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Contamination of Stethoscopes and Physicians' Hands After a Physical Examination

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Abstract

Objectives: To compare the contamination level of physicians' hands and stethoscopes and to explore the risk of cross-transmission of microorganisms through the use of stethoscopes.

Patients and Methods: We conducted a structured prospective study between January 1, 2009, and May 31, 2009, involving 83 inpatients at a Swiss university teaching hospital. After a standardized physical examination, 4 regions of the physician's gloved or ungloved dominant hand and 2 sections of the stethoscopes were pressed onto selective and nonselective media; 489 surfaces were sampled. Total aerobic colony counts (ACCs) and total methicillin-resistant *Staphylococcus aureus* (MRSA) colony-forming unit (CFU) counts were assessed.

Results: Median total ACCs (interquartile range) for fingertips, thenar eminence, hypothenar eminence, hand dorsum, stethoscope diaphragm, and tube were 467, 37, 34, 8, 89, and 18, respectively. The contamination level of the diaphragm was lower than the contamination level of the fingertips ($P<.001$) but higher than the contamination level of the thenar eminence ($P=.004$). The MRSA contamination level of the diaphragm was higher than the MRSA contamination level of the thenar eminence (7 CFUs/25 cm^2 vs 4 CFUs/25 cm^2; $P=.004$). The correlation analysis for both total ACCs and MRSA CFU counts revealed that the contamination level of the diaphragm was associated with the contamination level of the fingertips (Spearman's rank correlation coefficient, $\rho=0.80$; $P<.001$ and $\rho=0.76$; $P<.001$, respectively). Similarly, the contamination level of the stethoscope tube increased with the increase in the contamination level of the fingertips for both total ACCs and MRSA CFU counts ($\rho=0.56$; $P<.001$ and $\rho=.59$; $P<.001$, respectively).

Conclusion: These results suggest that the contamination level of the stethoscope is substantial after a single physical examination and comparable to the contamination of parts of the physician's dominant hand.

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The patient-to-patient transmission of microorganisms is a major threat to hospitalized patients and causes significant morbidity and mortality. The present evidence indicates that health care workers' hands are the main route of cross-transmission.[1,2] Small medical equipment, such as stethoscopes, may also contribute to the dissemination of microorganisms, but the evidence supporting this hypothesis is less robust and their role in microorganism propagation is poorly understood. Similar to any piece of medical equipment, stethoscopes have the theoretical capacity to be vectors of pathogens through a multistep process. First, stethoscopes must acquire microorganisms after contact with a source patient.[3] Second, these organisms must then survive on the object for at least several minutes and be transferred to the skin of a second patient during subsequent use. Numerous factors may affect the risk of transmission at each of these steps,[2,3] and assessing transmissibility is better achieved by studying 1 step at a time.

Many factors must be considered when conducting such studies. For example, as no piece of noncritical equipment used on patient wards is meant to be sterile, most objects in the health care environment will yield microorganisms when sampled. However, the clinical significance of detecting low levels of contamination is uncertain. One way to solve this difficulty and better understand the relative contribution of stethoscopes in the transmission of microorganisms is to place their levels of contamination into perspective with those of a universally recognized vector of dissemination, that is, the physician's own hands. If the number of bacteria recovered from stethoscopes is much lower

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than the number recovered from the examiner's hands, their role in the transmission of pathogens would be deemed more negligible. In contrast, if their contamination level is reported to be comparable with that of the examiner's hands, their capacity to transmit pathogens would be more significant and transmission mitigation measures would be more urgently needed.

We aimed to compare prospectively the contamination level of stethoscopes and physicians' hands after a single, standardized, physical examination by using quantitative cultures and 2 different markers of contamination.

PATIENTS AND METHODS

Setting

We conducted a structured prospective study between January 1, 2009, and May 31, 2009, at the University of Geneva Hospitals (HUG), Geneva, Switzerland. HUG is a 2200-bed primary and tertiary teaching hospital admitting 47,000 patients annually with a long-standing experience in hand hygiene promotion.[2,4] Patients were recruited from internal medicine and orthopedic operating wards by using a convenience-based recruitment strategy. Eligibility criteria included stable medical condition, absence of a life-threatening condition, absence of active skin infection, and age 18 years or more. Eligible patients colonized with methicillin-resistant *Staphylococcus aureus* (MRSA) were identified by reviewing infection control databases and ongoing surveillance activities. Screening for MRSA colonization after patient admission by sampling of the anterior nares and the perineal region with a sterile premoistened swab is a standard operating procedure at HUG in specified acute care wards.[5] The *mecA* gene is detected in samples by using gene multiplex, immunocapture-coupled, quantitative polymerase chain reaction.[5] The present study was approved by the institutional review board of HUG.

TABLE 1. Standardized Physical Examination[a]

1. Hand rubbing with alcohol-based formulation
2. Handshake
3. Palpation of radial artery for pulse measurement
4. Palpation of cervical and supraclavicular lymph nodes
5. Lung auscultation
• Posterior chest (6 locations)
6. Auscultation of heart (4 areas: pulmonic, aortic, tricuspid, and mitral)
7. Examination of abdomen
• Inspection and auscultation (4 quadrants)
• Percussion (evaluation of ascites and liver size)
• Superficial and deep palpation (including rebound tenderness)
• Palpation and auscultation of femoral pulses
8. Lower extremity examination
• Inspection of skin (color, temperature, and edema)
• Palpation of posterior tibial arteries
9. Final handshake

[a]The physical examination was conducted with and without sterile gloves by trained medical practitioners.

Standardized Physical Examination

After patient enrollment, 1 of 3 physicians (Y.L., C.T., or A.S.) was randomly selected to perform a physical examination at the patient bedside. The examination was standardized to ensure reproducibility (Table 1). Physicians were allowed to adapt to unforeseen events (such as unbuttoning the patient's gown or moving the bedside table) as long as the action was commonly encountered in routine clinical practice. An external observer ensured adherence to the standardized physical examination by using a checklist. A sterile stethoscope (Littmann Cardiology II, 3M) was used for each physical examination. Sterilization was conducted by using hydrogen peroxide gas plasma technology to preserve the integrity of the material (STERRAD 100NX Sterilizer, Advanced Sterilization Products).

The present study was divided into 2 phases. Phase 1 aimed to assess the total aerobic colony count (ACC). Sterile gloves (Protegrity Micro SMT PF, Cardinal Health) were worn by the examiner before the physical examination to ensure that the initial count would be zero. Phase 2 of the study focused solely on MRSA transmission, and the examiner conducted the physical examination with bare hands. The physician performed 2 consecutive hand hygiene procedures by using an alcohol-based hand rub formulation (Hopirub, B. Braun Medical AG) before the examination to ensure that hands were MRSA free. Each hand hygiene action strictly followed the World Health Organization–recommended technique and lasted at least 30 seconds.[1,3] To confirm the absence of MRSA, cultures of 4 regions of the examiners' hands were performed after hand hygiene and before the beginning of the physical

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