



A Structural Model of Hand Hygiene Compliance Factors among Hospital Nurses in Jember, Indonesia

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Summary

Introduction: Healthcare-associated infections (HAIs) are a global epidemic that has yet to be addressed. The occurrence of nosocomial infections is strongly associated with hand hygiene compliance. With an increase in the latter, the occurrence of nosocomial infections decreases. The percentage of people who wash their hands is still low—between 35 % and 55.3 % in Indonesia and 54.7 % worldwide.

Objective: To evaluate a structural model of hand hygiene compliance determinants among nurses in Indonesian hospitals. Perceived behavioral control, facility factors, and knowledge factors are some of the determinant factors.

Materials and methods: The population in the study was nurses at Jember Regency hospitals in Indonesia. The sampling technique included a total sample of 116 nurses. The inclusion criteria used are nurses who provide direct service to the patient and are willing to respond. In this study, an exclusion clerk refers to a nurse who was on leave or engaged in academic studies at the time of data collection. Data was analyzed descriptively and inferentially using path analysis with the Structural Equation Model (SEM) and the Partial Least Squares (PLS) technique in SmartPLS software.

Results: Hospital facilities become an important predictor of hand hygiene compliance ($p < 0.05$). The respondents agreed that the facilities available at the hospital were adequate, as demonstrated by high-grade response statements (61 %). Nurses' awareness has a significant influence on hand hygiene compliance ($p < 0.05$), good knowledge leading to a positive perception of maintaining hand hygiene behaviours. The respondents' level of knowledge of hand hygiene ranged from high (40 %) to low (34 %). Perceived behavioral control significantly affects hand hygiene behaviour ($p < 0.05$). Nurses with strong perceptions and beliefs about hand hygiene are more likely to have better hand hygiene performance. Respondent compliance with hand hygiene was high (60 %). The hospital facilities and nurse knowledge have a significant effect on perceived behavioral control with an explanatory factor of 36.4 %. All factors, namely hospital facilities, nurse knowledge, and perceived behavioral control were able to explain hand hygiene compliance by 45.2 %.

Conclusions: Factors of knowledge and facilities play a crucial role in shaping perceived behavioral control in hand hygiene. These three influencing criteria have positively influenced hand hygiene compliance among nurses in Indonesian hospitals. The structural model provides insights that can be used to design more effective infection prevention strategies, especially in health care.

Keywords: hospital-acquired infections (HAIs), hand hygiene compliance, knowledge factors, facility factors, perceived behavioral control.

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Структурная модель факторов соблюдения гигиены рук медсестрами больниц округа Джембер, Индонезия

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Резюме

Введение. Внутрибольничные инфекции (ВБИ) – это глобальная эпидемия, с которой еще предстоит справиться. Распространение нозокомиальных инфекций напрямую связано с гигиеной рук: риск возникновения ВБИ снижается с ростом степени ее соблюдения. Доля людей, которые регулярно и правильно моют руки, по-прежнему низка – от 35 до 55,3 % в Индонезии и 54,7 % во всем мире.

Цель исследования: оценка структурной модели детерминант соблюдения гигиены рук медсестрами в индонезийских больницах. К определяющим факторам относятся воспринимаемый поведенческий контроль, факторы больничной среды и уровень осведомленности.

Материалы и методы. В исследовании приняли участие 116 медсестер, работающих в больницах индонезийского округа Джембер. Критериями включения были непосредственная работа с пациентами и готовность принять участие в опросе, а исключения – нахождение в отпуске или на учебе на момент проведения исследования. Данные были проанализированы описательно и дедуктивно с использованием анализа путей с моделью структурных уравнений и методом частичных наименьших квадратов в программном средстве SmartPLS.

Результаты. Помещения больниц становятся важным предиктором соблюдения гигиены рук ($p < 0,05$). Респонденты согласились, что имеющиеся в больнице помещения были адекватными, о чем свидетельствуют их высокие оценки (61 %). Знания медсестер оказывают значительное влияние на соблюдение гигиены рук ($p < 0,05$): хорошие знания приводят к положительному восприятию важности гигиены рук. Уровень осведомленности респондентов о гигиене рук варьировался от высокого (у 40 % респондентов) до низкого (у 34 %). Воспринимаемый поведенческий контроль оказывает существенное влияние на поведение в отношении гигиены рук ($p < 0,05$). Медсестры с сильным восприятием и убеждениями с большей вероятностью будут иметь лучшие показатели соблюдения гигиены рук. Соблюдение респондентами гигиены рук было высоким (60 %). Больничные помещения и знания медсестер оказывают значимое влияние на воспринимаемый поведенческий контроль с объясняющим фактором 36,4 %. Вклад всех изученных факторов, а именно больничных помещений, знаний медсестер и воспринимаемого поведенческого контроля, в соблюдение гигиены рук составил 45,2 %.

Выводы. Факторы знаний и помещений играют решающую роль в формировании воспринимаемого поведенческого контроля в отношении гигиены рук. Эти три влияющих критерия положительно повлияли на соблюдение гигиены рук медсестрами индонезийских больниц. Структурная модель дает представление, которое можно использовать для разработки более эффективных стратегий профилактики внутрибольничных инфекций, особенно в здравоохранении.

Ключевые слова: внутрибольничные инфекции (ВБИ), соблюдение гигиены рук, факторы осведомленности, факторы помещений, воспринимаемый поведенческий контроль.

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Introduction

Prevention of hospital-acquired infections (HAIs) is a global problem that has not been resolved to date. This was confirmed by the World Health Organization (WHO) in the 2002 global report on infection prevention and control. The report states that no country claims to be free from HAIs [1]. In both developed and developing countries, this challenge still exists. In low- and middle-income nations, over 25 % of hospitalized patients may develop a HAI, which is two to twenty times higher than in developed countries [2].

The Indonesian government's program related to efforts to reduce HAIs is included in the infection prevention and control (IPC) health service area, namely the Infection Prevention and Control (PPI) program. The success of the PPI team in controlling nosocomial infections to date still reaches only 47 % [3]. Hand hygiene practices are an effective program for reducing the incidence of nosocomial infections. Several studies agree that hand hygiene compliance is closely related to the incidence of nosocomial infections. The higher the compliance with hand hygiene, the lower the incidence of nosocomial infections [4].

Hand hygiene compliance is still low both at the global and national levels, amounting to 54.7 % of hand hygiene compliance in the years 2021–2022 [5]. The national level (Indonesia) applies a hand hygiene compliance standard of 85 %. Based on several studies that have been conducted, the percentage of hand hygiene compliance is still far below the standard, namely 35 % to 55.3 % [6]. Healthcare practitioners' hand hygiene compliance can be enhanced by supplying alcohol-based hand rubs, towels, or tissue paper [7].

Hand hygiene compliance refers to the extent to which individuals adhere to recommended hand hygiene practices, such as proper hand washing or using hand sanitizers, to prevent the spread of infections. Various factors can influence hand hygiene compliance such as knowledge and perceived risk. Knowledge has an important role in hand hygiene behavior. Sound knowledge about hand hygiene creates a positive perception of hand hygiene compliance [8]. Good perception comes from the knowledge an individual has. Perception in the Theory of Planned Behavior (TPB) includes a person's external and internal ability to carry out a behavior or is termed perceived behavioral control. Nurses who provide services to patients have the perception that hand hygiene compliance is important to implement [9]. Knowledge and perception about hand hygiene can increase hand hygiene compliance [10].

Research has shown that nurses with higher levels of knowledge of hand hygiene are more likely to adhere to proper hand hygiene practices [11]. This highlights the importance of continuous education and training for healthcare professionals to improve compliance rates and ultimately reduce the spread of infections in healthcare settings [12]. Healthcare facilities need to invest in ongoing education and training programs to ensure that nurses are equipped with the necessary knowledge and skills to maintain high standards of hand hygiene. By prioritizing education, healthcare organizations can create a culture of safety and

reduce the risk of healthcare-associated infections [13]. Providing ongoing education and training to healthcare workers about the importance of hand hygiene and proper techniques can improve compliance rates [14].

While it is important to address the factors that influence hand hygiene compliance among healthcare workers [15], it is also essential to consider the opposing argument. Some may argue that despite efforts to improve hand hygiene practices, there are inherent challenges that hinder compliance [16]. For example, healthcare workers often face time constraints and heavy workloads, which can detract from their ability to prioritize hand hygiene. Additionally, the lack of knowledge and awareness among patients regarding their contribution to hand hygiene practices presents a significant barrier [17].

Moreover, the perceived ineffectiveness of hand hygiene practices and the lack of scientific information on the definitive impact of improved hand hygiene on hospital infection rates can also contribute to low compliance [11]. If healthcare workers are not convinced of the tangible benefits of rigorous hand hygiene, they may be less inclined to prioritize and adhere to recommended practices [18]. In summary, while education, training, and continuous monitoring are crucial components of improving hand hygiene compliance, it is imperative to recognize and address the inherent challenges and barriers that exist within healthcare settings. Resistance to change, lack of awareness, and scepticism regarding the effectiveness of hand hygiene practices must be acknowledged and strategically targeted to achieve meaningful and sustainable improvements in compliance rates [19].

Availability of resources, and limited access to hand hygiene products, such as soap and water or hand sanitizers, can hinder compliance. The culture and policies within healthcare facilities can influence hand hygiene compliance [20]. Healthcare facilities can influence hand hygiene compliance among nurses through the implementation of clear hand hygiene protocols and regular training sessions [21]. Additionally, providing easy access to hand sanitizer stations throughout the facility can also encourage nurses to practice proper hand hygiene. Furthermore, utilizing visual reminders such as posters and signs can serve as constant reinforcement for nurses to remember the importance of hand hygiene. Ultimately, creating a culture of accountability and prioritizing patient safety can further enhance hand hygiene compliance among nurses in healthcare facilities [22]. By fostering a supportive environment where nurses feel empowered to speak up and hold each other accountable for hand hygiene practices, facilities can further improve compliance rates. Regular audits and feedback mechanisms can also help identify areas for improvement and ensure long-term commitment to hand hygiene procedures [23]. The purpose of this study was to validate a structural model of hand hygiene compliance determinants among nurses in Indonesian hospitals. Perceived behavioral control, facility factors, and knowledge factors are some of the determinant factors.

Materials and Methods

This research uses a cross-sectional quantitative study carried out at one of the regional government hospitals in Jember, Indonesia. The research was conducted from June 20, 2023 to July 28, 2023. The population in the study were 116 hospital nurses providing direct services to patients. The sampling technique used total sampling. The inclusion criteria used were nurses who provided direct services to patients and were willing to be respondents. The sample exclusion criteria were nurses who were on leave or studying at the time the survey.

The data collection instrument is a questionnaire. The hospital facility variable questionnaire is structured based on five aspects adopted from the following sources: [10–13]. The nurse knowledge variable instrument is measured using five aspects adopted from [8, 24, 25]. The perceived behavioral control variable instrument is measured by five aspects adopted from [26, 27]. Hand hygiene compliance variable instrument is measured by five aspects adopted from [23]. The questionnaire was designed on the 5-option Likert scale. Based on the confirmatory factor analysis obtained the Cronbach's alpha values are 0.856, 0.825, 0.955, and 0.990 respectively for a hospital facility, hand hygiene compliance, nurse knowledge, and perceived behavioral control. The Cronbach's alpha values for all variables are higher than 0.70, so it is an acceptable level of accuracy.

Data is analyzed descriptively and inferentially using path analysis with the Structural Equation Model (SEM) and the Partial Least Squares (PLS) technique in SmartPLS software. The regression coefficient and

route analysis p-values of less than 0.05 were judged significant.

Results

The demographics and selected characteristics of the respondents are shown in Table 1.

Table 1 shows that the majority of respondents (53 %) are between the ages of 26 and 35. Male respondents outnumbered female respondents (56 % against 44 %). The majority of respondents (44 %) were diploma graduates.

Knowledge is closely related to the development of a person's behavior. Respondents' knowledge of hand hygiene ranged from high (40 %) to low (34 %). The impact of nurses' knowledge on hand hygiene compliance will help hospitals improve their hand hygiene practices. Nurses with adequate knowledge will be better able to understand the importance of hand hygiene in preventing infection transmission in the hospital setting. Furthermore, good knowledge can raise nurses' awareness of the health risks associated with poor hand hygiene. Thus, increasing nurses' knowledge can have a direct impact on increasing hand hygiene compliance in hospitals. This will contribute to a safer environment for patients and medical staff. Thus, the risk of nosocomial infections can be significantly reduced. Apart from that, efforts to prevent nosocomial infections will also be more effective with the involvement of more trained nurses.

The findings indicate that over 50 % of the participants perceived the hospital facilities as adequate. This is evidenced by the distribution of responses, with 61 % rating them as high, 27 % as

Table 1. The frequency distribution of respondents' demographic characteristics and associated variables

Таблица 1. Частотное распределение демографических характеристик респондентов и переменных

Demographic/variables / Демографические характеристики/переменные	Levels / Уровни	n	%
Sex / Пол	Male / Мужской	65	56
	Female / Женский	51	44
Age, years / Возраст, лет	18–25	7	6
	26–35	61	52
	36–45	38	33
	46–55	10	9
Education / Образование	Diploma / Среднее профессиональное	51	44
	Undergraduate / Бакалавр	23	20
	Postgraduate / Магистр	3	2
	Profession / Высшее профессиональное (специалитет)	39	34
Knowledge / Осведомленность	High / Высокий	46	40
	Moderate / Средний	30	26
	Low / Низкий	40	34
Hospital facility / Больница	High / Высокий	71	61
	Moderate / Средний	31	27
	Low / Низкий	14	12
Perceived behavioral control / Воспринимаемый поведенческий контроль	High / Высокий	17	15
	Moderate / Средний	25	22
	Low / Низкий	74	64
Hand hygiene compliance / Соблюдение гигиены рук	High / Высокий	70	60
	Moderate / Средний	11	10
	Low / Низкий	35	30

low, and the remaining responses falling within the lower category. This variable comprises infrastructure and facility availability and affordability metrics for hand hygiene. The availability and accessibility of hand hygiene equipment, supplies, and facilities can have a significant impact on nurse compliance with hand hygiene protocols. For example, if soap or hand sanitizers are scarce or sinks are inconveniently located, nurses may be less likely to follow hand hygiene protocols. Furthermore, the condition and cleanliness of the facilities can affect compliance. Broken or malfunctioning sinks, filthy or cluttered hand hygiene stations, and insufficient waste disposal can all deter nurses from practicing good hand hygiene.

The majority of respondents perceived their behavioral control as low (64 %), while only 15 % fell into the high category. The indications utilized in this variable include people's opinions about their control and how well they are able to wash their hands. Healthcare workers' adoption of hand hygiene measures is largely aided by perceived behavioral control. It speaks to how someone feels about the capacity to carry out the desired behaviour – in this case, washing hands properly. Several factors, including knowledge of hand hygiene, availability of resources (like soap and water or hand sanitizers), availability of protocols and guidelines for hand hygiene, organizational support for hand hygiene practices, and the belief that hand hygiene is effective in preventing infections, can all influence this perception.

Hand hygiene compliance is the practice of washing hands with water or using a hand-rub containing alcohol. The majority of respondents' hand hygiene compliance fell into the high category, at 60 %, and the low category, at 30 %, according to our findings. This number is still considerably below the hospital's > 80 % compliance standard value, despite the fact that all sinks and walls have hand hygiene posters that instruct patients on proper hand hygiene before entering their rooms. The willingness and self-awareness of nurses to practice proper hand hygiene substantially encourage compliance with the adoption of hand hygiene.

Structural model testing evaluates model fit, path coefficient, and R^2 . Model fit testing determines whether a model matches the data. Meanwhile, to determine the structural relationship between latent variables, hypothesis testing must be performed on the path coefficients between variables, as shown in Table 2.

The results of the direct influence test in Table 2 show that hospital facilities have a positive and significant effect on hand hygiene compliance with a path coefficient of 0.271 ($p < 0.05$). Hospital facilities have a positive and significant effect on perceived behavioral control (path coefficient = 0.338, $p < 0.05$). Nurse knowledge has a favorable and significant effect on hand hygiene compliance (path coefficient = 0.195, $p < 0.05$). Nurse knowledge significantly improves perceived behavioral control (path coefficient = 0.356, $p < 0.05$). Perceived behavioral control has a favorable and substantial effect on hand hygiene compliance (path coefficient = 0.343, $p < 0.05$).

Table 3 shows that hospital facilities are proven to have an indirect effect on hand hygiene compliance. It means that perceived behavioral control mediates the influence of hospital facilities on hand hygiene compliance. The nurse knowledge is proven to have an indirect effect on hand hygiene compliance. It means that perceived behavioral control mediates the influence of nurse knowledge on hand hygiene compliance.

The figure shows that hospital facilities and nurse knowledge have a significant effect on perceived behavioral control with an explanatory factor of 36.4 % ($R^2 = 0.364$). All factors, namely hospital facilities, nurse knowledge, and perceived behavioral control were able to explain hand hygiene compliance of 45.2 % ($R^2 = 0.364$).

Discussion

The results of tests using bootstrapping using SmartPLS software in this study showed the influence of hospital facility variables on hand hygiene compliance. This research supports the results of several previous studies stating that facilities can support a person's perception of behavior. Hand hygiene practices increased the most during the COVID-19 pandemic, where research

Table 2. Results of the direct effects test

Таблица 2. Результаты исследования прямого воздействия

	Original sample / Исходная выборка	Sample mean / Среднее	Standard deviation / Стандартное отклонение	T Statistics / t-статистика (O/STDEV)	p
Facility → Hand hygiene compliance / Больничные помещения → Соблюдение гигиены рук	0.271	0.272	0.114	2.380	0.018
Facility → Perceived behavioral control / Больничные помещения → Воспринимаемый поведенческий контроль	0.338	0.343	0.076	4.417	0.000
Knowledge → Hand hygiene compliance / Осведомленность → Соблюдение гигиены рук	0.195	0.198	0.094	2.073	0.039
Knowledge → Perceived behavioral control / Осведомленность → Воспринимаемый поведенческий контроль	0.356	0.355	0.081	4.372	0.000
Perceived behavioral control → Hand hygiene compliance / Воспринимаемый поведенческий контроль → Соблюдение гигиены рук	0.343	0.345	0.088	3.908	0.000

Table 3. Results of the indirect effects test
Таблица 3. Результаты исследования косвенного воздействия

	Original sample / Исходная выборка	Sample mean / Среднее	Standard deviation / Стандартное отклонение	T Statistics / t-статистика (O/STDEV)	p
Facility → Perceived behavioral control → Hand hygiene compliance / Больничные помещения → Воспринимаемый поведенческий контроль → Соблюдение гигиены рук	0.116	0.118	0.039	2.989	0.003
Knowledge → Perceived behavioral control → Hand hygiene compliance / Осведомленность → Воспринимаемый поведенческий контроль → Соблюдение гигиены рук	0.122	0.123	0.043	2.808	0.005

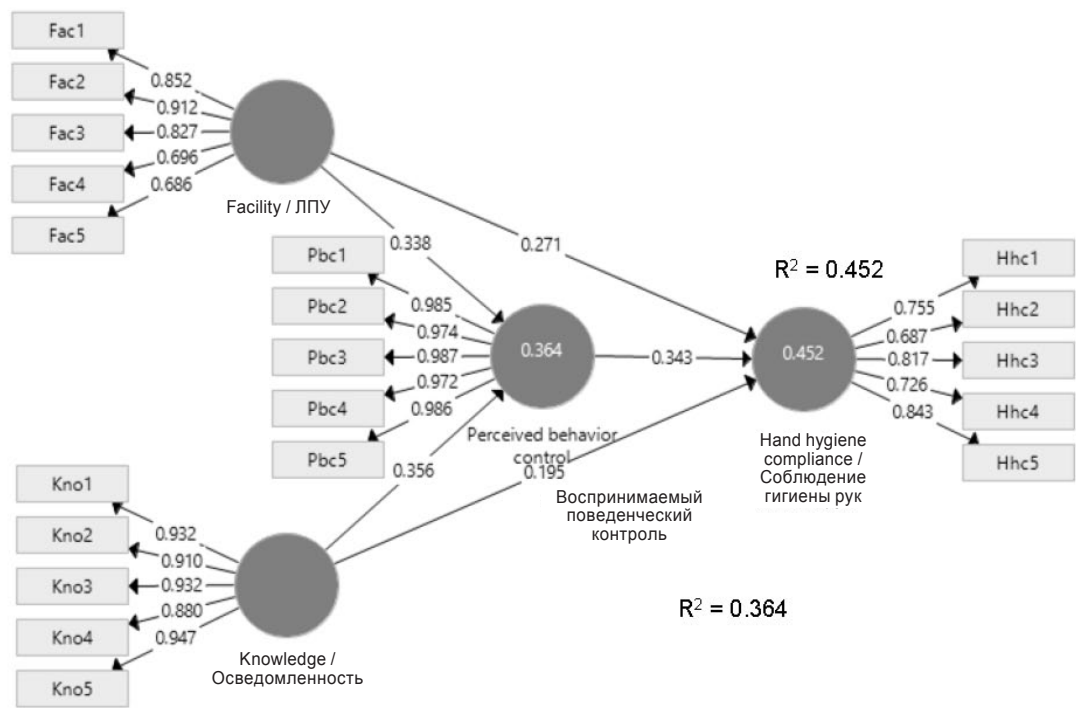


Figure. A structural model of hand hygiene compliance factors
Рисунок. Структурная модель факторов соблюдения гигиены рук

results showed that facilities were an important predictor of someone giving a positive perception of carrying out hand hygiene [28–30]. Referring to the theory that perception is influenced by several other follower variables, the results of this study state that facilities do not affect perception. It is possible that perceptions of hand hygiene compliance can be influenced by other external variables. Several variables that influence an individual's perception of hand hygiene can be seen from work experience, work stress, and others, so the strategy to increase the implementation of hand hygiene uses a multi-model strategy in order to touch on all factors [31]. Strong dedication from managers and leaders may also help employees keep the guidelines and procedures to follow the multimodal hand hygiene practice as recommended by WHO [32]. This research is in line with the result of [33] that the most of healthcare facilities have a medium or higher level of hand hygiene implementation, so funding of healthcare facilities and state income levels are important driving factors. The availability of resources and facilities is a key element to further

improve the quality of services and provide access to safe services in hospitals.

Based on the results of the direct effect test carried out with the help of SmartPLS software using bootstrapping, it is known that nurse knowledge has a significant effect on the intention to behave in hand hygiene. These results are consistent with several previous studies which stated that knowledge has a significant effect on a person's perception of behavior. The higher a person's knowledge, the more positive the perception of a behavior. Several studies disagree with these results [34]. The results are inversely different, stating that a person's knowledge does not affect individual perceptions. A person's high level of knowledge does not affect the perception of that person's behavior. The statement regarding the relationship between knowledge and perception is in line with the theory that good knowledge creates positive perceptions to carry out a behavior [35]. In line with the theory of planned behavior, a person's behavior patterns begin with the person's perception of the individual's ability to behave and how external

factors can support the behavior [36]. A person's behavior is determined by the individual's perception that the behavior is important, viewing the individual as vulnerable to health-related problems, believing that they are the one who can prevent a problem in the health sector, in this case, HAIs. This is interpreted as how a person perceives a behavior that is preceded by knowledge. A person's perception of behavior is influenced by other variables, both demographic and social, so that they can strengthen the reasons for behaving [37]. It is recommended that infection control committees reassess their instructional approaches and focus more on updating hand hygiene recommendations. Additionally, more experienced nurses should be employed in all units [38].

As previously indicated, the investigation revealed a significant direct relationship between perceived behavioral control and hand hygiene habit. Perceived behavioral control has been proven to have a significant effect on hand hygiene behavior. These findings are consistent with previous studies, which report that nurses with strong beliefs and awareness regarding hand hygiene demonstrate better compliance. Good perceptions regarding hand hygiene need to be improved by increasing nurses' knowledge of how to behave in hand hygiene in accordance with guidelines. Good hand hygiene risk perception can increase hand hygiene compliance [39]. The theory of planned behavior (TPB) has been utilized in the context of infectious disease epidemics, with studies assessing the utility of TPB in predicting preventative behavior regarding healthcare-associated infections (HAIs). The theory regarding perception is strengthened by the theory of planned behavior that perceived behavioral control consisting of control beliefs and power beliefs can have a direct influence on a person's behavior without mediation (intention). Individuals who have strong beliefs, both in terms of internal and external support to achieve behavior, can have a positive influence, resulting in a desired action [36]. Perceived behavioral control is the feeling of ease or difficulty. Perceived behavioral control is likewise expected to have a direct effect on planned behavior, assuming that it reflects actual control. TPB's ability to predict a variety of health behaviors has been widely demonstrated [40]. More specifically, in the context of this investigation, the TPB was utilized to predict hand washing. Previous studies have found beneficial relationships between perceived behavioural control and hand hygiene behaviors. The findings of [41] research demonstrated that subjective norms and perceived behavioral control were significantly and positively connected with hand hygiene behavior via intentions. However, in this study, attitude had no effect on hand hygiene intention or action. Consistent with previous research on TPB and health behavior, it was hypothesized that perceived behavioral control would predict intention to perform hand hygiene behavior, which in turn would predict hand hygiene behavior among nurses working at a public hospital in Jember, Indonesia.

Conclusion

In light of the findings, we may conclude that the hospital facilities, nursing knowledge, and perceived

behavioral control for hand hygiene were rated adequate. We discovered that female nurses who were older and had more experience had higher hand hygiene compliance than their counterparts. Furthermore, we discovered a strong and positive relationship between the ratings for knowledge, facility, and perception. The theory of planned behavior provides a valuable and effective framework for explaining the hand hygiene behavior of nurses of public hospitals in Jember, Indonesia. Continued commitment to improving hand hygiene practices is critical in the ongoing fight against the spread of infectious diseases. Nonetheless, further research is needed to determine the scope of other factors influencing hand cleanliness.

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