

Knowledge of final-year medical students at the University of the Free State of hand hygiene as a basic infection control measure

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Background: One of the main reasons for the spread of infection in the healthcare environment is inadequate hand hygiene. Poor knowledge of hand hygiene techniques leads to poor compliance. This study aimed to determine Free State University final-year medical students' knowledge of hand hygiene as a basic infection control measure.

Methods: This was a cross-sectional study using self-administered anonymous questionnaires. The questions and memorandum were based on an extensive literature review with WHO documentation on the guidelines for hand hygiene in health care. Each participant received an envelope with an optical computer card, questionnaire and information document during a pre-arranged class. Participants recorded their answers on the card by shading in the squares corresponding to their responses.

Results: The average score of the 107 participants was 46.8% (range 10.1–73.6%). Participants who felt that they had basic knowledge of hand hygiene ($n = 32$, 30.5%) had an average score of 47.9%. Participants with a self-reported knowledge level of more than basic but less than advanced ($n = 56$, 53.3%) had an average score of 44.9% while those who reported advanced knowledge ($n = 17$, 16.2%) had an average score of 50.8%. Three-quarters ($n = 81$, 77.1%) felt that their training was sufficient. Only 53.3% knew that the most important way to prevent the spread of infection is good hand hygiene. Only 10.5% of the students knew that hands should not be rinsed with water after using alcohol-based sanitisers.

Conclusion: Medical students have a poor level of knowledge regarding hand hygiene as a basic measure of infection control.

Keywords: hand hygiene, infection control, knowledge, medical students

Introduction

In developing countries, up to 20% of hospitalised patients contract nosocomial infections,¹ a major cause of increased morbidity, mortality and health costs.² According to Trampuz and Widmer,³ the hands of healthcare workers are the primary way that these infections are spread. One of the main reasons for the spread of infection in the healthcare environment is inadequate hand hygiene. According to the World Health Organization (WHO),¹ lack of knowledge of good hand hygiene practices is associated with poor compliance. In 2009, the WHO published its guidelines on hand hygiene in health care.¹ A practical WHO brochure,⁴ 'Hand Hygiene: Why, How & When', recommends that if hands are not visibly soiled, they should be rubbed with an alcohol-based formulation for 20 to 30 seconds and clear instructions are provided regarding proper rubbing. Visibly soiled hands should be washed with soap and water for 40 to 60 seconds with clear instructions regarding washing procedures. Hands should not be washed with soap and water immediately after or before using an alcohol-based handrub. Further guidelines are provided as to when hand hygiene is important.

A study in Saudi Arabia⁵ assessed medical students' knowledge and conduct regarding standard precaution and infection control. Most students (80.0%) believed that there was an urgent need for training in infection control, and 61.4% felt that their current medical programme did not provide enough information. The knowledge they did have at the time was obtained from other sources, such as pamphlets, or following the consultants' example. Only 39.0% knew the correct duration of handwashing while 51.1% believed that alcohol-based products could replace

basic handwashing. A third (33.5%) agreed that handwashing was unnecessary when gloves are used.

Nair *et al.*⁶ assessed the knowledge of medical students and nurses in India using the WHO hand hygiene questionnaire for healthcare workers. Almost 80% of the participants reported that they had received formal training in hand hygiene. However, their level of knowledge was moderate (score 50–74%) while only 9% had good knowledge (score > 75%). Nurses were found to have significantly better knowledge compared with the medical students. Another study⁷ in India found that 58.2% of the medical students routinely used alcohol-based hand sanitisers but only 38.1% knew that it takes 20 seconds for these sanitisers to kill most microorganisms.

In a Namibian study⁸ on a convenience sample of health sciences students, medical students had a higher mean score (73%) than nursing or radiology students regarding infection prevention and control. However, only 19.7% of medical students were reported to correctly specify the indications for alcohol-based hand sanitisers.

Aim of the study

To determine the level of knowledge of final-year medical students of the University of the Free State (UFS) of hand hygiene as a basic infection control measure.

Method

Study design

This was a cross-sectional study.

Table 1: Knowledge of final-year medical students at the University of the Free State of hand hygiene as a basic infection control measure; only correct options are indicated ($n = 105$)

Factor	n (%)*
1. The antimicrobial activity of alcohol results from the ability to: Denature proteins	53 (50.5)
2. Which part of a patient's room is most densely and diversely colonised by microorganisms? Doorknob	49 (46.7)
3. When using an alcohol-based hand sanitiser, what is the minimal time needed to kill most germs on your hands before rinsing with water? None of the listed options (i.e. NOT 2; 8; 10; 20 seconds)	11 (10.5)
4. Which of the following methods of hand drying after a wash prevents contamination to the greatest degree in a hospital environment? Paper towels	51 (48.6)
5. According to the World Health Organization (WHO), what should one do after using an alcohol-based hand sanitiser to prevent the formation of a biofilm? None of the listed options (i.e. NOT rinse hands with clean water; dry hands with sterile cloths; wash hands with soap and water; apply 1% chlorhexidine and rinse with clean water)	41 (39.1)
6. Apart from the issue of skin tolerance and level of comfort, water temperature ... Does not appear to be a critical factor for microbial removal from hands being washed	21 (20.0)
7. <i>Clostridium difficile</i> contaminated hand can easily be decontaminated with ... Washing hands with water and soap	52 (49.5)
8. Which one of the following statements regarding hand hygiene is incorrect? It is not necessary to wash your hands between patients during screening	89 (84.8)
9. Which statement is true about glove use? It is necessary to discard gloves after each task	83 (79.1)
10. The efficiency of alcohol-based hand hygiene products is not affected by the following factor(s): All of the above affects efficiency (percentage of alcohol in solution used; volume of alcohol used; whether hands are wet or dry when alcohol is applied)	56 (53.3)
11. Examination gloves are correctly used in which of the following statements: During direct and indirect patient exposure (e.g. contact with blood/emptying emesis basins)	73 (69.5)
12. How are antibiotic-resistant pathogens most commonly spread from one patient to another in healthcare settings? From one patient to another via hands of contaminated healthcare workers	34 (32.4)
13. What is the most frequent source of germs responsible for healthcare-associated infections with regard to cross-contamination? Germs already present on or within the patient	8 (7.6)
14. According to the WHO, what is the single most important way to prevent the spread of disease in the hospital environment? Handwashing	56 (53.3)
15. What should the temperature of water be when washing your hands? Medium hot	48 (46.2)
16. What is a necessity when washing your hands? Need to remove rings	43 (41.0)
17. The following hand condition can acquire and spread microorganisms the most readily: Wet hands	31 (29.5)
18. Which of the following should be avoided, as recommended by the WHO, as it is associated with increased likelihood of colonisation of hands with harmful germs? Both B and C (wearing of jewellery; wearing of long-sleeved white coats)	45 (42.9)
19. When a microbiologist swabs a patient's hand, the microorganism they would be able to find the most in terms of numbers is: <i>Staphylococcus epidermidis</i>	89 (84.8)

*The results indicate n (%) students who chose the correct answer.

Target population and sampling

The target population was all 128 final-year medical students at UFS in 2015. Questionnaires were distributed to 107 students, as 21 students were busy with rotations elsewhere at the time of the study.

Measurement

Data were collected using an anonymous, self-administered questionnaire available in English. The questions and memorandum were based on an extensive literature review^{9,10-24} with WHO documentation on the guidelines for hand hygiene in

health care as basis.¹ Knowledge was tested by 20 multiple-choice questions of which one question had to be disregarded during the analysis due to incorrect formulation of the question. Participants recorded their answers on an optical computer card by shading in the squares corresponding to their responses.

Data collection

Each participant received a numbered envelope with a computer card, questionnaire and an information document during a pre-arranged class. Completed cards were sealed in the provided envelopes and collected by the student researchers.

Table 2: Correct and most frequently chosen incorrect answer to questions where less than 40% of the students chose the correct option

Item	n (%)*
3. When using an alcohol-based hand sanitiser, what is the minimal time needed to kill most germs on your hands before rinsing with water?	
✓ None of the listed options (i.e. NOT 2; 8; 10; 20 seconds)	11 (10.5)
× 10 seconds	42 (40.0)
5. According to the World Health Organization (WHO), what should one do after using an alcohol-based hand sanitiser to prevent the formation of a biofilm?	
✓ None of the listed options (i.e. NOT rinse hands with clean water; dry hands with sterile cloths; wash hands with soap and water; apply 1% chlorhexidine and rinse with clean water)	41 (39.1)
× rinse hands with clean water	23 (21.9)
6. Apart from the issue of skin tolerance and level of comfort, water temperature ...	
✓ does not appear to be a critical factor for microbial removal from hands being washed	21 (20.0)
× A and C is correct (does appear to be a critical factor for microbial removal from hands being washed AND does appear to influence the efficiency of the antimicrobial activity of the antimicrobial agents used for hand washing purposes)	53 (50.5)
12. How are antibiotic-resistant pathogens most commonly spread from one patient to another in healthcare settings?	
✓ From one patient to another via hands of contaminated healthcare workers	34 (32.4)
× Both A and D (airborne spread from patients coughing or sneezing AND from one patient to another via hands of contaminated healthcare workers.	61 (58.1)
13. What is the most frequent source of germs responsible for healthcare-associated infections with regard to cross-contamination?	
✓ Germs already present on or within the patient	8 (7.6)
× All the above mentioned (the hospital's water system AND germs already present on or within the patient AND the hospital air (air conditioners included) AND the hospital environment (surfaces))	46 (43.8)
17. The following hand condition can acquire and spread microorganisms the most readily:	
✓ Wet hands	31 (29.5)
× All of the above (hands with undamaged skin AND dry hands AND hands with gloves AND wet hands)	58 (55.2)

✓ = correct answer; × = most frequently chosen incorrect answer.

*Clinical significance:

20-30 seconds of alcohol-based hand rub (ABHR) recommended by the WHO constitute just a single step in hand hygiene but the optimal time is being challenged. Rinsing hands with water or wiping them with a towel immediately after using ABHR might counteract the effect of the product. The benefit of ABHR is also lost since frequent hand washing with soap and water promote skin dryness and irritation.

Hot water promotes skin irritation and might not be readily available. It is reassuring and important to know that water temperature is of less importance.

The transmission of bacteria is more likely to occur from wet hands than from dry hands and proper drying of hands should therefore form an integral part of the hand hygiene process.

Knowing that HCW's hands is the most important source of the spreading of germs and the fact that most germs occur from patient's own colonization is critical important to understand to ensure that ABHR should be used before touching and after touching each patient.

Pilot study

A pilot study was done on 60 third-year UFS medical students. Errors in completing the cards included insufficient shading of squares, crossing out instead of erasing incorrect answers and not completing all the questions. This was addressed during the main study with clear instructions on how to complete the cards.

Data analysis

The computer cards were scanned by the Department of Information and Communication Technology Services, UFS. Data were analysed by the Department of Biostatistics, Faculty of Health Sciences, UFS, using SAS® version 9.3 (SAS Institute, Cary, NC, USA). Results are summarised by frequencies and percentages (categorical variables).

Ethical aspects

The protocol was approved by the Ethics Committee of the Faculty of Health Science, UFS [STUD NR 20/2015]. Permission for the study was obtained from the Dean of Faculty of Health Sciences, Head of School of Medicine, Vice-Rector Research and Dean of Student Affairs, UFS. Students were informed that participation was voluntary, that the participant could withdraw at any time and that completion of the test was taken as giving consent.

Results

Of the 107 questionnaires handed out, 105 (response rate 98.0%) were completed and analysed (response rate out of total class of

128: 82.0%). The highest percentage of the 105 participants reported receiving formal training on hand hygiene as an infection control measure during their third year ($n = 47$, 44.8%) and second year ($n = 38$, 36.2%). Three-quarters ($n = 81$, 77.1%) felt that their training was sufficient. Almost all of the participants ($n = 101$, 96.2%) agreed that the prevalence of nosocomial infections in South Africa was rising.

Participants' average score was 46.8% (median 47.3%, range 10.1–73.6%). Some 61% of participants scored < 50%. Participants who felt that they had basic knowledge of hand hygiene ($n = 32$, 30.5%) had an average score of 47.9%. Participants with a self-reported knowledge level of more than basic but less than advanced ($n = 56$, 53.3%) had an average score of 44.9% while those who reported advanced knowledge ($n = 17$, 16.2%) had an average score of 50.8%. None of the students indicated that they had no knowledge of hand hygiene. Table 1 summarises the knowledge questions and correct answers.

Most students knew that gloves should be discarded after each task (79.1%), that examination gloves are used during direct and indirect patient exposure (69.5%), and that *Staphylococcus epidermidis* is present in high numbers on a swab taken of a patient's hand (84.8%).

Table 2 constitute important and integral steps towards improving compliance with hand hygiene in clinical practice. For the six questions where less than 40% of the students chose the

correct option, Table 2 indicates the most frequently chosen incorrect option. For three of these questions students mainly chose the option 'all/some of the above', which included the correct answers but also incorrect answers.

Discussion

Although 69.5% of the final-year medical students self-reported more than basic to advanced levels of knowledge and 77.1% were satisfied with the training they received in this regard, 61% failed the knowledge test. Nair *et al.*⁶ reported that 91.3% of participants felt they had sufficient knowledge on hand hygiene, but found that their actual knowledge was poor; for example, only 25.2% knew that it was necessary to wash hands prior to administering an injection. In a British study²⁵ among third-year medical students, 83% of students reported receiving formal training on hand hygiene; however, large percentages did not know the correct indications for using alcoholic hand gel (58%) or the correct use of hand gloves (35%). In the current study, just 53.3% knew that, according to the WHO,¹ the single most important way to prevent the spread of disease in the hospital environment is good hand hygiene practices.

The majority of students agreed that the prevalence of nosocomial infections was increasing in South Africa. However, only 7.6% knew that the most frequent source of microorganisms responsible for these infections was the patients themselves. This is much lower than the 45% reported by Maheswari *et al.*²⁶ Less than half of the final-year medical students knew that long-sleeved white coats promote the spread of infections and that doorknobs have the highest load of microorganisms. According to the WHO, wearing long-sleeved coats should be avoided.¹

In 2009, the WHO stated that alcohol-based hand sanitisers were one of the few fast and effective ways of inactivating a variety of potentially harmful microorganisms. In addition, it was suggested that these sanitisers be adopted as the gold standard for hand hygiene in health care.¹ Our study found that only 10.5% of the students knew that hands should not be rinsed with water after using alcohol-based sanitisers, as this negatively affects the alcohol's antimicrobial activity. In comparison, Nair *et al.*⁶ reported that 46.3% of students were aware of this.

Study limitations

Questionnaires were completed at the start of the fifth year of training. Later during that year, students might receive further training in infection control. However, since they already had daily responsibilities in the hospitals, their level of knowledge at the time of the study raises concern.

Conclusion

Final-year medical students at the UFS have a poor level of knowledge regarding hand hygiene as a basic measure of infection control. Their understanding of alcohol-based sanitisers as an antimicrobial agent is poor. The students also have a misconception of their self-perceived level of knowledge.

Recommendation

We recommend that training on hand hygiene be extended to the fourth and fifth year of study. Clinical evaluations can include an infection control station to assess students' knowledge.

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