NEW JERSEY DEPARTMENT OF HEALTH AND SENIOR SERVICES

PREVENTION AND CONTROL OF LEGIONNAIRES’ DISEASE
ENGINEERING CONTROL AND REMEDIATION GUIDELINES

Legionella bacteria are naturally occurring, ubiquitous aquatic organisms. They prefer warm water temperatures with the ideal temperature for growth ranging from 77 to 115°F (25 to 46°C). These temperatures are typically found in cooling towers, and the hot water systems of general hospitals. Laboratory studies indicate that above 122°F (50°C) Legionella can survive but do not multiply. Even at 131°F (55°C), it takes 5-6 hours for Legionella to die.

Cases of Legionnaires’ disease result from exposure to contaminated water aerosols or by aspirating contaminated water. A link has been established between Legionnaires’ disease and potable water or aerosol-generating devices, such as cooling towers, showers, faucets, hot tubs, whirlpool spas, respiratory therapy equipment (e.g., nebulizers), and room air humidifiers. Immunocompromised patients at general hospitals are at greater risk of infection. Therefore, cooling towers, hot water systems, and other equipment that may generate aerosols must be properly operated and maintained as outlined below.

If a case of Legionnaires’ disease is definitively linked to a hospital, the implicated systems must be disinfected/treated immediately. Complete eradication of Legionella is not feasible and re-growth will occur. Therefore, long-term control measures must be implemented. Environmental surveillance (collecting water samples or plumbing system swab samples for Legionella analysis) is necessary to ensure that disinfection and long-term control measures are effective.

In hematopoietic stem cell transplant (HSCT) and solid organ transplant units, the environmental sampling frequency must be at least quarterly and in concert with the recommendations discussed below. In the absence of disease, environmental surveillance in non-HSCT and solid organ transplant units should be initiated as determined by the Legionella policy that was formulated by the hospital’s multi-disciplinary team.

Operation and maintenance

- Store and distribute potable cold water at <68°F (20°C).
- Hot water heating systems and cooling towers should be maintained according to the manufacturer's recommendations and current industry standards. Hot water storage tanks and cooling towers should be drained, cleaned, and disinfected at least annually.

* NJDHSS thanks and acknowledges the New York State Department of Health for its assistance in developing guidance materials which NJDHSS has adapted for distribution.
• The operation and maintenance of the cooling tower should be conducted under the guidance of a licensed professional engineer preferably experienced in cooling tower design and operation.

• A daily operation log and maintenance manual reflecting the latest standards must be developed and maintained for the hospital’s cooling tower and hot water systems. These should include written details regarding the proper use of anti-corrosives, biocides, and disinfectants, and records on repairs, alterations, operating times, monitoring, routine disinfections, and inspections.

• If the hospital’s building has the necessary mixing valves and/or anti-scald valves, hot water shall be stored above 140°F (60°C) and circulated with a minimum return temperature of 124°F (51°C). Mixing valves and/or anti-scald valves are necessary on such systems to reduce the final water temperature to no more than 110°F (43°C) in patient areas to prevent scalding. Anti-scald valves need to be operated according to manufacturer’s recommendations, which include periodically testing outlet temperatures.

• General hospitals that do not have the necessary mixing valves and/or anti-scald valves to operate according to the temperatures described above, or have not implemented other long term control measures, shall, at least semiannually, disinfect their distribution system using a high temperature or a chlorination flush (see “Disinfection” and “Long-Term Control Measures” sections below). Precautions must be taken to prevent scalding or exposure to water with chlorine levels greater than 4.0 parts per million (ppm). Precautions must also be taken to prevent any exposure to airborne levels of chlorine greater than 0.5 ppm.

• Recirculation loops in the hot water distribution system should be used to minimize stagnation, which promotes microbial growth. "Dead ends" or capped lines should be eliminated. Water lines in patient areas that have been dormant or unused should be disinfected and flushed before being placed back on line.

• When planning new construction, general hospitals should consider installing anti-scald valves on all hot water outlets, so that water temperatures in the distribution system may be set high enough to control Legionella growth.

• When the hot water distribution system is opened for repair/construction or subject to water pressure changes, the system shall, at the minimum, be thoroughly flushed before being returned to service. The need to disinfect using a high temperature or a chlorination flush before being returned to service should be evaluated on a case-by-case basis. If only a portion of the system is involved, disinfection may be used on only that portion of the system. Precautions should be taken to prevent patient exposure to aerosols during flushing.

• For HSCT and solid organ transplant units, the following additional measures should be implemented:
  o Remove, clean, and disinfect shower heads and tap aerators monthly by using a chlorine-based, EPA-registered product, or a chlorine bleach solution of 500-615 ppm.
  o Remove aerators from patient room sinks if environmental sampling yields positive results for Legionella spp.
**Disinfection**

- To routinely (e.g., at least semiannually) disinfect a hot water distribution system, each outlet should be flushed for > 5 minutes with water at 160°F – 170°F (71 to 76°C), or with water containing > 2 ppm free chlorine residual.
- These measures may need to be enhanced, prompted by either disease occurrence or results of environmental sampling per the hospital’s *Legionella* prevention, surveillance and control policies. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) states:
  - For thermal disinfection, longer flush time for superheating may be needed; and
  - For chlorine disinfection, chlorine should remain in the system for a minimum of 2 hours (not to exceed 24 hours), after which the system should be thoroughly flushed.

**Long-term control measures**

- Long-term control measures are complex and must be individualized. Expert advice should be sought when developing long-term control measures. Consultants must assess corrosion, scaling, biofilm, pH, temperature profile and other physical parameters that may negatively affect treatment.
- The primary treatment methods used for long term control of *Legionella* in hot water systems include the following: 1) installation of anti-scald valves on all outlets and maintaining a minimum return temperature of 124°F (51°C); 2) continuous chlorination to achieve a free chlorine residual of 1-2 ppm at the outlets; 3) periodic superheating and flushing; 4) silver/copper ionization; 5) chlorine dioxide treatment; or 6) use of a combination of the preceding treatment methods.
- In addition to evaluating primary treatment methods, consultants should determine whether other preventive measures are needed for long-term control. These measures may include replacing or disinfecting shower heads, installing mixing or anti-scald valves to allow higher temperatures in all or part of the system, replacing hot water tanks with instantaneous heaters, removing shock absorbers, replacing rubber washers with synthetic washers, removing aerators, periodically flushing to improve treatment at distal outlets, and modifying the hot water re-circulation system.
- After long-term control measures have been implemented, general hospitals must develop and regularly re-evaluate an environmental surveillance plan for *Legionella* (sampling protocol for water monitoring that includes chemical residual monitoring and effective bacterial control) along with their plan for active case surveillance.
Environmental surveillance for *Legionella*

*Culturing the environment in the absence of disease*

- Culturing for *Legionella spp.* in potable water samples from HSCT or solid organ transplant units shall be performed at least quarterly as part of a comprehensive strategy to prevent Legionnaires’ disease.
- General hospitals must convene their multidisciplinary team to assess the need for environmental sampling in non-HSCT or solid organ transplant units, using available empiric literature and their hospital’s risk assessment to guide their decision. If the decision to perform environmental testing is made, the NJDHSS recommends that you address the following issues before the sampling commences:
  - Culture is the gold standard for environmental testing for *Legionella*. The laboratory chosen for culturing should be proficient in culturing environmental samples for *Legionella*. PCR and DFA methods are not useful for environmental sampling (Please see “Culturing the Environment in the Presence of Disease” section below for further details).
  - The hospital should decide what measures will be taken for positive environmental results in the absence of disease. The CDC does not give specific guidance on this issue, while the Allegheny County, Pennsylvania, guidelines recommend that the hospital consider disinfection of the water system if more than 30% of outlets yield positive results. Additional guidance on the interpretation of sampling results is provided in PathCon Technical Bulletin 1.5, *Legionella* Bacteria in Environmental Samples: Hazard Analysis and Suggested Remedial Actions, PathCon Control Associates, June 1998.

*Culturing the environment in the presence of disease*

- Recommendations regarding environmental sampling for *Legionella spp.* shall be made in consultation with the NJDHSS if a case of possible or definite hospital-associated Legionnaires’ disease is identified. For this recommendation, the following issues are assessed:
  - Whether the case is a possible or definite hospital-associated case;
  - Whether the hospital has a previous history of hospital-associated Legionnaires’ disease;
  - Patient populations the hospital serves;
  - Physical plant structure; and
  - Availability of patient culture(s).
• Environmental sites appropriate for sampling are made with consultation from the NJDHSS Occupational Health Service.
• Environmental culturing must be performed by a laboratory that is experienced and has demonstrated proficiency in culturing *Legionella spp.* from environmental samples. The NJDHSS does not certify laboratories for environmental *Legionella* analysis.
• The laboratory chosen to perform environmental culturing must be able to serogroup *L. pneumophila*. If the organism that is causing disease is a species other than *L. pneumophila*, the laboratory must be able to speciate *Legionella*.
• All positive environmental cultures with the same species and serogroup as the patient isolate must be saved for molecular analysis.
• Polymerase chain reaction (PCR) and direct fluorescent antibody (DFA) methods alone should not be used for environmental sampling as they may detect non-viable organisms, and thus, positive results are difficult to interpret.

References

3. American Society of Heating, Refrigeration and Air Cooling Engineers, [www.ashrae.org](http://www.ashrae.org); Phone: (404) 636-8400
4. Cooling Tower Institute; [www.cti.org](http://www.cti.org); Phone: (281) 583-4087