



hydrosense

Legionella e-book

Introduction to Legionella

Ever since the first recorded outbreak of Legionnaires' disease in July 1976, when 29 out of the 182-people infected died due to poor maintenance of a hotel cooling tower in Philadelphia, more than 58 different species of Legionella have been discovered¹. Of these species, less than half cause disease. By far the species that is the greatest risk to human health is Legionella pneumophila which comes in 15 distinct 'serogroups' (distinct variations within a species.) Legionella pneumophila serogroup 1 is, by far, the most virulent strain and is responsible for 70 to 92% of laboratory-detected legionellosis cases in the United States and Europe² and for most outbreaks of Legionnaires' disease in the world to date (Legionellosis is the generic term used for sickness caused by Legionella bacteria).

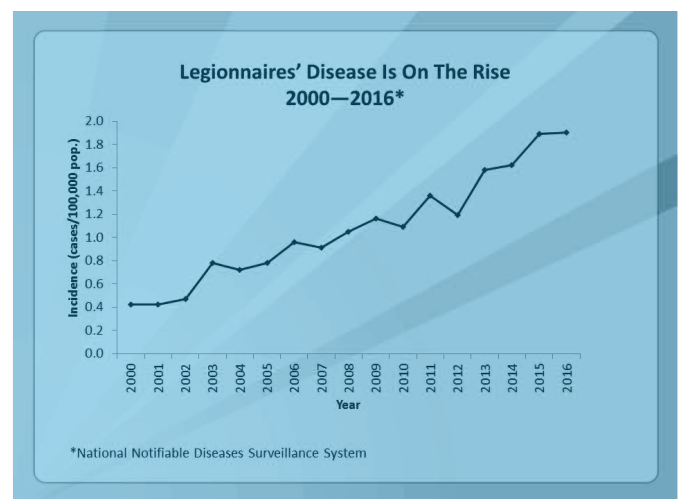
Legionella pneumophila is a deadly pneumonia-causing bacterium, which if inhaled by humans, can lead to fatal respiratory diseases. It is naturally occurring and is widespread in ponds, rivers and other natural water systems. But when the bacterium enters water systems in the built environment, conditions can often favor and encourage rapid growth and can lead to explosive outbreaks of Legionnaires' disease and other related infections.

If water systems, such as cooling towers, whirlpool spas, air misters and showers are not well maintained, they can soon become serious biological hazards, putting customers, staff and the general public at risk.

The business impact of an outbreak, from both operation and litigation standpoints, can be catastrophic and the consequences felt by victims and their families, heart-breaking.

In recent years, there has been an increase in cases of Legionnaires' disease worldwide, with reported incidences of Legionnaires' disease growing at an alarming rate. In 1993, there were a total of 1,242 cases of Legionnaires' disease in Europe. In 2018, this number had increased to a total of 5,960 cases³.

And in the US, reports from 2017 show that cases of Legionnaires' disease have gone up by 13.6%⁴, that's double the increase of the previous year! Figure 1., taken from CDC⁵, shows that **cases have increased by over 450% since 2000**, in the US.





hydrosense

smarter test, safer water

The infection is now killing ~1 in every 10 people who are infected⁵. However, this number is much larger in high-risk scenarios. For example, CDC states that 1 in 4 people who get the infection from a health care facility will likely die⁶.

In response to this problem, governments and court systems worldwide have been cracking down on the widespread negligence surrounding Legionella in workplaces and public spaces, with huge fines and litigation settlements. You can now be fined tens of thousands, or millions, if you are found to be negligent and can even face prison on grounds of manslaughter.

Illness Caused by Legionella



Legionella pneumophila bacteria causes Pontiac fever and Legionnaires' disease. **Pontiac fever is a mild flu-like illness with symptoms such as fever, headache and muscle aches, but it does not cause pneumonia.** It is very common for people to contract Pontiac fever when exposed to Legionella bacteria and medical practitioners will often assume that they have the common flu, since both have very similar symptoms. Interestingly, Pontiac fever seems to affect young, healthy individuals as well as those in high-risk groups for Legionnaires' disease.

According to The Centre for Disease Control and Prevention (CDC), up to 95% of people exposed in any outbreak can develop symptoms of Pontiac fever⁷. When one or more individuals contract Pontiac fever, it is important to establish where the source of the infection came from because this source could also lead to a far more serious outbreak of Legionnaires' disease.



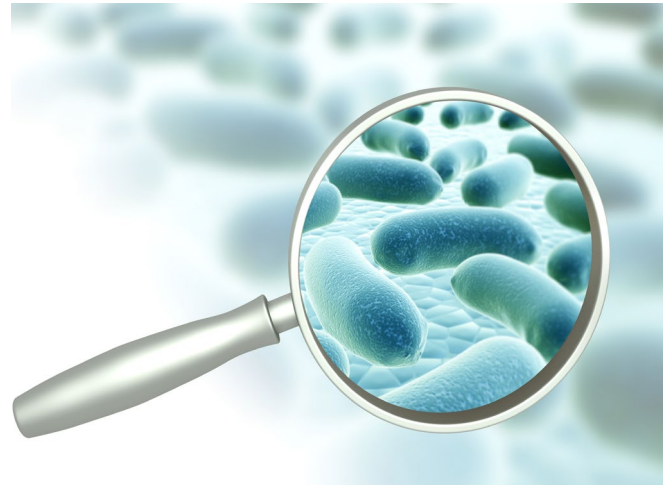
hydrosense

smarter test, safer water

Legionnaires' disease is a severe form of pneumonia, which causes potentially fatal complications to occur within human lungs. If the infection is not contained or treated early on, tiny air sacs (which can be found at the end of the breathing tubes in the lungs) fill up with fluid and pus and stop oxygen from passing into the blood. This causes carbon dioxide levels in the body to soar, triggers shortness of breath, and if the brain cannot get the oxygen it needs, can cause confusion, comas, heart failure and ultimately death⁸. The infection can also stop the kidneys from filtering blood, causing a build-up of toxic waste products in the bloodstream, as well as severe sepsis which can cause blood clotting, low blood pressure and organ failure⁵.

How is Infection Spread?

Legionnaires' disease is not contagious and cannot be caught by drinking contaminated water or from natural water sources. The infection is contracted when bacteria are inhaled into the lungs in the form of tiny contaminated water droplets or aerosols. These aerosols are produced anywhere where water is splashed or sprayed. Under the right conditions, Legionella can infest entire buildings within a matter of days and can cause devastating physical harm to individuals and catastrophic reputational damage to businesses.



The following conditions allow Legionella to multiply rapidly in man-made water systems and increase the risk of an outbreak:

- Temperatures between 20-45°C
- Changes in municipal water quality
- Construction
- Presence of old plumbing and corrosion
- Large and complex water systems – as these have a larger surface area for the growth of Legionella and can contain areas in which bacteria can evade biocides
- Areas of stagnation in the water system – for example when taps or showers have not been used in a while

- Dead legs and poor system design
- Differing levels of biocides present in the system
- Areas where no biocide is used
- Areas that produce a lot of water spray or aerosol
- Suboptimal duty holder chain of command
- Low levels of knowledge and education about Legionella in the appointed responsible persons
- Poor maintenance and control of control measures
- No control measures in place at all
- Areas where people with a weakened immune system are present
- pH fluctuations
- Changes in water pressure
- Nutritional build-up of biofilm, scale, sludge etc^{11*}

**Sources of protection and nutrition for Legionella are algae, amoebae and other bacteria. Scale, sludge, biofilm and other sediment can provide favorable conditions for growth and can protect bacteria from hostile temperatures and biocides, that would otherwise kill them¹².*

If any of the conditions mentioned are present at your location, it is imperative that the correct control measures are put in place to stop deadly bacteria from spreading and contaminating your whole water system. It is also important to note that while temperatures between 20-45°C promote the growth of Legionella, this does not mean that the parasitic bacteria cannot survive outside of these favorable temperatures.

Legionella has been found in temperatures as low as 6°C and as high as 60°C. The organisms don't seem to survive temperatures over 60°C and cannot multiply in temperatures under 20°C but in cooler environments, they may remain dormant until temperatures rise, for instance in the summer¹³.

Early Signs of Infection



Early signs of infection are often similar to those of the common flu and include fatigue, diarrhea, dry cough, fever, headaches and muscle pains. Individuals may also experience confusion and vomiting. Early symptoms of pneumonia are similar and include trouble breathing and chest pains, as well as a cough.

Long-term Side Effects

Those who are lucky enough to survive Legionnaires' disease can experience severe life-changing and long-term health impacts. A study carried on 122 survivors in the Netherlands found that **survivors of Legionnaires' disease suffered from chronic fatigue in 75% of cases; had neurological symptoms (such as short and long-term memory loss) in 66% of cases; neuromuscular symptoms (such as muscle pain and loss and movement issues) in 63% and post-traumatic stress disorder (PTSD) in 15% of cases.** On average survivors of Legionnaires' disease have a 1.5-year decrease in their health-related quality of life¹⁰.

Unfortunately, there is no vaccine for Legionellosis. People at increased risk of infection may choose to avoid high-risk areas, such as whirlpool spas. If exposure cannot be avoided, individuals should be advised to seek medical attention promptly if they develop symptoms of Legionnaires' disease or Pontiac fever⁷.

Who is at Risk?

Anyone can catch Legionnaires' disease. However, individuals with weakened immune systems are more prone to catching the infection and are less likely to have the physical capability to fight it off. These individuals include:

- *Older people (usually 50 years or older, especially male);*
- *Current or former smokers;*
- *People with a history of heavy drinking;*
- *People with a chronic lung disease;*
- *People with a weak immune system from diseases like cancer, diabetes, kidney failure or AIDS/HIV;*
- *People who take drugs that suppress (weaken) the immune system (e.g. after a transplant operation or chemotherapy).*

CDC's Vital Signs Report found that a shocking 80% of cases of Legionnaires' disease are nosocomial (contracted from health-care facilities)⁶, where water maintenance should be meticulous. Because of the high-risk nature of these buildings, it is critical that water systems are maintained properly and that routine Legionella tests are carried out. Preventing exposure using these techniques is the only way to prevent fatalities in people with weakened immune systems.



hydrosense

smarter test, safer water

How this Impacts your Organisation?

Legionella can live and grow in any plumbing system, including those which fall outside of regulatory oversight, making it extremely hard to control and prevent¹⁵. But, if you fail to take necessary measures to decrease the risk of Legionella to your staff and the public, both you and your organization will be liable for prosecution. In the United Kingdom, The Health and Safety at Work Act states that businesses must fully assess the risk of Legionella to their property¹⁶. If you fail to do so, you may be fined hundreds to hundreds of thousands of pounds. In the UK, **it is also possible for managers and directors to be fined and even imprisoned under health and safety legislation, or under common law, if a death has occurred because of the individual's negligence**¹⁷.

These fines are not to be taken lightly and are substantial enough to shut down your business. For example, in 2012, a warehouse store with a dirty hot tub display caused an outbreak of Legionnaires' disease which resulted in two fatalities and more than eighteen hospitalizations. In the summer of 2017, they were fined £1 million for their negligence.

In May of 2006, there was an outbreak of Legionnaires' disease at Central Baptist Hospital in the US, where numerous patients fell ill and lost their lives. While the hospital's water system was supposed to be kept at 60 degrees Celcius, the reality was that temperatures were being kept at 35 - 46 degrees Celcius. On top of that, the pumps which were meant to circulate water were damaged and water in the system

had become stagnant, thus creating ideal conditions for the growth and spread of Legionella. In 2008, North Central Baptist Hospital, along with a number of other defendants, had to pay a \$5.2 million dollar settlement¹⁸ - A heavy price to pay considering the issue could have been prevented with frequent routine testing.

Remember: You do not need to be identified as the source of an outbreak nor do people have to die for you to be prosecuted or for you to face litigation. You just have to be found to be negligent.

It is important to control your risk of Legionella, to keep yourself, your staff and the public safe. Failure to implement proper control systems or to carry out frequent risk assessments can lead to outbreaks, heavy fines, litigation settlements and huge reputational damage, for any organization, its owners and managers.

Find out what methods are available to you for Legionella testing in your facility. Download the Hydrosense Testing Methods ebook.

References:

1. Specialpathogenslab.com. (n.d.). Special Pathogens Laboratory, The Legionella Experts | Legionella Species. [online] Available at: <https://www.specialpathogenslab.com/legionella-species.php> [Accessed 15 May 2018].
2. Mercante, J. And Winchell, M. (2015). Current and Emerging Legionella Diagnostics for Laboratory and Outbreak Investigations. [online]. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4284297/> [Accessed 6 May 2018].
3. Joseph, C., Ricketts, K. and on behalf of the European Working G, C. (2010). Legionnaires' disease in Europe 2007–2008. Eurosurveillance, [online] 15(8). Available at: <https://www.eurosurveillance.org/content/10.2807/ese.15.08.19493-en> [Accessed 5 May 2018].
4. Centers for Disease Control and Prevention. (2018). Notifiable Diseases and Mortality Tables. [online] Available at: https://www.cdc.gov/mmwr/volumes/66/wr/mm6648md.htm?s_cid=mm6648md [Accessed 7 May 2018].
5. Cdc.gov. (2018). Legionnaires Disease and Pontiac Fever | Legionella | CDC. [online] Available at: <https://www.cdc.gov/legionella/> [Accessed 30 May 2018].
6. Henderson, R. (2017). Legionnaires' Disease. Information about Legionnaires' Disease. [online] Patient.info. Available at: <https://patient.info/health/legionnaires-disease-leaflet> [Accessed 7 May 2018].
7. CDC. (2017). CDC Press Releases: Patients in health care facilities at risk for Legionnaires' disease. [online] Available at: <https://www.cdc.gov/media/releases/2017/p0606-legionnaire-disease-risk.html> [Accessed 7 May 2018].
8. Prevention, C. (2017). Legionellosis (Legionnaires' Disease & Pontiac Fever) - Chapter 3 - 2018 Yellow Book | Travelers' Health | CDC. [online] CDC. Available at: <https://wwwnc.cdc.gov/travel/yellowbook/2018/infectious-diseases-related-to-travel/legionellosis-legionnaires-disease-pontiac-fever> [Accessed 7 May 2018].
9. BBC Science. (2013). What is pneumonia and why can it be so deadly?. [online] Available at: <http://www.bbc.co.uk/science/0/21969416> [Accessed 7 May 2018].
10. WHO Western Pacific Region. (2005). Legionellosis. [online] Available at: http://www.wpro.who.int/mediacentre/factsheets/fs_200502_environmental_health/en/ [Accessed 7 May 2018].
11. Lettinga, K., Verbon, A., Nieuwkerk, P., Jonkers, R., Gersons, B., Prins, J. and Speelman, P. (2002). Health-Related Quality of Life and Posttraumatic Stress Disorder among Survivors of an Outbreak of Legionnaires Disease. Clinical Infectious Diseases, [online] 35(1), pp.11-17. Available at: <https://academic.oup.com/cid/article/35/1/11/281461> [Accessed 5 May 2018].
12. Cdc.gov. (2018). Legionella Growth and Spread | Healthcare Facilities | CDC. [online] Available at: <https://www.cdc.gov/legionella/wmp/overview/growth-and-spread.html> [Accessed 15 May 2018].
13. Hse.gov.uk. (2002). Report of the public meetings into the legionella outbreak in Barrow-in-Furness, August 2002. [online] Available at: <http://www.hse.gov.uk/legionnaires/assets/docs/barrowreport.pdf> [Accessed 7 May 2018].



hydrosense

smarter test, safer water

14. Who.int. (2007). LEGIONELLA prevention of legionellosis. [online] Available at: http://www.who.int/water_sanitation_health/emerging/legionella.pdf [Accessed 15 May 2018].and the
15. Beer, K., Gargano,, J., Roberts, V., Hill, V., Garrison, L., Kutty, P., Hilborn, E., Wade, T., Fullerton, K. and Yoder, J. (2015). Surveillance for Waterborne Disease Outbreaks Associated with Drinking Water — United States, 2011–2012. [online] PubMed Central (PMC). Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4584589/> [Accessed 7 May 2018].
16. Hse.gov.uk. (n.d.). HSE -Legionnaires' disease - What you must do. [online] Available at: <http://www.hse.gov.uk/legionnaires/what-you-must-do.htm> [Accessed 7 May 2018].
17. Davies, A. (2012). Managing Legionnaires' Disease - Pitmans Law. [online] Pitmans Law. Available at: <https://www.pitmans.com/insights/news/managing-legionnaires-disease/> [Accessed 7 May 2018].
18. Ruiz, J. (2008). Legionnaire's Settlement. [online] Issuu. Available at: <https://issuu.com/jruiz47/docs/settlement> [Accessed 13 Jun. 2018].