RESEARCH ARTICLE

Educational sessions may not be enough to improve knowledge about hand hygiene: Assessing the knowledge about hand hygiene of health workers before and after an educational workshop in Sudan [version 1; peer review: 2 approved with reservations]

Ihab B. Abdalrahman¹, Sara Shamat ², Sara Mamoun², Reem Abdelraheem², Esraa Salah², Mohammed Elkhailifa ², Abduraheem Farah², Duaa Ali², Abdelmohaymin A. Abdalla², Eman Saeed², Mohamed Dafaalla ²

¹Acute Care Medicine, Soba University Hospital, University of Khartoum, Khartoum, Sudan

²Soba Center for Audit and Research, Soba University Hospital, Khartoum, Sudan

V1 First published: 11 Apr 2018, 7:449
<https://doi.org/10.12688/f1000research.13029.1>

Latest published: 11 Apr 2018, 7:449
<https://doi.org/10.12688/f1000research.13029.1>

Abstract

Background: In an attempt to defeat the high prevalence of health care associated infections, by raising the awareness about hand hygiene, we implemented a quasi-experimental study as part of a quality improvement project to evaluate the efficacy of focused educational workshop on knowledge about hand hygiene among health care workers in Sudan.

Methods: Seventy-three participants were recruited from two public hospitals and one private hospital in Khartoum, Sudan in September 2017. The knowledge before and after the educational workshop was assessed for each participant using the World Health Organization hygiene associated infection questionnaire. We analyzed data using SPSS v22 and used McNemar's test to compare knowledge before and after the workshop.

Results: Around 40% of participants worked in general ward and 85% of them were women. Almost 70% were midwives or nurses. The mean age of participants was 28.4 years. We compared the knowledge of hand hygiene between nurses and doctors before the workshop, and the results showed that nurses had better knowledge in almost all aspects of hand hygiene. When we compared the knowledge before and immediately after the workshop for all participants, we found that there was no significant improvement in almost all aspects of knowledge about hand hygiene ($P > 0.05$).

Conclusion: Comparing the knowledge before and after the

Open Peer Review

Approval Status ? ?

	1	2
version 1		
11 Apr 2018	view	view
1. Sile A. Creedon , University College Cork, Cork, Ireland		
2. Caitlin Liddelow , University of Wollongong, Northfields Ave, Wollongong, Australia		
Any reports and responses or comments on the article can be found at the end of the article.		

workshop, we found no significant improvement in almost all aspects of hand hygiene. Of note, nurses' knowledge about hand hygiene was consistently higher than doctors. Additional studies are needed to identify the optimal design of educational sessions.

Keywords

Educational sessions, hand hygiene, infection control, nurses and doctors, workshop, health-care associated infections

This article is included in the **Sociology of Health** gateway.

Corresponding author: Mohamed Dafaalla (mdafaallah200@gmail.com)

Author roles: **Abdalahman IB:** Conceptualization, Data Curation, Formal Analysis, Methodology, Project Administration, Resources, Supervision, Writing – Original Draft Preparation, Writing – Review & Editing; **Shamat S:** Data Curation, Formal Analysis, Methodology, Supervision, Writing – Original Draft Preparation; **Mamoun S:** Data Curation, Formal Analysis, Methodology, Writing – Original Draft Preparation; **Abdelraheem R:** Data Curation, Formal Analysis, Writing – Original Draft Preparation; **Salah E:** Data Curation, Formal Analysis, Writing – Original Draft Preparation; **Elkhalifa M:** Data Curation, Formal Analysis, Writing – Original Draft Preparation; **Farah A:** Data Curation, Formal Analysis, Writing – Original Draft Preparation; **Ali D:** Data Curation, Formal Analysis, Writing – Original Draft Preparation; **Abdalla AA:** Data Curation, Formal Analysis, Methodology; **Saeed E:** Data Curation; **Dafaalla M:** Formal Analysis, Methodology, Software, Writing – Original Draft Preparation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

Copyright: © 2018 Abdalahman IB *et al.* This is an open access article distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Data associated with the article are available under the terms of the [Creative Commons Zero "No rights reserved" data waiver](#) (CC0 1.0 Public domain dedication).

How to cite this article: Abdalahman IB, Shamat S, Mamoun S *et al.* **Educational sessions may not be enough to improve knowledge about hand hygiene: Assessing the knowledge about hand hygiene of health workers before and after an educational workshop in Sudan [version 1; peer review: 2 approved with reservations]** F1000Research 2018, 7:449 <https://doi.org/10.12688/f1000research.13029.1>

First published: 11 Apr 2018, 7:449 <https://doi.org/10.12688/f1000research.13029.1>

Introduction

Health-care associated infections (HAIs) are regarded as a major health problem endangering hospital-admitted patients in particular¹. In developed countries, 5–15% of hospitalized patients were at risk to acquire infections, especially those admitted to intensive care units; HAIs in Europe and USA were 4.6–9.3% and 4.5%, respectively². In contrast, the prevalence in some developing countries is as high as (19.1–14.8%)³. Health care associated infections (HAIs) results in prolonged hospital stay as it can add 18–24 days to the length of hospital stay and may result in more deaths. For instance, in Europe HAIs are responsible for 50,000–135,000 deaths out of 5,000,000 cases of HAIs, annually⁴. Moreover, it contributes to €13–24 billion of added healthcare costs⁵. All these facts highlight the morbidity and mortality from HAI.

Hand hygiene is a general term, referring to any action of hand cleansing using water and detergent and/or the use of alcohol-based hand sanitizers for the removal of transient micro-organisms from hands⁶. It is widely accepted that improved hand hygiene compliance contributes to the prevention of HAIs⁷. This consensus has been supported by several studies. For example, a hand hygiene culture changing program was conducted by Grayson *et al.* (2008) over two years in six Australian hospitals. This study demonstrated that the incidence of Methicillin-resistant-Staphylococcus aureus (MRSA) bacteraemia and the number of MRSA-positive clinical isolates were significantly reduced at the end of the study period⁵. Hand hygiene is found to be the single most effective measure to guard against healthcare-associated pathogens⁸.

There are various educational methods adopted to improve knowledge about hand hygiene as a key element to control HAI. For instance knowledge about hand hygiene could be included in the curriculum for medical and nursing students⁹. Another way is by taking advantage and to introduce the appropriate knowledge about hand hygiene to health care professionals gathered at conferences and professional meetings⁸. In addition educational workshops and sessions about hand hygiene among hospital staff should be arranged from time to time⁸. Lastly, educational hand-outs and posters about hand hygiene should be available in the working environments of health workers¹.

Implementation of different approaches regarding boosting hand hygiene knowledge shows a wide range of variability in the efficacy between educational and interventional approaches. Hand hygiene compliance improvement has been shown to be greater using educational approaches than practical interventions¹⁰. For instance, after delivery of an educational hand-out and poster campaign the rate of study participant complying with hand-washing guidelines was 83%¹. In addition, after two years of commencement of The Australian National Hand Hygiene Initiative in 2009, hand hygiene compliance increased from 43.6% to 67.8%⁷. Thus, giving educational lectures and workshops about hand hygiene practice appeared to have a noticeable impact on the knowledge and practice of hand hygiene among health care workers in these settings.

This study aimed to evaluate the knowledge about hand hygiene among health care workers in Sudan. In addition, we

assessed the role of an educational session as a recommended tool to improve the knowledge about hand hygiene among these same health care workers.

Methods

Ethical approval

Ethical approval was obtained from Soba University Teaching Hospital and Soba Centre for Audit and Research (approval no S248). All participants were fully informed about the workshop and the study prior to participation. Written consent was obtained from all participants for participation.

Study design

We implemented a quasi-experimental study as part of a quality improvement project designed and implemented by Soba University Hospital, University of Khartoum, to evaluate the efficacy of focused educational workshop on knowledge about hand hygiene among health care workers.

All health care providers in departments of emergency and internal medicine (73 participants) were recruited from two public hospitals (Soba Teaching Hospital and Saad Abuelela Hospital) and one private hospital (Fedail Hospital) in Khartoum, Sudan, in September 2017. Participants were recruited by the departments of infection control in their hospitals to enrol in this quality improvement project. Their knowledge before and after the educational workshop (see below) was assessed using the World Health Organization (WHO) HAI questionnaire.

WHO hygiene associated infection questionnaire

The questionnaire is composed of 20 single best answer questions. The first seven questions assess demographic variables; hospital name, ward, age, gender, profession, and previous hand hygiene training. The remaining questions assess different aspects of knowledge about hand hygiene¹¹.

Educational workshop

The educational workshop was composed of lectures and practical sessions delivered over eight working hours (see [Supplementary File 1](#)). The workshop was delivered by a qualified instructor who has completed a PhD on infection control. The knowledge about hand hygiene measures was delivered mainly through lectures, while the practical sessions focused on training about proper hand washing technique according to the WHO¹¹.

Statistical analysis

We analyzed data using SPSS v22. We used McNemar's test to compare knowledge of participants before and after the educational workshop

Results

Descriptive statistics

Around 40% of participants worked in general ward and 85.9% of them were women. Almost 70% were midwives or nurses. The mean age of participants was 28.4 years. [Table 1](#) shows the demographic characteristics of the participants.

Table 1. Demographic characteristics of the participants.

		%
Ward worked in	General	40.0
	Private	51.4
	Not applicable	8.6
Gender	Female	85.9
	Male	14.1
Profession	Nurse/midwife	69.8
	Doctor/resident	30.2
Received training in hand hygiene previously	Yes	33.8
	No	66.2

Multivariate analysis

We compared the knowledge of hand hygiene between nurses and doctors, and the results showed that nurses had a better knowledge in almost all aspects of hand hygiene. When we compared the knowledge immediately after the workshop we found out that there was no significant improvement in almost all aspects of knowledge about hand hygiene ($P>0.05$). **Table 2** illustrates these findings in more details. The text in **bolds** are the correct answers. P values in **bold** are the significant probabilities.

Dataset 1. Participant responses to the WHO handwashing questionnaire data before and after the educational session

<http://dx.doi.org/10.5256/f1000research.13029.d199687>

Table 2. Results of health-care associated infections questionnaire before and after an education workshop on hand hygiene.

(A) Hand disinfection topics; (B) hand rubbing, hand washing, and accessories topics. We used McNemar's test to compare knowledge of participants before and after the educational workshop. P values <0.05 indicates significant difference.

Table 2A		Before %	After %	Difference %	P value	Nurse/ midwife	Doctors
Use alcohol handrub	Yes	76.9	74.3	-2.60	0.68	81.4	57.9
	No	23.1	25.7	2.60		18.6	42.1
Germ transmission between patients	<u>Healthcare workers' hands when not clean</u>	75.8	77.5	1.70	0.31	75.0	73.7
	Air circulating in the hospital	6.1	1.4	-4.70		2.3	0.0
	Patients' exposure to colonized surfaces	15.2	12.7	-2.50		13.6	15.8
	Sharing non-invasive objects between patients	3.0	8.5	5.50		9.1	10.5
Source of germs	The hospital's water system	6.1	5.7	-0.40	0.21	4.7	10.5
	The hospital air	1.5	4.3	2.80		4.7	5.3
	<u>Germs already present on or within the patient</u>	10.6	18.6	8.00		20.9	21.1
	The hospital environment (surface)	81.8	71.4	-10.40		69.8	63.2
Hand disinfection before touching a patient	Yes	95.5	92.5	-3.00	0.37	93.0	88.9
	No	4.5	7.5	3.00		7.0	11.1
Hand disinfection immediately after a risk of body fluid exposure	Yes	71.2	65.0	-6.20	0.3	66.7	57.1
	No	28.8	35.0	6.20		33.3	42.9
Hand disinfection after exposure to the immediate surroundings of a patient	Yes	75.8	64.4	-11.40	0.17	64.1	71.4
	No	24.2	35.6	11.40		35.9	28.6
Hand disinfection immediately before a clean aseptic procedure	Yes	81.8	74.6	-7.20	0.3	74.4	78.6
	No	18.2	25.4	7.20		25.6	21.4
Hand disinfection after touching a patient	Yes	86.4	81.0	-5.40	0.581	92.9	57.1
	No	13.6	19.0	5.40		7.1	42.9

Table 2A							
		Before %	After %	Difference %	P value	Nurse/ midwife	Doctors
Hand disinfection immediately after a risk of body fluid exposure	Yes	83.1	80.3	-2.80	0.15	82.1	80.0
	No	16.9	19.7	2.80		17.9	20.0
Hand disinfection immediately before a clean aseptic procedure	Yes	67.7	56.7	-11.00	0.02	50.0	60.0
	No	32.3	43.3	11.00		50.0	40.0
Hand disinfection after exposure to the immediate surroundings of a patient	Yes	80.0	79.7	-0.30	<u>1.0</u>	80.5	80.0
	No	20.0	20.3	0.30		19.5	20.0
Hand rubbing is more rapid for hand cleaning than hand washing	True	75.8	60.3	-15.50	0.02	64.9	50.0
	False	24.2	39.7	15.50		35.1	50.0
Hand rubbing causes skin dryness more than hand washing	True	63.6	54.1	-9.50	0.15	57.9	50.0
	False	36.4	45.9	9.50		42.1	50.0
Hand rubbing is more effective against germs than handwashing	True	47.0	58.6	11.60	0.38	67.6	42.9
	False	53.0	41.	-11.60		32.4	57.1
Handwashing and hand rubbing are recommended to be performed in sequence	True	75.8	67.8	-8.00	0.82	68.4	64.3
	False	24.2	32.2	8.00		31.6	35.7
Minimal time needed for alcohol based hand rubbing to kill most of germs	20 seconds	69.7	28.4	-41.30	0.001	34.1	22.2
	3 seconds	3.0	9.0	6.00		14.6	0.0
	1 minute	21.2	40.3	19.10		31.7	61.1
	10 seconds	6.1	22.4	16.30		19.5	16.7
Table 2B							
		Before %	After %	Difference %	P value	Nurse/ midwife%	Doctors %
Type required before palpation of the abdomen	Rubbing	50.0	43.9	-6.10	0.26	43.9	47.
	Washing	43.9	53.0	9.10		53.7	47.1
	None	6.1	3.0	-3.10		2.4	5.9
Type required before giving an injection	Rubbing	34.8	34.4	-0.40	0.56	43.6	17.6
	Washing	60.6	62.5	1.90		53.8	76.5
	None	4.5	3.1	-1.40		2.6	5.9
Type required after emptying a bedpan	Rubbing	24.2	38.8	14.60	0.025	41.5	33.3
	Washing	71.2	59.7	-11.50		58.5	61.1
	None	4.5	1.5	-3.00		0.0	5.6
Type required after removing examination gloves	Rubbing	21.2	40.0	18.80	0.12	39.0	25.0
	Washing	75.8	60.0	-15.80		61.0	75.0
	None	3.0	0.0	-3.00		0.0	0.0
Type required after making a patient bed	Rubbing	45.5	37.9	-7.60	0.33	46.3	17.6
	Washing	48.5	62.1	13.60		53.7	82.4
	None	6.1	0.0	-6.10		0.0	0.0
Type required after visible exposure to blood	Rubbing	36.4	44.8	8.40	0.096	53.7	33.3
	Washing	59.1	55.2	-3.90		46.3	66.7
	None	4.5	0.0	-4.50		0.0	0.0
Avoid wearing jewellery	Yes	97.0	82.5	-14.50	0.012	75.0	100.0
	No	3.0	17.5	14.50		25.0	0.0
Avoid contacting damaged skin	Yes	87.9	84.4	-3.50	0.267	82.5	88.2
	No	12.1	15.6	3.50		17.5	11.
Avoid having artificial fingernails	Yes	93.9	83.1	-10.80	0.065	77.5	88.2
	No	6.1	16.9	10.80		22.5	11.8
Avoid regular use of hand cream	Yes	53.0	33.9	-19.10	0.017	30.8	43.8
	No	47.0	66.1	19.10		69.2	56.3

Discussion

Our study revealed that knowledge about hand hygiene and HAI is better among nurses and midwives in comparison to doctors. Some studies concluded the same results. In a study conducted by Ameer *et al.* nurses were found to have a better hand hygiene compliance rate (43.08%) compared to doctors (31.25%). Another study by Han *et al.* revealed that nurses' knowledge score was significantly higher than doctors¹². On the other hand, other studies showed opposite results. For example, Ekwere *et al.* conducted a study in a tertiary hospital in Southwest Nigeria and concluded that doctors had no significant better knowledge of hand washing than nurses¹³.

Overall there was no significant improvement in knowledge about hand hygiene and HAI after the educational workshop. Similarly, in a study done by Lee *et al.* there was no significant improvement in hand hygiene compliance or alcohol-based hand rub consumption following education¹⁰. In contrast, a case-control study that evaluated the effect of using educational activities and posters on hand hygiene compliance revealed a significant improvement in hand hygiene compliance compared to control hospitals⁸. Similarly, Abdraboh *et al.* (2012) concluded that performing educational sessions was among the most important activities to attain better health care worker hand hygiene compliance³.

But why didn't we improve hand washing knowledge after administration of the workshop? This could be attributed to deficiency in contents, environment, and teaching methods. Regarding teaching methods; the lecture duration was 3 hours which may not only make some of the candidates fail to follow the instructor but may also make it difficult for the instructor to stay focused. Moreover, the large number of participants (n=73) might make it difficult for instructors to deliver effective

education. The present result might be of help to alert instructors to review their teaching methods and these results emphasize the importance of feedback in improving learning methods. Cook in the article 'Twelve tips for evaluating educational programs' strongly advises that instructors should seek evaluation from stakeholders such as students and administrators. In addition, designing and validating an evaluation tool to evaluate the quality and effectiveness of educational programs would be of great help because it enables reliable evaluation and monitoring of the progress of the program¹⁴.

Conclusions

In conclusion, to meet the objectives of educational workshops we recommend that contents should be revised and cover all the hand hygiene guidelines that are stated by WHO. In addition, taking into consideration the language factor in delivering the information in understandable language to all participants. Lastly, the number of participants as well as the duration of the workshop should be reduced to a level that facilitates proper information delivery.

Data availability

Dataset 1: Participant responses to the WHO handwashing questionnaire data before and after the educational session. DOI [10.5256/f1000research.13029.d199687](https://doi.org/10.5256/f1000research.13029.d199687)¹⁵

Competing interests

No competing interests were disclosed.

Grant information

The author(s) declared that there were no grants involved in supporting this study.

Supplementary material

Supplementary File 1: Educational workshop content.

[Click here to access the data.](#)

References

1. Creedon SA: **Healthcare workers' hand decontamination practices: compliance with recommended guidelines.** *J Adv Nurs.* 2005; 51(3): 208–216.
[PubMed Abstract](#) | [Publisher Full Text](#)
2. World Health Organization: **Improved hand hygiene to prevent healthcare-associated infections.** Patient Safety Solutions, [online] 2007; 1(Solution 9).
[Reference Source](#)
3. Abdraboh SN, Milaat W, Ramadan IK, *et al.*: **Hand hygiene and health care associated infection: an intervention study.** *American Journal of Medicine and Medical Sciences.* 2016; 6(1): 7–15.
[Reference Source](#)
4. WHO Guidelines for Hand Hygiene in Health Care: **First Global Patient Safety Challenge: Clean Care is Safer Care.**
[Reference Source](#)
5. van De Mortel TF, Kermode S, Prozano T, *et al.*: **A comparison of the hand hygiene knowledge, beliefs and practices of Italian nursing and medical students.** *J Adv Nurs.* 2012; 68(3): 569–579.
[PubMed Abstract](#) | [Publisher Full Text](#)
6. Nabavi M, Alavi-Moghaddam M, Gachkar L, *et al.*: **Knowledge, Attitudes, and Practices Study on Hand Hygiene Among Imam Hossein Hospital's Residents in 2013.** *Iran Red Crescent Med J.* 2015; 17(10): e19606.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
7. McLaws ML: **The relationship between hand hygiene and health care-associated infection: it's complicated.** *Infect Drug Resist.* 2015; 8: 7–18.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
8. Mathai E, Allegranzi B, Seto WH, *et al.*: **Educating healthcare workers to optimal hand hygiene practices: addressing the need.** *Infection.* 2010; 38(5):

- 349–356.
[PubMed Abstract](#) | [Publisher Full Text](#)
9. Ojulong J, Mitonga KH, Iipinge SN: **Knowledge and attitudes of infection prevention and control among health sciences students at University of Namibia.** *Afr Health Sci.* 2013; 13(4): 1071–1078.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
10. Li Y, Wang Y, Yan D, *et al.*: **Self-reported hand hygiene practices, and feasibility and acceptability of alcohol-based hand rubs among village healthcare workers in Inner Mongolia, China.** *J Hosp Infect.* 2015; 90(4): 338–43.
[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)
11. World Health Organization: **Clean Care is Safer Care, tools for evaluation of hand hygiene practices and related perception and knowledge at a health-care facility is one vital element of the strategy to improve hand hygiene.**
[Reference Source](#)
12. Han K, Dou FM, Zhang LJ, *et al.*: **[Compliance on hand-hygiene among healthcare providers working at secondary and tertiary general hospitals in Chengdu].** *Zhonghua Liu Xing Bing Xue Za Zhi.* 2011; 32(11): 1139–1142.
[PubMed Abstract](#) | [Publisher Full Text](#)
13. Ekwere TA, Okafor IP: **Hand hygiene knowledge and practices among healthcare providers in a tertiary hospital, south west, Nigeria.** *Int J Infect Control.* 2013; 9(4).
[Publisher Full Text](#)
14. Cook DA: **Twelve tips for evaluating educational programs.** *Med Teach.* 2010; 32(4): 296–301.
[PubMed Abstract](#) | [Publisher Full Text](#)
15. Abdalrahman IB, Shamat S, Mamoun S, *et al.*: **Dataset 1 in: Educational sessions may not be enough to improve knowledge about hand hygiene: Assessing the knowledge about hand hygiene of health workers before and after an educational workshop in Sudan.** *F1000Research.* 2018.
[Data Source](#)

Open Peer Review

Current Peer Review Status: ? ?

Version 1

Reviewer Report 04 May 2022

<https://doi.org/10.5256/f1000research.14127.r135018>

© 2022 Liddelow C. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Caitlin Liddelow

University of Wollongong, Northfields Ave, Wollongong, NSW, Australia

I would like to thank the editor and the authors for allowing me the opportunity to review this paper. It addresses an important topic, hand hygiene in healthcare, which has been of particular interest the last few years. The paper is mostly well-written (some minor grammatical and language expressions that could be improved), however I am concerned by the lack of critical thinking and discussion in the introduction and discussion. There is a lot of behaviour change literature out there, lots with a focus on hand hygiene behaviours, which do not appear in this paper. There are also some details in the methods and results that should be included. I believe once my below comments have been addressed, the paper will be much improved.

Abstract:

- The abstract is clear and presents all of the necessary information required for an abstract.

Introduction:

- **Page 3:** Please provide some examples of health-care associated infections, for readers that may not be in health-care specifically.
- **Page 3:** For consistency, please remove the second (HAIs) from the first paragraph, as you have already done this in the first sentence.
- **Page 3:** Given the experimental study is based in Sudan, are there any statistics or figures regarding the prevalence of HAIs or HAI associated deaths in Sudan? This would be good to include in the introduction.
- **Page 3:** Your reference/citation for this sentence/study is incorrect. You talk about an Australian study by Grayson *et al.* but there is not Grayson *et al.* in your reference list. Please fix this: "For example, a hand hygiene culture changing program was conducted by Grayson *et al.* (2008) over two years in six Australian hospitals. This study demonstrated that the incidence of Methicillinresistant-Staphylococcus aureus (MRSA) bacteraemia and the

number of MRSA-positive clinical isolates were significantly reduced at the end of the study period”.

- **Page 3:** Whilst you provide a good overview of the current literature in the hand hygiene area, there have been numerous studies that have come out since the beginning of the Covid-19 pandemic that look at hand hygiene interventions. It would be good to see some of these studies cited in your introduction.
- **Page 3:** Your introduction lacks some critical thinking and review. I am curious as to why you have decided to do an experimental study on the impact of an education session on hand hygiene when the previous literature already shows this is effective? What is the reason for doing this study given these past studies? Is it because there are differences in the Sudanese culture that may not yield the same results as other studies? More of a rationale for why you have decided to do this specific study is needed.

Methods:

- **Page 3:** Please provide an example question from the WHO hygiene questionnaire.
- **Page 3:** How was this questionnaire scored? Was it a score out of 20? Did participants get separated into groups (e.g., low knowledge / high knowledge)?
- **Page 3:** Some more information on the workshops would be useful. Was it all delivered in one day? Was it in person or online? Was it conducted in one large group at each hospital, or multiple smaller groups? Where was the content in the workshops/lectures derived from? Did the practical sessions involve watching videos, role play, etc.? If possible, matching some of the components of the workshop to Behaviour Change Techniques (see Michie *et al*., 2013¹) would be useful.
- **Page 3:** You say you “used McNemar’s test to compare knowledge of participants before and after the educational workshop” but on page 4 under “multivariate analysis” you say that you compared between groups (doctors vs. nurses). This needs to be clearer on page 3.
- **Page 3:** Why was McNemar’s test conducted rather than a paired samples t-test (for before vs. after) or independent samples t-test (for doctors vs. nurses)? It is unclear why you would use a McNemars test (which is used with nominal data) when it appears, or is assumed, the score from the WHO questionnaire is scale data. More information and a rationale is required.

Results:

- **Page 3/4:** Did you collect information on how long participants had been in the profession? I would expect this would be important to know as it likely influences the results (i.e., if they have worked longer, they are more likely to have higher knowledge).
- **Page 4/5:** Please be consistent with your reporting of percentages and p-values. Some have 1 decimal place, some have 2 decimal places and some have 3.
- **Page 4:** It would be nice to see a combined hand hygiene knowledge score/percentage correct of participants from before the workshop to after the workshop.

Discussion:

- **Page 6:** Please include a correct citation and reference for Ameer *et al.* and Han *et al.* in the first paragraph of your discussion. You should not be discussing studies that you have not properly referenced.
- **Page 6:** It would be good if you included further discussion on why you/the authors think you received the results you did. In the first paragraph you provide evidence that is inline with your finding and then evidence that is the opposite. Why do you think nurses and midwives had greater knowledge compared to doctors?
- **Page 6:** There is an abundance of literature and research that says that providing education alone is not enough to change behaviour. This may be why you did not see any significant improvements after the workshop, as it was only education based. Some discussion of this is warranted, particularly in paragraph 2. See: Arlinghaus K. R., & Johnston, C. A. (2017). *Advocating for Behavior Change With Education*².
- **Page 6:** Please fix this in-text citation "Cook in the article 'Twelve tips for evaluating educational programs'.
- **Page 6:** More discussion of the theoretical and/or practical implications of this study is needed. For example, what do the findings tell us about hand hygiene knowledge amongst this sample, specifically in Sudan? What does it tell us about the difference between nurses and doctors?
- **Page 6:** There is no mention of strengths or limitations, or any suggestions for future research in this area. Please consider including some.

References

1. Michie S, Richardson M, Johnston M, Abraham C, et al.: The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Ann Behav Med.* 2013; **46** (1): 81-95 [PubMed Abstract](#) | [Publisher Full Text](#)
2. Arlinghaus KR, Johnston CA: Advocating for Behavior Change With Education. *Am J Lifestyle Med.* **12** (2): 113-116 [PubMed Abstract](#) | [Publisher Full Text](#)

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Behaviour change, health psychology, health interventions

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 25 June 2018

<https://doi.org/10.5256/f1000research.14127.r34546>

© 2018 Creedon S. This is an open access peer review report distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Sile A. Creedon

University College Cork, Cork, Ireland

Thank you for the opportunity to review this paper. I hope my comments are useful to you.

Introduction: Can you check the accuracy of the figures related to HCAI in developing countries please.

Intervention: The design of the educational intervention was face to face workshop. Given that this was the intervention, it needs to be described in much more detail. What other types of educational interventions were considered and why was this type chosen? Can you please add a referenced section to the introduction.

Design: The study design was quasi experimental. The authors need to explain more fully how the study met the criteria for quasi experimentation. Could it be more accurately described as an interventional study?

Sample: The participants were chosen by the infection prevention staff in each hospital. How did this occur? it needs a better explanation and the threat of bias also needs to be discussed. It seems to me that this may lead to targeting only staff who were 'known to' or perhaps were friendly with the infection prevention team.

Discussion: The discussion section needs to be developed more fully. In the opening paragraph, the authors state that there was no improvement in either knowledge or prevalence of HCAI's after the workshop. Did the study measure prevalence of HCAI's before and after the work shop?

If not, then you might review making this statement.

There is an attempt made to elucidate why the intervention did not work but it needs more than this. It would benefit from discussion of the design. Is there value in assessing knowledge immediately post intervention? Did you consider a longitudinal design?

Overall, there is some merit in this paper but it needs further development.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: My area of research is in infection prevention in acute care settings

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com

F1000Research