Predictors of stethoscope disinfection among pediatric health care providers

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Pediatrics
Health personnel

\textbf{Background:} Stethoscopes are contaminated with bacteria, but predictors of stethoscope disinfection frequency are unknown. We sought to describe health care provider stethoscope disinfection attitudes and practices and determine predictors of frequent disinfection.

\textbf{Methods:} We used an anonymous online survey of nurses, nurse practitioners, and physicians at a pediatric hospital. We assessed frequency and methods of disinfection, perceptions of contamination, and barriers to disinfection. Multivariate logistic regression models were used to identify independent predictors of disinfecting after every use.

\textbf{Results:} One thousand four hundred one respondents completed the survey: 76% believed that infection transmission occurs via stethoscopes, but only 24% reported disinfecting after every use. In multivariate analyses, belief that infection transmission occurs via stethoscopes significantly increased the odds of disinfection after every use (odds ratio [OR], 2.06 [95% confidence interval (CI): 1.38-3.06]). The odds of disinfection after every use were significantly decreased in those who perceived the following barriers: lack of time (OR, 0.31 [95% CI: 0.18-0.54]), lack of access to disinfection material (OR, 0.41 [95% CI: 0.29-0.57]), or lack of visual reminders to disinfect (OR, 0.22 [95% CI: 0.14-0.34]).

\textbf{Conclusion:} Only a minority of pediatric health care providers reported disinfecting their stethoscopes after every use. Increasing access to disinfection materials and visual reminders in health care facilities may improve stethoscope disinfection practices.

Stethoscopes have been purported to serve as potential vectors for pathogenic bacteria.\textsuperscript{1-5} Several studies have demonstrated that stethoscope membranes harbor bacteria, including methicillin-resistant \textit{Staphylococcus aureus} (MRSA)\textsuperscript{6-9} and vancomycin-resistant enterococci.\textsuperscript{10-12} These organisms have also been recovered from the earpieces of stethoscopes.\textsuperscript{13} \textit{S. aureus} colonies can survive on stethoscope membranes for longer than 18 hours.\textsuperscript{14} Without proper disinfection, stethoscopes represent a potential means of transmission of these organisms from one patient to another.

Routine disinfection of stethoscopes may reduce the potential for transmission by reducing the burden of contamination. Bacterial counts on stethoscopes can be reduced substantially by a variety of disinfectant products.\textsuperscript{3,8,15} Despite the availability of effective disinfectants, only a minority of health care providers regularly disinfects their stethoscope. In a survey of 150 health care workers in 1995, 48% of respondents reported cleaning their stethoscope daily or weekly.\textsuperscript{3} A 1999 study by Bernard et al found that only 22% of users regularly disinfect their stethoscope.\textsuperscript{14}

Several possible barriers to frequent stethoscope disinfection in health care settings may exist, and these barriers could be excellent targets for educational activities or quality improvement interventions. However, predictors of good disinfection practice are unknown. Our objectives were to characterize stethoscope disinfection practices and perceptions at a large academic pediatric hospital and to identify predictors of frequent stethoscope disinfection.

\textbf{METHODS}

\textbf{Survey design}

To determine pediatric health care providers’ perceptions and practices, we created a 17-item, Web-based survey to assess frequency,
method, and duration of stethoscope disinfection as well as perceptions about stethoscope contamination and optimal disinfection frequency. The survey also evaluated potential barriers to disinfection including lack of time, access to disinfection materials, visual reminders or verbal reminders from colleagues, task difficulty, and concern about wear and tear of stethoscopes. Additional potential predictors or confounders of disinfection frequency including age, gender, years of practice since graduating from professional school, and provider role were recorded.

The item selected a priori to be our primary outcome asked “When seeing patients, how often do you disinfect your stethoscope?”, with 7 response options ranging from “after every use” to “never” (Table 1). The survey was pilot tested using cognitive interviewing techniques for comprehension, clarity, and length by pediatrics residents, fellows, attending physicians, and nurses at Children’s Hospital Boston and Harvard Medical School, and revisions to the instrument were made based on feedback provided.

Participants

An e-mail that contained a link to the anonymous online survey was sent in October 2010 to 3,644 potentially eligible health care providers at Children’s Hospital Boston, of whom 1,923 were nurses and nurse practitioners, and 1,721 were physicians, including both trainees (pediatrics residents, chief residents, and fellows) and attending physicians. The e-mail addresses of study participants were compiled from hospital distribution lists of physicians and nurses. We excluded providers in specialties with anticipated low stethoscope usage, including dentistry, dermatology, laboratory medicine, nuclear medicine, ophthalmology, pathology, psychiatry, and radiology. After the initial e-mail, nonresponders received a total of 3 additional reminder e-mails at 7- to 10-day intervals. The Children’s Hospital Boston Committee on Clinical Investigation granted the study exemption from full review. Of note, Children’s Hospital Boston does not have a specific policy about stethoscope disinfection, although the hospital policy for cleaning, disinfection, and sterilization of patient care equipment states that noncritical items should undergo low-level disinfection prior to patient use.

Statistical analysis

Descriptive analyses of survey responses were compiled for each item. For our primary outcome, we chose to categorize the responses about frequency of disinfection as “after every use” versus all other responses to assess predictors of what we considered to be the most optimal disinfection frequency. We also analyzed the data using a combined outcome of “after every use” or “multiple times per day”. results were similar to our primary analysis and therefore are not presented. Multivariate logistic regression models were created to identify independent predictors of disinfecting after every use. We included the following potential predictors in our main model: provider age, gender, years seeing patients since graduation from professional school, role (nurse or physician), belief that stethoscopes can transmit infection, and the potential barriers to disinfection enumerated above. We also created separate models for nurses and physicians to assess whether specialty independently predicted disinfection practice among physicians. Two-sided P values of <.05 indicated statistical significance. All analyses were performed using Stata Version 10 (StataCorp LP, College Station, TX).

RESULTS

Of the initial 3,644 recipients, 436 (12%; 330 nurses and 106 physicians) were classified as ineligible because they either no longer worked at Children’s Hospital Boston, would not have access to e-mail during the study period, or reported that they did not use a stethoscope or that they only worked in a unit in which all patients have a dedicated stethoscope in the room. Of the remaining 3,208 eligible participants, 1,401 (44%) completed the survey, including 719 (45%) of 1,615 eligible physicians and 682 (43%) of 1,593 eligible nurses. Fifty-three percent of respondents were physicians, of whom 45% practiced in pediatric medical subspecialties, 30% in general pediatrics, 7% in emergency medicine, 5% in surgical fields, 4% in critical care, and 9% in other specialties. The median age of respondents was 37 years (interquartile range, 31-48), and 76% were female. Respondents had been in practice for a median of 11 years (interquartile range, 5-21).

Seventy-six percent of respondents believed that infection transmission occurs via stethoscopes. However, only 24% reported disinfecting their stethoscope after every use. Table 1 displays the discrepancy between reported stethoscope disinfection practices and respondents’ perceptions of optimal disinfection frequency. The predominant method of disinfection was use of either an alcohol wipe/swab (67%) or a wipe/swab impregnated with other disinfectants (18%), such as quaternary ammonium or chlorhexidine. A minority reported using alcohol-based hand sanitizer on their stethoscope (14%). Sixty-eight percent of providers reported spending 10 or fewer seconds per disinfection episode. The proportion of respondents who reported routinely disinfecting different parts of the stethoscope varied (diaphragm, 97.7%; bell, 94.9%; plastic tubing, 83.1%; metal tubing, 58.9%; earpieces, 60.0%).

Respondents were asked about potential barriers to routine stethoscope disinfection. A majority (52%) of providers agreed that they lacked access to devices or materials for disinfection when needed. Other factors, such as time required, difficulty of the task, lack of reminders, or concern about stethoscope wear and tear, were less frequently cited as obstacles to disinfection (Fig 1).

Table 1

<table>
<thead>
<tr>
<th>Frequency of disinfection</th>
<th>Current practice, n (%)</th>
<th>Perceived optimal practice, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After every use</td>
<td>337 (24.4)</td>
<td>1,067 (78.6)</td>
</tr>
<tr>
<td>Multiple times per day but not after every use</td>
<td>447 (32.3)</td>
<td>167 (12.3)</td>
</tr>
<tr>
<td>Once a day</td>
<td>122 (8.8)</td>
<td>51 (3.8)</td>
</tr>
<tr>
<td>Multiple times per week but not every day</td>
<td>121 (8.8)</td>
<td>12 (0.9)</td>
</tr>
<tr>
<td>Once a week or less often</td>
<td>150 (10.9)</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Only after seeing patients on contact precautions</td>
<td>152 (11.0)</td>
<td>55 (4.1)</td>
</tr>
<tr>
<td>Never</td>
<td>53 (3.8)</td>
<td>4 (0.3)</td>
</tr>
</tbody>
</table>

*N indicates the number of respondents who answered this question on the survey. Percentages may not sum to 100 because of rounding.

Fig 1. Reported obstacles to stethoscope disinfection.
reduce the effort required to obtain materials and would serve as alcohol wipes) readily available outside of every patient room could within hospitals. For example, making disinfectants (such as tate greater compliance with stethoscope disinfection practices infecting after every use. To our knowledge, this study is the disinfection, including lack of access to disinfection materials, lack after every use. Several common perceived barriers to frequent contribute to the transmission of infections. Nevertheless, only a minority of providers reported disinfecting their stethoscopes when visibly soiled with a 70% isopropyl alcohol wipe. The 2008 Healthcare Infection Control Practices Advisory Committee Guideline for Disinfection and Sterilization in Health-care Facilities recommends low-level disinfection for noncritical equipment that comes into contact with intact skin; the guideline states that such devices should be disinfected “when visibly soiled and on a regular basis (such as after use on each patient or once daily or once weekly).” A lack of clarity about the optimal frequency of disinfection of stethoscopes may contribute to variation in practice among health care providers.

It is important to note that, despite evidence of contamination of stethoscopes, their relative contribution to transmission of infections between patients remains unclear. There are several published outbreak investigations in which the organism of interest was isolated from stethoscopes (in addition to other environmental sources). In a study using simulated patient examinations, stethoscopes acquired and transferred methicillin-resistant S aureus and Clostridium difficile colonies nearly as often as gloved hands. Despite these reports, the burden of patient infections that can be attributed to transmission via stethoscopes in routine clinical settings is unknown, and data that prove the value of stethoscope disinfection as an important part of infection prevention are lacking. Even in the absence of specific data, given the collective experience with outbreaks and health care-associated infections linked to contaminated equipment, it seems reasonable to expect providers to regularly disinfect stethoscopes.

Our study has several limitations. Because we surveyed providers at a single hospital, the results may not be generalizable.

### DISCUSSION

We found that most health care providers at a large academic children's hospital believe that stethoscope contamination can contribute to the transmission of infections. Nevertheless, only a minority of providers reported disinfecting their stethoscopes after every use. Several common perceived barriers to frequent disinfection, including lack of access to disinfection materials, lack of time, and lack of visual reminders about stethoscope disinfection, were significantly associated with a lower likelihood of disinfecting after every use. To our knowledge, this study is the first to identify specific predictors of stethoscope disinfection frequency among physicians and nurses.

The discrepancy between reported beliefs and practices suggests that there are specific obstacles in the health care setting that prevent providers from adopting optimal stethoscope hygiene practices. Addressing the specific barriers that were significantly associated with less frequent disinfection in our study may facilitate greater compliance with stethoscope disinfection practices within hospitals. For example, making disinfectants (such as alcohol wipes) readily available outside of every patient room could reduce the effort required to obtain materials and would serve as a visual reminder. Lack of time is a barrier that is more difficult to modify for busy physicians and nurses, but educational materials could address the fact that effective stethoscope disinfection can be performed in less than 15 seconds. Among our respondents, belief that stethoscope disinfection occurs via stethoscopes was significantly associated with disinfection after every use. Educational campaigns that review the literature about stethoscope contamination may raise awareness of the potential for infection transmission via stethoscopes.

Among the physicians who responded to our survey, stethoscope disinfection after every use was significantly more common for those who worked in critical care or medical subspecialties as compared with all other fields. Potential explanations might include differences in perceived barriers, education, or availability of disinfectants within particular departments, or differences in knowledge about infection transmission or beliefs about the vulnerability of particular patient populations (such as critically ill children in intensive care settings). Future investigations could explore these drivers of behavior to inform the development of education and training about stethoscope disinfection.

Nearly all of the participants in our study who reported disinfecting their stethoscopes included the diaphragm and bell, whereas other components of the stethoscope were less frequently disinfected. We are not aware of any standard guidelines for stethoscope disinfection. In 2007, the American Academy of Pediatrics Committee on Infectious Diseases published a policy statement entitled “Infection Prevention and Control in Pediatric Ambulatory Settings.” This document states that “a reasonable means of decreasing contamination is to wipe the bell and diaphragm of the stethoscope . . . regularly, and whenever they become soiled, by using an EPA-approved disinfectant wipe labeled to be effective against hepatitis B or a 70% isopropyl alcohol wipe.”

### Table 2

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Bivariate OR (95% CI)</th>
<th>P value</th>
<th>Multivariate adjusted OR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provider characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.02 (1.01-1.03)</td>
<td>&lt;.001</td>
<td>1.01 (0.97-1.04)</td>
<td>.74</td>
</tr>
<tr>
<td>Male sex</td>
<td>0.72 (0.53-0.98)</td>
<td>.038</td>
<td>1.03 (0.68-1.56)</td>
<td>.88</td>
</tr>
<tr>
<td>Number of years seeing patients</td>
<td>1.02 (1.01-1.03)</td>
<td>&lt;.001</td>
<td>1.01 (0.97-1.04)</td>
<td>.69</td>
</tr>
<tr>
<td>Physician</td>
<td>0.55 (0.42-0.71)</td>
<td>&lt;.001</td>
<td>0.80 (0.55-1.15)</td>
<td>.23</td>
</tr>
<tr>
<td><strong>Beliefs</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Belief that stethoscopes can transmit infections</td>
<td>1.97 (1.42-2.75)</td>
<td>&lt;.001</td>
<td>2.06 (1.38-3.06)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Obstacles</strong></td>
<td></td>
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<tr>
<td>Lack of time</td>
<td>0.20 (0.13-0.33)</td>
<td>&lt;.001</td>
<td>0.31 (0.18-0.54)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Lack of access to disinfection materials</td>
<td>0.26 (0.20-0.35)</td>
<td>&lt;.001</td>
<td>0.41 (0.29-0.57)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Difficulty of task</td>
<td>0.51 (0.26-1.02)</td>
<td>&lt;.001</td>
<td>1.36 (0.62-2.97)</td>
<td>.45</td>
</tr>
<tr>
<td>Lack of visual reminders</td>
<td>0.16 (0.11-0.22)</td>
<td>&lt;.001</td>
<td>0.22 (0.15-0.34)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Lack of reminders from colleagues</td>
<td>0.19 (0.10-0.33)</td>
<td>&lt;.001</td>
<td>0.60 (0.30-1.21)</td>
<td>.16</td>
</tr>
<tr>
<td>Concern about stethoscope wear and tear</td>
<td>0.52 (0.37-0.71)</td>
<td>&lt;.001</td>
<td>0.75 (0.51-1.10)</td>
<td>.15</td>
</tr>
</tbody>
</table>
to other settings. In particular, barriers to disinfection in ambulatory settings may differ from those in a hospital. Our response rate was 44%, and we do not know whether those who chose not to answer the survey might have different stethoscope disinfection practices or perceived barriers to disinfection. Because the survey asks about self-reported behaviors, the potential for social desirability bias among respondents is present, although the low rate of reported disinfection suggests that responses do reflect actual behavior. The anonymity of the survey was also expected to contribute to the honesty of responses. We intentionally chose not to incorporate items from the Crowne-Marlowe scale or other measures of social desirability bias to keep the survey length short and hence increase participation. We did not perform any direct observation of practices to externally validate survey responses.

In summary, we found that, among pediatric health care providers at a large academic hospital, most believed that infections can be transmitted by stethoscopes, but only a minority reported disinfecting their stethoscope after every use. Perceived barriers that were significantly associated with lower disinfection frequency included lack of time, lack of access to disinfection materials, and lack of visual reminders about stethoscope disinfection. Simple interventions to directly address these barriers, including provision of alcohol wipes outside of every patient room and creating posters and other visible reminders, may improve stethoscope disinfection practices in health care facilities.

References