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Concise Communication

Preventing hospital-acquired Legionnaires' disease: A snapshot of clinical practices and water management approaches in US acute-care hospitals

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Abstract

In 2017, we surveyed 101 SHEA Research Network hospitals regarding Legionnaires' disease (LD). Of 29 respondents, 94% have or are developing a water management plan with varying characteristics and personnel engaged. Most LD diagnostic testing is limited to urine antigen testing. Many opportunities to improve LD prevention and diagnosis exist.

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Legionnaires' disease (LD) is a type of pneumonia caused by *Legionella pneumophila*. These bacteria thrive in warm water with stagnant flow, commonly present in hospital plumbing systems.[1] Infections occur when water containing *Legionella* is inhaled. Risk factors for LD include comorbid conditions common among hospitalized patients: older age, immunosuppression, and chronic lung disease. For these reasons, LD prevention deserves particular attention from the infection control community.

With the proliferation of LD reports in recent years, the healthcare epidemiology community has received new information to reduce the risk of *Legionella* growth in potable and nonpotable water systems.[2] In 2015, ASHRAE (formerly the American Society of Heating, Refrigerating and Air-Conditioning Engineers) released ASHRAE 188, an industry standard intended to minimize *Legionella* growth and transmission through the implementation of facility water management programs.[3] In June 2016, the Centers for Disease Control and Prevention (CDC) published a tool kit to translate ASHRAE 188 for audiences with less technical expertise.[4] In June 2017, the Centers for Medicare and Medicaid Services also issued a requirement for all Medicare-certified healthcare facilities to establish a water management plan.[5]

In this study, we sought to understand variations in LD prevention strategies including clinical practices for diagnosing LD and characterization of water management plans within the Society for Healthcare Epidemiology of America Research Network (SRN) hospitals.

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Methods

A 24-item electronic survey was e-mailed to SRN principal investigators on October 17, 2017. Up to 3 reminders were sent to nonrespondents until survey closure on November 30, 2017. Any US-based acute-care hospital within the SRN was eligible. For questions requiring nonepidemiologic expertise, consultation with colleagues was strongly encouraged.

Respondents were asked questions on clinical protocols for diagnosing cases of LD, maintenance practices of potable and nonpotable water systems, *Legionella*-specific prevention strategies, and knowledge of recent guidelines and regulations. Facility names, respondents and locations were not disclosed to the research team; responses were limited to 1 per facility. Results were analyzed using descriptive statistics in SAS version 9.4 software (Cary, North Carolina). The Emory University Institutional Review Board deemed this study to be nonhuman subjects research.

Results

In total, 29 respondents from 101 (29%) eligible facilities completed the survey. Respondents represented mostly academic medical centers (59%), and 93% were from facilities where the SRN principal investigator was registered with the SRN as having "hospital epidemiologist" or "infection committee chair" listed as a primary professional activity. Facilities were large (ie, 80% had >250 beds), and 83% had transplant or inpatient dialysis units. Most facilities (79%) had cooling towers; 28% reported having operational indoor decorative fountains or aesthetic water features; and 10% had whirlpool therapy spas.

Among the 29 respondents, 24 (83%) reported diagnosing LD cases at their facility in the previous 5 years, of which 9 (38%) suspected or confirmed at least 1 case to be healthcare-associated. Regarding diagnostic capacity, 25 respondents (86%) reported an

ability to test for LD in house using urine antigen tests (UAT), 21 respondents (72%) reported using respiratory culture, and 8 respondents (28%) reported using multipathogen molecular assays. However, 19 respondents (66%) indicated that routine LD testing for hospital-acquired pneumonia was limited to non–culture-based tests (eg, urine antigen tests or molecular assay), and only 4 respondents (14%) reported always conducting bacterial culture in conjunction with nonculture tests.

Moreover, 19 respondents (66%) had an established water management plan (WMP) for both potable and nonpotable water; 8 respondents (28%) reported a WMP was in development, 1 respondent (3%) had a WMP for nonpotable water only (with planning underway for potable water), and 1 respondent (3%) had no WMP. The facility without a WMP reported having no cases of LD in the past 5 years. To monitor potable water quality, 18 of 28 respondents (64%) reported routinely measuring disinfectant levels (eg, residual chlorine), 17 respondents (61%) reported routinely measuring temperature, and 15 rsepondents (54%) reported routinely measuring pH level. In addition, 17 respondents (61%) reported routinely testing for *Legionella* presence as part of their WMP. Having an existing WMP and performing routine tests on potable water were more frequently reported among larger facilities and those with transplant units, compared to those without (Table 1). Existing WMPs covering potable and nonpotable water were also more prevalent among the 9 facilities reporting a healthcare-associated LD case in the previous 5 years than in facilities not reporting a healthcare-associated case: 8 of 9 (88.9%) versus 11 of 20 (55%).

Regarding personnel actively engaged in WMP development, the most commonly reported domains of expertise were infection control (93%) and facilities and engineering (90%); risk management and public health staff were less frequently involved (Table 2). Although most facilities reported awareness of ASHRAE Standard 188 (97%) and the CDC toolkit (89%)—and used these to develop their facility's WMP—fewer were aware of the American Industrial Hygiene Association (AIHA)'s *Legionella* guidelines from 2015. Moreover, 24% of facilities reported not having conducted a risk assessment to identify areas within their infrastructure susceptible to *Legionella* growth, as outlined in these standards.

Discussion

In this sample of acute-care hospitals, the reported prevalence of established WMP and awareness of key LD prevention guidance documents was high. Nearly two-thirds of facilities reported already having established a WMP covering both potable and nonpotable water, though we did not determine their adequacy or comprehensiveness. This is substantially more than the 27% of hospitals in Minnesota that reported having a WMP before the release of the CMS directive in June 2017.[6]

Close to 60% of respondents reported having conducted a risk assessment for *Legionella* since 2014, yet some of these assessments likely occurred before publication of new prevention guidelines. As facilities continue refining their WMP, conducting periodic risk assessments with emphasis on *Legionella* prevention will be a continued priority.

For diagnosing LD, the UAT was the most prevalent diagnostic, with 86% indicating capacity to conduct UATs at their facility. This proportion is substantially higher than the 18.8% of acute-care hospitals reporting this capability in 2013.[7] Although this increase could signal general improvements in LD diagnostic

Table 1. Differences in *Legionella* Prevention Activities by Presence of Transplant Unit, Facility Size and Facility Type, 29 SHEA Research Network Respondents, October–November 2017

LD related activity	Transplant Unit, No. (%)		Facility Bed Size, No. (%)			Hospital Type, No. (%)	
	No (n = 11)	Yes (n = 18)	100–249 (n = 6)	250–459 (n = 10)	≥500 (n = 13)	Academic[a] (n = 17)	Other[b] (n = 12)
WMP is in place	6 (55)	14 (78)	2 (33)	8 (80)	10 (77)	13 (76)	7 (58)
Cultures for routine diagnostics							
Always/Sometimes	6 (54)	14 (78)	5 (83)	6 (60)	9 (70)	14 (82)	6 (50)
Rarely/Never	5 (45)	4 (22)	1 (17)	4 (40)	4 (31)	3 (18)	6 (50)
LD identified within 5 y	9 (82)	15 (83)	4 (67)	8 (80)	12 (92)	14 (82)	10 (83)
Routine potable water testing includes:[c]							
pH	4 (40)	11 (61)	3 (50)	5 (56)	7 (54)	9 (53)	6 (55)
Temperature	5 (50)	12 (67)	4 (67)	6 (67)	7 (54)	10 (59)	7 (64)
Legionella presence	5 (50)	12 (67)	2 (33)	7 (78)	8 (62)	11 (65)	6 (55)
L. pneumophila presence only	3 (30)	4 (22)	2 (33)	1 (11)	4 (31)	4 (24)	3 (27)
Aware of ASHRAE 188[c]	9 (90)	18 (100)	6 (100)	9 (100)	12 (92)	17 (100)	10 (91)
Aware of CDC tool kit[c]	9 (90)	16 (89)	6 (100)	8 (89)	11 (85)	15 (88)	10 (91)
Aware of AIHA guidance[c]	5 (50)	11 (61)	4 (67)	5 (56)	7 (54)	10 (59)	6 (55)

Note. SHEA, Society for Healthcare Epidemiology of America; LD, Legionnaires' disease; WMP, water management plan; CDC, Centers for Disease Control and Prevention; AIHA, American Industrial Hygiene Association.
[a]Academic medical center or university-affiliated academic medical center.
[b]Community teaching hospital with academic affiliation, community hospital, federal non-military hospital.
[c]Only 28 respondents to these questions.

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Table 2. Domains of Expertise Represented on Hospital Water Management Plan Development Teams, 29 SHEA Research Network Respondents, October–November 2017

Domain of Expertise[a]	Occupations	No. (%) (N = 29)		
Infection control	Hospital epidemiologist, Infection preventionist	27 (93)		
Facilities and engineering	Facilities manager or engineer, Maintenance Staff	26 (90)		
Microbiology	Clinical microbiologist, Environmental microbiologist[b]	15 (52)	Hospitals with top 4 domains of expertise 7 (24)	Hospitals with all 6 domains of expertise 1 (3)
Compliance and administration	Hospital administrator, Accreditation/compliance officer	13 (45)		
Risk management	Risk or quality management, Industrial hygienist	11 (38)		
Public health	State or local public health staff	3 (10)		

[a]Because various *Legionella* prevention guidance documents currently differ in regard to suggested expertise represented on a WMP team, the domains presented here represent general categories of expertise. The CDC toolkit suggests all domains and roles mentioned in Table 2, although there is no hierarchy of importance conveyed in various guidance documents.
[b]All provided by external consultants.

capacity, it more likely reflects the greater attention and capacity for LD prevention among the hospitals responding to this survey.

Although UAT may be the easiest and most ubiquitous diagnostic, it is not comprehensive; it only detects infections caused by *Legionella pneumophila* serogroup 1.[8] Although serogroup 1 is responsible for more than 80% of LD cases, relying solely on this test would miss cases caused by other pathogenic strains.[9,10] Notably, 72% of respondents reported the capacity to perform culture-confirmation testing in house, whereas only 14% reported doing so routinely. Thus, exploration of barriers to routinely culturing pneumonia patients should be considered.

The response rate for this survey was low, which limited our ability to conduct statistical analyses. While we lacked ample data on nonrespondents, they did not differ substantially from respondents in facility size or type. It is also likely that facilities participating in the SRN represent more prepared facilities; therefore, the SRN members who responded may substantially over represent *Legionella* preparedness in the general population of healthcare facilities. If true, these data still offer a timely snapshot of LD diagnostic capacities and water management planning at what may be the most prepared facilities in the country.

Although our results suggest that some facilities may meet current LD prevention guidelines, there is room for improvement. Infection control and facilities and engineering departments are frequently involved in WMP development, but consideration should be given to a broader range of expertise, including environmental health, environmental microbiology and industrial hygiene. At a time when LD cases are rising and pressures to improve LD prevention are increasing, lessons learned from facilities with robust WMP may benefit facilities developing or updating their plans.

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Conflicts of interest. The authors declare no conflicts of interests.

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