Editorial

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The Problem of Environmental *Legionella*

The public furor over Legionnaires' disease has now died down, but *Legionella* spp. remain a potential threat within and outside the hospital. As the article by Stout et al in this issue of *Infection Control* reminds us,[1] the bacteria lurk in many locations. We can probably never hope to eliminate them, but it is essential for hospital epidemiologists to estimate the magnitude of the threat for their patients and take appropriate measures to minimize infection. Most nosocomially acquired infections are produced by flora that are indigenous to the patient or have been carried to the patient on the hands of medical and nursing personnel. *Legionella* spp., which are not known to be part of the indigenous human flora, present a different problem, one that is easier to attack in many ways.

THE PRESENT STATE OF KNOWLEDGE

Soon after their recognition as pathogens, it was discovered that *Legionella* spp. were common environmental bacteria. Attention was concentrated on cooling towers and evaporative condensers by epidemiologic analysis of the epidemic of acute febrile disease, known as Pontiac Fever. Additional evidence that cooling towers were responsible for dissemination of bacteria came from an epidemic in Memphis and later from the infection of two maintenance workers who entered a tower in Burlington. Ironically, the mode of transmission in the original Philadelphia outbreak remains a mystery.

The first evidence that potable water might be an important vehicle for transmission of *Legionella* came from Oxford, England, where contaminated showerheads were associated with infection of two renal transplant patients.[2] Subsequently, transmission has been linked epidemiologically to respirators and nebulizers, but the mode of transmission remains unknown in most cases. The bacteria have been isolated repeatedly, however, from potable water systems and there is an impressive array of sites in which elimination of the bacteria from the water coincided with cessation of clinical cases of Legionnaires' disease.

Modern molecular epidemiology has added to our understanding of transmission. In a number of small outbreaks, molecular profiles (by plasmid analysis or monoclonal antibody testing) of clinical and environmental isolates were identical. An instructive survey of isolates from the Medical Center Hospital of Vermont suggested that there had been two environmental sources for bacteria in the community.[3] Isolates from patients during the two summer epidemics matched the profile of bacteria recovered from an adjacent cooling tower, whereas isolates from patients with sporadic nosocomially acquired infection matched the pattern of bacteria recovered from the hospital water system.

The distribution of *Legionella* in nature approaches ubiquity, but the bacteria have been easier to recover from heated water sources, both natural and potable. The report by Stout et al, therefore, is of interest, because it confirms that with sufficiently sensitive technique one can isolate the organisms from cold water sources also.[1] The problem with all of this environmental information is that the critical pieces needed for practical decisions are missing. As in the present report, the presence of *Legionella* in environmental sites does not equal human disease. Cooling towers are colonized with high frequency, but epidemics have been infrequent. Even a cooling tower that was associated with an epidemic on at least one occasion was innocuous at other times, when bacteria were also present. Investigators in Pittsburgh found a correlation between the frequency of positivity of environmental cultures and the presence of human disease,[4] but the issue is far from settled. No one has been able to estimate the infectious inoculum, either for a normal or immunologically compromised individual. The issue of virulence of environmental isolates can be addressed by inoculation of guinea pigs, but that procedure is expensive and we do not know how well virulence for rodent and man correlate. It seems likely that virulence is a factor,

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however, because certain serotypes and species have been infrequently associated with human disease.

Recovery of environmental *Legionella pneumophila* is now standard procedure and the report in this issue provides an additional technique for those interested in recovering small numbers of bacteria. *Legionella micdadei* has been more recalcitrant, however; cultures have been negative even when clinical cases were occurring. The physiology of these environmental organisms is not completely understood, but complex interactions with other components of the ecosystem are likely. Amoebae and algae can provide growth support in vitro and one investigator has suggested that certain types of rubber gaskets may support growth of these organisms.

Disinfection of environmental sources of *Legionella* has been difficult. Chlorine has been effective, both for cooling towers and for potable water systems, but at considerable cost to the structural integrity of the systems. Periodic elevation of hot water temperatures has also been employed, the danger being scalding of unsuspecting patients or personnel. In some instances, both modalities have been utilized.

A thorough review of the current status of *Legionella* research may be found in the proceedings of a symposium;[5] the role of the laboratory in detection of clinical and environmental *Legionella* has been recently reviewed.[6]

A PRACTICAL APPROACH TO THE PROBLEM

Instructors in the Epidemiology Course for commissioned officers at the Centers for Disease Control used to (and perhaps still do) start the session with the dictum, "Verify the diagnosis!" That advice serves well for *Legionella*. The incidence of human infection varies geographically, whether measured by seroprevalence studies of antibody or by infection in high-risk patients. The ubiquity of the bacterium in nature makes it likely that one would detect "false positive" environmental sites if attention were focused there. The injunction against thoughtless environmental culturing does not absolve epidemiologists or microbiologists of responsibility, because it is clear that *Legionella* infections may go undetected unless adequate diagnostic measures are instituted.[7] Although rapid detection systems and serology may play a role, the backbone of the diagnostic effort should be culture of respiratory secretions.[8] Commercial media, including selective and differential agars, are now available.

If clinical infection is documented, a program of microbiological surveillance of the environment should be undertaken and control measures instituted as necessary. The number of cases which demands action is unclear, but a low threshold should be maintained, because the evidence suggests that elimination of bacteria from the water systems is an effective control measure. Once Legionnaires' disease has been documented as a problem, especially in a medical facility, an ongoing program of microbiologic surveillance should be maintained, because the important epidemiologic triangle has been completed: 1) the bacteria have proven themselves virulent, 2) an effective means of transmission exists (even if not documented), and 3) a susceptible population for infection is readily available.

THE FUTURE

Legionella is no different from other pathogens in its challenge for hospital epidemiologists. Know the organisms that are a problem in your hospital (surveillance) and take appropriate measures to eliminate the risks (control). As with other agents the focus should be on human epidemiology rather than environmental microbiology.

Many areas remain undefined and in need of additional research. The growth requirements and interactions in nature, epecially for non-pneumophila species, need further clarification. More information on the factors that lead to human infection from environmental sources would be of great utility, but may be increasingly hard to obtain.

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