

What's growing on General Practitioner's stethoscope?

A. Carducci¹, M. Cargnelutti¹, F. Tassinari¹, A. Bizzarro¹, G. Cordio¹,
S. Carletti², L. Maccarini¹, G. Pelissero¹

Key words: Healthcare infections, stethoscope, hygiene, outpatient setting.

Parole chiave: Infezioni correlate all'assistenza, fonendoscopio, igiene, medicina del territorio

Abstract

Background. Non-critical medical devices, as stethoscopes, have long been considered as vectors in microorganisms' transmission. Cleaning standards for non-critical medical equipment are often unclear. This study was designed to assess the attitude of General Practitioners (GPs) towards cleaning their stethoscope and the degree of microbiological contamination of doctor's instrument in outpatient setting.

Study design. Observational, crossover study.

Methods. A structured questionnaire was administered to GPs to test their knowledge about medical instrument's cleanliness recommendations and the surface of the diaphragm of their stethoscopes was analyzed for bacteriological isolates using mass spectrometry technique.

Results. Most of GPs declared they don't know cleaning recommendations for non-critical medical devices and a relevant bacterial growth was identified on the majority of the stethoscopes' membranes. Almost all microbiological isolates resulted typically found in cutaneous flora.

Conclusions. We can't state that the GP's stethoscopes feature a risk of transmission for microbiological pathogens; anyway, because of the level of contamination we observed, cleaning recommendations to disinfect instruments on a regular basis should be better indicated.

Introduction

Healthcare-Associated Infections (HAIs) are a common cause of increased morbidity and mortality among hospitalized patients (1, 2). In order to prevent HAIs it's important to identify reservoirs of microorganisms that cause nosocomial infections (3, 4); the hands of healthcare's workers still represent one of the most important source of person-to-person transmission of pathogens (5, 6).

Assiduous hand-washing practice and barrier protection are two of the most frequent measures used for infection control (7).

Otoscopes, thermometers, sphygmomanometers and stethoscopes are also indicated as possible vehicles of microbiological agents (8-10). According to Spaulding classification these medical devices are considered non-critical medical equipment (11). Contamination of stethoscopes' diaphragm is often caused by the lack of a regular disinfection (before and after examining each patient) (7). Hand-washing practice is ruled by specific guidelines; no specific stethoscope's cleaning protocols are available. The Healthcare Infection Control Practices Advisory Committee (HICPAC) and the Centers for

¹ Department of Public Health, Experimental and Forensic Medicine, University of Pavia, Pavia, Italy

² Department of Microbiology, IRCCS San Raffaele, Milan, Italy

Disease Control and Prevention (CDC) guidance on sterilization and disinfection only suggest that non-critical medical equipment should be disinfected when visibly soiled and on a regular basis (such as after use on each patient or once daily or once weekly) (12).

A review of literature data shows that most of stethoscopes (47-100%) were contaminated and the mean level of contamination was in excess of the French Normalization Standard for cleanliness, which equates to <20 Colony-Forming Units (CFUs) per membrane (13). All these data were collected in hospital settings; the rate of instruments' contamination in healthcare outpatient settings is unclear (14).

The aims of this study were to assess doctors' knowledge about the cleaning standards for non-critical medical instruments (stethoscopes) and to determine the microbiological agents growing on General Practitioners' (GPs) stethoscopes.

Materials and methods

The study was conducted from April 2016 to May 2016 in the private practice of 58 GPs and 9 Pediatricians who had their medical office in the health district area of a northern Italian city of 70,000 inhabitants. A structured questionnaire was administered to all participants to test their knowledge and their habits about cleaning medical instruments. To ensure the anonymity of the survey, the questionnaires were numbered from 1 to 67 and were distributed at random. Microbiological samples were also collected from doctors' stethoscope. As done in other studies, instrument's diaphragms of all participants were gently pressed onto Columbia Agar with 5% Sheep Blood Plates for 5 seconds (15, 16). Each agar plate was marked with the same number that was reported on the corresponding questionnaire. At the end of the meeting,

doctors also received a brochure about cleaning recommendations for non-critical medical devices. All collected samples were carried to the laboratory within 1 hour and they were incubated aerobically at 37°. After 48 hours, plates were examined for bacterial growth and total bacterial count (TBC) of all CFUs was performed. As reported in previous studies, samples that showed more than 5 CFU/cm² were considered highly colonized. Bacterial colonies were identified by Matrix-Assisted Laser Desorption Ionization Time of Flight Mass Spectrometry (MALDI-TOF MS) (17).

Statistical analysis: All data were collected in a database (Microsoft Excel 2010®) for retrieval and statistical analysis. Descriptive statistical measures were calculated to examine questionnaire results and bacterial count differences. Comparisons were made using Chi-square test. P-value of <0.05 was considered indicative of a statistically significant difference.

Results

Overall, 8 (88%) Pediatricians and 48 (83%) GPs filled out the paper surveys. A total of 7 (78%) Pediatricians' stethoscopes and 46 (79%) GPs' stethoscopes were cultured. All doctors enrolled in the study work in an outpatient setting, so they were merged as a single group.

Questionnaire results

A total of 56 (83.5%) doctors filled out the survey.

The knowledge of participants about guidelines of hand-washing and recommendations of stethoscope cleaning is shown in Table 1. Analysis of the questionnaire revealed that 64.3% of doctors know hand-washing guidelines; instead, only 39% of them know cleaning recommendations for non-critical medical devices.

Table 1 - Doctors' knowledge about hand-washing guidelines vs stethoscope cleaning recommendation

| Survey's questions | Answers (%) |
|---|-------------|
| Do You know Hand-washing guidelines? | |
| Yes | 36 (64.3) |
| No | 20 (35.7) |
| Do You know stethoscope's cleaning recommendations? | |
| Yes | 22 (39) |
| No | 34 (61) |

Table 2 - Products used to clean stethoscope

| Products used | N° of doctors (%) |
|--------------------------------------|-------------------|
| No answer | 14 (25) |
| Alcoholic solutions | 12 (21.4) |
| Quaternary ammonium compounds | 8 (14.30) |
| Biguanide (Chlorhexidine) | 7 (12.5) |
| Generic disinfectant (unspecified) | 5 (8.9) |
| Chlorine compounds | 4 (7.1) |
| Peracetic Acid and Hydrogen Peroxide | 4 (7.1) |
| Hand soap | 2 (3.6) |

Figure 1 shows how often doctors reported to clean their stethoscope: 23% of participants stated to have never cleaned their stethoscope, 46% claimed to clean the stethoscope only when it is visibly soiled by blood or human secretions. At the question “do you think cleaning stethoscope could be useful to prevent transmission of bacteria between patients?” only 66% of attendees responded “Yes”.

Doctors were also asked to indicate the product or the active principle they used for cleaning their instruments (Table 2). Twelve (21.4%) participants declared to use alcoholic solutions, the ideal product suggested to reduce the contamination of the stethoscope's membrane, instead, 2 (3.6%) reported to use only hand soap for cleaning their instruments (18).

Microbiological results

TBC of all samples ranged from 0 to >100 CFU per agar plate.

Of the 53 stethoscopes membranes surveyed, 36 (68%) showed a mean CFUs value higher than 5/cm²: these samples were considered “contaminated” (Figure 2).

Complete bacterial identification results are reported in Table 3. The majority of identified microorganisms belonged to natural skin microbiota (19). Coagulase-Negative Staphylococci (CoNS) were the predominant isolates (growth on the 88.7% of agar plates), *Micrococcus* spp./*Kocuria* spp. were identified on 66% of the stethoscopes sampled, and *Bacillus* spp. on 9.4% of them. 1 stethoscope resulted colonized

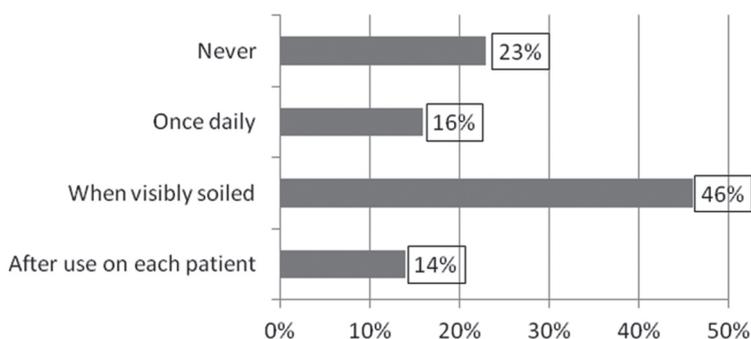


Figure 1 Frequency of stethoscope cleaning

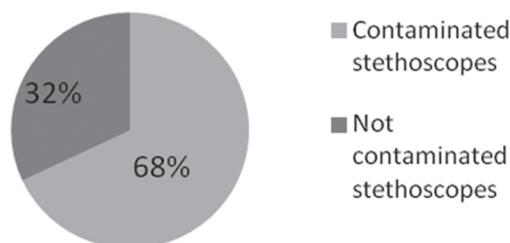


Figure 2 - Contamination rates of stethoscope's membranes

by *Staphylococcus aureus*. *Enterococcus faecalis* colonies (not physiologically included in cutaneous flora) were isolated from one sample.

Among the samples that showed the bacterial growth, the number of different identified bacterial Genera ranged from 1 to 4 (Table 4). More than two different bacterial Genera were isolated on 13 (24.5%) microbiological samples.

An attempt to correlate the number of different bacterial Genera isolated on each plate with the number of patients examined by the corresponding stethoscope was tried, but no statistically significant result was found ($p > 0.05$). Besides, no statistically significant correlations emerged between

Table 3 - Bacterial flora colonizing doctors' stethoscopes

| Bacterial isolates | Total N° (%) |
|--|--------------|
| Coagulase-negative <i>Staphylococcus</i> (CoNS) | 47 (88.7) |
| <i>Micrococcus</i> spp./ <i>Kocuria</i> spp. | 35 (66) |
| <i>Bacillus</i> spp. | 5 (9.4) |
| <i>Corynebacterium</i> spp./ <i>Brevibacterium</i> -spp./ <i>Cellulosimicrobium</i> spp. | 3 (5.6) |
| <i>Neisseria</i> spp./ <i>Moraxella</i> spp. | 2 (3.8) |
| Viridans Group Streptococci (VGS) | 2 (3.8) |
| <i>Staphylococcus aureus</i> | 1 (1.8) |
| <i>Streptococcus faecalis</i> | 1 (1.8) |

Table - 4 N° of different bacterial Genera per membrane

| N° of different bacterial Genera per membrane | N° of samples (%) |
|---|-------------------|
| 0 (absence of CFU growth) | 1 (1.8) |
| 1 | 12 (22.6) |
| 2 | 27 (51) |
| 3 | 12 (22.6) |
| 4 | 1 (1.8) |

the number of CFUs and doctors' cleaning habits.

Discussion and Conclusions

Our findings strongly highlight the need to raise awareness among physicians about the importance of the devices disinfection habits. Actually, in the analysis of the questionnaires, 34% of respondents did not know (or did not believe) that cleaning the stethoscope is useful for preventing the transmission of bacteria between patients, while 23% of respondents stated that they have never cleaned their stethoscope. Also 61% of the doctors didn't know any recommendation about personal instruments cleaning. Doctors we interviewed were poorly informed about the type of product, or active principle, they should use to clean their medical equipment.

Furthermore our laboratory findings provided evidence of the potential transmission of microorganisms through stethoscopes. In fact, about 68% of the membranes' samples showed an high growth, according to all previous literature data. Moreover, bacteria species we found resulted different from microbiological flora identified on stethoscopes' diaphragms of doctors that work in hospital setting (that include pathogens usually involved in nosocomial infections) (13). Instead, bacterial population we obtained was

similar to the one reported in another study carried out in an outpatient setting (14); these isolates are commonly considered part of the physiological skin microbiota or microbiological contaminants of the natural environment.

Anyway, the presence of *E. faecalis* and *S. aureus* as well as the high percentage of colonised stethoscopes, make it necessary to pay greater attention also to the management of non-critical equipment.

We didn't probably find a clear correlation between cleaning habits and CFUs count, because of the low number of health providers that work in the health district of our study.

Another limitation of this study is the possibility that the presence of an interviewer influenced the answers of the participants. Further studies will be required to better understand the strength of the association between the lack of adherence to cleaning recommendations and the contamination of stethoscopes.

In the analysis of doctors' cleaning habits it should be also considered that, in hospital setting, disinfection guidelines are managed by the relevant healthcare authority; instead, in outpatient setting, GPs don't have any clear instructions and no external control measures are provided.

To conclude, this study highlights the need to warn GPs about the risk of microorganisms' transmission through contaminated non-critical medical devices and to create a clear guideline to advise doctors working in health district's private practices.

Acknowledgment

This study was supported by the Pavia Medical Council.

Ethical Approval

It was not required because patients were not involved.

Conflict of interests

No conflict of interests is declared

Riassunto

Cosa cresce sul fonendoscopio del Medico di Medicina Generale?

Premessa. La strumentazione medica definita non critica, come il fonendoscopio, è da tempo considerata un possibile mezzo di trasmissione di microorganismi tra pazienti.

Le raccomandazioni circa la pulizia di tali strumenti sono spesso poco chiare.

Questo studio è stato realizzato con lo scopo di valutare la conoscenza e l'applicazione delle norme igienico-sanitarie da parte dei Medici di Medicina Generale (MMG) nei confronti della pulizia del proprio fonendoscopio ed il grado di contaminazione batterica dello strumento.

Metodi. Uno studio osservazionale, trasversale, è stato condotto somministrando ai medici un questionario riguardante le loro conoscenze in merito alle raccomandazioni di pulizia applicabili alla strumentazione medica personale. Inoltre, è stato raccolto un campione dalla superficie della membrana del loro fonendoscopio per lo studio delle popolazioni microbiologiche residenti attraverso l'utilizzo della spettrometria di massa.

Risultati. La maggior parte dei medici ha dichiarato di non conoscere le raccomandazioni circa la pulizia della strumentazione medica non critica ed un'elevata colonizzazione batterica è stata riscontrata sulla maggior parte dei fonendoscopi.

Quasi tutti i microorganismi isolati sono risultati appartenere alla normale flora cutanea.

Conclusioni. Non possiamo affermare che i fonendoscopi dei MMG rappresentino un rischio di trasmissione di agenti patogeni per i pazienti, ma, visto l'alto livello di contaminazione osservato, si sottolinea la necessità di implementare e diffondere le raccomandazioni per una regolare e corretta pulizia della strumentazione medica personale.

References

1. Bereket W, Hemalatha K, Getenet B, et al. Update on bacterial nosocomial infections. *Eur Rev Med Pharmacol Sci* 2012; **16**: 1039-44.
2. European Centre for Disease Prevention and Control. Annual Epidemiological Report on Communicable Diseases in Europe. Available from: http://www.ecdc.europa.eu/en/publications/Publications/0812_SUR_Annual_Epidemiological_Report_2008[Last accessed 2016 July 8].
3. Messina G, Ceriale E, Burgassi S, et al. Hosting the Unwanted: Stethoscope Contamination Threat. *BJMMR* 2014; **4**: 4868-78.

4. Parmar RC, Valvi CC, Sira P, Kamat JR. A prospective, randomised, double-blind study of comparative efficacy of immediate versus daily cleaning of stethoscope using 66% ethyl alcohol. *Indian J Med Sci* 2004; **58**:423-30.
5. Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR Recomm Rep* 2002; **51**: 1-44.
6. World Health Organization (WHO). WHO guidelines on hand hygiene in healthcare. Geneva: World Health Organization Press, 2009. Available from: <http://www.who.int/gpsc/5may/tools/9789241597906/en/> [Last accessed 2016 July 8].
7. Shiferaw T, Beyene G, Kassa T, Sewunet T. Bacterial contamination, bacterial profile and antimicrobial susceptibility pattern of isolates from stethoscopes at Jimma University Specialized Hospital. *Ann Clin Microbiol Antimicrob* 2013; **12**: 39.
8. Gupta N, Gandham N, Misra RN, et al. The potential role of stethoscopes as a source of nosocomial infection. *Med J DY Patil Univ* 2014; **7**: 156-9.
9. Messina G, Ceriale E, Lenzi E, Burgassi S, et al. Environmental Contaminants in Hospital Settings and Progress in Disinfecting Techniques. *BioMed Res Int* 2013; **2013**: 429780.
10. Uneke CJ, Ogbonna A, Oyibo PG, Onu CM. Bacterial contamination of stethoscopes used by health workers: public health implications. *J Infect Dev Ctries* 2010; **4**: 436-41.
11. Spaulding EH. Chemical disinfection of medical and surgical materials. In: Lawrence C, Block SS, eds. *Disinfection, sterilization, and preservation*. Philadelphia: Lea & Febiger, 1968: 517-31.
12. Rutala WA, Weber DJ, and the Healthcare Infection Control Practices Advisory Committee. Centers for Disease Control and Prevention. *Guideline for Disinfection and Sterilization in Healthcare Facilities*, 2008. Available from: http://www.cdc.gov/hicpac/pdf/guidelines/disinfection_nov_2008.pdf [Last accessed 2016 July 8].
13. O'Flaherty N, Fenelon L. The stethoscope and healthcare-associated infection: a snake in the grass or innocent bystander? *J Hosp Infect* 2015; **91**: 1-7.
14. Wilkins RL, Ruben R, Kenrick B, Noha D. Contamination Level of Stethoscopes Used By Physicians and Physician Assistants. *J Physician Assist Educ* 2007; **18**: 41-3.
15. Jones JS, Hoerle D, Riekse R. Stethoscopes: a potential vector of infection? *Ann Emerg Med* 1995; **26**: 296-9.
16. Rehman S, Razzaq H, Owais A. Could stethoscope be a source of infection? *Pak J Med Sci* 2011; **27**: 510-12.
17. Mimica M J, Dalla Valle Martino M, Pasternak J. MALDI-TOF MS in the clinical microbiology laboratory. *J Bras Patol Med Lab* 2013; **49**: 256-9.
18. Núñez S, Moreno A, Green K, Villar J. The stethoscope in the emergency department: a vector of infection? *Epidemiol Infect* 2000; **124**: 233-7.
198. Grice EA, Segre JA. The skin microbiome. *Nat Rev Microbiol* 2011; **9**: 244-53.

Corresponding author: Miriam Cargnelutti (MD), Department of Public Health, Experimental and Forensic Medicine, Unit of Hygiene, University of Pavia, Via Forlanini 2, 27100, Pavia, Italy
e-mail: miriam.cargnelutti01@universitadipavia.it