

# Stethoscopes as vectors of infections

**Nathania A J Burrie**

Fifth Year Medicine (Undergraduate)  
James Cook University, Cairns

*Nathania has clinical and research interests in tropical infectious diseases and medical education. She has undertaken volunteer work on Palm Island, and was the Convener of the Northern Territory Intervention Panel Discussion in 2009. Her shortlist of medical careers includes emergency medicine and rural general practice.*

**Aim:** To conduct a review of the literature to evaluate whether stethoscopes constitute a clinically significant vector of healthcare-associated infection, and to explore the behaviour, attitudes and beliefs about stethoscope hygiene amongst medical students.

**Methods:** Section one: PubMed was searched for empirical studies written in English, published before 1 May 2010, dealing with colonisation rates of stethoscopes and self-reported frequency of stethoscope cleaning by healthcare staff. Thirty-one articles were systematically reviewed. Section two: Qualitative and quantitative cross-sectional study of medical students. A convenience sample of seventeen undergraduate medical students in years two, three and four were asked a series of thirteen questions exploring their knowledge, practice of and attitudes towards stethoscope hygiene.

**Results:** The diaphragm and bell of stethoscopes are colonised with micro-organisms on average 87.3% of the time. On average, 14% of stethoscopes carry MRSA, and 16.5% carry gram-negative species. On average, 58.8% of doctors clean their stethoscope annually or never. Fifty-nine percent of students surveyed had never cleaned their stethoscope. Only 29% of students had ever been advised about stethoscope hygiene. Eighty-two percent of students felt senior colleagues had influenced their attitude (positive or negative) toward stethoscope hygiene. **Conclusions:** Stethoscopes potentially represent a moderate-to-high risk of infection transmission, particularly in vulnerable settings, yet stethoscope hygiene is rarely considered or practiced by doctors and medical students. Improving stethoscope hygiene in practice requires addressing the lack of formal education on the subject and the shortage of positive role models.



were reviewed systematically to answer four questions:

1. What is the rate of colonisation of stethoscopes?
2. What evidence is there that stethoscope colonisation results in nosocomial infection?
3. Are patient-dedicated stethoscopes used appropriately and effectively?
4. How often do healthcare staff reportedly clean their stethoscopes?

Subsequently, a very small qualitative and quantitative cross-sectional study was performed on a convenience sample of seventeen medical students, across the pre-clinical second (n=1) and third (n=4) years, and the clinical fourth-year (n=12). Participants were asked a series of thirteen questions (Table 1) exploring their knowledge of, practice of and attitudes towards stethoscope hygiene. The results of both of these investigations are discussed as follows.

**Table 1.** Peer survey questionnaire.

Peer Survey Questionnaire
What year of medicine are you studying?
In the course of your medical education, have you ever been advised about hand-washing?
• If yes, has this been formal or informal teaching?
Have you ever been advised about safe intravenous (IV) cannulation?
• If yes, has this been formal or informal teaching?
Compared to most methods of nosocomial infection transmission, what role do you think stethoscopes play?
Have you ever been advised about stethoscope cleaning?
• If yes, has this been formal or informal teaching?
Have you cleaned your stethoscope before?
• If yes, why and how did you clean it?
• If no, is there any reason why you have chosen not to, or why it has not occurred to you?
Do you think the attitude or example of senior colleagues has influenced your perception regarding stethoscopes as a vector of infection?
• If yes, how?
To your knowledge, does the regional teaching hospital have a protocol regarding stethoscope cleaning?

## Introduction

Infection control education is an area receiving an increasing amount of attention both from government agencies and in the literature. It has now been well demonstrated that good infection control practices in the clinical workplace depend upon comprehensive education from the student level up, and from the senior leadership level down. [1,2]

As a fourth-year medical student, a question arose while on clinical rotation: is the humble and universal stethoscope perhaps more of an infection risk than anyone consciously realises? I observed stethoscopes placed on unclean skin, on the abdomen of patients with gastroenteritis, near colostomy openings, sternotomy wounds and onto the chest of newborns without ever witnessing a stethoscope being cleaned by any member of staff. Furthermore, reflecting on my medical education thus far, stethoscope hygiene had not once been formally raised as an issue of which to be mindful.

This review therefore sets out to investigate the issue of stethoscope hygiene. The aims are two-fold: firstly, to examine and systematically review the literature to evaluate whether stethoscopes constitute a clinically significant vector of healthcare-associated infection; and secondly, to explore medical students' behaviour, attitudes and beliefs about stethoscope hygiene.

## Methods

A systematic search of the PubMed database was conducted, using the keywords "stethoscope," "infection control," "nosocomial," "vector" and "disinfection," which yielded a total 31 articles in English. These

## Results and Discussion

### Section 1: Systematic literature review

The literature review revealed firstly that the diaphragm and bell of stethoscopes are frequently colonised with micro-organisms (on average 87.3% of the time) (Table 2). [3-25] It is less clear whether the population of micro-organisms is typically pathogenic. The most abundant organisms tend to be coagulase-negative *Staphylococcus spp*, which are relatively benign. [6,9,12-15,17,18,20,22-24]

**Table 2.** Review of cross-sectional studies on colonisation rates and pathogenic profiles of stethoscopes (before cleaning).

Study	Number of stethoscopes (n)	Overall colonisation rate (%)	Mean CFU count per stethoscope
[3]	62	61	-
[4]	155	-	Personal: 50.3 Ward: 29.3
[6]	100	90	-
[5]	22 personal; 24 ICU	67 personal; 95 ICU	-
[7]	50	98	47.7
[8]	49	-	-
[9]	99	100	-
[10]	200	80	-
[11]	50	-	-
[12]	12	100	8 to 221
[13]	300	87	-
[14]	24	71	-
[15]	150	-	37
[16]	41	100	-
[17]	43	-	-
[18]	55	100	-
[19]	29	89	69
[20]	50	74	-
[21]	43	85	-
[22]	122	-	132
[23]	92	100	-
[24]	105	-	-
[25]	106	-	-
		Mean: 87.3%	Mean: 67.7

CFU = colony-forming unit; - = data not available; ICU = intensive care unit

On the other hand, an average of 14% of stethoscopes (one in seven) are colonised with MRSA, [7,10-12,16-18,20,21,24,25] and an average of 16.5% carry gram-negative species (Table 3). [7,13,14,16,17,21,23] The microbiological profile of stethoscopes varies significantly from study to study and hospital to hospital, thus making it difficult to make accurate generalisations. Nevertheless, some hospitals reported rates as high as 69% for MRSA [17] and 60% for gram-negative bacteria. [7] With this in mind, it is preferable to consider every stethoscope as a potential carrier of pathogenic organisms.

Crucially, there is some debate in the literature as to whether stethoscope contamination (or environmental contamination more broadly) can lead to infection in the patient. Eleven of seventeen articles supported the notion that a causal relationship does exist, particularly via indirect transmission from stethoscopes to clinicians' hands and then to patients. [13,26-32] This argument was reinforced by the fact that gram-positive bacteria survive for up to eighteen hours on stethoscope membranes, [33] and respiratory syncytial virus

(RSV) can be recovered from inanimate surfaces for up to six hours, [34,35] with these organisms remaining infectious when transferred from surfaces to hands. On the other hand, three studies highlighted that gram-negative bacteria only remain viable for several hours on stethoscope diaphragms, [33] and that environmental contamination by *Staphylococcus aureus* appears to play only a minimal role in infection transmission. [36,37]

**Table 3.** Mean profile of colonisation rate per species.

Species	Mean colonisation rate (% of stethoscopes)	Number of studies providing data
<i>Staphylococcus spp</i>	75.0	6
• <i>Staphylococcus aureus</i>	23.0	7
• Coagulase-negative spp	60.5	8
• MRSA	14.0	11
Gram-positive bacilli	69.5	2
Gram-negative spp	16.5	6
• <i>Acinetobacter spp</i>	1.4	3

The question of whether stethoscope contamination actually results in infection in the patient is pivotal to determining whether there is a true need for systematic stethoscope decontamination. At the time of writing, the literature seems not entirely cohesive on the issue, and further research is likely required before stethoscope hygiene will be aggressively implemented. However, until such evidence exists, it is wise for individual clinicians to err on the side of prudence and to consider that contaminated stethoscopes are indeed likely to result in clinical infection.

The main infection control measure currently in place regarding stethoscopes – that is, dedicated stethoscopes for patients infected with resistant organisms – is often not adhered to properly, primarily because staff find hospital-provided stethoscopes to have poor sound quality and to be uncomfortable. [8,38] In addition, one observational study found that stethoscopes designated for single-patient use were often used around other areas of the hospital. [12] This highlights the importance of considering other ways of minimising the risk posed by stethoscopes, such as frequent cleaning of the bell and diaphragm. In this way, systematic decontamination of stethoscopes between all patients would allow doctors and nurses to use their own stethoscopes safely, even on vulnerable or resistant strain-carrying patients.

### Section 2: Medical student survey

Twelve studies were identified in which a cross-sectional survey of the frequency of stethoscope cleaning by healthcare staff was performed. [3,5-7,10,11,14,15,17,19,22,33] Most showed very poor stethoscope hygiene. Contrary to current guidelines, [39] not a single study reported any percentage of staff cleaning their stethoscope before and after each patient. Rather, three quarters of the twelve studies reported high rates of doctors cleaning their stethoscope only annually or never (mean = 58.8% of doctors). [3,7,11,14,15,17,19,22,33] This is very similar to the findings in this peer survey, where more than half the students had never cleaned their stethoscope (59%), and 28% of those who had ever cleaned it had only done so once to six times in the last year (Table 4).

In contrast, three out of five studies showed that bacterial contamination rises significantly after one day of use without cleaning and after the stethoscope is used to examine more than five patients without cleaning, which suggests that even daily cleaning is not sufficient. [3,15,24] It is particularly interesting to note that doctors and students alike seem to believe stethoscope cleaning is appropriate in some circumstances.

**Table 4.** Frequency of stethoscope cleaning by students.

Frequency	Number (%)
Never cleaned their stethoscope	10/17 (59%)
Ever cleaned their stethoscope	7/7 (41%)
• Cleaned 1-6 times in last 12 months	2/7 (28%)
• Cleaned >6 times in last 12 months	0 (0%)
• At the end of each week	0 (0%)
• At the end of each day	2/7 (28%)
• After every patient encounter	3/7 (43%)

One study showed that 10% of doctors cleaned their stethoscopes only when it was soiled by blood or human secretions. [6] Similarly, three students wrote in the survey:

“I cleaned [my stethoscope] after using it on a patient who appeared visibly unclean. I don’t clean it before and after patients.”

“I cleaned it when I was in ICU because of high-risk patients in this ward.”

“I have cleaned the diaphragm once after using it on a patient with a *Pseudomonas* infection.”

Anecdotally, this type of attitude to when and why it is necessary to clean stethoscopes is quite common. In fact, if a student or clinician gives any thought to stethoscope hygiene, it is usually only in the context of a gastroenteritis epidemic with patients known to carry resistant organisms, or simply with visible and obvious soiling of the stethoscope.

The analysis of both the literature and the peer survey revealed three apparent principal reasons for the observed poor practice of and poor attitudes towards stethoscope hygiene. Firstly, the lack of formal education received by students on the subject plays an important role. While 100% of students had received formal teaching surrounding hand hygiene and 94% had been advised about safe intravenous cannulation (mainly through formal teaching), only 29% had ever been advised about stethoscope cleaning, and this had mostly (80%) been through informal teaching on placements (Table 5).

**Table 5.** Comparative frequency of education regarding different modes of infection transmission, and structure of teaching.

Student status of 17 students surveyed	Number (%)	Formal teaching Number (%)	Informal teaching Number (%)
Advised about hand-washing	17 (100%)	17/17 (100%)	8/17 (47%)
Advised about safe IV cannulating	16 (94%)	14/16 (87%)	8/16 (50%)
Advised about stethoscope cleaning	5 (29%)	1/5 (25%)	4/5 (80%)

The fact that stethoscope hygiene does not figure in the medical curriculum seems to have a large impact on students’ attitudes:

“It has slipped my mind considering we’ve never had any formal education regarding stethoscope hygiene.”

Not only does an absence of formal education on the subject predispose future clinicians to consider stethoscope hygiene unimportant, it also means that those who might have considered cleaning their stethoscope will not have developed an effective cleaning technique. [16] For these reasons, formal education must be considered in the effort to improve stethoscope hygiene practices.

The second most important factor contributing to poor stethoscope

hygiene practices seems to be an ignorance or absence of hospital protocol on the subject. Of two studies examining how many doctors had ever been advised about stethoscope hygiene, both found that 100% of surveyed doctors had never been advised. [17,19] Similarly, 100% of the students in the peer study had no knowledge of the presence or absence of stethoscope hygiene protocols at the regional teaching hospital, despite being initiated to the hospital protocol on hand hygiene, intravenous cannulation and sharps safety. These findings highlight that hospitals play a part in encouraging good clinical practice by instituting and enforcing relevant protocol.

Furthermore, governmental and non-governmental agencies play a part by producing guidelines and recommendations that shape hospital protocol in the first place. Thus, the roles of hospitals and guideline-producing agencies should be considered in the effort towards improving clinical stethoscope hygiene practice.

The third and possibly most important influence in engendering the current poor attitudes and behaviours in relation to stethoscope cleaning is the shortage of positive role models – and indeed, the presence of negative role models. When surveyed, 82% of students responded that doctors had indeed influenced their attitude towards stethoscope hygiene. Of these, 14% claimed their senior doctors had acted as positive role models, while the remaining 86% emphasised that not seeing doctors clean their stethoscopes had caused them not to value stethoscope hygiene. Either way, it appears the example of senior doctors makes lasting impressions on students:

“Since my placement in a rural town, where my head doctor taught me about stethoscope cleaning, I try to clean mine after every patient.”

“I haven’t met a doctor who cleans their stethoscopes between each patient, so I haven’t really felt the need to do so either.”

The importance of positive leadership has been recognised as an extremely powerful influence on the behaviour of subordinate colleagues in other areas of infection control for many years. [1,2,40] What is more, senior doctors seem to comply with infection control practices more if they perceive themselves as role models for other colleagues. [41] The literature review and peer survey findings suggest that the same principles apply to stethoscope hygiene.

### Conclusion

Stethoscopes represent a moderate-to-high risk of infection transmission, particularly in vulnerable settings. Nevertheless, stethoscope hygiene is rarely considered or practiced by doctors and medical students. This problem appears to stem from a lack of formal education on the matter, an absence or ignorance of hospital protocol and lastly – and most importantly – from a shortage of positive role models. Further research needs to be conducted to conclusively demonstrate whether stethoscope contamination results in clinically significant infections, as this is likely to help in the promotion of formal education on the matter. Governmental health bodies should continue to clarify their stance on the issue of stethoscope hygiene, and to put forward protocol recommendations to hospitals, which should in turn advise all staff and clinical students accordingly. Ideally such measures will ultimately ensure that enough senior clinicians will improve their own behaviours, so that they may subsequently act as positive role models to the ensuing generation of doctors. All of these efforts should be directed at eliminating every last significant source of healthcare-associated infection, and promoting a safer environment for staff and patients.

### Conflicts of Interest

None declared.

### Correspondence

N Burrie: nathania.burrie@jcu.edu.au

## References

- [1] Centre for Healthcare Related Infection Surveillance and Prevention. Medical leadership and the VIP network [Internet]. Brisbane; 2010 [updated 2010 Mar 29; cited 2010 May 21]. Available from: URL: [http://health.qld.gov.au/chrisp/medical\\_leadership/about.asp](http://health.qld.gov.au/chrisp/medical_leadership/about.asp)
- [2] Nichols A, Badger B. An investigation of the division between espoused and actual practice in infection control and of the knowledge sources that may underpin that division. *Brit J Infect Control* 2008;9(4):11-5.
- [3] Genne D, de Torrente A, Humair L, Siegrist H. Level of stethoscope contamination in the hospital environment. *Schweiz Med Wochenschr* 1996;126(51-2):2237-40.
- [4] Denholm J, Levine A, Kerridge I, Ashhust-Smith C, Ferguson J, d'Este C. A microbiological survey of stethoscopes in Australian teaching hospitals: Potential for nosocomial infection? *Aust Infect Control* 2005;10(3):79-86.
- [5] Whittington A. Bacterial contamination of stethoscopes on the intensive care unit. *Anaesthesia* 2009;64(6):620-4.
- [6] Parmar R, Valvi C, Sira P, Kamat J. 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(10):423-33.
- [7] Mangi R, Andriole V. Contaminated stethoscopes: A potential source of nosocomial infections. *Yale J Biol Med* 1972;45:600-4.
- [8] Zachary K, Bayne P, Morrison V, Ford D, Silver L, Hooper D. Contamination of gowns, gloves, and stethoscopes with vancomycin-resistant enterococci. *Infect Control Hosp Epidemiol* 2001;22(9):560-4.
- [9] Lecat P, Cropp E, McCord G, Haller N. Ethanol-based cleanser versus isopropyl alcohol to decontaminate stethoscopes. *Am J Infect Control* 2009;37:241-3.
- [10] Smith M, Mathewson J, Ulert I, Scerpella E, Ericsson C. Contaminated stethoscopes revisited. *Arch Intern Med* 1996;156:82-4.
- [11] Merlin M, Wong M, Pryor P, Rynn K, Marques-Baptista A, Perritt R, *et al.* Prevalence of methicillin-resistant *Staphylococcus aureus* on the stethoscopes of emergency medical services providers. *Prehosp Emerg Care* 2009;13(1):71-5.
- [12] Hudson H. Stethoscopes and infection control: A study into the use of stethoscopes in a paediatric ward and their possible contamination. *J Child Health Care* 2003;7:142-3.
- [13] Maluf M, Maldonado A, Bercial M, Pedroso S. Stethoscope: A friend or an enemy? *Sao Paulo Med J* 2002;120(1):13-5.
- [14] Wright I, Orr H, Porter C. Stethoscope contamination in the neonatal intensive care unit. *J Hosp Infect* 1995;29:65-8.
- [15] Jones J, Hoerle D, Riekse R. Stethoscopes: A potential vector of infection? *Ann Emerg Med* 1995;26(3):296-9.
- [16] Waghorn D, Wan W, Greaves C, Whittome N, Bosley H, Cantrill S. Stethoscopes: A study of contamination and the effectiveness of disinfection procedures. *Brit J Infect Control* 2005;6(1):15-7.
- [17] Sengupta S, Sirkar A, Shivanda P. Stethoscopes and nosocomial infection. *Indian J Pediatr* 2000;67(3):197-9.
- [18] Cohen H, Amir J, Matalon A, Mayan R, Beni S, Barzilai A. Stethoscopes and otoscopes: A potential vector of infection? *Fam Pract* 1997;14(6):446-9.
- [19] Breathnach A, Jenkins D, Pedler S. Stethoscopes as possible vectors of infection by *Staphylococci*. *BMJ* 1992;305:1573-4.
- [20] Sanders S. The stethoscope and cross-infection revisited. *Br J Gen Pract* 2005;55(510):54-5.
- [21] Youngster I, Berkovitch M, Heyman E, Lazarovitch Z, Goldman M. The stethoscope as a vector of infectious disease in the paediatric division. *Acta Paediatr* 2008;97(9):1253-5.
- [22] Nunez S, Moreno A, Green K, Villar J. The stethoscope in the emergency department: A vector of infection? *Epidemiol Infect* 2000;124:233-7.
- [23] Schroeder A, Schroeder M, D'Amico F. What's growing on your stethoscope? (And what you can do about it.) *J Fam Pract* 2009;58(8):404-9.
- [24] Leprat R, Minary P, Devaux V, de Waziere B, Dupond J, Talon D. Why, when, and how to clean stethoscopes. *J Hosp Infect* 1998;39:80-2.
- [25] Sood P, Mishra B, Mandal A. Potential infection hazards of stethoscopes. *J Indian Med Assoc* 2000;98(7):368-70.
- [26] Karanfil L, Murphy M, Josephson A, Gaynes R, Mandel L, Hill B, *et al.* A cluster of vancomycin-resistant *Enterococcus faecium* in an intensive care unit. *Infect Control Hosp Epidemiol* 1992;13:195-200.
- [27] Boyce J, Opal S, Chow J, Zervos M, Potter-Bynoe G, Sherman C, *et al.* Outbreak of multidrug-resistant *Enterococcus faecium* with transferable vanB class vancomycin resistance. *J Clin Microbiol* 1994;32:1148-53.
- [28] Livornese L, Sias S, Samel C, Romanowski B, Taylor S, May P, *et al.* Hospital-acquired infection with vancomycin-resistant *Enterococcus faecium* transmitted by electronic thermometers. *Ann Intern Med* 1992;117:112-6.
- [29] Zervos M, Dembinski S, Midesell T, Schaberg D. High-level resistance to gentamicin in *Streptococcus faecalis*: Risk factors and evidence for exogenous acquisition of infection. *J Infect Dis* 1986;153:1075-83.
- [30] Oie S, Hosokawa I, Kamiya A. Contamination of room door handles by methicillin-sensitive/methicillin-resistant *Staphylococcus aureus*. *J Hosp Infect* 2002;51:140-3.
- [31] Wenzel R, Thompson R, Landry S, Russell B, Miller P, Ponce de Leon S, *et al.* Hospital-acquired infections in intensive care unit patients: An overview with emphasis on epidemics. *Infect Control* 1983;4:371-5.
- [32] Marinella M, Pierson C, Chenoweth C. The stethoscope: A potential source of nosocomial infection. *Arch Intern Med* 1997;157:786-90.
- [33] Bernard L, Kereveur A, Durand D, Gonot J, Goldstein F, Mainardi J, *et al.* Bacterial contamination of hospital physicians' stethoscopes. *Infect Control Hosp Epidemiol* 1999;29:626-8.
- [34] Hall C, Douglas R, Geiman J. Possible transmission by fomites of respiratory syncytial virus. *J Infect Dis* 1980;141:98-102.
- [35] Hall C, Douglas R. Modes of transmission of respiratory syncytial virus. *J Pediatr* 1981;99:100-3.
- [36] Walsh T, Auger F, Tatem B, Hansen S, Standford H. Novobiocin and rifampicin in combination against methicillin-resistant *Staphylococcus aureus*: An in vitro comparison with vancomycin plus rifampicin. *Antimicrob Chemother* 1986;17(75-82).
- [37] Mack D. Stethoscope study overlooks bacteria on clinicians' hands. *J Fam Pract* 2009;58(10):513.
- [38] Wurtz R, Weinstein R. Microbiologic contamination and cleaning personal medical equipment. *JAMA* 1998;280(6):519-20.
- [39] Centre for healthcare related infection surveillance and prevention CHRISP ([chrisp@health.qld.gov.au](mailto:chrisp@health.qld.gov.au)). Response to enquiry regarding stethoscopes as a vector of infection [Online]. E-mail to Nathania Burrie ([nathania.burrie@jcu.edu.au](mailto:nathania.burrie@jcu.edu.au)) 2010 June 2 [cited 2010 Aug 28].
- [40] Hunt D, Mohammudally A, Stone S, Dacre J. Hand-hygiene behaviour, attitudes and beliefs in first year clinical medical students. *J Hosp Infect* 2005;59(4):371-3.
- [41] Pittet D, Simon A, Hugonnet S, Pessoa-Silva C, Sauvan V, Perneger T. Hand hygiene among physicians: Performance, beliefs, and perceptions. *Ann Intern Med* 2004;141(1):1-8.