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TECHNICAL PUBLICATION

INFORMATION & STRATEGY FOR THE
FACILITY MANAGER

LEGIONELLA FACT SHEET

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Legionnaires' disease is the severe pneumonia caused by *Legionella pneumophila* which, if left untreated, has a 12 - 16% case-fatality ratio. Serological evidence (presence of antibodies in blood) suggests that *L. pneumophila* is also the cause of Pontiac fever, a non-pneumonic, flu-like illness that is not life threatening. Although many persons exposed to *legionella bacteria* remain well, development depends upon the individual's immune status, general state of health and several other unknown factors.

"*Legionella*" is a new genus of bacteria discovered in 1977 which currently contains 39 species representing 54 serogroups. When classified scientifically, these unique microbes were placed in a separate *Order* and *Family*. Approximately 50% of known *legionella species* have been found to cause disease in humans. *Legionella* appear to be aquatic bacteria, occurring in surface waters, including rivers, lakes, streams and ponds. Some researchers in Britain and at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia are exploring the hypothesis that the host for *legionella bacteria* in nature may be protozoa, one-celled animals. Protozoa might shield these fastidious organisms from adverse environmental conditions such as unfavorable weather and perhaps even biocides. When conditions improve, protozoa may function as natural amplifiers, permitting *in vivo* proliferation of *legionella bacteria*.

Transmission of *legionella bacteria* to humans has been traced to contaminated cooling towers and domestic water systems. For cooling systems, the vehicle of transmission appears to be inhalation of aerosol drift generated by contaminated units. Contaminated tap water in respiratory therapy devices and humidifiers, and aerosols from showerheads served by contaminated hot water tanks have been implicated as sources of Legionnaires' disease.

The presence of *Legionella pneumophila* or other *Legionella species* means that we have grown these microorganisms on our culture media from your water sample. Although small numbers of *legionella bacteria* probably pose a minimum risk to healthy, immunocompetent individuals, ***corrective action should be kept in mind whenever legionella bacteria are isolated from a water sample.*** The risk to humans depends on the virulence of the isolate, the quantity of organisms to which a host is exposed, and the immune status of the person. Although the scientific community cannot agree on what number of *legionella bacteria* is acceptable, we believe colony counts, as expressed in Colony Forming Units (C.F.U.s) per ml of water, can be used as a loose guide for deciding when to implement corrective action. Laboratory procedures that suppress the growth of normal cooling tower bacteria ("*contaminants*") and enhance the detection of *Legionella species* result in a loss of viability of some *legionella bacteria*. For this reason, ***colony counts only approximate the actual number of legionella bacteria in a water specimen.*** Colony counts may be interrupted as follows:

- >100 C.F.U.s/ml = large number of *legionella bacteria*.
- 10-100 C.F.U.s/ml = moderate number of *legionella bacteria*.
- <10 C.F.U.s/ml = small number of *legionella bacteria*.

Although elimination of legionella bacteria is the desired goal, complete destruction of these organisms often proves to be quite difficult. Controlling the population of legionella bacteria may be a more realistic goal. By control, we mean minimizing the multiplication of legionella bacteria and reducing their numbers to levels as low as possible without damaging the cooling system.

A report of “no *Legionella* species isolated” refers to one of the following scenarios:

- No *legionella* bacteria are present in the sample.
- *Legionella* species may be present, but their detection is impaired due to the large numbers of contaminating organisms existing in the sample. Environmental stains of *Pseudomonas aeruginosa* have been shown to produce chemical substances called bacteriocins which have antagonistic activity for legionella bacteria.
- *Legionella* organisms, if present, were killed by the presence of biocide(s).
- *Legionella* species may be present in small numbers that escape detection by our culture procedures.
- Standard quality control practices do not always detect subtle lot-to-lot variations in BCYE agar media which may affect the performance of a given batch of medium to support the growth of *legionella* bacteria from environmental water sources.
- Although the *legionella* bacteria may not be present in the submitted sample, there is **no guarantee** that they are not present elsewhere in the system.

Recommendations for frequency of testing cooling systems for *legionella* bacteria are **empirical**. Testing a system before it is put into service for the season is highly recommended. A number of outbreaks have been associated with the start up of cooling systems after a period of dormancy. Three additional tests (e.g., one sample every 4-6 weeks per tower) distributed over the cooling season may be used to monitor the efficacy of the maintenance program. Staggered sampling is necessary to ascertain the microbial status of a cooling tower. Obviously, more frequent testing of towers demonstrating legionella bacteria is recommended to monitor the success of correct action measures.

Aggressive biocide treatment of contaminated cooling systems appears to be successful in **controlling legionella colonization**. The elimination (or *control*) of *legionella* bacteria

from a cooling tower is often a challenging task and may require multiple biocide “shock” treatments. Many times complete destruction of *legionella* bacteria in an infected tower proves to be quite difficult. Since *legionella* bacteria can survive a biofilm matrix, and perhaps even be protected within protozoan cysts, controlling the population of *legionella* microorganisms may be a more realistic goal.

Any person working directly in the mist of a cooling tower or other aerosol-producing device, or where airborne concentration of *legionella* bacteria are likely (e.g., power washing the inside of a cooling tower) should **wear a personal protective respiratory device**. *The state of Wisconsin recommends a full or a half face mask equipped with a (HEPA) filter or a “Type H” high efficiency filter capable of filtering aerosols, mists and particulates*. Combination HEPA and chemical cartridges are available which offer protection from airborne chlorine levels up to 10 ppm in air. Workers should be advised that filters must be replaced frequently as prolonged use of respirators in mist may cause loss of effectiveness and cause resistance to breathing.

Legionella bacteria apparently enter buildings in very low numbers via the municipal water system. These microorganisms proliferate in the sediment of large institutional hot water tanks when temperatures are slightly tepid. The water near the bottom of the tank may not be heated sufficiently to kill *legionella* bacteria. An environmental niche exists which favors growth of these microorganisms and poses a potential risks to hospital patients, hotel guests, and persons working in office buildings.

In hospital in some states, the temperature of hot water at shower, bathing, and handwashing facilities must not exceed 110°F. This temperature limitation was established to prevent scalding of patients. Many non-hospital facilities maintain their hot water systems in a tepid range for cost savings. Hot water systems which must be maintained below 113°F should be checked periodically for the presence of *legionella* bacteria.

In April of 1993, a Task Force of *legionella* experts convened by the Allegheny County Health Department (Pittsburgh, Pennsylvania) *concluded that “all hospitals should consider performing an environmental survey yearly. If transplants are performed, then a survey should be performed more often. An environmental survey should consist of: (a) all hot water tanks, (b) distal sites (faucets or showerheads). If hospital beds are less than 500, a minimum of 10 distal sites should be surveyed. If bed size is greater than 500, two distal sites per 100 beds are recommended. The distal sites should be taken from units housing patients at higher risk for acquiring Legionnaire’s disease (COPD, immunosuppressed and transplantation patients)”*.

“If the percent of positive cultures at the distal sites is equal or greater than 30% of the total number sampled, then disinfection of the water distribution system is appropriate”. We believe the same interpretative criteria should be applied to nursing homes due to the nature of the population they serve. A ***realistic goal for corrective action*** is minimizing the multiplication of *legionella bacteria* and reducing their numbers to levels as low as possible ***without damaging*** the domestic water distribution system.

For non-hospital facilities (e.g., office complexes, hotels/motels, etc.), you may wish to consider the following interpretive guidelines. *Legionellosis* has been associated with hot water systems having small numbers of organisms. For this reason, interpretation of culture results is as follows:

>10 C.F.U.s/ml = large number of *legionella bacteria*.

1 - 10 C.F.U.s/ml = moderate number of *legionella bacteria*.

<1 C.F.U.s/ml = low number of *legionella bacteria*.

For non-healthcare facilities, our recommendation is that hot water tanks and 6 - 10 distal sites (hot water taps or showerheads) be cultured yearly for the presence of *legionella bacteria*. As with healthcare facilities, the number of hot water system sites demonstrating *legionella bacteria* and

the colony counts will influence the decision for corrective action.

The above recommendations are empirical, i.e., based on practical experience and do not guarantee total freedom from *legionella contamination*. Negative test results should not lead to complacency or a relaxation of a good maintenance program. Professional services of a competent chemical treatment company should be used to develop a good maintenance program for cooling systems.

Reprint: James R. Watson, Ph.D.
(M.C.S. does not assume responsibility for the sampling protocol selected by the person(s) collecting the sample(s) or for the environmental water site(s) chosen for testing.