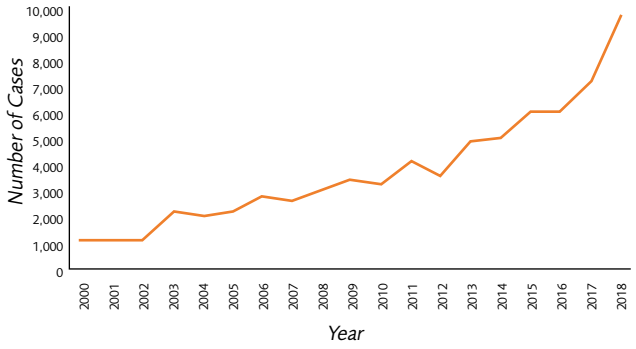
SIESO Medal

Implications of recent events on the risk of Legionnaires' Disease

Agnes Aparte and Aditi Holey, University College London, UK

Summary

Legionnaires Disease (LD) is not a common illness, but the number of reported cases has been increasing over time. Figure 1[1] indicates that the annual number of LD patients has grown tenfold during the last two decades in the US and reports from the UK agree with the trend [2,3]. However, authorities suspect that the rise in the recorded Legionella outbreaks is due to heightened awareness and developed testing, allowing more cases to be recognised.



Source: Nationally Notifiable Diseases Surveillance System

Figure 1 – Cases of Legionnaires Disease in the US 2000–2018

Case studies throughout history have shown the unique characteristics of the bacteria, Legionella. Several of these cases have shown that it is capable of travelling numerous miles from its source while another one-off study suggests that it could pass from person-to-person. An additional report of an unusual outbreak shows that there can be deficiencies with the testing procedure. Through these cases, health authorities have recognised and reinforced the need for safer technology to identify and eradicate Legionella.

Unfortunately, the hazards that Legionella pose have intensified due to COVID-19 as someone with symptoms of legionellosis can be misdiagnosed as a coronavirus patient. Developing studies show that patients with a history of legionellosis are more susceptible to COVID and vice versa[4]. At present, industries should continue to adhere to Health and Safety Executive (HSE) guidelines to prevent Legionella outbreaks while incorporating the new regulations against COVID-19.

Introduction to Legionella and COVID-19

SARS-COVID-19 has taken the world aback due to its contagious, debilitating, and fatal nature[5]; its attack on the lungs makes it a deadly pathogen. Legionnaires Disease (LD), a bacterial infection that also targets the lungs, has been hypothesised to have similarities to COVID. Legionella, the bacteria that causes legionellosis, usually grow in stagnant pools of warm water inside aquatic microorganisms[6].

There are numerous differences to consider between the pathogens. These include their kingdoms (virus vs bacteria), contagiousness (the coronavirus is highly contagious, Legionella is not), mortality rates (LD is more than thrice COVID) and side-effects (such as 'sticky blood' from COVID).

However, their similarities are considerably more significant since both pathogens attack the lungs. Both pose a higher risk to current and former smokers, those with underlying health conditions (especially lung diseases), older people, and affect males roughly twice more than females[7,8]. Moreover, their onset times (two days to two weeks) are equal. The symptoms for COVID and legionellosis are identical, ranging from a cough, progressing to a fever, breathlessness, and other respiratory problems. In severe cases, both infections could progress to pneumonia, severe acute respiratory syndrome, kidney failure (septic shock for Legionnaires), or death. Neither have a vaccine and poorly timed treatments for either disease may lead to the failure of the respiratory system[8].

At present, it is easy to mistake an individual with early symptoms of legionellosis as a COVID patient; this could result in the authorities being unable to identify the source of Legionella, which may expose that source to others. Additionally, research shows that one in five COVID patients in China and Japan are known to have a history of LD, which is concerning because LD patients are more vulnerable to COVID, and vice versa[4].

History of Legionella cases

Legionella got its name from the Pennsylvania Department of the American Legion convention outbreak in 1976[9,10]. Of the attendees, 234 contracted the disease, and 34 died, resulting in a mortality rate of 14.5%. After the incident, scientists developed a brief understanding of the causes, symptoms, and preventions of the illnesses caused by the bacteria. Despite this, almost a decade after in 1985, another major outbreak took place at Stafford General Hospital (68 were affected and 22 died). The mortality rate (32.3%) was much higher in this case since the outbreak took place in a hospital where most victims had compromised immune systems[11].

Since then, incidences have significantly increased in

knowledge and competence

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frequency.

Outbreaks from drinking-water systems are uncommon because Legionella does not enter the lungs while drinking water (unless one chokes)[12]. Instead, it is the mist formed around fountains, humidifiers, pools, showers, and other such facilities that is the leading cause of Legionella outbreaks[13].

Several case studies show that Legionella can have striking behaviours such as travelling about 6 miles from its source, producing negative test results despite its presence, and even having (unconfirmed) person-to-person transmission.

Movement of Legionella

There were several instances where Legionella drifted much further from their source [9].

The earliest was in 1988, at the headquarters of a broadcasting company in London. The outbreak affected 79 people (3 died) because of its ability to travel in air-conditioned environments [14]. The next outbreak took place in France (2003-2004), where the patients habituated regions over 12km from the source. It affected a total of 104, hospitalised 87 for LD, and killed 18. The source of the outbreak was powerful cooling towers at a petrochemical plant[15].

The farthest-reaching outbreak, however, was caused by an industrial air scrubber in Norway, 2005. Two adjacent districts had several cases of Legionella, and the local hospitals informed the governmental health agency of the outbreaks. Investigations promptly began to find and mitigate the sources of the legionella bacteria[16].

The Norwegian health officials obtained information that identified and tested the twenty-three local industries that could have had Legionella pneumophila in their reservoirs. The data obtained were used to calculate rates of infection and the likelihood of contracting Legionella within a certain radius of each possible source.

The results of the investigation showed that during the two weeks in which the outbreak occurred, the patients spanned 20km. There was no contact or overlapping movements amongst them. Residents within a 0.6-mile radius of an air scrubber with ideal growth conditions — mildly alkaline, temperatures of 40°C, an airflow of 20m/s and substantial water content — were at high risk.

Despite the new regulations introduced after the 2005 outbreak, another widespread outbreak occurred in 2008, where wastewater from aeration ponds (belonging to a biological treatment plant) was found to have Legionella. This water was fed into the local river (which also tested positive in both years), indicating that it contributed to the extensive spread of the outbreaks. Inspections carried out on the company infrastructure proved that the existing guidelines were being adhered to, causing the regulatory authorities to re-evaluate the original standards of maintenance[17].

Person-to-person transmission[18]

Although Legionella are non-contagious bacteria, the massive outbreak in Portugal 2014 suggests it may transmit among people. Case 1 (of the two concerned) was a middle-aged maintenance worker in Vila Franca de Xira with a history of smoking. Case 2 was his mother, a healthy woman in her early 70s.

The worker came home to Porto, 300km from work, and started exhibiting mild symptoms of LD. In just over a week, the symptoms escalated to severe respiratory problems. His mother took care of him before his hospitalisation the next morning, where he received cardiac and respiratory life support. In two weeks, the second case occurred when the mother admitted herself after exhibiting similar symptoms. Unfortunately, both patients died within three months.

The patients' urinary samples showed the presence of Legionella pneumophila, confirming LD. The bacterial strains collected underwent sequence-based typing and whole-genome sequencing through the health governmental agency. The 2-4 week gaps between their tests ensured there was no cross-contamination.

The results showed that 3.5 mega-bases of the genome sequence of the bacteria from patient two were identical to those in Vila Franca de Xira. The movements of patient two, however, showed that she remained in Porto. Her residence (and other locations she visited) were swabbed and tested negative for Legionella. Furthermore, the patients' similar onset times led scientists to speculate that person-to-person transmission occurred overnight when patient two cared for patient one.

This case of Legionella is one-off and is only a reminder that those who are in proximity of legionellosis patients for very long periods should be careful. The current advice remains that the disease is still non-contagious.

Inconclusive tests of water systems[19]

At a manufacturing facility (with administrative, engineering, and chemical divisions), three employees contracted Legionella.

The first case occurred at the chemical plant, the only premise with showering amenities. An employee was diagnosed with legionellosis for a few weeks but was able to return to work after recovery. Since this worker frequently used the showers, the facility was alerted of his illness and immediately initiated testing in all three sections of the facility's heated water systems.

The tests from this investigation came out negative.

Employers, therefore, believed the worker contracted Legionella from elsewhere, which was possible since the facility was following the minimum requirements set by the HSE. However, it is known today that there were no other outbreaks of Legionella in that surrounding area where the worker could have contracted it.

Nevertheless, within six months, two more cases occurred amongst the employees. Neither were chemical plant workers, so they had no contact with the showers at the facility, eliminating the shower piping as a possible source of contamination. The remainder of the facility's water systems were rechecked, but results were still negative.

This time, however, it was improbable that the employees both got the disease independently. Research into the victims' movements showed that these cases were likely linked to the facility, especially now that there were three cases of Legionella within six months. This doubt brought on further testing.

Eventually, inspections with the management proved that the laboratories (which were more than a mile away from the main facility) were not adhering to standards such as annual cleaning and regular disinfection, despite it testing negative for Legionella for three years. The HSE gave the company hefty

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fines for noncompliance.

This case emphasizes the need for UK companies to adhere to HSE guidelines in maintaining their facilities to avoid potential growth of Legionella in their water systems. It also indicates that testing for Legionella can be fallible because tests can come out negative despite the presence of the bacteria. There is also the possibility of being unable to test every water source in the area because Legionella is known to travel far from its source.

Lessons learned

The HSE suspects increasing stagnant water sources (which are ideal environments for Legionella) as the public returns from lockdown. It is therefore crucial that industries do not disregard HSE guidelines for Legionella while implementing those for COVID as both diseases are fatal. Probable new sources of stagnant water (and the aerosol producing nature of the systems) include any hot and cold-water systems (cooling towers, evaporative condensers, air-conditioning units) or any other still water systems in unattended infrastructures.

The HSE states that the removal of stagnated water, disinfection of the infrastructure, and replenishment with clean water are imperative to prevent outbreaks. In large systems, trained personnel must survey the system, implement the necessary tests, and ensure that the chemicals used are correctly preserved and dosed. Smaller systems should not present a risk, but larger, poorly maintained units are capable of being sources of bacterial growth. [20]

Preventing Legionella outbreaks is one of the central health focuses of companies during their operation. HSE guidelines must be upheld even if their water systems test negative for Legionella or are located far from the public as seen from the above cases. HSE protocols aim to adopt safer technology, regulate water treatment to kill bacteria at their sources, and monitor potential breeding sites[9]. Over the past decades, Legionella testing has improved considerably, resulting in more efficient detection and prevention of Legionella growth[21,22]. Failure in adhering to the guidelines may result in numerous preventable deaths which are a massive expense to the local community.

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