Impact of an Interventional Program on Improving Compliance of Hand Hygiene and Reducing Hospital-Acquired Infection in the Critical Care Unit

Jeneth Gutierrez, Aladeen Alloubani, Mohammad Alzaatreh, Mohammad Mari, Laila Akhu-Zaheya
University of Tabuk, Department of Nursing, Tabuk, Saudi Arabia, 1King Hussein Cancer Center, Nursing Research Unit, Amman, Jordan, 2Prince Hamzah Hospital, Department of Nursing, Amman, Jordan, 3Westways Staffing Services Inc, California, United States, 4Jordan University of Science and Technology, Faculty of Nursing, Irbid, Jordan

Abstract

Introduction: This study aimed to determine the effect of a hand hygiene (HH) and awareness campaign on knowledge and compliance with HH practices among health-care workers working staff in the main intensive care units and also to evaluate the rates of hospital-acquired infection (HAI) before and after the intervention. Methods: A prospective, interventional, pre–post design was utilized and carried out in three phases: the first stage was a 1-month preintervention stage to develop the foundation of the compliance rate of handwashing; the second stage was the interventional handwashing campaign; the third stage was the postintervention stage to improve the compliance rate of handwashing. Two instruments were used in this study: the HH Knowledge Questionnaire developed by the World Health Organization to assess HH knowledge and the Handwashing Questionnaire developed to evaluate HH washing. Results: HH knowledge has been increased from preintervention (M = 11.84, standard deviation [SD] = 2.41) to postintervention (M = 18.80, SD = 2.93), and the effective compliance with HH practice was as low as 49% in June 2017 to 75% in February 2018. In addition, the HAI rate was dropped from 13.2% in June 2017 to 9% in February 2018. An inverse association was recognized between HH compliance and HAI rates. Conclusions: These results recommend that reasonable approaches can decrease the HAI rate of intensive care units. A nationwide handwashing interventional program can be employed in all hospitals.

Keywords: Handwashing, hospital infections, intensive care units, knowledge

Introduction

Hospital-acquired infections (HAIs) are a major health-care issue, leading to considerable increase in mortality and morbidity and resulting in financial burden. One of the best methods to prevent and control HAI is maintaining hand hygiene (HH) by washing hands with water and detergents and using alcohol-based hand sanitizers. It has been provided that transmission of pathogens can be reduced to a considerable extent by observing effective HH practices. The literature indicates that HH practices are still at a lower rate of compliance and requires sustainable efforts for further development.

Several health-care institutions, such as the World Health Organization (WHO), have proposed HH practices to all health-care workers (HCWs) as a means of preventing infection. Despite the approved significance of HH in the health-care setting, researchers assert that it is quite a challenge to evaluate the extent of adherence to the respective HH practices.

Alcohol-based hand rub, which is part of HH practice, is playing a useful role in limiting infection transmission in health-care settings. However, the method is neglected by HCWs. Regardless of the fact that some of the previously

How to cite this article: Gutierrez J, Alloubani A, Alzaatreh M, Mari M, Akhu-Zaheya L. Impact of an interventional program on improving compliance of hand hygiene and reducing hospital-acquired infection in the critical care unit. J Global Infect Dis 2021;13:80-4.

Received: 21 May 2020 Revised: 21 September 2020 Accepted: 16 October 2020 Published: 16 April 2021

Access this article online

Quick Response Code: Website: www.jgid.org
DOI: 10.4103/jgid.jgid_147_20

Address for correspondence: Dr. Aladeen Alloubani, King Hussein Cancer Center, Nursing Research Unit, Amman, Jordan. E-mail: aa.1567@khcc.jo

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKLHRPMedknow_reprints@wolterskluwer.com
employed methods were revealed to be effective in enhancing the compliance rates, it is still required to attain a sustainable level of development.

The multidimensional HH is another approach to enhance HH compliance, thus controlling HAIs. International and national studies were conducted to examine the effect of the multidimensional HH approach that is the International Nosocomial Infection Control Consortium (INICC) on HH compliance in 19 different countries. This approach combines education, with reminders, continuous surveillance, performance feedback with the availability of supplies, and administrative support to achieve maximum outcome. The result indicates a significant improvement in HH compliance.

Most of the HH-related HAI studies have been conducted in developed countries. However, it has not been systematically studied in developing countries until the INICC started to evaluate and analyze the HAI rates with standardized methods.

This study aimed to determine the effect of a handwashing and awareness campaign on knowledge and compliance with HH practices among HCWs. Specifically, the study question was: What is the effect of HH campaign on HH knowledge, practice, and HAI?

The prospect of the study is significant since it was the first study in the northwest region of Saudi Arabia. In the current study, most of the strategies recommended by the WHO are combined, wherein each strategy works on HH compliance and HAI independently within varying degrees. Furthermore, the effectiveness of a multimodal program that does not include all strategies included in INICC multidimensional HH approach is unclear and therefore, further implementation is needed.

Methods

Study design
A prospective, interventional, pre-post design was utilized using one group pretest-posttest. Pre-post design is presented to understand and determine the effects of selected interventions.

Setting and participants
The study was conducted between June 2017 and February 2018 in the main intensive care unit (MICU), pediatric ICU (PICU), neonatal ICU (NICU), and coronary care unit (CCU) at one of the largest government hospital in Tabuk, Saudi Arabia. This hospital is a 445-bed tertiary hospital that contains a 22-bed PICU, 20-bed MICU, 16-bed NICU, and 3-bed CCU.

The managers and assistants were approached to evaluate the inclusion criteria. The inclusion criteria for HCWs should be worked in one of the selected units in the hospital with 24-h accountability and responsibility for operational processes, held a Bachelor or Master of Science degree, and were able to sign the consent form to participate in this study.

Ethical considerations
This study has been reviewed and permitted by the Institutional Review Board, with the ethical approval number: UT-54-1-2018. Moreover, ethical approval for this study was obtained by the training and scholarship center of the health of the approached hospital. The researchers assured the participants that the information was confidential. No personal data would be shared, and it would be used only for research purposes, while maintaining their anonymity. Furthermore, the researchers confirmed that the outcomes of the study would aid in recognizing the actual reasons behind the unsuitable handwashing practice and knowledge.

Measurements/instruments
An electronic questionnaire was constructed using the Google Drive website in which the participants used an electronic device (iPad) to answer the questionnaires. The questionnaire used in this study was composed of three parts: demographic sheet, HH Knowledge Questionnaire developed by the WHO to assess HH knowledge, and Handwashing Questionnaire developed by Alloubani et al. to assess the HH practice.

The demographic information included gender, age, experience, profession, departments, and education. The HH Knowledge Questionnaire consisted of 25 questions and addressed different factors related to HH knowledge. The correct answer was given one point. The total score ranged from 0 to 25. Scores ≤12 were considered poor, scores between 13 and 18 were considered moderate, and scores of ≥18 were considered high.

The Handwashing Questionnaire consists of eight questions to assess self-reported HH practice level. Each item was rated using a 5-point Likert scale. The total score ranges from 8 to 40, scores >20 were considered low, 20–30 was considered moderate, and <30 was considered a high level of HH practice.

Procedures
The study was conducted over three stages:

Preintervention
The first stage was a 1-month preintervention stage in June 2017 to develop the foundation of compliance rate of handwashing. The handwash observers were trained on the procedure, and they were monitored by the principal investigator daily. The questionnaire was administered to the participants preintervention in June 2017.

Intervention
The second stage was the interventional handwashing campaign carried between July 2017 and January 2018 as a part of the provincial educational program about HH practice improvement among HCWs.

The campaign’s steps involve:
- Facilitating: Lectures to educate HCWs about the importance of HH and the fundamental HAI concepts
- Posters: In the workplace explaining the five steps for HH practice demonstrating the correct use of alcohol-based solutions and handwashing techniques
• Leaflets: Describing the proper way to carry out HH
• Messages (SMS): To notify the nurses and other HCWs regarding the importance of HH. The previous steps were aimed at training and spreading alertness among HCWs. In addition, alcohol-based disinfectants were put inside and outside all rooms in the hospital, at the bedsides of the patients’ room, and in other visible and suitable sites.

Two hundred hours of observation for the HCWs were conducted directly using an observation record form. The observation was distributed equally into two stages. The first stage took place in June 2017 and the second started in February 2018.

The WHO guidelines were utilized to define the opportunities of handwashing and classify them into five groups: (1) pre the patient interaction, (2) before any task with aseptic, (3) post contact to bodily fluids, (4) post patient interaction and (5) post connection with surrounding of the patients. The observation locations were scheduled early, and observations were carried out in a daily manner at prespecified 1 h for each department during the morning shift.

The participants were observed closely to assess their compliance with handwashing. The observations were carried out for two patients at one time and directly during patient care. The staff did not have any information about the times of the observation.

Postintervention
The third stage was the postintervention stage in February 2018 to assess the improvement in handwashing compliance rates. The questionnaire was administered postintervention again in February 2018.

The compliance rate of handwashing by the HCWs’ was obtained by dividing the total number of handwashing actions using soap and water or hand sanitizing by the total opportunities number, then multiplying by 100. where the handwashing actions performance represented by the actual number of handwashing that were conducted by the HCWs’ through their tasks and within the manner of organized care, while the opportunities number represented by the indications for handwashing during the care procedure when handwashing should be achieved.

Data analysis
Data were analyzed utilizing the Statistical Package for Social Sciences (SPSS) for Windows, Version 21.0. Armonk, NY: IBM Corp. Descriptive statistics were used to describe the study variables and independent sample $t$-test and correlation Pearson with a 95% confidence level.

Results
Participants’ Sociodemographic
A total of 300 HCWs were approached; 220 were participated in the study at all phases with a response rate of 73.3%, including 164 nurses, 41 physicians, 11 radiology technicians, 2 physiotherapists, and 2 lab technicians. One-third of the participants were male (65, 29.5%). Moreover, the majority of the participants (152, 59.1%) were between 20 and 30 years old, and 136 (61.8%) participants had <5 years of experience. Nurses had the largest percentage of participants (164, 74.5%), followed by medical doctors (41, 18.5%). The detailed demographic data of the study participants are shown in Table 1.

Knowledge and practice about hand hygiene questionnaire
A significant difference ($t = -4.40, P > 0.001$) was observed between the pre ($M = 24.33; \text{standard deviation} [SD] = 3.31$) and post ($M = 32; SD = 3.91$) HH practice scores; this finding indicates that there is an improvement in practicing HH regularly during the shift. Whereas the knowledge has been increased from preintervention ($M = 11.84, SD = 2.41$) to postintervention ($M = 18.80, SD = 2.93$), and it was significant ($t = -8.39, P < 0.001$) [Table 2].

Hand hygiene (observation of pre- and post-intervention)
Table 3 displays an observation of 1355 opportunities of participants’ handwashing through the study stages. The HH action compliance was assessed using observation for the participants during patients’ care. The overall HH preintervention compliance rate was 49%, while it was 75% postintervention.

Health-care-associated infection rate
The average health-care-associated infection rate for 3 months preintervention was 13.2, as reported by the infection
control unit. After implementing the program, the average of health-care-associated infection decreased to 9% 3 months after the intervention.

**Relationship between hand hygiene knowledge and practice**

This section presents a summary of the associations between knowledge, practice, and HH compliance postintervention. Table 4 displays the correlation matrix among these three variables using a Pearson product-moment correlation.

A significant positive relationship was found between the overall score for knowledge and practice with HH compliance postintervention ($r = 0.49$ and $r = 0.28$, respectively, $P < 0.001$). In addition, a positive correlation was observed between knowledge and practice ($r = 0.61$, $P < 0.001$). This finding indicates that increasing the level of knowledge improved HH practice. In addition, the HH compliance increases when the knowledge increases.

**DISCUSSION**

This study aimed to explore the effectiveness of a hand hygiene program to the compliance of HCWs on the HH practices and HAI in the largest governmental hospital in Tabuk City. The results of the current study revealed the HCWs in the critical care unit possess a moderate level of knowledge-related hygiene preintervention. This result is in agreement with the results reported by Zakeri et al.\[22\] who reported a moderate level of knowledge among HCWs in the ICU. This result augments the need of the current study and similar studies, as the educational program is very helpful in HH knowledge and acquisition, which was ultimately reflected in HCW practice, which is also congruent with Suchitra and Lakshmi.\[23\] A contradictory conclusion was drawn from another study, which implies that the level of knowledge was lower among HCWs who received education.\[22\]

Further, the results showed a suboptimal level of HH self-reporting practice in the preintervention phase, it is an expected result based on the level of knowledge about HH, given that the level of knowledge and practice is highly correlated. Our findings revealed that HH practice self-reporting and observed compliance rate were in agreement. The compliance rate was below average. This was congruent with a previous study of the HH compliance rate who had reported a low compliance rate.\[24\] In the current study, after implementing the interventional program, the self-reporting of HH practice and compliance rate have improved, which is congruent with a previous study which implies that the implementation of the educational intervention program was successful in improving HH practice and compliance.\[25\]

In this study, monthly surveillance monitoring for HAI in critical care units showed that there is a decrease in overall HAI; the same conclusion was reported in previous studies, which revealed a decrease in the incidence of HAI rate after implementing an educational program.\[21,26\] Furthermore, our result indicates that there is a significant relationship between knowledge and practice. This is consistent with the findings of a study conducted by Nasirudeen,\[26\] which indicates that HH knowledge influences practice.

**Limitations**

The study results and its generalization should be taken with consideration for some limitations. Using the interventional design is practical; however, it has some limitations. Using one group, there is a possibility of rival hypotheses which would compete with the intervention as an explanation for the results. Although the participants were not informed about the time of observation, there is still the possibility of the Hawthorne effect in relation to handwashing that is equated with by increasing the frequency and the compliance of handwashing that will be undertaken by HCWs. Moreover, convenience sampling, although more practical, affects the generalizability of the study. In addition, this study was conducted only in one hospital as it the only major civilian hospital with intensive care units.

**Conclusion**

This study displayed the effectiveness of HH and awareness campaign which includes educational lectures and posters for enhancing compliance with HH practice in the critical care units. Improving HH practice among the HCWs is important to shed light on for better quality of care.
Further, longitudinal interventional studies are required to sustain the improvements in the HH compliance rate to decrease the HAI rates. Moreover, to maintain this level of improvement, proper education, periodical assessment, and training regarding HH practices for all HCWs are needed.

Acknowledgment

We would like to thank Manar Saleh (University of Houston; Teacher, Houston Independent School District) for her valuable assistance and support in editing and revising this manuscript.

Research quality and ethics statement

This study was approved by the Institutional Review Board / Ethics Committee approval number [UT-54-1-2018]. The authors followed applicable EQUATOR Network (http://www.equator-network.org/) guidelines during the conduct of this research project.

Financial support and sponsorship

The authors would like to acknowledge the financial support for this work, from Deanship of Scientific Research (DSR), the University of Tabuk, Tabuk, Saudi Arabia, under grant no. S-1438-0212.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Sax H, Allegranzi B, Chraiti MN, Boyce J, Larson E, Pittet D. The World Health Organisation hand hygiene observation method. Am J Infect Control 2009;37:827-34.
2. Ellingson K, Haas JP, Aiello AE, Kusek L, Maragakis LL, Olmsted RN, et al. Strategies to prevent healthcare-associated infections through hand hygiene. Infect Control Hosp Epidemiol 2014;35:937-60.
3. Freeman MC, Stocks ME, Cumming O, Jeandron A, Higgins JP, Wolf J, et al. Hygiene and health: Systematic review of handwashing practices worldwide and update of health effects. Trop Med Int Health 2014;19:906-16.
4. Chassin MR, Mayer C, Nether K. Improving hand hygiene at eight hospitals in the United States by targeting specific causes of noncompliance. Jt Comm J Patient Saf 2015;41:4-12.
5. von Lengerke T, Lutzke B, Krauth C, Lange K, Stahmeyer JT, Chaberyn IF. Promoting hand hygiene compliance: PSYGIENE—a cluster-randomized controlled trial of tailored interventions. Dtsch Arztebl Int 2017;114:29.
6. Pittet D, Allegranzi B, Boyce J, World Health Organization World Alliance for Patient Safety First Global Patient Safety Challenge Core Group of Experts. The World Health Organization Guidelines on Hand Hygiene in Health Care and their consensus recommendations. Infect Control Hosp Epidemiol 2009;30:611-22.
7. Farhoudi F, Sanaei Dashi A, Hoshangi Davani M, Ghalbei N, Sajadi G, Taghizadeh R. Impact of WHO hand hygiene improvement program implementation: A quasi-experimental trial. Biomed Res Int 2016;2016:7026169.
8. Haas JP, Larson EL. Measurement of compliance with hand hygiene. J Hosp Infect 2007;66:6-14.
9. Abdella NM, Tefera MA, Eredie AE, Landers TF, Malefa YD, Alene KA. Hand hygiene compliance and associated factors among health care providers in Gondar University Hospital, Gondar, North West Ethiopia. BMC Public Health 2014;14:96.
10. Musu M, Lai A, Mereu NM, Galletta M, Campagna M, Tidore M, et al. Assessing hand hygiene compliance among healthcare workers in six Intensive Care Units. J Prev Med Hyg 2017;58:E231-E237.
11. Pittet D, Mourouga P, Perneger TV. The members of the Infection Control Program. Compliance with hand washing in a teaching hospital. Ann Intern Med 1999;130:126-30.
12. Heldur OK, Bing J, Looman CW, van Gwodoever J, Kornelisse RF. The impact of an educational program on hand hygiene compliance and hospital-acquired infection incidence in an urban neonatal intensive care unit: An intervention study with before and after comparison. Int J Nurs Stud 2010;47:1245-52.
13. Mu X, Xu Y, Yang T, Zhang J, Wang C, Liu W, et al. Improving hand hygiene compliance among healthcare workers: An intervention study in a Hospital in Guizhou Province, China. Braz J Infect Dis 2016;20:413-8.
14. Rosenthal BD, Pawar M, Leblébíecliou H, Navoa-Ng JA, Villamil-Gómez W, Armas-Ruiz A, et al. Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach over 13 years in 51 cities of 19 limited-resource countries from Latin America, Asia, the Middle East, and Europe. Infect Control Hosp Epidemiol 2013;34:415-23.
15. Gould DJ, Moralejo D, Drey N, Chudleigh JH, Taljaard M. Interventions to improve hand hygiene compliance in patient care. Cochrane Database Syst Rev 2017;9:CD005186.
16. World Health Organisation (WHO). World alliance for patient safety: Manual for observers. Geneva, Switzerland: WHO; 2006.
17. Dimitrov DM, Rumrill PD Jr. Pretest-posttest designs and measurement of change. Work 2003;20:159-65.
18. Saafdar N, Cnich CJ, Maki DG. Nosocomial infections in the intensive care unit associated with invasive medical devices. Curr Infect Dis Rep 2001;3:487-95.
19. Rosenthal BD, Maki DG, Rodrigues C, Alvarez-Moreno C, Leblébíecliou H, Sobreyra-Oropeza M, et al. Impact of International Nosocomial Infection Control Consortium (INICC) strategy on central line-associated bloodstream infection rates in the intensive care units of 15 developing countries. Infect Control Hosp Epidemiol 2010;31:1264-72.
20. Tools For Evaluation and Feedback. World Health Organization; 2009. Available from: http://www.who.int/gpsc/5may/tools/evaluation_feedback/en/. [Last accessed on 2017 Jun 25].
21. Alloubani A, Taktak WF, Hussein AA, AlZanoun RM., Rabadi HN, Joyce T. Improving compliance of hand hygiene practises among intensive care unit employees in AL‑Istishari Hospital in Jordan. Am J Med Sci 2014;4:139-49.
22. Zakeri H, Ahmadi F, Rafeemanesh E, Saleh LA. The knowledge of hand hygiene among the healthcare workers of two teaching hospitals in Mashhad. Electron Physician 2017;9:5159-65.
23. Suchitra JB, Lakshmi Devi N. Impact of education on knowledge, attitudes and practices among various categories of health care workers on nosocomial infections. Indian J Med Microbiol 2007;25:181-7.
24. Chihapola V, Brar R. Impact of an educational intervention on hand hygiene compliance and infection rate in a developing country neonatal intensive care unit. Int J Nurs Pract 2015;21:486-92.
25. Pessoa-Silva CL, Hugonnet S, Pfister R, Touveneau S, Dharan S, Posfay-Barbe K, et al. Reduction of health care associated infection risk in neonates by successful hand hygiene promotion. Pediatrics 2007;120:e382-90.
26. Nasirudeen AM, Koh JW, Lau AL, Li W, Lim LS, Ow CY. Hand hygiene knowledge and practises of nursing students in Singapore. Am J Infect Control 2012;40:e241-3.