important factors for assessing risk

Legionella in My Water

Is there a regulatory limit for Legionella in water systems?

Cooling Towers

Neither the Centers for Disease Control and Prevention (CDC) nor the Environmental Protection Agency (EPA) define an enforceable regulatory limit for *Legionella* in cooling towers. Outbreak investigations have documented both low (<100 Colony Forming Units / mL) and high (>1000 CFU/mL) levels of Legionella in water samples from cooling towers. There are no evidence-based guidelines for establishing risk criteria for *Legionella* recovery from cooling towers. Although guidelines have been suggested from a few groups, the data used to establish action levels and disease risk is very limited. Therefore, these guidelines are overly restrictive (recommending remediation at lower levels) and should be interpreted with caution.

Other countries, and New York City and State, have adopted recommended or required actions based on the concentration of Legionella cultured from cooling water. The Australian guidelines are pragmatic in their approach and do not recommend high level (50 ppm) hyperchlorination when low levels of Legionella are detected (See Cooling Tower Control Strategy on page 6). New York has a similar approach in their regulation.

Healthcare Drinking Water Systems

Healthcare facilities include hospitals, clinics, dental offices, out-patient surgery centers, birthing centers and nursing homes. Legionnaires' disease is a well-recognized public health problem in hospitals. Nursing homes are a growing area for concern based on the increasing number of reported cases from long-term care facilities.

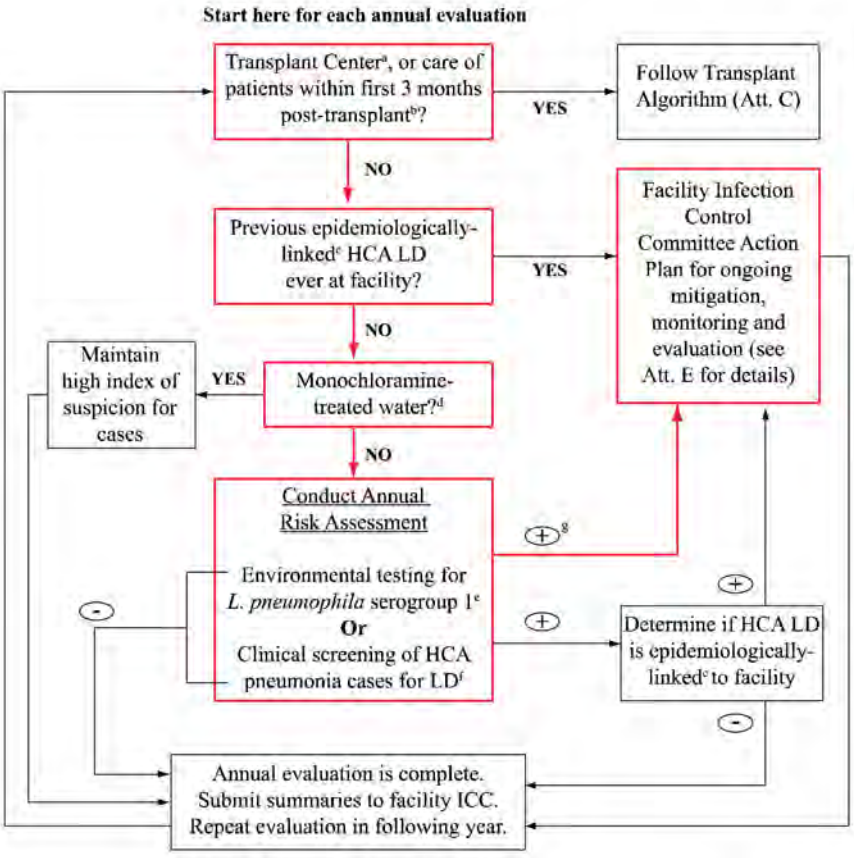
In contrast to the situation for cooling towers, evidence-based data is available for interpretation of culture results from hospital water distribution systems. Risk assessment should not be based on the concentration of Legionella recovered from a given water outlet; quantitation (CFU/ml) has not been shown to correlate with incidence of disease (Kool-1999). On the other hand, risk for Legionella infections increases as the extent of colonization increases (i.e., a high percentage of water outlets yield Legionella). In two

important factors for assessing risk

Legionella in My Water

studies, Legionnaires' disease did not occur unless 30% or more of water outlets were positive with *L. pneumophila* (Kool-1999, Stout-2007). New York State regulations also uses the 30% cut point. The locations and method of sample collection is collection is critical, so consult with a microbiologist knowledgeable in Legionella monitoring before collecting samples.

The use of percent positivity as a risk threshold was first adopted in Pennsylvania by the Allegheny County Health Department in their 1993 Legionella prevention guideline. This approach was adopted by the Veterans Affairs Healthcare System in their 2008 directive. That directive presented a simple **proactive** approach (see excerpt below) to protecting patients and building occupants. *Note that complete elimination of Legionella from a hospital water system has not been shown to be necessary to prevent the majority of cases of Legionnaires' disease.*



important factors for assessing risk

Legionella in My Water

Which Legionella species/serogroups cause disease?

It is not unusual to find multiple Legionella species and serogroups in a water sample. The presence of one species has not been shown to correlate or predict the presence of another species.

There are more than 58 species of Legionella, with approximately half implicated in human disease. The majority (>90%) of cases of Legionnaires' disease reported in the U.S. are caused by *Legionella pneumophila*. There are more than 16 serogroups of *Legionella pneumophila*, but serogroup 1 is responsible for the overwhelming majority of cases (see table below). Other serogroups have caused disease, however this is rare by comparison to serogroup 1. The data in the following table remains consistent with more recent data from Europe and the U. S.

L. anisa is frequently isolated from environmental specimens but very rarely causes disease. Disease caused by other Legionella species, like *L. anisa*, occurs almost exclusively in immunocompromised individuals. Only a handful of cases attributed to *L. anisa* have been reported. We consider this species nonpathogenic, and would NOT disinfect your water supply if *L. anisa* is present. For more information, see SPL's *Blue-White Legionella Fact Sheet*.

Proportion of Legionnaires' disease caused by each serogroup and species of Legionella reported to the Centers for Disease Control and Prevention, United States, 1980-1998. *Legionella pneumophila* is responsible for > 90% of all reported cases. (See table on following page 4.)

important factors for assessing risk

Legionella in My Water

Which Legionella species/serogroups cause disease?

Species, serogroup	All isolates, % (n = 2340)	Community-acquired infections % (n = 1259)	Hospital infections % (n = 890)
Legionella pneumophila	91.4	90.7	93.6
Serogroup 1	50.5	49.6	52.5
Serogroup unknown	32.1	33.9	28.2
Serogroup 2	1.2	1.4	1.1
Serogroup 3	2.0	1.5	2.9
Serogroup 4	1.1	1.0	1.3
Serogroup 5	1.1	0.8	1.7
Serogroup 6	2.9	1.7	5.2
Serogroup 7–14	0.5	0.8	0.7
L. bozemanii	1.3	1.3	1.2
L. dumoffii	1.5	1.4	1.0
L. gormanii	0.2	0.2	0.2
L. micdadei	2.8	2.8	2.8
L. feeleii	0.2	0.2	0.2
L. longbeachae	2.2	3.3	0.7
L. jordanis	0.3	0.2	0.1

Note: Only isolates identified by culture are included. From Benin A.L., Benson R.F., Besser R.E. Clin Infect Dis 2002; 35:1039-46.

What kind of exposure poses the greatest risk?

Most of us have been exposed to Legionella without incident. This is because healthy individuals are at little risk of illness even if exposed.

Direct exposure to very high concentrations of *Legionella pneumophila* serogroup 1 represents the greatest risk for acquiring disease in an otherwise healthy individual. An example of direct and intense exposure occurred in Louisiana when shoppers were exposed to *Legionella pneumophila* serogroup 1 from a misting device at a grocery store.

important factors for assessing risk

Legionella in My Water

What kind of exposure poses the greatest risk?

Hospitalized individuals are at greater risk due to impaired health status and greater chance of exposure during procedures. Aspiration of contaminated water can cause Legionnaires' disease in these patients.

What is the goal for risk assessments and when should disinfection be performed?

The goal of a risk assessment is to identify conditions that increase the probability of Legionnaires' disease as a result of exposure to water systems colonized with disease-causing Legionella bacteria. Remediation is not always necessary and should be discussed with professionals knowledgeable in the area of Legionnaires' disease and its prevention and control.

Sources

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important factors for assessing risk

Legionella in My Water

Cooling Tower Control Strategy

Recommended Actions Based on Concentration-Based Targets*

Test Result (cfu/mL)	Strategy
Not Detected**	1. Maintain *Legionella* monitoring ** Maintain water treatment program.
Detected at ≥10 but <1000 cfu/mL	2. Investigate a. Review water treatment program. b. Take necessary remedial action including immediate online disinfection and undertake control strategy described in footnotes. 3. Retest water within 3 to 7 days of plant operation: a. If not detected, continue to retest water every 3 to 7 days until two consecutive samples return readings of not detected and return to maintenance strategy. b. If detected at <100 cfu/mL repeat control strategy with online disinfection and retest. c. If detected at ≥ 100 <1000 cfu/mL investigate problem and review water treatment program, immediately carry out online disinfection, retest and repeat control strategy. d. If detected at ≥ 1000 cfu/mL undertake control strategy with online disinfection and retest.
Detected at ≥ 1000 cfu/mL	4. Investigate a. Review water treatment program. b. Take necessary remedial action including immediate online decontamination and under take control strategy. 5. Retest water within 3 to 7 days of plant operation: a. If not detected, continue to retest water every 3 to 7 days until two consecutive samples return readings of not detected and return to maintenance strategy. b. If detected at <100 cfu/mL repeat control strategy with online disinfection. c. If detected at ≥ 100 < 1000 cfu/mL investigate problem and review water treatment program, immediately carry out online disinfection, retest and repeat control strategy. d. If detected at ≥ 1000 cfu/mL investigate problem and review water treatment program, immediately carry out system decontamination, retest and repeat control strategy. See footnote for online and system disinfection information.

*This information is based on the control strategies from the Australia/New Zealand Standard. [See Australian/ New Zealand Standard AS/NZ S 3666.3:1998 for process details]
** Limit of detection <10 cfu/mL. Monthly monitoring required in Australia, not in U.S. Online Disinfection = Dose the cooling water system with either a different biocide or similar but increased concentration to that of the regular water treatment program. Online decontamination = dose recirculating water with chlorine-based compound equivalent to at least 5 mg/L free residual chlorine for at least one hour (maintain pH at 7.0- 7.6). System decontamination = maintain 5-10 mg/l free residual chlorine for minimum of one hour, drain and flush with disinfected water, clean wetted surfaces, refill and dose to 1-5 mg/L of free residual chlorine at pH 7.0-7.6 and circulate for 30 min.