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Hospital facilities, occupational safety environment and self-efficacy as predictors of healthcare-associated infections prevention and control compliance in nurses of inpatient care units

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ABSTRACT

Background and purpose: The implementation of healthcare-associated infections (HAIs) prevention and control program in hospitals remains sub-optimal. The present study aims to determine the relationships between nurse's self-efficacy, hospital's occupational safety environment, and the availability of facilities, with the compliance on HAIs prevention and control in hospital inpatient care units.

Methods: Cross-sectional survey was conducted with 128 nurses selected using systematic random sampling at Buleleng District Hospital's inpatient care units. Data collection was conducted in March 2018 using self-administered questionnaires. The questionnaire consisted of five sections including characteristics of respondents, HAIs prevention and control practices, self-efficacy, occupational safety environment and the availability of facilities. Bivariate analysis was conducted to calculate the Pearson correlation coefficients between variables. Multivariate analysis was performed with multiple linear regressions to examine self-efficacy, occupational safety environment and availability of facilities as predictors of the compliance on HAIs prevention and control.

Results: The study shows that 56.2% of nurses reported good compliance on HAIs prevention and control practices. Bivariate analysis shows a significant correlation between HAIs prevention and control compliance scores and self-efficacy (r=0.45; p=0.00), occupational safety environment (r=0.53; p=0.00), and the availability of facilities (r=0.65; p=0.00). Multivariate analysis shows that the availability of facilities is a significant predictor of HAIs prevention and control compliance (β=0.49; p<0.01) while self-efficacy and the occupational safety environment are also found to be significant predictors, although with lower standardized coefficients: β=0.16 (p=0.03) and β=0.17 (p=0.04), respectively.

Conclusion: The significant predictors of compliance on HAIs prevention and control are availability of facilities, self efficacy and hospital's occupational safety environment. This study highlights the importance of optimizing the availability of facilities, improving the occupational safety environment, and enhancing nurses' self-efficacy in order to reduce the incidence of HAIs in hospitals.

Keywords: Healthcare-associated infections, hospitals, facilities, occupational safety environment, self-efficacy

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INTRODUCTION

Healthcare-associated infections (HAIs) defined as the incidence of infection(s) among patients that may occur during their hospital care.[1] HAIs in hospitals can be transmitted via blood (i.e. syringes etc.), ventilators, urinary-tract catheters and surgical wounds.[1-3] Prevention of HAIs in developed countries such as the United States is committed as a top priority,[4,5] however, HAIs remain widely reported in the developed countries. A study in the United States conducted at 183 hospitals showed that from a total of 11,282 patients, 452 (4.0%) had contracted one or more HAI-related infections.[6] In Australia, the incidence of HAIs was reported 83,096 cases per year which is considered very large underestimate due to the lack of or incomplete data on common infections.[7]

HAIs is a major challenge for low and middle income countries.[8] In Asian countries, HAIs surveillance is rarely performed.[9] Several studies in Indonesia showed that the prevention and control of HAIs remain inadequate.[10-14] A routine report on the incidence of HAIs at a hospital in Surabaya, Indonesia, from 2012-2014 showed that HAIs rates ranged from 0.33%-0.59%.[15] The incidences of HAIs related to surgical-wound infection at Buleleng District Hospital from May-July 2016 were 0.5%-0.7%.[16] The proportion of HAIs in Indonesia appears to be low may be due to the sub-optimal surveillance system and/or the determination of HAIs diagnosis among patients in Indonesia. Some Indonesian hospitals did not report the incidence of HAIs.[17,18] HAIs is a sensitive issue because they can negatively affect a hospital's reputation. The prevention and control of HAIs in Indonesia is regulated by the Ministry of Health Regulation No. 27 (2017) which involves 11

aspects: hand hygiene, PPE use, decontamination of patient-care equipment, environmental health, waste management, linen management, health protection for hospital's workers, patients placement according to hospital procedures, cough and sneeze procedures, safe injection procedures, and lumbal punction.[19] Studies related to predictors of HAIs incidence have been conducted both in Indonesia and other countries, however, most studies focused only on particular aspects, such as hand hygiene and PPE use only, without including all the other aspects.[20-24] Studies on occupational safety environment and self-efficacy with HAIs are still limited.[24-28] Some studies reported that the incidence of HAIs is related to the availability of facilities, but the results are inconsistent.[26,29-32]

This study aims to determine the association between self-efficacy, occupational safety environment and the availability of facilities, with the compliance on HAIs prevention and control at Buleleng District Hospital's inpatient care units.

METHODS

A cross-sectional survey was carried out in March 2018 in all inpatient care units of Buleleng District Hospital. This is a Type B Hospital and the only public and largest among five hospitals available in Buleleng District.[33] The hospital has 333 beds[34] with the average bed occupancy rate of 76.12%.[35] There are a total number of 199 nurses in charged for inpatient care units and 128 nurses were selected as sample for this study using systematic random sampling. The sample size was calculated based on the following parameters: mean score of hand hygiene behaviour of 3.96, standard deviation of 2.1,[36] anticipated mean score of 4.5, 95% confidence level and power of 80%. The data were collected using self-administered questionnaires that had been pre-tested among 20 nurses at a different hospital. The questionnaire consisted of five sections: (i) characteristics of respondents (ii) HAIs prevention and control practices, (iii) self-efficacy, (iv) occupational safety environment and (v) the availability of facilities. The questionnaire of HAIs prevention and control practices was developed referring to the Ministry of Health Regulation No. 27 (2017) which comprised of 50 items examining ten aspects.[19] They are hand hygiene, PPE use, decontamination of patient-care equipment, environmental health, waste management, linen management, health protection for hospital's workers, patients placement according to hospital procedures, cough and sneeze procedures and safe injection procedures. The self-efficacy questionnaire was adopted from Bijl & Baggett's[37] which consists of 12 statements related to the aspects of magnitude, strength, and generality. The questionnaire of occupational safety environment was adopted from Schneider's[38] consisting of 15 statements covering three aspects of policies, practices and procedures. The questionnaire on the availability of facilities refers to the ministerial regulations regarding the technical requirements for hospital buildings and facilities[39] which consists of 26 items covering equipment and supporting facilities. Some items consist of four options: "strongly agree", "agree", "disagree" and "strongly disagree". Other items consist of: "always", "often", "sometimes" and "never". The options of "agree" or "always" were assigned a score of four; "agree" or "often" a score of three; "disagree" or "sometimes" a score of two, and "strongly disagree" or "never" a score of one.

The scores from each item were then summed to obtain a total score for each section namely: the total score of compliance on HAIs prevention and control; self-efficacy; occupational safety environment and facility availability. To understand the proportion of the nurses who comply with the HAIs prevention and control, the total scores from each section were grouped into two categories: "high" and "low"; "good" and "poor"; or "complete" and "incomplete", with the mean as the cut-off point for each section.

Bivariate analysis was conducted to calculate the Pearson's correlation coefficient between variables and Kolmogorov-Smirnov test was used to determine how likely the data are normally distributed. Multivariate analysis was performed with multiple linear regressions to examine self-efficacy, occupational safety environment and availability of facilities as predictors of the compliance on HAIs prevention and control. This study has been approved by the Ethics Committee of the Faculty of Medicine, Udayana University/ Sanglah General Hospital on February 21, 2018.

RESULTS

Table 1 presents the characteristics of respondents with majority of females, married, aged <25 years, diploma of nursing, contract workers and have worked in the hospital for less than 6 years.

Table 2 presents the proportions of respondents who scored well on HAIs prevention and control items. Overall, 56.2% of nurses reported implementing "good" HAIs prevention and control. In terms of the specific HAIs prevention and control practices: 68.8% reported "good" hand hygiene practices; 60.9% "good" PPE use; 60.9% decontaminating patient-care equipment; 53.1% have followed environmental health procedures; 64.8% have followed good waste management

Table 1 Characteristics of respondents

Variables	n	%
Sex		
Male	18	14.1
Female	110	85.9
Marital status		
Unmarried	31	24.2
Married	96	75.0
Widows/widowers	1	0.8
Age		
<25 years	17	13.3
25-34years	85	66.4
>35 years	26	20.3
Education		
High school graduate	2	1.6
Diploma of Nursing	64	50
Bachelor of Nursing	14	10.9
Ners (bachelor plus one year professional education)	48	37.5
Employment		
Government employee	43	33.6
Contract worker	85	66.4
Working period		
≤5 years	67	52.3
>5 years	61	47.7
Total	128	100.0

Table 2 Proportion of nurses based on the implementation of HAIs prevention and control

Implementation of HAIs prevention and control	n	%
Hand hygiene		
Poor	40	31.2
Good	88	68.8
PPE use		
Poor	50	39.1
Good	78	60.9
Decontamination of patient-care equipment		
Poor	50	39.1
Good	78	60.9
Environment health		
Poor	60	46.9
Good	68	53.1
Waste management		
Poor	45	35.2
Good	83	64.8
Linen management		
Poor	63	49.2
Good	65	50.8

Table 2 *Continue*

Implementation of HAIs prevention and control	n	%
Health protection for hospital's workers		
Poor	59	46.1
Good	69	53.9
Patient placement		
Poor	70	54.7
Good	58	45.3
Cough and sneeze procedures		
Poor	58	45.3
Good	70	54.7
Safe injection procedures		
Poor	28	21.9
Good	100	78.1
Overall implementation of HAIs prevention and control		
Poor	56	43.8
Good	72	56.2
Total	128	100.0

Table 3 Proportions and descriptive statistics for self-efficacy, occupational safety environment, availability of facilities, and the implementation of HAIs prevention and control

Variables	No of item	n (%)	Mean (SD)
Self-efficacy	12		41.8 (3.9)
High		67 (52.3)	
Low		61 (47.7)	
Occupational safety environment	15		48.6 (5.7)
Good		68 (53.1)	
Poor		60 (46.9)	
Availability of facilities	26		79.8 (11.1)
Complete		67 (52.3)	
Incomplete		61 (47.7)	
Overall implementation of HAIs prevention and control	50		171.5 (17.8)
Good		72 (56.2)	
Poor		56 (43.8)	

practices; 50.8% have adhered to good linen management practices; 53.9% had "good" health protection for hospital's workers; 45.3% adhering to good patient placement according to hospital procedures; 54.7% have followed good cough and sneeze protocols; and 78.1% have followed safe injection procedures.

Table 3 presents the proportions of respondents based on the following variables: self-efficacy, occupational safety environment, availability of facilities and implementation of HAIs prevention and control. The proportion of respondents with "high" self-efficacy was 52.3%. Within each section, the proportion of nurses with "good" self-confidence in completing tasks (magnitude) was 56.2%; "good" strength in completing nursing tasks was 55.5%, while "good" self-confidence in facing a variety of situations (generality) was only 39.1%. The proportion of respondents who reported the occupational safety environment as "good" was 53.1%. Within each section, nurses who rated "good" for hospital policy were 69.5%, for procedural aspects 56.2%, and for hospital practices 47.7%. The overall proportion of respondents who reported "adequate" availability of facilities was 52.3%. For each section, respectively 51.6%

Table 4 Pearson's correlation coefficient (R) between self-efficacy, occupational safety environment and availability of facilities, with the implementation of HAIs prevention and control

Variable	Self-efficacy (r)	Occupational-safety environment (r)	Availability of facilities (r)	Application of HAIs prevention and control (r)
Self-efficacy	1	0.51	0.41	0.45
Occupational safety environment	0.51	1	0.56	0.53
Availability of facilities	0.41	0.56	1	0.65
Implementation of HAIs prevention and control	0.45	0.53	0.65	1

Table 5 Standardized coefficients between self-efficacy, occupational safety environment and availability of facilities with the implementation of HAIs prevention and control

	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	p
(Constant)	52.03	12.92	-	4.03	<0.01
Self-efficacy	0.73	0.34	0.16	2.15	0.03
Occupational safety environment	0.52	0.26	0.17	2.02	0.04
Availability of facilities	0.79	0.12	0.49	6.25	<0.01

R=0.70
R square=0.49
Adjusted R square=0.48
F=39.43
Sig. F=0.00

and 44.5% nurses agreed that the equipment and supporting facilities were "adequate".

Table 4 shows the Pearson's (r) correlation coefficient matrix to determine the association(s) between the variables. The coefficient correlation between the implementation of HAIs prevention and control with self-efficacy was 0.45; with the occupational safety environment 0.53; and with the availability of facilities 0.65. We also found a relationship between the independent variables: namely, self-efficacy and occupational safety environment (r=0.51), self-efficacy and the availability of facilities (r=0.41), and the occupational safety environment and the availability of facilities (r=0.56).

Table 5 illustrates the results of multivariate analysis using multiple linear regressions to determine the association between self-efficacy, occupational safety environment and facilities availability with the compliance on HAIs prevention and control. The normality test conducted using *One Sample Kolmogorov-Smirnov* showed insignificant results for self-efficacy (p=0.06); occupational safety environment (p=0.46); facilities availability (p=0.86) and the implementation of HAIs prevention and control (p=0.08). Multiple regression analysis showed that the standardized coefficients (Beta) for self-efficacy was 0.16 (p=0.03); occupational safety environment=0.17 (p=0.04); and facilities availability=0.49 (p<0.01), with the equation of Y=0.16X1+0.17X2+0.49X3. The R square value was 0.49 (F=39.43, p=0.00).

DISCUSSION

This study investigated the implementation of HAIs prevention and control in 10 aspects (hand hygiene, PPE use, decontamination of patient care equipment, environmental health, waste management, linen management, health protection of hospital's workers, placement of patients, coughing and sneezing procedures, and safe injection procedures).

The results indicated that 56.2% of nurses at Buleleng District Hospital's inpatient care units reported "good" compliance on HAIs prevention and control. In terms of each aspect in the HAIs prevention and control, respondents had the highest score in safe injection procedures (78.1%) while the lowest score in patient placement (45.3%). In our study, patient placement refers to the practice of separating patients with infectious diseases from those with non-infectious diseases.

A study at *Prof.* Dr. *R.D.* Kandou General Hospital in Manado found that 88.3% of nurses correctly followed HAIs prevention and

control procedures.[21] Other studies reported the implementation of HAIs prevention and control in hospitals only in a specific aspect. A study at Banjarmasin Islamic Hospital's inpatient care units showed that 98.5% of nurses followed hand hygiene procedures while at RS "X" in Malang only 35%.[22,23] In our study, 68.8% of nurses reported "good" hand hygiene practices. Other study in developed countries, carried out at a Belgium hospital's ICU ward, showed that 82% of nurses adhered to hand-hygiene practices in the prevention of HAIs.[20] This finding shows that adherence to good hand hygiene practices was higher than that found at the hospital in Malang and the Buleleng District Hospital, but lower than the Banjarmasin Islamic Hospital. These differences are likely due to the different settings of the studies, namely an ICU ward and inpatient care units. Additionally, the differences may be due to how hand hygiene was measured and the standards used in each study.

The other aspects of HAIs prevention and control which widely publicized were PPE use and safe injection procedures. The present study at Buleleng District Hospital found that 60.9% of nurses "correctly" used PPE, whereas 81.7% reported in the study at Kandou General Hospital in Manado and 86.2% at Banjarmasin Islamic Hospital.[21,22] Nurses' adherence to safe injection procedures at Buleleng District Hospital was 78.1% while in the Manado study was reported 81.7%, and 83.1% at Banjarmasin Islamic Hospital.[21,22] These findings indicate that the compliance on PPE use and safe injection procedures at Buleleng District Hospital's inpatient care units is lower compared to those at Kandou General Hospital in Manado and Banjarmasin Islamic Hospital.

A number of qualitative studies have reported that the obstacles to implementing HAIs prevention and control for nurses include limited human resources; limited hospital resources; lack of training, weak monitoring and evaluation, inadequate facilities, lack of awareness among hospital staff, inconsistent recording of cases of HAIs and sub-optimal staff commitment to preventing and controlling HAIs.[40-42]

In our study, significant predictors of HAIs prevention and control compliance were the availability of facilities, self-efficacy and occupational safety environment. Other studies show that self-efficacy is also a predictor of HAIs prevention and control compliance although only in a specific aspect. For instance, the Belgian ICU study showed that self-efficacy was significantly associated with hand hygiene (β=0.37; p=0.00).[20] Another study at the Ministry of Interior Security Hospital, Saudi Arabia, reported that self-efficacy is positively related to hand hygiene for the prevention and control of HAIs.[24] Similar studies at 18 hospitals in Hunan Province, China, reported that adherence to HAIs prevention and control practices is influenced by self-efficacy.[25] However, our findings differ from the above studies in terms of respondents' characteristics, place, data-collection methods and the types of HAIs prevention and control practices investigated.

Several other studies also show similar results in terms of predictors of hospital's occupational safety environment. For example, studies at Bhayangkara Hospital in Manado, the Red Cross Hospital in Bogor and Banyumas Hospital show that hospital's occupational safety environment correlates significantly with HAIs prevention and control.[26-28]

Several other studies also show that the availability of facilities is related to the implementation of HAIs prevention and control (e.g. studies at the inpatient ward at a district hospital in Jakarta, also Bhayangkara Hospital and Kandou General Hospital in Manado).[26,30] However, other studies at Dr. Sardjito Hospital and "X" Hospital in Jakarta suggest that there is no significant relationship between hospital facilities and HAIs prevention and control.[31,32]

In this type of studies, direct observation is considered as the gold standard to measure the HAIs prevention and control practices. In our study, the measurement relies on a self-reported questionnaire, which potentially becomes the source of biases. Respondents might feel uncomfortable in providing an answer that suggested inappropriate practices or conditions. Another limitation is that the questionnaire was not tested for its validity and reliability. This study was conducted at only one hospital with a sample of nurses working in the inpatient ward, thus precautions should be taken in generalising the results to the broader patient-care contexts.

CONCLUSION

The lowest compliance on HAIs prevention and control was the patient placement. Availability of facilities, occupational safety environment and self-efficacy were significantly found as predictors of compliance on HAIs prevention and control. This study underlines that in order to reduce the incidence of HAIs in hospitals, there is a need to improve hospital facilities, the occupational safety environment, as well as nurses' self-efficacy, for example by implementing more intensive HAIs prevention and control training and supervision.

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