

# Stethoscopes as a Source of Hospital-Acquired Methicillin-Resistant *Staphylococcus aureus*

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*Stethoscopes are potential vectors of methicillin-resistant Staphylococcus aureus (MRSA). The purpose of this project was to determine the presence of MRSA on the diaphragms of personal and unit stethoscopes within a hospital setting before and after cleaning with alcohol prep pads. The sample consisted of 141 personal and unit stethoscopes in adult medical-surgical and intensive care units of a large university hospital in the Southeast. Each stethoscope was cultured once before cleaning and once after cleaning. Cultures were obtained using sterile swabs and inoculated on a selective medium for MRSA. Bacterial growth was noted in the precleaning group, but no MRSA colonies were detected. The postcleaning group had no bacterial growth. There was not enough data to statistically support that isopropyl alcohol is effective in decreasing bacterial counts; however, these findings suggest that current disinfection guidelines are effective in preventing MRSA colonization on stethoscopes in this setting.*

**Keywords:** stethoscopes, MRSA, disinfection, infection control, vector.

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**IN 2010, THE CENTERS** for Disease Control and Prevention (CDC)<sup>1</sup> estimated that hospital-acquired infections (HAIs) account for 1.7 million infections and 99,000 deaths each year in the United States. The direct medical costs of HAIs are estimated to be \$4.5 billion annually.<sup>2</sup> Additionally, the Centers for Medicare and Medicaid have informed agencies of the refusal to pay for HAIs.<sup>3</sup> It has been suggested that of the 5% to 10% of patients admitted to acute health care facilities who acquired HAIs, approximately 20% could have been prevented through strict adherence to infection control guidelines.<sup>4</sup>

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Unlike hand washing, the cleaning of stethoscopes has received little attention in the role of infection transmission. The Healthcare Infection Control Practices Advisory Committee<sup>5</sup> recommends that stethoscopes are disinfected when visibly soiled and on a regular basis but does not specify what constitutes a regular cleaning schedule. There is no consensus regarding which frequency of cleaning is most efficacious.

## Literature Review

In the past, stethoscopes have been shown to harbor potentially harmful bacteria. As early as 1972, stethoscopes were identified as a fomite on which bacteria are capable of surviving for various amounts of time.<sup>6</sup> *Escherichia coli* has been reported to live on inanimate objects for 1.5 hours to 16 months; *Staphylococcus aureus* (including methicillin-resistant *S aureus* [MRSA]), 17 days to 7 months; and *Clostridium difficile*, 5 months.<sup>7</sup> Not only have these organisms been shown to survive on the surface of inanimate objects, but also it has been reported that bacteria may be transferred to human skin from surfaces.<sup>8</sup>

The possibility that infectious organisms, particularly MRSA, can be transmitted via the stethoscope and contribute to HAIs is important to the nursing and medical community. The proportion of HAIs related to MRSA in intensive care units (ICUs) has increased from 2% in 1974 to 64% in 2004.<sup>1</sup> Furthermore, of the 94,000 cases of invasive MRSA infections that occur on average each year, 86% are health care-associated and lead to 19,000 deaths annually.<sup>9</sup> Cleaning practices for assessment tools, such as stethoscopes, are erratic, and potentially pathogenic bacteria have been found on the diaphragms of stethoscopes of physicians and nurses.<sup>10-12</sup> Although the role of stethoscopes in the transmission of pathogens has been examined,<sup>6,8,13</sup> few studies have discussed the role of stethoscopes in the transmission of MRSA.<sup>14</sup>

Common findings are reiterated throughout the literature. Colonization of stethoscopes by potential pathogens has been reported, and isopropyl alcohol has been shown to be an effective disinfectant for stethoscope diaphragms.<sup>15</sup> Cleaning of clinicians' stethoscopes is described as infrequent in self-reports despite recommendations that health care workers clean their stethoscopes frequently.<sup>14,16</sup>

### **Purpose**

The purpose of the study was to compare MRSA colonization on the diaphragm of stethoscopes before and after cleaning with isopropyl alcohol at a large teaching hospital. Objectives included the following: to determine the presence of MRSA on the diaphragm of clinicians' stethoscopes and to determine if the disinfectant isopropyl alcohol is useful in decreasing the number of colonies of MRSA on the diaphragm of stethoscopes.

### **Design**

The methodology was a pretest/posttest design, with each stethoscope serving as its own control. This design was chosen to demonstrate the effectiveness of cleaning on the bacterial counts of each stethoscope.

### **Sample**

The accessible population of clinicians' stethoscopes included the stethoscopes of nurses, physi-

cians, respiratory specialists, and nonpersonal unit stethoscopes. All available stethoscopes were included, which totaled 141 stethoscopes (282 total cultures with pre- and posttest). The clinicians were not informed beforehand that the researcher would be assessing stethoscopes. The researcher entered the floor unannounced and then began collecting stethoscopes individually. Seventeen units, including ICUs and medical-surgical units, were included. On average, eight stethoscopes were assessed per unit. Excluded were stethoscopes dedicated to patients with contact precautions and those that were not submitted to be studied.

### **Protection of Human Subjects**

Approval was obtained from the university as well as the medical center institutional review boards. Clinicians were assured anonymity, and consent was implied by submission of his or her stethoscopes to be studied. An information sheet detailing the procedure was available, and an opportunity to decline participation was given. The samples taken from the stethoscopes were labeled with a numbered code, and the names of clinicians were not identified in any way. Only the role of the clinician was recorded, such as nurse or physician. Participation posed no risk to the clinicians or patients. On average, the procedure required the individual to be without a stethoscope for 5 to 10 minutes.

### **Instruments**

The instruments used included sterile isopropyl alcohol 70% pads, sterile culture transport system with media, and CHROMagar (BBL CHROMagar; Becton, Dickinson, and Company, Franklin Lakes, NJ), a selective medium for MRSA. The validity of this medium as a rapid and sensitive selective surveillance medium for MRSA is established.<sup>17</sup> CHROMagar has been reported as superior to the medium TSA II for recovery and identification and comparable to all other methods of sampling, with the added benefit of being rapid and inexpensive.<sup>17</sup> Based on the supported findings in this study and in other literature, CHROMagar was chosen as the medium for the study.

### **Methods**

The present study was limited to a convenience sample of stethoscopes in adult medical-surgical

units and ICUs in a single level 1 trauma center hospital in the Southeastern United States. The data collection was limited to 2 weekdays within the same week. Each unit was only visited once during the 2 days.

Bias was limited by entering the units unannounced and gathering stethoscopes (with permission) for culturing without allowing physicians, nurses, or other personnel time for cleaning. Furthermore, the same procedure was used for each of the stethoscopes studied. A large sample was available ( $N = 141$ ), which minimizes some of the limitations found in studies with a small sample size. A post hoc power analysis revealed a power of 0.99 for the sample size. During data collection, bias was formed that certain brands of stethoscopes may harbor more bacteria than others. This was minimized by maintaining the same procedure for each stethoscope, despite differences in brands.

The diaphragm of each stethoscope was swabbed with a prepackaged sterile swab. The sterile swab was placed in the sterile transport medium that accompanied the package. The diaphragm was then cleaned with a sterile alcohol prep pad (70% isopropyl alcohol) with a circular motion. The diaphragm was allowed to dry and then swabbed again with a second sterile swab. This was repeated 141 times over the course of 2 days. Each day, cultures were taken to a local university microbiology lab, where the medium was kept. Each section was labeled and streaked with a single corresponding culture. The transported cultures were plated directly onto the medium by streaking the swab onto the medium. The cultures were incubated and assessed for growth at 24, 48, and 72 hours as recommended by the manufacturer of the medium.<sup>18</sup>

Control measures to promote unbiased results included swabbing only the diaphragm of the stethoscope without removing the ring, excluding stethoscopes dedicated to patients with the diagnosis of MRSA, and using only medical-surgical units and ICUs. In addition, limiting the study to only MRSA, using prepackaged alcohol prep pads, and gathering stethoscopes on floors with only adult patients are further controls. One plate of BBL CHROMagar was divided into quarters and then inoculated with MRSA, methicillin-

susceptible *S aureus*, *Streptococcus*, and *Staphylococcus epidermidis* (a common organism found on skin) as a comparison plate (Appendix 1).

The children's hospital and emergency department associated with the hospital were not included because data support that most cases of hospital-acquired MRSA occur in individuals aged 65 years and older.<sup>9</sup> Obstetrics and gynecology (OB/GYN), surgery, physicians' offices, and adult emergency were also excluded. Nonhospitalized patients or well OB/GYN patients have fewer risk factors than patients in the hospital and have correspondingly lower infection rates.<sup>19</sup> The researcher did not expand the study to other hospitals because of the limited amount of resources and time available. Instead, a large hospital with multiple ICUs and medical-surgical units was chosen. Because of the limitations, this study may only be generalizable to the adult patient population of ICUs and medical-surgical units in a large teaching hospital in the Southeastern United States. A number of units that were excluded may have unique environments that could make them prone to MRSA infection (such as community-acquired MRSA in the emergency department).

## Results

The sample set consisted of a total of 141 stethoscopes ( $N = 141$ ). This included stethoscopes from 12 (8.5%) physicians, 88 (62%) nurses, six (4.25%) respiratory therapists, and 35 (25%) unit stethoscopes; 48% of stethoscopes were from ICUs, and 52% were from medical-surgical units. The total number of cultures was 282 (one pre-cleaning sample and one postcleaning sample from each stethoscope). The stethoscopes of physician and respiratory therapists may travel from unit to unit with the clinician, whereas the stethoscopes of nurses and the units remain in that area.

After 72 hours of observation, no MRSA growth was noted in any of the 282 cultures. Unidentified bacterial growth was noted after 24 hours of observation on two plates (1.4%) (Appendix 2). At 72 hours of observation, unidentified growth was noted on four plates (2.8%). This is notable because this selective medium is intended to inhibit the growth of many organisms. Three of the six cultures that grew bacterial colonies were from

**Table 1. Comparison of Bacterial Colonies by Role**

Role	N	Precleaning Samples that Developed Colonies	Postcleaning Samples that Developed Colonies
Nurse	88	2	0
Unit	35	3	0
Physician	12	1	0
Respiratory therapy	6	0	0

unit stethoscopes, two were from the stethoscopes of nurses, and the final growth was taken from the stethoscope of a physician. Proportionally more unit stethoscopes and physician stethoscopes showed bacterial colonization (8.5% of unit stethoscopes and 8.3% of physicians' stethoscopes vs 2.2% of nurses' stethoscopes) (Table 1).

Although no MRSA was identified on the samples, there was a significant difference between the bacterial colony counts of precleaned cultures and postcleaned cultures ( $t = 2.494$ ;  $df = 140$ ;  $P = .014$ ). The number of stethoscopes with bacterial colonies is too small to compare with any statistical significance (Table 2).

## Discussion

The purpose of this study was to assess the current level of MRSA colonization on the diaphragm of stethoscopes found at a large teaching hospital and compare bacterial growth before and after disinfection with isopropyl alcohol. No MRSA was recovered from any of the stethoscope diaphragms studied. This was surprising because this finding is contrary to previous studies.<sup>14,16</sup> The implications of this study are that current guidelines set by the CDC may be effective in preventing MRSA colonization on the diaphragms of stethoscopes in this setting. The CDC<sup>5</sup> recommends that stethoscopes be cleaned regularly and when visibly dirty. Cleaning the stethoscope before and after every use, as with hands, is a simple method to prevent

bacterial colonization on the diaphragm of stethoscopes. Although the present study may suggest that this frequency of cleaning is unnecessary in preventing MRSA colonization, it is possible for pathogenic bacteria to grow on the stethoscope. No particular frequency of cleaning has been determined sufficient, so more frequent cleaning may be safer. This study implies that in most acute care settings, current cleaning treatments are effective in preventing MRSA growth. It does not, however, include specific units related to perianesthesia care, such as postanesthesia units. Further study in this area is needed.

Recommendations for future studies include repeating this study in other hospitals, including those in different regions, other university hospitals, and smaller community hospitals. Replication in these areas could give a better picture of the prevalence of MRSA contamination on stethoscopes. In addition, a replication of this study in units such as postanesthesia care units with high patient turnover rates could yield different results. More information should also be gathered qualitatively on attitudes about cleaning stethoscopes and current cleaning practices of the health care staff. This would shed light on beliefs that are affecting the frequency with which individuals clean their stethoscopes. Additionally, studying which types or brands of stethoscopes are more susceptible for harboring bacteria could be useful. A possible difference may exist between stethoscopes with a plastic

**Table 2. Comparison of Bacterial Colonies by Location**

Location	N	Precleaning Samples that Developed Colonies	Postcleaning Samples that Developed Colonies
Medical-surgical unit	73	3	0
ICU	68	3	0

ICU, intensive care unit.

diaphragm versus stethoscopes with a metal diaphragm. This may make one type more prone to bacterial carriage. The effect of regular multiple cleansing with isopropyl alcohol on the integrity of the diaphragm and its rubber ring warrants additional investigation.

## Conclusion

Further studies are needed to assess the link between MRSA colonization on stethoscopes and the effect on patient infection development. This

study suggests that MRSA contamination is not likely on stethoscopes in this setting. However, unidentified bacterial growth on an inhibitory medium could suggest that other pathogenic bacteria may be found on the stethoscopes of nurses and other clinicians. Further investigation of bacterial growth on the stethoscopes is needed if the pathogenicity of the bacteria is to be determined. The most significant challenge to further study may be studying the linkage between bacterial contamination of stethoscopes and patient outcomes. Maintaining a clean stethoscope is recommended as per current standard precautions.

## References

- Centers for Disease Control and Prevention. Overview of healthcare-associated MRSA. 2010. Available at: [http://www.cdc.gov/ncidod/dhqp/ar\\_mrsa.html](http://www.cdc.gov/ncidod/dhqp/ar_mrsa.html). Accessed April 15, 2010.
- Scott RD II. The direct medical costs of healthcare-associated infections in U.S. hospitals and the benefits of prevention. 2009. Available at: [http://www.cdc.gov/ncidod/dhqp/pdf/Scott\\_CostPaper.pdf](http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf). Accessed June 15, 2010.
- Deficit Reduction Act of 2005. Pub L.No. 109-71, § 5001(c), 120 Stat 4 (2006).
- Harbarth S, Sax H, Gastmeier P. The preventable proportion of nosocomial infections: An overview of published reports. *J Hosp Infect.* 2003;54:258-266.
- Centers for Disease Control and Prevention, National Center for Preparedness, Detection, and Control of Infectious Diseases, Division of Healthcare Quality Promotion. Guideline for Disinfection and Sterilization in Healthcare Facilities. 2008. Available at: [http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection\\_Nov\\_2008.pdf](http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf). Accessed May 31, 2010.
- Gerken A, Cavanagh S, Winner HI. Infection hazard from stethoscopes in hospital. *Lancet.* 1972;1:1212-1215.
- Kramer A, Schwebke I, Kampf G. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect Dis.* 2006;6:130.
- Marinella M, Pierson C, Chenoweth C. The stethoscope: A potential source of nosocomial infection? *Arch Intern Med.* 1997;157:786-790.
- Klevens R, Morrison M, Nadle J, et al. Invasive methicillin-resistant *Staphylococcus aureus* infections in the United States. *JAMA.* 2007;298:1763-1771.
- Whittington AM, Whitlow G, Hewson D, Thomas C, Brett SJ. Bacterial contamination of stethoscopes on the intensive care unit. *Anaesthesia.* 2009;64:620-624.
- Wilkins R, Restrepo R. Contamination level of stethoscopes used by physicians and physician assistants. *J Physician Assist Educ.* 2007;18:41-43.
- Wood M, Lund R, Stevenson K. Bacterial contamination of stethoscopes with antimicrobial diaphragm covers. *Am J Infect Control.* 2007;35:263-266.
- Guinto C, Bottone E, Raffalli J, Montecalvo M, Wormser G. Evaluation of dedicated stethoscopes as a potential source of nosocomial pathogens. *Am J Infect Control.* 2002;30:499-502.
- Merlin M, Wong M, Pryor P, et al. Prevalence of methicillin-resistant *Staphylococcus aureus* on the stethoscopes of emergency medical services providers. *Prehosp Emerg Care.* 2009;13:71-75.
- Lecar P, Cropp E, McCord G, Haller N. Ethanol-based cleanser versus isopropyl alcohol to decontaminate stethoscopes. *Am J Infect Control.* 2009;37:241-243.
- Schroeder A, Schroeder M, D'Amico F. What's growing on your stethoscope? *J Fam Pract.* 2009;58:404-409.
- Flayhart D, Hindler J, Bruckner D, et al. Multicenter evaluation of BBL CHROMagar MRSA medium for direct detection of methicillin-resistant *Staphylococcus aureus* from surveillance of cultures of the anterior nares. *J Clin Microbiol.* 2005;43:5536-5540. doi:10.1128/JCM.43.11.5536-5540.2005.
- BD Diagnostics. BBL CHROMagar MRSA: Quality control procedures. 2008. Available at: <http://www.bd.com/ds/technicalCenter/inserts/8012632%2805%29%281008%29.pdf>. Accessed March 2, 2010.
- Siegel J, Rhinehart E, Jackson M, Chiarello L, Healthcare Infection Control Practices Advisory Committee. Management of multi-drug resistant organisms in healthcare settings, 2006. Centers for Disease Control and Prevention. 2006. Available at: <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. Accessed May 31, 2010.

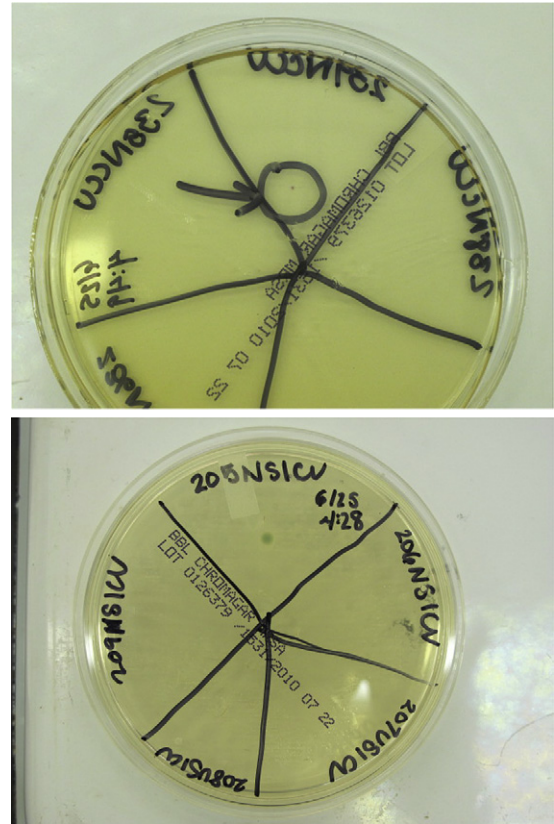


**Appendix 1**



Control plate. This is available in color online at [www.jopan.org](http://www.jopan.org).

**Appendix 2**



Examples of bacterial growth noted. This is available in color online at [www.jopan.org](http://www.jopan.org).