Prevention and Control of Legionnaire’s Disease

Infection Control Practitioner

A. Educate physicians, nurses, and Physical Plant personnel to heighten their awareness for Legionnaire’s Disease.

B. If a physician suspects Legionnaire’s Disease or legionellosis, and needs laboratory confirmation, consult the Referral Testing section or contact the Reference Lab (5-7930) for additional information on how to submit a specimen handling, collection, and transport.

C. Maintain a high index of suspicion for Legionnaire’s Diseases, especially in patients who are immunocompromised, patients over 65 years of age, and those with a chronic underlying disease.

D. Water is not routinely cultured for *Legionella spp*.

E. Review Physical Plant recommendations for cooling tower guidelines every two years.

F. **Secondary Prevention** - response to identification of laboratory-confirmed nosocomial legionellosis.

When a single case of laboratory-confirmed, definite nosocomial Legionnaire’s Disease is identified, or if two or more cases of laboratory-confirmed, possible nosocomial Legionnaire’s disease occur during a six-month period, the following procedures are carried out.

1. If a case is identified in a severely immunocompromised patient (e.g. an organ-transplant recipient) or if severely immunocompromised patients are being treated in the hospital, a combined epidemiologic and environmental investigation is conducted to determine the source(s) of *Legionella sp*. See policy for epidemiologic workup.

2. The local or state health department and CDC are contacted.

3. If severely immunocompromised patients are not being treated in the hospital, an epidemiologic investigation via a retrospective review of microbiologic, serologic, and postmortem data is conducted to identify previous cases. An intensive prospective surveillance is begun for additional cases of nosocomial Legionnaire’s disease.

   a. If evidence of continued nosocomial transmission is not present, the intensive prospective surveillance is conducted for at least 2 months after the date surveillance was initiated.
b. If evidence of continued nosocomial transmission is present:

1) An environmental investigation is conducted to determine the source(s) of Legionella sp. by collecting water samples from potential sources of aerosolized water, following the methods described in Appendix A, and saving the subtyping isolates of Legionella sp. obtained from patients and the environment.

2) If a source is not identified, surveillance is continued for new cases for at least 2 months, and depending on the scope of the outbreak, either defer decontamination pending identification of the source(s) of Legionella sp. or proceed with decontamination of the hospital's water distribution system, with special attention to the specific hospital areas involved in the outbreak.

3) If a source of infection is identified by epidemiologic and environmental investigation, it is properly decontaminated. (See Physical Plant guidelines).

4) Immunocompromised patients will be restricted from taking showers, and must use only sterile water for their oral consumption until Legionella sp. becomes undetectable by culture in the hospital water.

5) Assess the efficacy of implemented measures in reducing or eliminating Legionella sp. by collecting specimens for culture at 2-week intervals for 3 months.

   a) If Legionella sp. are not detected in cultures during 3 months of monitoring at 2-week intervals, cultures are collected monthly for another 3 months.

   b) If Legionella sp. is detected in one or more cultures, the implemented control measures are reassessed and modified accordingly with repeat decontamination procedures. Options for repeat decontamination include either the intensive use of the same technique used for initial decontamination or a combination of superheating and hyperchlorination.

6) Adequate records are kept of all infection-control measures, including maintenance procedures and of environmental test results for cooling towers and potable-water systems.
Appendix A

Culturing Environmental Specimens for *Legionella sp.*

If the Director of Infection Control and the Chairman of the Infection Control Committee determine that environmental cultures are necessary, the Director of Microbiology will be consulted for appropriate sampling protocols. The Guidelines for Environmental Infection Control in Healthcare Facilities, 2003, Appendix C 3, *Water Sampling Strategies and Culture Techniques for Detecting Legionellae*, will be reviewed and followed.

1. Any water source that might be aerosolized should be considered a potential source for transmission of legionellae. The bacteria are rarely found in municipal water supplies and tend to colonize plumbing systems and point-of-use devices. To colonize, legionellae usually require a temperature range of 77°F–108°F (25°C–42.2°C) and are most commonly located in hot water systems.
2. Legionellae do not survive drying. Therefore, air-conditioning equipment condensate, which frequently evaporates, is not a likely source.
3. Water samples and swabs from point-of-use devices or system surfaces should be collected when sampling for legionellae.
4. Swabs of system surfaces allow sampling of biofilms, which frequently contain legionellae.
5. When culturing faucet aerators and shower heads, swabs of surface areas should be collected first; water samples are collected after aerators or shower heads are removed from their pipes.
6. Swabs can be streaked directly onto buffered charcoal yeast extract agar plates if the plates are available at the collection site.
7. If the swabs and water samples must be transported back to a laboratory for processing, immersing individual swabs in sample water minimizes drying during transit. Place swabs and water samples in insulated coolers to protect specimens from temperature extremes.
8. Consider the following sites as potential reservoirs:
   a. Potable water system
      - Incoming water main
      - Water softener
      - Holding tanks/cisterns
      - Water heater tanks (at the inflow and outflow sites)
      - Potable water outlets (e.g. faucets or taps, showers), especially outlets located in or near case-patients' rooms
   b. Cooling tower/evaporative condenser
      - Make-up water (i.e. water added to the system to replace water lost by vaporation, drift, and leakage)
      - Basin (i.e., area under tower for collection of cooled water)
      - Sump (i.e., section of basin from which cooled water returns to heat source)
      - Heat source (e.g., chillers)
   c. Other Sources
      - Humidifiers (i.e., nebulizers)
      - Bubblers for oxygen
      - Water used for respiratory therapy equipment
      - Decorative fountains
      - Irrigation equipment
      - Fire sprinkler system (if recently used)
      - Whirlpools/spas

Procedures for collecting and processing environmental specimens for *Legionella spp.*
1. Flush lines for 2 minutes before collecting water.
2. Remove screens and aerators before collecting water.
3. Collect water (1 liter samples, if possible) in sterile, screw-top bottles.
4. Collect culture swabs of internal surfaces of faucets, aerators, and shower heads in a sterile screw top container. Submerge each swab in 5 – 10 mL of sample water taken from the same device from which the sample was obtained.
5. Transport samples to the second floor Microlab as soon as possible.
6. Samples not processed within 24 hours should be refrigerated.
7. Microlab will test the samples by using semiselective culture media using procedures specific to the cultivation and detection of *Legionella spp*. Direct fluorescent antibody technique for identifying *Legionella spp* is not suitable for environmental samples. Consult current literature before relying on PCR testing.

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Physical Plant

I. Cooling Towers
   A. When a new hospital building is constructed, place cooling tower(s) in such a way that the tower drift is directed away from the hospital's air-intake system and design the cooling towers such that the volume of aerosol drift is minimized.
   B. For operational cooling towers, install drift eliminators, velocity stacks, regularly use an effective biocide, maintain the tower according to the manufacturer's recommendations, and keep adequate maintenance records (Appendix B).

II. Water-distribution system
   A. No recommendation for routinely maintaining potable water at the outlet at greater than or equal to 50°C or less than 20°C, or chlorinating heated water to achieve 1-2 mg/L free residual chlorine at the tap.
   B. No recommendation for treating water with ozone, ultraviolet light or heavy-metal ions.

III. If there is Evidence of a Nosocomial Transmission and the Heated Water System is indicated
   A. Decontaminate the heated-water system either by superheating (i.e., flushing for at least 5 minutes each distal outlet of the system with water greater than or equal to 65°C) or by hyperchlorination (i.e., flushing for at least 5 minutes all outlets of the system with water containing greater than or equal to 10mg/L of free residual chlorine) Post warning signs at each outlet being flushed to prevent scald injury to patients, staff, or visitors.
   B. Depending on local and state regulations regarding potable water temperature in public buildings, in hospitals housing patients who are at high risk for acquiring nosocomial legionellosis (e.g., immunocompromised patients) either a) maintain potable water at the outlet at greater than or equal to 50°C or less than 20°C or b) chlorinate heated water to achieve 1-2 mg/L of free residual chlorine at the tap.
C. No recommendation for treatment of water with ozone, ultraviolet light or heavy-metal ions.

D. Clean hot-water storage tanks and water heaters to remove accumulated scale and sediment.

IV. If cooling towers or evaporative condensers are implicated, decontaminate the cooling tower system.

V. Keep adequate records of all infection control measures, including maintenance procedures, and of environmental test results for cooling towers and potable water systems.

Appendix B

Procedures for Cleaning Cooling Towers and Related Equipment

If System is Implicated in Outbreak

I. Before Chemical Disinfection and Mechanical Cleaning.
   
   A. Provide protective equipment to workers who perform the disinfection, to prevent their exposure to a) chemicals used for disinfection and b) aerosolized water containing *Legionella* sp. Protective equipment may include full-length protective clothing, boots, gloves, goggles, and full or half-face mask that combines a HEPA filter and chemical cartridges to protect against airborne chlorine levels of up to 10 mg/L.
   
   B. Shut off cooling tower.
      1. If possible, shut off the heat source.
      2. Shut off fans, if present, and the cooling tower/evaporative condenser (CT/EC).
      3. Shut off the system blowdown (i.e., purge) valve. Shut off the automated blow down controller, if present, and set the system controller to manual.
      4. Keep make-up water valves open.
      5. Close building air-intake vents within at least 30 m of the CT/EC until after the cleaning procedure is complete.
      6. Continue operating pumps for water circulation through the CT/EC.

II. Chemical Disinfection
   
   A. Add Biotreat 183 and follow safety instruction on the product label. Examples of disinfectant include sodium hypochlorite (NaOCl) or calcium hypochlorite (Ca(OCl)₂), calculated to achieve initial free residual chlorine (FRC) of 50 mg/L (i.e., 3.0 lbs {1.4 kg} industrial grade NaOCl {12%-15% available Cl} per 1,000 gal of CT/EC water; 10.5 lbs {4.8 kg} domestic grade NaOCl {3%-5% available Cl} per 1,000 gal of CT/EC water; or 0.6 lb. {0.3 kg} Ca (OCl) 2 per 1,000 gal of CT/EC water.) If significant biodeposits are present, additional chlorine may be required. If the volume of water in CT/EC is unknown, it can be estimated (in
gallons) by multiplying either the recirculation rate in gallons per minutes by 10 or the refrigeration capacity in tons by 30. Other appropriate compounds may be suggested by a water-treatment specialist.

B. Record the type and quality of all chemicals used for disinfection, the exact time the chemicals were added to the system, and the time and results of FRC and pH measurements.

C. Add Coolite 302 dispersant simultaneously with or within 15 minutes of adding Biotreat 183. The dispersant is bed added by first dissolving it in water and adding the solution to a turbulent zone in the water system. Automatic-dishwasher compounds are examples of low or nonfoaming silicate-based dispersants. Dispersants are added at 10-25 lbs (4.5-11.25 kg) per 1,000 gallons of CT/EC water.

D. After adding disinfectant and dispersant, continue circulating the water through the system. Monitor the FRC by using an FRC-measuring device (e.g., a swimming pool test kit), and measure the pH with a pH meter every 15 minutes for 2 hours. Add chlorine as needed to maintain the FRC at greater than or equal to 10 mg/L. Because of the biocidal effect of chlorine is reduced at a higher pH, adjust the pH to 7.5-8.0. The pH may be lowered by using any acid (e.g., muriatic acid or sulfuric acid used for maintenance of swimming pools) that is compatible with the treatment of chemicals.

E. Two hours after adding disinfectant and dispersant or after the FRC level is stable at greater than or equal to 10 mg/L, monitor at 2-hour intervals and maintain the FRC at greater than or equal to 10 mg/L for 24 hours.

F. After the FRC level has been maintained at greater than or equal to 10 mg/L for 24 hours, drain the system. CT/EC water may be drained safely into the sanitary sewer. Municipal water and sewerage authorities should be contacted regarding local regulations. If a sanitary sewer is not available, consult local or state authorities (e.g., Department of Natural Resources) regarding disposal of water. If necessary, the drain-off may be dechlorinated by dissipation or chemical neutralization with sodium bisulfite.

G. Refill the system with water and repeat the procedure outlined in steps II. B-F above.

III. Mechanical Cleaning

A. After water from the second chemical disinfection has been drained, shut down the CT/EC.

B. Inspect all water-contact areas for sediment, sludge, and scale. Using brushes and/or low pressure hose, thoroughly clean all CT/EC water-contact areas, including the basin, sump fill, spray nozzles, and fittings. Replace all components as needed.
C. If possible, clean CT/EC water-contact areas within the chillers.

IV. After Mechanical Cleaning

A. Fill the system with water and add chlorine to achieve FRC level of 10 mg/L.

B. Circulate the water for 1 hour, then open the blowdown valve and flush the entire system until the water is free of turbidity.

C. Drain the system.

D. Open any air-intake vents that were closed before cleaning.

E. Fill the system with water. CT/EC may be put back into service using an effective water-treatment program.

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