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Original Article

Microbiology Section

# Impact of Healthcare Workers' Educational Background on Hand Hygiene Practices in a Tertiary Care Hospital: A Cross-sectional Study

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## ABSTRACT

**Introduction:** The practice of Hand Hygiene (HH) is an important measure to reduce the incidence of Hospital-Acquired Infections (HAIs). As Healthcare Workers (HCWs) are constantly in contact with patients and their surroundings, they should be well-informed about HH.

**Aim:** To assess the effect of different educational backgrounds on the practice of HH among HCWs and suggest measures to rectify any gaps.

**Materials and Methods:** This questionnaire-based cross-sectional study was conducted among HCWs at Gadag Institute of Medical Sciences, Gadag, Karnataka, India including doctors, nurses and laboratory technicians, over the duration of one month in March 2024. Universal sampling was used to select the study subjects. A HH knowledge questionnaire for HCWs developed by the World Health Organisation (WHO) was employed for data collection. The responses were categorised into three groups based on scores: good, moderate and low knowledge. Data were entered into an Excel sheet and analysed using Epi Info software. Frequencies, Chi-square tests, etc., were applied. A p-value of <0.05 was considered significant.

**Results:** The response rate for the study was 311 (58%). The majority of subjects (236 or 76%) had moderate knowledge about HH. Doctors displayed better knowledge than nurses, who in turn showed better knowledge than technicians. However, 297 (95.5%) of them had received formal training in HH within the last three years and 299 (96%) participants routinely used Alcohol-Based Hand Rub (ABHR) for HH.

**Conclusion:** Differences in educational background significantly affect the knowledge of HH among HCWs. This study emphasises the need for repeated training, motivation and regular supervision to increase the knowledge of HH among HCWs, especially among nurses and technicians.


**Keywords:** Alcohol based hand rubs, Education, Hand sanitisers, Hand washing

## INTRODUCTION

Worldwide, patients and HCWs face a serious risk of HAIs. HAIs impact hundreds of millions of people annually, with the burden being greater in low- and middle-income countries, according to published data [1]. According to WHO estimate, around 1.4 million patients are affected by HAIs at any given moment [2]. The consequences of HAIs include longer hospital stays, higher rates of morbidity and mortality, a greater financial burden on patients and their families, and an increase in Antibiotic Resistance (ABR) [1]. Pathogens are frequently transmitted from one patient to another through the hands of healthcare personnel. In this regard, HH is considered one of the most important aspects of infection control [3].

HH is an umbrella term for handwashing procedures used to prevent infections and colonisation in patients, HCWs and the healthcare environment. Methods can include using water alone, water and soap, an ABHR, or water with a medicated (antiseptic) detergent. Using ABHRs reduces skin microbes more quickly and requires less time than washing [1]. The WHO has established specific standards for HH [4]. One initiative aimed at stopping the spread of HAIs is the WHO's "My Five Moments for Hand Hygiene" campaign. The five scenarios that necessitate the use of HH are: before handling a patient, before performing aseptic and clean procedures, after being at risk of coming into contact with bodily fluids, after touching a patient and after touching the patient's surroundings [4].

Despite the importance of HH practices, global adherence among HCWs is low, with an average compliance percentage of less than or roughly 50% [5]. Previous studies have examined HCWs' adherence to WHO guidelines for HH and evaluated their understanding of HH practices [1,6]. In the majority of these studies, data were gathered using the WHO's HH knowledge questionnaire for HCWs [7,8]. The present study was conducted to specifically identify the gaps in the knowledge of HCWs regarding the "when, how, and why" of HH and to assess the influence of their educational background on this.

The aim of this study was to assess the effect of different educational backgrounds on the practice of HH among HCWs and to suggest measures to rectify any gaps. The primary objective of the study was to assess the knowledge of HH among HCWs at Gadag Institute of Medical Sciences (GIMS), Gadag, Karnataka, India. The secondary objective of the study was to determine the association between knowledge of HH and the educational background and formal training of HCWs at GIMS, Gadag, and to suggest measures to address any gaps.

## MATERIALS AND METHODS

The present cross-sectional study was conducted among HCWs at Gadag Institute of Medical Sciences, Gadag, Karnataka, India. The study took place over the duration of one month in March 2024. The confidentiality of study participants was maintained by identifying them with numbers. Ethical clearance for the study was obtained from the Institutional Ethical Committee (L. No. GIMS/ICE/151/24). Informed consent was obtained from all participants in this study.

To acquire data, the universal sampling approach was employed. The estimated sample size was 540, calculated by adding the total number of doctors, nurses and laboratory technicians in our institution.

**Inclusion criteria:** All doctors (including consultants, postgraduate students, and interns), nurses, and laboratory technicians in our institution who provided voluntary consent to participate in the study were included in the study.

**Exclusion criteria:** HCWs absent during the data collection period and those with hand deformities were excluded from the study.

### Study Procedure

A self-administered WHO HH questionnaire for HCWs [7], consisting of 21 items, was distributed to all participants. The initial 11 questions aimed to gather demographic details (personal ID, date, facility, service, ward, city, country, gender, age, profession, department). Two questions were included regarding formal training in HH and routine use of ABHR, and the remaining eight questions assessed knowledge of HH, with subquestions making a total of 25 questions. Each correct response was awarded one mark, while incorrect responses received zero marks [8]. The level of HH knowledge was classified into three groups based on the score: a score of more than 75% was considered good, 50-74% as moderate and less than 50% as low [8].

## STATISTICAL ANALYSIS

Data were entered into an Excel sheet and analysed using Epi Info software. Frequencies, Chi-square tests and other statistical methods were used. A p-value <0.05 was considered significant.

## RESULTS

Out of a total of 540 HCWs, 311 participated in the present study. The gender distribution among the study participants was almost equal [Table/Fig-1]. The distribution of profession/educational background among the participants is shown in [Table/Fig-2]. Of these, 297 (95.5%) had received formal training in HH within the last three years, and 299 (96%) routinely used ABHR for HH [Table/Fig-3,4]. [Table/Fig-5] shows the responses to the survey based on the HH knowledge questionnaire for healthcare workers by WHO.

| Gender | n (%) |
|---|---|
| Male | 155 (49.8) |
| Female | 156 (50.2) |

**[Table/Fig-1]:** Distribution of gender of participants.

| Profession | n (%) |
|---|---|
| Doctors | 236 (76) |
| Nurses | 47 (15) |
| Technicians | 28 (9) |

**[Table/Fig-2]:** Distribution of profession/background education among the participants.

| Formal training in Hand Hygiene (HH) | No. of doctors | No. of nurses | No. of technicians | Total no. of participants |
|---|---|---|---|---|
| Received formal training in HH in last three years | 222 | 47 | 28 | 297 (95.5%) |
| Did not receive formal training in HH | 14 | 0 | 0 | 14 (4.5%) |
| Total | 236 | 47 | 28 | 311 |

**[Table/Fig-3]:** Formal training in Hand Hygiene (HH) among Healthcare Workers (HCW).

Only 132 (42.4%) of respondents believed that unclean hands of healthcare personnel would be the primary means of spreading potentially dangerous germs from patient to patient in a medical facility. Just 77 (25%) of the participants were certain that the germs already present on or inside the patient were the most common cause of HAIs. A total of 302 (97%) respondents acknowledged that practicing HH before handling a patient would undoubtedly prevent the spread of germs to them, while 280 (90%) agreed that practicing HH just before a clean or aseptic procedure would prevent the spread of germs to the patient. Regarding the HH actions to prevent the spread of germs to HCWs, 278 (89%) of the participants stated that HH after touching a patient would be helpful, 283 (91%) agreed that it would be useful right after a risk of body fluid exposure, and 274 (88%) thought it would be beneficial after exposure to a patient's immediate surroundings.

| Routine use of alcohol based hand rub for Hand Hygiene (HH) | No. of doctors | No. of nurses | No. of technicians | No. of participants |
|---|---|---|---|---|
| Yes | 227 (96%) | 47 (100%) | 25 (89%) | 299 (96%) |
| No | 09 (4%) | 0 | 03 (11%) | 12 (4%) |
| Total | 236 | 47 | 28 | 311 |

**[Table/Fig-4]:** Routine use of alcohol based hand rub for Hand Hygiene (HH) among the participants.

However, only 193 (62%) of the HCWs correctly identified that 20 seconds is the minimum amount of time needed for an ABHR to eradicate the majority of hand germs. Wearing jewellery (76%), damaged skin (83%), and artificial fingernails (84%) were identified by the majority as situations associated with an increased likelihood of colonization of hands with harmful germs.

[Table/Fig-6] represents the distribution of HH knowledge among the HCWs. The majority (76%) of HCWs exhibited moderate knowledge regarding HH, 19% showed poor knowledge, and only 5% had good knowledge of HH. Most participants with good knowledge were found to be doctors. On the other hand, the majority of technicians were found to have poor knowledge, while most nurses exhibited moderate knowledge of HH. The difference in knowledge scores between different educational backgrounds among HCWs was statistically significant (p-value=0.00001).

[Table/Fig-7] shows the association of HH knowledge with respect to formal training received in the past. There was no significant association between formal training in HH received in the past and knowledge of HH (p-value=0.2923).

## DISCUSSION

The understanding of HH practices among different HCWs was investigated in this study. Similar to previous studies, the gender distribution of participants in this study was almost equal [9,10]. However, in some other studies, female participants outnumbered males [11]. Routine HH practices significantly lower the number of potential infectious agents, such as *Staphylococcus aureus*, Gram negative bacilli, or yeasts, that are carried on hands and thus reduce morbidity and mortality [12-14]. In present study, the majority of participants had already received formal training in HH within the last three years. A total of 96% of nurses and 100% of doctors, respectively, followed routine ABHR practices, while the percentage was less than 90% in the case of technicians. The COVID-19 pandemic has played a major role in creating awareness about HH even among the general population, reinforcing HH practices and prompting HCWs to undergo HH training [15].

From the survey, it is clear that less than 50% of the participants knew about the source of potential germs and the most common routes of cross-transmission in hospitals. In a study conducted in Mashhad, Iran, more than 70% of HCWs had good knowledge of the routes of transmission; however, fewer than 50% knew about the origin of pathogens in HAI transmission [16]. The need for practicing HH is still unknown to the majority of HCWs.

On the other hand, most of them had a better understanding of the "five moments of HH" [4]. This contrasts with findings from research in Nigeria, where less than half of the HCWs knew that handwashing was indicated before touching a patient [17].

| Parameter (Correct response in Bold letters) | | Frequency (%) |
|---|---|---|
| **1. Main route of cross transmission of potentially harmful germs between patients in a healthcare facility** | | |
| **Healthcare Workers (HCW) hands when not clean** | | 132 (42.4) |
| Air circulation in the hospital | | 34 (11) |
| Patients exposure to colonised surfaces | | 134 (43.1) |
| Sharing non invasive objects | | 11 (3.5) |
| **2. Most frequent source of germs responsible for healthcare associated infections** | | |
| Hospitals water system | | 37 (12) |
| Hospital air | | 59 (19) |
| **Germs already present on or within the patient** | | 77 (25) |
| The hospital environment | | 138 (44) |
| **3. Hand Hygiene (HH) actions that prevent transmission of germs to the patients** | | |
| 3a. Before touching a patient | **Yes** | 302 (97) |
| | No | 9 (3) |
| 3b. Immediately after a risk of body fluid exposure | Yes | 274 (88) |
| | **No** | 37 (12) |
| 3c. After exposure to the immediate surroundings of a patient | Yes | 249 (80) |
| | **No** | 62 (20) |
| 3d. Immediately before a clean/aseptic procedure | **Yes** | 280 (90) |
| | No | 31 (10) |
| **4. Hand Hygiene (HH) actions that prevent transmission of germs to the HCW** | | |
| 4a. After touching a patient | **Yes** | 278 (89) |
| | No | 33 (11) |
| 4b. Immediately after a risk of body fluid exposure | **Yes** | 283 (91) |
| | No | 28 (9) |
| 4c. Immediately before a clean/aseptic procedure | Yes | 256 (82) |
| | **No** | 55 (18) |
| 4d. After exposure to the immediate surroundings of a patient | **Yes** | 274 (88) |
| | No | 37 (12) |
| **5. Which of the following statements on Alcohol-Based Hand Rub (ABHR) and hand washing with soap and water are true?** | | |
| **5a. Hand rubbing is more rapid for hand cleansing than hand washing** | | |
| **True** | | 284 (91) |
| False | | 27 (9) |
| **5b. Hand rubbing causes skin dryness more than hand washing** | | |
| True | | 245 (79) |
| **False** | | 66 (21) |
| **5c. Hand rubbing is more effective against germs than hand washing** | | |
| **True** | | 185 (59) |
| False | | 126 (41) |
| **5d. Hand washing and hand rubbing are recommended to be performed in sequence** | | |
| True | | 227 (73) |
| **False** | | 84 (27) |
| **6. Minimal time required for alcohol based hand rub to kill most germs in your hands** | | |
| **20 seconds** | | 193 (62) |
| 3 seconds | | 15 (5) |
| 1 minute | | 81 (26) |
| 10 seconds | | 22 (7) |
| **7. Which type of Hand Hygiene (HH) method is required in the following situations?** | | |
| **7a. Hand Hygiene (HH) method required before palpation of abdomen** | | |
| **Rubbing** | | 233 (75) |
| Washing | | 69 (22) |
| None | | 9 (3) |
| **7b. Hand Hygiene (HH) method required before giving an injection** | | |
| **Rubbing** | | 178 (57) |
| Washing | | 121 (39) |
| None | | 12 (4) |
| **7c. Hand Hygiene (HH) method required after emptying a bed pan** | | |

| | |
|---|---|
| **Rubbing** | 121 (39) |
| Washing | 186 (60) |
| None | 4 (1) |
| **7d. Hand Hygiene (HH) method required after removing examination gloves** | |
| **Rubbing** | 138 (45) |
| Washing | 169 (54) |
| None | 4 (1) |
| **7e. Hand Hygiene (HH) method required after making patient's bed** | |
| **Rubbing** | 151 (49) |
| Washing | 157 (50) |
| None | 3 (1) |
| **7f. Hand Hygiene (HH) method required after visible exposure to blood** | |
| Rubbing | 74 (24) |
| **Washing** | 233 (75) |
| None | 4 (1) |
| **8a. Which of the following should be avoided as associated with increased likelihood of colonisation of hands with harmful germs? A. wearing jewellery** | |
| **Yes** | 236 (76) |
| No | 75 (24) |
| **8b. Which of the following should be avoided as associated with increased likelihood of colonisation of hands with harmful germs? B. Damaged skin** | |
| **Yes** | 259 (83) |
| No | 52 (17) |
| **8c. Which of the following should be avoided as associated with increased likelihood of colonisation of hands with harmful germs? C. Artificial finger nails** | |
| **Yes** | 261 (84) |
| No | 50 (16) |
| **8d. Which of the following should be avoided as associated with increased likelihood of colonisation of hands with harmful germs? D. Regular use of hand cream** | |
| Yes | 172 (55) |
| **No** | 139 (45) |

**[Table/Fig-5]:** Table representing the responses to survey based on Hand Hygiene (HH) knowledge questionnaire for HCWs by World Health Organisation (WHO).

| Profession | Good knowledge | Moderate knowledge | Poor knowledge | Total | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| Doctors | 13 (5.05%) | 190 (80.50%) | 33 (13.98%) | 236 (76%) | 30.884 | 0.00001 |
| Nurses | 3 (6.38%) | 35 (74.46%) | 9 (19.14%) | 47 (15%) | | |
| Technicians | 1 (3.57%) | 11 (39.28%) | 16 (57.14%) | 28 (9%) | | |
| Total | 17 (5%) | 236 (76%) | 58 (19%) | 311 | | |

**[Table/Fig-6]:** Knowledge distribution by profession/educational background among the study participants.
p-value is significant at p<0.05; Chi-square test applied

| Formal training in Hand Hygiene (HH) within 3 years | Good knowledge | Moderate knowledge | Poor knowledge | Total | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| Received formal training | 16 | 227 | 54 | 297 | 1.109 | 0.2923 |
| Did not receive formal training | 1 | 9 | 4 | 14 | | |
| Total | 17 | 236 | 58 | 311 | | |

**[Table/Fig-7]:** Knowledge in Hand Hygiene (HH) with respect to formal training in HH.
p-value is not significant at p <0.05; Chi-square test applied

Knowledge regarding the effectiveness, adverse effects and usefulness of both handwashing and hand rubbing varied among HCWs. There still seems to be some confusion regarding the selection of hand rubbing or handwashing as the required procedure for achieving HH in various scenarios. Results from a survey conducted in Pune showed that the majority preferred handwashing with soap and water over hand rubbing with alcohol-based solutions in selected scenarios [18].

More than 50% were aware of the contact time required for ABHR. A closer look revealed that in present study, participants had a distorted perception of the negative effects of hand rubbing (such as dry skin) and a lack of understanding about those effects. This finding aligns with a study conducted in Iran [16]. Such misconceptions must be addressed, and correct information should be provided to HCWs to improve their compliance with HH.

Even though the majority of participants knew that jewellery, damaged skin, or artificial fingernails could increase the likelihood of colonisation with pathogens, only a small percentage understood the effects of hand cream usage on the colonisation of hands. Meanwhile, in a study at a tertiary care centre in Saudi Arabia, most participants had better knowledge in this area [11]. Awareness regarding the proper selection of HH procedures is lacking among HCWs. This is very important, as exposure to pathogens and their subsequent spread can be effectively blocked only when appropriate HH practices are followed. This is emphasised in the "WHO Guidelines on HH in Healthcare" [19].

In present study, the majority of HCWs showed moderate knowledge regarding HH, similar to findings from a study conducted in Karad (74%) [5]. The overall HH knowledge test score was 77.5% in a study conducted in Rwanda among HCWs [20]. In contrast, a study from Imphal, conducted among junior doctors and students, concluded that the majority of participants had poor knowledge [21]. These differences could be due to variations in training practices across different centres and among different study participants.

When comparing profession/educational background and knowledge of HH, doctors outperformed nurses and nurses outperformed technicians. This indicates that knowledge acquired during education and a better understanding of HAIs play a role in gaining knowledge about HH and subsequently its adherence. The difference was statistically significant (p-value=0.00001). Hence, it can be concluded that the educational background of HCWs impacts infection control practices in a tertiary healthcare centre. Increased awareness regarding various pathogens and the action of disinfectants on them during their studies contributes to doctors' superior knowledge regarding HH. Even though nurses demonstrate

better adherence to HH practices through regular use of ABHR, their knowledge still requires improvement. Daily interaction and practice of HH have indeed provided moderate knowledge to the majority of nurses. However, they need targeted education on the "why, when, and how" of HH.

Technicians tend to have less interaction with patients compared to the previous two categories, and their medical background is also comparatively limited. This is evident when we analyse their knowledge, with only 4% exhibiting good knowledge and 57% showing poor knowledge. Like nurses, they also require targeted education, but in a more simplified manner, so that the importance of proper HH can be imprinted on them without making it tedious. In short, the gap in knowledge must be addressed because good knowledge is associated with better adherence to HH practices, and a lack of this knowledge can lead to cross-infections among patients and increase the burden of HAIs [17].

Although the majority of study participants had formal training in HH in the past three years and routinely practice HH, their knowledge percentage needs to increase, as the association between training and knowledge was not significant (p-value=0.2923) according to this survey. Awareness and knowledge about HH can be increased to 100% by frequently conducting awareness programs organised by the Infection Control Committee in the hospital, so that gaps in knowledge can be rectified in a timely manner. Coupling educational programs that use cognitive, emotional and behavioural methods with motivational interventions is more effective, as suggested by experts [22,23].

### Limitation(s)

The present study was a cross-sectional study and inherently has its limitations. The sample distribution was not uniform due to the differing number of staff available in the institution. Additionally, the participants' attitudes and compliance with HH were not assessed in this study.

## CONCLUSION(S)

There is a better awareness of HH among HCWs. The educational background of HCWs impacts HH practices and, in turn, infection control practices in a tertiary healthcare centre. The emphasis should be placed on repeated training, especially for nurses and technicians. The knowledge score on HH can be increased to 100% through educational interventions that help recognise HH opportunities, improve the availability of HH facilities and provide periodic training and evaluation of HH practices.

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**Authors' contribution:** VPR: Conceptualisation, Data Collection, Formal Analysis, Writing - Original Draft, Review, and Editing. MCB: Conceptualisation, Formal Analysis, Writing - Review, and Editing.

**Guarantor:** The first author is the guarantor. The datasets generated during and/or analysed during the current study are available from the first author.

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- Manual Googling: Apr 22, 2025
- iThenticate Software: May 27, 2025 (9%)

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