Editorial

Legionella in the Hospital Water Supply: A Plea for Decision Making Based on Evidence-Based Medicine

Janet E. Stout, PhD; Victor L. Yu, MD

Hospital-acquired legionnaires' disease has become a global public health issue. In this issue of *Infection Control and Hospital Epidemiology,* Sabrià et al present the most comprehensive environmental surveillance to date for *Legionella* in hospitals.[1] The key findings from 20 Barcelona hospitals were as follows: (1) *Legionella pneumophila* was isolated from 85% (17/20) of hospital potable hot-water systems; (2) *L pneumophila* serogroup 1 was not the most common serotype isolated from the positive hospitals; and (3) each hospital had its own unique DNA subtype of *L pneumophila.*

The overall risk for acquisition of *Legionella* is multifactorial, with host susceptibility (immunosuppressed patients, especially organ transplant recipients and elderly patients with chronic lung disease, are at highest risk) and degree of colonization within the water supply as the most important factors. Interestingly, risk assessments based on quantitation (colony-forming units) at distal sites (water faucets, showerheads) are not predictive of risk of hospital-acquired infection.[2-4] On the other hand, the percentage of distal sites that are positive directly correlates with the incidence of legionnaires' disease; the greater the percentage of sites yielding *Legionella,* the more likely that cases will occur. The converse also appears true. If there is no *Legionella* in the water supply, then cases will not occur.

Oftentimes when the lay media get wind of an outbreak of hospital-acquired legionnaires' disease, a wave of negative publicity can occur, with financial repercussions for the unfortunate hospital with loss of patients and malpractice suits. The public is not aware that *Legionella* is a common inhabitant of man-made water distribution systems. Their incorrect assumption is that *Legionella* is an unwelcome invader of a poorly maintained water system and that negligence plays a role in its presence. This becomes ironic, because only a few hospitals have the diagnostic tests available that give a knowledgeable physician with a high index of suspicion the capability of diagnosing hospital-acquired legionnaires' disease. These hospitals and their physicians should be congratulated instead of maligned. In other hospitals, legionellosis goes undiagnosed, and mortality is incorrectly attributed to other causes. For example, The Hospital European Georges Pompidou in Paris recently experienced 12 cases of hospital-acquired legionnaires' disease over an 8-month period. The fault was placed on the "low-quality galvanized steel" used in the pipes, lack of heating platforms to keep the water at 55°C at every level, and other factors.[5] It would have been most interesting if the hospital survey performed in Barcelona had been performed in Paris. We suspect that Hospital Pompidou was unfairly singled out for blame. Certainly, the problems identified in the news article have not been scientifically validated as risk factors for *Legionella* colonization, and much of the $1.35 million spent may have had little effect on *Legionella* colonization.

Although *Legionella* colonization in surveys of Nova Scotia and United Kingdom hospitals was only 23% and 12%, respectively,[6,7] most studies show higher colonization rates, with a Centers for Disease Control and Prevention (CDC) study showing 100% in San Antonio hospitals.[3] The key issue is "does colonization lead to hospital-acquired legionellosis?" There are persuasive data that it does; at least six controlled studies document occurrence of hospital-acquired legionnaires' disease after discovering *Legionella* in the hospital water supply.[8-12]

The CDC has intimated that negative environmental cultures may prompt "a false sense of security."[13] Where is the evidence that supports this statement? Only if a survey is inadequately performed or the laboratory is not experienced and knowledgeable in the isolation of *Legionella* from environmental samples would the results be unreli-

From the Special Pathogens Laboratory and Infectious Disease Section, VA Medical Center and University of Pittsburgh, Pittsburgh, Pennsylvania. Address reprint requests to Victor L. Yu, MD, VA Medical Center, University Drive C, Pittsburgh, PA 15240.

01-ED-184. Stout JE, Yu VL. Legionella *in the hospital water supply: a plea for decision making based on evidence-based medicine.* Infect Control Hosp Epidemiol *2001;22:670-672.*

able. The CDC has overestimated the difficulty in microbiology testing for *Legionella*. With adequate training, hospital microbiologists can easily become proficient in the recovery of *Legionella* from environmental specimens. If an outside laboratory performs the testing, it should be experienced in *Legionella* culture and identification; numerous reference laboratories now have this capability.[14]

Thus, the answer to this problem should not be a recommendation against routine environmental surveys, but rather a recommendation to perform the survey properly and use optimal culture methodology. Both the Maryland Scientific Working Group and the Allegheny County Health Department Guidelines recommend routine environmental cultures for *Legionella* in acute-care hospitals.[15,16]

An adequate environmental survey must include a sufficient number of samples collected from a variety of locations. These locations should roughly represent the distribution network of the hot-water system and likely points of use for patients. For example, sampling points should include multiple floors and wings, and areas of greatest concern such as units housing patients at high risk for acquiring legionnaires' disease (oncology, transplant, and medical-surgical units). In the Allegheny County Health Department Guidelines, the suggested number of outlets to be sampled for an average 500-bed hospital is a minimum of 10 distal sites, plus the hot-water storage tanks.[16] If the bed size is greater than 500, two distal sites per 100 beds is the recommendation. In the report by Sabrià et al,[1] it appears that the number of distal sites sampled was low, approximately six per facility (63 showers and 63 taps/20 hospitals), plus the hot-water return and hot-water tank.

We would not recommend the method of sample collection used by Sabrià et al.[1] They collected 5-L samples from the hot-water tanks and return lines; swab samples from faucets were diluted into 2 L of hot water. If both a swab and a water sample are collected from an outlet, the swab sample should be collected first (use a swab that has an ampule of transport medium at the base to keep the swab moist during transport); then 100 to 200 mL of hot water should be collected from the outlet. Do not dilute the organisms collected on the swab by placing the swab in the water sample. The water is filter concentrated, and the swab is pretreated with acid. The media used for culturing *Legionella* from the environment should include both the nonselective buffered charcoal yeast extract (BCYE) agar and a selective medium that contains glycine,[17] such as MWY (modified Wadowsky Yee)-BCYE, as used by Sabrià et al.[1] Most hospitals send their samples to a reference laboratory for testing. The collection and shipping of 2- to 5-L samples has not been shown to increase the sensitivity of testing and is clumsy and difficult to handle.

The CDC has been a forceful advocate for intense clinical surveillance for hospital-acquired legionnaires' disease without knowledge of the status of the hospital water supply. This seems unnecessarily wasteful, because hospitals that are free of *Legionella* colonization in the water would not have cases on their wards.[10,11,18] Regardless, this CDC recommendation has been widely ignored. In a National Nosocomial Infections Surveillance (NNIS) System study of 192 hospitals, only 7% routinely tested all clinical sputum specimens for *Legionella*.[19] Even more startlingly, only 21% of hospitals that had experienced cases of hospital-acquired legionellosis had established routine testing for *Legionella* in respiratory tract specimens.

Conclusive data that will resolve this issue lie dormant, awaiting the motivated investigator. A follow-up study by Sabrià is logically obvious. Given the colonization seen in Barcelona hospitals, these investigators should do a prospective study aimed at detection of cases of hospital-acquired legionnaires' disease. If cases are detected in only those hospitals colonized with *Legionella,* the scientific foundation for this recommendation of obtaining routine cultures of the environment would be solidified. Follow-up studies by Liu et al, Marrie et al, Joly et al, and Kool et al can also address this issue.[3,6,7,18] Liu, Marrie, and Kool et al found *Legionella* in hospital water supplies in the United Kingdom, Nova Scotia, and San Antonio, but they did not perform a clinical study to ascertain whether such colonization could be epidemiologically linked to undiagnosed cases of hospital-acquired legionnaires' disease. Since *Legionella* colonization of large building water supplies is stable for years,[20-22] these investigators should return to these hospitals and perform a prospective clinical study of applying *Legionella* diagnostic tests, especially culture, to patients with hospital-acquired pneumonia at hospitals colonized with *Legionella* and hospitals free of *Legionella*. Cases of unrecognized legionnaires' disease might well be revealed. Joly et al did perform such a follow-up study for 9 months at 10 hospitals colonized with *Legionella* versus 10 hospitals that were *Legionella*-free; they found that colonized hospitals experienced legionnaires' disease significantly more often than did non-colonized hospitals (P=.054).[18]

Until environmental cultures are performed routinely, hospitals will continue to experience legionnaires' disease with its attendant high mortality. The disease remains underdiagnosed largely because of failure to adopt in-house laboratory testing for *Legionella*. Environmental cultures would allow a rational, cost-effective approach by increasing the index of suspicion for legionnaires' disease by physicians and making in-house laboratory testing available. Cost-effective and reliable disinfection measures exist if the level of colonization is high.[23,24] Evidence-based medicine should now be the means by which this contentious issue is resolved.

REFERENCES

1. Sabrià M, García-Núñez M, Pedro-Botet ML, Sopena N, Gimeno JM, Reynaga E, et al. Presence and chromosomal subtyping of *Legionella* species in potable water systems in 20 hospitals of Catalonia, Spain. *Infect Control Hosp Epidemiol* 2001;22:673-676.
2. Kohler JR, Maiwald M, Luck PC, Helbig JH, Hingst V, Sontag HG. Detecting legionellosis by unselected culture of respiratory tract secretions and developing links to hospital water strains. *J Hosp Infect* 1999;41:301-311.
3. Kool JL, Bergmire-Sweat D, Butler JC, Brown EW, Peabody DJ, Massi DS, et al. Hospital characteristics associated with colonization of water systems by *Legionella* and risk of nosocomial legionnaires' disease: a

cohort study of 15 hospitals. *Infect Control Hosp Epidemiol* 1999;20:798-805.
4. Best M, Yu VL, Stout J, Goetz A, Muder RR, Taylor F. *Legionellaceae* in the hospital water supply: epidemiological link with disease and evaluation of a method of control of nosocomial legionnaires' disease and Pittsburgh pneumonia. *Lancet* 1983;2:307-310.
5. White C. The deadly glitz of a grand new hospital. *Business Week* [online]. November 5, 2001. (www.businessweek.com)
6. Liu WK, Healing DE, Yeomans JT, Elliot TS. Monitoring of hospital water supplies for *Legionella*. *J Hosp Infect* 1993;24:1-9.
7. Marrie T, Green T, Burbridge S. *Legionellaceae* in the potable water of Nova Scotia hospital and Halifax residences. *Epidemiol Infect* 1994; 112:143-150.
8. Muder RR, Yu VL, McClure J, Kominos S. Nosocomial legionnaires' disease uncovered in a prospective pneumonia study: implications for underdiagnosis. *JAMA* 1983;249:3184-3188.
9. Rudin JE, Wing EJ. A comparative study of *Legionella micdadei* and other nosocomial acquired pneumonia. *Chest* 1984;86:875-880.
10. Johnson JT, Yu VL, Best M, Vickers RM, Goetz A, Wagner R, et al. Nosocomial legionellosis uncovered in surgical patients with head and neck cancer: implications for epidemiologic reservoir and mode of transmission. *Lancet* 1985;2:298-300.
11. Yu VL, Beam TR Jr, Lumish RM, Vickers RM, Fleming J, McDermott C, et al. Routine culturing for *Legionella* in the hospital environment may be a good idea: a three-hospital prospective study. *Am J Med Sci* 1987;294:97-99.
12. Goetz AM, Stout JE, Jacobs SL, Fisher MA, Ponzer RE, Drenning S, et al. Nosocomial legionnaires' disease discovered in community hospitals following cultures of the water system: seek and ye shall find. *Am J Infect Control* 1998;26:6-11.
13. Besser R. Eye on America investigation [transcript]. CBS News. December 15, 2000.
14. Freije MR. *Legionellae Control in Health Care Facilities: A Guide for Minimizing Risk.* Indianapolis, IN: HC Information Resources, Inc; 1996.
15. State of Maryland Department of Health and Mental Hygiene. *Report of the Maryland Scientific Working Group to Study* Legionella *in Water Systems in Healthcare Institutions.* Baltimore, MD: State of Maryland Department of Health and Mental Hygiene; June 14, 2000.
16. Allegheny County Health Department. *Approaches to Prevention and Control of* Legionella *Infection in Allegheny County Health Care Facilities.* 2nd ed. Pittsburgh, PA: Allegheny County Health Department; 1997:1-15.
17. Ta AC, Stout JE, Yu VL, Wagener MM. Comparison of culture methods for monitoring *Legionella* species in hospital potable water systems and recommendations for standardization of such methods. *J Clin Microbiol* 1995;33:2118-2123.
18. Joly JR, Alary M. Occurrence of nosocomial legionnaires' disease in hospitals with contaminated potable water supply. In: Barbaree JM, Breiman RF, Dufour AP, eds. Legionella: *Current Status and Emerging Perspectives.* Washington, DC: ASM Press; 1994;39.
19. Fiore AE, Butler JC, Emori TG, Gaynes RP. A survey of methods to detect nosocomial legionellosis among participants in the National Nosocomial Infections Surveillance System. *Infect Control Hosp Epidemiol* 1999;20:412-416.
20. Mansfield SD, Bezanson GS. Characterization and cloning of a 37-kb plasmid carried by *L. pneumophila* recovered from patients and hospital water over a 12-year period. *Can J Microbiol* 1997;43:193-197.
21. Lawrence C, Reyrolle M, Dubrou S, Forey F, Decludt B, Goulvestre C, et al. Single clonal origin of a high proportion of *Legionella pneumophila* serogroup 1 isolates from patients and the environment in the area of Paris, France, over a 10-year period. *J Clin Microbiol* 1999;37:2652-2655.
22. Rangel-Frausto MS, Rhomberg P, Hollis RJ, Pfaller MA, Wenzel RP, Helms CM, et al. Persistence of *Legionella pneumophila* in a hospital's water system: a 13-year survey. *Infect Control Hosp Epidemiol* 1999;20:793-797.
23. Lin YE, Vidic RD, Stout JE, Yu VL. *Legionella* in water distribution systems. *Journal of the American Water Works Association* 1998;90:112-121.
24. Stout JE, Lin LE, Yu VL. Survey of hospitals using copper-silver ionization for the control of *Legionella*. 5th International Conference on *Legionella*; Ulm, Germany; 2001. Abstract P80.