Environmental Health Information Related to Legionellosis in Healthcare Facilities

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Table of Contents

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I. INTRODUCTION

Environmental Information

Legionella bacteria are naturally occurring waterborne organisms. Although the bacteria are common in aquatic environments, legionellosis is usually associated with exposures from environments that amplify their numbers. *Legionella* amplify in warm-water locations with the ideal temperatures 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 healthcare facilities. Laboratory studies indicate that above 122°F (50°C) *Legionella* can survive, but may not multiply. Even at 131°F (55°C), it takes 5-6 hours before *Legionella* will be inactivated. There is some variability in the heat resistance capabilities of the various *Legionella* species, which has implications for short- and long-term treatment schemes.

Cases of Legionnaires' disease result from exposure to contaminated water aerosols or by the aspiration of contaminated water. A link has been established between Legionnaires' disease and potable water or aerosol-generating devices, such as cooling towers, hot tubs, whirlpool spas, respiratory therapy equipment, room-air humidifiers, showers and faucets. Immune compromised patients at healthcare facilities are at greater risk of infection. Therefore, cooling towers, hot water systems, and other equipment that may generate aerosols should be properly operated and, where feasible, multiple barriers should be developed to prevent exposures of patients to environments where *Legionella* spp. have been shown to readily amplify. Cooling towers need appropriate treatment. In addition, discharges should be controlled as far as drift eliminators and proximity to air intake units or other locations where people may be exposed.

Epidemiological Considerations

Certain host factors place persons at greater risk for acquiring Legionnaires' disease. Persons with severe immunosuppression from organ transplantation or chronic underlying illness, such as malignancies or end-stage renal disease, are considered at the **greatest risk** for acquiring, and dying from, Legionnaires' disease. Persons with diabetes mellitus, chronic lung disease, human immunodeficiency virus (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 diagnosis of all healthcare facility-associated pneumonia that occurs in patients who are at moderately increased risk or greatest risk for acquiring Legionnaires' disease. Additionally, Legionnaires' disease should be considered in the differential diagnosis in residents admitted from long-term care facilities to the hospital with signs and symptoms consistent with pneumonia.

Surveillance for Legionnaires' disease

Environmental health practitioners need to be involved in and closely collaborate with clinicians, plant facility engineers, technicians, laboratorians, and the infection control department. This interaction is critical to prevent and control healthcare facility-associated Legionnaires' disease. **The recommendations below describe clinical surveillance implementation and how legionellosis can be discriminated from other pneumonias:**

1. Ensure the availability of laboratory tests for *Legionella* (i.e., culture and urinary antigen).
    - All patients 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 healthcare facility-associated pneumonia.

2. Determine the facility's strategy for clinically identifying cases of healthcare facility-associated Legionnaires' disease. This can be operationalized by:

    - Educating all clinicians to perform testing for *Legionella* for all patients who develop healthcare facility-associated pneumonia who are at moderately increased or greatest risk for Legionnaires' disease, and
    - Performing urinary antigen testing and sputum culturing when pneumonia is in the differential diagnosis.

3. It is critical that the following samples are collected from patients:

    - **Culture of respiratory specimens for *Legionella* species, and**
    - **Detection of urinary antigen for *L. pneumophila* 1**.

4. Matching of isolates from the patient and the environment becomes critical in determining the possible points of exposure during an investigation.

The following surveillance definitions apply for assessing community versus facility-associated Legionnaires' disease, given an incubation period of two to ten days:

1. Community-associated Legionnaires' disease: the patient resided in the community and not any healthcare facility for the entire incubation period and presented with onset of illness within 48 hours of admission.
2. Possible healthcare facility-associated Legionnaires' disease: the patient was in a healthcare facility for part of the incubation period.
3. Definite healthcare facility-associated Legionnaires' disease: the patient was in a healthcare facility for the entire incubation period.

Note that all cases of possible or definite healthcare facility-associated Legionnaires' disease are to be reported to the appropriate public health authority within 24 hours of diagnosis.

II. ENVIRONMENTAL ASSESSMENT

It is recommended 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 and any chemical treatment systems (ASHRAE). The purpose of the exercise is to determine 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", partially 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 on-going 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.

If a facility does not have a multidisciplinary team, NYSDOH staff should encourage the formation of this group. 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 would 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 Health Care Facility

If a case of Legionnaires' disease is linked to a NYSDOH regulated long-term care facility 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 re-growth will most likely occur**. Therefore, long-term control measures, or other barriers such as point-of-use microfiltration, may be needed in the future. Environmental surveillance, 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 would 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 (NYSDOH, 2005). 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').

III. OPERATIONS AND MAINTENANCE

Good operations and maintenance procedures should be developed by the facility's multi-disciplinary team. 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 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 (43°C) in patient 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 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 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 water and ice)[1] ;
  - Remove sink aerators from patient 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.).

IV. DISINFECTION

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

[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.

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 (CDC, 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* sp. 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 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.

V. 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 (NYSDOH, 2005).
- Facilities housing less vulnerable patients 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. 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 populations the facility serves?
  - Physical plant structure (hot water flow, complexity of the system, blue prints)?
  - Availability of patient 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 alone should not be used for environmental sampling as they may detect non-viable organisms, and thus, positive results could be difficult to interpret.

VI. 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/client, 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. 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 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.

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).

VII. INITIATING AN INVESTIGATION & CRITERIA FOR CLOSE-OUT

Not all reports of legionellosis will result in an on-site investigation by NYSDOH environmental and/or epidemiology staff. Table 1 categorizes situations involving single or multiple reports of possible or definite cases of legionellosis. This table should be used as a guideline. It should be noted that if the EAF indicates vulnerabilities, one key recommendation would be that the facility begin remediating the problems using staff with appropriate experience in controlling legionellae. If those individuals do not exist 'in house', it may be necessary to seek outside expertise.

Table 2 presents the criteria for closing out any event or outbreak whether or not an on-site investigation occurred. Key to the close-out of any event or investigation is the lack of on-going illness and the implementation of environmental recommendations that were deemed necessary and protective by NYSDOH.

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IX. CONTACTS

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2. Cooling Technology Institute; www.cti.org; Phone: (281) 583-4087.

Table 1. Investigation of Healthcare-Associated *Legionella* Cases in Hospitals and Long-Term Care Facilities

Situation	Facility **without** Transplant Units[1]	Facility **with** Transplant Unit(s)
1 possible case, no cases within the past 6 months	Epi: Retrospective and prospective surveillance dependent upon details of case[2] Env: EAF completion or update and review by NYSDOH §[2]	Case is an inpatient of Solid Organ or HSCT Unit: Epi: Retrospective and prospective surveillance Env: EAF completion; environmental investigation pending in-house assessment or, if necessary, use of an outside consultant. Case had little or no contact with Solid Organ or HSCT Unit: Epi: Retrospective and prospective surveillance Env: EAF completion or update and review by NYSDOH§[2]
1 definite case, no cases within the past 6 months	Epi: Retrospective and prospective surveillance Env: EAF completion or update; environmental investigation as indicated §§[2]	Case is an inpatient of Solid Organ or HSCT Unit: Epi: Retrospective and prospective surveillance Env: EAF completion and environmental investigation Case had little or no contact with Solid Organ or HSCT Unit: Epi: Retrospective and prospective surveillance Env: EAF completion or update; environmental investigation as indicated §§[2]
≥1 possible or definite case within the past 6 months	Epi: Retrospective and prospective surveillance, additional epidemiologic investigation as indicated (e.g. site visit, detailed exposure history, case-control study) Env: EAF completion or update; environmental investigation as indicated §§[2]	Case is an inpatient of Solid Organ or HSCT Unit: Epi: Retrospective and prospective surveillance Env: EAF completion or update and environmental investigation Case had little or no contact with Solid Organ HSCT Unit: Epi: Retrospective and prospective surveillance Env: EAF completion or update and environmental investigation as indicated §§[2]
≥2 possible cases among patients visiting an outpatient transplant unit	N/A	Epi: Retrospective and prospective surveillance Env: EAF completion and environmental investigation

[1] Locations housing vulnerable populations other than those in HSCT or Solid Organ Transplant Units may need special consideration, e.g. oncology units or cardio-pulmonary ICU/CCU.

[2] Case details that may be considered in determining the extent of investigation (not all-inclusive):

a. History or lack of history of cases in the facility;
b. If "possible", the number of days spent in the facility during the exposure period;

c. If "possible" for more than one facility, factors that make the exposure more likely to have occurred at one particular facility; (e.g. infection with an unusual *Legionella* species that has been isolated at one of the facilities or an ongoing outbreak at one of the facilities);
d. Factors that decrease the probability that exposure occurred in the facility (e.g. a case in an immunosuppressed person with a History of Legionnaires' disease and a persistently positive urine antigen).
e. Factors that increase the probability that the exposure occurred in the facility (e.g. PFGE match)
f. Number, intensity, and nature of water exposures while in the facility;
g. Recent water testing results, if done;
h. Water treatments or other measures in place to lessen *Legionella* growth (copper-silver, monochloramine, mixing valves, etc.).

§ If vulnerabilities are determined by the EAF, and appropriate staff are not available in the facility, appropriate outside expertise may be needed to help resolve the issues. Site visit is not recommended.

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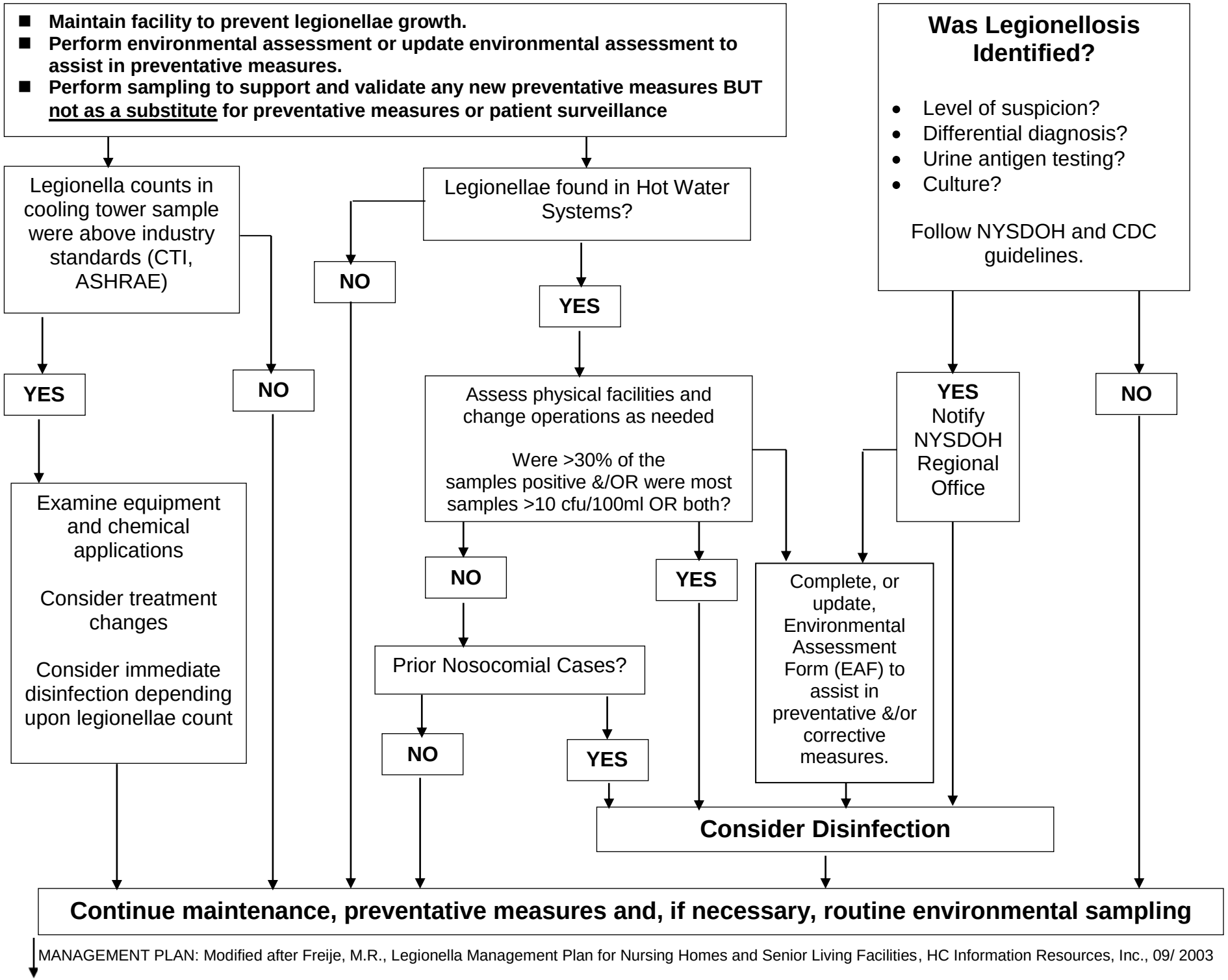
Table 2: *Legionella* Investigation Close-out Criteria

Situation	NYSDOH Close-out Criteria
No environmental investigation (beyond completion of EAF)	Six months after onset of last case; implementation or acknowledgement of environmental recommendations by the health care facility.
Environmental investigation performed No clinical isolates available for molecular typing, or clinical isolate does not match environmental isolates from initial round of cultures, (or no environmental isolates available for molecular typing)	When environmental monitoring results are acceptable (in the case of cultures, <30% sites positive for three successive months) and at least 6 months has passed since onset of last case; implementation or acknowledgement of environmental recommendations by the health care facility.
Environmental investigation performed Clinical isolate(s) match environmental isolate(s) by molecular typing	When environmental monitoring results show eradication of the implicated *Legionella* strain and at least 6 months has passed since onset of last case; implementation or acknowledgement of environmental recommendations by the health care facility.
Facility not cooperative with investigation, no additional cases during the 6 months after the last case	6 months after onset of last case
Facility not cooperative with investigation, additional case(s) occur during the following 6 months	Involve OHSM or OLTC as appropriate Further follow-up dependent on OHSM/OLTC action; if no action then close 6 months after onset of last case


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 surveillance
Was Legionellosis Identified?
Level of suspicion?
Differential diagnosis?
Urine antigen testing?
Culture?
Follow NYSDOH and CDC guidelines.
Legionella counts in cooling tower sample were above industry standards (CTI, ASHRAE)
Legionellae found in Hot Water Systems?
NO
YES
YES
NO
Assess physical facilities and change operations as needed
Were >30% of the samples positive &/OR were most samples >10 cfu/100ml OR both?
YES Notify NYSDOH Regional Office
NO
Examine equipment and chemical applications
Consider treatment changes
Consider immediate disinfection depending upon legionellae count
NO
YES
Complete, or update, Environmental Assessment Form (EAF) to assist in preventative &/or corrective measures.
Prior Nosocomial Cases?
NO
YES
Consider Disinfection
Continue maintenance, preventative measures and, if necessary, routine environmental sampling
MANAGEMENT PLAN: Modified after Freije, M.R., Legionella Management Plan for Nursing Homes and Senior Living Facilities, HC Information Resources, Inc., 09/ 2003