBAREE,
GEORGE KLEIN, WILLIAM MARTIN, AND CLAIRE BROOME

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Connecticut 06010*

Numerous investigators have suggested a role for potable water in outbreaks of nosocomial Legionnaires disease (LD) (1, 2, 3). An investigation of an outbreak of nosocomial LD has allowed us to extend previous observations concerning the role of contaminated potable water among immunosuppressed patients receiving respiratory therapy.

Between December 1980 and December 1982, 36 cases of nosocomial LD occurred in a 400-bed Connecticut hospital. However, only 18 of these patients had been hospitalized continuously during the 10 days before onset of illness, so only

correlated and it was difficult to evaluate them as independent variables. Further analysis of the relationship between steroids and antacids, nebulizers and steroids, and antacids and nebulizers also was limited by the small number of cases. However, examining the data in an unmatched fashion was useful in examining trends among variables.

Among those receiving steroids, antacid use increased the risk of illness (88 versus 17%) (Table 1). However, among those not being treated with steroids, antacid therapy did not appear to have an effect (20 versus 17%).

Figure 1(CDC, 1982)

1994: 12 years later-outbreak at the same hospital

Vol. 19 No. 12

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY

905

A RECURRENT OUTBREAK OF NOSOCOMIAL LEGIONNAIRES' DISEASE DETECTED BY URINARY ANTIGEN TESTING: EVIDENCE FOR LONG-TERM COLONIZATION OF A HOSPITAL PLUMBING SYSTEM

Lisa A. Lepine, MD; Daniel B. Jernigan, MD, MPH; Jay C. Butler, MD; Janet M. Pruckler, BA; Robert F. Benson, MS; Grace Kim, MD; James L. Hadler, MD; Matthew L. Cartter, MD; Barry S. Fields, PhD

ABSTRACT

BACKGROUND: In 1994, a hospital reported an increase in nosocomial legionnaires' disease after implementing use of a rapid urinary antigen test for *Legionella pneumophila* serogroup 1 (Lp-1). This hospital was the site of a previous nosocomial legionnaires' disease outbreak during 1980 to 1982.

METHODS: Infection control records were reviewed to compare rates of nosocomial pneumonia and the proportion of cases attributable to legionnaires' disease during the 1994 outbreak period with those during the same period in 1993. Water samples were collected for *Legionella* culture from the hospital's potable water system and cooling towers, and isolates were sub-

P=.56); however, 3.2% of nosocomial pneumonias were diagnosed as legionnaires' disease in 1993, compared with 23.9% in 1994 (RR, 9.4; *P*<.001). In 1994, most legionnaires' disease cases were detected by the urinary antigen testing alone. MAb testing and AP-PCR demonstrated identical patterns among Lp-1 isolates recovered from a patient's respiratory secretions, the hospital potable water system, and stored potable water isolates from the 1980 to 1982 outbreak.

CONCLUSIONS: There may have been persistent transmission of nosocomial legionnaires' disease at this hospital that went undiscovered for many years because there was no active

Nosocomial Legionnaires' Disease Outbreaks Acute Care Hospitals, CT, 1980 - 1995

Hospital	Year(s)	Number of Cases		Serogroups	Source
		Confirmed	Probable		
A	1980-1982	19	18	1,4,5	Water
B	1986	2	2	1	Water
A	1994	7	13	1	Water
C	1995	4	1	3	Water

1997 and beyond...Legionellosis surveillance in CT

- added to list of physician & laboratory reportable diseases to CT DPH & the local health department



Figure 1 (Furian, 2020)

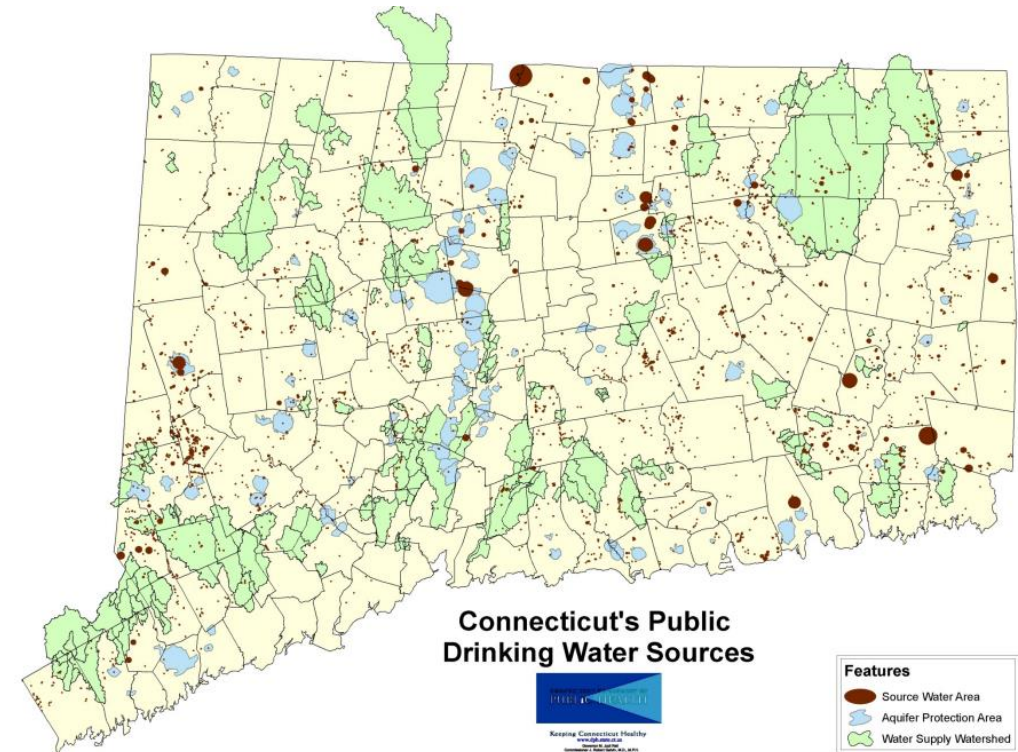


Figure 2 (DPH, 2015)

THE UNCOMFORTABLE TRUTH: Legionella is becoming more common

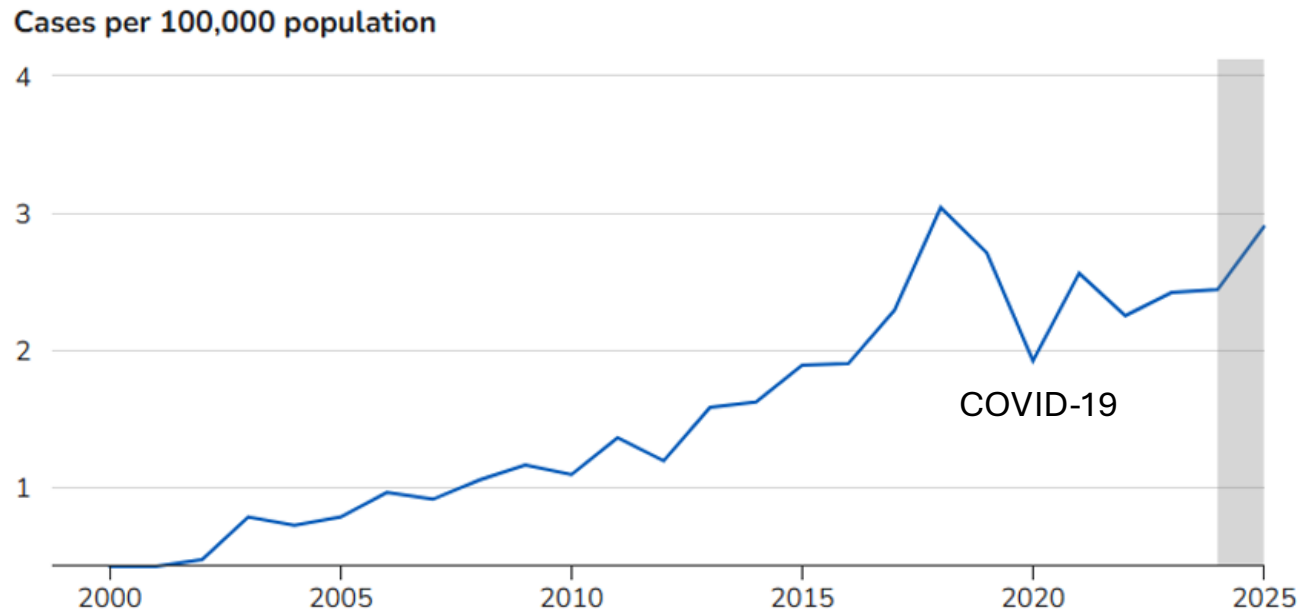


Figure 1: (CDC, 2025)

- Warmer temperatures/climate change
- Outdated plumbing
- More extreme weather condition (increased rainfall)
- Human error & negligence in maintaining water systems
- Aging population
- Budget constraints

WORLDWIDE ISSUE



Figure 1 ([Worldwide], n.d)

Legionnaires' disease cluster in Savoie, France: 43 cases and two deaths reported; source under investigation

FRI 14 AUG 2026

Legionnaires' disease cluster reported in Toronto, Ontario, Canada, with six confirmed cases; source investigation ongoing

TUE 18 AUG 2026

Legionnaires' disease cluster reported in Linz, Upper Austria, with 31 cases and three deaths; source investigation ongoing

THU 27 AUG 2026

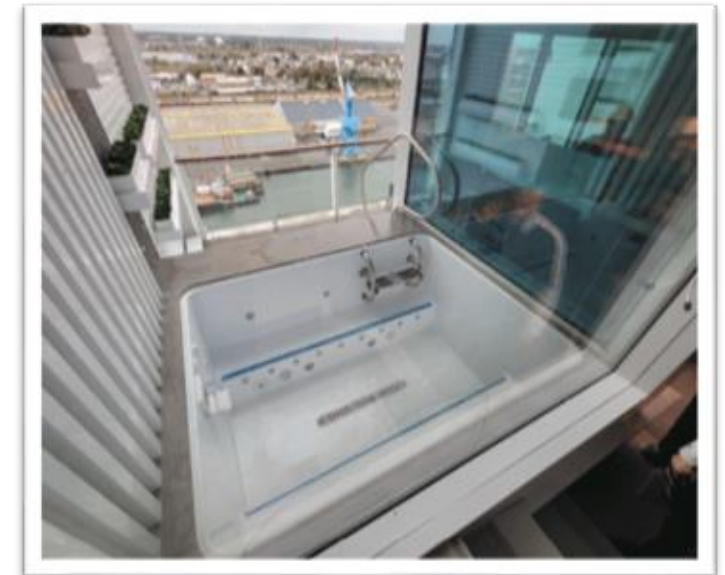
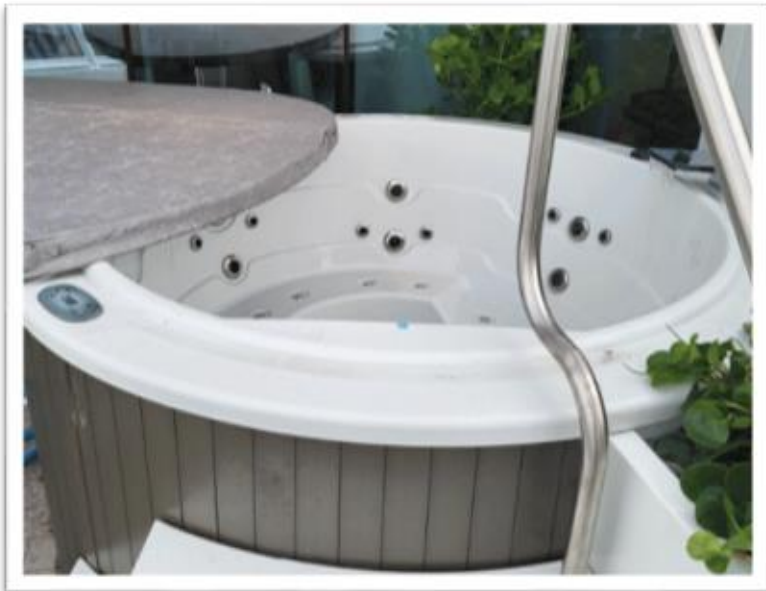


Two Outbreaks of Legionnaires Disease Associated with Outdoor Hot Tubs for Private Use — Two Cruise Ships, November 2022–July 2024

Weekly / October 24, 2024 / 73(42);950–954

[Print](#)

Sooji Lee, MSPH¹; Chris Edens, PhD¹; Troy Ritter, PhD²; Luis O. Rodriguez, MS²; Kara Tardivel, MD³; Natalia A. Kozak-Muiznieks, PhD¹; Melisa Willby, PhD¹; Nancy Ortiz, PhD³; Adam L. Cohen, MD¹; Jessica C. Smith, MPH¹ ([VIEW AUTHOR AFFILIATIONS](#))



Recent USA
Legionella
Outbreaks

California: Kaiser Permanente Santa Clara Medical Center Outbreak

- 18 cases of *Legionella* infection between 06 and 09 May 2026
- No fatalities
- The source of exposure had not been identified
- The water was treated

Ohio: Country Lanes Gardens Long Term Care Facility Outbreak

- 8 cases, 1st case July 29
- 8 hospitalizations, no fatalities
- The source of exposure had not been identified
- Installed water filters and restricted water use

NYC OUTBREAK SUMMER 2026

Preliminary PCR-positive cooling-tower addresses identified by NYC - not confirmed outbreak sources.



- 11 deaths
- 79 hospitalizations
- 82 cooling towers at 80 buildings tested positive for legionella
- 94 cases
- 110 violations

Upper East Side outbreak case count rose rapidly

Cumulative confirmed cases reported in official public updates, July 2–29, 2026.



Legionella cases reported to DPH from UConn

Overview

[View Legionellosis configuration](#)

8 Last 30 Days

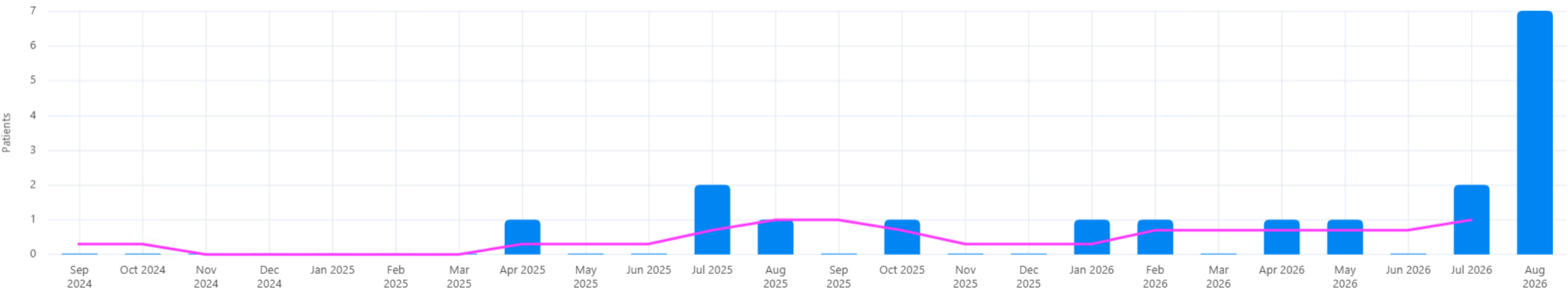
+1500% Above Average

Postal Codes

Postal Code	City	Last 30 Days	Sep 2024 through Jul 2026
06053	NEW BRITAIN	3	
06013	BURLINGTON	1	
06070	SIMSBURY	1	
06092	WEST SIMSBURY	1	
06107	WEST HARTFORD	1	
06109	WETHERSFIELD	1	

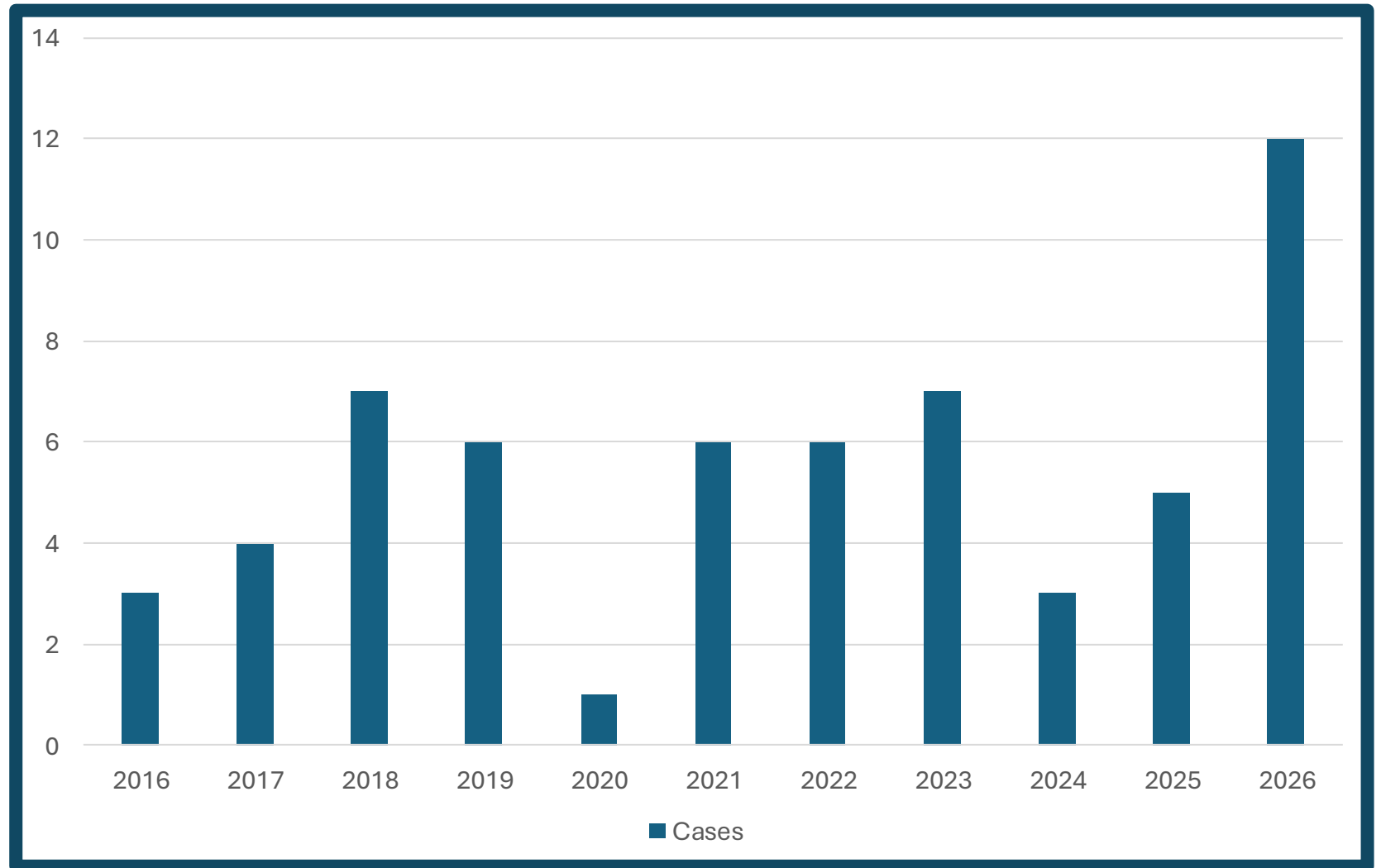
Trends

Display Mode **Rolling Average** Control Chart



***all cases were outside of UConn exposure**

UCONN
Legionella
cases reported
CT DHP
2016-2026



Legionellosis (Week 34) Weekly cases* of notifiable diseases, United States, U.S. Territories, and Non-U.S. Residents week ending August 29, 2026

Nationally Notifiable Infectious Diseases and Conditions, United States: Weekly Tables

Weekly cases* of notifiable diseases, United States, U.S. Territories, and Non-U.S. Residents week ending August 29, 2026
(Week 34)

Reporting Area	Legionellosis			
	Current week	Previous 52 weeks Max †	Cum YTD 2026 †	Cum YTD 2025 †
U.S. Residents, excluding U.S. Territories	116	340	5,341	6,335
New England	-	31	272	287
Connecticut	-	13	143	100
Maine	-	3	18	6
Massachusetts	-	13	94	123
New Hampshire	-	4	11	25
Rhode Island	-	6	5	16
Vermont	-	2	1	17
Middle Atlantic	19	150	960	1,301
New Jersey	-	14	23	190
New York (excluding New York City)	13	35	323	316
New York City	2	93	414	483
Pennsylvania	4	22	200	312

Figure 1: (CDC, 2025)

It continues to silently kill claiming victims and leaving death in its wake

A cartoon in the Observer newspaper on Sunday 11 August 1985, page 19, about Legionnaires' disease after a 1985 hospital outbreak in Britain



Figure 1 (MacFarlane, et. Al, 1977)

A person's hands are holding a small, square wooden-framed chalkboard against a solid blue background. The chalkboard has a black surface with the words "ANY" and "questions?" written in white chalk. "ANY" is in all caps and a larger font, while "questions?" is in a smaller font and lowercase. The chalk has a slightly grainy texture.

ANY
questions?

Figure 1(Leibowitz, 2026)

References

- Baker-Goering, M., Roy, K., Edens, C., & Collier, S. (2021). Economic Burden of Legionnaires' Disease, United States, 2014. *Emerging Infectious Diseases*, 27(1), 255-257. <https://doi.org/10.3201/eid2701.191198>
- Bouscher, D. (2023 August 7). *CDC scientist peeved by holiday party chatter named Legionnaires' disease in 1976* [Video] . The Mercury News. <https://www.mercurynews.com/2023/08/07/video-cdc-scientist-peeved-by-holiday-party-chatter-named-legionnaires-disease-in-1976>
- Cassell, K., Gacek, P., Warren, J. L., Raymond, P. A., Cartter, M., & Weinberger, D. M. (2018). Association Between Sporadic Legionellosis and River Systems in Connecticut. *The Journal of Infectious Diseases*, 217(2), 179–187. <https://www.jstor.org/stable/26493856>
- Cassell, K., Gacek, P., Rabatsky-Ehr, T., Petit, S., Cartter, M., & Weinberger, D. M. (2019). Estimating the True Burden of Legionnaires' Disease. *American journal of epidemiology*, 188(9), 1686–1694. <https://doi.org/10.1093/aje/kwz142> Center for Disease Control and Prevention. (2023, March 23). *Legionnaire's Disease*. <https://www.cdc.gov/museum/online/story-of-cdc/legionnaires/index.html>
- Center for Disease Control and Prevention. (2025 Jan 3). *Legionella Control Toolkit*. <https://www.cdc.gov/control-legionella/php/toolkit/figure-1-legionella-control-toolkit.html>
- Center for Disease Control and Prevention. (2025, June 9). *Surveillance Report 2018-2019*. <https://www.cdc.gov/legionella/php/surveillance/surveillance-report-2018-2019.html#figure-2>
- Center for Disease Control and Prevention. (2025, May 29). *Estimate of Waterborne Disease Burden in the United States/ Waterborne Disease and Outbreak Surveillance Reporting*. <https://www.cdc.gov/healthy-water-data/waterborne-disease-in-us/results.html>
- Center for Disease Control and Prevention. (2025, Dec 1). *Legionellosis Surveillance and Trends*. <https://www.cdc.gov/legionella/php/surveillance/index.htm>
- Clopper, B. R., Kunz, J. M., Salandy, S. W., Smith, J. C., Hubbard, B. C., & Sarisky, J. P. (2021). A Methodology for Classifying Root Causes of Outbreaks of Legionnaires' Disease: Deficiencies in Environmental Control and Water Management. *Microorganisms*, 9(1), 89. <https://doi.org/10.3390/microorganisms9010089>
- *Display from The Philly Killer special exhibition*. Personal photograph taken by Lisa at the Mütter Museum, Philadelphia, PA, 2026
- Garcia-Vidal, C., Labori, M., Viasus, D., Simonetti, A., Garcia-Somoza, D., Dorca, J., Gudíol, F., & Carratalà, J. (2013). Rainfall is a risk factor for sporadic cases of Legionella pneumophila pneumonia. *PloS one*, 8(4), e61036. <https://doi.org/10.1371/journal.pone.0061036>

- Garrison, L. E., Kunz, J. M., Cooley, L. A., Moore, M. R., Lucas, C., Schrag, S., Sarisky, J., & Whitney, C. G. (2016). Vital Signs: Deficiencies in Environmental Control Identified in Outbreaks of Legionnaires' Disease - North America, 2000-2014. *MMWR. Morbidity and mortality weekly report*, 65(22), 576–584. <https://doi.org/10.15585/mmwr.mm6522e1>
- Glick, T. H., Gregg, M. B., Berman, B., Mallison, G., Rhodes, W. W., Jr, & Kassanoff, I. (1978). Pontiac fever. An epidemic of unknown etiology in a health department: I. Clinical and epidemiologic aspects. *American journal of epidemiology*, 107(2), 149–160. <https://doi.org/10.1093/oxfordjournals.aje.a112517>
- Goldhaber, Susan. (2024, Aug 13). Legionnaire's Disease: A Clear and Present Danger. American Council on Science and Health. <https://www.acsh.org/news/2024/08/13/legionnaires-disease-clear-and-present-danger-48924>
- Fisman, D. N., Lim, S., Wellenius, G. A., Johnson, C., Britz, P., Gaskins, M., Maher, J., Mittleman, M. A., Spain, C. V., Haas, C. N., & Newbern, C. (2005). It's not the heat, it's the humidity: wet weather increases legionellosis risk in the greater Philadelphia metropolitan area. *The Journal of infectious diseases*, 192(12), 2066–2073. <https://doi.org/10.1086/498248>
- Danford, Matt (2025, May 12). Ice machines spread Legionella in hospital oncology unit, prompting testing overhaul. Healio. <https://www.healio.com/news/infectious-disease/20250430/legionella-in-medical-facilities-can-spread-through-ice-study-shows>
- Hicks, L. A., Rose, C. E., Jr, Fields, B. S., Drees, M. L., Engel, J. P., Jenkins, P. R., Rouse, B. S., Blythe, D., Khalifah, A. P., Feikin, D. R., & Whitney, C. G. (2007). Increased rainfall is associated with increased risk for legionellosis. *Epidemiology and infection*, 135(5), 811–817. <https://doi.org/10.1017/S0950268806007552>
- Hingston, S. (2016, July 22). 11 Things You Might Not know About Legionnaires' Disease. City Life Philly Magazine. <https://www.phillymag.com/news/2016/07/22/legionnaires-disease-Philadelphia/>
- LaGarde, A. (1996, Nov 7). *Forensic Files-Season 1, Episode 7-Legionnaire's Disease* [Video]. Facebook. <https://www.facebook.com/watch/?v=713375380775807>
- Lee, S., Edens, C., Ritter, T., et al. (2024). Two Outbreaks of Legionnaires Disease Associated with Outdoor Hot Tubs for Private Use — Two Cruise Ships, November 2022–July 2024. *MMWR Morb Mortal Wkly Rep* 2024;73:950–954. DOI: <http://dx.doi.org/10.15585/mmwr.mm7342a33>
- Legionnaires' Disease: Recent Updates and Insights. (2025, Aug 6). USA Tales Teller. <https://usatalesteller.com/legionnaires-disease-recent-updates-and-insights-2025/>
- Leonard, N. (2025, Sept 03). How a Philadelphia outbreak of Legionnaires' disease in 1976 led to modern-day investigations and surveillance. WHY. <https://why.org/articles/legionnaires-disease-history/>

- Lepine, L. A., Jernigan, D. B., Butler, J. C., Pruckler, J. M., Benson, R. F., Kim, G., Hadler, J. L., Cartter, M. L., & Fields, B. S. (1998). A recurrent outbreak of nosocomial legionnaires' disease detected by urinary antigen testing: evidence for long-term colonization of a hospital plumbing system. *Infection control and hospital epidemiology*, 19(12), 905–910.
- Lowry, P. W., Blankenship, R. J., Gridley, W., Troup, N. J., & Tompkins, L. S. (1991). A cluster of legionella sternal-wound infections due to postoperative topical exposure to contaminated tap water. *The New England journal of medicine*, 324(2), 109–113. <https://doi.org/10.1056/NEJM199101103240207>
- Moffa, M. A., Rock, C., Galiatsatos, P., Gamage, S. D., Schwab, K. J., & Exum, N. G. (2023). Legionellosis on the rise: A scoping review of sporadic, community-acquired incidence in the United States. *Epidemiology and infection*, 151, e133. <https://doi.org/10.1017/S0950268823001206>
- New York City Health Department Provides Update on Community Cluster of Legionnaires’ Disease in Central Harlem(2025, Aug 14). NYC Health. <https://www.nyc.gov/site/doh/about/press/pr2025/nyc-health-provides-third-legionnaires-cluster-update.page>
- Norman. A (2025, Sept 3). What is Legionnaires’ Disease. ATI. <https://allthatsinteresting.com/legionnaires-disease>
- NYC Legionnaires’ Disease Outbreak: 2 Dead, 58 Sick-What New Yorkers Need to Know. (2025, Aug 5). Fingerlakes1.com.<https://www.fingerlakes1.com/2025/08/05/legionnaires-disease-new-york-outbreak-3733567/>
- Pareek, A., Singhal, R., Pareek, A., Chuturgoon, A., Sah, R., & Apostolopoulos, V. (2025). Global surge of Legionnaires' disease in 2024: urgent call for heightened awareness and preparedness. *The Lancet. Microbe*, 6(4), 101031. <https://doi.org/10.1016/j.lanmic.2024.101031>
- Pennington, C. (2017). First Phase of Dental Care Center Completed. *UConn Today*. <https://today.uconn.edu/2017/10/first-phase-dental-care-center-completed/>
- Recent Outbreaks from *Legionella* and Other Waterborne Pathogens (n.d.). Lamps Water Quality Management. <https://hcinfo.com/about/outbreaks/recent>
- Sakamoto, R. (2024) Legionnaires' disease outbreak in Philadelphia and the 1976 United States presidential election. *Sociology Lens*, 37(2), 269–284. Available from: <https://doi.org/10.1111/johs.12442>
- Sanford J. P. (1979). Legionnaires' disease--the first thousand days. *The New England journal of medicine*, 300(12), 654–656. <https://doi.org/10.1056/NEJM197903223001205>
- Sinnerton, J. (2016 Jan 2). Deadly Disease on Ice. Courier Mail. <https://hydrochem.com.au/resource/how-can-ice-machines-spread-legionnaires-disease/>
- Tobin, J. O., Beare, J., Dunnill, M. S., Fisher-Hoch, S., French, M., Mitchell, R. G., Morris, P. J., & Muers, M. F. (1980). Legionnaires' disease in a transplant unit: isolation of the causative agent from shower baths. *Lancet (London, England)*, 2(8186), 118–121. [https://doi.org/10.1016/s0140-6736\(80\)90005-7](https://doi.org/10.1016/s0140-6736(80)90005-7) Klein. C.(2025, May 27). Remembering the Legionnaires' Outbreak. History. <https://www.history.com/articles/the-discovery-of-legionnaires-disease>
- UConn Health. *The UConn School of Dental Medicine Announces Faculty Promotions*. <https://today.uconn.edu/2011/09/the-uconn-school-of-dental-medicine-announces-faculty-promotions/>
- University of Connecticut (n.d.). *Department of Animal Science*. <https://animalscience.uconn.edu/research/>
- Walker, J (2023). Educational Passport to Dentistry Event Held for Boys and Girls Club of Hartford. *UConn Today*. <https://today.uconn.edu/2023/05/educational-passport-to-dentistry-event-held-for-boys-and-girls-club-of-hartford/>
- Wolfman-Arent, A. (2021, Aug 13). How the “Grande Dame of Broad Street’ led to the discovery of Legionnaires’ disease. WHYY. <https://billypenn.com/2021/08/13/bellevue-stratford-hotel-legionnaires/>