Environmental Health Information Related to Legionellosis in Healthcare Facilities

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Contents

NEW YORK STATE DEPARTMENT OF HEALTH (NYSDOH)
PREVENTION AND CONTROL OF LEGIONNAIRES' DISEASE
ENVIRONMENTAL GUIDANCE AND ENGINEERING MEASURES

I. REGULATORY REQUIREMENTS

New York State Department of Health (NYSDOH) regulations entitled "Protection Against *Legionella*," which are located in Part 4 of Title 10 of the *Official Compilation of Codes, Rules and Regulations of the State of New York* (hereinafter 10 NYCRR Part 4), became effective on July 6, 2016. 10 NYCRR Subpart 4-1 applies to all cooling towers relating to registration and reporting, maintenance, testing, notification, disinfection, inspection, certification and recordkeeping. 10 NYCRR Subpart 4-2 addresses additional requirements for general hospitals and residential health care facilities licensed under Article 28 of the New York State Public Health Law (hereinafter covered facilities), which include development, and completion of, at a minimum, annual updates to the environmental assessment and preparing as well as implementing a *Legionella* Sampling and Managing Plan (SMP) for potable water systems, and taking necessary actions in response thereto. More information on these requirements is available at http://health.ny.gov/environmental/water/drinking/legionella/. Additionally, the full text of the regulation can be found at https://regs.health.ny.gov/content/part-4-protection-against-legionella.

Note that appropriate sections of the regulation are mentioned parenthetically below as needed.

II. ENVIRONMENTAL ASSESSMENT

Covered facilities are required to proactively perform an environmental assessment of their water systems (10 NYCRR § 4-2.3), which must be done by completing the assessment form, entitled "Environmental Assessment of Water Systems in Healthcare Settings," available at: http://www.health.ny.gov/forms/doh-5222.pdf

As outlined in Form 5222, the environmental assessment must involve reviewing facility characteristics. The facility should also consider the best management practices of the industry (e.g. the most current version of ANSI/ASHRAE 188 including normative annex A; Allegheny County, 1997). The purpose of the assessment is to determine any potentially hazardous conditions that would allow for amplification of *Legionella* spp. and to structure a response in advance of any environmental sampling for *Legionella*.

The completed environmental assessment form must be retained on-site and made available to NYSDOH upon request. Once the environmental assessment form is completed, it must be reviewed and updated at least once a year. Potentially hazardous conditions need to be evaluated and corrected. Key considerations that may need correction include the presence of corrosion product/sediment, tepid hot or cold water, stagnant water, and the persistent lack of disinfectant residuals.

Updates to the environmental assessment form and attendant files and information must accompany any significant construction or repair work that is done in the facility. It is recommended that initial and on-going assessments be conducted by a **multidisciplinary team** composed of key individuals in each facility who represent the expertise, knowledge, and functions related to the facility operations and service.

All covered facilities should have a multidisciplinary team, which should include at a minimum:

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

A description of the facility water system that includes a **process flow diagram** must be prepared, and it is recommended that this be completed by the multidisciplinary team. The process flow diagram should illustrate, step-by-step, how/where the water is received, transported, and delivered to end-points within the building potable water system. The diagram should include all piping, water-using devices (e.g., spas, pools, washing machines, ice machines, decorative fountains, dishwashers) and water-processing devices (e.g., back-flow prevention devices, water heaters, expansion tanks, etc.), starting at the point where the supply water enters the building and ending where the water exits the piping at a fixture, at a drain or feeds a non-potable use. For hot water systems, the recirculation path should be described. The process flow diagrams should have sufficient detail to enable the systematic identification, characterization and management of potentially hazardous conditions throughout the building water systems. However, they should be simple enough for every member of the multidisciplinary team to understand. The process flow diagrams should be confirmed as accurate by visual inspection. Please refer to the appropriate sections of Normative Annex A in the current version of ANSI/ASHRAE 188 and CDC, 2016 for additional guidance.

As part of the environmental assessment process, an SMP that includes a schedule for environmental sampling for *Legionella* spp. must be developed (10 NYCRR § 4-2.4). Sampling needs to be representative of the facility (see Section III. below) and performed to determine the extent of colonization, including the possibility of extensive biofilm involvement and areas of concern.

The response to sampling results must be based on responsive actions outlined in Appendix 4-B of 10 NYCRR Subpart 4-2 (see Section V. below). This information will help guide the facility in the next steps for continued monitoring, initiating treatment, and/or retaining a consultant.

III. Sampling for *Legionella*

When potable hot/cold water sampling is (1) required as a result of disease, or other condition specified by NYSDOH, or (2) conducted in response to a routine environmental assessment, the recommended sampling sites should include, but not be limited to:

- A sample of the inlet cold water supply at the first available tap
- One water sample from the return piping of the circulated heating system(s)
- One water sample of the outlet of the heating system(s)
- Samples from floors that house ill patients/residents, as well as additional floors. Three samples should be collected from each floor. This is normally done as follows:
    - 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
- For the 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

At least 10 sampling sites (taps/showers) are recommended in hospitals with <500 beds; two sites per 100 beds is recommended for facilities with ≥500 beds. However, separate hot water systems within a building require their own set of samples. Samples must be representative of the entire water system(s).

These samples must be collected from each separate hot water system that may be involved in case exposures. When sampling during an investigation, the facility needs to work with NYSDOH to determine the number of samples needed. In hematopoietic stem cell transplant (HSCT) and solid organ transplant units, the environmental sampling frequency must not exceed an interval of 90 days (10 NYCRR § 4-2.4(a)(2)).

A. Sampling Technique

The following steps should be followed when collecting water samples:

- Water samples should be first-draw samples, except for the cold water inlet, which should be collected after a three-minute flush
    - First-draw hot water samples are used to determine "percent positivity" (see section B)
- Temperature, pH, and residual chlorine levels should be obtained with all water samples (immediately after the first draw)
    - Temperatures should be obtained from the first-draw samples and after a three-minute flush
    - The temperature profile for hot and cold water systems will help determine low flow/poor flow areas and serves as a surrogate for water age
- Aseptic technique should be used in collecting the water samples and filling sample containers
- Thiosulfate should be used in all samples to inactivate free chlorine
- Transport samples at 12 +/- 6 ^{o}C. Ship samples in a cooler without ice. Do not freeze. If ambient temperatures are above 18 ^{o}C, include a small, well-wrapped blue ice pack in the cooler to prevent samples from overheating.
- 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 from the same location
    - Cotton swabs prepared with buffers or alginate swabs are not recommended

There will 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 on the level of suspicion.

Use of adenosine triphosphate (ATP) methods will also help determine the background microbial populations and increase, or decrease, the index of suspicion with regard to water system overall microbiological quality. However, ATP values and heterotrophic plate counts may not correlate with

each other, and they do not always correlate well with the levels of legionellae as determined by culture methods.

B. Interpretation of Culture Results

Culture results are assessed based on the number of positive sites per Appendix 4-B, with some special consideration given to the *L. pneumophila* serotypes and secondarily to *Legionella* spp. (see box below). Although some current literature suggests that colony counts (i.e., colony forming units (CFU)) are of limited value, in combination with the number of positive sampling sites they may be very useful in determining both a level of concern and an appropriate response. All culture data should be reported using the volume of samples actually processed. For example, if 200 ml are collected and 100 ml are processed by the laboratory for culture, the results should be reported as *N* CFU/100ml. Facilities should report the raw data. As noted earlier: When sampling during an investigation, the sampling locations needs to be determined in consultation with the NYSDOH.

As outlined in Appendix 4-B, if the number of positive sampling sites is:

≥30% THEN short-term treatment is required. If this was already done as part of an outbreak response, the system needs to be reassessed to determine the efficacy of the treatment. The treatment approach may need to be repeated or revised.

<30% THEN continue to monitor the facility at the sampling frequency prescribed in the Sampling and Management Plan.

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.

Facilities sampling because of illness and/or an excessively high number of positive Legionella sampling sites should obtain culture results of <30% positivity for three successive months. This is necessary as a means of validating remediation or other corrective measures. These successive monthly sets of results should be evaluated in consultation with NYSDOH to determine whether the facility can revert to the interval prescribed by Subpart 4-2.

In areas that house vulnerable populations, and/or as part of a long-term control strategy, facilities should consider implementing 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 potentially hazardous conditions in a facility and a final solution. Point-of-use microfiltration can also be used as an added barrier in locations serving compromised patients/residents (See section V.A.1 below).

IV. OPERATIONS AND MAINTENANCE

Good operations and maintenance procedures should be developed by the facility's multidisciplinary team. The items noted below are suggested elements of the SMP. Elements can be added or deleted depending upon the outcome of a facility environmental assessment. For additional guidance on drafting an SMP, refer to 10 NYCRR § 4-2.4. In addition, information in Normative Annex A of ANSI/ASHRAE 188-15 and the CDC toolkit (CDC, 2016) can be used as guidance to assist in the development of the SMP.

A. Heating and Cooling

Hot water heating systems (non-potable) should be maintained according to the manufacturer's recommendations and current industry standards.

Please Note: Cooling towers must be registered and operated in conformance with 10 NYCRR Subpart 4-1 and appropriate industry management practices (Section 7.2 ANSI/ASHRAE Standard 188; NSF Protocol 453). This must include annual start-up and shut-down procedures.

All owners of cooling towers must register their towers using the statewide electronic system prior to initial operation and whenever ownership changes (10 NYCRR § 4-1.3(a)). Cooling towers for facilities located in the five boroughs of New York City also need to be registered with the appropriate City agency.

10 NYCRR Subpart 4-1 contains required **critical elements** that need to be addressed in regard to the cooling tower maintenance program and plan (MPP):

- All cooling tower owners shall obtain or update an MPP plan for each tower (10 NYCRR § 4-1.4(a)).
    - The plan must contain a schedule for routine bacteriological sampling at intervals not to exceed 30 days while the cooling tower is in use as well as a schedule for Legionella culture sampling to be performed with 14 days after start-up and then at intervals not to exceed 90 days while the tower is operational. Cooling towers that are in use year-round must sample at intervals not to exceed 90 days, and within two weeks after start-up following maintenance (10 NYCRR § 4-1.4(b)(1) and (2)).
- There are special conditions for additional *Legionella* culture sampling and analysis when there are power failures, loss of biocide treatment, failure of conductivity control, or any other control methods to maintain proper cycles of concentration, or when determined to be necessary by NYSDOH (10 NYCRR § 4-1.4(b)(3)).
- Provisions for taking immediate action in response to a bacteriological and *Legionella* culture analyses (10 NYCRR §4-1.4(b)(4), including following the required responsive actions in 10 NYCRR Appendix 4-A, and contacting the local health department within 24 hours (10 NYCRR §§ 4-1.4(b)(4) and 4-1.6)

- Additional provisions should be added on proper culture analysis methods (10 NYCRR § 4-1.4(b)(5)), a shutdown and disinfection plan for permanently decommissioning a cooling tower (10 NYCRR § 4-1.4(b)(6)), treatment and flushing of cooling tower parts during idle conditions (10 NYCRR §4-1.4(b)(7)), and cleaning and disinfection prior to re-starting a cooling tower (10 NYCRR §4-1.4(b)(8)).

Please refer to 10 NYCRR § 4-1.4 for the complete list of requirements. In addition, refer to the template of the MPP available at: https://www.health.ny.gov/environmental/water/drinking/legionella/docs/cooling_tower_maintenance_program_plan_template_.docx .

This template provides additional information (including a process flow diagram) that would be useful for assessing cooling apparatus.

B. Building 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 (ANSI/ASHRAE 188-2018). This would also include consideration for 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 a minimum:

- Be thoroughly flushed before being returned to service
- Be evaluated for disinfection on a case-by-case basis using an ambient temperature, a high temperature or chlorination flush before being returned to service
    - It is important to refer to local codes for the rehabilitation of premise water systems after repair or construction

If only a portion of the system is involved, disinfection may occur on only that portion. Precautions should be taken to prevent patient/resident exposure to aerosols, high temperatures, or high concentrations of chlorine during flushing.

Please note: the **environmental assessment form** must be reviewed and updated after completion of any building construction or repair activities that may affect the potable water system.

C. Water Storage and Premise Distribution

Potable **cold water** should be stored and distributed at <68°F (20°C).

Hot water storage tanks should be drained, cleaned and disinfected according to manufacturer's recommendations or at least annually. 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 that required by local codes. This temperature is usually no more than 110 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 that 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 perform an environmental assessment that includes *Legionella* sampling in order to determine the extent of any biological hazard related to *Legionella*.

"**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, they should be removed or altered to prevent recurrence of the problem. Old water hammer arrestors may need periodic replacement.

Dormant water lines in patient/resident areas should be flushed or disinfected before being placed back into service. Periodic running of water in empty patient/resident rooms is recommended.

Electronic faucets (i.e., "on-demand" or "hands free" faucets) should be monitored along with other sites in the *Legionella* sampling and management plan.

Hematopoietic stem cell transplant (HSCT) and solid organ **transplant units** should consider implementing 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 good operations and maintenance practices 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; see Section IV below)[1]
- Removal of 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 who are considered more vulnerable than the general facility census (e.g. oncology, ICU/CCU involving cardio-pulmonary patients, etc.).

V. CONTROL/DISINFECTION

As summarized in Appendix 4-B and Section III B above, control measures or disinfection must be performed when ≥30% of samples test positive for *Legionella*. Control measures should also 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, which may require the facility hire a consultant and also should be done in consultation with NYSDOH. Further, where one or more cases of legionellosis are, or may be, associated with a

[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.

facility, culture sampling timeframes and interpretation must be conducted at the direction of NYSDOH (10 NYCRR § 4-2.4(b)(1) and Appendix 4-B, n1)

An updated environmental assessment should be completed prior to disinfection. Both short- and long-term control and disinfection measures are described below. Short-term (or acute disinfection) options may only have a temporary positive effect or they may be ineffective (Chen, Y., 2007; Lin, Y.E. et al., 2011). It should be noted that repeated use of these methods can dislodge biofilm and may be destructive to facility piping and hardware. Long-term control measures may provide for more effective control. 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.

A. Short-term Control Measures

1. Point-of-use filters

Transmission of *Legionella* via the potable water system can be controlled using point-of-use (POU) filters. These devices, typically applied to a single tap or showerhead, prevent microbial contaminants in the water from being transmitted from the tap to individuals using them. POU filters with a pore size of 0.2 microns have been reported effective for preventing environmental transmission of *Legionella*. However, POU devices that are not replaced according to the manufacturer's recommendations become fouled and provide media that supports microbial growth. Depending upon water source and delivered turbidity, some locations may experience more rapid filter fouling. This may require a prefilter or point-of-entry filtration to extend the POU filter life.

2. Heat and flush

Older 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; Lin, Y.E. et al, 2011). More recent experience indicates that use of this treatment should be limited for several reasons. First, many facilities cannot achieve these temperatures or exposure times making the method difficult to implement. Therefore, a facility should attempt to attain temperatures of 160° F (71 C) for greater than five minutes (Sehulster 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 of exposure time to be effective (Freije, 1996). Second, be aware that heat and flush is often not successful and may give limited control over a short period. Recent guidance suggests that targeting heat and flush treatments to specific problem areas may be more successful than treating an entire potable hot water system. Care should be taken in assessing the hot water system for corrosion, the presence of elastomeric gaskets, or plastics that may not tolerate higher temperatures and result in component failure.

After heat and flush application, the water system should be re-sampled no sooner than seven days and no later four weeks after this disinfection to determine the efficacy of the treatment and the reoccurrence of legionellae (10 NYCRR Appendix 4-B). "Rebound" of *Legionella* colonization to higher numbers than originally detected may also occur. **Failure of heat and flush protocols** may require the use of hyperchlorination. In the case of exceedance, treatment and resampling is required as presented in Appendix 4-B.

3. Routine flushing

Flushing is a control measure used to help address several possible deficiencies including aged water and poor disinfectant residual. Flushing also may help remove sediment and turbid water from the potable water system. Typically, the method would include sequentially opening taps in an impacted zone, floor or building for the time necessary to purge the old or turbid water from pipes. The protocol may also involve fixtures, tanks or other areas and components. Effective flushing for a focused location can take several minutes while whole-building flushing may take many hours. Duration is dependent upon the size of the system, pipe and component size, flow rates and the total volume of water to be flushed.

The water system should be re-sampled no sooner than seven days and no later four weeks after the procedure to determine disinfectant residuals (where applicable) and the efficacy of the flushing regarding the levels of legionellae (10 NYCRR Appendix 40B). In the case of exceedance, treatment and resampling is required as presented in Appendix 4-B. **Failure of a flushing protocol** may require the use of hyperchlorination.

4. Hyperchlorination

Performing hyperchlorination is usually a more difficult short-term treatment to implement. Also, when unsuccessful, *Legionella* growth can "rebound" resulting in bacterial levels that are higher than originally detected. For these reasons it may be necessary to contact a consultant who can assist with the hyperchlorination of an entire building (Lin, Y.E. et al, 2011).

- 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 seven days and no later four weeks after disinfection to determine the efficacy of the treatment and re-occurrence of legionellae (10 NYCRR Appendix 4-B). In the case of exceedance, treatment and resampling is required as presented in Appendix 4-B.

If additional culture analysis determines that hyperchlorination treatment does not succeed in lowering the concentration of *Legionella* in the hot water system, the treatment may be repeated. In some instances long-term continuous treatment methods may be needed (i.e., chlorine dioxide or copper-silver treatment).

5. 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 no sooner than seven days and no later four weeks afterwards (10 NYCRR Appendix 4-B). The system should be re-evaluated after culture data are received. In the case of exceedance, treatment and resampling is required as presented in Appendix 4-B.

6. 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, Y.E. et al, 2011).

Chloramination—i.e., treatment with monochloramine—has been shown to be more effective at controlling growth of *Legionella* in building plumbing systems than chlorine. (Flannery et al, 2006). The greater stability of monochloramine results in higher disinfectant concentrations in potable hot water systems because chlorine dissipates rapidly at higher temperatures. Monochloramine is also able to penetrate biofilms. Chloramine-treated systems produce disinfection by-products that should be monitored on a regular basis.

It is important to note that water heater temperatures <50° C, building heights taller than 10 stories, interruption of water service, and other factors may all work to counteract the benefits of any control measure (Flannery et al, 2006).

Actions for Legionnaires' disease in a Healthcare Facility

If a case of Legionnaires' disease is linked to a covered facility, it is critical that the facility, in consultation with NYSDOH, consider steps needed to treat the implicated water system following the completion of an updated environmental assessment (10 NYCRR § 4-2.3). Since complete eradication of *Legionella* may not be feasible and re-growth will most likely occur, long-term control measures, or other barriers such as point-of-use microfiltration, may be needed. Environmental surveillance—collecting water samples or surface samples from water appliance fixtures for *Legionella*—is necessary to ensure that the recommended treatment and long-term control measures are appropriate to the system. Sampling periods should be determined by the sampling and management plan (10 NYCRR § 4-2.4) but will be directed by NYSDOH where one or more cases of legionellosis are, or may be, associated with the facility (10 NYCRR § 4-2.4(b)(1).

B. Long-term Control Measures

Long-term control measures are complex and should be individualized to the facility. Where there are persistent results, as determined by NYSDOH, showing ≥ 30 positive sampling sites, qualified professionals must be sought when developing and implementing long-term control measures. Such qualified professionals 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, low level chlorination, chlorine dioxide and chloramination. Consultants, or other experts, should provide sufficient data to justify the selected long-term treatment. 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
- Modifying the hot water re-circulation system or adding automated temperature controls
- Periodic superheating and flushing
- Replacing hot water tanks with instantaneous heaters
- Removing or replacing 'shock absorbers' (i.e., water hammer arrestors)
- Periodically flushing to improve existing treatment, or reduce water age, at distal outlets
- Replacing shower heads
- Using a combination of the preceding treatment methods

In **HSCT and solid organ transplant units**, and any other units designated as having at-risk patients (e.g., oncology and cardiopulmonary ICU/CCU), consideration should be given to point-of-use filtration. 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 re-evaluate the environmental surveillance component of their sampling and management plan for *Legionella* (routine water monitoring), along with their plan for active case surveillance. See 10 NYCRR § 4-2.4 for the full plan requirements.

VI. ENVIRONMENTAL SURVEILLANCE FOR *LEGIONELLA*

A. Culturing the Environment – Required Routine Test Plan

All covered facilities shall conduct *Legionella* spp. culture sampling and analysis of potable water samples at intervals not to exceed 90 days for the first year following adoption of the sampling and management plan (10 NYCRR § 4-2.4). After the first year, the 90-day sampling schedule must continue for HSCT and solid organ transplant units as part of a comprehensive strategy. Facilities or units housing less vulnerable patients/residents must test annually at sampling sites determined by the environmental assessment. NYSDOH recommends that the following issues be addressed before sampling commences:

- Methodology for collecting samples should be consistent with current guidance (See section III above, and 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 on 18 of this document).
- Culture is the gold standard for environmental testing for *Legionella*. **Culture by a laboratory certified by the NY - Environmental Laboratory Approval Program (ELAP) is required**.

- Although polymerase chain reaction (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 as a result of completing an environmental assessment and implementing the sampling and management plan.** Refer to 10 NYCRR Appendix 4-B and to section III.B, "Interpretation of Culture Results," above.

B. Culturing the Environment in the Presence of Disease

The required environmental sampling for *Legionella* spp. will be made in consultation with 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 (See 10 NYCRR § 4-2.4(b)). Answers to the following questions will help determine sampling requirements:

- Possible or definite healthcare facility-associated case?
- Previous history of healthcare facility-associated Legionnaires' disease?
- Patient/resident populations the facility serves?
- Location(s) in building where patient/resident spent time?
- Location of the facility relative to any community outbreak?
- Physical plant structure (hot water flow, complexity of the system, water age, blue prints)?
- Availability of patient/resident culture(s)?
- Completion of an environmental assessment form?

Environmental sites appropriate need to be selected in consultation with the NYSDOH, and may also occur in consultation with qualified professionals. (Stout et al, 2007). As noted in subsection A above, environmental culturing must be performed by an ELAP-certified laboratory that is experienced in culturing *Legionella* spp. from environmental samples. Laboratories must be able to distinguish *L. pneumophila* serogroup 1 from other *Legionella pneumophila* isolates as well as other species (see box on page 7 above).

Polymerase chain reaction (PCR) and direct fluorescent antibody (DFA) methods **alone** cannot not be used for environmental sampling as they may detect non-viable organisms, thus rendering positive results difficult to interpret.

Routine sampling and environmental assessment as a prevention strategy

Routine sampling and environmental assessment as prevention strategies should occur in conjunction with the recommendations or requirements discussed above. Prior to sampling, the SMP must be in place to address any positive environmental samples. Sampling and analysis within hematopoietic stem cell transplant and solid organ transplant units must be conducted an intervals not to exceed 90 days.

REFERENCES

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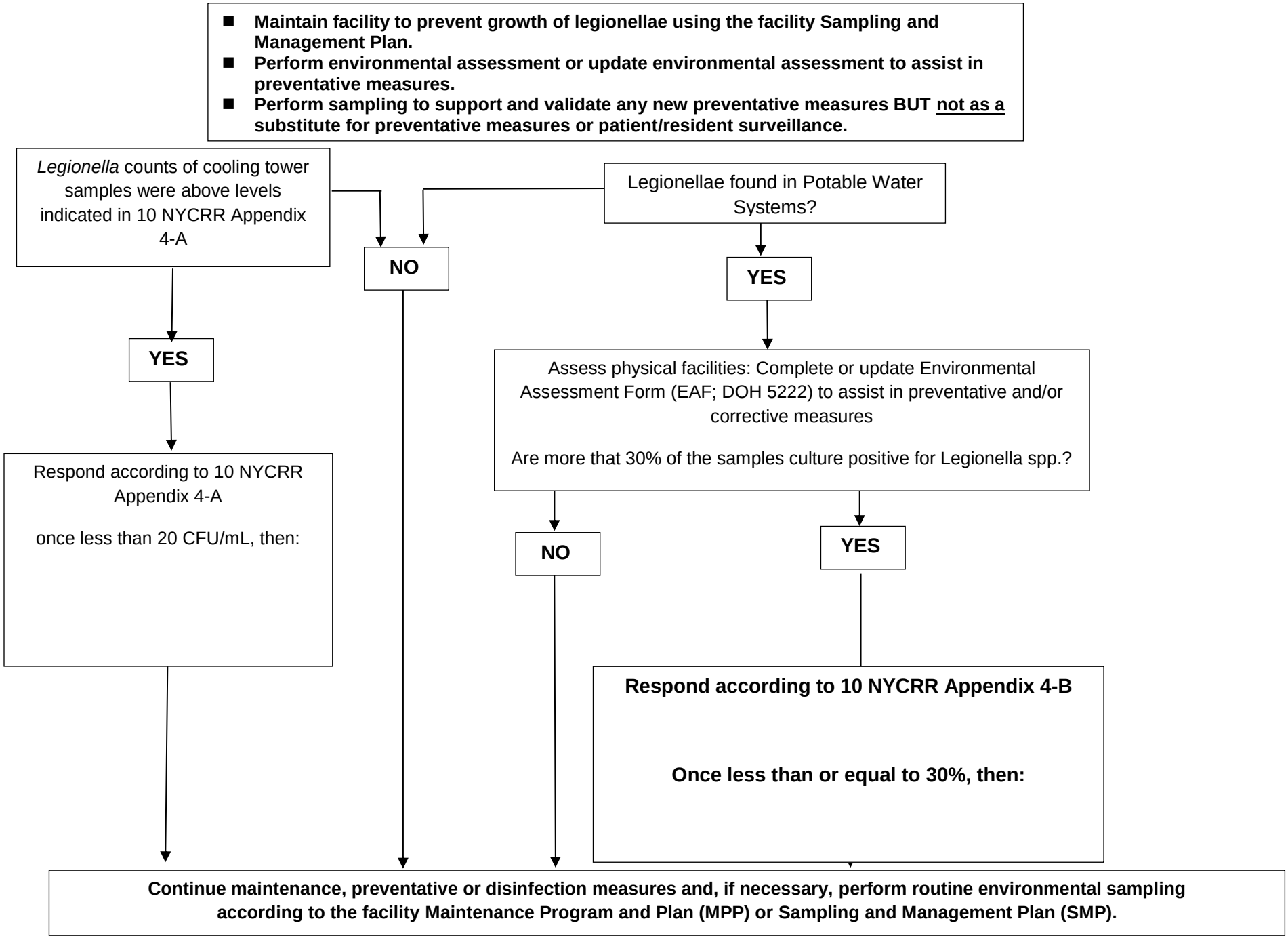
Appendix A: NYSDOH Regional Epidemiology Program Offices

Central New York Regional Office	(315) 477-8166
Metropolitan Regional Office	(914) 654-7149
Western Regional Office	(716) 847-4503
Central Office, Albany	(518) 474-1142

Appendix B: *Legionella* in Healthcare Facilities Decision Tree


■ Maintain facility to prevent growth of legionellae using the facility Sampling and Management Plan.
■ 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.
Legionella counts of cooling tower samples were above levels indicated in 10 NYCRR Appendix 4-A
Legionellae found in Potable Water Systems?
NO
YES
YES
Assess physical facilities: Complete or update Environmental Assessment Form (EAF; DOH 5222) to assist in preventative and/or corrective measures
Are more that 30% of the samples culture positive for Legionella spp.?
Respond according to 10 NYCRR Appendix 4-A
once less than 20 CFU/mL, then:
NO
YES
Respond according to 10 NYCRR Appendix 4-B
Once less than or equal to 30%, then:
Continue maintenance, preventative or disinfection measures and, if necessary, perform routine environmental sampling according to the facility Maintenance Program and Plan (MPP) or Sampling and Management Plan (SMP).