

## Fact Sheet: *Legionellosis*

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***Brought to you by the APSP Recreational Water Quality Committee (RWQC)***

### I. INTRODUCTION

Legionellosis is an infection caused by the bacterium *Legionella*. There are at least 46 species and 70 subgroups (serogroups). Approximately half of the species may cause human disease. Approximately 90 percent of all infections are caused by one species: *Legionella pneumophila*.

The bacterium was named *Legionella pneumophila* after a 1976 outbreak in Philadelphia during an American Legion convention. During the outbreak, at least 239 people were infected. The outbreak began when a number of attendees developed serious pneumonia. The pneumonia did not respond to conventional medical treatment and 34 people died. Initially, it was not known whether the pneumonia was caused by infection or by chemical poisoning. After an extensive investigation, the illness was traced to previously-unknown bacteria that were found growing in the HVAC system at one of the convention hotels.

Legionellosis is not spread by person-to-person contact. Legionellosis is caused by inhaling airborne droplets of water containing *Legionella* bacteria. The diagnosis of Legionellosis requires specialized tests not routinely performed on persons with pneumonia or fever.

Legionellosis can occur in two forms. The most serious form is Legionnaires' Disease. Legionnaires' Disease is a severe form of pneumonia and it can be fatal, especially to smokers and individuals with weakened immune systems. Smokers and individuals with weakened immune systems require prompt medical treatment or the prognosis can be dire. The second form of Legionellosis is Pontiac Fever, which is a mild infection and has symptoms similar to the flu. Individuals recover quickly from Pontiac Fever and do not usually require medical treatment.

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**Table 1 — Comparison of Legionnaires' Disease and Pontiac Fever**

	Legionnaire's Disease	Pontiac Fever
Type of Illness	<ul style="list-style-type: none"> <li>• Progressive pneumonia</li> <li>• 5-15% fatality rate</li> <li>• Treatment required</li> <li>• Highest fatality rate in health care facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Flu-like illness</li> <li>• Recovery in 2-5 days</li> <li>• Medical treatment not necessary</li> </ul>
Symptoms	<ul style="list-style-type: none"> <li>• Severe pneumonia with chills and cough</li> <li>• Muscle aches, headache, tiredness, loss of appetite, and diarrhea</li> </ul>	<ul style="list-style-type: none"> <li>• Fever</li> <li>• Muscle aches</li> </ul>
Infection rate	<5% of those exposed	>95% of those exposed
Incubation	2-10 days	36-hours
Risk Factors	<ul style="list-style-type: none"> <li>• Smoking and lung disorders</li> <li>• Diabetes, cancer, and kidney disease</li> <li>• AIDS/HIV</li> <li>• Age older than 50</li> <li>• Heavy drinking</li> </ul>	<ul style="list-style-type: none"> <li>• None known</li> </ul>

## II. WHERE DOES IT COME FROM?

Current studies show that *Legionella* bacteria are widespread in nature; more than 40 percent of all fresh waters contain *Legionella* bacteria. The bacteria most likely enter man-made systems, such as HVAC systems, water heaters, and spas, via the fill water.

*Legionella* bacteria have a special lifestyle and unique nutritional requirements. *Legionella* bacteria grow only when other microorganisms are present. The other microorganisms supply nutrients for the *Legionella*. Most of the time the *Legionella* bacteria live as parasites inside of protozoa, especially amoeba. Sometimes *Legionella* grow as small colonies inside biofilm with other bacteria and fungi. Periodically, some of the *Legionella* break out of the protozoa or the biofilm and randomly swim in the water. It is these free swimming *Legionella* cells that can cause Legionellosis.

*Legionella* are found only in wet locations and they die when their environment dries out. The *Legionella* bacteria grow slowly at temperatures under 61°F, but thrive when the temperature is between 90°F and 106°F.

Operating conditions inside cooling towers, humidifiers, domestic hot water systems, and spas are similar to the wet, natural habitat of *Legionella*. When these systems are not properly maintained, a significant biofilm will develop. This creates the environment where *Legionella* can grow and multiply into large colonies. If this happens, cooling towers, humidifiers, and showers may then broadcast fine droplets of *Legionella*-filled water into the air. If the droplets are the correct size, individuals can inhale the droplets. The droplets enter the lungs where they invade white blood cells and produce Legionellosis.

### III. LEGIONELLOSIS CASES

The U.S. Centers for Disease Control and Prevention (CDC) estimates that there are between 8,000 and 18,000 cases of Legionellosis in the U.S. every year. Public health officials estimate that less than ten percent of all cases are reported. The overall fatality rate is between 10 percent and 15 percent. The majority of Legionellosis infections are caused by accidental contact with the bacteria in natural bodies of water such as lakes or rivers.

The second largest source of infection is health care facilities such as hospitals and nursing homes. The fatality rate for these infections can be as high as 50 percent. This is not surprising in that these individuals have underlying health issues, which frequently include weakened immune systems. Engineered water systems, such as cooling towers and humidifiers, are the major source of infections.

A small number of cases have been traced to showers and spas. In spas, *Legionella* become trapped in the bubbles from aeration. When the bubbles break the surface, they burst and release fine droplets that contain the bacteria. Spa users and others in the vicinity inhale the airborne droplets into their lungs, where the bacteria produce an infection. It is likely that the majority of infections from contaminated spas are Pontiac Fever, the less severe form of Legionellosis. *Legionella* bacteria have not been found in spas that are properly maintained. Swimming pools have not been linked with outbreaks.

Table 2 — Distribution of Legionellosis Cases

Percentage of Cases	Category	Source(s)
>50%	Isolated	Unknown natural source
23%	Hospital-acquired	Health care facilities
10-20%	Linked to outbreak	Cooling towers, humidifiers, showers, spas

#### IV. EXAMPLES OF OUTBREAKS FROM SPAS AND PORTABLE HOT TUBS

The following well-publicized cases are typical Legionellosis outbreaks from spas. According to CDC Surveillance Summary data, outbreaks of this type continue to occur as a result of inadequate sanitation.

Case 1. In 1994, an outbreak occurred on a cruise ship sailing between New York City and Bermuda. A clinical investigation of the infected passengers confirmed 14 cases. One person died. The investigation showed that the ship's spa was the source of the outbreak. The spa's sand filter was infested with microorganisms, including *Legionella pneumophila*. The infestation developed because the sanitizer concentration had not been properly maintained.

Further investigation indicated that at least 28 passengers on nine previous cruises had also developed Legionellosis.

Note: After this outbreak, the CDC developed operational guidelines for spas on cruise ships. A link to the operational manual is included in the references of this bulletin.

Case 2. In 1996, an outbreak of 23 cases and two deaths was reported in Virginia. Twenty-two of the individuals required hospitalization. The mean age of the victims was 65. A clinical investigation traced the cases to a large home improvement center. DNA evidence positively traced the bacteria to a display spa in the store. The spa had been filled with drinking water but was never treated with a sanitizer. All patients reported being in the vicinity of the spa. The average time spent in the store was 79 minutes. Several patients spent 10 minutes in the spa display area. Four patients reported only walking by the spa display.

Case 3. In 1999, a total of 188 cases of Legionnaires' Disease and 15 deaths were reported in the Netherlands during an outbreak that occurred at a large flower and consumer show. Public health authorities began an extensive investigation after receiving reports of numerous cases of severe pneumonia. Although several possible water handling systems were involved, the evidence implicated a display spa. The spa was filled with water and held at 99° F four days prior to the show. The spa was never treated with a sanitizer.

#### V. HOW DO YOU CONTROL IT?

*Legionella* bacteria are easily controlled if adequate sanitizer concentration is maintained at all times. No outbreaks have occurred when the water in the spa is properly maintained.

*Legionella* and many other bacteria can quickly develop into very large colonies if the disinfectant/sanitizer level is not sufficient. This is especially true in spas with bathers. The organic load (body oils, perspiration, urine, feces, and cosmetics) in these spas provides a high concentration of nutrients for microorganisms. The warm temperature coupled with organic load allows microorganisms to develop large colonies rapidly.

The U.S. Environmental Protection Agency (EPA) regulates products that control bacteria in swimming pools and spas. Those products registered by the EPA as disinfectants/sanitizers have been proven to adequately control bacteria in swimming pools and spas. A number of treatments are sold that claim to control bacteria but that have not been registered by the EPA, and the ability of these products to control bacteria has not been independently verified. Therefore, these products may not provide the necessary control of disease-causing bacteria.

The APSP recommends that all spa and portable hot tub operators:

- Use an EPA-registered disinfectant/sanitizer. The product label will use one of these two words.
- Follow the label directions.
- Maintain the concentration of the disinfectant/sanitizer specified on the label at all times.
- Maintain the pH between 7.2 and 7.8.
- Perform regular oxidation and water replacement.
- Heavily used spas and commercial spas require frequent water replacement.
- Lightly used residential spas require cleaning and refilling every three months.

If an outbreak is confirmed or suspected, the spa must be decontaminated at once.

- Close the spa immediately.
- Turn off the blowers.
- If the spa is indoors, make certain that air for the spa room does not circulate into the rest of the facility through the HVAC system.
- Replace the filter cartridges or filter media.
- Chemically clean the filter housing and all accessible areas. Disinfecting bathroom cleaners are suitable for most spas. The area should be rinsed with tap water and the rinse water discarded before the spa is refilled.
- Decontaminate the spa (see [Decontamination of Spas and Wading \(Kiddie\) Pools Fact Sheet](#)).

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