

Legionellosis Report 2017

**Bureau of Epidemiology,
Division of Infectious
Disease Epidemiology**

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pennsylvania
DEPARTMENT OF HEALTH

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Background

Legionellosis is a general term for any disease caused by *Legionella* bacteria. The bacterium is named after a 1976 outbreak among people who attended an American Legion convention in Philadelphia. Some of the convention attendees developed a previously unrecognized type of pneumonia that became known as Legionnaires' disease (LD). A milder disease, also caused by *Legionella* bacteria, is called Pontiac fever.

People become infected with *Legionella* when they inhale 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 symptoms include cough, shortness of breath, fever, muscle aches (myalgia) and headaches. The disease has two forms:

- **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 patient does not have pneumonia. Pontiac fever is probably not a true infection but, rather, a reaction that can follow exposure to the bacteria. Symptoms begin five to 72 hours after exposure.

Healthcare-associated Legionnaires' disease, as opposed to LD from other sources, 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 and potentially exposing patients. According to the Centers for Disease Control and Prevention (CDC), 25% of patients who become infected with Legionnaires' disease in health care facilities die from the illness.^{1,2} Healthcare-associated LD cases are categorized as definite or possible.

- **Definite healthcare-associated case:** Patient was hospitalized or a resident of a long-term care facility for the entire 10 days prior to onset.
- **Possible healthcare-associated case:** Patient had exposure to a health care facility (as an inpatient, outpatient, visitor, volunteer or employee) for a portion of the 10 days prior to onset. Health care facilities include hospitals, nursing homes, doctor's offices, dialysis clinics, outpatient surgery centers, dental clinics and all other facilities where patients receive health care services.

See the Pennsylvania Department of Health (DOH) [Legionellosis Fact Sheet](#) for more information.

Case Definition

DOH follows the Council of State and Territorial Epidemiologists (CSTE)/CDC case definition for [Legionellosis/Legionnaires' Disease or Pontiac Fever \(*Legionella pneumophila*\)](#).

Suspected case: A case with pneumonia or both fever and myalgia is a suspected case if it meets at least one of the presumptive (suspected) laboratory criteria below:

- By seroconversion: 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);
- By seroconversion: fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigen and validated reagents;
- By the detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue or pleural fluid by direct fluorescent antibody (DFA) staining, Immunohistochemistry (IHC) or other similar method, using validated reagents; or
- By detection of *Legionella* species by a validated nucleic acid assay.

Confirmed case: A case with pneumonia or both fever and myalgia is a confirmed case if it meets at least one of the confirmatory laboratory criteria below:

- By culture: isolation of any *Legionella* organism from respiratory secretions, lung tissue, pleural fluid or other normally sterile fluid;
- By detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents; or
- By seroconversion: fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents.

Case Reporting

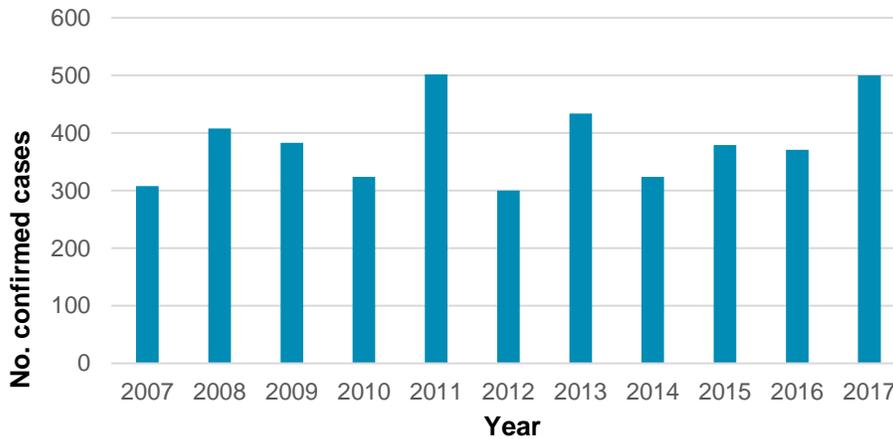
In Pennsylvania, clinical laboratories are required to report positive legionellosis test results to DOH by the next workday ([28 Pa. Code § 27.22](#)). In addition, clinicians are required to report cases of legionellosis within 24 hours of identification ([28 Pa. Code § 27.21a](#)). Reports are submitted electronically (either through electronic laboratory reporting or online key entry) through Pennsylvania's electronic reportable disease surveillance system, PA-NEDSS ([33 Pa.B. 2439](#)).

In addition, legionellosis outbreaks identified by DOH state health centers or Pennsylvania local health departments are to be reported to the Division of Infectious Disease Epidemiology, Bureau of Epidemiology on the same day in which they are identified ([28 Pa. Code § 27.43a](#)).

Summary of 2017 Cases

In 2017, while the United States experienced a record number of legionellosis cases (U.S. total 7,458), Pennsylvania also had a near-record with 500 confirmed cases (Figure 1). The only previous year in which Pennsylvania had exceeded that total was 2011 with 502 cases. Going back to 2007, case totals have ranged from 300 to 502 cases. The 10-year mean and median (calculated from 2007-2016 data) were 373.3 and 375 cases, respectively. By any standard, Pennsylvania’s 2017 total of 500 cases was well above normal.

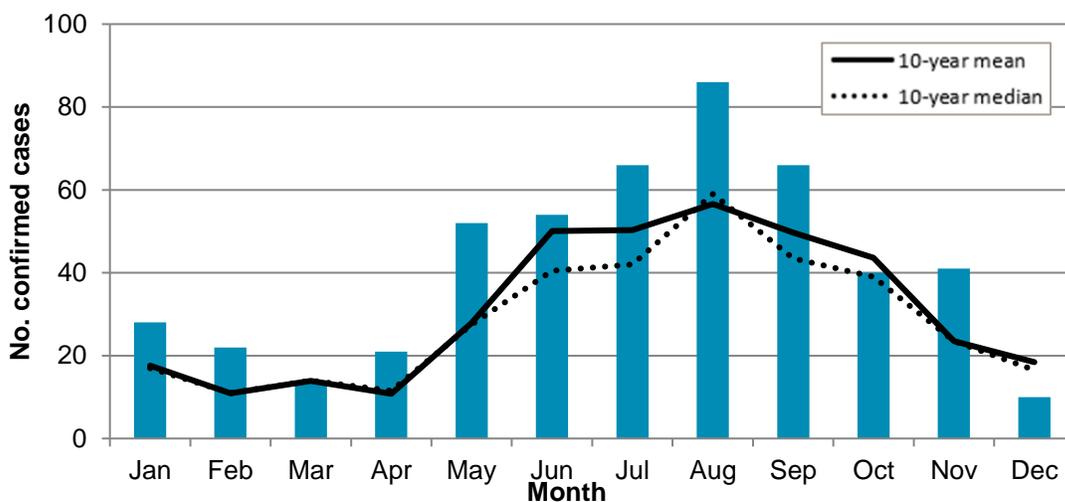
Figure 1 – Confirmed Legionellosis Cases by Year, 2007-2017



Source: PA-NEDSS MMWR dataset

In all but three months of 2017, the monthly case count was above both the mean and the median (Figure 2). In accordance with typical seasonal patterns, the monthly case counts were highest in the summer and fall (Figures 2 and 3).

Figure 2 – Confirmed Legionellosis Cases by Month, 2017

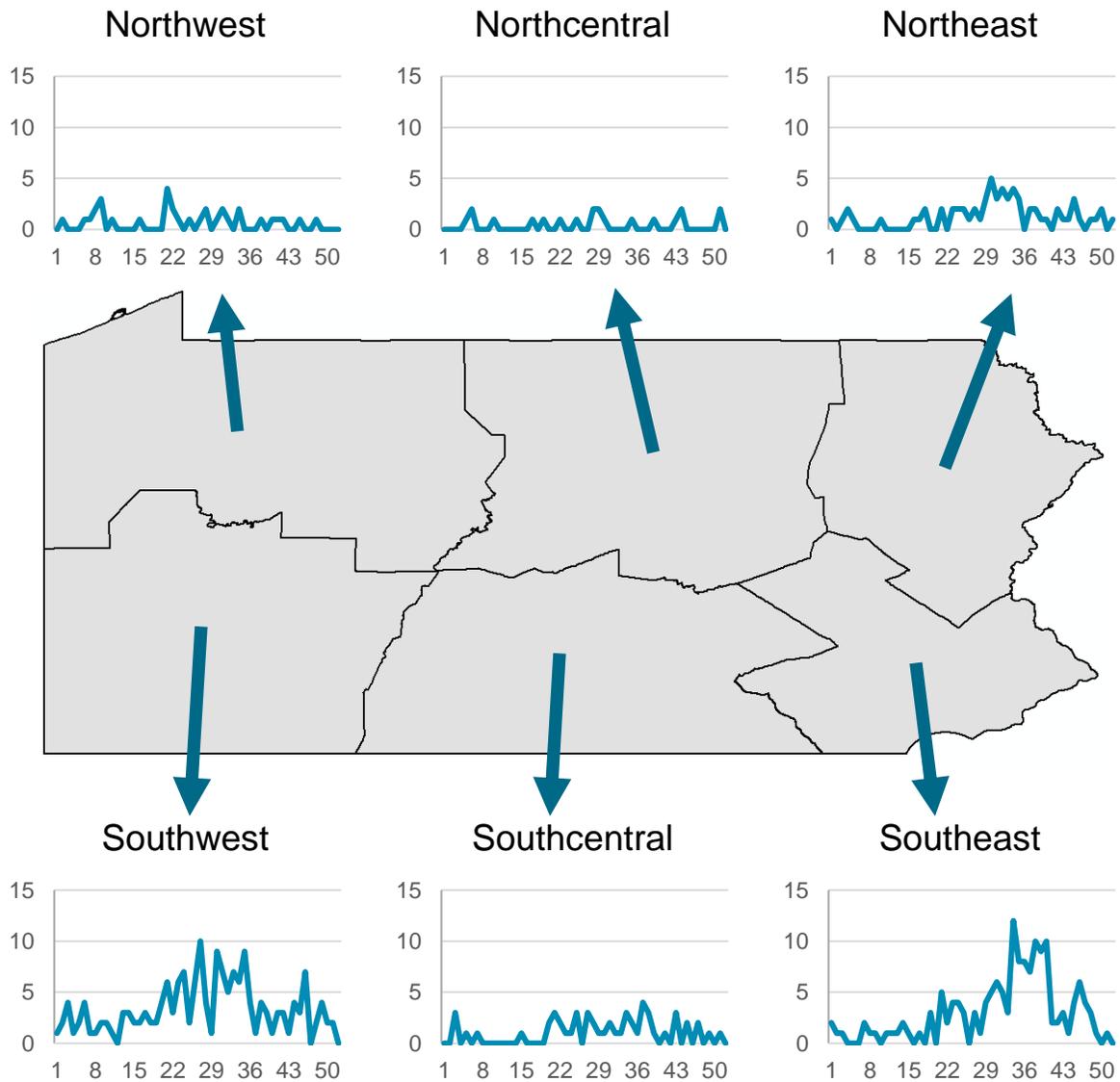


Mean and median calculated from 2007-2016 data

Source: PA-NEDSS MMWR dataset

In Figure 3, it is evident that the majority of cases occur in the southwest and southeast regions of the state, the two major population centers.

Figure 3 – Confirmed Legionellosis Cases by Pennsylvania Region and Week, 2017

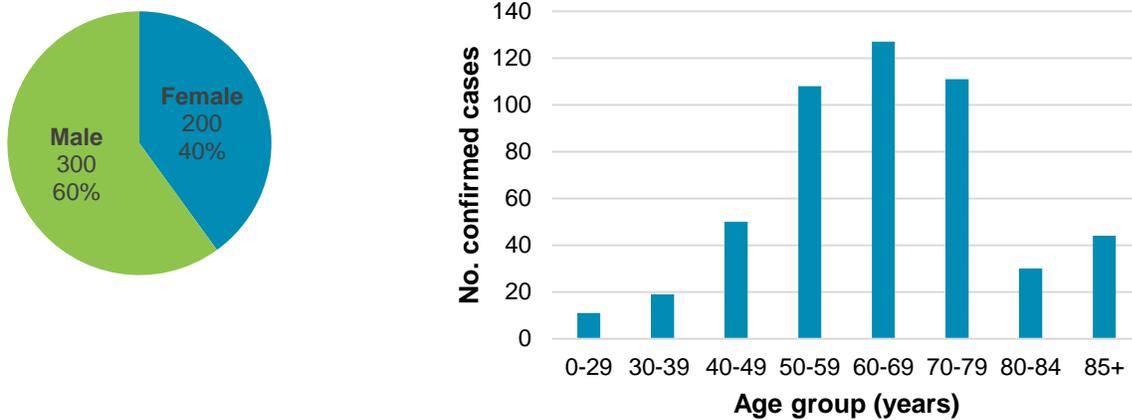


Source: PA-NEDSS MMWR dataset

The MMWR week is the week of the epidemiologic year for which the National Notifiable Diseases Surveillance System (NNDSS) disease report is assigned by DOH for the purposes of CDC's Morbidity and Mortality Weekly Report (MMWR) disease incidence reporting and publishing. Values for MMWR week range from 1 to 53, although most years consist of 52 weeks.

Consistent with national trends,² 60% of Pennsylvania's 2017 cases were male (U.S.: 61.5% male) and 84% were 50 years of age or older (U.S.: 84% ≥50 years of age) [Figure 4].

Figure 4 – Confirmed Legionellosis Cases by Sex and Age, 2017



Source: PA-NEDSS MMWR dataset

The proportion of 2017 legionellosis cases that were hospitalized and/or died were similar to national statistics from 2015, the most recent year for which national numbers are available. Ninety-six percent (96.0%) of Pennsylvania cases were hospitalized compared to 95.8% nationally, while 6.4% of Pennsylvania cases died compared to 7.0% of cases nationwide (Table 1).²

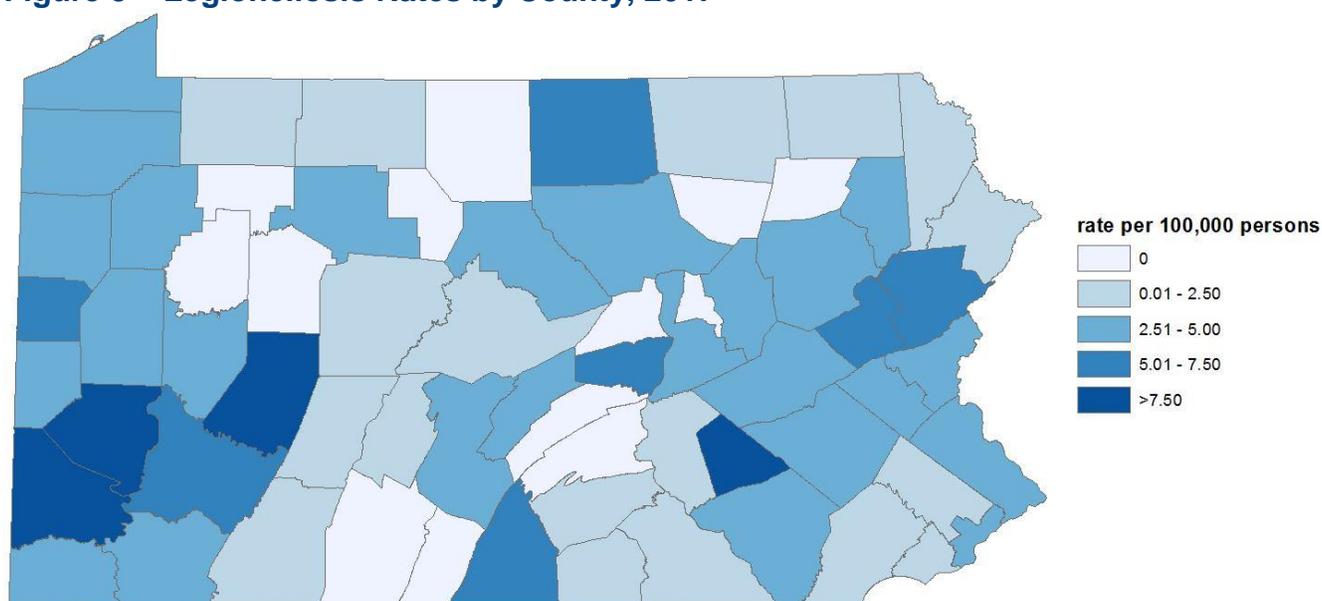
Table 1 – Confirmed Legionellosis Case Outcomes, 2017

Outcomes	No. cases	(%)
Hospitalized		
Yes	480	(96.0%)
No	9	(1.8%)
Unknown	11	(2.2%)
Died		
Yes	32	(6.4%)
No	422	(84.4%)
Unknown	46	(9.2%)

Source: PA-NEDSS MMWR dataset and Philadelphia Department of Public Health (PDPH) MAVEN database

Pennsylvania county populations vary widely, from a low of 5,085 in Cameron County to a high of 1,526,006 in Philadelphia County, making comparisons of county case counts uninformative. To compare the burden of disease among Pennsylvania counties, incidence rates (IR) – the number of cases of legionellosis per 100,000 persons – were calculated. In general, the highest rates of legionellosis were on the western side of Pennsylvania (Figure 5). The counties with the highest rates were Lebanon (IR = 12.7 cases/100,000 persons [17 cases]), Washington (IR = 8.2 cases/100,000 persons [17 cases]), Indiana (IR = 7.9 cases/100,000 persons [7 cases]), and Allegheny (IR = 7.8 cases/100,000 persons [95 cases]). A few counties with small populations had moderately high incidence rates due to just two or three cases each. Although Philadelphia County had the second highest case count in the state with 66 cases (second to Allegheny County's 95 cases), it had the 18th highest incidence rate with just 4.3 cases/100,000 persons. Thirteen of the 67 counties in Pennsylvania had no cases of legionellosis in 2017.

Figure 5 – Legionellosis Rates by County, 2017



Source: Case counts (numerator data) were obtained from the PA-NEDSS MMWR dataset. County population figures (denominators for rate calculations) were obtained from [2010 U.S. Census population data](#).

Pennsylvania as a whole had an incidence rate of 3.9 cases per 100,000 persons, approximately 60% higher than the overall U.S. incidence rate of 2.4 cases per 100,000 persons (Table 2). When the 50 states and Washington, D.C. were ranked according to 2017 legionellosis incidence rates, Pennsylvania was sixth highest. However, more than half of the top ranking jurisdictions had much smaller populations than Pennsylvania, and five of them had fewer than 100 cases. Only two other top ranking jurisdictions – New York and Ohio – had more cases than Pennsylvania.

Table 2 – Top 10 U.S. Jurisdictions by Legionellosis Incidence Rates, 2017

Rank	Jurisdiction	Incidence rate	No. cases
1	District of Columbia	7.6	46
2	New York	5.3	1022
3	Ohio	5.2	601
4	New Hampshire	4.8	63
5	Rhode Island	4.8	50
6	Pennsylvania	3.9	500
7	Delaware	3.8	34
8	Vermont	3.5	22
9	Michigan	3.5	347
10	Connecticut	3.4	120
United States		2.4	7,458

Source: State case counts (numerator data) were obtained from the [National Notifiable Infectious Diseases and Conditions: United States, Table 2h](#). State population figures (denominators for rate calculations) were obtained from [2010 U.S. Census population data](#).

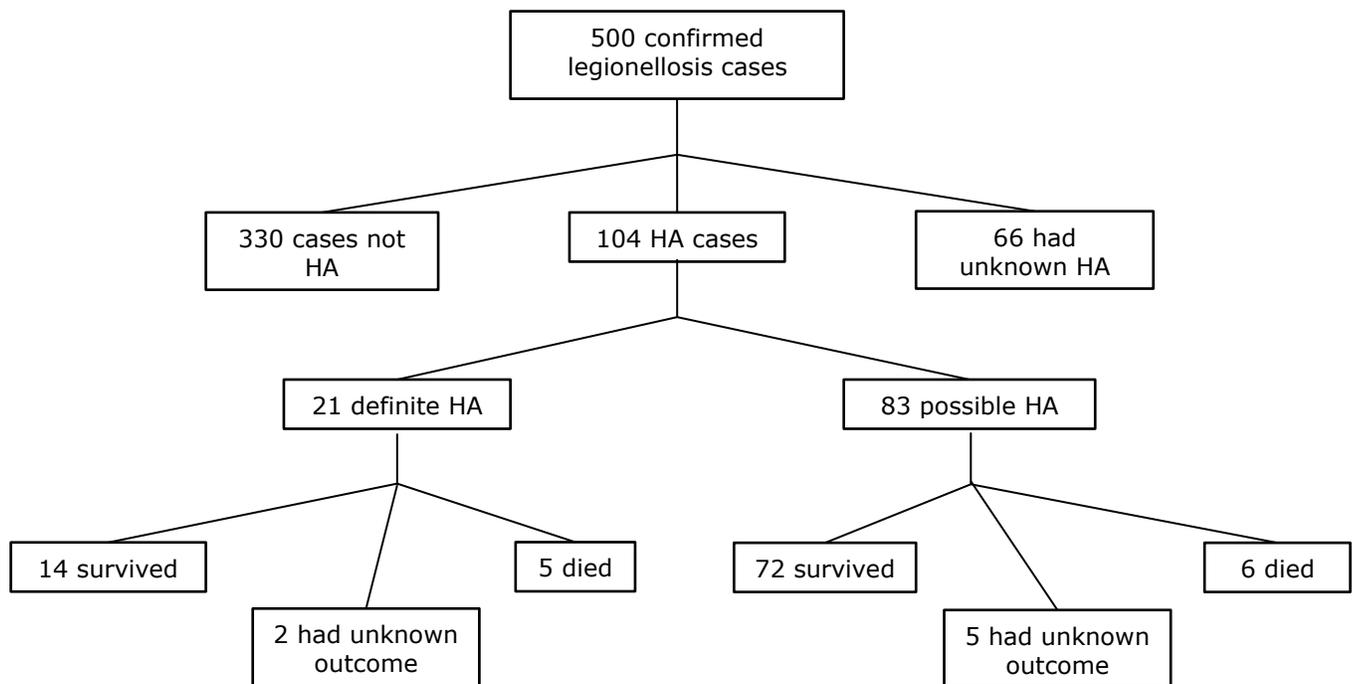
Outbreaks

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 10 days prior to their illness onsets. In 2017, seven legionellosis outbreaks, comprised of 40 cases, were identified and investigated. This is in comparison to between one and seven outbreaks per year in 2012 to 2016. The 2017 outbreaks involved residents of seven counties. Two outbreaks were linked to hotels, one occurred in a long-term care facility, and one was associated with a cooling tower at an industrial site. Two outbreaks were community outbreaks in which no source was identified. The other outbreak involved Pennsylvania residents who were exposed during out-of-state travel.

Healthcare-Associated Legionellosis Cases

Of 500 confirmed legionellosis cases, 104 (21%) were known to have health care exposures and were therefore classified as healthcare-associated (HA) cases (Figure 6). Twenty-one cases were definite healthcare-associated cases, meaning they were in a health care facility for the entire 10-day period leading up to their illness. Of these, five (24%) were known to have died as a result of their illness. Eighty-three cases were possible healthcare-associated cases. Of these, six (7%) were known to have died. These case fatality rates are similar to CDC's estimates that one-quarter of definite healthcare-associated cases and 10% of possible healthcare-associated cases die from their illness.^{1,2}

Figure 6 – Healthcare-Associated Legionellosis Case Outcomes, 2017



HA = healthcare-associated

Definite HA case = patient was in a health care facility for the entire 10 days before illness onset.

Possible HA case = patient was in a health care facility for part of the 10 days before illness onset.

Source: PA-NEDSS MMWR and RISK datasets and PDPH MAVEN database

Healthcare-associated legionellosis cases had a variety of health care exposures as shown in Table 3. Some cases had lengthy inpatient or long-term care stays leading up to their illnesses, while other health care exposures were brief and low risk (e.g., a blood draw or a visit to a hospitalized friend or family member). Some patients had multiple health care exposures during the 10 days before illness onset. For example, one definite healthcare-associated case was an inpatient at a long-term care facility but also went to an outpatient appointment at a clinic.

Table 3 – Healthcare-Associated Legionellosis Case Exposure Types, 2017

Healthcare exposures*	Healthcare-associated Cases		Total
	Definite	Possible	
Visit type:			
Inpatient	26	16	42
Outpatient	1	54	55
Employee	0	37	37
Visitor or volunteer	0	20	20
Facility type:			
Hospital	5	70	75
Long-term care	21	17	38
Clinic	1	40	41

*Some patients had >1 health care exposure.

Source: PA-NEDSS MMWR and RISK datasets and PDPH MAVEN database

Appendix A: Case Investigations

When a legionellosis report is entered in PA-NEDSS, a community health nurse (CHN) in the patient's home jurisdiction initiates an investigation. The CHN typically first contacts the health care provider or hospital infection control practitioner to verify test results, learn the patient's clinical signs and symptoms (including if the patient was diagnosed with pneumonia), and to find out if the patient is well enough to be interviewed or if there is a proxy who can speak for the patient. Next, the CHN calls the patient or proxy to confirm symptoms, identify the onset date, and inquire about risk factors in the 10 days prior to onset such as health care exposures, hotel stays and exposures to aerosolized water. The CHN documents the symptoms, risk factors and other information in PA-NEDSS and closes the investigation. If the case reported travel exposures, the CHN notifies CDC via email so they can look for additional cases from other states that have reported common exposures.

On a regular basis, the legionellosis surveillance coordinator reviews the newly completed investigations. The investigations are checked for completeness and correctness, and the surveillance coordinator verifies that CDC was notified of travel exposures. If a patient had a health care exposure, the surveillance coordinator verifies that education and appropriate recommendations were provided to the health care facility. If a patient had an exposure in a jurisdiction other than the patient's home jurisdiction, the surveillance coordinator shares the exposure information with the jurisdiction where it occurred. Periodically, the surveillance coordinator sends batches of de-identified legionellosis case data (including test results and risk factors) to CDC for inclusion in a nationwide database.

Appendix B: Follow-up for Healthcare-Associated Cases

If a patient was exposed in a health care facility, the CHN follows the guidance below.

1. Verify that case meets the case definition and determine if it is a definite or possible healthcare-associated case of legionellosis.
 - a) Definite: Patient was hospitalized or a resident of a long-term care facility for the entire 10 days prior to onset.
 - b) Possible: Patient had exposure to a health care facility for a portion of the 10 days prior to onset.
2. Contact the health care facility and provide education on legionellosis, if necessary. Inquire about potential sources that may have exposed the patient to *Legionella*, including but not limited to: decorative fountains, respiratory therapy equipment, humidifiers, pools, hot tubs, showering, potable water, ice, cooling towers or evaporative condensers, nearby bodies of water, and any recent construction, plumbing repairs, water main breaks/repairs, etc. Assess whether there are any especially high-risk patients in the facility. Determine if there is a recent history of other legionellosis cases associated with the facility. Confirm that the facility has a water management plan in place.
3. For a single definite healthcare-associated case, or two or more possible healthcare-associated cases:
 - a) Recommend prevention measures be instituted immediately. The health care facility should restrict showering, provide bottled water for drinking, clean ice machines and ensure sterile water is used for medical devices.
 - b) Recommend environmental sampling and *Legionella* testing by a CDC-certified ELITE lab.
 - c) Recommend the facility hire a private consultant to assist with control measures.
 - a. Short term: conduct thermal eradication or shock chlorination.
 - b. Long term: consider installing a secondary disinfection system or verify existing system is operating properly, review and revise water management plan.
 - d) Recommend the facility search for pneumonia cases in the facility during the past 12 months that could have been healthcare-associated legionellosis cases.
 - e) Recommend that facility and physicians maintain a high index of suspicion for legionellosis in patients with pneumonia and remind them of the preferred diagnostic tests. Any new cases (among inpatients, outpatients, visitors, volunteers or employees) should be immediately reported to DOH.
 - f) Continue periodic follow-up with the facility for four months from last case onset to get updates and determine if there is evidence of ongoing transmission.
4. For a single possible healthcare-associated case:
 - a) Recommend that facility and physicians maintain a high index of suspicion for legionellosis in patients with pneumonia and remind them of the preferred diagnostic tests. Any new cases (among inpatients, outpatients, visitors, volunteers or employees) should be immediately reported to DOH.
 - b) If environmental testing is conducted at the facility and samples are positive for *Legionella*, follow guidance for definite healthcare-associated cases.

Appendix C: Outbreak Surveillance

The legionellosis surveillance coordinator reviews the risk factor data on a regular basis. A computer program pulls all risk factor data for investigations opened within the past year. Risk factors from all open and newly completed investigations are flagged for review. If two or more cases from the past year report a common risk factor, all investigations are reviewed. After considering the extent of exposure, potential sources of *Legionella* at the facility and overall likelihood of an outbreak occurring at the site, an outbreak investigation might be initiated.

Appendix D: Outbreak Investigations

DOH investigations of legionellosis outbreaks follow the general protocols outlined below.

Outbreaks associated with buildings

- Health care facility (HCF) outbreaks: HCFs are usually familiar with *Legionella* and have the capability to do in-house environmental testing. DOH is generally involved as a consultant.
 - DOH provides guidance and consultation.
 - The HCF conducts environmental testing, focusing on areas where patients spent time. On occasion, the facility hires a private contractor to do testing.
 - If any environmental samples are positive for *Legionella*, the HCF may conduct their own remediation, or they may hire a private contractor to do it.
 - The HCF conducts enhanced prospective clinical surveillance and notifies DOH of any additional cases of legionellosis.
- Non-health care facility outbreaks: Non-health care facilities may be unfamiliar with *Legionella* and require extensive education.
 - DOH provides education and guidance.
 - DOH and the facility assess potential sources such as decorative fountains, hot tubs, cooling towers, etc. and immediately discontinue use of any that are non-essential.
 - Environmental testing may be conducted by DOH, the Pennsylvania Department of Environmental Protection (DEP) and/or a private contractor hired by the facility.
 - If any environmental samples are positive for *Legionella*, the facility hires a private contractor to conduct remediation and follow-up testing.
 - If potentially exposed persons live in other states, DOH will post an Epi-X Call for Cases in an effort to identify additional cases.
 - DOH will monitor PA-NEDSS for additional cases.

Community outbreaks

- DOH will assess potential sources such as cooling towers, decorative fountains, etc. DOH and/or DEP will contact parties responsible for the potential sources.
- DOH, DEP, and/or a private contractor may conduct environmental testing.
- If any environmental samples are positive for *Legionella*, the responsible party hires a private contractor for remediation.

Appendix E: Additional Resources

[Legionellosis fact sheet](#) (DOH)

The following CDC resources are shared with facilities when appropriate:

- [Developing a Water Management Program to Reduce *Legionella* Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards](#): Many buildings need a water management program to reduce the risk for *Legionella* growing and spreading within their water system and devices. This toolkit is designed to help people understand which buildings and devices need a *Legionella* water management program to reduce the risk for Legionnaires' disease, understand what makes a good program, and determine how to develop it.
- [Federal Requirement to Reduce *Legionella* Risk](#): In June 2017, the Centers for Medicare & Medicaid Services (CMS) released a survey and certification memo stating that health care facilities should develop and adhere to ASHRAE-compliant water management programs to reduce the risk for *Legionella* and other pathogens in their water systems.
- [Legionnaires' Disease: A problem for health care facilities](#): CDC outbreak investigations show that effective water management programs – actions that reduce the risk of *Legionella* growing and spreading in building water systems – can help prevent problems that lead to Legionnaires' disease. Health care facility leaders should be aware that Legionnaires' disease is a risk in their facility and that they can take action to prevent infections.
- [Environmental Investigation Tools](#): This page provides tools to assist in the environmental component of legionellosis outbreak investigations ([Legionella Environmental Assessment Form](#), [CDC Sampling Procedure and Potential Sampling Sites](#), [Sample Data Sheet](#), and [Environmental Investigation Videos](#)). These may be useful to health care facilities that are conducting their own environmental sampling and testing.
- [Considerations When Working with *Legionella* Consultants](#): Deciding whether to work with a consultant to develop a *Legionella* water management program or for remediation services, as well as the exact type and number of consultants to use, depends upon the situation and the consultant's area of expertise.
- [Considerations for Public Hot Tub Operators](#): Operators that focus on hot tub maintenance and operation to ensure continuous, good water quality are the first line of defense in preventing the spread of recreational water illnesses.
- [Disinfection of Hot Tubs Contaminated with *Legionella*](#): Learn about best practices for remediation of hot tubs.

Other useful resources:

- [ASHRAE Guideline 12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems 2000](#): This guideline provides information on the ecology of *Legionella* and guidance to minimize and remediate colonization in building water systems.
- [ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems \(ANSI approved\)](#): This standard, first published in 2015, establishes minimum risk management requirements for building water systems to prevent legionellosis.

- [Frequently Asked Questions on ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems](#): Get answers to frequently asked questions about ASHRAE Standard 188, which outlines a minimum legionellosis risk management program for buildings.
- [Cooling Tower Institute Legionellosis guideline: Best practices for control of *Legionella*](#): The purpose of this guideline is to provide information and guidance in order to minimize *Legionella* in evaporative cooling water systems, specifically evaporative condensers, closed-circuit fluid coolers and cooling towers.

Citations

1. Soda EA, Barskey AE, Shah PP, et al. Vital Signs: Health Care–Associated Legionnaires’ Disease Surveillance Data from 20 States and a Large Metropolitan Area — United States, 2015. MMWR Morb Mortal Wkly Rep 2017;66:584–589. DOI: <http://dx.doi.org/10.15585/mmwr.mm6622e1>
2. Shah PP, Barskey AE, Binder A, et al. Legionnaires’ Disease Surveillance Summary Report, United States, 2014-2015. Centers for Disease Control and Prevention 2018. <https://www.cdc.gov/legionella/health-depts/surv-reporting/2014-15-surv-report-508.pdf>