



Bacterial contamination of stethoscopes on the intensive care unit

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Summary

We assessed how often bedside stethoscopes in our intensive care unit were cleaned and whether they became colonised with potentially pathogenic bacteria. On two separate days the 12 nurses attending the bedspaces were questioned about frequency of stethoscope cleaning on the unit and the bedside stethoscopes were swabbed before and after cleaning to identify colonising organisms. Twenty-two health care providers entering the unit were asked the same questions and had their personal stethoscopes swabbed. All 32 non-medical staff cleaned their stethoscopes at least every day; however only three out of the 12 medical staff cleaned this often. Out of 24 intensive care unit bedside stethoscopes tested, two diaphragms and five earpieces were colonised with pathogenic bacteria. MRSA cultured from one earpiece persisted after cleaning. Three out of the 22 personal stethoscope diaphragms and five earpieces were colonised with pathogens. After cleaning, two diaphragms and two earpieces were still colonised, demonstrating the importance of regular cleaning.

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Stethoscopes were first identified as potential vectors for bacterial infection over 30 years ago [1]. Both the diaphragm and earpieces of physician's personal stethoscopes and bedside stethoscopes are frequently colonised with a variety of pathogenic organisms including methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) which cause significant morbidity and mortality on the intensive care unit (ICU) [2–5]. Cleaning stethoscopes with isopropyl alcohol dramatically reduces the number of bacterial colonies on the diaphragm by 94–100% [2, 3], however regular cleaning has little impact on the colonisation of the earpieces [4]. How often a stethoscope must be cleaned to limit contamination is not well established although there is a correlation between degree of contamination and frequency of cleaning [4].

As is usual practice in critical care, patients on our 12-bed mixed medical and surgical ICU are strictly barrier nursed, with visiting physicians requested to use the bedside stethoscopes, and not their personal equipment. Our unit's infection control guidelines advise that the bedside stethoscopes should be cleaned at the

start of every shift. Our study aimed to answer the following questions:

What was the current stethoscope cleaning practice on our unit?

What was the level of bacterial contamination of stethoscopes?

What was the impact of current user decontamination practice on such contamination?

Methods

The Chairman of our local Research Ethics Committee reviewed the protocol and confirmed that formal ethical committee approval was not required. The study was performed on two separate days, 3 months apart, to ensure that the bedside stethoscopes had been frequently used between study days. On each study day, the 12 nursing staff attending each bed space were asked to complete an anonymous questionnaire asking how often they cleaned the bedside stethoscopes and what method they used. The diaphragm and bell of the stethoscopes were then swabbed with a sterile cotton bud, moistened

with sterile saline, and inoculated onto blood and MacConkey agar plates. The stethoscope ear pieces were separately swabbed and inoculated onto separate plates. Staff were then asked to clean the stethoscope and their choice of cleaning materials was noted. Following cleaning the stethoscopes were allowed to dry, and reswabbed as described previously. For comparison any healthcare professional entering the unit on the study day who was carrying a stethoscope was also asked to complete the same questionnaire and had their stethoscope swabbed before and after cleaning. Participants were reassured that their responses were anonymous and encouraged to answer honestly. No one was included in the study more than once if they happened to be working on the ICU on both study days.

The inoculated plates were incubated at 37 °C for 24 h. An experienced microbiologist, blinded to the identity of the agar plates, identified and quantified any cultured organisms using standard protocols and potential pathogens underwent antibiotic sensitivity testing. Coagulase-negative staphylococcus, *Bacillus* spp. and ‘diphtheroids’ were considered as normal skin flora for the purposes of this study.

This study was performed 18 months after the launch of the NHS ‘clean your hands campaign’ aimed at raising awareness of hospital acquired infection, and all staff working in our hospital are expected to have signed an infection control policy ‘contract’ in which they agreed ‘to regularly clean vital equipment such as stethoscopes’.

Results

Over both study days 24 nursing staff attending the bed spaces were questioned and the 12 bedside stethoscopes were swabbed on each occasion. In the study period 22 health care professionals carrying stethoscopes visited patients on the unit; 10 doctors, nine physiotherapists, two medical students and a nurse all of whom agreed to participate in the study. Nine doctors (seven junior doctors, two registrars), not directly involved in the study design, were permanently based on the ICU and had worked there for one month at the start of the study.

When questioned they all only used the bedside stethoscopes and could not recall having ever cleaned them.

Cleaning practice

All the ICU nursing staff questioned claimed to have cleaned the bedside stethoscopes in their bedspace at least once during their current shift (Table 1). Twenty out of 22 (91%) cleaned the stethoscope every time it was used and 2 out of 22 (9%) cleaned it at the start of their shift. Medical staff cleaned their personal stethoscopes infrequently and of the 10 doctors and two medical students visiting the unit only three (25%) cleaned either daily or after every use, three (25%) cleaned every one to 6 months and two (17%) had never cleaned their personal stethoscopes. In contrast to medical staff all the allied health professionals visiting the unit claimed to clean their personal stethoscopes at least daily and frequently after every use.

Method of cleaning

Use of isopropyl alcohol swabs designed to prepare skin for venepuncture was the preferred method of cleaning with 29 of the 46 questioned favouring this method. Eight applied alcohol gel designed for hand washing and only one person used soap and water to clean their stethoscope. The remaining seven, who were all ICU nurses, cleaned their stethoscopes with detergent wipes designed for cleaning hospital equipment such as trolleys.

Culture results (Table 2)

Diaphragms

The diaphragms of 67% of personal stethoscopes and 95% of ICU bedside stethoscopes were colonised with bacteria, however these were infrequently pathogenic with 8% of personal stethoscopes compared to 14% of bedside stethoscopes carrying pathogenic organisms. One ICU bedside stethoscope was colonised with a fully sensitive *Acinetobacter iwoffi* and a further stethoscope was colonised with an *Acinetobacter baumannii* which showed ‘panresistance’; resistant to all standard antimicrobials except polymyxins. This stethoscope was from the room of a patient colonised with this organism, and had been

Table 1 Frequency of stethoscope cleaning.

Frequency of cleaning	After every use	At least every day	At least every week	At least every month	Every 1–6 monthly	Never
ICU bedside stethoscopes						
ICU nurses (n = 22)	20	2	0	0	0	0
Personal stethoscope of visitors to the ICU						
Doctors (n = 10)	3	0	1	3	1	2
Medical students (n = 2)	0	0	0	2	0	0
Physiotherapists (n = 9)	9	0	0	0	0	0
Nurses (n = 1)	1	0	0	0	0	0

Table 2 Culture results from stethoscopes pre- and postcleaning. Antibiotic sensitivities in brackets.

	Diaphragm precleaning	Diaphragm postcleaning	Ear pieces precleaning	Ear pieces postcleaning
ICU bedside stethoscopes (n = 24)				
No growth	8	10	6	8
Skin flora only	14	13	13	15
Pathogenic bacteria	2	0	5	1
Organisms cultured and significant antibiotic sensitivities	BS 8 – <i>A. iwoffi</i> (fully sensitive) BS 24 – <i>A. baumannii</i> (panresistant – S to colistin only)		BS 3 – MRSA (R methicillin, penicillin) BS 8 – <i>A. radioresistans</i> (R ceftazidime) BS 11 – <i>A. iwoffi</i> (fully sensitive) BS 13 – <i>A. iwoffi</i> (fully sensitive) BS 14 – <i>A. iwoffi</i> (fully sensitive)	BS 3 – MRSA (R methicillin, penicillin)
Personal stethoscopes (n = 22)				
No growth	1	5	0	2
Skin flora only	18	14	17	18
Pathogenic bacteria	3	2	5	2
Organisms cultured and significant antibiotic sensitivities	PS 7 – MRSA (R – all Beta-lactams, gentamicin, S – teicoplanin, vancomycin) PS 7 – <i>Enterobacter cloacae</i> (R – Cephalosporin) PS 12 – <i>A. baumannii</i> (S – carbapenems, colistin) PS 22 – <i>S. aureus</i> (S – methicillin, R- penicillin, fusic acid) PS 22 – <i>Stenotrophomonas maltophilia</i> (S – piperacillin and tazobactam only)	PS 7 – MRSA (R – all Beta-lactams, gentamicin, S – teicoplanin, vancomycin) PS 22 – <i>Stenotrophomonas maltophilia</i> (S – piperacillin and tazobactam only)	PS 2 – <i>S. aureus</i> (S methicillin R penicillin, fusidic acid) PS 11 – <i>Pseudomonas leuteola</i> (S – piperacillin and tazobactam) PS 12 – <i>A. baumannii</i> (S – carbapenems, colistin) PS 20 – <i>A. iwoffi</i> (S – carbapenems, colistin) PS 21 – <i>A. iwoffi</i> (S – carbapenems, colistin)	PS 11 <i>Pseudomonas leuteola</i> (S – piperacillin and tazobactam) PS 12 – <i>A. baumannii</i> (S – carbapenems, colistin)

BS, bedside stethoscope; PS, personal stethoscope (number designates a specific stethoscope); S, sensitive; R, resistant.

cleaned during the index shift. Pathogenic bacteria colonising personal stethoscopes were also frequently multidrug resistant with one stethoscope colonised with both MRSA and a multidrug resistant *Enterobacter cloacae*. Additional personal stethoscopes were colonised with methicillin-sensitive *S. aureus*, *Stenotrophomonas maltophilia* and less resistant *Acinetobacter* species. Cleaning did not completely eradicate MRSA or *S. maltophilia* from two stethoscopes.

Ear pieces

The ear pieces of stethoscopes were also frequently colonised with bacteria cultured from 18 of 24 (75%) ICU bedside stethoscopes and all 22 personal stethoscopes tested showing colonisation. Five (21%) of the ICU bedside stethoscopes and five (23%) of the personal stethoscopes were colonised with potentially pathogenic bacteria. ICU bedside stethoscopes earpieces were

commonly colonised with *Acinetobacter* spp. One bedside stethoscopes ear piece was colonised with MRSA. Three personal stethoscopes were colonised with sensitive *Acinetobacter* spp., one was colonised with MSSA and one with *Pseudomonas leuteola*. Cleaning failed to eradicate MRSA, *Pseudomonas* spp. and *A. baumannii* from the colonised ear pieces.

Thus overall 5 out of 46 (11%) stethoscope diaphragms were colonized with potentially pathogenic bacteria, which fell to 2% after cleaning. Ten out of 46 (22%) stethoscope earpieces were colonised with potentially pathogenic bacteria, which fell to 7% after cleaning.

Discussion

All the ICU nursing staff and other allied health professionals reported cleaning stethoscopes at least daily, contrasting with medical staff, one-third of whom only

cleaned their stethoscope at best every month. There is obviously concern that participants in the study may have felt pressured to provide 'model' answers despite assurances of anonymity. However we surmise that such a big difference between the visiting medical and non-medical staff likely reflected a greater acceptance amongst non-medical staff of stethoscope cleaning as part of routine patient care. Both the ICU bedside stethoscopes and personal stethoscopes commonly carry potentially pathogenic bacteria and it is therefore concerning that medical staffs' stethoscopes are cleaned so infrequently, in spite of a high profile infection control programme. Despite studies demonstrating that cleaning with isopropyl alcohol reduces stethoscope colonisation by > 94% [2, 3] our study shows that in a clinical context pathogenic bacteria can persist after cleaning on both the diaphragm and ear pieces. This clearly has implications for both the safety of patients and the stethoscope user.

Our study is too small to assess the efficacy of the various cleaning methods used, however all the stethoscopes colonised with potentially pathogenic organisms which persisted after cleaning were cleaned with isopropyl alcohol swabs which is the favoured method of other authors and a stethoscope manufacturer [6]. These stethoscopes reportedly underwent at least daily cleaning which emphasises the importance of both frequency and thoroughness of cleaning. The ear pieces are by design difficult to access and clean adequately whilst the diaphragm design of many stethoscopes involves a rim that can only be thoroughly cleaned by disassembling the diaphragm which is impractical for regular cleaning. The design of stethoscopes may therefore have to be revisited to limit areas inaccessible to cleaning.

The fact that these persisting pathogens were frequently resistant to multiple antibiotics reflects the prevalence of resistant organisms colonising patients and equipment on both ICUs and the general wards within our hospital. *Acinetobacter* spp. were cultured from several stethoscopes, including a pan resistant strain of *A. baumannii* from an ICU stethoscope diaphragm. These were confirmed to be different strains by the Health Protection Reference Laboratory. Antibiotic resistant strains of acinetobacter have recently caused widespread outbreaks in hospitals in North America and Europe [7–9]. Eradication of the bacteria from equipment is considered a vital part of outbreak control and over 20% of ICUs with outbreaks have to close for cleaning [10]. Simple regular cleaning of stethoscopes may therefore help prevent outbreaks and limit them when they do occur.

This relatively small workplace audit translated into an appreciable laboratory workload, with 184 primary cultures and many more subsequent sub cultures for identification purposes. Although our data represent a

modest snapshot from one institution, we have no reason to believe that the lessons we have learned are not more widely applicable. The specific lessons we have learned are:

- 1 Stethoscope cleaning is inconsistently performed, particularly amongst medical staff which presents a quality improvement opportunity.
- 2 Even regular cleaning of stethoscopes with alcohol at arbitrary times is insufficient to prevent colonisation with pathogenic bacteria; stethoscopes should be cleaned before and after each use, the recommended strategy for other items of equipment such as endoscopes [11].
- 3 Ear pieces of stethoscopes frequently carry pathogenic organisms, potentially posing a risk to the stethoscope user, and also, given the propensity of staff for draping stethoscopes around necks, risk recontaminating an adequately cleaned diaphragm.

Future research questions include: what are the barriers to complying with infection control programmes? What is the optimal stethoscope design to facilitate decontamination? What is the most effective and practicable means of decontamination?

Whether or not a contaminated stethoscope leads to the colonisation of a patient with that organism is difficult to prove, however the risk–benefit balance for reducing the potential risk seems incontestable and greater emphasis needs to be placed on stethoscope cleaning as part of routine practice.

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