

## RESEARCH BRIEF

## Prevalence and Risk Factors of Methicillin-Resistant *Staphylococcus aureus* Colonization among Critically Ill Hospitalized Patients in a Tertiary Care Center in Houston, Texas: An Active Surveillance Pilot Project

The Centers for Disease Control and Prevention (CDC) has reported an increase in the number of healthcare-associated infections, with an estimated 1.7 million infections resulting in approximately 99,000 deaths per year in the United States.<sup>1</sup> Every year, more than 126,000 individuals who are hospitalized are infected with methicillin-resistant *Staphylococcus aureus* (MRSA).<sup>2</sup> In 2005, approximately 19,000 people died due to healthcare-associated or community-associated invasive MRSA infection during their hospital stay.<sup>3</sup> Multidrug-resistant organisms, such as MRSA, were associated with increased durations of hospital stays and higher costs.<sup>4</sup> The ongoing increase in the prevalence of MRSA infection has led various agencies to propose recommendations, guidelines, and programs to battle this emerging epidemic.

By implementing CDC and Society for Healthcare Epidemiology of America recommendations for active surveillance of MRSA, Memorial Hermann–Texas Medical Center, an urban tertiary care hospital in Houston, Texas, was able to determine the prevalence of MRSA colonization among non-pediatric patients admitted to intensive care units and evaluate the risk factors associated with colonization. This small, cross-sectional, prospective pilot project involved MRSA screening in the 7 adult intensive care units (ICUs), including neurological trauma, shock trauma, medical, cardiac care, cardiovascular, burn, and transplant units.

Screening criteria included the following: (1) patients newly

admitted to the ICU, with the current duration of hospital stay not exceeding 3 days; or (2) patients internally transferred within the hospital to an ICU, with the current duration of ICU stay not exceeding 3 days. Nursing staff were responsible for collecting specimens from patients and for following standard modified contact isolation protocol, which included wearing clear gowns and gloves during the patient's ICU stay. Specimens were collected from the nares with use of dry, unmoistened sterile BBL CultureSwabs Liquid Stuart swabs (BD) and were processed using the BD GeneOhm IDI-MRSA assay in vitro diagnostic test (BD) for rapid MRSA detection.

Statistical analysis was performed using Stata, version 10 (StataCorp); EpiInfo, version 3.3 (CDC); and JavaStat (Ghent University). A descriptive analysis was performed for categorical and risk factor data. Crude odds ratios, 95% confidence intervals, and *P* values were computed for risk factors. Pearson  $\chi^2$  test was used to calculate significance, and the significance level was set at *P* < .05. This study was exempt from review by the Institutional Review Board of the University of Texas Health Science Center at Houston.

From March 1 through May 31, 2007, 1,283 (83.4%) of 1,531 non-pediatric patients admitted to an ICU were screened for nasal MRSA colonization. Of those 1,283 patients screened, demographic and risk factor data were available for 1,260 (98.2%). Nasal MRSA colonization at the time of ICU admission was unresolved for 73 patients because of specimen or a reagent failure during testing. Therefore, a total of 1,187 (77.5%) of the 1,531 patients admitted to an ICU were described in this analysis. Overall, the prevalence of colonization with MRSA among patients in this study population at the time of ICU admission was 12.5% (149 of 1,187 patients).

The patients screened included 717 male patients (60%) and 470 female patients (40%) aged 13–106 years (mean age, 54 years). Univariate analysis demonstrated that 1.4 male patients for each female patient were colonized with MRSA at the time of ICU admission. Ethnic categories represented

TABLE 1. Potential Risk Factors for Nasal Methicillin-Resistant *Staphylococcus aureus* Colonization at the Time of Intensive Care Unit Admission

Risk factor	Odds ratio (95% confidence interval)	<i>P</i> <sup>a</sup>
Sex	0.91 (0.64–1.29)	.59
Source of admission (community or hospital)	0.99 (0.62–1.57)	.97
Duration of hospital stay at time of swab collection	1.02 (0.64–1.60)	.95
Hospitalization during the previous 6 months	2.48 (1.70–3.63)	<.001
Hospitalization during the previous 12 months	2.27 (1.57–3.80)	<.001
Transferred from another healthcare facility	0.79 (0.50–1.24)	.30
Diabetes mellitus	1.63 (1.14–2.32)	.007
Neoplastic disease	0.73 (0.38–1.42)	.36
Drug use	1.19 (0.66–2.15)	.56

<sup>a</sup> By Pearson  $\chi^2$  test.

in the patient population screened included white, African American, Asian or Pacific Islander, all others, and unknown; the highest prevalence of MRSA colonization was found among Asian/Pacific Islander patients (13.3%). Patients aged 41–55 and 56–70 years had the highest prevalence of colonization (15.3% and 13.7%, respectively). The medical ICU had the highest prevalence of MRSA colonization (23.1%) among the 7 ICUs. The prevalence of MRSA colonization among patients hospitalized during the previous 6 or 12 months was double that among patients who were not hospitalized (22.3% and 20.7%, respectively). The prevalence was the same among patients admitted from the community and from within the hospital.

Table 1 presents the potential risk factors for nasal MRSA colonization at the time of ICU admission. Risk factors associated with colonization included hospitalization during the previous 6 months (odds ratio, 2.48 [95% confidence interval, 1.70–3.63];  $P < .001$ ), hospitalization during the previous 12 months (odds ratio, 2.27 [95% confidence interval, 1.57–3.80];  $P < .001$ ), and diabetes mellitus (odds ratio, 1.63 [95% confidence interval, 1.14–2.32];  $P = .007$ ). There were no significant differences between patients who were colonized with MRSA and those who were not colonized with MRSA at the time of ICU admission with regard to sex, source of admission (community or within hospital), and duration of hospital stay at the time of swab collection (dichotomously divided at 3 days). There was no association between MRSA colonization at the time of ICU admission and transfer from another healthcare facility, neoplastic disease, or drug use.

Because of the lack of MRSA colonization data for Houston's adult population, we were unable to determine whether a prevalence of 12.5% is atypical for the Houston area. The prevalence of nasal MRSA colonization at hospital admission for the United States from 2002 through 2004, captured by active surveillance screening, ranged from 7% to 12%.<sup>5–7</sup> Therefore, our finding is typical of those from other prevalence studies conducted in the United States and coincides with the continual increasing trend of MRSA colonization prevalence. Risk factors were similar to those found in previous studies, except for neoplastic disease and drug use.<sup>7–10</sup> The study design eliminated systematic bias, and laboratory testing results eliminated reporting bias. This study is limited because of its 3-month time frame, a non-pediatric population, and a lack of sample size calculation. Risk factor data were limited to information available in electronic hospital databases. Overall, this active surveillance screening pilot project provided valuable epidemiological information, which can aid in future interventions for the education, control, prevention, and treatment of MRSA. A future comprehensive study involving a large population and a longer screening period is warranted.

## ACKNOWLEDGMENTS

We thank BD for providing the GeneOhm laboratory testing kits at no cost for the pilot study.

*Potential conflicts of interest.* All authors report no conflicts of interest relevant to this article.

**Carolina Espinoza, MPH; Virgie Fisher, CIC;  
Willine Jean, MPH; Barbara Gaines, MSN;  
Koya Davis, MPH; Audrey Wanger, PhD;  
Eric Brown, PhD; Jacquelyn Slomka, PhD;  
Luis Ostrosky-Zeichner, MD**

From the Memorial Hermann–Texas Medical Center (C.E., V.F., W.J., B.G., K.D., A.W., L.O.-Z.) and The University of Texas Health Science Center, School of Public Health (E.B., J.S.), Houston, Texas.

Address reprint requests to Carolina Espinoza, MPH, Quality and Patient Safety, 9301 Southwest Freeway, Suite 480, Houston, TX 77074 (Carolina.Espinoza@memorialhermann.org).

Received June 15, 2010; accepted July 19, 2010; electronically published December 3, 2010.

© 2010 by The Society for Healthcare Epidemiology of America. All rights reserved. 0899-823X/2011/3201-00XX\$15.00. DOI: 10.1086/657670

## REFERENCES

1. Division of Healthcare Quality Promotion. Estimates of healthcare-associated infections. <http://www.cdc.gov/ncidod/dhqp/hai.html>. Accessed May 1, 2008.
2. Institute for Healthcare Improvement. 5 Million lives campaign. Getting started kit: reduce methicillin-resistant *Staphylococcus aureus* (MRSA) infection how-to guide. Cambridge, MA: Institute for Healthcare Improvement; 2006:1–48.
3. Division of Healthcare Quality Promotion. Fact sheet: invasive MRSA. <http://www.cdc.gov/mrsa/library/MRSA-Surveillance-Summary.html>. Accessed November 28, 2010.
4. Muto CA, Jernigan JA, Ostrowsky BE, et al. SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of *Staphylococcus aureus* and *Enterococcus*. *Infect Control Hosp Epidemiol* 2003;24(5):362–384.
5. Hidron AI, Kourbatova EV, Halvosa JS, et al. Risk factors for colonization with methicillin-resistant *Staphylococcus aureus* (MRSA) in patients admitted to an urban hospital: emergence of community-associated MRSA nasal carriage. *Clin Infect Dis* 2005;41(2):159–166.
6. Peterson LR, Hacek DM, Robicsek A. 5 Million lives campaign case study: an MRSA intervention at Evanston Northwestern Healthcare. *Jt Comm J Qual Patient Saf* 2007;33(12):732–738.
7. Warren DK, Guth RM, Coopersmith CM, Merz LR, Zack JE, Fraser VJ. Epidemiology of methicillin-resistant *Staphylococcus aureus* colonization in a surgical intensive care unit. *Infect Control Hosp Epidemiol* 2006;27(10):1032–1040.
8. Haley CC, Mittal D, Laviolette A, Jannapureddy S, Parvez N, Haley RW. Methicillin-resistant *Staphylococcus aureus* infection or colonization present at hospital admission: multivariable risk factor screening to increase efficiency of surveillance culturing. *J Clin Microbiol* 2007;45(9):3031–3038.
9. Heymann DL. Control of Communicable Diseases Manual. 18th ed. Washington, DC: American Public Health Association; 2004.
10. Elston DM. Community-acquired methicillin-resistant *Staphylococcus aureus*. *J Am Acad Dermatol* 2007;56(1):1.