

COMPARATIVE STUDY ON KNOWLEDGE OF HAND HYGIENE AMONG MEDICAL STUDENTS, RESIDENT DOCTORS, AND NURSES AT TERTIARY HEALTH INSTITUTION OF UTTAR PRADESH

SOM NATH^{1*}, NIDHISH KUMAR², RAJESH KUMAR³

¹Department of Community Medicine, Autonomous State Medical College, Shahjahanpur, Uttar Pradesh, India. ²Department of Pathology, Autonomous State Medical College, Shahjahanpur, Uttar Pradesh, India. ³Department of Paediatrics, Autonomous State Medical College, Shahjahanpur, Uttar Pradesh, India. Email: drsommathrewa@gmail.com

Received: 01 May 2022, Revised and Accepted: 12 June 2022

ABSTRACT

Objectives: Comparative study on knowledge of proper hand hygiene among junior resident doctors, junior nurses, and undergraduate medical students and recommendation to improve its awareness at the level of Tertiary Health Care.

Methods: An institution-based cross-sectional study conducted among undergraduate medical students, junior doctors, and junior nurses at the tertiary care hospital of government medical college, for a period of 3 months duration. The selection of study subjects was done by purposive sampling method from each respective group of health service providers. A self-structured closed-ended questionnaire related to hand hygiene knowledge with the help of the "WHO hand hygiene questionnaire for Health Workers" and the knowledge was assessed. Appropriate software SPSS version 21 applied for analysis.

Results: Overall response rate of participants was 95%. Moderate number (69.9%) of health-care providers knew about the "common route of transmission of microbes" while knowledge of "germs on or around the patient be frequent source of infection" was poor (21.8%). The knowledge of medical students (63.9%) and junior doctors (60%) was found to be significantly higher than nurses (5.6%), ($p=0.001$) for "both hand rub and hand washing are equally effective against microbes." Overall, low level of knowledge for hand hygiene was among nurses (16.7%), doctors (14%), and medical students (34.7%).

Conclusions: Most respondents show moderate knowledge for hand hygiene but there is still need of raising awareness for proper hand hygiene while providing health-care services to patient.

Keywords: Hand hygiene, Germs, Knowledge, Health professional.

© 2022 The Authors. Published by Innovare Academic Sciences Pvt Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>) DOI: <http://dx.doi.org/10.22159/ajpcr.2022v15i9.45097>. Journal homepage: <https://innovareacademics.in/journals/index.php/ajpcr>

INTRODUCTION

Hand hygiene is essential to keep ourself healthy and is one of the effective methods to protect from hospital-acquired infection rates [1,2]. Hand hygiene is a health-related term, includes proper hand washing or hand Rub with antiseptic [1]. Failure in performing proper hand hygiene may lead to spread of infective microbes during providing health-care services [3] and may sometimes lead to an outbreak [1]. Proper washing of hands with soap and water is essential for visible soiled hand [4] and is protective in many such situations. In the unavailability of soap and water, alcohol-based hand sanitizer containing minimum of 60% alcohol can be used. An approach to reduce the spread of infection can effectively be done by maintaining proper clean hand, particularly from residential place to working area or work area to children then to hospitals and thereby whole community [5]. Proper education for hand washing may decrease the number of sufferings due to diarrhea by 23–40% [1,2,6] and due to respiratory infection by 16–21% [2].

There is proper indication for hand washing and antiseptic use on hands as described by CDC [1]. There is requirement of proper hand washing with soap and water in visible dirty, contaminated, or soiled hands. Not visible soiled hands can be disinfected with hand rub with alcoholic base before coming in contact with patient. Several studies reported that in spite of relatively simple procedure for hand hygiene, its compliance is low among health professional [7-10]. Providing proper awareness, education related to hand hygiene and its training can reduce health care-associated infection (HCAI) risk [11,12]. Hence, there is a need of assessment of knowledge of proper hand hygiene and its comparison among different health-care providers, namely, junior resident doctors, junior nurses, and undergraduate medical students and recommendation

to improve awareness for good hand hygiene practices at tertiary care level government medical college and hospital of Uttar Pradesh.

METHODS

This was an institution-based cross-sectional study conducted among undergraduate 3rd year medical students, junior resident doctors, and junior nurses at the tertiary care hospital under government medical college of U.P. and study subjects were selected from each respective group of health professional using purposive sampling method. All the study subjects willing to participate and given informed consent were included in this study. Those not willing to participate/not given the consent/not feeling well were excluded from the study. Study period was of 3 months duration, that is, from January 11, 2022, to March 10, 2022. Informed verbal consent was taken from each participating study subject, namely, undergraduate medical students 72, junior doctors 25, and nurses 36, after explaining the content and nature of the study. Ethical clearance was taken from the Institutional Ethical Committee.

A self-structured, closed-ended questionnaire, containing a set of 25 multiple-choice questions or "yes"/"no" questions related to hand hygiene knowledge, was prepared, with the help of the "WHO hand hygiene questionnaire for Health Workers" [13] and the knowledge of health professional was assessed. The score for each question was allotted 01 so maximum score for knowledge was considered as 25. A total score greater than 75% was taken good, 50–74% as moderate, and less than 50% score, as poor. Data from pro forma were collected, compiled, and analysis done by applying appropriate software under SPSS version 21. Mean value with standard deviation, frequency, Chi-square test, degree of freedom, and p value was calculated.

RESULTS

In the present study, out of total 140 health professional approached, 133 were participated, namely, 72 from 75 undergraduate medical students (96%); 36 from 40 junior nurses (90%); and all 25 junior resident doctors (100%). Overall response rate of participants was 95%. Mean age was 21.83 years \pm 1.78 of medical students, junior doctors 29.16 years \pm 2.73, and junior nurses 28.53 years \pm 5.27 (Table 1). Total 85% of the study participants (namely, medical student 88.5%, resident 92%, and nurses 94.4%) had taken formal training of hand hygiene knowledge (Table 1).

Moderate number (69.9%) of health-care providers (namely, medical students 62.5%, junior doctors 76%, and junior nurses 80.6%) knew "the unclean hands of health care workers are the common route of transmission of microbes among patients." Awareness for "microbes on or around the patient may be frequent source of germs," was poor (21.8%). Majority (67.7%) of health professional (medical students (65.3%), junior doctors (68%), and junior nurses (72.2%)) were aware of necessity of hand hygiene "before touching the patient" or prevent from "microbes of body fluid exposure" to the patient (66.2%). Most nurses (94.2%), medical students (58.3%), and doctors (40%) knew need of hand hygiene "before clean aseptic procedure" for the patient (p=0.001). Poor knowledge of hand hygiene actions on germs transmitted after exposure to immediate surroundings of patient (19.5%), namely, junior doctors (40%), junior nurses (22.2%), and medical students (11.1%) (p=0.007) (Table 2).

Most of the participants were aware of prevention of health care workers from germs be possible by proper hand hygiene "after touching a patient" (80%); "immediately after a risk of body fluid exposure" (72.2%); "after exposure to the immediate surroundings of a patient" (83.5%); while "not immediately before a clean/aseptic procedure" (25.6%).

All nurses and medical students (77.8%) and junior residents (44%) knew about "hand rubbing more rapid in cleansing than hand washing" (p=0.003). Few health professional (21.8%) were aware of, "hand rubbing not causes more skin dryness than hand washing."

"Hand rub and Hand washing are equally effective against microbes;" this knowledge was comparatively more among medical students (63.9%) and junior doctors (60%) than nurses (5.6%) (p=0.001) and "there is no recommendation of hand washing and hand rubbing in sequence" (doctors (68%) and medical students (61.1%), and nurses (27.8%) (p=0.0001). Moderate (69.2%) health service providers (medical students 77.8%, nurses 61.1%, and junior doctors 56%) knew about minimum time (20 s) for alcohol-based hand rub to kill microbes.

Majority (67.7%) of health professional (medical students [77.8%] and nurses [66.7%], and junior doctors [40%]) knew about hand rubbing is mandatory "before palpation of patient's abdomen" and also "before giving an injection" (52.6%) (nurses 66.7%, doctors 60%, and medical students 43.1%) (p<0.05).

Average number of participants had a knowledge for need of hand hygiene mainly by hand washing "After emptying a bed pan" (76.7%) or "visible exposure to blood" (75.9%).

Poor knowledge (26.3%) of need of hand rubbing "after preparing patient's bed" by health professional, namely, doctors (36%), medical students (30.6%), and nurses (11.1%) (p=0.046). Most of the health

professional were aware of "Rubbing/Washing, essential after removing examination gloves" (80.5%) (Table 2).

Most health service providers (78.2%) were aware of colonization of germs be increased by "Wearing Jewellery" (doctors/92%, nurses/86.1%, and medical students/69.4%, p=0.024) and "by finger nails" (81.2%) (doctors 92%, medical students 88.9%, and nurses 58.3%) (p=0.0001).

Only few health professional (25.6%) (doctors 48%, nurses 38.9%, and medical students 11.1%) were aware of non-colonization of germs on hand by regular use of hand cream (p=0.001). Majority of health professional (82.0% knew about "Damaged skin is associated with increased colonization of microbes") (Table 2 and Fig. 1).

Level of knowledge for hand hygiene was graded by responses given by the participants. In the present study, each correct response for question was given 1 score and maximum score was 25 for a set of 25 questions. Respondents with 75–100% of total score were graded as good response, 50–74% as average response while less than 50% score as poor response. In this study, total 27.1% of respondents showed poor response, that is, having low level of knowledge for hand hygiene, namely, nurses (16.7%), doctors (14%), and medical students (34.7%) but moderate knowledge for hand hygiene was seen among 58.6% of respondents (medical students 58.3%, junior residents 60%, and nurses 58.3%) while only few respondents (14.3%) (medical students 6.9%, junior doctors 20%, and nurses 25%) showed "Good knowledge of Hand hygiene" (X²=9.649, p=0.047) (Table 3).

DISCUSSION

Overall response rate of participants was 95%. Mean age of undergraduate medical students was 21.83 years \pm 1.78, junior doctors 29.16 years \pm 2.73, and junior nurses was 28.52 years \pm 5.27 (Table 1). In the present study, majority of health professional (85%) had previously received formal training in hand hygiene knowledge (medical student 77.8%, resident 92%, and nurses 94.4%) similar to other study, namely, Thakkar *et al.* study (94.2%), Nair *et al.* (95%), and Kamble *et al.* (85.4%) [14-16].

In our study, moderate no. (69.9%) of health-care providers (namely, medical students 62.5%, junior doctors 76%, and junior nurses 80.6%) knew about the "common route of transmission of deleterious microbes among patients is through unclean hands" of health care workers HCAL. Findings were different from Thakkar *et al.* study (<50%), Kamble *et al.* (27.2%), and nearly similar to Mehta *et al.* study, nurses 74% and students 46.4% [14,16,17].

Our study shows poor knowledge for "germs on or around the patient," be the frequent source of microbes during health services (21.8%) but was significantly more among doctors (48%) than nurses (19.4%) and medical students (13.9%) (p<0.05) in accordance with the findings of Thakkar *et al.* (<35%) (medical 23.1%, dental 36.4%, and nursing 25%) and Mehta *et al.* study (nurses 40% and students 22.5%) [14,17].

In the present study, majority of health professional knew the necessity of hand hygiene, particularly 'Before touching the Patient' (66.2%), 'After infected body fluid exposure' (66.2%), 'before clean aseptic procedure' (64.7%) (p=0.001)(Nurses knew significantly more than medical students / doctors).Whilst only few participants (19.5%) knew about 'No role of hand hygiene after exposure to immediate surroundings of patient' viz. junior doctors/40%, junior nurses /22.2%, and medical students/11.1% (statistically significant p=0.007). Results

Table 1: Distribution of respondents according to number and mean age of participants

| Respondents | Medical students | | Junior resident | | Junior nurses | |
|-------------|------------------------|----------------------------|-----------------|----------------------------|---------------|----------------------------|
| | No. and age (in years) | Age in years Mean \pm SD | Number | Age in years Mean \pm SD | Number | Age in years Mean \pm SD |
| Total | 72 | 21.833 years \pm 1.776 | 25 | 29.16 years \pm 2.733 | 36 | 28.527 years \pm 5.272 |

Table 2: Distribution of health-care providers according to knowledge for hand hygiene

| S. No. | Questions (answers correct response) | Medical students (n=72) (%) | Resident doctor (n=25), (%) | Nurse (n=36), (%) | Total (%) | X ² test | P-value |
|--------|---|-----------------------------|-----------------------------|-------------------|------------|---------------------|---------|
| 1 | Formal training already done (Yes) | 56 (77.8) | 23 (92.0) | 34 (94.4) | 113 (85) | 6.41 | 0.041 |
| 2 | Main route of transmission of potentially harmful germs between patients? (health care workers hands when not clean) | 45 (62.5) | 19 (76.0) | 29 (80.6) | 93 (69.9) | 4.26 | 0.119 |
| 3 | Most frequent source of germs responsible for health care-associated infections? (germs already present on or within the patient) | 10 (13.9) | 12 (48.0) | 07 (19.4) | 19 (21.8) | 12.825 | 0.002 |
| | Which of the following hand hygiene actions prevents transmission of germs to the patient? | | | | | | |
| 4 | Before touching a patient (yes) | 47 (65.3) | 17 (68.0) | 26 (72.2) | 90 (67.7) | 0.531 | 0.767 |
| 5 | Immediately after risk of body fluid exposure (yes) | 44 (61.1) | 19 (76.0) | 25 (69.4) | 88 (66.2) | 2.075 | 0.354 |
| 6 | After exposure to immediate surroundings of a patient (no) | 8 (11.1) | 10 (40.0) | 8 (22.2) | 26 (19.5) | 10.07 | 0.007 |
| 7 | Immediately before a clean/aseptic procedure (yes) | 42 (58.3) | 10 (40.0) | 34 (94.4) | 86 (64.7) | 21.89 | 0.001 |
| | Which of the following hand hygiene actions prevents transmission of germs to the health care worker? | | | | | | |
| 8 | After touching a patient (yes) | 58 (80.6) | 20 (80.0) | 29 (80.6) | 60 (80.5) | 0.004 | 0.998 |
| 9 | Immediately after a risk of body fluid exposure (yes) | 52 (72.2) | 18 (72.0) | 26 (72.2) | 96 (72.2) | 0.000 | 1.00 |
| 10 | Immediately before a clean/aseptic procedure (no) | 24 (33.3) | 05 (20.0) | 05 (13.9) | 34 (25.6) | 5.269 | 0.072 |
| 11 | After exposure to the immediate surroundings of a patient (yes) | 58 (80.6) | 21 (84.0) | 32 (88.9) | 111 (83.5) | 1.214 | 0.545 |
| | Which of the following statements on alcohol-based hand rub and hand washing with soap and water is true? | | | | | | |
| 12 | Hand rubbing is more rapid for hand cleansing than hand washing (true) | 56 (77.8) | 11 (44.0) | 28 (77.8) | 95 (71.4) | 11.35 | 0.003 |
| 13 | Hand rubbing causes skin dryness more than hand washing (false) | 20 (27.8) | 02 (08.0) | 07 (19.4) | 29 (21.8) | 4.418 | 0.110 |
| 14 | Hand rubbing is more effective against germs than hand washing (false) | 26 (36.1) | 10 (40.0) | 34 (94.4) | 70 (52.6) | 34.728 | 0.0001 |
| 15 | Hand washing and hand rubbing are recommended to be performed in sequence (false) | 28 (38.9) | 08 (32.0) | 26 (72.2) | 62 (46.6) | 13.359 | 0.001 |
| 16 | What is the minimal time needed for alcohol-based hand rub to kill most germs on your hands? (20 s) | 56 (77.8) | 14 (56.0) | 22 (61.1) | 92 (69.2) | 5.632 | 0.06 |
| | Which type of hand hygiene method is required in the following situations? | | | | | | |
| 17 | Before palpation of the abdomen (rubbing) | 56 (77.8) | 10 (40.0) | 24 (66.7) | 90 (67.7) | 12.128 | 0.002 |
| 18 | Before giving an injection (rubbing) | 31 (43.1) | 15 (60.0) | 24 (66.7) | 70 (52.6) | 6.037 | 0.049 |
| 19 | After emptying a bed pan (washing) | 58 (80.6) | 18 (72.0) | 26 (72.2) | 102 (76.7) | 1.311 | 0.519 |
| 20 | After removing examination gloves (rubbing/washing) | 58 (80.6) | 21 (84.0) | 28 (77.8) | 107 (80.5) | 0.364 | 0.833 |
| 21 | After making a patient's bed (rubbing) | 22 (30.6) | 09 (36.0) | 04 (11.1) | 35 (26.3) | 6.169 | 0.046 |
| 22 | After visible exposure to blood (washing) | 50 (69.4) | 21 (84.0) | 27 (75.0) | 101 (75.9) | 3.529 | 0.163 |
| | Which of the following should be avoided, as associated with increased likelihood of colonization of hands with harmful germs? | | | | | | |
| 23 | Wearing jewellery (yes) | 50 (69.4) | 23 (92.0) | 31 (86.1) | 104 (78.2) | 7.351 | 0.024 |
| 24 | Damaged skin (yes) | 57 (79.2) | 21 (84.0) | 31 (86.1) | 104 (82.0) | 0.870 | 0.647 |
| 25 | Artificial fingernails (yes) | 64 (88.9) | 23 (92.0) | 21 (58.3) | 108 (81.2) | 17.03 | 0.0001 |
| 26 | Regular use of a hand cream (no) | 08 (11.1) | 12 (48.0) | 14 (38.9) | 34 (25.6) | 17.876 | 0.0001 |

Table 3: Level of the knowledge of hand hygiene

| Hand hygiene knowledge | Response grade score range | Medical students (n=72) (n) % | Junior residents (n=25) (n) % | Junior nurses (n=36) (n) % | Total Respondents (n=133) (n) % | Statistical tests | | |
|------------------------|----------------------------|-------------------------------|-------------------------------|----------------------------|---------------------------------|-------------------|----|---------|
| | | | | | | χ^2 | df | P-value |
| Low | <50% | 25 (34.7) | 05 (20.0) | 06 (16.7) | 36 (27.1) | 9.649 | 4 | 0.047 |
| Moderate | 50-74% | 42 (58.3) | 15 (60.0) | 21 (58.3) | 78 (58.6) | | | |
| Good | 75% | 05 (6.9) | 05 (20.0) | 09 (25.0) | 19 (14.3) | | | |

were similar to the findings of Kamble *et al.* study like "before touching a patient" (70.9 %); "immediately after risk of body fluid exposure" (67.2%); "immediately before a clean/aseptic procedure" (61.8%) while "After exposure to immediate surroundings" (23.6%) [16].

In our study, most of the health service providers knew "Hand hygiene prevent Health professional from germ transmission after touching a patient" (80.5%); "Immediately after risk of body fluid exposure" (72.2%); "After exposure to the immediate surroundings

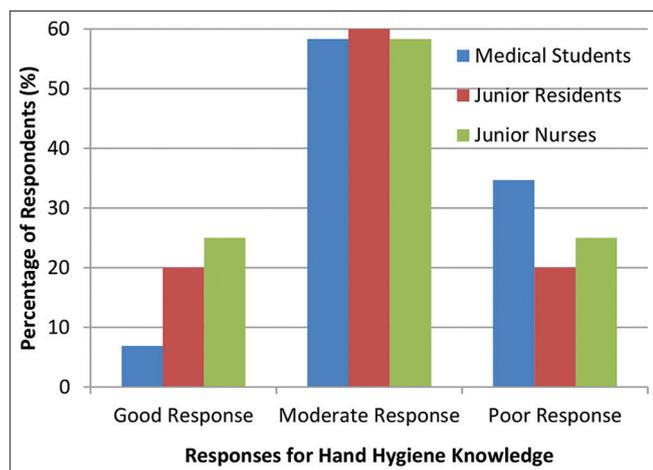


Fig. 1: Hand hygiene knowledge of health professional (%)

of patient" (83.5%); while "not immediately before a clean/aseptic procedure" (25.6%).

In the present study, awareness of junior doctors (44%) was significantly different from nurses (77.8%) / medical students in respect to 'hand rubbing more rapid for cleansing than hand washing' ($p=0.003$). Whilst poor knowledge for 'drying of skin is similar in both after use of hand rubbing or hand washing' (21.8%). Nurses (94.4%) knew significantly more than medical Students/36.1%, junior doctors /40%, about 'effectiveness of hand rub similar to hand wash against microbes'. Whilst doctors/68%, medical students /61.1% knew more about 'no recommendation of hand washing and hand rubbing in sequence' (53.4%, $p=0.0001$). 'Minimum time for alcohol based hand rub to kill microbes' was known to majority of participants. Our findings were different from Kamble *et al.* study with responses for "Hand rubbing is more rapid than hand cleansing" (50.9%); "hand washing is more effective against germs than hand rubbing" (61.8%); "hand washing causes more skin dryness than hand rubbing" (36.3%); "hand washing and hand rubbing are not recommended to be performed in sequence" (21.8%); and "minimum 20 s time is needed for alcohol-based hand rub to kill most germs" (38.1%) [16].

In the present study, average number of participants had a knowledge for need of hand hygiene mainly by hand washing "After emptying a bed pan" (76.7%) and "After visible exposure to blood" (75.9%). Findings were in adherence with Kamble study "after emptying a bed pan" (80%) and "after visible exposure to blood" (72.7%) [16].

Medical students (77.8%) and nurses (66.7%) knew significantly more than junior doctors (40%) about hand rubbing mandatory 'prior to palpation of Pt's abdomen' (67.7%); 'after preparing Pt's bed' (26.3%) and 'before giving an injection' (52.6%) (Nurses 66.7%, doctors 60%, significantly more than medical students 43.1%, ($p < 0.05$); 'after removing examination gloves' (80.5%). This was in accordance with Kamble *et al.* study, namely, 'before palpation of the abdomen' (54.5%), 'before giving an injection' (23.6%), and 'after making a patient's bed' (29.1%); 70.9% of students followed hand rubbing after removing examination gloves [16] while Thakkar *et al.* study documented poor hand hygiene knowledge 'before the palpation of the abdomen' or 'giving an injection' [14].

In our study, poor awareness for hand hygiene (hand rubbing) "after preparing Pt's bed" (doctors (36%) and medical students (30.6%) knew significantly more than nurses (11.1%) ($p=0.046$), opposite to Thakkar *et al.* study (69.19%) [14].

In the present study, majority of the health service providers were aware of increased colonization of germs, mainly by "Wearing Jewellery" (78.2%) (doctors 92%, nurses 86.1%; significantly more than medical

students 69.4%, $p=0.024$) and "using Finger Nails" (81.2%) (doctors 92%, medical students 88.9%, significantly more than nurses 58.3%) ($p=0.0001$) whereas poor knowledge of non-colonization of germs on hand by regular use of hand cream (25.6%) (doctors 48%, nurses 38.9%, significantly more than medical students 11.1%) ($p=0.001$). Majority of health professional (82.0%) knew that "Damaged skin is associated with increased colonization of microbes." Above findings were nearly similar to Kamble *et al.* study [16].

A total 27.1% of respondents showed low response/level of knowledge for hand hygiene; nurses (16.7%) followed by doctors (14%) and medical students (34.7%) and moderate knowledge for hand hygiene was among 58.6% of total respondents (medical students 58.3%, junior residents 60%, and nurses 58.3%) while only few respondents (14.3%) (medical students 6.9%, junior doctors 20%, and nurses 25%) had "Good knowledge of Hand hygiene." This difference in level of knowledge for hand hygiene among different cadre of respondents (medical students, doctors, and junior nurses) was found to be statistically significant ($X^2=9.649$, $p=0.047$). Findings were different from Thakkar *et al.* study; good knowledge (7.59%) with better hand hygiene knowledge among medical students in comparison to dental and nursing students and Nair *et al.* moderate knowledge (74%), good (9%) while nursing students had significantly better knowledge than medical students [14,15]; Mehta *et al.* study, poor response (6%) and moderate knowledge (78%) [17].

There is some limitation of the study like lack of the previous studies in our chosen area so comparison of previous knowledge of hand hygiene among health professional of our study area is not possible.

CONCLUSIONS

Moderate number of health professional knew about the frequent source and route of germ transmission and benefits of hand hygiene, namely, hand washing or hand rubbing at different steps while providing health services to the patient like touching/giving injection to the patient, exposed to body fluid/surrounding the patient. Nurses and medical students knew better of hand rub, a faster process, and mandatory before examining patient. There was poor awareness for hand hygiene (hand rubbing) "after preparing Patient's bed" and "non-colonization of germs by regular use of hand cream on hand. Knowledge of doctors and nurses was moderate particularly for colonization of germs on 'Wearing Jewelry'. Whilst doctors and medical students knew more than nurses about germs on 'using Finger Nails.' Average numbers of respondents show moderate knowledge for hand hygiene whereas only few health professional have good knowledge of hand hygiene and poor knowledge was among 27.1% of respondents.

Knowledge of hand hygiene should be upgraded to 100% mark and this can be achieved only by proper health education and behavioral change communication to health service providers. Frequent hand hygiene training should be conducted among health professional and knowledge should be monitored. Feedback of performance should be taken to evaluate the correct knowledge of hand hygiene and encourage health service providers to follow correct healthy procedure.

ACKNOWLEDGMENT

We are most grateful to all health professional posted at the medical institution of tertiary care level, for their full cooperation and support in our study. Special appreciation to participating undergraduate medical students, junior nursing staff. and junior resident doctors who contributed in the project.

AUTHOR CONTRIBUTION

Dr. Nidhish Kumar, Prof (Dr.) Rajesh Kumar had participated in the research study with literature search, definition of intellectual content, collection of data, and manuscript review.

Concept of present original research article was prepared by Dr. Som Nath and also contributed in preparing design, analysis of collected data, statistical analysis, preparing manuscript, and editing of manuscript.

CONFLICTS OF INTEREST

Nil.

FUNDING

No funding was granted for this study.

REFERENCES

- Centers for Disease Control and Prevention. Handwashing: Clean Hands Save Lives. Available from: <https://www.cdc.gov/handwashing/index.html> [Last accessed on 2022 Jan 03].
- World Health Organization. Evidence of Hand Hygiene to Reduce Transmission and Infections by Multi-Drug Resistant Organisms in Health-Care Settings. Geneva: World Health Organization; 2014.
- Centers for Disease Control and Prevention, MRSA. Available from: <https://www.cdc.gov/mrsa/index.html> [Last accessed on 2022 Jan 01].
- Boyce JM, Pittet D. Healthcare Infection Control Practices Advisory Committee. Society for Healthcare Epidemiology of America. Association for Professionals in Infection Control. Infectious Diseases Society of America. Hand Hygiene Task Force. Guideline for hand hygiene in health-care settings: Recommendations of the healthcare infection control practices advisory committee and the HICPAC/SHEA/APIC/IDSA hand hygiene task force. *Infect Control Hosp Epidemiol* 2002;23:S3-40. doi: 10.1086/503164, PMID 12515399
- Jefferson T, Del Mar C, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, et al. Physical interventions to interrupt or reduce the spread of respiratory viruses: Systematic review. *BMJ* 2009;339:b3675. doi: 10.1136/bmj.b3675, PMID 19773323
- Centers for Disease Control and Prevention, MRSA Available from: <https://www.cdc.gov/mrsa/index.html> [Last accessed on 2022 Jan 04].
- Pittet D, Hugonnet S, Harbarth S, Mourouga P, Sauvan V, Touveneau S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Infection control programme. *Lancet* 2000;356:1307-12. doi: 10.1016/S0140-6736(00)02814-2, PMID 11073019
- Longtin Y, Sax H, Allegranzi B, Schneider F, Pittet D. Videos in clinical medicine. Hand hygiene. *N Engl J Med* 2011;364:e24. doi: 10.1056/NEJMvcm0903599, PMID 21449775
- Tibballs J. Teaching hospital medical staff to handwash. *Med J Aust* 1996;164:395-8. doi: 10.5694/j.1326-5377.1996.tb124899.x, PMID 8609848
- Trampuz A, Widmer AF. Hand hygiene: A frequently missed lifesaving opportunity during patient care. *Mayo Clin Proc* 2004;79:109-16. doi: 10.4065/79.1.109, PMID 14708954
- World Health Organization. WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge Clean Care is Safer Care. Geneva: World Health Organization Press; 2009. Available from: https://www.who.int/publications/2009/9789241597906_eng.pdf [Last accessed on 2021 Dec 11].
- Boyce JM, Pittet D. Healthcare Infection Control Practices Advisory Committee. HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for hand hygiene in health-care settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA hand hygiene task force. Society for healthcare epidemiology of America/association for professionals in infection control/infectious diseases society of America. *MMWR Recomm Rep* 2002;51:1-45.
- World Health Organization. Hand Hygiene Knowledge Questionnaire for Health-Care Workers. Geneva: World Health Organization; 2009. Available from: http://www.who.int/gpsc/5may/Hand_Hygiene_Knowledge_Questionnaire.doc?ua=1 [Last accessed on 2021 Dec 02].
- Thakker VS, Jadhav PR. Knowledge of hand hygiene in undergraduate medical, dental, and nursing students: A crosssectional survey. *J Fam Med Prim Care* 2015;4:582-6. doi: 10.4103/2249-4863.174298, PMID 26985420
- Nair SS, Hanumantappa R, Hiremath SG, Siraj MA, Raghunath P. Knowledge, attitude, and practice of hand hygiene among medical and nursing students at a tertiary health care centre in Raichur, India. *ISRN Prev Med* 2014;2014:608927. doi: 10.1155/2014/608927
- Kamble VS, Biradar SM, Takpore A, Reddy S. Knowledge of hand hygiene practices among students of ESIC medical college, Gulbarga, Karnataka, India. *Int J Community Med Public Health* 2016;3:94-8. doi: 10.18203/2394-6040.ijcmph20151234
- Mehta A, Tripathi K. Knowledge, attitude and practices of hand hygiene among nurses and nursing students in a tertiary health care center of Central India: A questionnaire based study. *Int J Community Med Public Health* 2019;6:5154-60. doi: 10.18203/2394-6040.ijcmph20195462