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Nurses' compliance with the five moments of hand hygiene and healthcare-associated infections

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Abstract

Background: Adherence to the five moments of hand hygiene in hospital settings plays a crucial role in preventing healthcare-associated infections (HAIs). Despite the widespread dissemination and acceptance of these guidelines, nurses' compliance rates remain suboptimal in many healthcare institutions. Numerous factors have been identified as influencing nurses' adherence to the five moments of hand hygiene.
Purpose: To identify factors associated with nurses' compliance with the five moments of hand hygiene in reducing healthcare-associated infections.
Method: This study employed a quantitative, non-participatory observational design using a cross-sectional correlational approach. A total of 334 nurses from Prof. Dr. I.G.N.G. Ngoerah General Hospital were recruited as participants. Data were collected through structured questionnaires and analyzed using univariate, bivariate, and multivariate statistical methods.
Results: Overall, the compliance rate of nurses with the five moments of hand hygiene was 62.0%. The main factors significantly associated with compliance included the type of treatment room (p = 0.007; AOR = 2.116; 95% CI: 1.225–3.656), belief (p = 0.001; AOR = 16.596; 95% CI: 4.726–58.279), and glove use (p = 0.001; AOR = 5.957; 95% CI: 3.430–10.340).
Conclusion: The key determinants affecting compliance with the five moments of hand hygiene include nurses' beliefs, the use of gloves, and the type of treatment room. Beyond the variables examined in this study, additional predictors such as patient conditions, stress levels, workload, and socio-cultural influences may also contribute to variations in nurses' adherence to the five moments of hand hygiene.

Keywords: Five Moments; Hand Hygiene; Nurses.

INTRODUCTION

Healthcare-associated infections (HAIs), also known as nosocomial infections, are infections acquired in healthcare settings after patients have been hospitalized for more than 48 hours and are not in the incubation stage at admission (Ministry of Health of the Republic of Indonesia, 2017). HAIs remain a major global health challenge, affecting both developed and developing nations regardless of technological advancement. Globally, approximately one in every 100 hospitalized patients contracts an HAI, and among every ten patients with an HAI, one will die. The annual incidence of HAIs is estimated to be twice as high as that of 32 other infectious diseases (Suetens, Latour, Kärki, Ricchizzi, Kinross, Moro, Jans, Hopkins, Hansen, Lyytikäinen, Reilly, Deptula, Zingg, Plachouras, & Monnet, 2018). The negative consequences of HAIs include prolonged hospital stays, increased treatment costs, disability leading to reduced family productivity, chronic morbidity, and even mortality (Ministry of Health of the Republic of Indonesia, 2017). In developing countries or in healthcare facilities that fail to meet

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minimum standards, the incidence of HAIs is reported to be two to three times higher than in developed nations (Suetens et al., 2018).

According to the World Health Organization (WHO), the global incidence of HAIs ranges between 7% and 22% annually, accounting for an estimated 8.9 million cases. Developing countries experience higher rates of HAIs than developed countries. In Southeast Asia, the HAI incidence reaches 22%, while in Indonesia, it is estimated to be 30% higher than the regional average, making Indonesia one of the countries with the highest burden of HAIs (Goh, Marbawi, Goh, bin Abdul Asis, & Gansau, 2023). At Prof. Dr. I.G.N.G. Ngoerah General Hospital, a major referral center under the Ministry of Health, the annual incidence of HAIs has been reported at 13% (Sanglah General Hospital Denpasar, 2021), with a surgical site infection rate of 0.60% among closed fracture cases (Prof. Dr. I.G.N.G. Ngoerah General Hospital, 2023). One contributing factor to HAIs is inadequate compliance with the Five Moments for Hand Hygiene recommended by the WHO.

At Prof. Dr. I.G.N.G. Ngoerah General Hospital, nurse compliance with the Five Moments for Hand Hygiene reached 88.27% in the first semester and 88.97% in the second semester figures that meet national targets. However, the remaining 11.03% non-compliance rate warrants investigation to identify contributing factors, particularly considering patient safety principles that aim to prevent unintended harm during healthcare delivery (Aryana, Agustini, Adianta, & Sagitarini, 2025). The Institute of Medicine (2000) defines patient safety as "freedom from accidental injury," while Kelley and Hurst (2009) describe it as the degree to which harmful outcomes are avoided, prevented, and mitigated in healthcare processes (Sucipto, 2014; Titania, 2019). Without effective control, HAIs can substantially increase healthcare costs and elevate mortality rates by 2–20 times compared to those in developed countries. Healthcare facilities may even become sources of outbreaks, with antimicrobial-resistant organisms further driving antibiotic use and treatment costs (Suetens et al., 2018).

The occurrence of HAIs is explained through the chain of infection, which comprises several interconnected elements: infectious agents (e.g., bacteria, viruses, fungi, and parasites), reservoirs (e.g., humans, medical devices, or the environment), and transmission pathways. Microorganisms leave their reservoirs through portals such as the respiratory, digestive, or urinary tracts and enter susceptible hosts often patients with weakened immunity through surgical wounds or invasive medical devices. Transmission occurs primarily through direct or indirect contact, with the hands of healthcare workers serving as a key vector when not properly cleaned before or after patient contact (Ministry of Health of the Republic of Indonesia, 2017).

Breaking this chain of infection requires adherence to the Five Moments for Hand Hygiene, a WHO-endorsed strategy identifying five critical moments for hand cleansing to prevent infection transmission. The WHO's multimodal approach to infection prevention emphasizes improving management systems and ensuring the availability of hand hygiene infrastructure such as sinks, tissues, and alcohol-based hand rubs (World Health Organization, 2012). Historically, the importance of hand hygiene was demonstrated by Ignaz Semmelweis in Austria and Oliver Wendell Holmes in the United States, whose pioneering studies linked hand contamination to postpartum maternal mortality rates as high as 16%. Following the introduction of hand hygiene practices before patient contact, maternal deaths dropped to 3% (World Health Organization, 2009b).

Despite strong evidence supporting hand hygiene as a highly effective infection control measure, compliance among healthcare workers remains inconsistent. According to Lawrence Green's Predisposing-Enabling-Reinforcing Model (1993), behavior including compliance is shaped by predisposing factors (knowledge, education, beliefs, age, gender), enabling factors (facilities and infrastructure such as sinks and hand rubs), and reinforcing factors (such as reminders or supervision) (Irwan, 2017).

Numerous studies have explored factors affecting hand hygiene compliance. For instance, education and knowledge enhancement have been shown to improve compliance (Hoffmann, Sendlhofer, Gombotz, Pregartner, Zierler, Schwarz, Tax, & Brunner, 2020; Sari & Sari, 2023), while predisposing, enabling, and reinforcing factors have

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significant relationships with hand hygiene implementation (Wandira, Ashari, Fitrasyah, & Yani, 2019). Other research has demonstrated that attitudes, beliefs, and knowledge strongly correlate with compliance (Rianita & Suryani, 2019; Fhirawati & Kurniawan, 2023; Fouad & Eltaher, 2020; Le, Lehman, Nguyen, & Craig, 2019; Paudi, 2022). Conversely, some studies found no significant association between knowledge and compliance (Maryana & Anggraini, 2021). In addition, factors such as hand rub availability, nurses' beliefs, and glove use have also been identified as influencing compliance (Maniriho, Rajeswaran, Collins, & Chironda, 2019; Schmutz, Grande, & Sax, 2023).

Given these findings, this study aims to empirically identify and analyze the factors most strongly associated with nurses' compliance with the Five Moments for Hand Hygiene at Prof. Dr. I.G.N.G. Ngoerah General Hospital. As a major referral hospital that receives patients from multiple facilities often with multidrug-resistant microorganisms ensuring strict hand hygiene adherence is essential to interrupt infection transmission chains and enhance patient safety outcomes.

RESEARCH METHOD

A non-participatory quantitative observational design with a cross-sectional analytical approach was employed to examine the relationship between knowledge, belief, and facility-related factors (treatment room, hand rub availability, and glove use) with nurses' compliance to the five moments of hand hygiene as part of healthcare-associated infection (HAI) prevention efforts. All variables were measured simultaneously to identify the factors influencing compliance. The study was conducted across all patient care units at Prof. Dr. I.G.N.G. Ngoerah General Hospital from August 26 to September 26, 2024, over an eight-week period during working hours. The study population comprised 1,262 nurses with nursing or midwifery backgrounds. Using the Slovin formula, 304 nurses were randomly selected, and to anticipate missing data, the total number of respondents was increased to 334. Inclusion criteria included all nurses at Prof. Dr. I.G.N.G. Ngoerah General Hospital who were directly involved in patient care and performed the five moments of hand hygiene. Exclusion criteria included nurses performing life-saving procedures, those on leave or sick, and those unwilling to participate. A stratified random sampling technique was applied to determine the number of samples from each treatment area, resulting in 82 respondents from the intensive care units and 252 from non-intensive care units. Sampling was performed randomly, ensuring equal opportunity for participation.

Data collection used structured questionnaires and observation forms. The observation forms, completed by trained auditors, included information on compliance with the five moments of hand hygiene and infrastructure availability. The knowledge questionnaire consisted of five multiple-choice questions. Each correct answer scored one point, and the total score was converted into a percentage, categorized as good (>50%) or poor (≤50%). This instrument was adapted from the Infection Prevention and Control Committee (PPI) of Prof. Dr. I.G.N.G. Ngoerah Hospital. Validity testing yielded an r value of 0.998 (>0.211), indicating validity, and a Cronbach's alpha of 0.668 (>0.60), showing reliability. The belief questionnaire consisted of five positively worded statements assessed on a three-point Likert scale: strongly agree (3), agree (2), and disagree (1). Scores were categorized as good (>50%) or poor (≤50%). Validity testing showed an r value of 0.406 (>0.211), confirming validity. The treatment room variable was measured on a nominal scale (intensive vs. non-intensive care units), while the hand hygiene audit form used by the PPI Committee had been validated with an r value of 0.998 (>0.211) and demonstrated high reliability (Cronbach's alpha = 0.980). Observations assessed nurses' compliance with the five moments of hand hygiene across three activities: rubbing, washing, and rinsing. Data were analyzed using descriptive statistics, frequency distributions, chi-square tests, and binary logistic regression to identify significant predictors of compliance. Ethical clearance for this study was obtained from the ITEKES Bali Ethics Commission (No. 04.0264/KEPITEKES-BALI/VII/2024) and the Research Ethics Committee of Prof. Dr. I.G.N.G. Ngoerah Hospital in collaboration with the Universitas Udayana Ethics Committee (No. 1970/UN14.2.2.VII.14/LT/2024).

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RESEARCH RESULTS

Table 1. Respondent Characteristics (N=334)

Variable	Results	X^2	p-value
Age (Mean±SD)(Range)(Year)	(45.5±7.379)(18-60)		
Age (n/%)			
18 - 40	152/45.5		
41 - 60	182/54.5		
Gender (n/%)			
Male	127/38.0		
Female	207/62.0		
Knowledge (n/%)			
Good	307/91.9	0.092	0.762
Poor	27/8.1		
Belief (n/%)			
Good	278/83.2	6.262	0.012
Poor	56/16.8		
Treatment Room (n/%)			
Intensif	82/24.6	2.278	0.131
Non intensif	252/75.4		
Hand Rub (n/%)			
Yes	330/98.8	6.599	0.020*
No	4/1.2		
Handscoond (n/%)			
Yes	148/44.3	24.299	0.001
No	186/55.7		
Compliance (n/%)			
Yes	207/62.0		
No	127/38.0		

*Fisher's Exact Test, Exact Sig Value

The data presented in the table indicate that most of the nurses who participated in this study were aged between 41 and 60 years (54.5%), while those aged 18–40 years accounted for 45.5%. In terms of gender distribution, 38.0% of respondents were male and 62.0% were female. The majority of nurses (91.9%) demonstrated good knowledge regarding the Five Moments for Hand Hygiene, whereas 8.1% exhibited poor knowledge. Regarding confidence in implementing the Five Moments for Hand Hygiene to prevent healthcare-associated infections (HAIs), 83.2% of nurses reported a good level of confidence, while 16.8% reported low confidence. Based on the work area, 24.6% of nurses worked in intensive care units, and 75.4% were assigned to non-intensive care units. Hospital management support for the provision of hand rubs to facilitate compliance with the Five Moments for Hand Hygiene was reported as adequate in 98.8% of healthcare areas, with only 1.2% indicating inadequate availability. During clinical activities, 44.3% of nurses reported using gloves, while 55.7% did not. Overall, the compliance

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rate with the Five Moments for Hand Hygiene was 62.0%, and 38.0% of nurses were classified as non-compliant.

The chi-square test yielded a χ^2 value of 0.092 and a p-value of 0.762 for the knowledge variable, indicating no significant relationship between knowledge level and hand hygiene compliance. Consequently, this variable was excluded from the multivariate analysis. Regarding self-efficacy, however, the chi-square test results ($\chi^2 = 6.262$; $p = 0.012$) revealed a significant relationship between self-efficacy and nurses' adherence to the Five Moments of Hand Hygiene. Thus, this variable was included in the multivariate analysis. Additionally, the chi-square test of independence revealed a significant difference in adherence between nurses in the intensive care unit (ICU) and those in non-intensive care units ($\chi^2 = 2.278$; $p = 0.131$). Although no significant partial relationship was observed, the variable met the modeling criteria ($p < 0.25$) and was included in the multivariate analysis. Nurses' adherence to the Five Moments for Hand Hygiene was related to the availability of hand sanitizer. A chi-square test demonstrated a statistically significant relationship between hand sanitizer availability and adherence ($\chi^2 = 6.599$; $p = 0.020$), warranting the inclusion of this variable in the multivariate analysis. Furthermore, a chi-square test demonstrated a significant relationship between gloves and hand hygiene adherence ($\chi^2 = 24.299$; $p = 0.001$), warranting inclusion of this variable in the multivariate analysis.

Overall, four independent variables were identified as being associated with nurses' adherence to the Five Moments for Hand Hygiene: treatment room, self-efficacy, glove use, and hand sanitizer availability.

Table 2. Key Predictors of Nurses' Compliance with the Five Moments of Hand Hygiene

Variabel	B	S.E.	Wald	df	Sig.	OR	95% C.I	
							Lower	Upper
Treatment Room								
Non intensif	0.750	0.279	7.221	1	0.007	2.116	1.225	3.656
Intensif								
Bilief								
Poor	2.809	0.641	19.213	1	0.000	16.596	4.726	58.279
Good								
Handscoon								
No	1.785	0.282	40.147	1	0.000	5.957	3.430	10.346
Yes								

The results of the binary logistic regression analysis revealed three variables that were significantly associated with nurses' compliance with the Five Moments for Hand Hygiene: treatment room, belief, and glove use. The treatment room variable showed a significance value of $p = 0.007$ (< 0.05), indicating a partial relationship with hand hygiene compliance. Nurses working in non-intensive care units were 2.116 times more likely to comply with the Five Moments for Hand Hygiene, with odds increase of 0.750 compared to those working in intensive care units. The belief variable also demonstrated a significant association ($p = 0.001 < 0.05$), showing that nurses with lower confidence were 16.596 times more likely to comply with the Five Moments for Hand Hygiene, with an odds increase of 2.809 compared to nurses with higher confidence. Similarly, the glove-use variable had a significance value of $p = 0.001$ (< 0.05), suggesting a partial relationship with compliance. Nurses who did not wear gloves were 5.957 times more likely to comply with the Five Moments for Hand Hygiene, with odds increase of 1.785 compared to those who wore gloves. Among the variables examined, belief was identified as the most dominant predictor of compliance, followed by glove use and treatment room.

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DISCUSSION

The knowledge variable in this study describes many nurses who have a good level of knowledge. Prof. Dr. I.G.N.G Ngoerah General Hospital has included education, training, and education programs for all employees in the indicators that must be met each year. Knowledge can be obtained through learning and experience gained through observation, perception, and recognition through cognitive processes (Swarjana, 2022), while the factors that influence knowledge are experience, culture, information, and level of education (Notoatmodjo, 2003). Knowledge is the domain of a person's behavior to act (Nursalam, 2012), sometimes knowledge, attitude, and facilities do not guarantee a person's behavior (Green, 1993). There are six levels of the cognitive domain: knowing (know) is a process of remembering what has been learned, which is the lowest level of knowledge, followed by higher levels of understanding, application, analysis, synthesis, and evaluation (Blum & Knollmueller, 1975). The knowledge possessed does not guarantee that a person will behave according to their abilities, depending on the cognitive domain they possess.

Nurses' belief that performing five moments of hand hygiene can reduce HAIs is a positive belief. A person's positive or negative beliefs or perceptions stem from knowledge, experience, and information obtained, which encourage a person to act on something (Dillyana, & Nurmala, 2019). Motivation, perception, actions, or behaviors that arise consciously or unconsciously stem from a person's inner drive based on assumptions and considerations of the situation that will occur. Beliefs are derived from knowledge obtained formally or informally and from life experiences shaped by the environment or influential figures in society. Sometimes a person's beliefs do not guarantee behavior because there are other factors that can influence them. These other factors can strengthen or weaken a person. To foster a person's belief in something, individuals or communities need to be provided with continuous, up-to-date, science-based information and evidence, supported by figures who are experts in the field (Green, 1993).

Treatment rooms are included in the infrastructure variable. Intensive care rooms have mechanical air circulation to maintain standard temperature and humidity, vinyl flooring to reduce microorganism colonization, and each patient bed is equipped with hand rub to improve compliance with five moments of hand hygiene. Hand rub is placed at each entrance and exit for staff. Non-intensive care rooms have natural air circulation, hand rubs are placed in front of staff and patient entrance and exit doors, and the flooring is not vinyl. In general, the standards for treatment rooms are essentially the same, namely considering the comfort of room temperature and humidity, and the presence of air flow or air change hours. The floor of the room is dust-free, impervious, non-porous, non-patterned, easy to clean, light in color, and the junction between the floor and wall is not angular or has a hospital plinth. The walls of the room are made of waterproof material, are not porous, are easy to clean, and are not prone to mold growth. Supporting facilities such as tables, chairs, beds, and others must not be porous, patterned, or absorb dust, and must be easy to clean.

Hand rub is available throughout the treatment area, but in some places the hand rub dispenser is empty. Hand rub is an alcohol-based liquid containing 60%-90% alcohol that is used to clean hands in order to inhibit the growth of microorganisms on the hands, in accordance with hand hygiene guidelines (World Health Organization, 2012). Hand rub should be used according to the five moments of hand hygiene, and alcohol-based hand rub should be placed at points of care such as at the entrance and exit of treatment rooms, attached to patient beds, at the nurse station, on treatment trolleys, and carried by each healthcare worker in small quantities (World Health Organization, 2009a). Monitoring of hand rub conditions, including contents, expiration date, and dispenser caps in undamaged or closed condition, is conducted daily to ensure the effectiveness of the liquid remains usable.

Gloves, or more commonly known as gloves, are more often not worn than worn when providing health services. Gloves are personal protective equipment (PPE) that serve to protect health workers from exposure to body fluids or microorganisms from patients to health workers or vice versa, where their

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use is indicated when health workers perform service activities, as stipulated in Minister of Health Regulation No. 27 of 2017. Gloves should be removed immediately after completing an activity. It is not permitted to move from one patient, activity, or patient zone to another using the same pair of gloves, as this poses a risk of transmitting germs to the environment or other patients. When using gloves during invasive procedures or aseptic procedures, hand hygiene must be performed beforehand, as outlined in the Hand Hygiene Manual Guidelines (World Health Organization, 2009a). Not all healthcare activities require the use of gloves. Healthcare workers must analyze healthcare activities or predict the risks associated with using gloves or not using gloves when providing care to patients. The most important and mandatory requirement is to perform the five moments of hand hygiene immediately before and after providing healthcare services to patients (in accordance with moments 1 to 5).

The level of compliance among nurses in performing five moments of hand hygiene is still below target (low), when referring to the national quality indicators set by the Ministry of Health. The results of this study are in line with the results of a study conducted in Nigeria, which showed that the level of compliance of nurses in performing hand hygiene was still below standard (Oyibo, 2022). This is also in line with the results of a study in Vietnam, where the level of compliance of nurses was still below standard (Le, et al., 2019). The results of this study are also supported by research in South Africa, where the level of compliance of nurses in performing hand hygiene is still below standard (Bale, Ramukumba, & Mudau, 2021). The results of this study contradict the results of research conducted in Austria, where the level of compliance of nurses in performing hand hygiene is above standard (Hoffmann, et al., 2019). The results of this study also contradict the results of a study in Sukoharjo, which stated that the level of nurse compliance with hand hygiene was above standard (Sari & Sari, 2023). The Hand Hygiene Technical Reference Manual issued by the WHO does not specify a compliance threshold that must be achieved, but rather assesses progress over time.

The level of knowledge among nurses is relatively good, but the results of the study show that there is no direct relationship between nurses' knowledge and compliance with the five moments of hand hygiene. This study is in line with findings in Pangkalpinang, which show that even though the level of knowledge is quite good, there has been no significant increase in compliance with hand hygiene (Maryana & Anggraini, 2021). In contrast, research conducted in Saudi Arabia shows that knowledge has a direct relationship with healthcare workers' compliance with hand hygiene (Fouad & Eltaher, 2020). Knowledge is one of the main domains in behavioral theory, which plays an important role in shaping daily habits or behaviors. In the context of the five moments of hand hygiene, knowledge provided through direct learning about the indications, techniques, and objectives of hand hygiene can deepen nurses' understanding. This is expected to foster a work culture oriented towards patient safety. However, as explained in the literature, knowledge alone is not enough to change behavior.

External factors, such as the work environment and facility support, as well as internal factors, such as motivation or established habits, also influence compliance. Good knowledge can improve compliance, but only if that knowledge is relevant and applied in daily practice. Although nurses' knowledge levels are relatively good, increased compliance with the five moments of hand hygiene does not always occur simply because of knowledge. This may be due to other factors such as limited resources or facilities, or the existence of pre-established habits. Therefore, increased compliance does not only depend on knowledge, but also requires a conducive environment, such as the availability of resources to perform hand hygiene in service areas. In addition, external factors such as the social environment and peer influence also play an important role in shaping behavior. Thus, to achieve optimal compliance improvement, hospitals need to integrate various mutually supportive factors, including the provision of facilities, strengthening of work culture, and continuing education for health workers.

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Nurses have a high level of confidence in relation to the implementation of five moments of hand hygiene. This study shows that strong confidence in the effectiveness of five moments of hand hygiene is directly proportional to increased compliance by nurses in implementing hand hygiene protocols. In addition, a high level of confidence is also associated with a decrease in the incidence of Healthcare-Associated Infections (HAIs) in hospitals. This decrease in the incidence of HAIs has a positive impact both materially (reducing treatment costs) and non-materially (improving the quality of health services). The results of this study are in line with findings in Palu City, which state that predisposing factors, including confidence, are significantly related to hand hygiene behavior (Wandira, et al., 2019). Belief is an important element in behavioral theory, serving as motivation to act or perform a behavior. Beliefs are formed from an individual's perception of an action, which can arise consciously or unconsciously based on assumptions or previous experiences. In the context of five moments of hand hygiene, nurses' beliefs about the effectiveness of these actions can influence their level of compliance.

This theory is in line with the concept of predisposing factors in health theory, which states that factors such as knowledge, attitudes, and beliefs can influence individual behavior in maintaining personal hygiene, including hand hygiene. Given the importance of beliefs in increasing compliance with the five moments of hand hygiene, hospitals should pay more attention to developing good beliefs in nurse education and training. By building a strong understanding of the benefits and effectiveness of hand hygiene, nurses will be more motivated to implement the protocol consistently. Therefore, strengthening beliefs about the five moments of hand hygiene should be a priority in hospital health education programs in order to reduce the incidence of HAIs and create a safer service environment for patients.

The results of the study show that the treatment room is not directly related to nurses' compliance in performing five moments of hand hygiene. Although intensive care rooms have more hand hygiene support facilities, such as hand rubs available at each patient bed, in front of the room door, and on health service trolleys, hand hygiene compliance does not always increase. The situation in intensive care rooms, which have higher emotional levels and workloads, affects nurses' compliance. Conversely, non-intensive care rooms, which are more stable in terms of room conditions and have limited hand rub facilities only at the front of patient rooms, show results that contradict research in Pangkalpinang, which states that care rooms are related to compliance in performing hand hygiene (Maryana & Anggraini, 2021).

Health behavior theory shows that the physical environment, including supporting facilities and equipment, plays an important role in supporting or hindering hand hygiene behavior. The placement of hand rubs at the point of care, such as at each patient bed and treatment trolley, is expected to facilitate and encourage healthcare workers to be more reflexive in performing hand hygiene. However, the literature also shows that factors such as workload, motivation, habits, culture, and lack of supervision can influence the extent to which available facilities are implemented in practice.

According to behavioral change theory, even though supporting facilities are available, the motivation and habits of healthcare workers remain key factors in behavioral change. Although hand hygiene facilities in intensive care rooms are more complete, increased compliance with the five moments of hand hygiene is not only influenced by the number of facilities, but also by other factors such as the emotional state of nurses, workload, and the work culture in the room. Therefore, hospitals must develop more comprehensive strategies, such as training that increases nurses' awareness and motivation, as well as creating a work culture that is more supportive of hand hygiene implementation. In addition, stricter supervision and periodic evaluation of the implementation of hand hygiene guidelines in all care rooms will help increase compliance, which in turn can reduce the incidence of Healthcare Associated Infections (HAIs).

The results of the study show a significant relationship between the availability of hand rub and the level of compliance of nurses in performing five moments of hand hygiene. A study conducted in a hospital in Indonesia revealed that after hand rub became available in hospital facilities, nurses' compliance with hand hygiene increased (Efendy &

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Hutahaean, 2022). Research in Vietnam also found that low compliance with hand hygiene in hospitals was greatly influenced by the limited availability of hand hygiene facilities (hand rub) in care areas (Le, et al., 2019). The knowledge, beliefs, and perceptions of healthcare workers are not sufficient to improve compliance with the five moments of hand hygiene without adequate support facilities, such as hand rub (Green, 1993). This is in line with the theory of behavioral change, which states that a supportive environment, including the availability of easily accessible hand hygiene facilities, is very important to make it easier for healthcare workers to carry out appropriate preventive measures at the right time. This theory emphasizes the importance of integrating knowledge and the provision of supportive facilities so that the desired behavior can be consistently achieved. Prof. Dr. I.G.N.G. Ngoerah General Hospital has demonstrated a high level of commitment to providing hand rub in service areas as a form of support for improving hand hygiene compliance. However, to achieve greater success, support from each room manager is needed, especially in ensuring that the availability of hand rub is part of their routine tasks.

The provision of adequate hand rub at the point of care will make it easier for nurses to quickly access hand hygiene facilities, which can encourage them to be more reflexive in applying hand hygiene in accordance with the five moments of hand hygiene rules. Thus, increased hand hygiene compliance can create a better patient safety culture and help hospitals achieve "The International Patient Safety Goals" standards, which play an important role in reducing the incidence of HAIs.

The results of the study show a significant relationship between the use of gloves and the level of compliance of nurses in performing five moments of hand hygiene. The use of personal protective equipment, such as gloves, is recommended to protect healthcare workers and patients from the transmission of pathogenic germs. However, many nurses who use gloves believe that they no longer need to practice hand hygiene after using protective equipment, as they feel protected from hospital germ contamination. This can reduce compliance with the five moments of hand hygiene protocol, which ultimately contributes to an increase in HAIs. Research results in Switzerland also show that low compliance rates are caused by exposure of hands covered with gloves to other areas of the body, which increases the possibility of cross-contamination (Schmutz, et al., 2023).

According to WHO hand hygiene guidelines, the use of personal protective equipment such as gloves does not replace the obligation to practice proper hand hygiene. Although gloves appear to be a physical barrier against germs, in reality they have very small pores (around 0.3 microns) that still allow pathogens to penetrate and spread. Health literature reveals that cross-transmission can occur if healthcare workers do not perform hand hygiene procedures after removing gloves, even if personal protective equipment is used. Thus, implementing the five moments of hand hygiene remains an important preventive measure, both before and after contact with patients, even when wearing gloves. Although gloves have an important function in protecting healthcare workers and patients from direct exposure to pathogens, the misconception that wearing gloves exempts nurses from the obligation to practice hand hygiene is very dangerous. This can lead to a decrease in compliance with the five moments of hand hygiene protocol, which ultimately increases the risk of hospital-acquired infections. Therefore, hospitals need to improve education and training to emphasize that the use of gloves must always be followed by proper hand hygiene procedures, as stipulated in WHO guidelines. Policies that support the strengthening of hand hygiene procedures, regardless of the use of personal protective equipment, are essential to prevent cross-contamination and reduce the incidence of HAIs.

The results of the study show that individual beliefs are the most dominant factor influencing compliance with the five moments of hand hygiene. The results of the study show that medical personnel who have poor beliefs about the five moments of hand hygiene in preventing HAIs tend to be more consistent in complying with protocols, while those who have good beliefs actually have poor compliance rates. This shows that even with good beliefs, there is no guarantee that these good beliefs will always be reflected in appropriate behavior, as there are other factors that influence such behavior.

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Some of the influencing factors include the treatment room (patient situation, workload, presence of closed-circuit television, digital surveillance system), behavior and lifestyle such as stress management and mental health, environment or workplace (availability of support facilities, monitoring and supervision), social and psychological factors (such as the influence of coworkers), and leadership that always sets an example of practicing the five moments of hand hygiene.

The "pre-action model" theory reveals that personal beliefs or attitudes greatly influence behavior. Beliefs described in the behavioral change theory model can direct individuals to take actions that are considered important for health, such as practicing five moments of hand hygiene. However, the theory also emphasizes that behavior is not only influenced by beliefs, but also by other external factors, such as the work environment, workload, and social support, stressful work situations, supervision, and managerial support. All of these factors play an important role in determining the success of behavioral change implementation, including compliance with the five moments of hand hygiene. Therefore, for the work environment aspect, it is important to conduct effective monitoring and reduce workloads that can affect nursing staff discipline. In addition, the influence of coworkers, leadership that sets a good example, and stress and mental health management also play a role in strengthening beliefs and encouraging appropriate behavior. By creating a supportive environment and providing consistent education, it is hoped that medical personnel will become more aware of the importance of maintaining hand hygiene, which will ultimately increase compliance with the five moments of hand hygiene and reduce the incidence of HAIs.

The results of the study show that gloves have the second highest level of correlation after the variable of confidence. Nurses who do not wear gloves have a good level of compliance in performing five moments of hand hygiene compared to nurses who wear gloves. The research data shows that nurses who do not wear gloves have a good level of knowledge and belief compared to nurses who wear gloves. Nurses who do not wear gloves have a level of alertness, awareness, and negative assumptions about the impact of not performing the five moments of hand hygiene, which is derived from their knowledge and belief in the risk of transmission of dangerous pathogens, which encourages them to perform the five moments of hand hygiene. Beliefs derived from knowledge are one of the main domains in shaping behavior. Wearing gloves is indeed important to protect nurses and patients from direct contact with pathogenic germs, but this should not be a reason to neglect proper hand hygiene procedures.

The decline in compliance with the five moments of hand hygiene among nurses who use gloves indicates a misunderstanding that needs to be corrected through training and continuing education. A strong belief in the importance of hand hygiene and knowledge about the risk of pathogen transmission that remains even when using personal protective equipment must be emphasized. Hospitals should also conduct audits and supervision of nurses who use gloves to ensure that they continue to follow proper hand hygiene practices to reduce the risk of infection and support the prevention of Healthcare-Associated Infections (HAIs).

The results of the study indicate that the treatment room has a dominant third-level relationship after the variable of hand gloves in influencing nurses' compliance with the five moments of hand hygiene. This study found that nurses working in intensive care units had higher compliance rates than those in non-intensive care units, better knowledge and confidence levels in non-intensive care units than in intensive care units, and more complete hand washing facilities in intensive care units than in non-intensive care units. Although the care unit is an important factor, other factors such as workload and the fulfillment of hand hygiene needs in the service area also influence the level of nurse compliance. The "preset-procedure model" theory states that the environment can influence individual behavior. A good working environment, with adequate supporting facilities, will increase the awareness and readiness of medical personnel to carry out the correct procedures.

Treatment rooms that are not equipped with adequate facilities or that are crowded can interfere with the smooth implementation of hand hygiene procedures. Although treatment rooms are a factor that influences compliance with the five moments of

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hand hygiene, I believe that this factor does not work in isolation. In practice, the condition of treatment rooms is often associated with high workloads, limited facilities, and emotional stress felt by nursing staff. Therefore, in addition to paying attention to the condition of treatment rooms, it is also important to strengthen support for nursing staff in terms of stress management and workload regulation. Stricter supervision and the provision of adequate support facilities in the treatment room can encourage medical personnel to be more disciplined in implementing the five moments of hand hygiene, which in turn can reduce the incidence of HAIs.

RESEARCH LIMITATIONS

One limitation that may exist is the limited sample size; researchers only involved one hospital (Prof. Dr. I.G.N.G. Ngoerah General Hospital), so the results may not be generalizable to other hospitals, especially those with different characteristics or treatment room conditions. This study only focused on the research variables, while there are other factors that may also affect compliance with five moments of hand hygiene, such as nurses' workload, personal motivation, or broader hospital policies. Potential bias in observation: observation of nurse compliance was carried out by internal hospital staff, so there is a possibility of bias in data collection, such as a tendency to display better behavior in front of researchers. This could affect the accuracy of the recorded results related to compliance with the five moments of hand hygiene.

CONCLUSION

Knowledge, belief, treatment room, hand rub, and gloves are simultaneously related to compliance with five moments of hand hygiene, but partially there are three factors that are predominantly related to compliance with five moments of hand hygiene, namely: belief, gloves, and treatment room. In addition to the factors used in this study, there are other predictors that also influence nurses' compliance with the five moments of hand hygiene, such as patient situation, stress levels, workload, and socio-cultural factors.

SUGGESTIONS

Hospitals need to conduct consistent training and awareness campaigns on the importance of hand washing. This must be communicated in a clear and evidence-based manner so that nursing staff are firmly convinced that hand washing is one of the most effective measures for preventing infection.

Hospitals can strengthen internal policies that support hand washing practices, such as establishing clear procedures and conducting regular checks on compliance with these protocols. This provides psychological reinforcement that hand washing is a responsibility that must be taken seriously.

To reinforce confidence in the implementation of hand washing, hospitals must ensure that supporting facilities and equipment, such as sufficient hand rub, are available at every point of care. Easy and convenient access can reduce barriers to routine hand washing.

Hospitals can provide constructive feedback and rewards to nurses who demonstrate high compliance with hand washing procedures. This can encourage other nurses to follow this positive example. An incentive or reward system based on compliance with hand washing protocols can also be implemented.

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