Data and Case Study of Effective Legionella Regulations

By

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IDEXX Water

ABSTRACT

Since the discovery of *Legionella pneumophila* as the causative agent of the mysterious outbreak in 1976 in Philadelphia, PA, the world has seen a steady increase of Legionnaires' disease. Several regions around the world have responded to significant outbreaks by developing and implementing laws to prevent this disease, but with mixed success. This presentation will describe various global laws, regulations, and guidelines currently in place intended to reduce this disease. Data from the 2021 European Centers for Disease Control (ECDC) on legionellosis will be covered, including geographies that preferentially use PCR and/or culture of patient samples versus, or in addition to, the Urine Antigen Test (UAT). Additionally, there will be a case study looking at the successes in France with managing cooling towers for *Legionella pneumophila* and which hands-on activities helped contribute to cleaner cooling towers and a reduction in disease cases. Both France and New York (State & City) have rules to manage Legionnaires' disease from cooling towers. Case and outbreak data from both France and New York, adjusted for population, will be presented and discussed. Two goals of this presentation are to give AWT members practical options to consider when writing and managing truly effective water management programs and also to encourage members to support right-sized rules to reduce this very preventable disease.

INTRODUCTION

Several countries, health agencies, and industry organizations have laws, rules or guidance to help prevent Legionnaires' disease (legionellosis) in the built environment. In addition, the European Commission has also addressed Legionella in public drinking water through the recast of the EU Drinking Water Directive, EU 2020/2184[1], that requires Member States to determine where and how public drinking water systems should identify and test for the risk of Legionella or *Legionella pneumophila*. The US Environmental Protection Agency (EPA) has recently been considering changes to the Safe Drinking Water Act rules to consider addressing the risk of *Legionella pneumophila* in public water systems[2].

However, this paper will focus on the rules that affect the built environment. These rules typically apply to buildings that have certain features and fixtures that create a risk of Legionella being aerosolized in water, such as buildings with these attributes:

- Multiple apartments and/or more than one centralized hot water system
- Healthcare facilities that have overnight stays
- Facilities that house or treat those who are immunocompromised, e.g., burn units, dialysis units, cancer treatment facilities
- Housing for people over 65 years of age
- One or more cooling towers
- A pool, spa or sauna
- Fountains, inside or outside

Buildings with attributes or fixtures like these, and others, provide the opportunity for *Legionella pneumophila* to live and multiply in warm, stagnant water, and then become aerosolized through some mechanical mechanism. Additional examples of at-risk fixtures include showers, hot tubs, sink sprayers, misters, and many other aerosolizing devices. The intent of the prevention rules covered here is to ***reduce*** the number of Legionella bacteria in the water and, thus, reduce the number of bacteria that can be aerosolized, breathed in, and create illness cases and outbreaks and deaths.

The most common sources that can cause wide-spread legionellosis disease risk are potable water, recreational water, and cooling towers (Table 1). The potable water found primarily in building systems could be showers and sink sprayers. Recreational water sources include pools, hot tubs and spas. Cooling towers are particularly important sources to control as the aerosols from them can affect a large number of people over a wide area. Significant outbreaks from cooling towers led to some of the first legionellosis prevention rules nearly 10 years ago.

Table 1 US Centers for Disease Control and Prevention National Outbreak Reporting System (NORS) (2009 – 2020)

Investigated Legionella outbreaks from 2009 - 2020		
Water Type	**No. of outbreaks**	**Illnesses per outbreak**
1. Drinking water, well water	248	1169
2. Recreational water; pools, spas, hot tubs	124	657
3. Cooling towers and evaporated condensers	35	440

Source: US CDC, NORS, Legionella etiology, https://wwwn.cdc.gov/norsdashboard/

GLOBAL RULES TO PREVENT LEGIONELLOSIS

First, a caveat to this section. Discussed here are laws and regulations put in place in global regions to prevent legionellosis and may not be the entirety of all laws and rules as changes are frequent. The information presented here is to the best knowledge of the author.

Several global laws, guidelines, and codes in various geographic regions have been put in place to reduce legionellosis cases. Along with having different sources to be managed, the routine testing targets also vary, and testing occurs for either all 60+ Legionella species, *Legionella pneumophila (Sg1 -SG14)*, or a mix of both targets, often for different building and fixture types.

Data from these law, guides and codes are often collected at the state or country level, with differing degrees of transparency to the remainder of the world. However, there are some data collections available, including a 2023 report from the European Centre of Disease Prevention and Control (ECDC) that outlines legionellosis cases and causes[3] from reporting European Union member countries.

The ECDC report notes that cases of legionellosis have increased, overall, from 1.8/100,000 (2017) to 2.4/100,000 (2021), an effective increase of 75%. Given this sharp increase, one could question whether the laws, guides and codes are actually having the desired effect of decreasing this disease. While no one is able to predict if disease cases would be even higher today without these policies in place this does seem a reasonable assumption, based on data trends shown in the ECDC report.

Some details that could lead to successfully reducing or better managing legionellosis could be attributed to the specifics of these laws, guidelines, and codes, including which compliance testing target is chosen for routine test reporting and managing legionellosis. The ECDC report points out that the most common causative agent of legionellosis cases, as determined by culture confirmation, was *Legionella pneumophila* (serotypes 1-16) at 97% whereas Legionella *non-pneumophila* were responsible for only 3% of cases. This 3% was primarily comprised of *L. longbeachae,* which is typically found in soil and not water. Focus on managing and testing for the dominant disease-causing pathogen*, Legionella pneumophila* 1-16, could lower case burden and slow the pace of the disease.

Public health agencies and researchers tend to agree that cases of legionellosis are underreported, and this is highlighted in a report from the National Academies of Science, Engineering and Medicine (NASEM) in a report published in 2019[4], which highlights legionellosis to be underestimated globally by eight- to ten-fold[4]. Some of this underestimation has been attributed to the use of the Urine Antigen test, a clinical test that detects only *Legionella pneumophila* serogroup 1, and under-reporting of cases in the population.

When it comes to whether there is a UAT-bias in the *Legionella pneumophila* composition of the legionellosis, extensive research from Denmark's Statens Serum Institute disproved this hypothesis[12]. The Danish study showed that 93%+ of LD cases were caused by *Legionella pneumophila* even when other non-UAT diagnostic methods (PCR in this case) were used. Similar results were found by Schoonmaker et al analysis of over 40 years of New York State clinical data. They found that case diagnoses after the widespread adoption of UAT testing under-reported a higher percentage of *L. pneumophila* SG 2-15 than of other non-pneumophila species[13].

CASE STUDY COMPARING LEGIONELLA RULE EFFECTIVNESS

With these laws, guides and codes the goal is to improve public health outcomes by having cleaner, safer building water systems and fixtures. To illustrate how these polices can have a positive effect, we will look at two case studies. In both cases the countries manage similar building types and/or fixtures. One country manages and performs routine testing for all Legionella species and in the other case*, Legionella pneumophila*. While certainly other policy and enforcement factors may play into the success or failure of one country over the other, the managed target is certainly one obvious difference to explore and help understand how successful health outcomes can be achieved.

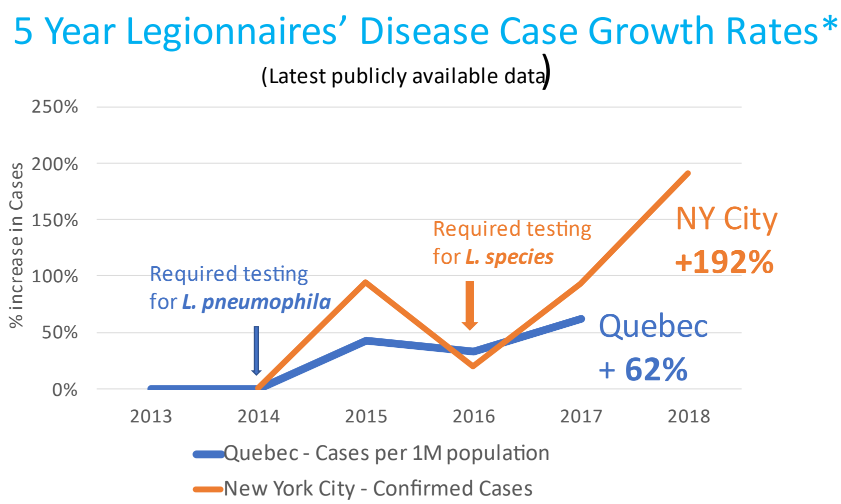
Case Study 1. Quebec Province, Canada vs. New York

Both Quebec Province and the state of New York have rules that govern the management of cooling towers to lower the risk of legionellosis.

In New York, the bacterial target required to be managed and mitigated is all Legionella species with an action limit of ≥ 20/mL. In practice, this means if species of Legionella is detected over the action limit, the tower can be required to be either taken off-line, cleaned, reinspected or banned from use, depending on the concentration of Legionella species. It is important to note here that has never been a legionellosis outbreak from a cooling tower, globally, that was known to be caused by any pathogen other than *Legionella pneumophila*[5]. The result of NYC's approach as shown in Figure 1 below indicates the unabated growth trajectory of LD cases in NYC by +192% over a 5-year period.

In Quebec, similar rules apply for cooling towers, but in 2014, Quebec changed their strategy from all Legionella species to focus on managing and responding to *Legionella pneumophila* (all serotypes, SG2 – 14) with an action limit of ≥ 10/mL. This approach targets the primary disease-causing pathogen, *Legionella pneumophila*, at a lower action limit than NYC and ensures early detection of the pathogen, informing proactive remediation where necessary. In assessing the success of these two programs, and adjusting for population differences, Figure 1 shows the higher success rate of the Quebec law versus New York state.

Figure 1. Québec versus New York case rate of legionellosis (Legionnaires' disease)



*Normalized per yearly population

Source: NYC Health: Epi Query, accessed 10.6.2020; *Le Flash Vigie*, Bulletin of the Ministry of Health and Social Services of Quebec, May 2018, Vol. 13, N. 4

In both regions, the case rate of legionellosis has increased, but the rate of increase for New York is substantially higher (i.e., 3 times) than that of Quebec.

Does this mean Quebec has been more successful in combating legionellosis?

Racine *et. al*. states this is likely true. This group analyzed treatment parameters and *Legionella pneumophila* results for 323 cooling systems over a 3.5-year period and showed a steady decrease of this bacterium over time[6]. The authors state that: "*The study concludes that this regulation, including the sampling requirement led to a sharp decrease in the presence and level of the Legionella [pneumophila] bacteria in the cooling systems studied.*" Further, the authors state that "*…the current Legionella level is the strongest predictor of future incidence*".

Certainly, the overall water quality management of cooling towers also plays a role in safety, as well as low target bacteria levels. The question then becomes, is the focus on managing and mitigating *Legionella pneumophila* key to making Quebec more successful than New York or is it a coincidence? Wouldn't the presence of any Legionella species be of concern and allow the cooling tower eventually to also have *Legionella pneumophila,* therefore; shouldn't all species be monitored and give better protection?

Recent studies have contested this 'indicator' theory and provide evidence that supports Legionella species as not being a good indicator for the presence, real or future, of *Legionella pneumophila*[7]. A KWR Research Institute (Netherlands) report states that non-Legionella pneumophila is does not meet 4 of the 5 characteristics of a good indicator bacteria outlined by the World Health Organization (WHO) and thus non-legionella pneumophila is not a good indicator of the presence or absence of *Legionella pneumophila*. Radziminski and White published a similar observation and concluded that "*There was not a statistically significant correlation between the concentrations of non-pneumophila species of Legionella and L. pneumophila*"[8].

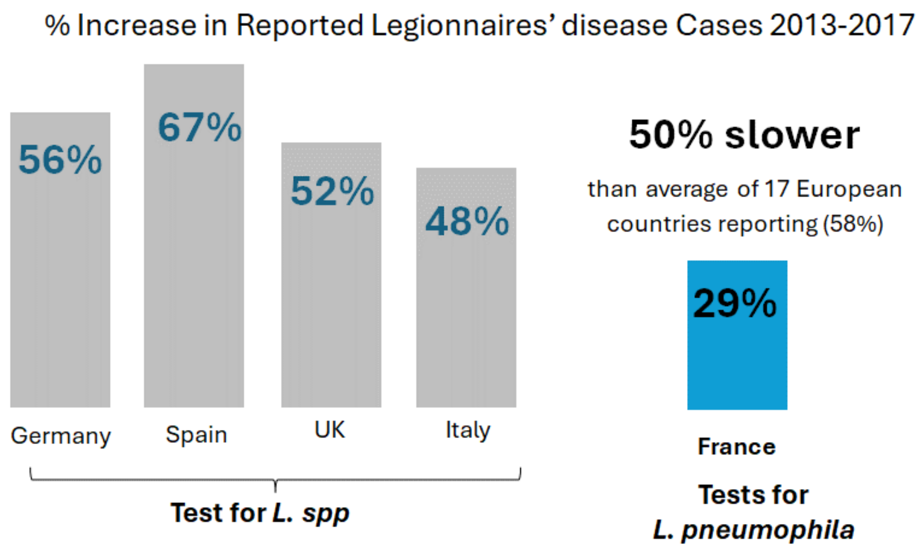
Since Legionella non-pneumophila is not a good indicator for the presence of *Legionella pneumophila*, it would make sense to change the target of the law and move toward the better indicator, which is the focus of case study #2.

Case Study 2. France vs. United Kingdom, Germany, Italy, Spain

Regulations to prevent legionellosis have been in place since 1998 in France. The earliest rules were in response to an outbreak from a cooling tower during the World Football Cup. The institution of this French law, like many other regions, often follows catastrophic events like this.

Until 2010, France relied on Legionella species for routine testing requirements for cooling towers. In 2010, France revised the rules to instead require routine testing for *Legionella pneumophila* in cooling towers, keeping some Legionella species testing in specific hospital areas. Since that change, France has seen increase in legionellosis at a far lower rate than Germany (56%), Italy (48%), Spain (67%) and the UK (52%).

Figure 2: National Legionnaires' disease case growth rate by L. spp. vs. *L. pneumophila* focus (ECDC Data 2013-2017)



Source: European Centre for Disease Prevention and Control. *Surveillance Report: Annual Epidemiological Report for 2017: Legionnaires' Disease.* Stockholm, Sweden: European Centre for Disease Prevention and Control; 2019. www.ecdc.europa.eu/sites/portal/files/documents/AER_for_2017-Legionnaires-disease_0.pdf. Published January 2019.

Similar to the Quebec and New York comparison, multiple reasons can be attributed to France's success in controlling legionellosis, especially from cooling towers. However, having a clear, focused target on *Legionella pneumophila* has been noted by key researchers such as Walker & McDermott (2021) to be an effective strategy for controlling Legionnaires disease. Additionally, this approach is cost-effective as it prevents unnecessary and costly remediation for species of Legionella that would not pose a threat to public health. Given that 97% of total culture-confirmed cases (with and without UAT diagnoses) were caused by *Legionella pneumophila*[10],targeting control strategy on Legionella species imposes unnecessary economic burden on buildings owners or managers to remediate a cooling tower or a building for something that is not a public health risk.

CONCLUSIONS:

- With the global legionellosis cases on the rise, several regions around the world are creating, enacting, or at least contemplating laws, guidelines, and regulations to address the challenge of protecting residents and visitors from legionellosis. Regions with specific policies for monitoring and controlling *Legionella pneumophila*, along with stringent enforcement, are achieving better health results on a larger scale.
- As *Legionella pneumophila* continues to be the main disease-causing pathogen, focusing Water Management Plans on this target has been proven to be a cost-effective solution for reducing the disease burden. This focused approach saves building owners and managers from excessive monitoring and unnecessary remediation costs.

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