Legionellae

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Introduction:

The genus **Legionella** is a pathogenic group of gram negative bacteria, causing Legionellosis which is the illnesses caused by the Legionella bacteria. Due to the disease first being identified in 1976 at a Legionnaires' convention in Philadelphia, it has come to be called the Legionnaires' disease. Legionnaires' disease is a pneumonia type illness, while a milder version caused from breathing dead Legionella bacteria, is called Pontiac fever.[ii] Lawyers call Legionella the new asbestos. If an outbreak occurs in the facility you operate or designed, the resulting consequences can be expensive and disruptive.

Legionella flourishes in a warm and wet environment and is transmitted by aerosol. The size of the bacteria is 0.1 – 0.5 micron, which makes it ideal to take up residence in the innermost parts of the human lung. After 2 – 10 day s after exposure, flue like symptoms becomes apparent. Depending on how quickly treatment has begun, survival can be about 95%. With delayed treatment, survival drops to 60%. Legionella is a serious disease deserving serious attention.

Because it is generally water related, particular attention needs to be given to the buildings plumbing system. Although legionellae can be formed in HVAC system components, primarily the cooling towers and system condensate drains, statistically the water distribution system is the major contributor.

Facts about Legionnaires' Disease in the U.S.

- 25,000 estimated cases annually-(80% unidentified
- Cases by Building Type
  - Healthcare acquired: 23% (5,250)
  - Travel Associated: 24% (6,000)
- Related to Construction
  - 25% (6,250) of all outbreaks occur within 1 year of construction / renovation
- 4,000 estimated annual fatalities
- $34,000 average hospital cost per case
- 219% increase in reported U.S. LD cases since 2000-2009
- 120,000 estimated deaths since identified in 1976

Discussion:

The chief ingredients to develop Legionella are water, heat, nutrients, and oxygen, all conveniently provided in a building's domestic hot water system. Optimum temperatures for Legionella to grow is between 86 degrees to 120 degrees Fahrenheit (25 to 50 degrees Celsius)

If the water flows quickly through the distribution system, the bacteria has limited chance to grow. But a large distribution system that is poorly circulated, with 'dead' loops with no circulation or lightly used fixtures (i.e. mop sinks), oversized piping, or a circuit branch left when fixtures have been removed……all provide ideal opportunities for the bacteria to grow.

An ideal domestic MW system would be an instantaneous heater that rapidly heats cold water to 120 degrees Fahrenheit (50 degrees Celsius) for immediate use with no opportunity to become stagnate. This system is ideal for small distribution systems that do not require circulation to maintain hot water at the point of use.

If a storage tank is necessary to handle hot water demand, it is advisable to heat the stored water to 140 degrees Fahrenheit (60 degrees Celsius). Because this elevated temperature is higher than code allows for general distribution, mixing with cold water is necessary.

Complicating determining the mixed water temperature is disagreement among the code bodies as to what is the "correct temperature." Although most plumbing codes call for mix temperature of 110 degrees Fahrenheit to limit scalding, to maintaining safe hot water supply other authorities (OSHA, ASHRAE, ASPE) prefer 120 degrees F which is more adverse to the Legionella development.

Because Legionellae is common to the environment, facilities such as health care and retirement facilities, require at least yearly testing. If the sample test comes back with greater than 1 PPM indicated, this is grounds to become aware of possible future problems and advisedly to increase the frequency of testing to keep watch on the situation. If a test result is greater than 10 PPM, corrective action should begin. Greater than 100 PPM and this presents serious danger of human infection.

Treatment:

Numerous methods for corrective action have been tried with varying degrees of success.

Thermal disinfection, which is raising the hot water temperature above 140 degrees for a sustained time, is costly energy wise, labor intensive, and presents the possibility of scolding. Results are less than stellar.

Hyper chlorination is also a possible method to be used. To be effective some background knowledge is helpful before undertaking disinfection with chlorine. Utilities are diverging from the use of pure chloramine to the use mono-chloramine because of the longer residual time. Chlorine degrades as it disinfects so the chlorine residual can drop to minimum levels as it goes through a building water system. This appears to be undesirable until it is understood that the chlorine level is degrading because it is doing the job of disinfection.

Mono chloramines do a better job of maintaining the desired residual chlorine level, which is the EPA's metric for safe drinking water[iii]., at the expense of not being a very good disinfectant As a result facility relying are mono chloramines to treat their drinking water have higher incidence of Legionella infection.

Complicating remediation with chlorine in water treated with mono-chloromine is that when the two mix, the result is release of ammonium compounds, which serve to provide nutrients for the Legionella bacteria.

Preferred treatment in this case would be chlorine dioxide, with the best means of administrating being chemical injection downstream of the hot water mixing valve, where it can be part of the hot water circulation system. The injection system should be adjusted to maintain a residual of 0.1 – 0.5 PPM for approximately one week. At this level the water can still be used for non-potable uses like showers and hand washing, while potable water needs can be met with bottled water while the treatment is underway. Should someone accidentally drink the water being treated, it will taste chlorinated but in moderation will not harm them.

Prevention:

Components that merit periodic inspection for Legionella include slower valves, faucet aerators, and mixing valves. Particularly if a Legionella infection is apparent, these should be disassembled and cleaned. Point of use mixing valves are to be avoided and eliminated if possibly due to mixing caused by leaking through the integral check valves creating a mixed temperature ideal for development of Legionellosis. If their use is unavoidable, providing supplement check valves to compliant what comes with water mixing valves, shown be installed.

Stagnant water from unused or minimally used fixtures, along with dead end pipe branches, are common breeding grounds and should be removed if possible.

Potential Sources of Legionella

- Cooling Towers
- HVAC unit Condensate Drains
- Showers, Aerators
- Faucets
- Respiratory Therapy Equipment
- Room-air Humidifiers
- Decorative Fountains
- Ice Machines
- Whirlpools
- Clinical Equipment

Other devices commonly overlooked are interior water features. Aerosols created from aeration from bubblers, combined with heat from decorative incandescent lamps, make for an item of concern if water treatment is ignored. In addition to lowering power cost, replacement with more efficient LED lamps will not heat the water as much as incandescent lamps.

Water filters, in contradiction to their purpose of filtering out nutrients and debris, can become breeding grounds if not changed regularly. Carbon filters, used to remove odor and chemicals from water, also remove chlorine and its disinfection properties. Water softeners reduce the chlorine content of water.

Conclusion:

In brief, to avoid problems with Legionella, it is essential to eliminate conditions and temperatures in your water system that allow Legionella to grow. Current knowledge of the system layout is important so that unused fixtures, and piping without constant flow, should be removed or otherwise modified so as not to create a breeding ground for Legionella.

Rather than reacting to a case of Legionella, prevention thru periodic testing and informed maintenance is easier than the cure.

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[i] This paper is a synopsis of a presentation given by Mr. Tim Keane, (Legionella Risk Management, inc) at the Viega Education Center in Nashua New Hampshire on July 15, 2014

[ii] Taken from Wikipedia

[iii] The Environmental Protection Agency (EPA) Safe Drinking Water Act (SDWA) was established in 1974 to protect the quality of drinking water in the U.S. This law focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground sources.