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Legionella – A Horror Story in the Making 42 Years Later

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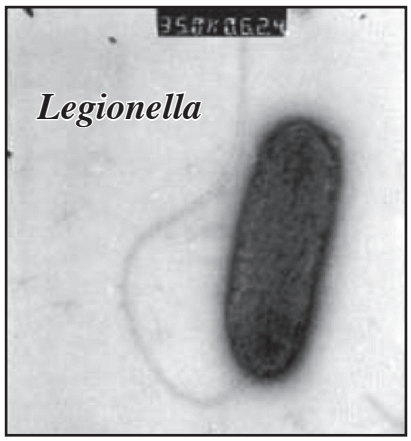
The word itself, Legionella, conjures terrifying images of excruciatingly painful breathing and final death. Our story began 42 years ago on August 2, 1976, in Philadelphia, PA when several retired servicemen who had recently attended a convention of the American Legion had presented at a clinic with atypical pneumonias – and four were already dead.

In total, 180 Legionnaires contracted the disease, dubbed the "Philly killer," and 29 of them had died. Working around the clock, a Centers for Disease Control (CDC) microbiologist, Joseph McDade, determined that the rod-shaped bacterium, Legionella pneumophila, was the causative agent of the Philly killer. The source of the pathogen was ultimately traced to the air-conditioning cooling tower on the convention hotel. A bus driver and several pedestrians who had simply passed by the front of the hotel also contracted the disease.



It has been believed that although Legionnaires' Disease (LD), or legionellosis, is deadly, it is also rare. Unfortunately, this belief is being challenged worldwide as the battle with this contagion is rising to new levels. Some of the legionellosis cases are now coming from middle-aged patients usually not considered likely candidates for the disease. There are now more than 10,000 cases of Legionnaires' disease reported each year. To further complicate matters, clinicians often misdiagnose LD as community-acquired pneumonia (CAP) or hospital-acquired pneumonia (HAP), thus leading to underreported LD cases and number of fatalities. The correct diagnosis of LD has increased with the introduction of the urinary antigen test. However, the test is not foolproof since it cannot detect all Legionella species.

Since it is very difficult to clinically distinguish patients with LD from patients with other types of pneumonias, Legionella should be considered in any CAP or HAP case. Legionella ranks second to pneumococcus on the list of agents causing severe CAP. CAP caused by Legionella has a higher mortality rate (5 to 30%) than pneumonia caused by other organisms.[1] HAP has a fatality rate of 28%[2].

In addition to Legionella pneumophila, at least 19 Legionella species have been documented as human pathogens. It is now well known that Legionella most often spreads by colonizing biofilms in plumbing systems, and the source is typically the municipal water supply. Examples of Legionella amplification in buildings often come from cooling towers, evaporative condensers, humidifiers, ice machines, potable water heaters, water pipes and distribution systems, shower heads, faucets, decorative fountains, nebulizers, hot tubs, and whirlpool baths. There is no vaccine for LD. Prevention and maintenance of building water systems is the frontline battlefield in the war on this pervasive malady.

Once scientists discovered that LD was caused by a gram-negative bacterium susceptible to antibiotics, some declared the war on the Philly killer won. However, in 2017 (41 years after the first outbreak), the Centers for Medicare and Medicaid Services (CMS) issued a directive requiring healthcare facilities to reduce the risk of Legionella in water systems to prevent cases and outbreaks of LD. Unfortunately, scientists are learning that the bacterium is more than what they had originally thought. It is a killer that could easily be described in a science fiction thriller or a horror story.

The Organism

Legionella pneumophila serogroup 1, the deadliest strain of LD, has an ideal growth temperature range of 80-120°F. Yet, the bacterium can survive in ice. Legionella has been associated with cold water dispensers and ice chips from hospital ice machines. Legionella species have been traced to garden hoses, soil, lakes, streams, and rivers. Legionella has also been isolated in Antarctic snow pack. In 1999, Legionella longbeachae infections were reported in Australia from exposure to potting soil and dripping hanging pots. In 2002, LD was responsible for a death after a near-drowning incident in a lake in Finland. In 2015, 12 people died from LD traced to air conditioning systems in New York's Bronx borough.[3] In 2018, an outbreak of LD in Bresso, Italy, affected 26 people, including three elderly individuals who died.[4] Legionella was found in one sample from the home of a patient and in one from a public fountain.

Of all the survival attributes of this organism, perhaps its best defense is the fact that it is a parasite. In the watery realm, where Legionella thrives, many other organisms abound. These organisms exist in a constant state of feeding frenzy and starvation. The kings of the microscopic world are perhaps the protists. These microorganisms, like the amoeba and paramecium, are considered by microbiologists to be the "gun boat hunter-killers" munching on bacteria in a manner that conjures up images of the old Pac-Man arcade game.

The Parasite

In the environment, Legionella have been shown to be parasites of protozoa. Normally, Legionella are very susceptible to biocides and disinfectants such as chlorination. However, once safely harbored inside protozoa, chlorination cannot reach and kill the Legionella cells. Inside the protozoan hosts, after being engulfed in a process known as phagocytosis, Legionella multiplies while safely cocooned in a vacuole. One infected protozoan can produce up to a thousand new Legionella cells. After killing the protozoan hosts in ways still under investigation, the newly created bacterial cells reinfect new hosts.

If Legionella infects protozoans, why should that be a concern for human health? It has been proposed that the infectious particle for LD is an amoeba infected with the bacteria[5]. Although this has not yet been proven, there are many lines of evidence to suggest that protozoa play major roles in the transmission of LD.

LD is caused when moisture particles of aerosolized water containing Legionella bacteria are inhaled into our lungs. Once inside the alveoli, the same death spiral observed in protozoa is observed in the human body where macrophages, the immune system cells that engulf invaders and keep us healthy, are infected by the invaders. The invaders multiply inside our lungs and eventually cause severe pneumonia and LD.

Can It Get Any Worse?

About 2 to 10% of patients with LD are coinfected with other organisms. These coinfecting organisms include typical pulmonary pathogens associated with other Legionella species, other bacteria, viruses, fungi, and parasites. Although thought of as a pulmonary disease, LD has been shown to infect other parts of the body such as the brain and colon. Polymicrobial infections are a leading cause of death when clinicians fail to identify and treat the dual component of infection.[6]

These coinfections, termed "superinfections" cause severe disease and death. Superinfection by Pseudomonas aeruginosa should be suspected in any case of LD. Pseudomonas aeruginosa has emerged as an important pathogen during the past two decades. It causes between 10% and 20% of infections in most hospitals. It is especially prevalent among patients with burn wounds, cystic fibrosis, acute leukemia, organ transplants, and intravenous-drug addiction.[7]

Where Do We Go from Here?

Severe disease itself, acute renal failure, a smoking habit, and immunocompromise are the most consistently identified prognostic factors of death in LD.[6] Over the past 42 years, scientists have come a long way with regard to understanding the organisms causing LD, the mode of transmission, and how to reduce or eliminate the risk of infection. Thus far, eradication has proven to be an unattainable goal. How will Legionella evolve over the next century? Will infection outside of the lungs (extrapulmonary), although currently rare, become common? Erythromycin continues to be an effective antibiotic against Legionella, as is Azithromycin and other newly developed drugs. But despite all the recent advances in medicine, and given the fact that Legionella bacteria are everywhere in the environment, this battle will continue for many years, especially if antibiotic resistance increases. There is optimism that the newly developed regulatory directives and water treatment plans will greatly reduce the incidence of this preventable disease.

F.W. Webb's Legionella Directive

If your facility is at risk for Legionella, organizations like F.W. Webb's Alliance Environmental Group (AEG) can help. They handle these challenges by selecting the most efficacious and cost-effective approach to Legionella assessment, evaluation, treatment, control, and mitigation. They develop comprehensive water management plans in accordance with the CMS Directive.

For more information on Legionella assessment, evaluation, treatment, and control in the Northeast, contact Alliance Environmental Group at 857-998-3711.

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