

Pennsylvania Legionellosis Report 2021-2023

Bureau of Epidemiology

October 16, 2024



**Pennsylvania
Department of Health**

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Abbreviations

PADOH	Pennsylvania Department of Health
CDC	Centers for Disease Control and Prevention
CSTE	Council of State and Territorial Epidemiologists
PA-NEDSS	Pennsylvania National Electronic Disease Surveillance System
LD	Legionnaire's Disease
PF	Pontiac Fever
XPL	Extrapulmonary legionellosis
DFA	Direct Fluorescent antibody staining
IHC	Immunohistochemistry
MMWR	Morbidity and Mortality Weekly Report

Executive Summary

Legionellosis is an illness caused by *Legionella* bacteria, which can lead to Legionnaire's disease, Pontiac fever, or extrapulmonary legionellosis. Most people with legionellosis have general respiratory symptoms, which often result in pneumonia. From 2021-2023, 1,231 people met the criteria to be considered a confirmed or probable case of legionellosis in Pennsylvania, or approximately 410 people per year. Although the yearly incidence rate of legionellosis in Pennsylvania was lower than in the years leading up to the COVID-19 pandemic (2017-2019), the yearly incidence rate reported from 2021-2023 was consistently above the national average.

In Pennsylvania, the majority of people with legionellosis became sick during the summer and early fall months. From 2021-2023, incidence rates were higher in the northeast and southwest regions of the state than in other areas. Additionally, the incidence rate of legionellosis from 2021-2023 was higher in men and those in older age groups, consistent with national data. From 2021-2023, approximately 86% of people with legionellosis in Pennsylvania were hospitalized, and 5% died. Approximately 19% of people with legionellosis were considered health care-associated cases; approximately 10% of these individuals died. While fewer legionellosis outbreaks were investigated by public health from 2021-2023 than in the years leading up to the COVID-19 pandemic, it is unclear whether this may have been impacted by a decrease in reporting or diagnosis due to the impacts of COVID-19.

Background

This report summarizes the epidemiology of legionellosis from reports received by Pennsylvania Department of Health (PA DOH) from 2021 to 2023. These data provide information on the impact of the COVID-19 pandemic on legionellosis case reporting in Pennsylvania and includes reports that occurred after a revised legionellosis case definition was implemented in 2020 and published on CDC's website here:

<https://ndc.services.cdc.gov/case-definitions/legionellosis-2020/> (Council of State and Territorial Epidemiologists (CSTE), 2019).

Legionellosis is an illness caused by *Legionella* bacteria. *Legionella* is a genus of bacteria with several different species, many of which cause disease in humans. *Legionella* bacteria are naturally occurring in the environment and can become a health concern when they are able to grow and spread, often in building water systems. *Legionella* grow well in warm, stagnant (no movement) water and are associated with biofilms that may develop along pipe networks. People may become infected with *Legionella* when they breathe in the bacteria in mists or vapors (such as those from showers, bubbling hot tubs, or decorative fountains) or when they aspirate (choke on) drinking water that contains the bacteria.

Legionellosis is primarily associated with 3 clinically distinct illnesses:

- Legionnaires' disease is the more severe form of infection, which includes pneumonia and can lead to death. Symptoms begin two to 10 days after exposure to the bacteria.
- Pontiac fever is a milder illness in which the person does not have pneumonia. Symptoms begin five to 72 hours after exposure.
- Extrapulmonary legionellosis is a *Legionella* infection outside the lungs. It is rare and can occur as a complication of *Legionella* pneumonia or can occur independently. This can manifest as an infection in the heart, a wound, or another site in the body. Most people with legionellosis whose disease is reported to public health had immunocompromised status (Franco-Garcia, et al., 2017). In contrast with Legionnaires' disease and Pontiac fever, many infections of extrapulmonary *Legionella* disease are caused by *Legionella* species other than *L. pneumophila* (Muder and Yu, 2002).

According to national data, people most susceptible to legionellosis include those with advanced age, weakened immune systems, or with chronic lung diseases (Barskey, et al., 2022). Health care-associated legionellosis is of particular concern. Many patients being treated at health care facilities (including hospitals and long-term care facilities) have conditions that put them at higher risk of becoming infected with *Legionella*. Additionally, large buildings with complex plumbing systems, such as hospitals, are at increased risk of harboring *Legionella* bacteria in their water systems, potentially leading to exposure to patients, staff, volunteers, or visitors.

Methods

This report gathered data from case investigations from Pennsylvania’s electronic reportable disease surveillance system, PA-NEDSS and Philadelphia Department of Public Health’s disease surveillance system. In Pennsylvania, clinical laboratories are required to report positive legionellosis test results to PA DOH by the next workday (28 Pa. Code § 27.22). In addition, clinicians are required to report cases of legionellosis within 24 hours of identification (28 Pa. Code § 27.21a). Reports are submitted electronically (either through electronic laboratory reporting or online key entry) to PA-NEDSS (33 Pa.B. 2439). Staff from PA DOH or Philadelphia Department of Public Health attempt to collect additional information from people who meet criteria to be considered a case of legionellosis through case investigation questionnaires conducted over the phone. These questionnaires collect information on symptoms, risk factors or exposures of interest, hospitalization and death status, and other key variables of interest. Legionellosis outbreaks identified by PA DOH state health centers or Pennsylvania local health departments are to be reported to the Division of Surveillance, Bureau of Epidemiology on the same day in which they are identified for further investigation (28 Pa. Code § 27.43a). Population estimates were retrieved from the United States Census Bureau’s website using the American Community Survey (ACS) 2022 5-year Demographic and Housing Estimates (United States Census Bureau, 2022).

Case Definition

PA DOH follows the current Council of State and Territorial Epidemiologists (CSTE) case definition for legionellosis reporting. Case definitions are a set of criteria used to classify people who become sick as cases of a disease for public health. The most recent update to the legionellosis case definition was implemented in January 2020. This case definition made updates to the previous version (implemented in 2005). Key updates include introducing a new probable case definition, clarifying the inclusion of Pontiac fever and extrapulmonary legionellosis cases, and reclassifying the detection of *Legionella* species in lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary sites as confirmatory laboratory criteria. This case definition is included below (Council of State and Territorial Epidemiologists (CSTE), 2019):

Laboratory Criteria

Confirmatory laboratory evidence:

- Isolation of any *Legionella* organism from lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site
- Detection of any *Legionella* species from lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site by a validated nucleic acid amplification test
- Detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents
- Fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents

Presumptive laboratory evidence:

- None required for case classification

Supportive laboratory evidence:

- Fourfold or greater rise in antibody titer to specific species or serogroups of *Legionella* other than *L. pneumophila* serogroup 1 (e.g., *L. micdadei*, *L. pneumophila* serogroup 6)
- Fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigens
- Detection of specific *Legionella* antigen or staining of the organism in lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site associated with clinical disease by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents

Epidemiologic Linkage

1. Epidemiologic link to a setting with a confirmed source of *Legionella* (e.g., positive environmental sampling result associated with a cruise ship, public accommodation, cooling tower, etc.).
OR
2. Epidemiologic link to a setting with a suspected source of *Legionella* that is associated with at least one confirmed case.

Criteria to Distinguish a New Case from an Existing Case

An individual should be considered a new case if their previous illness was followed by a period of recovery prior to acute onset of clinically compatible symptoms and subsequent laboratory evidence of infection. The recovery period for legionellosis can vary based on patient-specific factors. CDC consultation is encouraged for case classification of individuals without clear periods of recovery or subsequent acute illness onset.

Case Classification

Suspect

- Suspect Legionnaires' disease (LD): A clinically compatible case of LD with supportive laboratory evidence for *Legionella*.
- Suspect Pontiac fever (PF): A clinically compatible case of PF with supportive laboratory evidence for *Legionella*.
- Suspect Extrapulmonary legionellosis (XPL): A clinically compatible case of XPL with supportive laboratory evidence of *Legionella* at an extrapulmonary site.

Probable

- Probable Legionnaires' disease (LD): A clinically compatible case with an epidemiologic link during the 14 days before onset of symptoms.
- Probable Pontiac fever (PF): A clinically compatible case with an epidemiologic link during the 3 days before onset of symptoms.

Confirmed

- Confirmed Legionnaires' disease (LD): A clinically compatible case of LD with confirmatory laboratory evidence for *Legionella*.
- Confirmed Pontiac fever (PF): A clinically compatible case of PF with confirmatory laboratory evidence for *Legionella*.
- Confirmed Extrapulmonary legionellosis (XPL): A clinically compatible case of XPL with confirmatory laboratory evidence of *Legionella* at an extrapulmonary site.

Health Care-Associated Cases

After cases are reported, PA DOH staff attempt to contact all individuals who appear to meet the laboratory criteria of a potential legionellosis case for interview to collect additional information, including clinical features, exposures, and risk factors. These data assist in case classification and outbreak identification to support disease prevention efforts in Pennsylvania and importantly, help identify health care-associated cases which are of particular concern. People who meet the criteria to be considered a health care-associated case of legionellosis are those who visited, worked at, or stayed at a health care facility such as a hospital, nursing home, clinic, urgent care center, or any other facility that provides medical care or treatment services during their incubation period. Health care-associated cases are categorized as presumptive or possible as defined below:

- **Presumptive health care-associated cases** are individuals that had a continuous stay in a health care facility for at least 10 days in the 14 days prior to onset.
- **Possible health care-associated cases** are individuals that worked in or visited the facility for fewer than 10 days in the 14 days prior to onset.

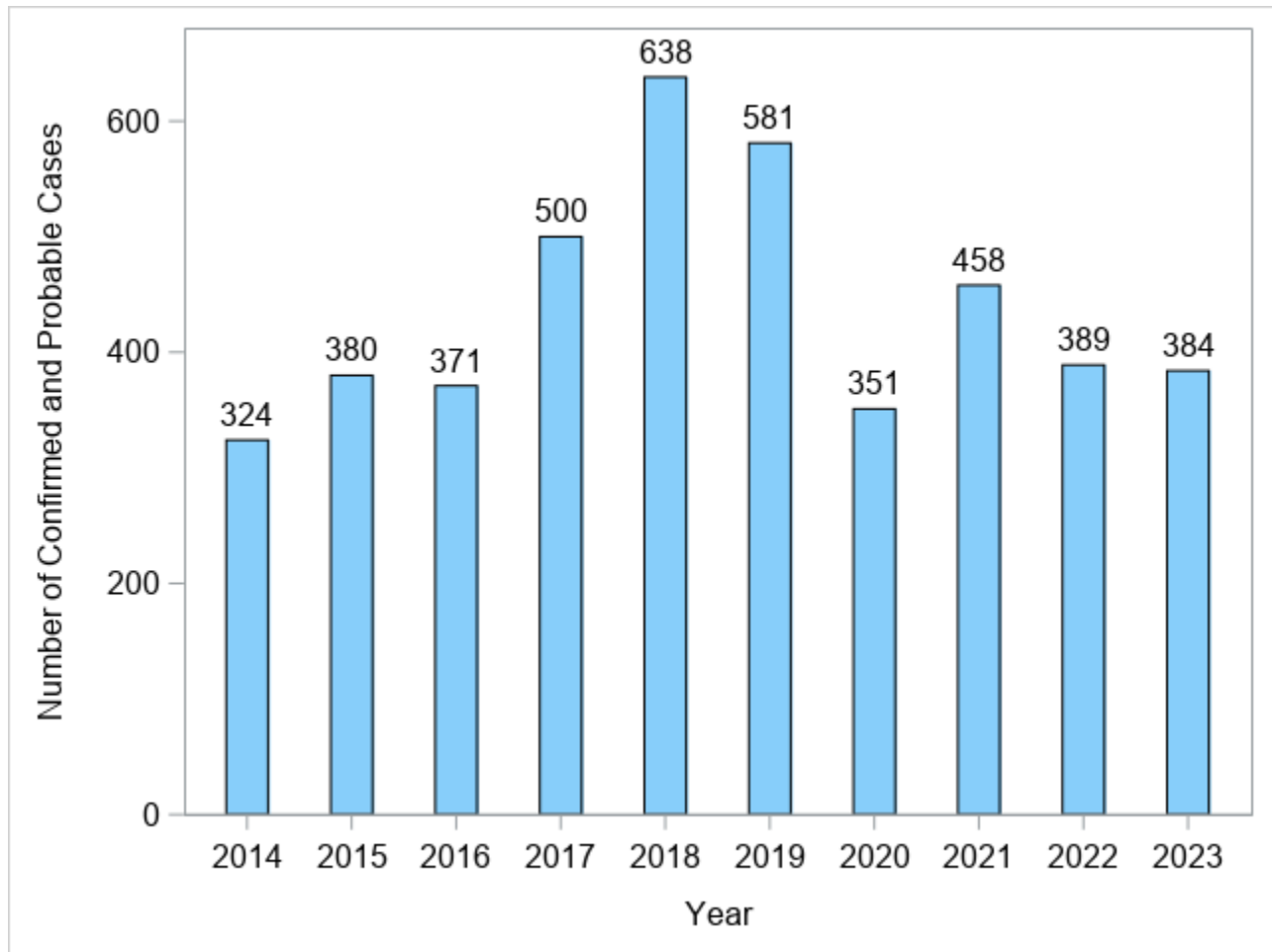
Findings

Epidemiology

From 2021-2023, PA DOH received reports for 1,231 people who met the criteria to be considered a confirmed or probable case of legionellosis in Pennsylvania, or an average of 410 people per year. The annual incidence rate in Pennsylvania (or number of confirmed and probable cases reported to PA DOH per year) per 100,000 population was 3.53 in 2021, 2.99 in 2022, and 2.96 in 2023. According to the most recent CDC data published on the Nationally Notifiable Infectious Diseases and Conditions Annual Tables, the national incidence rate of legionellosis was 2.56 per 100,000 population in 2021 (Centers for Disease Control and Prevention [CDC], 2024). Based on these data, the annual incidence rate in Pennsylvania from 2021-2023 is above the national incidence rate.

In the years preceding the 2020 COVID-19 pandemic, Pennsylvania reported record-high numbers of legionellosis cases, with counts of confirmed and probable cases totaling 638 in 2018 and 581 in 2019. However, the number of legionellosis cases reported in 2020 was significantly lower, with 351 cases reported during that year. This decline was also noted nationally and has been attributed to potential underreporting, underdiagnosis, or reduced risk of infection due to COVID-19 isolation guidance (Reddy et al., 2023). In 2021-2023, case reports in Pennsylvania were below the previous 5-year average of 488 cases per year (based on data from 2016-2020) but were above the number of cases reported in 2020 (n=351, Figure 1). In the years following the 2020 COVID-19 pandemic, there were some concerns that there would be an increased risk of *Legionella* in some settings due to building re-openings. There is a potential increase in stagnant water in plumbing systems due to closed or unused buildings which may facilitate *Legionella* growth. However, cases in 2021-2023 remained below the previous 5-year average.

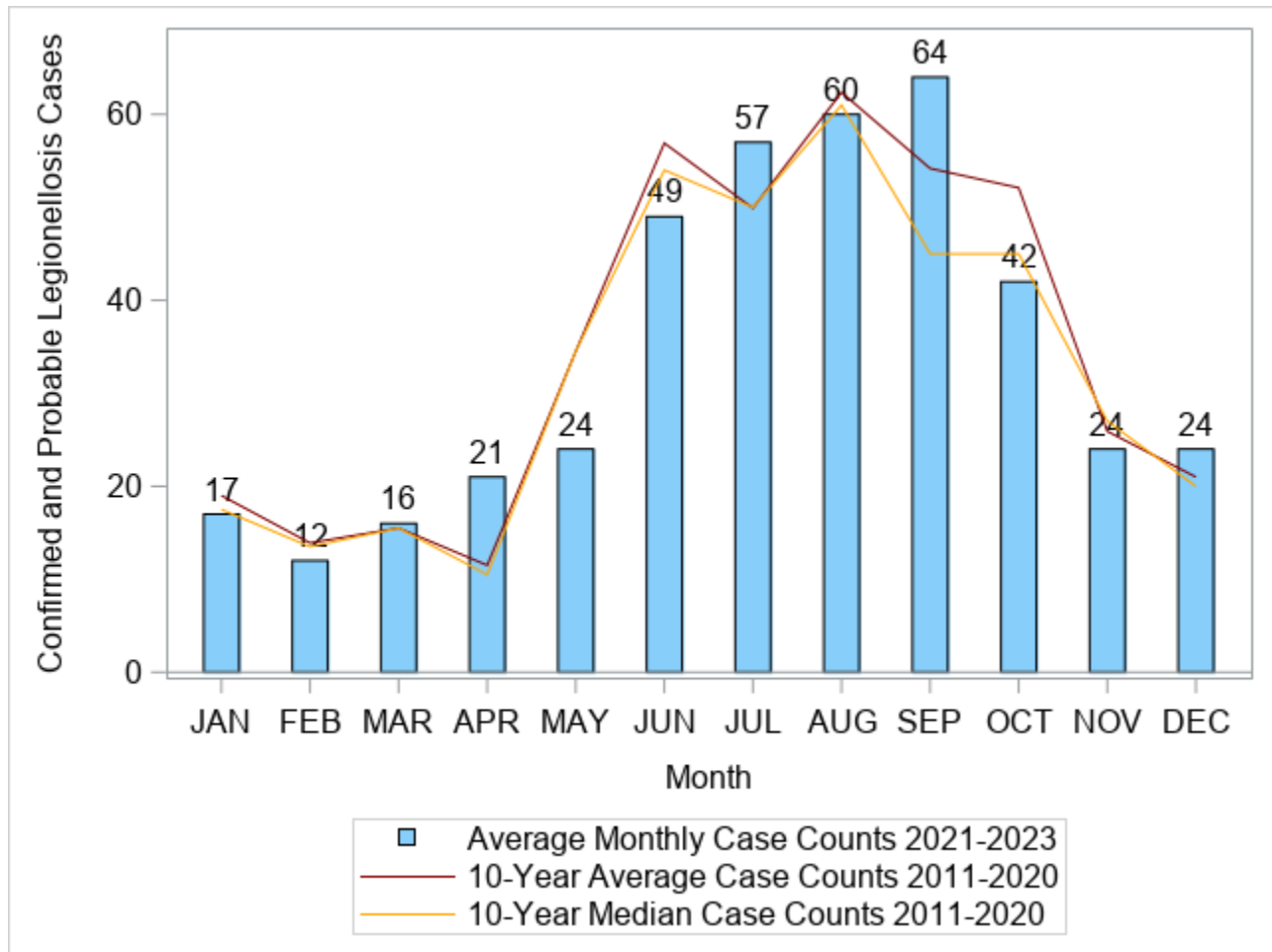
Figure 1 – Confirmed and Probable Legionellosis Cases by Year, 2014-2023



Source: PA-NEDSS MMWR dataset

Legionellosis follows a seasonal trend in Pennsylvania, with more individuals meeting the criteria to be considered a case of legionellosis in the summer and early fall months. This pattern has remained consistent over the past 10 years of data, as shown in Figure 2. However, during the months of April and September, the average monthly number of cases reported in 2021-2023 was above the previous 10-year average. Further, the month with the largest average number of cases per month for 2021-2023 was September, while the month with the largest average number of cases for 2011-2020 was August. This suggests that in recent years, more cases were reported in the late spring and early fall than what had been seen in Pennsylvania previously.

Figure 2 – Average Number of Confirmed and Probable Legionellosis Cases by Month, 2021-2023

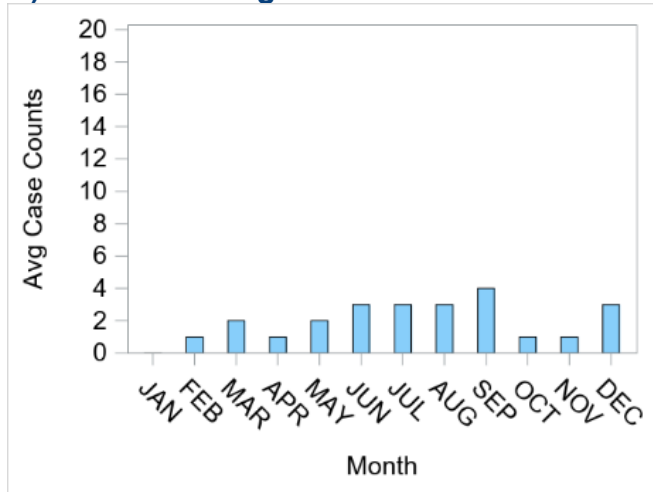


Source: PA-NEDSS MMWR dataset

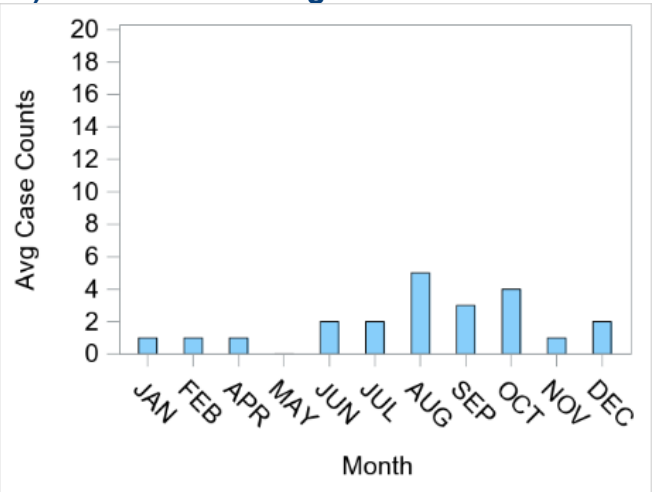
Figure 3 displays the average number of cases reported by region and month for 2021-2023 in Pennsylvania. While there were regional differences in the total number of cases reported during this time, the seasonal pattern remained similar across regions. Summer and early fall months had the highest while winter months had the lowest number of monthly cases by region.

Figure 3 – Average Confirmed and Probable Legionellosis Cases by Region and Month, 2021-2023

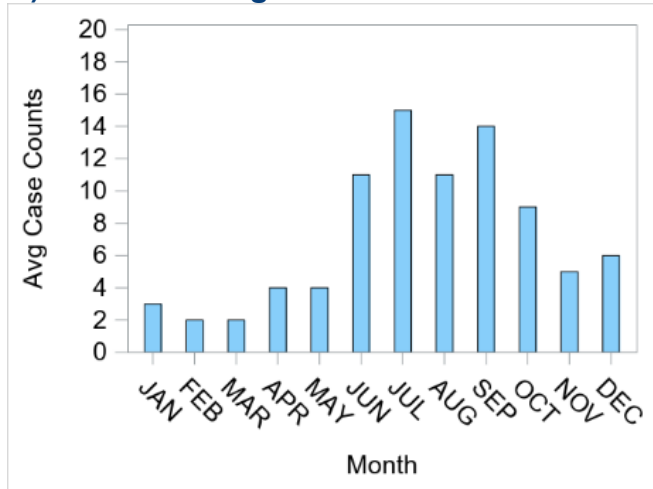
A) Northwest Region



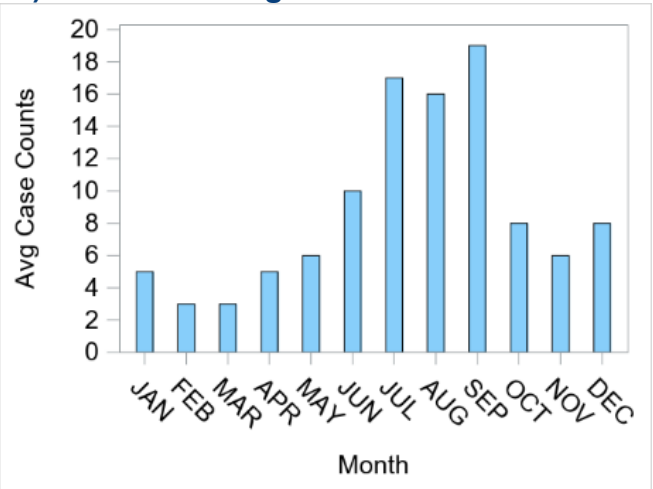
B) North Central Region



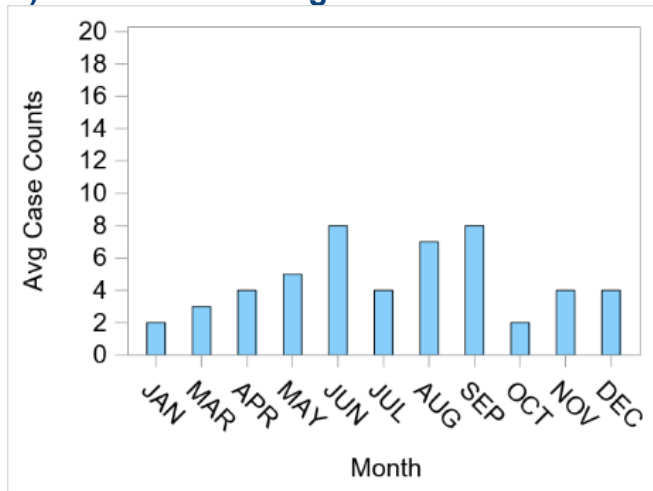
C) Northeast Region



D) Southwest Region



E) South Central Region



F) Southeast Region

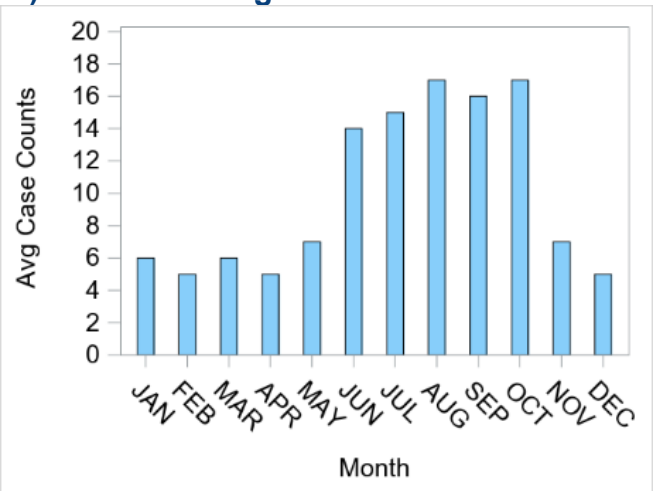


Table 1 displays the average number of legionellosis cases reported per year and region from 2021-2023. Additionally, Table 1 also presents these case counts adjusted for the total population of each region and statewide (case rate per 100,000 population). Overall, the average number of cases reported in 2021-2023 per year statewide was 410 or 3.15 cases per 100,000 population. The northeastern region had the highest average yearly case rate from 2021-2023, with 5.19 cases reported per 100,000 population. While the southeastern region reported the highest total cases (120 per year), its adjusted case rate was lower than the statewide rate. (Table 1).

Table 1 – Confirmed and Probable Legionellosis Cases by Region 2021-2023

Region	Average Yearly Case Counts 2021-2023	Average Yearly Case Rate per 100,000 population 2021- 2023
Statewide	410	3.15
Northwest	23	2.60
North central	22	3.18
Northeast	85	5.19
Southwest	108	4.01
South central	52	3.23
Southeast	120	2.19

Similarly to what has been observed nationally (Barskey et al., 2022), males account for both a higher number of legionellosis cases (approximately 63%) in Pennsylvania and had a higher case rate per 100,000 population than females from 2021-2023 (Table 2). Also, in line with national findings, more cases of legionellosis occurred in people in older age categories than in younger age categories. While the 55–64-year-old age category had the largest number of legionellosis cases reported on average between 2021 and 2023 (n=106), the 75-84 year old age category had the highest case rate per 100,000 population in Pennsylvania (8.94 per 100,000 population, Table 2).

Table 2 – Confirmed and Probable Legionellosis Cases per 100,000 population by Sex and Age, 2023

	Average Yearly Case Counts 2021-2023	Average Yearly Case Rate per 100,000 population 2021- 2023
Total population	410	3.15
Sex: Male	257	4.01
Female	154	2.34
Age: 0-24	4	0.10
25-34	13	0.77
35-44	29	1.84
45-54	66	4.11
55-64	106	5.84
65-74	102	7.26
75-84	63	8.94
85+	27	8.31

Between 2021 and 2023, an average of 353 individuals who met the criteria to be considered a confirmed or probable legionellosis case were hospitalized per year. This represents 86.1% of the total average yearly cases reported during that time period (Table 3). Additionally, an average of 19 individuals died, or 4.6% of average yearly cases reported. These numbers are slightly lower than what was reported in CDC’s national report from 2022, which stated that the rate of hospitalization among cases nationally between 2018 and 2019 was 93-96% and the rate of death was between 6-7% (Barskey et al., 2022).

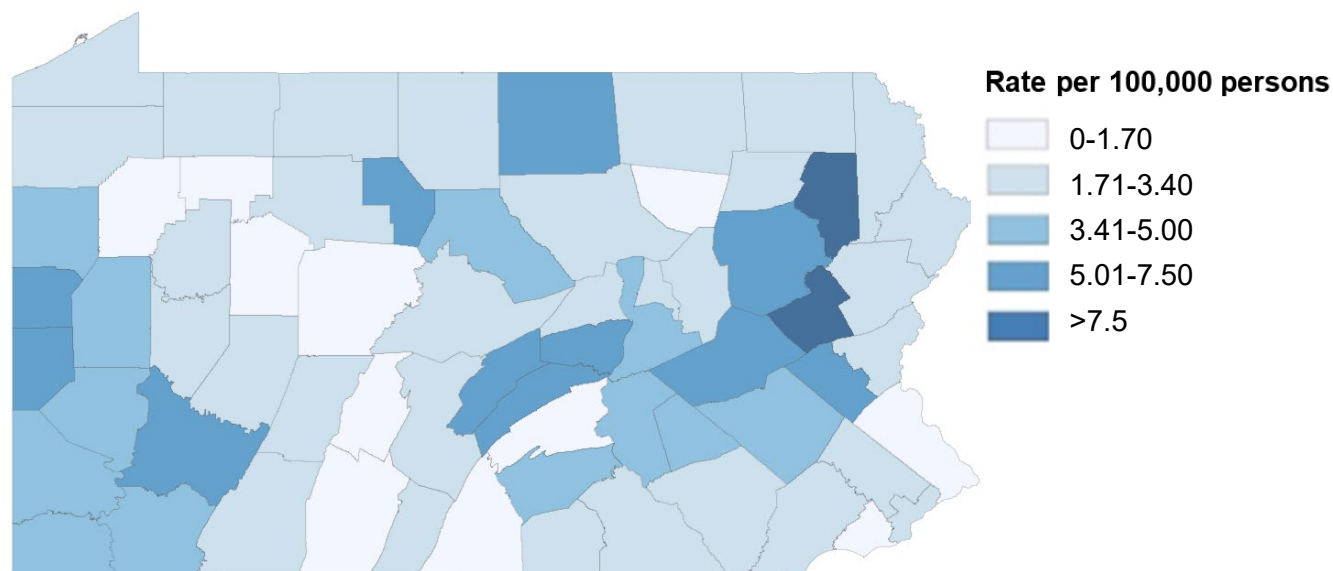
Table 3 – Confirmed and Probable Legionellosis Cases, 2021-2023

Outcomes	Average Yearly Case Counts 2021-2023 N (%)
Hospitalized: Yes	353 (86.1%)
No	10 (2.4%)
Unknown	47 (11.5%)
Died: Yes	19 (4.6%)
No	302 (73.7%)
Unknown	89 (21.7%)

Pennsylvania county populations vary widely, from a low of 4,536 in Cameron County to a high of 1,593,208 in Philadelphia County according to American Community Survey (ACS) 2022 5-year Demographic and Housing Estimates (United States Census Bureau, 2022). To account for variations in county population, average yearly incidence rates per 100,000 population per county from 2021-2023 were calculated and displayed in Figure 4. Lackawanna County had the highest incidence of legionellosis in Pennsylvania (8.5 average

yearly cases per 100,000 population), followed by Carbon County (7.7 average yearly cases per 100,000 population), and Cameron County (7.3 average yearly cases per 100,000 population). Although the largest number of average yearly cases between 2021-2023 were reported in Philadelphia (average of 48 cases per year) and Allegheny County (average of 38 cases per year), these counties have lower incidence rates of legionellosis per 100,000 population than others (2.4 average yearly cases per 1,000,000 population in Philadelphia and 3.8 average yearly cases per 100,000 population in Allegheny County).

Figure 4 – Average Confirmed and Probable Legionellosis Incidence per 100,000 Population by County, 2021-2023



Health Care-Associated Cases

Health care-associated cases are defined as individuals who worked at, visited, or stayed in a health care facility during their 14-day incubation period. Of the 1,231 confirmed and probable cases of legionellosis cases reported in Pennsylvania from 2021-2023, information on whether these cases were health care-associated was available for 941, or an average of 314 per year. Among these, approximately 19.1% were classified as health care-associated. Thirty cases were determined to be presumptive health care-associated cases because they spent at least 10 out of the 14 days of their incubation period at that facility, and 99 were determined to be possible health care-associated having spent fewer than 10 days of their incubation period at the facility. Table 4 displays the average number of health care and non-health care associated legionellosis cases per year between 2021 and 2023 by key risk factors and outcomes.

Table 4 – Reported risk factors and outcomes among health care-associated and not health care-associated legionellosis cases, 2021-2023

Risk Factors and Outcomes	Average Yearly Case Counts that are Health Care-Associated 2021-2023 N (%)	Average Yearly Case Counts that are not Health Care-Associated 2021-2023 N (%)
Total ¹	60	254
Sex: Male	33 (55.0%)	164 (64.6%)
Female	27 (45.0%)	90 (35.4%)
Age: 0-24	1 (1.7%)	3 (1.2%)
25-34	2 (3.3%)	6 (2.4%)
35-44	3 (5.0%)	19 (7.5%)
45-54	6 (10.0%)	41 (16.1%)
55-64	16 (26.7%)	62 (24.4%)
65-74	13 (21.7%)	66 (26.0%)
75-84	13 (21.7%)	42 (16.5%)
85+	6 (10.0%)	16 (6.3%)
Hospitalized: Yes	57 (95.0%)	234 (92.1%)
No	1 (1.7%)	9 (3.5%)
Unknown	2 (3.3%)	11 (4.3%)
Died: Yes	6 (10.0%)	8 (3.1%)
No	42 (70.0%)	208 (81.9%)
Unknown	12 (20.0%)	38 (15.0%)

¹Information on whether cases are health care-associated is missing for an average of 58 legionellosis cases per year between 2021 and 2023.

Compared to cases determined not to be health care-associated, health care-associated cases were more likely to be male and in the 75+ age categories, Table 4. Health care-associated cases were more likely to be hospitalized due to their *Legionella* infection (95.0%) compared to cases that were not health care-associated (92.1%). Finally, health care-associated cases were much more likely to die as a result of their illness (10.0%) than those that were not health care-associated (3.1%), Table 4. This finding aligns with CDC’s reported case fatality rate among health care-associated legionellosis cases of 10% (Barskey et al., 2022).

Outbreaks

A legionellosis outbreak is defined as two or more cases of legionellosis within 12 months that were exposed to the same risk factor in the 14 days prior to their illness onsets. Outbreak dates are based on the date of the first illness associated with the outbreak. Between 2021 and 2023, four legionellosis outbreaks, comprised of 20 cases total, were identified to be associated with exposures that occurred in Pennsylvania. These outbreaks occurred at

facilities located in four counties in the southeast, southwest, and southcentral regions of the state. Two outbreaks were associated with health care facilities, one with a hotel, and one with a prison. This number of outbreaks is fewer than the previous 5-year average of approximately four outbreaks identified with Pennsylvania exposures per year from 2016 to 2020.

Disease Prevention and Control

There is no vaccine to prevent legionellosis. The key to preventing the disease is proper maintenance of the water systems in which *Legionella* grow, including drinking water systems, hot tubs, decorative fountains and cooling towers. Persons at increased risk of infection may choose to avoid high-risk exposures, such as being in or near a hot tub. See resources below for more information on legionellosis prevention and control.

Legionellosis Resources

- Pennsylvania Department of Health Legionellosis Fact Sheet:
<https://www.pa.gov/content/dam/copapwp-pagov/en/health/documents/topics/documents/diseases-and-conditions/Legionellosis.pdf>
- Centers for Disease Control and Prevention (CDC)'s *Legionella* Website:
<https://www.cdc.gov/legionella/index.html>
- Centers for Disease Control and Prevention (CDC)'s Controlling *Legionella* Website:
<https://www.cdc.gov/control-legionella/index.html>

Citations

Barskey, A., Lee, S., Hannapel, E., Smith, J., Edens, C., & Division of Bacterial Diseases, National Center for, C. (2022, December). Centers for Disease Control and Prevention. Retrieved from Legionnaires' Disease Surveillance 2018-2019: <https://www.cdc.gov/legionella/health-depts/surv-reporting/2018-19-surv-report-508.pdf>

Franco-Garcia, A., Varughese, T., Lee, Y., Papanicolaou, G., Rosenblum, M., Hollman, T., Koehne, G., Boulad, F., Babady, N., Tang, Y., Seo, S. Diagnosis of extrapulmonary legionellosis in Allogeneic hematopoietic cell transplant recipients by direct 16S ribosomal ribonucleic acid sequencing and matrix-assisted laser desorption/ionization time of flight mass spectrometry. *Open Forum Infect Dis.* 2017;4(3):ofx140 Epub 2017 Jul 13

Muder, R., Yu, V. Infection due to *Legionella* species other than *L.pneumophila*. *Clin Infect Dis.* 2002;35(8):990.

Centers for Disease Control and Prevention (CDC). National Notifiable Diseases Surveillance System, 2021 Annual Tables of Infectious Disease Data. Atlanta, GA. CDC Office of Public Health Data, Surveillance, and Technology, 2024. Available at: <https://www.cdc.gov/nndss/data-statistics/infectious-tables/index.html>.

Council of State and Territorial Epidemiologists (CSTE). (2019). Retrieved from Revision to the Case Definition for National Legionellosis Surveillance, 19-ID-04: https://cdn.ymaws.com/www.cste.org/resource/resmgr/position_statements_files_2023/19-id-04_legionellosis_final.pdf

Pa. Code § 27.21a. Reporting of cases by health care practitioners and health care facilities. Retrieved from Commonwealth of Pennsylvania Code. Title 28, Chapter 27: <https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/028/chapter27/s27.21a.html>

Pa. Code § 27.22. Reporting of cases by clinical laboratories. Retrieved from Commonwealth of Pennsylvania Code. Title 28, Chapter 27: [https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/028/chapter27/s27.22.html#:~:text=\(a\)%20A%20person%20who%20is,the%20presence%20of%20a%20disease%2C](https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/028/chapter27/s27.22.html#:~:text=(a)%20A%20person%20who%20is,the%20presence%20of%20a%20disease%2C)

Pa. Code § 27.43a. Reporting by local morbidity reporting offices of outbreaks and selected diseases. Retrieved from Commonwealth of Pennsylvania Code. Title 28, Chapter 27:

<https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/028/chapter27/s27.43a.html>

Pa. Bulletin. 33 Pa.B 2439. Electronic Disease Surveillance System. Retrieved from Pennsylvania Bulletin, Commonwealth of Pennsylvania. Volume 33, Issue 20:
<https://www.pacodeandbulletin.gov/Display/pabull?file=/secure/pabulletin/data/vol33/33-20/941.html>

Reddy, D., Alex, D., Zonunmawii, C., Prabhu, S., & Dhiliban, D. N. (2023). Decreased Legionnaires' disease incidence in the United States during the COVID-19 pandemic, 2020-2022.

United States Census Bureau. (2022). 2022 American Community Survey 5-year Demographic and Housing Estimates. Retrieved from
<https://data.census.gov/table/ACSDP1Y2022.DP05?g=040XX00US42>.