Legionnaires Disease: A Synopsis

In 1976 there was an outbreak of 221 pneumonia cases associated with an American Legion convention in Philadelphia, Pennsylvania. It was determined that the bacterium legionella was the causative agent of the outbreak. Since that time legionellosis, or Legionnaires Disease as it is commonly referred to, has been a controversial subject. Outbreaks of legionellosis continue to occur. Since cooling tower systems have been implicated as sources of outbreaks, it is important that water treatment professionals have an understanding of what is known and what is not known about Legionnaires Disease. The following is a summary of the information currently available on this subject. Legionella is a fresh water bacterium. It has been isolated from such sources as wet soil, lakes, rivers, streams, cooling towers and piping systems. The word most often used to describe legionella is "ubiquitous", meaning omnipresent or being everywhere. It is true that this organism is all around us and can be isolated from most fresh water sources.

Legionella is a aerobic bacterium. This means it requires the presence of oxygen to survive and grow. In laboratory tests the bacterium has been shown to withstand a pH as low as 2.0. Temperatures up to 55 Deg C (131 Deg F) can be tolerated and growth can occur at temperatures up to 45 Deg C (113 Deg F). In general the cells are 0.5-1.0 micrometers in width and 1.0-3.0 micrometers in length. The legionella bacterium grows at a slower rate than most other fresh water bacteria.

Legionella depends upon the presence of appropriate nutrients and minerals for growth. Two of the most important are an amino acid called L-Cysteine and iron. Laboratory experiments have shown that some species of legionella can multiply intracellularly within certain free-living protozoa. In addition to protozoa, algae and non-legionella bacterial have been shown to play important roles in the proliferation of legionella. Algae provide growth stimulation of legionella through substances produces by the algae. Non-legionella bacteria can be used as sources for the amino acid L-Cysteine.

There are two forms of Legionnaires Disease; pneumonia and Pontiac Fever. Of the two forms the pneumonia is much more serious. The pneumonia form of legionellosis is transmitted by the breathing in the water vapors containing legionella. This allows the bacterium to infect the lung tissue. The incubation period can be anywhere from 2 to 10 days long. The attack rate is 1-4% of those exposed. There is a 15- 20% mortality rate for persons actually coming down with the pneumonia. The symptoms, which come on gradually, can include fever (39 Deg C, 102 Deg F), headache, cough and upset stomach. This form of legionellosis is generally thought to be seasonal with the greatest number of outbreaks occurring in the summer and fall.

Persons most at risk to the pneumonia form of legionellosis include adults, the elderly and those persons who have low immune tolerances.

Pontiac Fever is a mild, self-limiting form of legionellosis. It has an incubation period of only 36 hours. Pontiac Fever has an extremely high attack rate (95%), yet there has never been a fatality attributed to this form of the disease. Pontiac Fever is most likely to occur in working age adults. This form of legionellosis has a rather sudden onset but recovery generally occurs in 48 hours. The symptoms are a low grade fever and headache.

There are currently 23 recognized species of legionella. Of these, only 11 have been isolated from infected humans. One of these species, Legionella pneumophila has been implicated as the causative agent for approximately 85% of all known cases of legionellosis. The same species of the bacterium can cause either the pneumonia or Pontiac Fever. At the present time, it is not know what factors influence the bacterium to cause one form of the disease instead of the other.

Each species of legionella is divided into specific forms of the species called serogroups.

This table lists the eleven species of legionella that are known to cause disease in humans and the number of serogroups associated with each.

Species Implicated in Human Infections	**Number of Serogroups**
L.pneumophila	13
L.bozemanii	1
L.dumoffii	1
L.micdadei	1
L.longbeachae	2
L.jordanis	1
L.oakridgensis	1
L.wadsworthii	1
L.feeleii	2

L.hackeliae	2
L.maceachernii	1

Using a technique called isoenzyme typing, each serogroup can be further subdivided. The use of this technique has resulted in the discovery of 62 genetic variations of L. pneumophila serogroup 1.Efforts to control the outbreak of legionellosis through the elimination of legionella bacteria are futile. The ubiquitous nature of the organism makes such a task an impossible undertaking. The use of routine testing methods designed to qualitatively or quantitatively identify the presence of legionella in a given water source is of questionable value and may prove legally risky.

The identification of a legionella species in a given water source does not prove any association with disease. This is due to the genetic diversity of the organism.

Close surveillance of outbreaks is the primary indirect control measure for legionellosis at this time. Once a case is confirmed, in-depth epidemiological testing must be done on the victims in order to identify the exact species, serogroup and different genetic variation of the serogroup that is the causative agent. Once the particular causative agent has been identified, testing can begin on suspect water sources to find the source(s) containing the exact microorganism isolated from the victims. At the present time this in the only way to determine the source of an outbreak of legionellosis.

There are many questions regarding Legionnaires Disease that researchers are unable to answer at the present time. At what level of concentration in a water source does legionella become virulent? What is the infectious dose of each legionella species for humans? Why have only eleven of the twenty-three species of legionella been isolated from infected humans? Are there multiple modes of transmission? One mode of transmission for the pneumonia form of legionellosis has been identified, but the mode of transmission of Pontiac Fever is still a mystery. Why do only a portion of the persons exposed to the bacteria come down with the disease? What causes the bacterium to cause one form of the disease over the other? Until these questions and other questions can be answered in a responsible manner, blanket control of legionella and legionellosis is impossible.

So how are responsible water treatment professional supposed to handle questions regarding Legionnaires Disease? The following common sense recommendations are not designed to eliminate legionella, but rather to minimize the potential of the bacteria to get out of control and cause on outbreak of disease.

Keep the system operating within the established parameters. The accumulation of suspended matter and organic matter can contribute to the proliferation of legionella.

Undertake an effective biocide program that includes two, alternating biocides that function in differing manners. (i.e. alternate a quaternary ammonium based biocide with a

carbamate biocide.) The control of other microflora within a system can and does have a direct impact upon the growth of legionella.

Monitor levels of other bacteria within the system. Since legionella grows at a rate slower than most other bacteria, it is probable that the system would experience other problems prior to legionella becoming a problem.

Inspect the site for air intake sites in the vicinity of the cooling tower. By minimizing the exposure of persons to water vapors from the cooling system, you can minimize the potential for an outbreak of disease.

By following the above recommendations, you will provide your customers with the best possible protection against Legionnaires Disease. The information contained in this article represents a summary of the information currently available. It is designed to be used in an informative manner only.