



HAND CONTAMINATION, HAND HYGIENE KNOWLEDGE AND PRACTICE OF MEDICAL TRAINEES IN DIAGNOSTIC LABORATORY

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ABSTRACT

The objective of this study was to determine bacterial contamination of the hands in a group of medical trainee students attending practical training, in order to verify the reliability of the information on hand hygiene (HH) adherence obtained by a self-reporting questionnaire. The study questionnaire was designed with the purpose of investigating the effectiveness of basic health education and distributed to a convenience sample of 36 medical trainee students. Data collected was combined with the bacterial contamination of the hands measured both at the point of entry and exit from the ward. The most effective procedure in reducing bacterial contamination was the alternate use of hand washing and hand rubbing compared to only one practice and the absence of hand hygiene (geom. mean: 190, 400 and 900 CFU/hand respectively). Hand contamination was significantly higher in students who declared to have hardly ever/never implemented HH teaching during clinical practice compared to those who stated to have done it frequently/always (geom. mean: 695 vs 260 CFU/hand). The current investigation further enriches something new to the subject of Hand Hygiene which is an assessment of bacterial contamination of the hand to confirm the reliability of the information provided from the study questionnaire. The study findings though emphasize some critical aspects in Hand Hygiene teaching among medical trainee students, focus that substantial knowledge follows with correct laboratory behaviour techniques and subsequently result in significant reduction of bacterial contamination of the hand.

Keywords: Bacterial Contamination, Education, Hand Hygiene, Medical Trainee Students

I INTRODUCTION

Health Care-associated Infections (HCAIs) are the most important public health problem, creating a direct effect on the morbidity and mortality of patients, length of stay (LOS) in the hospital and expenses for both antimicrobial treatments and hospitalization [1]. About 30% of HCAIs can be prevented by simple control measures, and hand hygiene (HH) is the most effective single behaviour that can stop the spread of infection [2] Despite the availability of extensive guidelines, compliance with HH among healthcare workers is still low, rarely exceeding 50%, thus representing a critical issue in all healthcare settings [3]. Lack of time and lack of knowledge can be considered as



the barrier to HH compliance. Additionally, cultural barriers, lack of education and/or poor awareness of the risk of pathogens cross-transmission may contribute to a poor HH compliance [4]. Interventions designed to improve HH adherence within healthcare assistants have a limited long-term success: most of the campaigns promoting compliance seem to be associated with a transient effect, stressing the difficulty in changing personnels deep-rooted behaviour [5]. In this context, a key point in improving the compliance with HH protocols can proceed from establishing the effectiveness of the educational process of medical trainees since the beginning of their clinical training.

Several studies have examined undergraduate's HH knowledge and practices via a self-administered questionnaire, but this instrument has been reported to overestimate adherence [6]. Therefore, the main purpose of this study was to measure bacterial contamination of the hands in a group of Indian medical trainees attending clinical departments for practical training, in order to verify the reliability of the information on HH knowledge and practices obtained by a questionnaire. This questionnaire was administered with the aim of exploring the effectiveness of basic education. Information from this study may be useful to assess critical points and therefore to plan the application of targeted measures in the educational process of medical trainee students, in order to assure the adoption of proper behaviour from the beginning of their future jobs.

II METHODS

Study Design: This cross-sectional study was conducted between June-2016 to December-2016. The study sample consisted of 36 medical trainees attending practical training at the Diagnostic Laboratory in Mumbai, Maharashtra, India. The course was conducted for a period of 6 months. The bacterial contamination was investigated by hand swabbing specimen collected from all the study participants before entering the ward, and a second hand swabbing specimen at the end of the training shift. The study was performed in agreement with the principles of the Declaration of Helsinki. All the study participants signed a written informed consent.

Microbiological investigations: Samples from the dominant hand of all the study participants were collected by swabbing fingers and palms. Swabs were collected with the sterile cotton buds, soaked in 0.85% sterile saline solution [14]. Specimens were instantaneously transported to the laboratory for the determination of Heterotrophic Plate Count (HPC) at 37°C by the pour plate method using a reference standard, Plate Count Agar (PCA, Oxoid). The potentially pathogenic microorganisms like *Staphylococcus aureus*, *Pseudomonas aeruginosa*, coliforms, micrococci, enterococci and coagulase negative staphylococci (CNS) were also investigated by the standard cultural methods and validated with appropriate biochemical tests. Enumeration of bacterial colonies was done after incubation period of 24hours and 48hours. Experimental results were expressed as the number of colony forming units (CFU)/hand.



Study Questionnaire: The study questionnaire was prepared exclusively for the purpose of current study. It was composed of 20 questions and organized in three parts. The first part aimed to collect the general information about age and gender of the study participants. The second part of questionnaire was related to the knowledge of HH acquired during the medical training course, and consisted of six questions addressed to the following topics: when to perform HH, who is protected by proper HH, technique and duration of the procedures, usefulness of proper hand hygiene in hospital and relationship between HH and nosocomial infections. Whereas, in the third and final part, information about the morning shift activities that just concluded i.e. the department attended, activities carried out, tools employed, HH procedures applied (hand washing and/or hand rubbing) and other protective devices adopted, such as gloves, goggles and masks.

Statistical analysis: Statistical analysis was performed using SPSS software 21.0 (SPSS Inc, Chicago, IL). For knowledge items, a score of one was given for each correct answer, and a total score was calculated ranging from 0 to 6 with increasing knowledge. Logarithmic transformation was used in statistical analysis to normalize the non-normal distribution of the microbiological data, and the results are presented as geometric mean values.

III RESULTS

Questionnaire

The study comprised of 26 (72.22%) male and 10 (27.78%) female subjects. The mean age (\pm SD) was 24.2 \pm 5.4 years and 23.7 \pm 1.9 years, respectively. Table 1 summarizes the hand hygiene practices declared by the examined students.

A wide spectrum of patient care was declared among the medical trainee students: the patient’s personal hygiene, wound treatment, distribution of medicines, instrument contact, and collection of specimens, contact with biological fluids, and consultation of case history and the use of invasive instruments. 74% of medical students declared only a single type, mainly “observation during ward round” (56.1%).

Table 2 shows the HH knowledge scores in the study subjects in relation to the self-reported practices. Mean scores were significantly higher in students who applied HH compared to those not applying it, particularly at the ward entry. The lowest scores were measured in those who declared hardly ever/never implementing HH teaching during daily practice.

TABLE 1: Hand Hygiene (HH) practices and clinical activities frequencies in the study subjects

At least one practice	Frequency	Percentage (%)	Number of study subjects
Hand Washing	Once	75	27 / 36
	Twice	38.89	14 / 36



Hand Rubbing	Three or more times	22.2	8 / 36
	Once	36.11	13 / 36
	Twice	30.55	11 / 36
Gloves Use	Three or more times	25	09 / 36
	1-3 pairs	86.11	31 / 36
	4-10 pairs	36.11	13 / 36
	11-20 pairs	5	02 / 36
	>20pairs	0	0
HH at the Entry	%	27.7	10 / 36
HH at the Exit	%	25	09 / 36
Types of Activity	One type	75	27/36
	Two types	22.2	8/36
	Three types	5	2/36
	Four types	0	0/36
	Five types	0	0/36

TABLE 2: Mean scores of HH knowledge according to self-reported HH practices in the study subjects

HH practices	(N=36)	HH Knowledge score
		Mean ± SD
HH at the entry	Yes (20)	4.75 ± 0.87
	No (16)	4.58 ± 0.60
HH at the exit	Yes (18)	4.59 ± 0.77
	No (18)	4.82 ± 0.79
HH	Hand washing and hand rubbing (17)	4.96 ± 0.72
	Only one procedure (12)	4.36 ± 0.73
	None (07)	4.72 ± 0.78
Gloves use	Yes (20)	4.80 ± 0.84
	No (16)	4.59 ± 0.98
HH in clinical practice	Always/frequently (26)	4.98 ± 0.37
	Hardly ever/Never (10)	4.67 ± 0.50

IV BACTERIAL CONTAMINATION

All collected swabs before and after the training shifts were culture positive. Total number of bacterial (HPC) before training ranged from 23 to 157.750 CFU/hand (median, 1000) and from 20 to 776.875 CFU/hand (median, 450) at

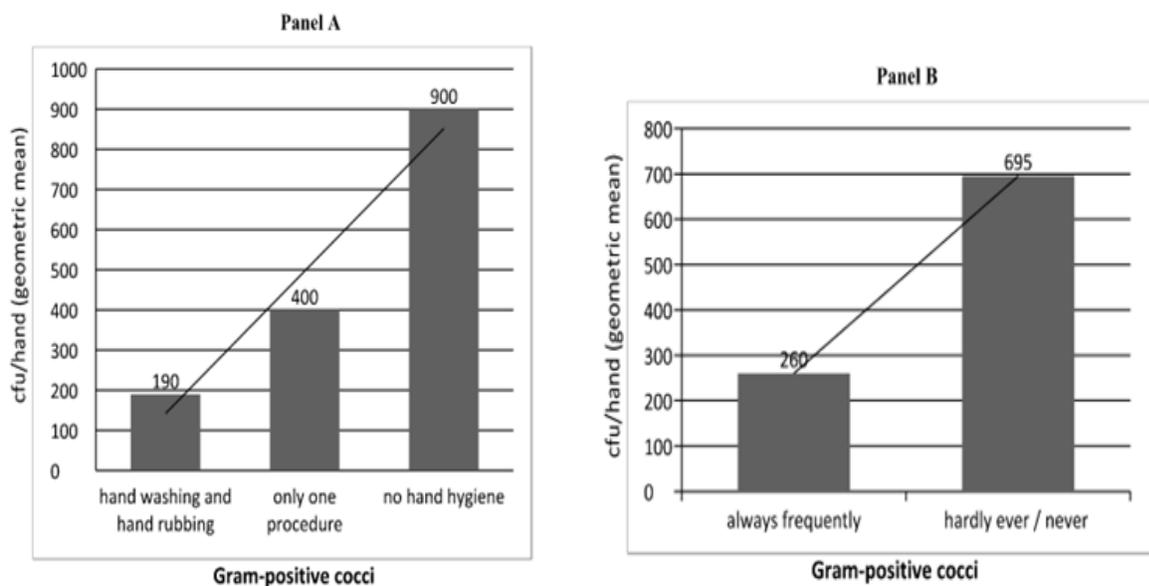
the end of training. The predominant flora was normal skin flora: coagulase-negative staphylococci and *Micrococcus* species, together hereinafter named as gram-positive cocci.

As shown in the Figure, bacterial contamination of the hand in the study subjects at the exit from the ward according to HH procedures and self-reported compliance. Gram-positive cocci count was significantly higher in the absence of HH practices, and the most effective procedure in reducing bacterial contamination was the alternate use of hand washing and hand rubbing (Panel A). Bacterial contamination of the hand was significantly higher in students who declared to hardly ever/never implement HH teaching during clinical practice compared to those who stated having done it frequently/always (Panel B).

V DISCUSSION

The current study discusses the three important attributes of Hand Hygiene so as to reduce the risk of nosocomial infection. This study also underscores the effectiveness of appropriate education to Medical students, the weight of knowledge in the application of appropriate practices during medical training, and the relationship between HH and bacterial contamination of the hand.

FIGURE 2: Hand Contamination at ward exit according to Hand Hygiene procedures (Panel A) and self-reported Hand Hygiene compliance (Panel B)



The sample size in this study, although not an entire representation of the entire medical trainee student population, exhibited a distribution in gender and age similar to other investigations recently performed on such groups. The role of professional mentors and teachers appears be of foremost importance in increasing student’s awareness of the risk of nosocomial acquired infections and the need for effective hand hygiene compliance, as documented in other



studies [7]. In India, medical students generally attend hygiene and public health teaching during the fifth/sixth year course with a delay in proper knowledge of HH practices. This study therefore stresses the opportunity to anticipate the teaching of basic hygiene when students begin clinical training. The limited HH performed by the medical trainee students under investigation may also depend on the infrequent occasions of patient interaction as the most frequent clinical activity deducted by the questionnaires was “*observation during the ward round*”, a tradition which nowadays should give way to a more appropriate professional training.

In the current study, the relevance of knowledge on the practical application of HH is confirmed. Students declaring to have not or rarely implemented any hand disinfection/washing are those who achieved the lowest score in HH knowledge. Similarly, low scores resulted in students stating lack of hand washing and/or hand rubbing at the ward entry. Proper hand hygiene at this moment represents another aspect which requires reinforcement during the educational programs, especially within the medical studies curricula.

A self-report questionnaire may be a critical point in the assessment of the effective HH application, because students can overestimate their compliance [8, 9]; therefore the measure of bacterial contamination of the hands to corroborate information obtained by questionnaire was introduced. The swabs collection, conducted by a single trained operator, was decided on the basis of feasibility: this method being simple, quick, sensitive and able to isolate and to quantify many different microorganisms with a single specimen. It permits the sampling of large numbers of subjects with little disturbance even in a hectic healthcare environment [10].

Several studies have examined the adequacy of hand cleansing by microbiological proof [11, 12]. This field study seems to prove the experimental data exhibiting the reduction of hand contamination after proper application of alcohol-based hand rub and/or soap and water. From the results of this study, the alternate use of the two procedures was confirmed to be the most effective way to reduce bacterial contamination, and this study agrees with the need to use both, depending on time, opportunity, accessibility and hand soiling degree (Figure 2, panel A) [13].

A possible limitation of this study is the use of a non-validated study questionnaire. The study questionnaire was designed ad-hoc to collect an amount of information in the shortest time like the training activities and HH practices carried out during the morning clinical practicum as well as general knowledge about hand hygiene, thus necessitating a short and simplified tool. While, the questionnaire in this study was not validated, it was prepared after an accurate literature review and consulting expert opinions; final content, comprehensibility and clarity.

VI CONCLUSIONS

The current investigation further enriches something new to the subject of Hand Hygiene which is an assessment of bacterial contamination of the hand to confirm the reliability of the information provided from the study questionnaire. The study findings though emphasize some critical aspects in Hand Hygiene teaching among medical trainee students, focus that substantial knowledge follows with correct laboratory behaviour techniques and subsequently result in significant reduction of bacterial contamination of the hand.



ACKNOWLEDGEMENT: I thank all the medical trainee students who participated in the current study.

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