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RISKTOPICS

Legionnaires' Disease
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Thousands of people are hospitalized each year due to Legionnaires' Disease. It is a respiratory disease caused by the bacterium *Legionella Pneumophila* that thrives particularly in warm waters such as in cooling towers and air conditioning systems. An awareness of potential exposure to Legionnaires' Disease and regular follow up of recommended preventive measures are essential key elements of an effective risk management program. These steps will help minimize the incidents and potential litigation from Legionnaires' Disease outbreaks.

INTRODUCTION

Ever since its first documented outbreak (34 deaths and 221 reported cases) at the 1976 American Legion Convention in the Bellevue-Stratford Hotel in Philadelphia, Legionnaires' Disease has received a lot of attention. In addition to outbreaks affecting several people, many sporadic cases continue to be reported from identified and unidentified sources. The US Center for Disease Control (CDC) (www.cdc.gov/legionella/index.htm) estimates between 8,000 and 18,000 people are hospitalized each year with Legionnaires' disease in the U.S. However, because many cases are not properly diagnosed or reported, the actual number of cases may be higher. Mortality rates of 5-15 percent have been reported.

Legionnaires' Disease is caused by the bacterium *Legionella Pneumophila*. *Legionella* bacteria are found naturally in the environment, usually in water; though the bacteria grow best in warm water, like that found in cooling towers, hot water tanks, hot tubs (spas), or large plumbing systems. The potential to contract disease occurs when the bacteria are carried into the lungs with aerosolized water mist/vapor. Since there are many virulent strains of *Legionella* bacteria and wide variations in individual susceptibility, there is no specific "danger" or "safe" dose or level of exposure. Although the bacteria can attack anyone, individuals with a weakened immune system are particularly vulnerable, such as the elderly population (usually 65 years of age or older), as well as people who are smokers or those who have a chronic lung disease (like emphysema).

Two distinct forms of Legionellosis exist. Legionnaires' Disease is a respiratory disease, with pneumonia-like symptoms appearing within 2-10 days of initial exposure. Pontiac Fever is a milder version of the illness that is accompanied by fever and muscle aches similar to influenza. For most healthy people, recovery from Pontiac Fever typically occurs within 2-5 days without treatment.. Onset of the disease is within a few hours to two days of exposure. Legionnaires' Disease, on the other hand, is the more severe form. In addition to fever and muscle ache, as in Pontiac Fever, headaches, loss of appetite, and tiredness are usual symptoms. Some patients may also get diarrhea and may show decreased kidney function. A chest x-ray may show pneumonia. Symptoms are often confused with pneumonia, and other specific tests are required for proper diagnosis. A healthy individual, if exposed, is more likely to get the milder version Pontiac Fever. An individual with a compromised immune system is more likely to get the Legionnaires' Disease, which, if not diagnosed and treated promptly, can be fatal.

DISCUSSION

Although the ecology of *Legionella Pneumophila* in water is not fully understood, biofilm formation, sludge, sediments and organic material provide suitable conditions for its survival and growth. Warm standing water is the ideal environment for survival and propagation of *Legionella Pneumophila* bacteria. They are found in many water systems, but they reproduce in high numbers in warm (68°-113° F) stagnant water. Exposure to the diseases is associated with inhaling aerosols of water containing the bacteria. Cooling tower water and evaporative condensers of large air-conditioning systems have been the primary sources of these bacteria in many past major outbreaks. The 1976 outbreak at the American Legion Convention was attributed to contaminated cooling water in the hotel's HVAC system. Since then, other outbreaks and incidents of Legionnaires' Disease have been reported from hot tubs on the cruise ship *Horizon* in 1994 and a display hot tub in a store show room in Virginia in September 1996. About 200 people were exposed with 22 fatalities from *Legionella Pneumophila* associated with a portable display whirlpool unit at a Flower and Consumer Products Show in Amsterdam, Netherlands. In recent years, outbreaks have been associated with a water wall in a Wisconsin hospital, a public whirlpool spa in France, potable water in a housing building at an Air National Guard Base in Michigan, a Hotel in Bali, use of a pressure washer at a food processing plant in the UK, and a mock rain forest, water fall, and spa located in the atrium of a retirement home in Illinois.

Typically, cooling systems in commercial occupancies, such as hotels, office buildings, hospitals, nursing homes and high-rise residential apartment buildings are known for Legionnaires' Disease exposure. In addition, industrial process water cooling tower operations in diverse processes ranging from large injection molding to food processing and petrochemical operations are some of the less frequent exposure sources that are usually underestimated.

Although there is no evidence of transmission of Legionnaires' Disease associated with drifts from golf courses, lawn and garden irrigation sprays, the possibility of exposure exists any time aerosolized droplets of water from a contaminated source are airborne and inhaled. A number of other sources with potential for aerosol or mist waters are also suspected of transmission of bacteria. The bacteria have been found in hot water tanks, recirculation industrial process water cooling systems, shower heads and faucets. It can also be found naturally in ponds and small lakes. There is no evidence of transmission of disease from drinking contaminated waters or people-to-people transmission.

Additional less common but possible exposure examples include:

- indoor decorative water features and fountains;
- ultrasonic mist machines; respiratory therapy equipment;
- spas and whirlpools
- rinse water spray in dentist offices
- industrial process cooling water systems
- mist sprays for fresh produce at supermarkets.

GUIDANCE

It is important to take a comprehensive risk management approach that starts with a risk assessment by regular testing of water samples to detect the level of *Legionella* organisms (colony forming units/mL), specific strains of bacteria, and identifying critical control points in flow diagrams for potential growth, aerosolization and transmission. Since cooling water systems in large air conditioning systems are the primary known source of spread of *Legionella Pneumophila*, proper testing, maintenance and operation of cooling water systems is essential for prevention of the diseases in vulnerable occupancies described earlier.

Microbiological controls using many available biocides, individually or in combination is the key to prevention of *Legionella* colonization and proliferation. Cooling towers, condenser coils, condensate trays and air filters should be inspected and cleaned regularly. Cooling water should be treated with recommended disinfectants, such as chlorine, bromine, or quaternary ammonia compounds.

For hot tubs and spas, regular testing for bacteria and proper disinfecting of water and filters are important precautions to take for prevention. The Center for Disease Control (CDC) is now recommending using 4-5 parts per million of residual chlorine or 4-6 parts per million of bromine to sanitize water in hot tubs and whirlpools. Although routine testing is not recommended by the CDC for potable waters, water quality should be sampled periodically to check for the presence and

growth of *Legionella Pneumophila* bacteria in irrigation spray waters, decorative water fountains, water falls, or flowing waters. Consideration should be given in the design and installation of water system to reduce any potential for airborne aerosols. In addition, the cooling water system should be designed to reduce the potential for standing water, and the building air intakes should be located away from cooling towers to reduce the potential for aerosols from drifts entering the ventilation system.

Regular testing of water and use of recommended disinfectants to treat the water is the primary preventive measures recommended by experts. Water systems and filters should be flushed and cleaned periodically. In addition to many common sense mitigation steps, such as elimination of stagnant standing water and controllable sources of nutrients and avoidance of drifts and aerosolization, The Cooling Tower Institute (CTI) recommends best practices (Guidelines: Best practices for control of *Legionella*) that includes:

- Monitoring for *Legionella* in cooling water system by visual inspection, biofilm as well as microbiological sampling
- Routine halogen (chlorine, bromine) treatment according to manufacturer's label instructions
  - Continuous biocide application (continuous free residual halogen 0.5-1.0 ppm as Cl2)
  - Intermittent application (free halogen residual of 1.0-2.0 ppm of Cl2)
  - Hyper-halogenation (5 ppm of free halogen residual for at least 6 hours)

The best practice document also provides mechanical design considerations for the cooling tower for minimization of Legionnaires' Disease exposure. It also stresses the importance of adequate record keeping and documentation.

Several useful resources are listed in this document that provides additional guidance on prevention and mitigation of Legionnaires' Disease.

CONCLUSION

Since the 1976 outbreak of Legionnaires' Disease in Philadelphia, the awareness of Legionnaires' Disease has increased significantly. The US Centers for Disease Control (CDC), UK Health and safety executive (HSE) and organizations like The Cooling Tower institute and The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASRAE) have created a lot of guidance for prevention and mitigation of this known biological risk of harm. Even if these requirements may not be mandated in all situations and for all occupancies, it is prudent for all companies to take reasonable steps to control this known risk to their employees, visitors, customers and guests. An awareness of potential exposure to Legionnaires' Disease and regular follow up of recommended preventive measures are essential key elements of an effective risk management program for controlling outbreaks and incidents of Legionnaires' Disease to help minimize exposure to potential litigation.

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