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Behavioral determinants of hand hygiene compliance among nurses in intensive care units in Hai'l, Saudi Arabia

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ABSTRACT

Hand hygiene (HH) is widely regarded as the single most effective method of preventing healthcare-associated infections yet achieving and maintaining compliance among healthcare workers remains a significant challenge. This study aims to identify behavioral determinants of HH compliance using the Attitude-Social Influence-Self-Efficacy (ASE) model among Intensive Care Unit (ICU) nurses in Saudi Arabia. This is a descriptive cross-sectional study using a self-reported questionnaire among ICU nursing staff in 6 Ha'il, Saudi Arabia hospitals. The study employed convenience sampling, using the Behavioral Determinants of Hand Hygiene Compliance in ICU questionnaire with 128 respondents. Frequency, percentage, mean, standard deviation, ANOVA, Pearson-r, and Multiple Regression analysis were used. Total compliance to HH for six hospitals was 86.83%. Self-efficacy was high (mean=3.59, SD=.54). The average score of participants' knowledge of HH was 57% (SD=2.30). Only social pressure was identified as a predictor of noncompliance to HH (β=-1.97; P=.001). The current data highlight the importance of self-efficacy, social influence, positive attitude, and good knowledge regarding HH. However, only social pressure was a predictor of compliance with HH guidelines. When developing interventions to improve HH in ICUs, strategies should include these determinants tailored to the individual, cultural, and institutional factors.

1. Introduction

Healthcare-associated infections (HCAIs) are the most common adverse event in healthcare delivery worldwide, affecting hundreds of millions of patients each year (WHO, 2016). An estimated 30% of patients are affected by HCAIs (ECDC, 2013). Investigating HCAI is a continuing concern, particularly as hospitals worldwide face unique challenges due to the COVID-19 pandemic. The higher-than-usual hospitalizations and shortages of healthcare professionals and equipment may have affected HCAIs surveillance and incidence (CDC, 2021). HCAIs are frequently associated with inadequate hand hygiene (HH) practices among healthcare workers (HCWs) (Musu et al., 2017). Most HCAIs are transferred through direct contact, mainly through HCWs' hands. A simple, low-cost intervention, such as HH, is a significant area of interest in infection control and a vital measure in preventing and reducing HCAIs (WHO, 2009). The WHO has urged all countries and stakeholders to work together to prevent HCAIs (WHO, 2009). To sustain the global promotion and sustainability of HH in healthcare worldwide, the WHO launched a global campaign Clean Care is Safer Care, in 2005, and Save Lives: Clean Your Hands in 2009. The latter is celebrated annually on May 5 during World Hand Hygiene Day (WHO, 2009). Despite the relative simplicity of HH procedures and recommendations, HH compliance (HHC) generally remains low (Thakker and Jadhav, 2015; Sadule-Rios and Aguilera, 2017). Most healthcare settings face difficulties maintaining high levels of HHC among HCWs (Mahfouz et al., 2013; Musu et al., 2017). A review of 96 empirical research conducted in Europe, the United States, Canada, Australia, and Asia revealed a median compliance rate to HH of 40% among HCWs, with lower rates in ICUs (30–40%) than in other settings (WHO, 2009). In Saudi Arabia, high rates of noncompliance, between 41%

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and 58%, were observed among ICU staff (Alsubaie et al., 2013; Mahfouz et al., 2013).

The COVID-19 pandemic has highlighted the need for a worldwide improvement in HCWs' HHC, in addition to the role of human behavior in disease control (Clancy et al., 2021; Stadler and Tschudin-Sutter, 2020; Sin and Rochelle, 2022). During the COVID-19 pandemic, compliance of HCWs with HH has improved considerably (Derksen et al., 2020; Ragusa et al., 2021; Wang et al., 2021). It was higher than typical at the start of the COVID-19 epidemic. However, it quickly began to decline. Therefore, it is believed that even during a pandemic, it can be challenging to maintain HHC (Moore et al., 2021). The increased adherence to HH during the COVID-19 pandemic is thought to be primarily due to HCWs' fear of being infected. Recent studies found that HCWs are more likely to comply with HH in self-protective moments than in patient-protective moments (Brooks et al., 2021; Kolola and Gezahegn, 2017; Madden et al., 2021; Iversen et al., 2020). It was also reported that they are more likely to perform HH after being involved in contaminated tasks than before critical tasks, which suggests that a sense of disgust may affect their HHC (Chang et al., 2021). Improvements in compliance rates prior to patient contact can indicate an overall increase in awareness and motivation to provide a safe environment for patients (Israel et al., 2020). Several reasons were presented in previous studies of nurses' HH noncompliance. Examples include forgetfulness, ignorance of guidelines, insufficient time, high workload and under-staffing, difficulty in putting on gloves with wet hands and challenges in accessing sink locations, products placed in inconvenient locations, skin irritation, and lack of appropriate HH products available at the point of care (Marques et al., 2017; Watson, 2016; Smith et al., 2019).

Protecting patient health is critical to reducing the risk of HCAI by developing and implementing effective preventative interventions (Musu et al., 2017). Such intervention could be more effective when centered on behavior change. Deep and unconscious habits drive HH behavior and are, therefore, difficult to change (de Wandel, 2017). Commitment to HH practices can be poor, even with the availability of high-quality infrastructure and resources (Ganesan et al., 2022). Neither knowledge nor reasoning about the impact on patient safety is a predictor of HHC (de Wandel et al., 2010; Huis et al., 2012). Significant improvements in HHC could be achieved when supplemental interventions are added to the WHO-5 approach (Luangasanatip et al., 2015). Identifying the reasons for HHC plays an important role in developing targeted interventions. Substantial evidence suggests that behavior modification programs can be effective in cultivating specific habits (Hobbs et al., 2013). However, analysis of interventions to promote HHC among HCWs reveals that behavioral change is difficult to achieve and maintain, potentially due to an inability to ground the interventions with suitable behavioral theory. Theory can help improve the understanding of behavior and design and implement interventions to achieve behavior change maintenance (Kwasnicka et al., 2016).

Many theoretical models provide a framework to investigate a wide range of behaviors, including HH behavior in hospitals. One example of such a models is the Attitude–Social influence–Self-efficacy (ASE) model. The model was developed by de Vries et al. (1988) with the aim of understanding the individual's motives to perform a specific behavior. The model integrates ideas of The Theory of Planned Behavior developed by Ajzen (1985), which is an extension of the Theory of Reasoned Action by Fishbein and Ajzen (1975) and Bandura's social learning theory (Bandura and NIMH, 1986). ASE uses valid concepts that can assist in clarifying the individual's behavior or the intention to change the behavior.

One's attitude toward the behavior predicts voluntary behavior. Attitudes refer to the individual's concepts about behavior. Social influence is another aspect that strongly relates to performing a specific behavior (Kwasnicka et al., 2016). Social influence occurs when others impact a person's opinions, feelings, and behaviors (Mannetti et al., 2012). A compliment from a colleague or staff member responding to proper HH would be an example of social influence. Being around high-compliance co-workers (i.e., role models) is a typical example of a positive and valuable social influence (Hoffmann et al., 2020). In Ahmadipour et al. (2022), HCWs reported the existence of negative models, such as the influence of experienced nurses or physicians who did not adhere to HH guidelines, as a reason for their noncompliance. Self-efficacy refers to an individual's belief in their ability to succeed in a given situation. Low self-efficacy might make it more difficult to follow the recommendations or comply with them (Bandura, 1977). According to a study by de Wandel et al. (2010), adherence to HH was promoted by the professionals' perception of high self-efficacy rather than their reasoning about the impact of the procedure on patient safety. It is possible that HCWs may display varying self-efficacy levels according to how they view their capabilities.

The outcomes of HHC are preferable when a combination of determinants is addressed. This reinforces the need to utilize alternative HH improvement initiatives that target factors such as attitude, social influence, and self-efficacy (Pereira et al., 2017; Ribeiro et al., 2019; Huis et al., 2012). The need for continuous behavioral research in ICUs has been emphasized in several previous studies (Sadule-Rios and Aguilera, 2017; Smiddy et al., 2015). In such studies, the use of theoretical models to better understand the complexity of HH is supported (Smiddy et al., 2015). ASE can be used to develop a shared knowledge of the elements that influence HCWs' compliance with HH guidelines. To improve the safety of patients and healthcare providers and prevent the spread of HCAIs, effective compliance with HH is needed. Good compliance

with HH helps reduce costs and provide high-quality care, which is one of the goals of the Kingdom's Vision 2030. Therefore, this study aims to identify behavioral determinants of HHC using the ASE model among ICU nurses in Saudi Arabia to help develop interventions to improve HHC.

2. Methodology

2.1. Design

A descriptive cross-sectional study using a self-reported questionnaire was carried out in May 2022 among ICU nursing staff in 6 Ha'il, Saudi Arabia hospitals.

2.2. Study area and target population

The study collected data from nurses working in adult, pediatric, and neonatal ICUs in 6 central public hospitals in Ha'il, Saudi Arabia. Data were collected using a web-based self-reported questionnaire. The sample was collected using non-probability convenience sampling. The targeted population was nursing staff in the ICUs willing to complete the questionnaire. Inclusion criteria include ICU nurses who are available and willing to participate in the study.

2.3. Data collection

To assess the behavioral determinants of HHC among ICU nurses, nurses were asked to voluntarily complete an anonymous closed-ended self-reported web-based questionnaire. The Google Forms platform was used to create the questionnaire. A QR code to access the questionnaire was distributed among the nursing staff in ICUs through the nursing management office of each hospital. The questionnaire explored the ASE model concerning HHC during patient care. The questionnaire was adopted by de Wandel et al. (2010) after permission was granted from the author of the tool.

The questionnaire used in this study includes four parts. The first part collects background information, including gender, area of work, level of education, and years of experience. The second part assesses compliance based on the guidelines from the CDC, which consist of (12 items) on a 5-point scale, ranging from 0% to 100% in steps of 25%. The third part is designed to assess attitude–social influence–self-efficacy regarding HH. It consists of questions about attitudes toward HH (12 items), social influence (10 items), and self-efficacy (10 items). All items were scored on a 5-point scale, going from strongly agree to strongly disagree. The fourth part of the questionnaire consists of 12 questions to assess participants' knowledge regarding HH, which was selected from a validated CDC questionnaire on HH. Further, the questionnaire has an acceptable interclass subscale (>0.60) for its reliability.

2.4. Ethical considerations

The Research Ethics Committee approval was obtained from the IRB of the investigators' institution, which is associated with the Ministry of Health (approval no 2022-13). The participants were provided with a consent form on the first page of the questionnaire and proceeding to the questionnaire implied that they agreed to participate in the study. An information sheet was also provided before beginning the study. In the information sheet, participants were briefed as to the purpose of the study, the confidentiality of the questionnaire data, and the time required to complete the questionnaire. To ensure the participants' autonomy, they were informed of their right to refuse to participate or withdraw from the study at any time. No significant risks were associated with participation in the questionnaire, as it was web-based and did not involve direct contact with participants. The questionnaire was designed anonymously, and the responses were analyzed as group data.

2.5. Data analysis

SPSS software Version 28 was utilized to perform the statistical tests with a significance level of 0.05. (2-tailed). The characteristics of participants were described using descriptive statistics. One ANOVA test was applied to compare the mean rate of HHC among six hospitals. Hospital number four showed a slight positive skew in compliance rate due to the few high scores. However, considering most of the values within this variable were customarily distributed among the other hospitals. The normality criterion does not seem to have an issue in this case. Pearson correlation was performed to identify the variables with a p-value less than 0.05 so that they could be included in regression analysis. A multiple linear regression test was performed to find the independent variables that can predict adherence to HH. A normality test was conducted for all independent and dependent variables, which yielded a normal data distribution.

3. Results

3.1. Characteristics of study respondents

A total of 128 ICU nurses took part in the study. Most of the nurses were female (96.9%), with 87.5% (n=112) having a bachelor's degree. Participants work in Hospital 1 (4.70%), Hospital 2 (16.40%), Hospital 3 (5.50%), Hospital 4 (26.6%), Hospital 5 (21.90%), and Hospital 6 (25%). Years of working experience were different among respondents: less than one year (4.70%), more than one and less than 5 years (31%), more than 5 and less than 10 years (27%), more than 10 and less than 15 years (30%), and more than 15 years (6%) (Table 1).

Table 1: Distribution of the respondents based on their profile, N=128

Variables		Frequency	Percentage
Sex	Male	4	3.10
	Female	124	96.90
Level of education	Diploma	12	9.40
	Bachelor's	112	87.50
	Master's	4	3.10
Years of experience	Less than one year	6	4.70
	More than one and less than 5 years	40	31.30
	More than 5 years and less than 10 years	35	27.30
	More than 10 and less than 15 years	39	30.50
	More than 15 years	8	6.30
Area of work	Hospital 1	6	4.70
	Hospital 2	21	16.40
	Hospital 3	7	5.50
	Hospital 4	34	26.60
	Hospital 5	28	21.90
	Hospital 6	32	25.00

3.2. Compliance rate of hospitals in Ha'il with intensive care units

Table 2 shows the differences in compliance rates among six hospitals. The means were not statistically significant, F (5, 122)=.419, p=.835, with a mean of (88.25%) for Hospital 1, (85.22%) for Hospital 2, (89.57%) for Hospital 3, (87.32%) for Hospital 4, (86.13%) for Hospital 5, and (87.12%) for Hospital 6.

3.3. Description of dependent and independent variables of HHC

The total HHC represents an overall high mean score of 86.83% (SD=8.20) among ICU nurses. The highest compliance rate of 98.8% was observed for the item "after body, blood fluid or excretions contact." In contrast, the lowest compliance rate was 75.39% noted for the item "wash hands after gloves removal." On a 5-point scale ranging from 1 to 5, the attitude toward HH was scored 2.74 (SD=.70), indicating low attitude among participants about HHC. The highest attitude score (mean=3.86, SD=0.57) was for the Att_{Moral} subscale and the lowest attitude scores (mean=2.10, SD=0.94; mean=2.25, SD=1.25) were for the Att_{Time} subscale and Att_{Use} subscale, respectively. The reported total score of social influence was 3.88 (SD=.46) with high scores (mean=4.50, SD=0.60; mean=3.60, SD=.58; mean=3.54, SD=90) for the Soc_{Supp} subscale, Soc_{Norm} subscale, and Soc_{Press} subscale, respectively. The global self-efficacy score was high (mean=3.59, SD=.54), demonstrating high self-efficacy. The average score of participants' knowledge of HH was 6.87 out of 12 (SD=2.30) or 57%, indicating a medium level of HH knowledge (Table 3).

3.4. Predictors of HHC

Pearson correlation analysis identified four independent variables that significantly correlate with HHC (Table 4). They were involved in the multiple regression test to confirm the final predictors of HHC. After adding and removing variables several times, the final regression model (Table 5) identified only the social pressure (β=-0.032; P=0.001) as a predictor of noncompliant HH behavior. Therefore, ICU nurses reporting poor social pressure appear less compliant with HH.

4. Discussion

The present study aimed to investigate the behavioral determinants of HHC among ICU nurses in 6 hospitals. Our results showed that the self-reported compliance rates were high, at 86.83%. A low score was noted regarding time and usefulness-related attitudes toward HH compliance. On the other hand, the social influence and self-efficacy score was high. These results suggest an association between the two determinants and HHC. However, in the final regression model, only social pressure was found to be a predictor of noncompliant HH behavior. This result is consistent with the literature, indicating that participants who reported poor social pressure appear to be less compliant with HH. Another important finding is that of HH knowledge; the study participants were found to have a medium knowledge of HH.

It is generally known that utilizing a self-report method inflates findings, and bias can be introduced as participants tend to report higher rates of socially desirable behavior (Ajzen, 2005). Self-reported high rates of HHC were also reported in several studies (Alshammari et al., 2018; Piras et al., 2018) that contradict observed HHC rates which appear to be particularly poor (Alshammari et al., 2018; Alsubaie et al., 2013; Engdaw et al., 2019; Lambe et al., 2019; Mahfouz et al., 2013).

Table 2: The compliance rate of hospitals in Ha'il with intensive care units for the Year 2022, N=6

Hospital	Compliance rate (Mean)
Hospital 1	88.25%
Hospital 2	85.22%
Hospital 3	89.57%
Hospital 4	87.32%
Hospital 5	86.13%
Hospital 6	87.12%

HH is regularly audited by direct observation in Saudi Arabia and many other countries, based on WHO recommendations (WHO, 2009). Direct observation is still the golden slander for monitoring HH compliance, although it has been questioned in

terms of data validity for several reasons. It can induce the Hawthorne effect, which can inflate results (El-Saed et al., 2018; Hagel et al., 2015; Purssell et al., 2020).

Table 3: Description of dependent and independent variables of HHC, N=128

Variable	Test score, mean (SD)	
Total compliance (Com_{TOT})	86.83% (8.20)	
Attitude		
Time-related attitude items (Att_{Time})	2.25 (0.94)	
Morality-related attitude items (Att_{Moral})	3.86 (0.57)	2.74 (.70)
Usefulness-related attitude items (Att_{Use})	2.10 (1.25)	
Social influence		
Normative behavior social influence items (Soc_{Norm})	3.60 (0.58)	
Support-related social influence items (Soc_{Supp})	4.50 (0.60)	3.88 (.46)
Pressure-related social influence items (Soc_{Press})	3.54 (0.90)	
Total self-efficacy (Eff_{TOT})	3.59 (0.54)	
Total knowledge ($Know_{TOT}$)	6.87 (2.30)	

Table 4: The relationships between potential behavioral predictors and self-reported HHC, N=128

Variables	ComTOT	AttTime	AttMoral	AttUse	SocNorm	SocSupp	SocPress	EffTOT	KnowTOT
ComTOT	1	-.207**	-.044	.096	-.195*	-.088	-.215**	-.168*	.173
AttTime		1	.139	.015	.656**	.205*	.095**	.769**	.054
AttMoral			1	-.046	.117	.301**	.136	. .347**	-.008
AttUse				1	.038	-.215**	.007	-.124	-.397**
SocNorm					1	.182*	.652**	.715**	.029
SocSupp						1	.212**	.629**	.128
SocPress							1	.728**	.050
EffTOT								1	.134
KnowTOT									1

See Table 3 for an explanation of abbreviations; No multicollinearity exists; **: Pearson correlation significant up to .01 level; *: Pearson correlation significant up to .05 level

Table 5: Linear regression analysis demonstrating adjusted relationships with total HHC N=128

Variables	Non-standardized Coefficients		Standardized coefficients	t	P
	B	Standard error	Beta		
Consta-nt	-1.994	.192	-	-10.397	<0.001
$Social_{press}$	-.032	.003	-.208	-9.197	.001
R^2			0.046		
F			6.136		

Only a tiny percentage of overall HH opportunities within a unit are documented (Xu et al., 2021). Direct observation requires a significant amount of time and effort in addition to possible observer bias (WHO, 2009). The reality that HH monitoring can be an efficient method of improving staff compliance cannot be dismissed, although recent studies have found a significant change in nurses' HH compliance using an electronic HH tracking system with real-time reminders (Granqvist et al., 2022; Meng et al., 2019; Zhong et al., 2021; Xu et al., 2021). An electronic system monitors HH opportunities 24/7 with much less effort. A significant decrease in HCAI was also observed in a study that utilized a similar system (Akkoc et al., 2021). Additional research is needed to find effective methods for direct observation of HHC in addition to automated reminders and monitoring methods.

Our results revealed a correlation between overall social influence with HHC, including normative behavior, social support, and social pressure. The highest score was for social support. Support can improve a person's ability to continue their behavior. For example, head of ward support was one of the critical determinants of HHC among nurses in a study conducted in Indonesia (Handiyani et al., 2019). However, in the present study, further statistical tests revealed only social pressure as a predictor of noncompliance to HH behavior. This outcome is similar to those of Dyson et al. (2013) but contrary to Yang et al. (2021). In the present study, 98% of respondents reported that noncompliance with HH leads to remarks from colleagues and/or superiors. The importance of providing effective immediate feedback to HCWs at an individual or group level is emphasized by WHO and previous studies to sustain improvements in HHC (Alrumi et al., 2020; Azim and McLaws, 2014; Ofek Shlomai et al., 2015; WHO, 2009). Feedback should be repeated continuously to sustain the desired outcomes. Participants in the Granqvist et al. (2022) study indicated that they preferred to receive individual feedback rather than group feedback. A study by Boyce (2019) concluded that ICU staff recommended providing direct individualized feedback at the bedside where the HH is performed. On the other hand, the study participants in Tan and Olivo (2015) reported that feedback was not an effective method. This can be attributed to different cultural perceptions as the hospital in Saudi Arabia includes employees of multicultural backgrounds. In such a case, the method in which the feedback is delivered is of significance. However, the optimal ways of providing feedback remain unclear.

Self-efficacy can play an important role in HHC since compliance can be improved by a perceived

high self-efficacy. High levels of self-efficacy among nurses were identified in the present study; these findings are consistence with studies conducted in Saudi Arabia and Germany (Tan and Olivo, 2015; Lutze et al., 2017). Among ICU staff, self-efficacy was positively related to HHC in de Wandel et al. (2010). Intention to wash hands was also associated with self-efficacy by Derksen et al. (2020). Bandura (1977) implied that people tend to adopt a behavior if they feel they have control and can do it successfully. Positive perception about one's ability to carry out a certain activity can be a vital mediator between knowledge and behavior (Bandura, 1977; Pereira et al., 2020). Those individuals with poor self-efficacy fear challenges and tend to give up when faced with obstacles (Luszczynska and Schwarzer, 2005). Hence, self-efficacy can explain how the individual's actions are guided. It is not a matter of acquiring special skills but believing they exist or can be developed by personal effort (Pereira et al., 2020). Therefore, finding ways to increase the individual's self-efficacy is vital to the behavioral change process. Bandura (1995) suggested that practice and observational learning can help improve self-efficacy in addition to individual and institutional efforts. Behavioral change theories have proven their effectiveness in infection prevention and control. However, additional research on their utility to guide interventions to promote HHC among HCWs is needed (Srigley et al., 2015).

Nurses widely report time-related concerns as barriers to HHC (Piras et al., 2017). Our study sample expressed a low time-related attitude concerning HHC. A negative attitude toward time is the most important indicator of HH noncompliance to de Wandel et al. (2010). Similarly, in Sadule-Rios and Aguilera (2017), one of the primary challenges with HHC was time. Stahmeyer et al. (2017) claimed that performing HH according to guidelines is time-consuming, which should be considered when planning for infection prevention programs.

Being aware of the effectiveness of HH in preventing HCAIs can be a vital predictor of HHC (Cruz and Bashtawi, 2016). Positive perception toward HH indicates an understanding that the benefits of practicing good HH outweigh the barriers (Maniriho et al., 2019). Contrary to our results, the belief about the usefulness of HH was high in Tan and Olivo (2015). Most participants in Maniriho et al. (2019) believed HH was the most effective strategy for preventing and minimizing HCAIs. While in Irek et al. (2019), positive attitudes toward HH were limited among the study participants, including nurses and doctors.

The study participants were found to have a moderate knowledge of HH. Similar results were reported by Faujdar et al. (2020), Goodarzi et al. (2020), and Shehu et al. (2019). This contradicts other studies in the area where high levels of knowledge were reported (Aledeilah et al., 2018; Al-Faouri et al., 2021; Tan and Olivo, 2015). However, all mentioned studies utilized different tools to assess HH knowledge. The moderate level of knowledge among nurses may be due to various individual, educational, and organizational aspects that affect the learning process (Goodarzi et al., 2020). The current study's high rates of self-reported HHC may reflect overconfidence among nurses, which might interfere with future infection prevention education (Bushuven et al., 2019). In Atif et al. (2019), a lack of knowledge was identified as a barrier to HHC. Continuous educational reinforcement and feedback are believed to be crucial to sustaining a high and consistent level of compliance (Alrumi et al., 2020; Baccolini et al., 2019). Nonetheless, having high levels of knowledge did not seem to reflect on compliance in a study by Nematian et al. (2017). In some recent studies, knowledge was poor despite prior HH training (de Arriba-Fernández et al., 2021; Santana-López et al., 2020). HCWs may not be incorporating this knowledge into their everyday practice due to a lack of motivation. Although the provision of HH education programs can increase compliance, interventions focused on behavioral constructs (e.g., attitudes, social influence, self-efficacy) could be more effective at improving HH behavior than interventions focusing solely on knowledge, awareness, and facilitation (Huis et al., 2012).

5. Limitations

To the best of our knowledge, this is the first study to investigate the behavioral determinants of HHC in this cohort of ICU nurses. However, a number of limitations need to be noted. For example, the data was obtained using a self-reported questionnaire. Therefore, it is susceptible to various self-reporting biases. Additionally, because this is a descriptive study, causal inferences should be treated with caution. Finally, due to the small sample size and the fact that only a particular cohort of nurses was included, findings might not be generalizable. Despite these limitations, the study yielded important data and provided a new understanding of the behavioral determinants of HHC, which might guide future interventions to improve ICU nurses' HHC.

6. Conclusion

The principal objective of this study was to investigate the relevant behavioral determinants that can help inform effective future HH intervention. Our findings stress that behavioral beliefs are of great importance to HHC. Our results show that social pressure predicts compliance with HH guidelines. The current data also highlight the importance of self-efficacy, social influence, positive attitude, and good knowledge regarding HH. Future interventions can address a combination of determinants to achieve behavioral change. These findings contribute in several ways to our understanding of HH behavior and provide a basis for developing future interventions and evaluation tools to improve HHC in ICUs. Strategies should

include these determinants tailored to the individual, cultural, and institutional factors.

Compliance with ethical standards

Ethics approval

The Research Ethics Committee approval letter was obtained from the IRB of the General Directorate of Health Affairs, Hail region (approval no 2022-13).

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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