

# Examination of staphylococcal stethoscope contamination in the emergency department (pilot) study (EXSSCITED pilot study)

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## ABSTRACT

**Introduction:** The objective of this study was to determine the prevalence of *Staphylococcus*-contaminated stethoscopes belonging to emergency department (ED) staff and to identify the proportion of these that were *Staphylococcus aureus* or methicillin-resistant *Staphylococcus aureus* (MRSA).

**Methods:** We conducted a prospective observational cohort study of bacterial cultures from 100 ED staff members' stethoscopes at three EDs. Study participants were asked to complete a questionnaire.

**Results:** Fifty-four specimens grew coagulase-negative staphylococci and one grew methicillin-susceptible *S. aureus*. No MRSA was cultured. Only 8% of participants, all of whom were nurses, reported cleaning their stethoscope before or after each patient assessment. Alcohol-based wipes were most commonly used to clean stethoscopes. A lack of time, being too busy, and forgetfulness were the most frequently reported reasons for not cleaning the stethoscope in the ED.

**Conclusions:** This study indicates that although stethoscope contamination rates in these EDs are high, the prevalence of *S. aureus* or MRSA on stethoscopes is low.

## RÉSUMÉ

**Introduction:** L'objectif de cette étude était de déterminer la prévalence des stéthoscopes contaminés par des *staphylocoques* parmi les stéthoscopes utilisés par le personnel du service des urgences (SU) et d'établir quelle proportion de ceux-ci sont contaminés par des *Staphylococcus aureus* ou des *Staphylococcus aureus* résistants à la méthicilline (SARM).

**Méthodes:** Nous avons mené une étude de cohorte prospective des cultures bactériennes provenant de 100 stéthoscopes appartenant aux membres du personnel du «SU» dans trois services des urgences. Les participants à l'étude ont été invités à remplir un questionnaire.

**Résultats:** Cinquante-quatre échantillons ont produit des staphylocoques à coagulase négative; un échantillon a produit des *S. aureus* sensibles à la méthicilline. Aucun SARM ne s'est développé. Seulement 8% des participants, lesquels étaient tous membres du personnel infirmier, ont rapporté qu'ils nettoyaient le stéthoscope qu'ils utilisaient pour les évaluations de patients avant ou après chaque usage. Des lingettes imprégnées d'alcool sont le moyen le plus souvent utilisé pour nettoyer les stéthoscopes. Le manque de temps, le fait d'être trop occupé et l'oubli sont les raisons qui ont été les plus fréquemment invoquées pour justifier le fait que les stéthoscopes utilisés par le service des urgences n'ont pas été nettoyés.

**Conclusions:** Bien que les taux de contamination des stéthoscopes utilisés par ces services des urgences soient élevés, cette étude indique une faible prévalence des *S. aureus* ou des SARM sur les stéthoscopes.

**Keywords:** contamination, emergency department, infection control, *Staphylococcus aureus*, stethoscope

Stethoscopes are commonly and frequently used in the assessment of patients in the emergency department (ED). In this heterogeneous and high patient volume environment, stethoscopes often come into direct contact with patients with nonintact and/or infected skin. As nondisposable instruments, stethoscopes can serve as potential fomites in the ED unless regularly disinfected.

Studies have linked the contamination of medical equipment, such as sphygmomanometer cuffs<sup>1</sup> and electronic thermometers,<sup>2</sup> to clinically significant nosocomial infections. The prevalence of nosocomial infections varies widely internationally.<sup>3</sup> The Canadian

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Nosocomial Infection Surveillance Program (CNISP) reported infection rates of hospital-acquired methicillin-resistant *Staphylococcus aureus* (MRSA) that dramatically increased during a 12-year period, from 1995 to 2006.<sup>4</sup> Studies from Israel,<sup>5</sup> Spain,<sup>6</sup> and the United States<sup>7,8</sup> reported *S. aureus* contamination rates of 5 to 17% of ED health care providers' stethoscopes. In two of these studies, the proportion of MRSA ranged from 16 to 25%.<sup>5,7</sup> To date, there are no published studies of stethoscope or other instrument contamination in Canadian EDs.

The primary objective of this study was to determine the prevalence of *Staphylococcus*-contaminated stethoscopes in three Canadian EDs and to identify the proportion of stethoscopes contaminated with *S. aureus* and MRSA. Secondary objectives consisted of identifying stethoscope cleaning habits practiced by ED health care providers and barriers to stethoscope cleaning. This study compared culture results between demographic groups.

## **METHODS**

This prospective observational cohort study was conducted at three tertiary care EDs, with a combined annual census of 110,000 visits, in Hamilton, Ontario. These hospitals include a regional trauma and burn centre, a pediatric hospital, and a regional cancer centre. This study was reviewed and approved by the institution's research ethics board.

Study participants were a convenience sample of ED physicians and nurses at each of the three sites who had their personal stethoscope on hand and were on duty during the times the researchers (P.H.P.T. and A.W.) were collecting specimens. Researchers, not on clinical duty at these times, recruited individuals by asking them to participate in the study at the time of specimen collection. Therefore, ED staff did not receive any advance notice on which days study recruitment would take place. All data were collected from July 13 to August 26, 2009. Research staff obtained informed written consent from each subject. ED health care providers who had already participated in the study were excluded from repeat enrolment so that each person submitted a stethoscope only once.

Researchers collected data on participant demographics, stethoscope cleaning practices, and perceived barriers to cleaning through a written questionnaire completed by participants. Immediately after obtaining informed consent, investigators collected specimens

using a standardized protocol. Although ED staff may have cleaned their stethoscope prior to recruitment, once enrolled, they were not permitted to do so until the specimen had been obtained. Sterile swabs moistened with sterile normal saline were swabbed over the entire surface of the stethoscope diaphragm and bell for 5 to 10 seconds and then stored in sterile Amies transport medium. Specimens were labeled with a unique identifier that specified only the date and hospital site of collection and were transported to the microbiology laboratory. Both microbiologists (J.A.S. and C.L.M.) were blinded to the origin of the specimens.

Swabs were inoculated onto blood agar plates and incubated aerobically in 5% CO<sub>2</sub> at 37°C (98.6°F) for 48 hours. Plates were examined at 24 and 48 hours for growth.<sup>5</sup> Gram stain was performed on all colonies. Gram-positive cocci were further investigated with catalase, tube coagulase, and *S. aureus* latex agglutination tests. Isolates positive on all three tests were classified as *S. aureus*. Isolates that were catalase positive and tube coagulase negative were classified as coagulase-negative staphylococci (CoNS). *S. aureus* isolates were transferred to MRSA-selective chromogenic medium and incubated for 24 hours, with suggestive colonies then confirmed as MRSA using polymerase chain reaction for the *mecA* gene. Given that specimens required 48 hours to be processed completely and laboratory services were not available for this study during weekends or after hours, research staff obtained specimens from Monday to Wednesday throughout the morning and early afternoon.

All data were entered into a study-specific Microsoft Access database. Basic statistical methods were used to report contamination rates and questionnaire results. Multiple comparisons of proportions were analyzed using the chi-square test, and results were reported as probability values using 0.05 as the level of statistical significance. Point estimates for the primary outcome are reported with 95% confidence intervals (95% CIs), calculated using the exact method.

## **RESULTS**

One hundred ED staff were invited and consented to participate, completed the questionnaire, and had their stethoscope swabbed for bacterial culture growth and analysis (approximately 50 physicians and 200 nurses work at the three sites, for a total of 250 potentially

eligible ED staff). On average, 10 participants were recruited per shift at a given hospital site. No ED staff declined to take part in the study. Participant demographic data are presented in Table 1. Data on participant cleaning practices and perceived barriers to cleaning one's stethoscope are presented in Table 2.

Participants were almost equally distributed across the three sites, and the majority (61%) had less than 5 years of experience in the ED. Seven percent of staff were aware that they had assessed patients identified as being colonized or infected with MRSA during their shift.

Overall, bacterial growth was observed in specimens from 70 stethoscopes after 48 hours of incubation; 30 had no growth (Table 3). Coagulase-negative staphylococci were cultured from 54 specimens. One specimen or 1% (95% CI 0–5.5%) was positive for *S. aureus*, but this was not MRSA. Thirty specimens grew other bacteria, including gram-negative cocci and bacilli.

There was no statistically significant difference between the three sites in terms of bacterial growth. Seventy-eight percent of physicians' stethoscopes and 65% of nurses' stethoscopes had bacterial growth after 48 hours of incubation. There was no statistically significant difference between these two provider groups (Table 4).

All questionnaire respondents reported that stethoscopes should be cleaned daily. Most participants (80%) reported cleaning their stethoscope within the last week and a smaller proportion (59%) at least once a shift. Only 8% of all ED staff, all of whom were

nurses, reported cleaning their stethoscope before or after each patient encounter. Ethyl alcohol-based wipes ( $n = 49$ ), hand sanitizer ( $n = 35$ ), and propyl alcohol-based wipes ( $n = 21$ ) were the most commonly used

	<i>n</i>
ED site	
1	40
2	29
3	31
ED role	
Physicians	37
Nurses	63
Years of experience in the ED	
< 2	34
2–5	27
5–10	15
> 10	22
Unspecified	2
Assessed MRSA patients during shift	7

ED = emergency department; MRSA = methicillin-resistant *Staphylococcus aureus*.

	<i>n</i>
Last cleaned	
Today	23
Yesterday	15
Last week	36
Last month	18
Cannot recall	8
Cleaning frequency	
Before/after every patient	8
Several times a shift	35
At start or end of shift	16
Every week	21
Every month	10
Never	0
Other*	10
Cleaner used <sup>†</sup>	
Ethyl alcohol wipe	49
Propyl alcohol wipe	21
Hand sanitizer	35
Virox wipes	11
Soap and water	1
Other <sup>‡</sup>	5
Unspecified	1
Frequency that stethoscope should be cleaned	
Daily	98
Weekly	0
Less than monthly	0
Monthly	0
Unspecified	2
Barriers to cleaning stethoscopes <sup>‡</sup>	
Lack of time or too busy	57
Forgetfulness	34
Lack of access to supplies	18
Laziness	5
Lack of knowledge regarding best cleaner	3
Concern for damaging one's stethoscope	3
Stethoscope shape/design	2
Sharing of stethoscopes	1
No barriers identified	3
Unspecified	12

\*3 unspecified, 1 intermittently, 4 after seeing an isolated patient, 1 whenever remembered, 1 every 2 months.  
<sup>†</sup>Total exceeds 100 as participants were permitted to specify more than one answer to the question.  
<sup>‡</sup>Including bleach, hydrogen peroxide, and PerCept wipes.

**Table 3. Culture results after 48 hours**

	<i>n</i>
Specimens with growth	70
Colonies*	
CoNS	54
<i>Staphylococcus aureus</i>	1
MRSA	0
Other bacteria	30
Gram-positive cocci	3
Gram-positive bacilli	12
Gram-negative cocci	3
Gram-negative bacilli	12
Specimens with no growth	30

CoNS = coagulase-negative staphylococci; MRSA = methicillin-resistant *Staphylococcus aureus*.  
\*Total exceeds 100 as more than one colony type may have grown on a single stethoscope.

cleaning methods. The most commonly reported barriers to cleaning stethoscopes in the ED were a lack of time or being too busy ( $n = 57$ ), forgetfulness ( $n = 34$ ), and a lack of access to cleaning supplies ( $n = 18$ ).

No physicians and 12.7% of nurses reported cleaning their stethoscope before or after each patient encounter. The most common barrier to cleaning one's stethoscope cited by physicians was forgetfulness, whereas for nurses, it was not having enough time or being too busy to do so.

The frequency of bacterial growth was inversely related to the frequency of stethoscope cleaning. For those who cleaned their stethoscope before or after each patient encounter, several times a shift, and at the start or end of a shift, bacterial growth at 48 hours was found in 50%, 65.7%, and 71.4% of samples, respectively. For participants who cleaned their stethoscope every week or less frequently, this proportion was 80%.

Of the specimens obtained from the seven participants who specified that they had assessed a patient colonized or infected with MRSA during their shift, two grew CoNS and four were contaminated with other bacteria. One had no growth. There was no trend in terms of when their stethoscope was last cleaned or the frequency of cleaning.

## DISCUSSION

This is the first Canadian study examining stethoscope contamination in the ED. The results of this study demonstrate that the majority of stethoscopes used by physicians and nurses in the three study EDs are contaminated with bacteria, most of which are common skin flora (CoNS). However, the overall contamination of 70% is lower than the 80 to 90% reported in other ED studies.<sup>5,7,8</sup> Three possible explanations for this are as follows. First, participants in our study reported cleaning their stethoscope more frequently than has been reported in other studies. Specifically, we found that 80% of participants cleaned their stethoscope at least on a weekly basis, whereas in the studies by Nunez and colleagues and Jones and colleagues, this was only 20% and 48%, respectively.<sup>6,8</sup> Second, our study was conducted at a time of increased awareness regarding infection control. In the spring of 2009, there was an outbreak of *Clostridium difficile* at a local hospital, resulting in several deaths. There was also much concern for an emerging H1N1 flu pandemic. These events received significant media attention and may have led to more frequent stethoscope cleaning during the study. Finally, given the nature of our study hospitals, with larger numbers of relatively immunocompromised patients (e.g., burn, pediatric, and cancer

**Table 4. Culture results by study site and ED participant role\***

	No. of specimens with growth/no. of specimens (%)	<i>p</i> -value
Study site		
1	32/40 (80.0)	
2	19/29 (65.5)	
3	19/31 (61.3)	0.184
ED role		
Physicians	29/37 (78.4)	
Nurses	41/63 (65.1)	0.361

ED = emergency department.  
\*Comparison of results between study sites and between ED roles were not statistically significant.

patients), at baseline, local staff might be more inclined to disinfect their equipment on a regular basis.

This study found that 1% of ED stethoscopes were contaminated with *S. aureus*, but none of the cases were MRSA. Furthermore, given the calculated 95% CI presented above for this outcome, it would be unlikely that the overall stethoscope contamination rate with MRSA would exceed 5.5% in our study population. These results are in contrast to those of other ED studies with rates of 5 to 17% for *S. aureus*<sup>5-8</sup> and 16 to 25% of isolates being MRSA.<sup>5,7</sup> In Canada, overall, only 2% of all *S. aureus* isolates were methicillin resistant.<sup>9</sup> This value is significantly lower than those in the United States (78%)<sup>10</sup> and Israel (33%).<sup>11</sup> On registering at any of the EDs in this study, online patient records are screened, and if positive for previous MRSA infection or colonization, these patients are isolated in a room with a sign identifying the need for contact precautions. A cart with appropriate personal protective equipment and disinfecting products is placed in front of the patient's room door. The lower prevalence of MRSA in Canada and the rigorous screening and isolation strategies used in our EDs may explain the results of this study when compared to those previously cited.

Gram-negative bacteria were isolated but not identified in this study. Previous studies that isolated gram-negative organisms found some of them to be pathogenic, including *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella* spp, and *Acinetobacter* spp.<sup>5-7,12,13</sup>

In comparing physicians to nurses, higher rates of contamination were demonstrated in the stethoscopes belonging to physicians. The studies by Smith and colleagues and Jones and colleagues also found increased bacterial contamination in their physician groups.<sup>7,8</sup> This result might be due to differing cleaning practices, education in infection control, and/or number of patients seen during their ED shift.

Among stethoscope cleaning products, alcohol-based wipes were most commonly used in our study. Several studies have demonstrated that such wipes are extremely effective at disinfecting stethoscopes after use, reducing the number of colony-forming units (CFUs) per stethoscope by 94 to 100%.<sup>6,8,14,15</sup>

A study conducted in hospital geriatric wards demonstrated that simple strategies, consisting of a poster campaign, announcements at departmental meetings, and making alcohol wipes more readily available, dramatically reduced stethoscope bacterial

contamination by 41% and MRSA contamination by 100% at 3 months.<sup>16</sup> The effectiveness of such interventions has not been assessed in EDs.

### **LIMITATIONS**

This pilot study identified one *S. aureus* isolate that was not methicillin resistant. These results are likely influenced by the fact that the study was conducted at a time of increased awareness for infection control, which may have led ED health care providers to clean their stethoscopes more frequently, thereby reducing the typical, overall contamination rates and rates of *S. aureus* and MRSA. Also, our study protocol was designed specifically to identify only CoNS, methicillin-susceptible *S. aureus*, and MRSA. Seeing that the other organisms isolated from the stethoscopes may be pathogenic, full identification would be important in future studies.

### **CONCLUSION**

The majority of stethoscopes used in three Canadian tertiary care EDs are contaminated with bacteria, mostly with skin flora such as CoNS. The prevalence of *S. aureus*-contaminated stethoscopes is 1%; no MRSA was isolated. The majority of ED health care providers reported cleaning their stethoscope at least on a weekly basis; most used alcohol-based wipes. Perceived barriers to cleaning stethoscopes in the ED include a lack of time or being too busy and forgetfulness.

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**Competing interests:** None declared.

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