

Quality Assessment of Hand Hygiene and Effectiveness of WHO 6 Step Training among Healthcare Personnel in a Tertiary Care Cancer Hospital in Trivandrum, India: A Cross-sectional Study

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ABSTRACT

Introduction: World Health Organization (WHO) 6 steps for effective Hand Hygiene (HH) practice to prevent cross infections emphasises on coverage of all aspects of the hand with the Alcohol Based Hand Rub (ABHR). The quality of hand rubbing usually remains un-monitored among healthcare workers. Hence, interventions to ensure both compliance and quality combined with periodic training would fill the deficiency in these practices in the healthcare setting.

Aim: To analyse the quality of HH using an Ultraviolet (UV) sensitive ABHR among healthcare workers in the Operation Theatre (OT) and post-surgical Intensive Care Unit (ICU).

Materials and Methods: This cross-sectional study was conducted in Regional Cancer Centre, Trivandrum, Kerala, India. Study population included 104 healthcare providers in the OT and post-surgical ICU, over a period of two months, from June 2017 to July 2017. Participants were asked to disinfect their hands according to WHO 6 steps using an ABHR to which an UV light sensitive pigment was added, and then place them in an UV light sensitive cabinet. Digital images of both sides of their hands were recorded. Every area of the hand not covered by the hand rub appeared as a dark spot and was considered an

error. Pass criteria allowed a maximum of two small uncovered areas (dark spots $<0.6 \text{ cm}^2$) on the dorsal side of the hand and no uncovered areas on the palmar aspect. Each hand was observed specifically at four areas and the most missed areas were identified. Statistical analysis was done by Fisher's-exact test using Statistical Package for Social Sciences (SPSS) version 28.0.

Results: Out of the total 104 participants, 28 were doctors, 46 were nurses, 22 were nursing students and 8 were OT technicians. A total of 65 participants were males (62%) and 85 participants (82%) were in the 35-40 years age group. The HH was found to be better on the right hand in all the sub-groups studied. The difference in the hand rub coverage on all the four observed areas of the right hand was not significant. On the left-side, hygiene in between the fingers (p-value 0.012) and at the finger tips (p-value 0.007) was poorest. Among the groups studied, doctors performed better with a higher group score of 60.7% compared to 22.7% of that of nursing students (p-value 0.030).

Conclusion: Quality of HH practice using ABHR among personnel involved in peri-operative care is poor and requires improvement with regular monitoring and training.

Keywords: Alcohol based hand rub, Compliance, Hand hygiene practice, Healthcare workers, World Health Organisation

INTRODUCTION

The HH is now regarded as one of the most important elements of infection control for preventing Hospital Acquired Infections (HAI's) [1]. Adherence to the recommended HH practices remains unacceptably low, rarely exceeding 40% of situations in which HH is indicated [1]. The global initiative of WHO "Clean Care is Safer Care" launched in 2005 emphasises the need for developing countries to focus on the implementation of basic infection prevention practices. In 2009, WHO launched guidelines and tools on HH and recommends five crucial moments and six practical hand rubbing steps through which ABHR have been proven effective [2].

Targeted, multifaceted approaches focusing on system change, administrative support, availability of ABHR, motivation, training and intensive education of Healthcare Workers (HCW) and reminders in the workplace have been recommended for improvement of HH [3]. HH is the "corner stone" of prevention of most communicable diseases [4]. ABHRs constitute the most effective agents to avoid bacterial cross transmission via hands of Healthcare Personnel (HCP) [5]. The WHO HH guidelines address several aspects related to the quality of the HH action. A specific 6-step technique has been

recommended via the "How to Hand Rub" poster [2]. Despite these recommendations and guidelines, compliance with HH remains suboptimal among HCP [6].

The HAIs are infections acquired in hospital by the patient who was admitted for a reason other than that infection [7]. The importance of hands in the transmission of hospital infections has been well demonstrated and can be minimised with appropriate HH [8]. Hand rubbing with alcohol based solutions is now considered the standard of care [9,10]. Most studies on HH have focussed on monitoring compliance to the five moments rather than the quality of application [11-14]. The primary aim of the study was to analyse the quality of HH using an UV sensitive hand rub among healthcare workers in the OT and post-operative ICU.

MATERIALS AND METHODS

A cross-sectional study was conducted at Regional Cancer Centre (RCC), Thiruvananthapuram, Kerala, India, during June to July 2017 after obtaining Institutional Review Board approval IRB No. 09/2016/07. Informed consent was obtained from all individual participants included in the study.

Inclusion criteria: The study was conducted on voluntary participants. A total of 104 OT and post-surgical ICU personnel including doctors, nurses, OT technicians and nursing students were included.

Exclusion criteria: Staffs with hypersensitive skin or with skin allergies were excluded.

Sample size estimation: Based on the study by Szilágyi L et al., with a proportion of 77% pass, level of significance fixed at 5% and precision at 10%, the minimum sample require for the present study was 68 [2].

$$n = \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

n=sample size, p=0.77, d=0.10, $Z_{1-\alpha/2}=1.96$ for $\alpha=0.05$

All the staffs in the OT and ICU were included to avoid selection bias.

Procedure

The assessment was done by the same investigator on different days and different working shifts so as to include majority of the staff. Since RCC is a tertiary cancer hospital, all the medical, paramedical and nursing staffs were trained every six months on the importance and techniques of HH practices. The purpose of the study was explained to all the included staff. They were instructed to disinfect their hands during the course of their work with an ABHR, (Sterilium; Propan-2-ol 45.0 g, Propan-1-ol 30.0 g, Mecetroniumetil sulfate 0.2 g, Glycerol 85%, Tetradecane-1-ol, Patent blue V 85%, Purified water) to which an odourless and colourless UV light sensitive pigment (Schülke Optik; Schülke and Mayr GmbH, Norderstedt, Germany) [2] was added. The hands were then placed in a cabinet which had an inbuilt UV light. Digital images of the palmar and dorsal aspect of the hands upto the wrist were obtained. The images were evaluated for the quality of the hand rubbing technique.

Four main areas of the hand were assessed; palm, dorsum, in between the fingers and tips of fingers. Dark spots $<0.6 \text{ cm}^2$ were defined as small errors. A maximum of two small uncovered areas on the dorsum of the hand and no uncovered area on the palmar aspect was considered as good hygiene, as described in study by Szilágyi L et al., [2]. Data was obtained separately for both the hands. The identifying variables included date, time and to which category of OT staff they belonged to. All the data were computerised.

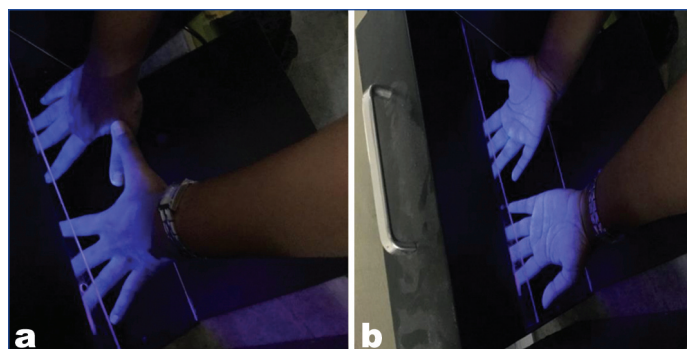
STATISTICAL ANALYSIS

The statistical analysis of the data was done using the SPSS version 28.0. The categorical variables were presented using counts and percentages. The association between two categorical variables were assessed using Fisher's-exact test. A p-value of <0.05 was considered as significant.

RESULTS

Out of the total 104 participants, 28 were doctors, 46 were nurses, 22 were nursing students and 8 were OT technicians. A total of 65 participants were males (62%) and 85 participants (82%) were in the 35-40 years age group. The areas on the hand that were coated with the hand rub appeared as brightly lit areas whereas the areas that were missed appeared as dark spots [Table/Fig-1]. After analysing the digital images, the total pass percentage was 50% when all the groups were considered. Out of 28 doctors, 17 (60.7%) passed the test which was highest among all the groups. Nursing students performed the worst with 17 (77.3%) failures. A total of 20 (43.5%) staff nurses failed whereas 26 (56.5%) passed. Of the eight technicians, 50% met the pass criteria. A statistically significant difference (p-value 0.030) was found in the hygienic practices between the studied HCWs [Table/Fig-2].

The difference in hand rub coverage among the participants on all the four observed areas of the right hand were not significant (palm-p-value 0.211, dorsum- p-value=0.246, between fingers- p-value



[Table/Fig-1]: Digital examination in Ultraviolet (UV) cabinet. a) Dorsal aspect of hand of healthcare personnel b) Palmar aspect of hand of healthcare personnel.

Group		Hand hygiene		Total	p-value
		Bad	Good		
Staff nurses	Count	20	26	46	0.030
	% within group	43.5%	56.5%	100.0%	
Doctors	Count	11	17	28	
	% within group	39.3%	60.7%	100.0%	
Nursing students	Count	17	5	22	
	% within group	77.3%	22.7%	100.0%	
Technicians	Count	4	4	8	
	% within group	50.0%	50.0%	100.0%	
Total	Count	52	52	104	
	% within group	50.0%	50.0%	100.0%	

[Table/Fig-2]: Quality of hand hygiene among all the groups. p-value <0.05 is significant

0.355, fingertips- p-value=0.085) [Table/Fig-3]. In the left hand however, uncovered areas were seen mostly between the fingers and at the fingertips with significant p-values of 0.012 and 0.007, respectively [Table/Fig-4,5]. Hence, it was concluded that the HH of the right hand was better. The missed areas of both the hands with respect to each group are demonstrated [Table/Fig-2,6].

DISCUSSION

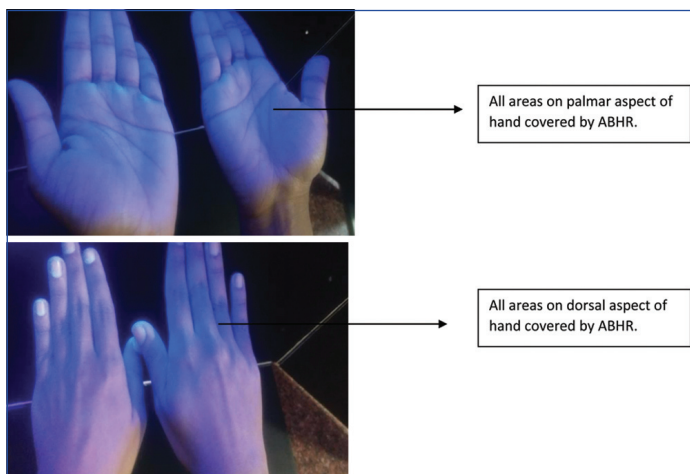
Healthcare associated infections are gaining increasing attention as they cause high morbidity, mortality and treatment costs. Though it is well established that they could be preventable, the development of multi-drug resistant strains and the paucity of availability of newer anti-microbials have necessitated a re-look in to the basic practices of infection control. Good hand washing can fight the spread of the common cold, meningitis, bronchitis, influenza, hepatitis A, and most types of infectious diarrhoea [14]. A review of randomised controlled trials of handwashing interventions in developing countries found that handwashing can reduce diarrhoeal episodes by an average 31% and also the incidence of respiratory infections by 21% [11].

Microorganisms that cause HAIs are commonly transmitted via the hands of healthcare personnel [12,13]. Two types of microbes colonise the hands; the resident flora which reside in the superficial layers of the skin and the transient flora which colonise the superficial skin layers. The transient ones do not multiply, are acquired by HCWs during direct contact with the patient and their surroundings. They are the usual causes of HAI's and are amenable to removal by HH [1]. Every year on the October 15, Global Hand washing Day has been celebrated since 2008 to motivate and mobilise people around the world to wash their hands [13]. Proper HH is the single most important, simplest and least expensive means of reducing the prevalence of HAI's [14-16].

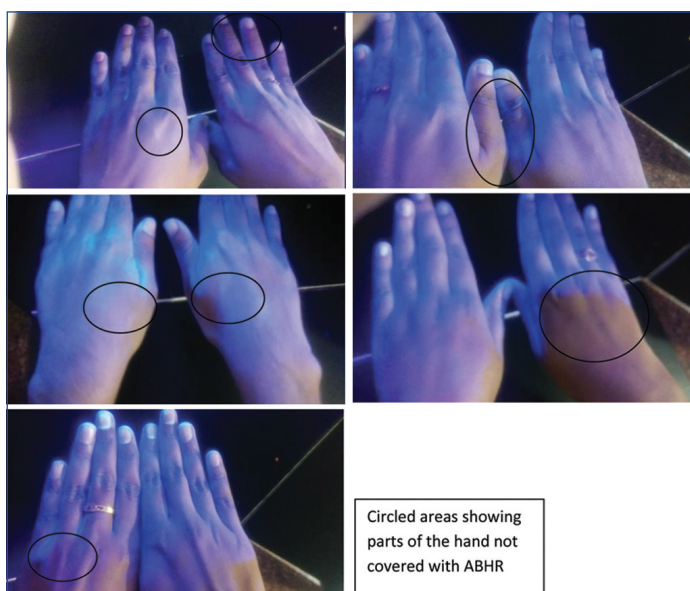
In 2002, the Centre for Disease Control recommended the use of ABHRs for the decontamination of hands especially when they are not visibly soiled. In the absence of manufacturers recommendations, a volume of 3 ml is recommended to ensure full coverage [15]. They

Hand areas	Hand rub coverage	Right hand (Total N=104)				p-value	Left hand (Total N=104)				p-value
		Staff nurses# (N=46) n (%)	Doctors# (N=28) n (%)	Nursing students# (N=22) n (%)	Technicians# (N=8) n (%)		Staff nurses# (N=46) n (%)	Doctors# (N=28) n (%)	Nursing students# (N=22) n (%)	Technicians# (N=8) n (%)	
Palm	Missed	1 (0.96)	1 (0.96)	3 (2.88)	0	0.211	2 (1.92)	0	3 (2.88)	0	0.168
	Unmissed	45 (43.26)	27 (25.96)	19 (18.26)	8 (7.69)		44 (42.3)	28 (26.92)	19 (18.26)	8 (7.69)	
Dorsum	Missed	16 (15.38)	8 (7.69)	12 (11.53)	2 (1.92)	0.246	9 (8.65)	7 (6.73)	10 (9.6)	2 (1.92)	0.168
	Unmissed	30 (28.8)	20 (19.2)	10 (9.6)	6 (5.76)		37 (35.57)	21 (20.19)	12 (11.53)	6 (5.76)	
Between fingers	Missed	19 (18.26)	12 (11.53)	14 (13.46)	4 (3.84)	0.355	16 (15.38)	9 (8.65)	15 (14.42)	1 (0.96)	0.012
	Unmissed	27 (25.96)	16 (15.38)	8 (7.69)	4 (3.84)		30 (28.8)	19 (18.26)	7 (6.73)	7 (6.73)	
Finger tips Nails	Missed	25 (24.03)	14 (13.46)	18 (17.3)	4 (3.84)	0.085	20 (19.2)	9 (8.65)	16 (15.38)	1 (0.96)	0.007
	Unmissed	21 (20.19)	14 (13.46)	4 (3.84)	4 (3.84)		26 (25)	19 (18.26)	6 (5.76)	7 (6.73)	

[Table/Fig-3]: Percentage distribution of staff with most missed areas on the palm, dorsum, between fingers and finger tips of right and left hand. p-value <0.05 is significant

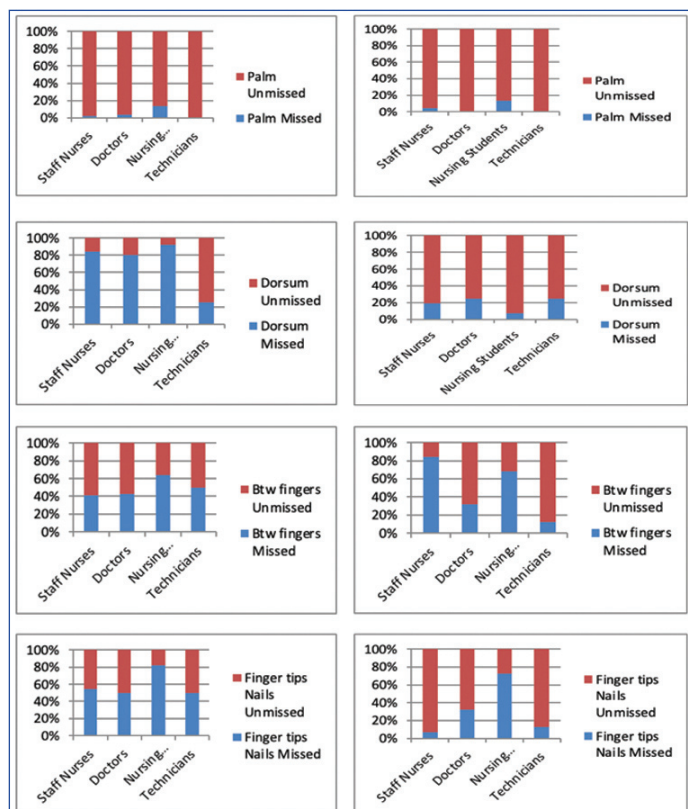


[Table/Fig-4]: Good hand hygiene, dorsal and palmar aspect.



[Table/Fig-5]: Poor hand hygiene with missed areas on the dorsal aspect, in between fingers and finger tips.

could be superior to hand washing as they take less time, are more effective, less irritating to the skin, and contribute to sustained improvement in compliance associated with decreased infection rates [16]. ABHR kills 99.8% of organisms living on the hands [17]. The gel contains hand moisturisers which keep the hands in good condition-therefore using alcohol gel is much kinder on the hands than soap and water [16,18,19]. There is substantial evidence in the literature comparing traditional hand washing methods with soap and water with ABHR [20-22]. ABHR has been consistently found to be more effective than hand washing with antimicrobial or non antimicrobial soaps in the studies by Wang Y et al., and Widmer



[Table/Fig-6]: Graphical distribution of missed and unmissed areas of right and left hand grouped by occupation.

AF et al., switching to alcohol based disinfection in the ICUs would decrease the time necessary from 1.3 hours (17% of total nursing time) to 0.3 hours (4% of total nursing time) [23,24]. The WHO guidelines for HH in healthcare; based on criteria issued by the Hospital Infection Control Practice Advisory Committee (HICPAC); in 2006 defined ABHR, where available as the standard care for HH practices in healthcare settings, whereas hand washing is reserved for particular situations only [21,24].

According to a study by WHO, the highest prevalence of nosocomial infections occurs in ICU and in acute surgical and orthopaedic wards [22]. In the study, the OT and the post-surgical ICU was chosen as the setting because most of the patients have undergone chemotherapy are immunosuppressed, undergone extensive resections and the intensity of patient care needed is high. Hand rubbing with ADHR is the recommended HH practice in ICU of present study centre. The staff to patient ratio is low and the number of HH opportunities per patient hour is higher than in the wards. Therefore the compliance and the quality required also need to be higher.

Most literature on HH practices is on the compliance rates and the causes of its failure in HCWs [17,19]. The compliance rates vary from 5 to 89% with an overall average of 38.7% [23]. Some of

the main factors for poor compliance include lack of knowledge, combined with unawareness of HH indications, high patient to nurse ratio, working in intensive care, working during the week, working in surgical care unit, performing activities with high risk of cross transmission and caring of patients recovering from clean/clean-contaminated surgery in the post-anaesthesia care unit [25]. All the groups in the study were aware of the HH indications and were familiar with the WHO recommendations [26,27].

While performing the six steps of hand rubbing, coverage of all the areas of the hand indicates a good HH. Despite good knowledge and compliance, some areas may remain missed and they may act as potential sources for transmitting infections by the HCWs. Since there was no established methodology to test the quality, an objective assessment to assess the coverage of the hands with the ABHR by obtaining digital images was done. The UV sensitive pigment that we used was colourless and odourless. In the study done by Szilágyi L et al., an UV sensitive cabinet was used to look for patterns and trends in missed areas after the use of WHO's 6 Step technique with ABHRs, a similar method was followed in the present study [2]. Their study was conducted at The National University Hospital (NUH) of Singapore and Tery-Hand monitoring devices provided by the Budapest University of Technology and Economics (BME, Hungary) were used to obtain digital images. They evaluated a total of 4642 hospital staff and grouped them by their gender and occupation. The most frequently missed sites that they identified were the dorsal side of fingers, the proximity of nails, on thenar eminence and the wrist crease in comparison, in the present study, a total of 104 staff were studied and grouped by their occupation. HH was found to be poorer on the left hand. The most missed areas were the finger tips and in between fingers of the left hand. The results were not analysed with respect to age and gender.

Though the non compliance was not monitored, the study gave the advantage of monitoring the quality of the hand rubbing technique. It was easy to perform, and took lesser time to obtain the results. The study identified the key areas of the hand that needed to be focused. The poor quality observed could be due to time constraints, increased turnover of the patients or the lack of knowledge.

The results of the study were put forth to the hospital infection control committee as well as the OT committee. Over the next three months, HCW's other than the OT and the ICU were observed and similar deficiencies were found in the HH. Hence, further training of HH practices involved focussing on the finer details of hand rubbing. Compliance and faulty techniques were identified, audited and reported. The audits were displayed every week. The present study did not conduct a follow-up study to assess the improvement of the HH quality or in the incidence of infections three months after a change in the training programmes. But by extending this study to the patient treatment areas of the entire hospital, we hope to improve the awareness with regard to poor quality of the HH practices among HCW's.

Limitation(s)

The major limitation of the present study was that the study was limited to a particular setting and did not include the HCWs of the entire hospital. Hence, the sample size of the study was small. Another drawback was that the volunteers did not undergo a microbiological assessment of their hands to confirm the quality of disinfection of the areas covered by the ABHR. It was assumed that if the hands were fully covered it qualified for a good hygiene. Also only a single reading of each staff was obtained.

CONCLUSION(S)

The study concluded that HH was poor among the HCW's of the present hospital despite good infection control and training programmes. Though HH with ABHR was widely practiced in the institute, missed areas were seen which suggested a faulty

technique. Since most of the patients in the study setting are immunocompromised, infections among them call for aggressive adherence to quality in HH. Using this simple strategy will make monitoring easy and help us to formulate training programmes specifically targeted at the risk groups. Monitoring compliance does not translate into monitoring the quality of HH.

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