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PART TWO OF A TWO-PART SERIES

LEGIONELLOSIS

An Unintended Consequence of Building Water Systems

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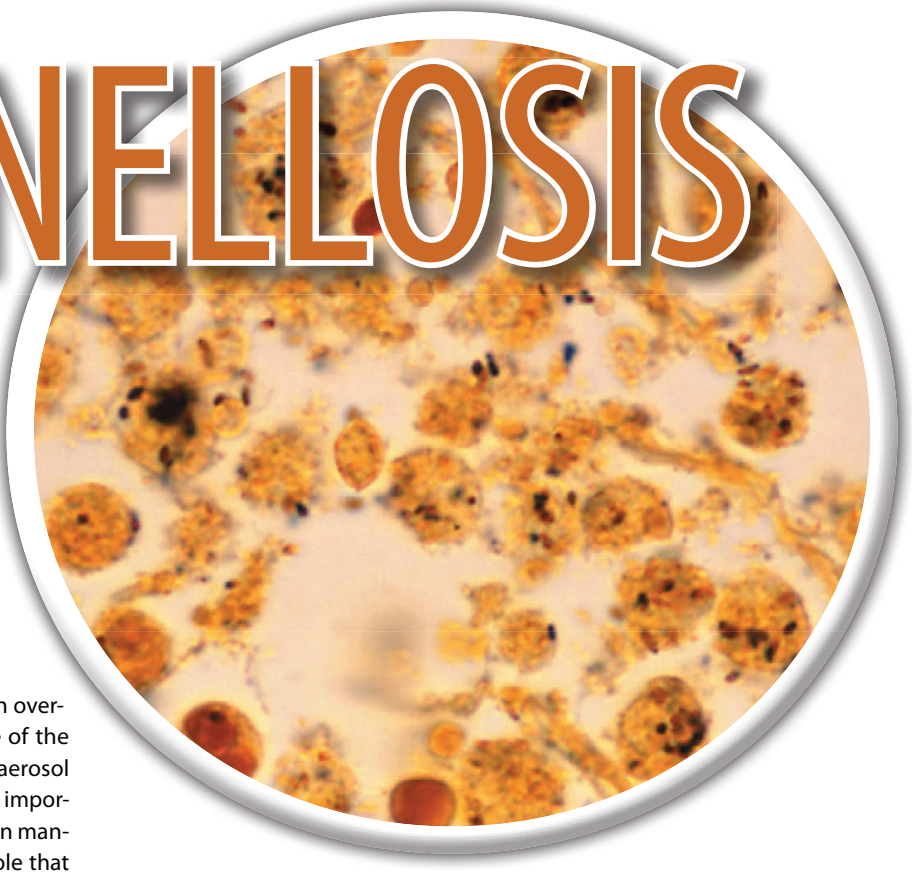

FIGURE 1. *This micrograph depicted cytoarchitectural details seen in a lung tissue specimen from a patient with fatal pneumonia due to Legionnaires' disease. The* Legionella *bacteria are found naturally in the environment, usually in water, growing best in warm water, like the kind found in hot tubs, cooling towers, hot water tanks, large plumbing systems, or parts of the air-conditioning systems of large buildings.*

Part one of this two-part article provided an overview of Legionnaires' disease, the source of the bacterium in hospital water systems and aerosol vectors of infection. Part two focuses on the important role that a multidiscipline team plays in managing the legionellosis risk. The specific role that environmental services (EVS) plays in collaboration with infection prevention, facility engineering, and risk management in the establishment and implementation of a *Legionella* Water Safety is described in part two. Additional public health information can be found at **www.cdc.gov/legionella/index.html**.

Preventive risk management

Outbreaks of Legionnaires' disease are serious but preventable. The U.S. Occupational Safety and Health Administration (OSHA) requires employers and facility owners to provide personal protection against *Legionella* under the General Duty Clause of the Occupational Safety and Health Act. Despite this precautionary measure, Legionnaires' disease may still occur due to lack of familiarity with water processes in a complex system and/or lack of effective microbiological controls.

The Joint Commission specifies under Environment of Care that a health care facility has a plan for managing pathogenic biological agents. Inspectors at these facilities look for a written plan and the documentation that proves the plan is valid and being followed.

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) is planning to publish a new standard for preventing legionellosis associated with building water systems. Proposed ASHRAE Standard 188P will specify that facility managers must ensure that building water systems are operated and maintained to reduce risk of legionellosis through a hazard analysis and control approach. Compliance will apply to any facility including hospitals and assisted living centers that uses utility and/or potable (domestic water) water systems. ASHRAE Guideline 12 published in 2000, is an excellent resource (ASHRAE, 2000).

Our recommended approach to reducing risk is first to recognize the potential for *Legionella* to colonize an engineered water system and next, to develop, implement and follow a *Legionella* Water Safety Plan (WSP). This is accomplished through the following steps:

1 Assemble a cross functional water safety team (WST) including representatives from Environmental Services, Infection Prevention, Safety/Risk Management, Engineering, and third party experts. Each member of the WST plays a unique role in the development and management of the Water Safety Plan (Figure 2). The WST should meet at least quarterly to ensure that defined risk-reduction strategies are being followed, documented, validated, and verified. Adjustments made by the team must be reflected in the written Water Safety Plan (WPS).

2 Identify the water system process steps using a simple flow process diagram. Evaluate the potential microbial growth, aerosol exposure and human hazards associated with each process step.

3 Determine the recommended hazard control strategies for each process step based on the potential associated hazards. Some process steps may be considered critical process steps because control can be applied. They are essential to preventing or limiting the potential for system conditions to cause human harm.

4 Monitoring may be needed or required for a critical process step, based on the hazards associated with that step. Monitoring should include minimum and/or maximum control limits. There is a maximum and/or minimum value to which a parameter must be controlled to prevent or limit the potential for system conditions to cause human harm.

5 Monitoring schedules for process steps should include the frequency of monitoring and responsibility for monitoring.

6 Specific corrective action should be specified in the WSP, and as such, must be taken whenever critical limits are not met.

7 Periodically verify critical limits, procedures, corrective actions and documentation to ensure the WSP is valid.

A WSP may identify a need for remediation and disinfection of the various water systems in a facility or the need for continuous addition of a secondary disinfectant to the potable water system. The method of continuous disinfection and the type of disinfectant used needs to be carefully considered.

Role of secondary disinfection in hazard control

Water entering a building has typically been disinfected by a municipality, but effective chlorine levels may diminish as water travels to end-use points. Low levels of chlorine can allow for *Legionella* colonization. The continuous injection of an additional biocide (or secondary disinfectant) to a building's potable water system can help reduce the risk of *Legionella* colonization. In some cases, the secondary disinfectant is added only to the hot water recirculation loop in a facility to target those highest risk plumbing systems. Disinfectants approved by the Safe Drinking Water Act (SWDA) for secondary disinfection include chlorine, chlorine dioxide, chloramines and others.

Monitoring and control is essential

Secondary disinfection is only as good as the monitoring and control of the levels of the disinfectant. A monitoring system will provide greater assurance that the secondary disinfection system is operating properly. A robust monitoring and control strategy allows for quick response to upsets or changes in operating conditions that can negatively affect your WSP. To be effective, the building operator must know when levels of disinfectant rise above or fall below the critical limits defined in the WSP. For this reason, automated monitoring and control systems that use email and/or cell phone notification of alarms is recommended. In addition, web access to real-time information is beneficial as it allows for optimizing control parameters and detection whenever designated parameters are outside limits. This can also be used for tracking and trending system records over time.

Documentation

An equally important benefit with today's systems is the ease of collecting and documenting information. Information such as

FIGURE 2. *Roles of a cross-functional Water Safety Team (WST).*

historical trends of operational parameters and raw data, alarm conditions and corrective actions taken in response to changing dynamics can be collected for future reference. This is critical to ensuring consistent results and accountability.

Testing the water

Testing of water samples for the *Legionella* bacterium can add value to the overall WSP. Part of the process of developing a *Legionella* WSP testing protocol is defining the number of samples, locations and frequency of sampling. Criteria for testing include:

1. Members of the WST agree that sampling is appropriate and necessary.
2. Documentation shows the date, place and time of sampling.
3. Shipping of the water sample to a laboratory certified by the CDC as being proficient in isolating *Legionella*. The testing program is referred to as the Environmental *Legionella* Isolation Techniques Evaluation (ELITE) program. Testing laboratories designated as CDC ELITE certified can be found at www.cdc.gov/legionella/elite.html.
4. A plan to respond to any samples that test positive for *Legionella*. The CDC has publically stated that "there is no safe level of *Legionella* in a water system" (Hicks, 2013).

Working together on WSP

A thoughtful *Legionella* WSP with good monitoring, control and documentation is achievable, but given the complexity of facility water systems today, risks from exposure to waterborne pathogens are difficult to manage without multidisciplinary participation. A well implemented WSP along with secondary disinfection and monitoring/control systems is the backbone of a comprehensive WSP. It takes the combined efforts of EVS and other teams to ensure successful risk-reduction against exposure of patients, visitors and staff to *Legionella*. The operation of a water system in the absence of a WSP increases public health, regulatory, legal and public image risk. ●

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