JOURNAL OF
TAZEEZ IN PUBLIC HEALTH

تعزيز
tazeez

September 2025; Vol. 2; Issue 3

Original Research

Knowledge, Attitude, and Obstacles to Hand Hygiene Practices in Riyadh, Kingdom of Saudi Arabia: A Preliminary Cross-Sectional Study

Abdulrahman S. Alfadhli[1]; Nouf A. Alghamdi[1]; Mahmoud Abulmeaty[1]; Jack B. Fu[2]; Wadi B. Alonazi[3]*

1. Department of Community Health Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia
2. Department of Palliative, Rehabilitation & Integrative Medicine, University of Texas MD Anderson Cancer Center
3. Health Administration Department, College of Business Administration, King Saud University, Riyadh, Kingdom of Saudi Arabia

*Correspondence: waalonazi@ksu.edu.sa

Abstract

Objectives: As a primary objective, this study aims to assess healthcare workers' knowledge and attitudes about hand hygiene (HH) in Riyadh, Saudi Arabia. A secondary objective is to identify barriers to HH implementation. **Methods:** In a cross-sectional study, a total of 203 employees worked at different departments, such as Intensive Care Unit, hospital wards, and surgery, of both genders were recruited from King Khaled University Hospital, Riyadh, Kingdom of Saudi Arabia. Employees' knowledge, attitude, and obstacles to adequate HH practice were assessed using an anonymous electronic questionnaire. **Results:** the mean percentage of the ideal answers of the knowledge and attitude questions was 46.8% (standard deviation (SD): 15.5), 49.6% (SD: 21.4) respectively. Department was the only socio-demographic variable significantly associated with knowledge (p=0.028). on the other hand, department and shift time were significantly associated with attitude (p= 0.005 and 0.030, respectively). No clear dominant obstacles were reported among participants. **Conclusion:** This study revealed that knowledge and practice of HH among Saudi health providers are currently insufficient. Further study involving a larger sample size with different sociodemographic characteristics is needed to explore the reasons for non-compliance.

Keywords: Hand hygiene, knowledge, attitude, obstacles, healthcare

Published : **September 30th, 2025**

To Cite: Alghamdi, N., Alonazi, W. ., Abulmeaty, M., Alfadhli, A., & B. Fu, J. Knowledge, Attitude, and Obstacles to Hand Hygiene Practices in Riyadh, Kingdom of Saudi Arabia: A Preliminary Cross-Sectional Study. (2025). JOURNAL OF TAZEEZ IN PUBLIC HEALTH, 2(3), 139-148. https://doi.org/10.62464/hsx8mw53

Introduction

The improvement of good habits and the modification of bad habits is an appropriate strategy to determine behavioral changes leading to more compliance with hand hygiene (HH) and reduced Healthcare-Associated Infections (HCAI) [1]. Applying HH with antibacterial soap can prevent many diseases, such as communicable or chronic gastrointestinal and respiratory diseases [2]. According to the World Health Organization, inadequately cleaned hands is a leading cause of infection transmission among healthcare providers [3]. In the Middle East, 18% of patients are infected while receiving treatment [4]. Therefore, an understand the magnitude of the problem and effective solutions to reduce healthcare related complications and costs.

The COVID-19 pandemic has called attention to the importance of HH practice in decreasing the spread of disease-causing viruses and bacteria. Clothing should be free of pathogens during clinical practice when there is contact between health caregivers and patients. Health practitioner jewelry, rings, and nail extensions were found to be major obstacles to adequate HH. [5]. Hospitals have changed their policies and procedures to better align with guideline recommendations. Barriers to healthcare worker HH guideline compliance include being too busy, lack of sufficient hand sanitizers, and perception that hand washing is not a major concern [6] [12].

However, there is a clear difference in HH compliance rate between doctors, nurses, employees, and hospital departments. A systematic review found that nurses, physicians, and other staff HH compliance were 43.4%, 32.6%, and 53.8%, respectively [7]. In relation to hospital departments, compliance was found to differ by units: neonatology (68.2%), intensive care unit (ICU) (41.8%), obstetrics and gynecology (39.4%), adult emergency (26.7%), children emergency (24.6%), medicine (22.4%), surgery (14.9%), and pediatrics (12.8%). Nurses were more likely to practice HH (33.2%) compared with physicians (29.0%) [8]. HH education campaigns, such as the German Clean Hands Campaign, can improve compliance by raising awareness among health caregivers [9] [10] [11].

Additional studies regarding HH attitudes and compliance in different settings are needed. The primary objective of this preliminary study is to assess healthcare worker knowledge and attitudes to HH in Riyadh, Kingdom of Saudi Arabia. A secondary objective is to identify obstacles to HH practice.

Methods

Design and setting

This cross-sectional survey study was conducted at King Khalid University Hospital (KKUH), Riyadh, Kingdom of Saudi Arabia, between September and October 2022. A random sampling technique was used to select study healthcare worker participants.

Study population

Participants had to be at least 18 years of age and above. The cohort comprised of 203 participants working at KKUH either during the morning or night shift between September and October 2022. Participants worked at the following departments at KKUH: public health, ICU, ministry of health, emergency room, surgery, outpatient, administration, renal, laboratory, quality and management, maintenance, medical records, law authority, education authority, and hospital wards.

Ethical considerations

Ethical approval was obtained from the institutional review board at KKUH; approval of the research project number is E-22-7163. All participants provided electronic informed

consent, and a statement of anonymity and confidentiality was included.

Instrument

Participants were asked to complete an anonymous electronic questionnaire generated via Google Forms and distributed on various platforms like Twitter, WhatsApp, and email. The total number of participants who responded to the survey was 288. All responses were received in one month, with a response rate of 70%. This questionnaire comprised five main sections with 21 questions and was developed and distributed in Arabic.

Ten experts in the public health field reviewed the initial questionnaire and were given a week to submit their comments. Based on their feedback, specific modifications were made and amended, such as correcting linguistic errors and rewording some questions. At the beginning of the questionnaire, participants were informed about the study objective, the confidentiality of collected data, and the estimated completion time. After applying several modifications and pilot testing, the final questionnaire was composed of four sections with a total of 21 questions that required approximately 5–10 min to complete and was made available online for one month between September and October 2022.

The five sections of the questionnaire focused on personal and demographic details, knowledge, attitude, obstacles of HH, and responsibility for failure in HH (participants' point of view) (Appendix 1). The first section had six questions about socio-demographic characteristics, including age, gender, job title, working department, shift time, and years of experience at KKUH. The second section assessed the participants' knowledge of HH proper practice using a questionnaire consisting of three multiple-choice questions, each with four possible answers, of which only one was correct, such as how many moments are needed to perform HH?, How long alcohol-based sanitizer take to eliminate most germs on the hand?, and What is the ideal time for washing hands with soap and water?.

The third section was used to measure the participants' attitude toward HH, consisting of five questions: one question with four possible answers and three as "yes" or "no" questions; such as on average of the last 10 patient interactions, How often do you practice HH?, Do you often use alcohol-based hand sanitizer to practice HH?, If you notice that one of your colleagues is failing to perform HH practices, will you inform them?, Have you ever been informed by one of your colleagues that you have failed even once in the practice of HH?, Has a patient ever asked you to perform HH before performing any procedure for him/ her? The ideal/correct answers to the knowledge and attitude questions were adapted from the WHO [13].

Each correct answer of knowledge and attitude was assigned one point, while an incorrect answer scored zero. Therefore, the participants' knowledge of HH proper practice score was between 0 to 3; The scores were categorized as either poor= 0–1 point, average= 1-2 points, or good= 2-3. Participants attitudes range between 0 to 5, categorized as poor= 0-1.66 points, average= 1.66-3.32, or good= 3.32-5.00. The participants' knowledge and attitude levels were assessed as a mean percentage for the correctly answered questions.

The fourth section measured the obstacles to the HH using six "yes" or "no" questions and one multiple choice question with four possible options; Such as, Have you received any training course on HH during the last three years?, Do you have a Basic Infection Control Skills License (BICSL)? Is there any penalty from the department or hospital administration for someone who fails to practice HH?, Does the hospital's infection

control department provide you with the latest updates in this field? Are there signs or posters that remind you of the practice of HH in your department? Does the hospital administration provide sufficient materials and supplies necessary for the practice of HH?

The last fifth section investigated was the participants' point of view regarding the responsibility for failure in HH. This section included one multiple-choice question with four possible options; In your opinion, who bears the more significant part of the failure to practice good HH?

Sample size calculation

$$n = \left(\frac{(Z_{\alpha/2})(\sigma)}{E}\right)^2$$

To determine the sample size, we have used the above formula. Where Z is 1.96, the normal distribution z-value corresponds to a confidence level of 95%. σ is the expected standard deviation of the knowledge score prior to the study (and we set it to 0.75; typically, SD is one-fourth the range, i.e., one-fourth of the 3). Finally, E is the acceptable error in our expectation, i.e., E is how much error in the average score we maximally accept (and we set it to 0.5). Plugging all this information (t = 1.96, σ = 0.75, e = 0.5) into the formula results in n = 8.6 (approximately 9). So, 9 is the minimum accepted sample size required to find the average knowledge score.

Statistical analysis

Statistical analysis was performed using SPSS statistical software (Version 26). The Anderson–Darling test was used to evaluate the variable distribution. Categorical data were expressed as a number and a percentage. Differences between categorical variables were assessed with a t-test or ANOVA. A p-value of <0.05 was statistically significant.

Results

Two hundred-three participants completed the survey. Table 1 presents the general characteristics of the studied population. Most participants were aged ≥25 years old (93.1%). In addition, the sample is roughly divided between doctors (31%), health educators (30%), and nurses (29.6%).

Table 1. Sample demographic characteristics (n=203[1])

Variables	n	%
Age		
18-25	14	6.9
26-35	71	35
36-44	64	31.5
45+	54	26.6
Gender		
Male	113	55.7
Female	90	44.3
Job Title		
Doctor	63	31
Health education	61	30
Nurse	60	29.6
Other	19	9.4
Department		
ICU	87	42.9
Hospital wards	42	20.7
Surgery	40	19.7
Other	34	16.7
Shift Time		
Morning	112	55.2
Evening	66	32.5
Midnight	25	12.3
Years of Experience		
01-Mar	39	19.2
04-May	69	34
06-Sep	70	34.5
10+	25	12.3

[1]Data presented as number and percentage

Knowledge and attitude of HH

Table 2 shows the number and the percentage of correct answers for each question (n = 8). In relation to the three knowledge questions, the mean percentage of correct answers was 46.8% (standard deviation [SD]: 15.5). Of the

participants, 58.6% were able to correctly identify the ideal number of moments needed to perform HH, which was the highest scoring question overall. The second most correctly answered question (56.2%) was identifying the time for washing hands with soap and water. In contrast, the least correctly answered question was identifying how long alcohol-based sanitizer takes to kill most germs on hand (25.6%).

On the other hand, the five attitude questions varied considerably in terms of the percentage of ideal answers. The mean percentage of ideal answers was 49.6% (standard deviation [SD]: 21.4). Of the participants, 76.4% were prone to alert their colleagues when they failed to perform HH, which was the highest scoring question overall. The second most ideally answered question (65.5%) was related to the often use of alcohol-based hand sanitizer to practice HH. On the other hand, the least ideally answered question was identifying the times required to practice HH (15.8%), followed by 36.9% who have yet to encounter a patient asking them to perform HH. Lastly, 53.2% have never been informed by a colleague that they failed in the practice of HH.

Association between the socio-demographic variables and knowledge/ attitude of HH

Table 3 shows that the average knowledge score (ranges from 0 to 3) is 1.4 (SD = 0.84), while the average practice score (ranges from 0 to 5) is 2.48 (SD = 0.99), both of which are below the middle of their possible ranges, i.e., 1.5 and 2.5 respectively.

Department was the only variable significantly associated with knowledge (p-value= 0.028). However, there was a statistically significant tendency toward the association between age and knowledge (p= 0.07). No significant difference was observed between knowledge and other variables (Table 3).

On the other hand, in relation to attitude, Table 3 shows that department and shift time are significantly associated with attitude (p= 0.005 and 0.030, respectively). No significant difference was observed between attitude and other variables (Table 3).

Table 2. Number and percentage of correct answers to the knowledge/ attitude questions (n=203[1])

Question (1 Point for each Question)	Correct/ideal answer	n (%)
Knowledge		
How many moments are needed to perform HH?	5 [3]	119 (58.6)
How long does alcohol-based sanitizer take to kill most germs on the hand?	20-30 seconds	52 (25.6)
What is the ideal time for washing hands with soap and water?	40-60 seconds	114 (56.2)
The average percentage of correctly answered questions.		46.8% (15.0)[2]
Attitude		
On average, over ten times were HH is required, How often do you practice HH?	10	32 (15.8)
Do you often use alcohol-based hand sanitizer to practice HH?	Yes	133 (65.5)
If you notice that one of your colleagues is failing to perform HH practices, will you inform them?	Yes	155 (76.4)
Have you ever been informed by one of your colleagues that you have failed even once in HH?	No	108 (53.2)

Has a patient ever asked you to perform HH before performing any procedure for him/ her?	No	75 (36.9)
The average percentage of ideally answered questions.		49.6% (21.4) [2]

HH, hand hygiene; [1] Data presented as number and percentage unless otherwise stated; [2] Mean (standard deviation, SD); [3] The ideal 5 moments is: Moment 1 - Before touching a patient. Moment 2 - Before a procedure. Moment 3 - After a procedure or body fluid exposure risk. Moment 4 - After touching a patient. Moment 5 - After touching a patient's surroundings [13].

Table 3. Association between the socio-demographic variables and knowledge/ attitude of HH (n=203)

Variable	n	Knowledge			Attitude		
		Mean score[1]	SD	P-value[2]	Mean score[1]	SD	P-value[2]
Age (year)							
18-25	14	1.14	0.94	0.079	2.79	0.80	0.419
26-35	71	1.49	0.80		2.56	1.05	
36-44	64	1.53	0.71		2.41	0.86	
45+	54	1.20	0.93		2.37	1.08	
Gender							
Male	113	1.42	0.83	0.691	2.54	0.96	0.319
Female	90	1.38	0.84		2.40	1.02	
Profession							
Doctor	63	1.49	0.71	0.275	2.35	0.80	0.619
Health education	61	1.25	0.90		2.54	1.24	
Nurse	60	1.50	0.87		2.50	0.94	
Other	19	1.32	0.82		2.63	0.76	
Department							
ICU	87	1.55	0.87	0.028*	2.37	0.96	0.005*
Hospital wards	42	1.43	0.70		2.71	1.08	
Surgery	40	1.08	0.79		2.15	0.89	
Other	34	1.38	0.85		2.85	0.89	
Shift time							
Morning	112	1.40	0.82	0.729	2.64	1.03	0.030*
Evening	66	1.36	0.88		2.26	0.95	
Midnight	25	1.52	0.77		2.32	0.74	
Work experience							
1-3	39	1.23	0.84	0.130	2.33	0.98	0.648
4-5	69	1.52	0.83		2.52	0.99	
6-9	70	1.47	0.77		2.46	0.89	
10+	25	1.16	0.94		2.64	1.25	
Total	**203**	**1.40**	**0.83**		**2.48**	**0.99**	

SD, standard deviation; HH, hand hygiene; ICU, Intensive Care Unit

[1] Scores were the mean of correct/ ideal answers per participant. Knowledge: poor= 0–1 point, average= 1-2 points, or good= 2-3. Attitude: poor= 0-1.66 points, average= 1.66-3.32, or good= 3.32-5.00.

[2] Differences between the three groups were assessed through ANOVA, while two groups were via t-test.

* Significant different <0.05.

Obstacles to the HH

Table 4 illustrates that no clear dominant obstacle exists among participants since the

percentage of "yes" answers is approximately 60% or more in all the listed questions.

Responsibility of failure in HH; Participants' point of view

It can be seen from Figure 1 that participants vary in their opinion regarding who is responsible for any HH failure in the hospital. Most participants think it is the health workers' responsibility (37.4 %), followed by the responsibility of the infection control department (35.9%), hospital administration (25.1%), and other sides (1.5%).

Table 4. Answers to the questions related to obstacles (n=203)

Question	n (%[1])
Have you received any training courses on HH during the last three years?	150 (73.9)
Do you have a BICSL?	120 (59.1)
Is there any penalty from the department or hospital administration for someone who fails to practice HH?	142 (70.0)
Does the hospital's infection control department provide you with the latest updates in this field?	141 (69.5)
Are there signs or posters that remind you of the practice of HH in your department?	157 (77.3)
Does the hospital administration provide sufficient materials and supplies necessary for the practice of HH?	161 (79.3)

BICSL, Basic Infection Control Skills License; HH, hand hygiene

[1] Percentage of "yes" answers.

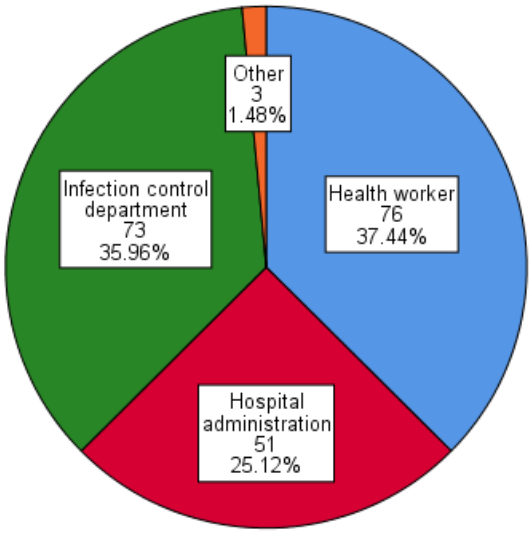

Figure 1. Participant opinion regarding who bears the more significant part of the failure to practice proper HH (n=203). Data are presented as numbers and percentages.

Discussion

Hygiene practices, especially hand washing, are essential in limiting illness transmission, specifically for COVID-19. In our HH study of KKUH (Riyadh, Kingdom of Saudi Arabia) healthcare workers, less than half were found to have ideal levels of HH knowledge and attitudes.

Regarding variable knowledge, the findings revealed that respondents had a shared knowledge of maintaining good HH. Multiple investigations have shown that the general population also has extensive knowledge of COVID-19 [14] [15]. A wide range of participant knowledge concerning the spread of COVID-19 through contaminated surfaces was observed. For example, the western portion of the Kingdom had citizens with greater levels of knowledge than the rest of the country [16]. Those from lower socioeconomic statuses and with lower levels of education exhibited less knowledge regarding the spread of COVID-19 [17]. The proper use of soap, water, and hand sanitizers, as well as the required time for successful handwashing, should be emphasized to the public [18]. A significant factor is inspiring people to prioritize HH through increased knowledge [19]. To guarantee extensive knowledge transmission,

future interventions should create educational programs targeting various age ranges and social groupings.

The attitude of people toward HH procedures was another aspect of this investigation. Most respondents supported the necessity of handwashing in reducing the spread of illness, contributing a favorable attitude toward the practice. This is consistent with studies showing how vital optimistic attitudes are for increasing handwashing rates. The current study reported that there was a wide variety of opinions shown by the mean percentage of optimal responses (49.5%; SD: 21.4). The question about notifying coworkers about a failure to do HH received the highest score, with 76.4% of respondents prepared to intervene in such cases. However, the question of how often people practiced HH had the lowest percentage of perfect responses, with just 15.8% of participants giving a perfect response. Based on these results, additional HH procedures education is needed. It has been evident that during the partial lockdown, women were more likely to remain at home than males since they were prevented from taking their children out in public [20]. This research found that female participants had more compliant attitudes than male participants regarding not touching their faces while wearing gloves and washing their hands after removing them.

Successful strategies can only be created if the obstacles to good HH are first identified. This research uncovered several difficulties encountered by Saudi citizens. Poor access to handwashing facilities was another factor [21]. Soap and hand sanitizers were often in short supply in public areas. Participants also mentioned cultural issues, lack of time, and poor awareness of adequate hand-cleaning procedures as barriers to maintaining good hygiene [22]. Another study observed that, among other things, respondents said that they found it challenging to practice consistent HH due to their busy schedules, their tendency to forget when they should wash their hands, and the difficulty in obtaining necessary supplies. Participants in mass gathering activities are strongly urged to bring their personal cleaning supplies and antimicrobial agents to alleviate these issues and boost uptake. 92% of people, primarily women, said they had skin problems from washing their hands too much [23]. Moisturizer use after washing your hands is one such suggestion that has been shown to reduce the likelihood of subsequent complications.

Our study was subject to the same limitations as most cross-sectional studies. First, due to its cross-sectional nature, causality cannot be established. Second, since we were unable to recruit all health care providers in Riyadh City, the small sample size limits the statistical power and ability to detect significant associations. This makes it difficult to generalize our findings. Furthermore, in this study, since there was no specific strategy to distribute the questionnaire, a response rate could not be calculated, and our sample was therefore considered a convenience sample. Third, our online questionnaire study was made intentionally brief to reduce respondent burden and maximize response rates but limited the amount of data obtained. Fourth, self-administered surveys do not always reflect clinical practice and may have biased the present study.

Conclusion

The findings of this study that there has been inadequate HH knowledge and practice among Saudi health providers. Additional HH training and continuous education are needed. Future efforts to improve HH compliance should consider factors that contribute to poor HH including physical changes (e.g. a lack of resources and access to facilities), education efforts (that include cultural considerations, and promoting a culture of accountability among

healthcare team members. The cultural elements and social norms that impact HH behaviors in Saudi Arabia might be studied more deeply in future research to guide culturally sensitive treatments.

Contribution of each author:

WA conceived the study. AA recruited participants and conducted collection. NA did the statistical analyses. NA, JF drafted the manuscript. All authors critically reviewed and helped with data interpretation and contributed to the final version of the manuscript. NA and, AA can provide all original data for review. The other authors have no conflicts of interest to disclose.

Data Availability Statement

The datasets generated or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

The authors declare no conflicts of interest.

Funding Statement

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

[1] B. Allegranzi and D. Pittet, "Role of hand hygiene in healthcare-associated infection prevention," Journal of Hospital Infection, vol. 73, no. 4, pp. 305–315, Dec. 2009, doi: 10.1016/j.jhin.2009.04.019.

[2] A. E. Aiello, R. M. Coulborn, V. Perez, and E. L. Larson, "Effect of Hand Hygiene on Infectious Disease Risk in the Community Setting: A Meta-Analysis," Am J Public Health, vol. 98, no. 8, pp. 1372–1381, Aug. 2008, doi: 10.2105/AJPH.2007.124610.

[3] WHO, "WHO guidelines on hand hygiene in health care," Jan. 15, 2009. https://www.who.int/publications/i/item/9789241597906 (accessed Jun. 16, 2023).

[4] The National Guard Health Affairs, Infection Prevention, and Control manual. 2013. Accessed: Jun. 16, 2023. [Online]. Available: https://www.moh.gov.sa/CCC/Documents/GCC%20Infection%20control%20manual%202013%20revisedOPT.pdf

[5] M. Wałaszek, M. Kołpa, A. Różańska, B. Jagiencarz-Starzec, and Z. Wolak, "Hospital knowledge and practice of doctors and nurses regarding hand hygiene in a survey," Przegl Epidemiol, pp. 119–132, 2020, doi: 10.32394/pe.74.09.

[6] E. L. Larson, D. Quiros, and S. X. Lin, "Dissemination of the CDC's Hand Hygiene Guideline and impact on infection rates," Am J Infect Control, vol. 35, no. 10, pp. 666–675, Dec. 2007, doi: 10.1016/j.ajic.2006.10.006.

[7] K. A. Lambe et al., "Hand Hygiene Compliance in the ICU," Crit Care Med, vol. 47, no. 9, pp. 1251–1257, Sep. 2019, doi: 10.1097/CCM.0000000000003868.

[8] J. A. Omiye et al., "Hand Hygiene Practice Among Health Care Workers in a Tertiary Hospital in Sub-Saharan Africa (Handy Study)," Aug. 2019. https://pubmed.ncbi.nlm.nih.gov/31385596/ (accessed Jun. 16, 2023).

[9] M. Hoffmann et al., "Hand hygiene compliance in intensive care units: An observational study," Int J Nurs Pract, vol. 26, no. 2, Apr. 2020, doi 10.1111/ijn.12789.

[10] O. D. RN, D. Jones, M. Martello, A. Biron, and M. Lavoie-Tremblay, "A Systematic Review on the Effectiveness of Interventions to Improve Hand Hygiene Compliance of Nurses in the Hospital Setting," Journal of Nursing Scholarship, vol. 49, no. 2, pp. 143–152, Mar. 2017, doi: 10.1111/jnu.12274.

[11] D. J. Gould, D. Moralejo, N. Drey, and J. H. Chudleigh, "Interventions to improve hand hygiene compliance in patient care," in Cochrane Database of Systematic Reviews, D. J. Gould, Ed., Chichester, UK: John Wiley & Sons, Ltd, 2010. doi: 10.1002/14651858.CD005186.pub3.

[12] M. K. Bolon, "Hand Hygiene," Infect Dis Clin North Am, vol. 30, no. 3, pp. 591–607, Sep. 2016, doi: 10.1016/j.idc.2016.04.007.

[13] WHO, "Your 5 Moments for Hand Hygiene," May 05, 2009. https://www.who.int/multi-media/details/your-5-moments-for-hand-hygiene-poster (accessed Jun. 16, 2023).

[14] E. M. Mazlan, M. H. Osman, and M. S. Saud, "The Level of Competency Knowledge in Safety Training among Construction Personnel," Journal of Construction in Developing Countries, vol. 24, no. 2, pp. 157–172, Dec. 2019, doi: 10.21315/jcdc2019.24.2.7.
[15] C. Barrett and K. L. Cheung, "Knowledge, socio-cognitive perceptions and the practice of hand hygiene and social distancing during the COVID-19 pandemic: a cross-sectional study of UK university students," BMC Public Health, vol. 21, no. 1, p. 426, Mar. 2021, doi: 10.1186/s12889-021-10461-0.
[16] C. Derksen, F. M. Keller, and S. Lippke, "Obstetric Healthcare Workers' Adherence to Hand Hygiene Recommendations during the COVID-19 Pandemic: Observations and Social-Cognitive Determinants," Appl Psychol Health Well Being, vol. 12, no. 4, pp. 1286–1305, Dec. 2020, doi: 10.1111/aphw.12240.
[17] Akshaya Srikanth Bhagavathula, Wafa Ali Aldhaleei, Jamal Rahmani, and Jagdish Khubchandani, "Knowledge, Attitude, Perceptions and Practice towards COVID-19: A systematic review and Meta-analysis," Jun. 24, 2020. https://www.medrxiv.org/content/10.1101/2020.06.24.20138891v2 (accessed Jun. 16, 2023).
[18] R. Sah, A. Mohanty, A. Reda, A. Siddiq, R. K. Mohapatra, and K. Dhama, "Marburg virus re-emerged in 2022: recently detected in Ghana, another zoonotic pathogen coming up amid rising cases of Monkeypox and ongoing COVID-19 pandemic- global health concerns and counteracting measures," Veterinary Quarterly, vol. 42, no. 1, pp. 167–171, Dec. 2022, doi: 10.1080/01652176.2022.2116501.
[19] J. M. Boyce and D. W. Schaffner, "Scientific Evidence Supports the Use of Alcohol-Based Hand Sanitizers as an Effective Alternative to Hand Washing in Retail Food and Food Service Settings When Heavy Soiling Is Not Present on Hands," J Food Prot, vol. 84, no. 5, pp. 781–801, May 2021, doi: 10.4315/JFP-20-326.
[20] W. M. Northington, S. T. Gillison, S. E. Beatty, and S. Vivek, "I don't want to be a rule enforcer during the COVID-19 pandemic: Frontline employees' plight," Journal of Retailing and Consumer Services, vol. 63, p. 102723, Nov. 2021, doi: 10.1016/j.jretconser.2021.102723.
[21] A. Mersha et al., "Perceived barriers to the practice of preventive measures for COVID-19 pandemic among health professionals in public health facilities of the Gamo zone, southern Ethiopia: a phenomenological study," BMC Public Health, vol. 21, no. 1, p. 199, Dec. 2021, doi: 10.1186/s12889-021-10256-3.
[22] Mst. F. Rahman Zuthi, Md. A. Hossen, S. K. Pal, M. H. Mazumder, S. M. F. Hasan, and Md. M. Hoque, "Evaluating knowledge, awareness and associated water usage towards hand hygiene practices influenced by the current COVID-19 pandemic in Bangladesh," Groundw Sustain Dev, vol. 19, p. 100848, Nov. 2022, doi: 10.1016/j.gsd.2022.100848.
[23] Y. Ataiyero, J. Dyson, and M. Graham, "The barriers and facilitators to hand hygiene practices in Nigeria: A qualitative study," Am J Infect Control, vol. 51, no. 3, pp. 295–303, Mar. 2023, doi: 10.1016/j.ajic.2022.10.013.