

**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 1 to 2 days incubation period, influenza-like illness, also known as non-pneumonic legionellosis) and Legionnaires' disease (a progressive pneumonia with a 2 to 10 days 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). A range of 125-250 cases of *Legionella* are reported each year in New York State. 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 hematological 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-hematological 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 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 by **both**:
 - **culture** of respiratory specimens for *Legionella* spp., and
 - detection of **urinary antigen** for *Legionella pneumophila* serogroup 1.
- 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 agar is required for culture.
 - Save isolates of *Legionella* for the epidemiologic investigation.
- Urinary antigen
 - Enzyme-linked immunosorbent assay (ELISA) or radioimmunoassay 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 organisms that are non-viable as well as viable which presents a challenge in diagnosis and comparing 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 with Legionnaires' disease from patients 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.

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. Schulster 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.

**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 care staff, plant facility engineers and technicians, laboratorians, and the infection control department is integral 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 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 who develop a facility-associated pneumonia who are at moderately increased or greatest risk for Legionnaires' disease; **OR**
 - Culturing all respiratory specimens that are 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 facility-associated Legionnaires' disease, given an incubation period of 2 to 10 days:
 - Community-associated Legionnaires' disease: the patient 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 was not in the facility during the entire incubation period.
 - Definite healthcare facility-associated Legionnaires' disease: the patient was in the facility for the entire incubation period.
- All cases of community-associated 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 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 Regional Epidemiology Program by:
 - Completing a Healthcare Facility (Nosocomial) Infection Control Report (DOH 4018 form
<http://www.health.state.ny.us/nysdoh/infection/infecreport.pdf>)
 and:
 - Faxing to the Regional Epidemiology Program (facsimile # 518-408-1745).
 - Electronically submit through the Health Provider Network (HPN) when the Nosocomial Infection Control Reporting Application is available
 (<https://commerce.health.state.ny.us/hpn/help/applications.html#N>).
 - If multiple cases are identified during an investigation, only one DOH 4018 form need be completed.

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 to water-borne organisms. The following recommendations are consistent with the Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee.

- 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 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 or family (e.g., humidifiers, CPAP, BiPAP) for use during an in-patient stay. The following issues should be addressed in policy and procedure:
 - Responsible person(s) for assessing equipment brought in from the patient's home.
 - Responsible person for cleaning and processing of such devices.
 - Responsible person to educate the patient and family regarding proper use and care of such devices.
 - Documentation that the following occurred:

- The use of the device was recommended by the patient's clinician;
- The use of the device was cleared by the designated person(s);
- Education of the patient and family occurred;
- Adequate supplies of sterile water are in the patient room for use; and
- Daily cleaning and processing 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 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 aerators from patient care areas if environmental sampling yields positive results for *Legionella* spp..
 - Restrict patients on the unit from taking showers.
 - Provide patients with sterile water for tooth brushing, drinking, flushing nasogastric tubing and dilution of enteral nutrition for administration via a nasogastric tube.
 - Notify patients 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 rooms. If this is initiated:
 - The facility must assure hand hygiene products are available (i.e., 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' 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 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 urinary antigen for *Legionella* 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 and environmental isolates;
 - Other infection control measures, including:
 - Reinforcement of recommendations described in “Use and care of respiratory equipment for the prevention of Legionnaires' disease” in this document; and
 - Tap water restrictions for immune compromised populations.
 - Notification to patients 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.
2. Schulster 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. 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.

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

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

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

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

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

Operation and Maintenance

- Store and distribute potable cold water at <68°F (20°C).
- Hot water heating systems and cooling towers should be maintained according to the manufacturer's recommendations and current industry standards (see References). Hot water storage tanks and cooling towers should be drained, cleaned and disinfected at least annually.
- The operation and maintenance of the cooling tower should be conducted under the guidance of a licensed professional engineer preferably experienced in cooling tower design and operation.
- A daily operation log and maintenance manual reflecting the latest standards must be developed and maintained for your cooling tower and hot water systems. These should include written details regarding the proper use of anti-corrosives, biocides, and disinfectants, and records on repairs, alterations, operating times, monitoring, routine disinfections, and inspections.

- If your facility's building has the necessary mixing valves and/or anti-scald valves, hot water shall be stored above 140°F (60°C) and circulated with a minimum return temperature of 124°F (51°C). Mixing valves and/or anti-scald valves are necessary on such systems to reduce the final water temperature to no more than 110° F (43°C) in patient areas to prevent scalding. Anti-scald valves need to be operated according to manufacturer's recommendations, which include periodically testing outlet temperatures.
- 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, shall, at least semiannually, disinfect their distribution system using a high temperature or a chlorination flush (see Disinfection and Long-Term Control Measures described below). Precautions must be taken to prevent scalding, or exposure to chlorine levels greater than 4.0 parts per million (ppm).
- Recirculation loops in the hot water distribution system should be used to minimize stagnation, which promotes microbial growth. "Dead ends" or capped lines should be eliminated. Water lines in patient areas that have been dormant or unused should be disinfected and flushed before being placed back on line.
- When planning new construction, facilities should consider installing anti-scald valves on all hot water outlets, so that water temperatures in the distribution system may be set high enough to control *Legionella* growth.
- When the hot water distribution system is opened for repair/construction or subject to water pressure changes, the system shall, at the minimum, be thoroughly flushed before being returned to service. The need to disinfect using a high temperature or a chlorination flush before being returned to service should be evaluated on a case-by-case basis. If only a portion of the system is involved, disinfection may be used on only that portion of the system. Precautions should be taken to prevent patient exposure to aerosols during flushing.
- For hematopoietic stem cell transplant (HSCT) and solid organ transplant units, the following additional measures should be implemented:
 - Remove, clean, and disinfect shower heads and tap aerators monthly by using a chlorine-based, EPA-registered product, or a chlorine bleach solution of 500-615 ppm.
 - Remove aerators from patient room sinks if environmental sampling yields positive results for *Legionella* spp.

Disinfection

- To routinely (e.g., at least semiannually) disinfect a hot water distribution system, each outlet should be flushed for ≥ 5 minutes with water at 160°F – 170°F (71 to 76°C), or with water containing ≥ 2 ppm free chlorine residual.
- These measures may need to be enhanced, prompted by either disease occurrence or results of environmental sampling per your facility's *Legionella* prevention, surveillance and control policies. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) states:

- For thermal disinfection, longer flush time for superheating may be needed;
- For chlorine disinfection, chlorine should remain in the system for a minimum of 2 hours (not to exceed 24 hours), after which the system should be thoroughly flushed.

Long-Term Control Measures

- Long-term control measures are complex and must be individualized. Expert advice should be sought when developing long-term control measures. Consultants must assess corrosion, scaling, biofilm, pH, temperature profile and other physical parameters that may negatively affect treatment.
- The primary treatment methods used for long term control of *Legionella* in hot water systems include the following: 1) installing anti-scald valves on all outlets and maintaining a minimum return temperature of 124°F (51°C); 2) continuous chlorination to achieve a free chlorine residual of 1-2 ppm at the outlets; 3) periodic superheating and flushing; 4) silver/copper ionization; 5) chlorine dioxide (*recently used and under evaluation*); or 6) use a combination of the preceding treatment methods.
- In addition to evaluating primary treatment methods, consultants should determine whether other preventative measures are needed for long-term control. These measures may include replacing or disinfecting shower heads, installing mixing or anti-scald valves to allow higher temperatures in all or part of the system, replacing hot water tanks with instantaneous heaters, removing shock absorbers, replacing rubber washers with synthetic washers, removing aerators, periodically flushing to improve treatment at distal outlets, modifying the hot water re-circulation system, etc.
- After long-term control measures have been implemented, facilities must 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 or solid organ transplant units shall be performed at least quarterly as part of a comprehensive strategy to prevent Legionnaires' disease.
- Facilities must convene their multidisciplinary team to assess the need for environmental sampling in non-HSCT or solid organ transplant units, using available empiric literature and their facility's risk assessment to guide their decision. If the decision to perform environmental testing is made, the NYSDOH recommends that you address the following issues 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*. PCR and DFA methods are not useful for environmental sampling (Please see *Culturing the Environment in the Presence of Disease* below for further details).
- The facility should decide what measures will be taken for positive environmental results in the absence of disease. The CDC does not give specific guidance on this issue, while the Allegheny County, PA guidelines recommend that the facility consider disinfection of the water system if more than 30% of outlets yield positive results.

Culturing the Environment in the Presence of Disease

- Recommendations regarding environmental sampling for *Legionella* spp. shall be made in consultation with the New York State Department of Health (NYSDOH) if a case of possible or definite healthcare facility-associated Legionnaires' disease is identified. The New York City Department of Health and Mental Hygiene (NYCDOHMH) will also provide consultation for New York City facilities. For this recommendation, the following issues are assessed:
 - Whether the case is a possible or definite healthcare facility-associated case;
 - Whether the facility has a previous history of healthcare facility-associated Legionnaires' disease;
 - Patient populations the facility serves;
 - Physical plant structure; and
 - Availability of patient culture(s).
- Environmental sites appropriate for sampling are made with consultation from the NYSDOH Center for Environmental Health. The NYCDOHMH Environmental Health may also consult for facilities from NYC.
- Environmental culturing must 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.
- The laboratory chosen to perform environmental culturing must be able to serogroup *L. pneumophila*. If the organism that is causing disease is a species other than *L. pneumophila*, the laboratory must be able to speciate *Legionella*.
- All positive environmental cultures with the same species and serogroup as the patient isolate must be saved for molecular analysis.
- Polymerase chain reaction (PCR) and direct fluorescent antibody (DFA) methods alone should not be used for environmental sampling as they may detect non-viable organisms, and thus, positive results are difficult to interpret.

References

1. Schulster 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.
2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers. ASHRAE guideline 12-2000 - minimizing the risk of legionellosis associated with building water systems. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. 2000:1-17.
3. American Society of Heating, Refrigeration and Air Cooling Engineers www.ashrae.org; Phone: (404) 636-8400
4. Cooling Tower Institute; www.cti.org; Phone: (281) 583-4087

REFERENCES AND ADDITIONAL RESOURCES: LEGIONNAIRES' DISEASE

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.
5. American Society of Heating, Refrigerating, and Air-Conditioning Engineers. ASHRAE guideline 12-2000 - minimizing the risk of legionellosis associated with building water systems. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. 2000:1-17.
6. American Society of Heating, Refrigeration and Air Cooling Engineers
www.ashrae.org
Phone: (404) 636-8400
7. Cooling Tower Institute
www.cti.org
Phone: (281) 583-4087

Additional Resources

1. CDC website: Legionellosis: Legionnaires' Disease and Pontiac Fever
www.cdc.gov/ncidod/dbmd/diseaseinfo/legionellosis_g.htm
2. Yu, VL. Resolving the controversy on environmental cultures for legionella: a modest proposal. *Infect Control Hosp Epidemiol* 1998;19:893-897.
3. Kool JL, Bergmire-Sweat D, Butler JC, Brown EW, Peabody DJ, Massi DS, Carpenter JC, Pruckler JM, Benson RF, Fields BS. Hospital characteristics associated with colonization of water systems by *legionella* and risk of nosocomial legionnaires' disease: a cohort study of 15 hospitals. *Infect Control Hosp Epidemiol* 1999; 20:798-805.
4. Stout JE, Yu VL. Experiences of the first 16 hospitals using copper-silver ionization for legionella control: implications for the evaluation of other disinfection modalities. *Infect Control Hosp Epidemiol* 2003;24:563-568.
5. Srinivasan A, Bova G, Ross T, Mackie K, Paquette N, Merz W, Perl TM. A 17-month evaluation of a chlorine dioxide water treatment system to control legionella species in a hospital water supply. *Infect Control Hosp Epidemiol* 2003;24:575-579.
6. Freije, MR. Legionella control in health care facilities, 1996. H.C. Info Resources. Indianapolis. Phone: (800) 801-8050 E-Mail: TOFG@USA.pipeline.com
7. Muraca P, et al. Disinfection of water distribution systems for legionella. *Infect Control Hosp Epidemiol* 1990;11:79-88.
8. States S, Kuchta J, Young W, Conley L, Ge J, Costello M, Dowling J, Wadowsky R. Controlling legionella using copper-silver ionization. *Journal of the American Water Works Association* 1998;90:122-129.

**NEW YORK STATE DEPARTMENT OF HEALTH
REGIONAL EPIDEMIOLOGY PROGRAM OFFICES**

| | |
|----------------------------------|----------------|
| Capital District Regional Office | (518) 408-5396 |
| Central New York Regional Office | (315) 477-8166 |
| Metropolitan Regional Office | (914) 654-7149 |
| Western Regional Office | (716) 847-4503 |
| Central Office, Albany | (518) 473-4439 |