RESEARCH BRIEFS

Completeness of Surveillance Data Reported by the National Healthcare Safety Network: An Analysis of Healthcare-Associated Infections Ascertained in a Tertiary Care Hospital, 2010

The Centers for Disease Control and Prevention (CDC) has estimated that there are 1.7 million healthcare-associated infections (HAIs) annually in the United States, which result in 99,000 deaths and $4.5 billion in excess healthcare costs.[1] A key intervention to control HAI is ongoing surveillance with feedback to healthcare providers.[2] Surveillance provides data that allow the determination of endemic infection rates, early detection of epidemics, and assessment of the efficacy of interventions.

Currently, the premier surveillance system for HAI in the United States is the National Healthcare Safety Network (NHSN), which is managed by the CDC.[3] The NHSN was established in 2005 to integrate and supersede 3 legacy surveillance systems at the CDC: the National Nosocomial Infections Surveillance system (NNIS), the Dialysis Infections Surveillance Network, and the National Surveillance System for Healthcare Workers.[4] NHSN reports have provided data on device-associated HAI (ie, central line–associated bloodstream infections, ventilator-associated pneumonia, and catheter–associated urinary tract infections) and selected surgical site infections. Unlike the NNIS, the NHSN has provided device-associated infection rates for patients housed both in intensive care units (ICUs) and in non-ICU wards. Our study was undertaken at an 800-bed tertiary care facility to determine the completeness of NHSN data; specifically, to determine what fraction of all HAIs would have been included in a data report issued by the NHSN.

This study was conducted at the University of North Carolina Hospitals using our surveillance data for the year 2010. Infection control surveillance was conducted by 5 infection preventionists in consultation with 2 full-time faculty members. Comprehensive hospital-wide surveillance that included all CDC-defined sites was performed in accordance with CDC criteria.[5] Sources for identification of healthcare-associated infections included laboratory reports of positive culture results, results of serological testing or molecular-based diagnostic tests, morbidity and mortality conferences, autopsies, and administrative charge code data to assist in identifying surgical site infections. All surveillance data are entered into an electronic database.

We subdivided our 2010 nosocomial infection data into 2 categories: HAIs that had been included in an NHSN report, and HAIs that had not been included in an NHSN report (Table 1). Overall, approximately 50% of our ascertained HAIs could have been included in a published NHSN report. For example, NHSN reports focus on device-associated infections.[4] Our data revealed that pneumonias that were not associated with receipt of mechanical ventilation (ie, all hospital-acquired pneumonias), bloodstream infections that were not associated with a central line, and urinary tract infections that were not associated with a urinary catheter accounted for 29.5%, 22.3%, and 37.7% of these body site infections, respectively. In a broader sense, ventilator-associated pneumonias accounted only for 18.6% of respiratory tract infections. NHSN reports include data on surgical site infections only for selected surgical procedures.[6] For example, NHSN reports do not include the following surgical procedures: plastic surgery; ear, nose and throat surgery; and burn surgery. Our data revealed that 25.4% of our surgical site infections were not captured by NHSN-reported procedures. Infections classified as "other," which is a heterogeneous group of infections (eg, endocarditis, osteomyelitis, conjunctivitis, and epidural/subdural abscess), accounted for 16.5% of all infections that were not reported to the NHSN. Our database also included the number of bloodstream infections secondary to infections at other body sites. In 2010, 125 secondary bloodstream infections were reported, including 18 that were secondary to urinary tract infections (data not shown).

NHSN is the premier surveillance system in the United States for healthcare-associated infections. Certain infections (ie, central line–associated bloodstream infections) must be reported to the NHSN by hospitals that receive funding from the Center for Medicare and Medicaid Services.[7] Twenty-three states now require hospitals to report selected HAIs to the NHSN.[8] The NHSN reports provide data that allow hospitals to benchmark their HAI rates against collated data from a large number of US hospitals.[2] This is a crucially important use of NHSN data, because it allows hospitals to focus their prevention efforts on those HAIs for which their hospital has high rates, compared with rates at other facilities.

The ultimate goal of infection control is to reduce all HAIs, ideally to zero. Surveillance is an important component of infection control. Infection control surveillance includes ascertainment of nosocomial infections with use of standard definitions, aggregation of the data, analysis of the data, and feedback of the data to key decision leaders. The NHSN performs a crucial function by allowing hospitals to benchmark their data. The strengths of the NHSN include the following: a large number of hospitals are currently reporting data, standard HAI definitions are used, data are reported for specific hospital units (eg, coronary care unit and medical ward), and surgical site infection rates are risk adjusted. However, it is important to realize that NHSN reports do not include all HAIs that may be ascertained in a healthcare facility. It is noteworthy that, although we included twice as many HAIs

TABLE 1. Percentage of Healthcare-Associated Infections (HAIs) Included in Surveillance by the National Healthcare Safety Network (NHSN), University of North Carolina (UNC) Hospitals, 2010

HAI	No. of HAIs			HAIs included in NHSN surveillance reports, %
	Included in NHSN surveillance (n = 633)	Not included in NHSN surveillance (n = 631)	Total (n = 1,264)	
Respiratory tract infection				
Overall	41	179	220	18.6
Ventilator-associated pneumonia	41	...		
Hospital-associated pneumonia	...	65		
Tracheobronchitis	...	108		
Other respiratory tract infection	...	6		
Bloodstream infection				
Overall	153	44	197	77.7
Central line associated	153	...		
Not central line associated	...	44		
Surgical site infection				
Overall	249	85	334	74.5
Superficial	54	32		
Deep	61	32		
Organ space	134	21		
Urinary tract infection				
Overall	190	115	305	62.3
Catheter associated	190	...		
Not catheter associated	...	114		
Other	...	1		
Other	...	208	208	0

NOTE. Data do not include bloodstream infections secondary to urinary tract infections (urosepsis).

as would have been included in NHSN reports, our data still did not include all possible HAIs. For example, our hospital does not perform active surveillance for surgical site infections that occur after discharge from the hospital. Such surveillance has been demonstrated to increase detection of surgical site infections.[9]

Our data suggest that approximately 50% of HAIs that occur in a tertiary care hospital are not included in published NHSN reports. Surveillance for nosoocomial infections that are not included in NHSN reports still allows hospitals to detect epidemics and assess the impact of interventions on reducing HAI incidence, even in the absence of the ability to benchmark the data.

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REFERENCES

1. Klevens RM, Edwards JR, Richards CL, et al. Estimating health care–associated infections in U.S. hospitals, 2002. *Public Health Reports* 2007;122:160–166.
2. Gaynes R, Richards C, Edwards J, et al. Feeding back surveillance data to prevent hospital-acquired infections. *Emerg Infect Dis* 2001;7:295–298.
3. Centers for Disease Control and Prevention. About NHSN. http://www.cdc.gov/nhsn/about.html. Accessed July 10, 2011.
4. Dudeck MA, Horan TC, Peterson KD, et al. The National Healthcare Safety Network (NHSN) report, data summary for 2009, device-associated module. *Am J Infect Control* 2011;39:349–367.
5. Centers for Disease Control and Prevention. Surveillance definition of healthcare-associated infection and criteria for specific types of infections in the acute care setting. http://www.cdc.gov/

nhsn/PDFs/pscManual/17pscNosInfDef_current.pdf. Accessed July 17, 2011.
6. Edwards JR, Peterson KD, Mu Y, et al. National Healthcare Safety Network (NHSN) report: data summary for 2006 through 2008, issued December 2009. *Am J Infect Control* 2009;37:783–805.
7. Centers for Disease Control and Prevention. CMS hospital inpatient quality reporting program. http://www.cdc.gov/nhsn/FAQ_CMS_HAI.html. Accessed July 17, 2011.
8. Centers for Disease Control and Prevention. Facilities in these states are required by law to report HAI data to NHSN. http://www.cdc.gov/hai/stateplans/required-to-report-hai-NHSN.html. Accessed July 17, 2011.
9. Holtz TH, Wenzel RP. Postdischarge surveillance for nosocomial wound infection: a brief review and commentary. *Am J Infect Control* 1992;20:206–213.

Evaluation of Stethoscopes as Vectors of *Clostridium difficile* and Methicillin-Resistant *Staphylococcus aureus*

Healthcare workers' stethoscopes are potential vectors for transmission of pathogens because they frequently come in contact with the skin of patients and are not routinely cleaned between examinations. Point-prevalence culture surveys have demonstrated that stethoscope diaphragms may be contaminated with pathogens such as *Clostridium difficile* and methicillin-resistant *Staphylococcus aureus* (MRSA).[1-5] However, previous publications have not directly quantified the risk for transmission of *C. difficile* and MRSA by stethoscopes. Here, we examined the risk for transmission of these pathogens by stethoscopes in the laboratory and during simulated examinations of patients and evaluated methods to disinfect contaminated stethoscopes.

The study protocol was approved by the Cleveland Veterans Affairs Medical Center's Institutional Review Board. The efficiency of direct and indirect transfer of nontoxigenic *C. difficile* spores (American Type Culture Collection 43593) and MRSA (a clinical isolate of pulsed-field gel electrophoresis type USA300) by stethoscope diaphragms was tested in the laboratory. Ten-microliter aliquots containing 1–4 $\log_{10}$ colony-forming units (CFUs) of spores or 1–3 $\log_{10}$ CFUs of MRSA were inoculated directly onto disinfected diaphragms (McCoy) or onto skin surfaces and allowed to dry for 10 minutes. For *C. difficile*, the skin site was the forearm of a human volunteer. For MRSA, a processed pig skin surface was used. To assess direct transfer, the contaminated diaphragms were imprinted for 10 seconds directly onto prereduced *C. difficile* brucella agar[6] for isolation of *C. difficile* and onto CHROMagar (Becton Dickinson) containing 10 μg/mL cefoxitin for MRSA. To assess indirect transfer, disinfected stethoscope diaphragms were pressed onto contaminated skin sites for 10 seconds and imprinted onto selective agar. *Clostridium difficile* brucella agar plates were incubated anaerobically, and MRSA plates were incubated in room air at 37°C for 48 hours. All experiments were repeated 3 times, with the inclusion of uninoculated control stethoscopes in each experiment.

To assess methods of stethoscope disinfection, 10-μL aliquots of the pathogens were inoculated onto the diaphragm and allowed to dry. The diaphragm was wiped for 10 seconds with a 1 × 2-inch 70% isopropyl alcohol pad (Medline), a 2 × 2-inch gauze pad (Tyco Healthcare) moistened with sterile water, or the same gauze pad moistened with 70% ethanol. The diaphragm was imprinted onto selective agar and cultured as described previously.

We assessed the transfer of pathogens by stethoscopes from the skin of patients with *C. difficile* infection or MRSA colonization during a standardized simulated examination of the heart, lungs, and abdomen (12 skin sites total and 5-second contact time for each site). After auscultation, the diaphragm was imprinted onto selective agar and cultured as described previously. For comparison, the same skin sites were palpated with sterile gloves premoistened with sterile water, and the fingers were imprinted onto selective agar. Identification and susceptibility testing for MRSA was performed on the basis of Clinical and Laboratory Standards Institute guidelines.[7] Suspected *C. difficile* isolates were confirmed as previously described.[6] Paired *t* tests were used to compare colony counts transferred by stethoscopes versus hands. A Fisher exact test was used for categorical data.

Figure 1 shows the findings for direct and indirect transfer of the pathogens by stethoscopes. Stethoscopes directly transferred nearly 100% of *C. difficile* spores inoculated onto the diaphragm to agar plates, whereas the number of MRSA colonies transferred directly to the agar plate was ~2 $\log_{10}$ CFUs fewer than the original inoculum, presumably due to loss of viability with desiccation. For indirect transfer from skin, stethoscopes acquired and transferred on average 1–1.5 $\log_{10}$ CFU fewer spores or MRSA than were transferred directly.

Gauze moistened with sterile water or alcohol was more effective than alcohol wipes in removing *C. difficile* spores from stethoscope diaphragms (98%–99% vs 92%–94% removal; $P < .05$). Alcohol wipes and ethanol-moistened gauze were more effective than water-moistened gauze for removal of MRSA (100% vs 94% removal).

Simulated examinations were conducted on 35 *C. difficile* infection patients and 57 MRSA carriers. In comparison to hand imprints, stethoscope imprints resulted in nonsignificant trends toward less frequent acquisition and transfer of *C. difficile* (5/35 [14%] vs 11/35 [31%]; $P = .15$) and MRSA (11/57 [19%] vs 15/57 [26%]; $P = .5$). The numbers of *C. difficile* colonies acquired and transferred by stethoscopes and gloved hands were similar (mean ± SD, 1.2 ± 2.0 and 7.3 ± 14.6; $P = .20$), but stethoscopes acquired and transferred fewer colonies of MRSA (mean ± SD, 5.9 ± 8.6 and 14.3 ± 11.4; $P = .01$).

Our findings suggest that stethoscopes may be an underappreciated vector for transmission of pathogens. During