

**NEW YORK STATE DEPARTMENT OF HEALTH
PREVENTION AND CONTROL OF LEGIONNAIRES' DISEASE
GUIDANCE FOR CLINICIANS: BACKGROUND AND DIAGNOSIS**

Background

Legionellosis is a bacterial disease that is associated with two distinct illnesses: Pontiac fever (a self-limited, influenza-like illness with a 1 to 2 day incubation period, also known as non-pneumonic legionellosis) and Legionnaires' disease (a progressive pneumonia with a 2 to 10 day incubation period that may be accompanied by cardiac, renal and gastrointestinal involvement). The causative agent in 90% of infections is *L. pneumophila*. *L. pneumophila* is further classified into serogroups, of which serogroup 1 is most common. Many other *Legionella* spp. can cause disease in humans, including *L. micdadei*, *L. bozemanii*, *L. dumoffii*, and *L. longbeachii*.

Legionella species 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). The ten-year average number of cases of Legionnaires' disease reported to New York State annually is 539 (including NYC). Cases may be community- or healthcare facility-associated and result from exposure to contaminated water aerosols or aspirating contaminated water. Outbreaks of Legionnaires' disease have been reported throughout the world. Numerous citations have appeared in the medical literature describing the link between Legionnaires' disease and potable water or aerosol-generating devices, such as nebulizers, cooling towers, showers, faucets, hot tubs, whirlpool spas, respiratory therapy equipment, and room-air humidifiers.

Certain host factors will place persons at greater risk for acquiring Legionnaires' disease. Persons with severe immunosuppression from organ transplantation or chronic underlying illness, such as hematologic malignancy or end-stage renal disease, are at the **greatest risk** for acquiring, and dying from, Legionnaires' disease. Persons with diabetes mellitus, chronic lung disease, non-hematologic malignancy, HIV, the elderly, and persons who smoke cigarettes are at **moderately increased risk**. The disease is rare among children. Healthcare facility-associated Legionnaires' disease may be underestimated in facilities where clinicians do not perform routine specific diagnostic testing for the disease.

Legionnaires' disease cannot be distinguished clinically from pneumonia caused by other agents. Therefore, clinicians should maintain a heightened awareness and include *Legionella* as a causative agent in the differential of all healthcare facility-associated pneumonia that occurs in patients/residents who are at moderately increased risk or greatest risk for acquiring Legionnaires' disease. Additionally, *Legionella* should be considered in the differential diagnosis in adults admitted from long term care facilities to the hospital with signs and symptoms consistent with pneumonia. Pneumonia that develops after 48 hours of hospitalization is considered healthcare facility-associated (see Attachment 2).

Diagnosis

- Obtain chest x-ray as clinically indicated.
- Test patients/residents by **both**:
 - **Culture** of respiratory specimens for *Legionella* spp., and
 - Detection of *Legionella* **urinary antigen**.
- Alert the laboratory when requesting culture for *Legionella* spp. as special media must be used for isolation of the organism.
- Save isolates from respiratory specimens since they are necessary in facility-associated Legionnaires' disease investigations to match with other clinical and environmental isolates.

Laboratory testing

- Bacterial culturing of *Legionella* spp.:
 - Alert the laboratory that *Legionella* is being considered as a causative agent. (Buffered charcoal yeast extract (BCYE) agar is required for culture.)
 - Save isolates of *Legionella* for the epidemiologic investigation.
- *Legionella* urinary antigen
 - Enzyme-linked immunosorbent assay (ELISA), radioimmunoassay, or rapid lateral flow immunoassay is performed on a urine sample.
 - Antigen testing is not reliable to detect *Legionella* spp. other than *L. pneumophila* serogroup 1.
- Other methods of identification include:
 - Direct fluorescent antibody (DFA) staining.
 - Polymerase chain reaction (PCR).
 - PCR testing will identify non-viable as well as viable organisms which presents a challenge in diagnosis and comparison of clinical and environmental isolates.
 - Serologic tests require acute and convalescent phase sera obtained 2 – 4 weeks apart.
 - Serology is not helpful in establishing the diagnosis in a timely manner. A single positive titer does not distinguish patients/residents with Legionnaires' disease from patients/residents with other etiologies of pneumonia.
 - Immunohistochemical staining is available at the Centers for Disease Control and Prevention (CDC).
- When cultures are positive for *Legionella* spp.:
 - Isolates should be submitted to the NYSDOH Wadsworth Laboratories (or New York City Department of Health and Mental Hygiene Public Health Laboratory for NYC facilities) as per the NYSDOH Laboratory Reporting of Communicable Disease Guidelines, located on the Wadsworth Center Website at: <http://www.wadsworth.org/labcert/regaffairs/RAindex.htm>.
 - The public health laboratory will perform confirmation, serogrouping, and pulsed-field gel electrophoresis if indicated.

Clinicians should notify the Department of Infection Control in their facility if a suspected or confirmed case of *Legionella* is diagnosed in one of their patients/residents. Clinicians should also maintain a high index of suspicion for

legionellosis in the setting of community-onset or healthcare facility-associated pneumonia to ensure early therapy, particularly in high risk individuals.

References

1. Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R. Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. *MMWR* 2003;53(No. RR-3):1-36.
2. Sehulster L, Chinn RYW. Guidelines for environmental infection control in health-care facilities, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. *MMWR* 2003;52(No. RR-10):1-44.
3. American Thoracic Society. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am J Respir Crit Care Med* 2005;171:388-416.
4. Goetz, A.M.; Muder, R.R. *Legionella pneumophila*. In: APIC text of infection control and epidemiology. 2nd ed. Washington, D.C.: Association for Professionals in Infection Control and Epidemiology, Inc.;2005:76-1–76-8.

Attachment 2

NEW YORK STATE DEPARTMENT OF HEALTH PREVENTION AND CONTROL OF LEGIONNAIRES' DISEASE INFECTION CONTROL GUIDANCE: SURVEILLANCE, INVESTIGATION AND CONTROL

A close collaboration among clinicians, patient/resident care staff, plant facility engineers and technicians, laboratorians, and the infection control department is necessary to prevent and control facility-associated Legionnaires' disease. The recommendations below should be incorporated in your facility policies and procedures.

Surveillance for Legionnaires' disease

- Ensure the availability of laboratory tests for *Legionella* (i.e., culture and urinary antigen). Determine your facility's strategy for clinically identifying cases of facility-associated cases of Legionnaires' disease. All patients/residents who are at greatest risk or moderately increased risk for acquiring Legionnaires' disease (see Attachment 1) should be tested for *Legionella* if they develop a facility-associated pneumonia. This can be operationalized by either:
 - Educating all clinicians to perform testing for *Legionella* for all patients/residents who develop a facility-associated pneumonia who are at moderately increased or greatest risk for Legionnaires' disease or in patients/residents not in these risk categories who are not responding to typical community- or healthcare facility-associated pneumonia treatment ;
 - OR**
 - Culturing all respiratory specimens received by the laboratory for *Legionella*.
- At least semiannually, review the availability and clinicians' use of laboratory diagnostic tests for *Legionella* in the facility. If testing is assessed as inadequate, implement measures to enhance clinicians' use of the tests.
 - If all respiratory specimens are cultured for *Legionella*, the facility does not have to measure adequacy of testing.
- The following surveillance definitions apply for assessing community- versus healthcare facility-associated Legionnaires' disease, given an incubation period of 2 to 10 days:
 - Community-associated Legionnaires' disease: the patient/resident was in the community for the entire incubation period and presented with onset of illness within 48 hours of admission.
 - Possible healthcare facility-associated Legionnaires' disease: the patient/resident was not in the facility during the entire incubation period.
 - Definite healthcare facility-associated Legionnaires' disease: the patient/resident was in the facility for the entire incubation period.
- All cases of community- and healthcare facility-associated Legionnaires' disease should be reported to the appropriate public health authority within 24 hours of diagnosis:
 - All cases of Legionnaires' disease are to be reported to the local health department where the patient/resident resides by submitting a confidential

case report form DOH 389 (NYC residents are reported to the NYCDOHMH by submitting a confidential case report on the NYCDOHMH Universal Reporting Form).

- Possible or definite healthcare facility-associated cases of Legionnaires' disease are to also be reported to the NYSDOH Healthcare Epidemiology and Infection Control program by submitting a report on the Nosocomial Outbreak Reporting Application (NORA) system located on the Health Commerce System (HCS; formerly Health Provider Network or HPN) at: <https://commerce.health.state.ny.us/hcs/index.html>
 - If you already have access to NORA, click the NORA link under "My Applications" at the left of the page. The appropriate NYSDOH Regional Epidemiology office or New York City Department of Health and Mental Hygiene (NYCDOHMH) office will follow up with the facility after the electronic submission of the report is received.
 - If you need access to NORA, contact your facility's HCS (formerly HPN) coordinator and ask to be assigned the 'Infection Control Practitioner' role in the Communications Directory. A paper NORA report must be completed and submitted by fax while your access to NORA is being processed. The paper NORA report form can be downloaded at: <http://www.health.ny.gov/forms/doh-4018.pdf>

Prevention of Legionnaires' disease: Use and care of respiratory equipment

Tap water should never be used for rinsing semi-critical respiratory devices or filling reservoirs of respiratory equipment or devices that create aerosols due to the risk of exposing patients/residents to waterborne organisms. The following recommendations are consistent with the CDC's *Guidelines for Preventing Healthcare-associated Pneumonia, 2003*:

- Use sterile water for rinsing nebulization devices and other semicritical respiratory-care equipment after they have been cleaned and disinfected.
- Use sterile water for filling reservoirs of devices used for nebulization.
- Do not routinely use large volume room-air humidifiers that create aerosols. If use of such a device is deemed medically necessary, the following recommendations apply:
 - Follow the above recommendations regarding rinsing and filling with sterile water.
 - Subject the device to sterilization or high-level disinfection daily.
- The same standards of care for respiratory equipment in healthcare facilities apply to respiratory equipment brought in by the patient/resident or family (e.g., humidifiers, CPAP, BiPAP) for use during an in-patient stay. Facility staff should be assigned to:
 - Assess equipment brought in from the patient's/residents' home.
 - Clean and reprocess devices brought in from home.
 - Educate patient/resident and family regarding proper use and maintenance of equipment brought in from home.
 - Document the following:

- The use of the device was recommended by the patient's/resident's clinician;
- The use of the device was cleared by the designated person(s);
- Education of the patient/resident and family occurred;
- Adequate supplies of sterile water are in the patient/resident room for use; and
- Daily cleaning and processing has occurred as above.

Prevention of Legionnaires' disease: Protective environments/transplantation units

Protective environments are specialized patient care areas that have a positive air flow relative to the corridor that can safely accommodate persons that have undergone allogeneic hematopoietic stem cell transplant (HSCT). Patients who have received HSCT or a solid organ transplant are at highest risk for acquiring and dying from Legionnaires' disease. The following additional recommendations are for this population. Facilities may choose to expand this recommendation, and utilize these measures for other patient/resident care units that service population groups they assess are at high risk for Legionnaires' disease (e.g., oncology patients receiving chemotherapy).

- 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.
- If *Legionella* spp. are determined to be present in the water supply of the unit:
 - Decontaminate the water supply as recommended in Attachment 3.
 - Remove faucet aerators from patient/resident care areas if environmental sampling yields positive results for *Legionella* spp.
 - Restrict patients/residents on the unit from taking showers.
 - Provide patients/residents with sterile water for tooth brushing, drinking, flushing nasogastric tubing and dilution of enteral nutrition for administration via a nasogastric tube.
 - Notify patients/residents and family members of the need and the rationale for the water restriction on the affected unit.
 - If the above recommendations are in place and a case of facility-associated Legionnaires' disease is identified, reinforce adherence to above recommendations, and additionally consider:
 - Not utilizing sinks in patient/resident rooms. If this is initiated, the facility must ensure:
 - Hand hygiene products are available (e.g., alcohol-based hand rubs), and
 - There is reasonable access to a sink if hands are visibly soiled (i.e., the employee does not have to thread their way through doorways and/or stairs to access a sink).
 - Do not use tap water for patients'/residents' sponge baths.

Investigation and control of Legionnaires' disease

If a single case or multiple cases of Legionnaires' disease are detected:

- Report to the NYSDOH and local health department as described in “Surveillance for Legionnaires’ disease” above.
- The NYSDOH will open an investigation and provide consultation for facilities reporting a possible and/or definite case(s) of healthcare facility-associated Legionnaires’ disease. Investigations in New York City facilities will be conducted jointly with the New York City Department of Health and Mental Hygiene.
- Recommendations for control will vary depending on the types of patients/residents the facility services, whether the case is a probable or definite healthcare facility-associated case, and certain elements of the physical plant. The recommendations will cover:
 - Retrospective and prospective surveillance to identify additional cases;
 - Obtaining *Legionella* urinary antigen for cases identified on retrospective surveillance (if causative agent is *L. pneumophila* serogroup 1);
 - Assessment of physical plant, potable water systems, construction activities, and current water treatment and maintenance;
 - Environmental culturing;
 - Molecular analysis of patient/resident and environmental isolates;
 - Reinforcement of recommendations described in “Use and care of respiratory equipment for the prevention of Legionnaires’ disease” in this document;
 - Tap water restrictions for immune compromised populations; and
 - Notification to patients/residents and family members if a water restriction is indicated, including the rationale for the restriction.

References

1. Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R. Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. *MMWR* 2003;53(No. RR-3):1-36.
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**NEW YORK STATE DEPARTMENT OF HEALTH PREVENTION AND
CONTROL OF LEGIONNAIRES' DISEASE ENVIRONMENTAL
GUIDANCE AND ENGINEERING MEASURES**

Environmental Assessment

The New York State Department of Health (NYSDOH) recommends that facilities proactively perform an environmental assessment of their water systems. This assessment involves reviewing facility characteristics, hot and cold water supplies, cooling and air handling systems and any chemical treatment systems. The purpose of the assessment is to discover any vulnerabilities that would allow for amplification of *Legionella* spp. and to structure a response in advance of any environmental sampling for *Legionella*. Factors to be considered include, but are not limited to:

- Facility Characteristics
 - Types of care
 - Age of buildings
 - Floor space and numbers of beds/population capacity
- Source of water supply and treatment
 - Hot and cold water temperature profiles
 - Free chlorine residuals
 - Presence and location of thermostatic mixing valves
 - Presence and service of water softener systems
 - Supplemental (long-term) water treatments for microbial contamination
 - Other water quality parameters (pH, TOC, etc.)
- Heating and Cooling
 - Age and types of heating and cooling components
 - Service records, warranties and manufacturer recommendations
 - Locations
 - Service contracts and vendors
 - Chemical treatments, shut-down and start-up procedures
- Construction Issues
 - Internal plumbing repairs or construction
 - External construction
 - Water main breaks or repairs
 - Colored water issues
 - Sprinkler system service or malfunction/repair.
 - Potential cross-connections

For specific information on additional factors to be considered during this review process, an assessment form entitled “Environmental Assessment of Water Systems in Healthcare Settings”, originally developed by CDC and modified for use in New York State, is available from NYSDOH on the Health Commerce System. A similar, regularly updated, form is also available from CDC on their website (www.cdc.gov). Once the

assessment is completed, it should be reviewed and updated at least one time per year.

Updates to the environmental assessment form, and attendant files or information, should accompany any significant construction or repair work that is done in the facility. Initial or ongoing assessment should be conducted by a multidisciplinary team composed of key individuals in each facility that represent the expertise, knowledge and functions related to the facility operations and service.

Multidisciplinary teams should include at a minimum:

- Infection Control
- Physical Facilities Management
- Engineering
- Clinicians
- Laboratory
- Hospital Management.

As part of the assessment process itself, environmental sampling for *Legionella* sp. could be performed to determine the extent of colonization, including the possibility of extensive biofilm involvement and areas of concern.

The response to sampling results should be based on decision-making strategies outlined below and on the percentage of culture positive sites. This information will help guide the facility to the next steps for continued monitoring, initiating treatment, and/or retaining a consultant.

Recommended Actions for Legionnaires' disease in a Healthcare Facility

If a case of Legionnaires' disease is linked to a NYSDOH regulated nursing home or hospital, the facility **in consultation with NYSDOH** should consider disinfection of the implicated water system following an assessment of the facility (Refer to the 'Environmental Assessment Section'). **Complete eradication of *Legionella* may not be feasible and, without long-term control measures, re-growth will likely occur.**

Therefore, long-term control measures, or other barriers such as point-of-use microfiltration, may be needed. Environmental surveillance, such as collecting water samples or plumbing system swab samples for *Legionella*, is necessary to ensure that the recommended disinfection and long-term control measures are appropriate to the system. Sampling periods should be determined in consultation with NYSDOH.

Routine sampling and environmental assessment as a prevention strategy

In hematopoietic stem cell transplant (HSCT) and solid organ transplant units the environmental sampling frequency should be at least quarterly and in conjunction with the recommendations discussed below and with current NYSDOH guidance. Prior to sampling, a facility plan should be in place to address any positive environmental samples. In the absence of disease, environmental surveillance of any other units considered to be more vulnerable than the general facility census (e.g. oncology, ICU/CCU involving cardiopulmonary patients, etc.) could be initiated as determined by

the *Legionella* policy that was formulated by the facility's multi-disciplinary team or as part of a routine facility assessment (see 'Environmental Assessment Section').

OPERATIONS AND MAINTENANCE

The items noted below are suggested elements of an environmental management plan. Elements can be added or deleted depending upon the outcome of a facility environmental assessment.

Heating and Cooling

- Hot water heating systems (non-potable) and cooling towers should be maintained according to the manufacturer's recommendations and current industry standards (ASHRAE; CTI, 2008). This should include annual start-up and shut-down procedures.
- The operation and maintenance of the cooling tower should be conducted under the guidance of a water treatment expert experienced in cooling tower design and operation.
- A daily operation log and maintenance manual reflecting the latest standards should be developed and maintained for your cooling tower and hot water systems (e.g. flushing hot water tanks, instantaneous heaters, mixing valves, etc.).
- Cooling tower documentation should include written details regarding the proper use of corrosion inhibitors, biocides, and disinfectants, and records on repairs, alterations, operating times, monitoring, routine disinfection, and inspections.
- Operations should follow current industry practice (ASHRAE; CTI, 2008) Documentation should be reviewed on a periodic basis to assure it is consistent with current standards of practice.
- Operational changes to the system(s) may also warrant a review of existing materials.

Construction and Repair

- When planning new construction, facilities should consider installing anti-scald valves on hot water outlets, so that water temperatures in the recirculation lines and distribution system may be set high enough to control *Legionella* growth. This would also include the use of instantaneous heaters to maintain higher temperatures.
- When the hot water distribution system is opened for repair/construction or subject to water pressure changes, the system should, at the minimum:
 - Be thoroughly flushed before being returned to service.
 - On a case-by-case basis, be evaluated for disinfection using a high temperature or chlorination flush before being returned to service.
 - If only a portion of the system is involved, disinfection may occur on only that portion of the system.
 - Precautions should be taken to prevent patient/resident exposure to aerosols, high temperatures or high concentrations of chlorine during flushing.

Storage and Premise Distribution

- Store and distribute potable cold water at <68°F (20°C).
- If your facility has the necessary mixing valves and/or anti-scald valves, hot water should be stored above 140°F (60°C) and circulated with a minimum return temperature of 124°F (51°C; Darelid, 2002). Instantaneous water heaters can also provide and maintain high water temperatures without storage. Mixing valves and/or anti-scald valves are necessary on such systems to reduce the final water temperature to no more than 120° F (49°C) in patient/resident areas to prevent scalding.
 - Recirculation loops with high temperatures do not guarantee a reduction in *Legionella* colonization at distal sites that are supplied via risers which result in lower temperatures (Chen, 2005).
 - Anti-scald valves need to be operated according to manufacturer’s recommendations, which include periodic testing of outlet temperatures and documentation of results.
- Facilities 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, should: [1] Perform an environmental assessment (which could include *Legionella* sampling); [2] Update the environmental assessment annually.
- "Dead ends", capped lines, and the location of water hammer arrestors should be documented. If they appear to be a source of corrosion, microbiologically influenced corrosion or biofouling, then they should be removed or altered to prevent recurrence of the problem. Old water hammer arrestors may need periodic replacement.
- Water lines in patient/resident areas that have been dormant or unused should be flushed or disinfected before being placed back into service. Periodic running of water in empty patient/resident rooms is recommended.
- Electronic (also known as “on-demand” or “hands free”) faucets should be monitored along with other sites in a *Legionella* sampling plan.
- Hot water storage tanks should be drained, cleaned and disinfected at least annually.
- Hematopoietic stem cell transplant (HSCT) and solid organ transplant units could implement the following additional measures. These measures will not have any long-term positive impact on the control of *Legionella* unless they are done in conjunction with a good operations and maintenance scheme or long-term treatment methods.
 - Use point-of-use filters where necessary or appropriate (showers, sinks, nursing stations used for supplying patients/residents water and ice)¹ ;
 - Remove sink aerators from patient/resident room sinks if environmental sampling persistently yields positive results for *Legionella* spp.

These latter measures may also be considered for other patients that are considered more vulnerable than the general facility census (e.g. oncology, ICU/CCU involving cardio-pulmonary patients, etc.).

DISINFECTION

Disinfection should be performed if indicated by the results of an environmental

¹ Establishment of water stations where drinking water and ice can be produced using filters with pore sizes of no more than 0.2 microns. In addition, shower wands with these 0.2 micron filters could serve as an alternative to shower restrictions and dry baths.

assessment or in response to disease. If multiple possible or definite case(s) of legionellosis are identified, it is advisable to consider immediate disinfection. This may require that the facility hire a consultant. The disinfection and culture sampling should be done in consultation with NYSDOH.

When possible, a baseline assessment or an updated Environmental Assessment should be completed prior to disinfection. Acute disinfection options may only have a temporary positive effect or they may be ineffective (Chen, Y., 2007). It should be noted that repeated use of these methods can mobilize biofilm and may be destructive to facility piping and hardware. The facility's multidisciplinary team should be involved in all disinfection decision making. Appropriate education and control measures need to be implemented prior to disinfection to prevent injuries.

Short Term Control Measures

Heat and Flush

The literature suggests bringing hot water temperatures to 160 F (71 C) and flushing each tap for a minimum 30 minutes to be effective (Best, 1984). Many facilities cannot achieve these temperatures or exposure times. Under less-than-optimum circumstances a facility should attain temperatures of 160 F (71C) for greater than 5 minutes (Schulster and Chin, 2003). Lower temperatures and shorter exposure times will be less effective (Darelid, 2002; Chen, 2005; Van der Mee-Marquet, 2006). For example, temperatures of 140 F (60 C) may require greater than 30 minutes exposure times to be effective (Freije, 1996)

Failure of heat and flush protocols may require the use of hyperchlorination. The water system should be re-sampled no sooner than 7 days and no later than 4 weeks after disinfection to determine the efficacy of the treatment and the rate of re-occurrence of legionellae.

Hyperchlorination

Performing hyperchlorination is usually a more difficult short-term treatment to implement. It may be necessary to contact a consultant that can assist with the hyperchlorination of an entire building.

- Hyperchlorination should target a minimum free chlorine residual of 2.0 ppm for no less than two hours but no more than 24 hours.
- Free chlorine residual should be confirmed at multiple locations throughout the system.
- Current literature also suggests that an initial concentration of 10 - 20 ppm for two hours should be followed by reducing the concentration to > 2.0 ppm (A range of 2.0 to 6.0 ppm is required for control of *Legionella*) for up to 24 hours, after which the system should be thoroughly flushed.

The hot water system should be sampled no sooner than 7 days and no later 4 weeks after disinfection to determine the efficacy of the treatment and re-occurrence of legionellae. If additional culture analysis determines that acute treatment does not succeed in lowering the concentration of *Legionella* in your hot water system the treatment may be repeated. In some instances long-term continuous treatment methods may be needed

(chlorine dioxide or copper-silver treatment).

Low Level Continuous Chlorination

As an intermediate treatment, when either heat and flush or hyperchlorination are contraindicated, another option is to continuously treat both hot and cold water with supplemental chlorine until a permanent control measure is implemented. The target concentration should be 0.5 ppm free chlorine residual at the most distal locations from the treatment location. After implementation, culture of legionellae should be performed within 7 to 10 days.

Other Short-Term Control Measures

Empirical data indicate that the application of copper-silver on a temporary basis has been successful in controlling the re-growth of *Legionella* spp. Typical implementation requires a 30-day (or longer) treatment period with frequent culture monitoring. Cultures should be collected just prior to application of copper-silver, at a mid-point and at the presumed end of the treatment period. Inordinately high numbers of positive sites (>30%) at the end of 30 days would result in an additional 30-day (or more) treatment. The long-term efficacy of this type of treatment may be limited (e.g. up to six months) but it would allow the facility time to examine long-term treatment options (Lin, et al, 2011).

Long-Term Control Measures

Long-term control measures are complex and should be individualized. Expert advice should be sought when developing and implementing long-term control measures. If consultants are retained, they should 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 silver/copper ionization and chlorine dioxide. Consultants, or other experts, should provide sufficient data to justify selection of the long term treatment selected. When applying these long-term treatments localized flushing may help attain target chemical concentrations in problem areas. Additional steps that could be used in conjunction with these long-term measures include:

- Installing anti-scald valves on all outlets and maintaining a minimum return temperature of 124°F (51°C).
- Continuous chlorination to maintain a free chlorine residual of 0.2 ppm at the outlets.
- Periodic superheating and flushing.
- Use a combination of the preceding treatment methods.
- When evaluating primary treatment methods, consultants, or other experts, should determine whether other preventative measures are needed for long term control.

These measures may include:

- 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 or replacing ‘shock absorbers’ (i.e., water hammer arrestors);
- Periodically flushing to improve treatment at distal outlets;
- Modifying hot water re-circulation system or adding automated temperature controls;
- Replacing shower heads.
- In HSCT and solid organ transplant units, and any other units your facility has designated as having at-risk patients (e.g., oncology and cardiopulmonary ICU/CCU), consideration should be given to point-of-use filtration. The use of microporous filters may be used as a temporary additional barrier or a long-term control measure for targeted at risk areas. Alternatively, a single drinking water/ice machine station, using point-of-use filters, could be established to prepare water and ice for delivery to patient/resident rooms.
- After long-term control measures have been implemented, facilities should develop, and regularly re-evaluate, an environmental surveillance plan for *Legionella* (routine water monitoring) 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 and solid organ transplant units should be performed at least quarterly as part of a comprehensive strategy to prevent Legionnaires’ disease.
- Facilities housing less vulnerable patients/residents than those listed above should convene their multidisciplinary team to determine the need for environmental sampling by using available empiric literature and their facility’s risk and environmental assessment to guide their decision. When the decision to perform environmental testing is made, the NYSDOH recommends that the following issues be addressed before the sampling commences:
 - Methodology for collecting samples should be consistent with current guidance. See the Guidelines for Environmental Infection Control in Health-Care Facilities: Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee, June 2003, Appendix p. 43, and Box 2 p.18.
 - Culture is the gold standard for environmental testing for *Legionella*. The laboratory chosen for culturing should be proficient in culturing environmental samples for *Legionella*. Laboratory participation in the CDC ELITE program for proficiency testing is highly recommended (<http://www.cdc.gov/legionella/elite-intro.htm>).
 - Although PCR protocols to detect *Legionella* spp. are not standardized, PCR can be very useful to guide culture and remediation efforts. Please see *Culturing the Environment in the Presence of Disease* below for further details.
 - **The facility should decide what measures will be taken in response to positive environmental results in the absence of disease.** Refer below to "Interpretation of Culture Results".

Culturing the Environment in the Presence of Disease

- Recommendations regarding environmental sampling for *Legionella* spp. should be made in consultation with the NYSDOH if a case of possible or definite healthcare facility-associated Legionnaires' disease has been identified or in the context of an ongoing outbreak of Legionnaires' disease in the surrounding community. Answers to the following questions will help determine what recommendations will be made:
 - Possible or definite healthcare facility-associated case?
 - Previous history of healthcare facility-associated Legionnaires' disease?
 - Patient/resident populations the facility serves?
 - Location of the facility relative to any community outbreak?
 - Physical plant structure (hot water flow, complexity of the system, blue prints)?
 - Availability of patient/resident culture(s)?
 - Completion of an environmental assessment form?
- Environmental sites appropriate for sampling should be chosen in consultation with the NYSDOH Center for Environmental Health and/or consultants/experts.
- Environmental culturing should be performed by a laboratory that is experienced in culturing *Legionella* spp. from environmental samples. The NYSDOH does not certify laboratories for environmental *Legionella* analysis at this time. However the CDC ELITE program is available for culture proficiency testing of laboratories.
- Laboratories should be able to distinguish *L. pneumophila* from other *Legionella* species.
- Polymerase chain reaction (PCR) and direct fluorescent antibody (DFA) methods used for environmental sampling may detect non-viable organisms, and thus, have value limited to screening for the potential presence of viable organisms.

RECOMMENDED SAMPLING PLAN

If a potable hot/cold water sampling plan is required as a result of disease, or is done as part of a routine environmental assessment, the recommended sampling sites should include but not be limited to:

- One water sample of the inlet of the heating system(s)
- One water sample of the outlet of the heating system(s)
- One sample of the inlet of the cold water supply
- Floors that housed ill patients/residents, as well as additional floors, should be sampled. Three samples should be collected from each floor. This is normally done in the following fashion:
 - Tap closest to first delivery of hot water from the riser
 - One sample from the middle of the system
 - One sample from the last outlet before the water returns to heaters
- Where multiple risers supply hot water to a limited number of rooms from a circulation loop, several locations corresponding to the loop should be sampled.
- One additional random sample should be collected from each floor when wings have extensive lengths of piping and complex paths. Good judgment should be

used to determine representative sites (e.g. if cold water taps frequently yield "tepid" water).

- For initial building assessment it is suggested that a surface sample (swab) be performed at locations representing the middle or end of the hot water line on each floor.

Sampling Technique

- Water samples should be first draw samples. First draw hot water samples are used to determine "percent positivity" (see below).
- Temperature, pH and residual chlorine levels should be obtained with all water samples (immediately after the first draw). Temperatures should be obtained with first draw sample and after a three minute flush. The temperature profile for hot or cold water systems will help delineate low flow/poor flow areas.
- Aseptic technique should be used in collecting the water samples and filling vessels.
- Thiosulfate, to inactivate free chlorine, should be used in all samples.
- Store samples at 4°C for transport to the lab. (Dry ice is NOT recommended. Ice or "blue" ice bricks and a cooler are preferred).
- Surface samples should be collected with sterile cotton swabs that are dipped in water from the sample site. The swab is aseptically broken off into the bottle containing sample water. Cotton swabs prepared with buffers or alginate swabs are not recommended.

There may be variations of this sampling scheme. Most consultants, vendors, and other experts will make similar recommendations or add suspect sites (dead legs, infrequently used areas, low flow zones, water softener equipment, roof top tanks, ice machines, etc.) depending upon the level of suspicion. At least 10 sites (taps/showers) are recommended in hospitals with <500 beds; 2 sites per 100 beds is recommended for facilities with >500 beds.

Use of ATP methods will also help determine the background microbial populations and increase, or decrease, the index of suspicion with regard to water system microbiological quality. However, high ATP values with high heterotrophic plate counts do not always correlate with the occurrence of high levels of legionellae.

Interpretation of Culture Results

Culture results would be assessed based on the number of positive sites with some special consideration given to the *L. pneumophila* serotypes and secondarily to *Legionella* species. Although some current literature suggests that colony counts (colony forming units (CFU)) are not useful information, in combination with the data on the number of positive sampling sites, this additional information may be very useful in determining a level of concern and how to react to that concern. Any location with double-digit levels of legionellae per 100 ml, when linked together with >30%-positive sampling sites, should be considered an area of concern.

If the number of positive sampling sites is:

- >30% - THEN acute treatment is often recommended; follow NYSDOH guidelines to protect patients/residents. If this was already done as part of an outbreak response, the system needs to be reassessed to determine the efficacy of the treatment. It may need to be repeated.
- =30% - THEN treatment may need to be considered (dependent upon *Legionella* species and facilities assessment information). This is a borderline condition; therefore, if the number of colony forming units is quite high (generally double-digit colony count values per 100 ml sample), even if the number of positive sites is 30%, an acute treatment may be advisable.
- <30% - THEN continue to monitor the facility on a quarterly basis. This should be done in combination with patient/resident surveillance measures. If there is no change after one year, reduce routine monitoring to 2 (or three) times per year.

When assessing the number of positive sampling sites the following is a guideline for the level of concern for the species of the isolates recovered*:

- Primary concern is *Legionella pneumophila* 1;
- Secondary concern is *L. pneumophila* serotypes 2 – 6;
- Less concerning are sporadic isolates of *L. pneumophila* 7-16 and non-*pneumophila* species; exceptions to this lower level of concern are:
 - When a facility is extensively colonized with any *L. pneumophila* 7-14 and/or non-*pneumophila*;
 - There is extensive occurrence of *L. anisa*, *L. micdadei* or *L. bozemanii***.
 - Disease is caused by *L. pneumophila* 7-16 or any non-*pneumophila* species.

*Composed from Benin, et al, 2002, and data reported to the CDC from 1980 – 1998

**Each of these organisms has caused disease in New York State.

As noted earlier, it may be advisable to implement point-of-use microfiltration for the establishment of water stations where drinking water and ice can be produced using filters with pore size of no more than 0.2 microns. In addition, shower wands with microporous filters are also available as an alternative to shower restrictions and dry baths. Point-of-use microfiltration may be a useful barrier during the period between the determination of facility vulnerability and a final solution. Point-of-use microfiltration can also be used as an added barrier in locations serving compromised patients/residents.

A version of a *Legionella* management/action plan is attached (cooling tower sampling should be done by your vendor; refer to the appropriate industry guidance such as ASHRAE Standard 188).

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- Maintain facility to prevent legionellae growth.
- Perform environmental assessment or update environmental assessment to assist in preventative measures.
- Perform sampling to support and validate any new preventative measures BUT not as a substitute for preventative measures or patient/resident surveillance.

Was Legionellosis Identified?

- Level of suspicion?
- Differential diagnosis?
- Urine antigen testing?
- Culture?

Follow NYSDOH and CDC guidelines to determine answer.

