Infection Control Practice on Vital Signs Equipment: A Survey Among Senior Nursing Students in Iloilo City, Philippines

Zea Maize S. Suarez, Ryan Michael F. Oducado, Eric Lorenz C. Josue, Treesha Llen C. Gayoso, Christy Anne L. Ocate, Janelene Joy A. Lujan
West Visayas State University, College of Nursing, La Paz, Iloilo City, Philippines
rmoducado@wvsu.edu.ph

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Abstract *–Blood pressure apparatuses, stethoscopes and thermometers serve as vehicles for pathogens. Previous studies have shown that these equipment harbor potentially pathogenic microorganisms and even antibiotic-resistant strains within the hospital environment. Practice of good infection control on vital signs equipment therefore plays an important role in preventing the spread of infections that can be acquired during hospitalization. However, studies on infection control practice on these equipment among nursing students have not been given much attention. This descriptive cross-sectional study was conducted to determine the senior nursing students' practice of infection control on vital signs equipment. A researcher-made, self-administered survey instrument was used to collect data among 202 randomly selected senior nursing students in six nursing schools in Iloilo City, Philippines. Descriptive and parametric inferential statistical tools were employed to analyze and interpret the data gathered. Results indicated that while a higher proportion of nursing students almost always disinfected their thermometers, only one out of five almost always disinfected their BP apparatuses, and only two out of five almost always performed disinfection of their stethoscopes after each patient use and every after clinical duty. Forgetfulness and laziness in doing the disinfection process were the primary reasons for non-disinfection. A significant correlation was found between nursing students' self-report infection control practice and the infection control practice of their fellow nursing students. It is evident that there are senior nursing students that do not regularly practice high standard infection control of their vital sign's equipment. Strengthening practice, modeling good behaviors, and adopting clear guidelines on infection control of vital signs equipment must be initiated in the undergraduate nursing program.*

Keywords *– infection control, nursing students, role modeling, social learning, vital signs*

INTRODUCTION

The rise in healthcare-associated infections or HAIs is a major concern among members of the healthcare team. The World Health Organization (WHO) estimates that approximately, the prevalence of HAIs in developed countries varies between 5.1% and 11.6% [1]. Correspondingly, the Centers for Disease Control and Prevention (CDC) reported that about 2 million patients suffer from HAIs annually [2]. These infections occur across the globe. About 7% of these occur in developed countries and 10% in developing countries [3]. In the Philippines, limited published information is provided about the prevalence of HAIs. A study reported that 63 out of 224 or 28% of patients in public hospitals had HAIs with pneumonia as the most common identified infection [4].

HAIs can be transmitted either via direct or indirect contact [5]. Inanimate objects such as blood pressure (BP) apparatus, stethoscope and thermometer, which are considered non-critical patient care equipment, serve as vehicles that passively carry pathogens. These equipment that are used repeatedly throughout the day provide an environment in which the agent grows, multiplies, or produces toxin, and therefore are potential cradles of indirect cross-contamination. Earlier studies discovered that vital signs equipment harbor a relatively high degree of bacterial contamination with a significant percentage of isolates that are considered potentially pathogenic [6]-[10]. Stethoscope was recognized as a fomite transmitting potentially pathogenic microorganisms and antibiotic-resistant strains within the hospital setting [6], [9]-[10]. Previous studies also noted poor disinfection of BP cuffs and stethoscopes among medical health personnel including nurses [8], [11].

Disinfection of vital signs equipment is an essential component of care which has been undervalued in recent years. Nurses and nursing students play a crucial role in preventing and controlling the spread of infections brought about by unintended cross-contamination from the said equipment that can cause detrimental effects to patients. While there are published studies that investigated the infection control practice on vital signs equipment, greater part of studies available were conducted abroad among healthcare workers while scarce studied the nursing student population.

OBJECTIVES OF THE STUDY

This study was conducted to determine the infection control practice on vital signs equipment among senior nursing students in Iloilo City, Philippines. Specifically, this study aimed to determine: 1) the self-report extent of infection control practice on vital signs equipment after each patient use and every after 8-hour clinical duty; 2) the observed extent of infection control practice on vital signs equipment of fellow nursing students after each patient use and every after 8-hour clinical duty; 3) the practice of handwashing before using vital signs equipment; 4) the reasons for non-disinfection of vital signs equipment; and 5) whether or not there is a significant correlation between the nursing students' self-report infection control practice on vital signs equipment and the infection control practice on vital signs equipment of their fellow nursing students.

MATERIALS AND METHODS

A descriptive cross-sectional method of investigation was employed involving 202 randomly selected senior nursing students from six (6) Colleges of Nursing in Iloilo City. The overall sample size was proportionally allocated to six nursing schools and desired sample units were randomly drawn using the fishbowl technique.

A researcher-made survey questionnaire was used to gather the data needed for the study. Using a 5-point Likert scale, the participants were asked how often they, and how often they have observed their fellow nursing students disinfect with alcohol their vital signs equipment after each patient use and every after 8-hour clinical duty. The responses were "almost never" when disinfection of vital signs equipment is done 0-19% of the time; "rarely" if 20-39% of the time; "sometimes" if 40-59% of the time; "often" if 60-79% of the time; and "almost always" when disinfection of vital signs equipment is performed 80-100% of the time. The questionnaire also asked about the handwashing practice prior to use of the BP apparatus, stethoscope, and thermometer and were answerable by "yes" or "no". The last part was a checklist that was utilized to identify the possible reasons or factors why students failed to disinfect their vital signs equipment.

The items in the instrument were developed based on the role of the nurse in infection control, relevant related studies and from the CDC guidelines on disinfection and sterilization [12]. The instrument was subjected for content validation to a panel of four (4) nurses who are experts in the field of infection control and evaluated the survey instrument using the criteria set forth by Good and Scates (1972) [13]. To avoid survey biases and to ensure that the instructions and items in the instrument were clear, pilot testing was done among 100 nursing students. Cronbach's alpha values for practice scales ranged from .61 to .88.

Before actual data gathering, permission to conduct the study from the Dean of each of the Colleges of Nursing was secured. During the actual survey, written informed consent was obtained after a brief orientation and explanation of the purpose of the study was given to the study participants. The researchers distributed the questionnaires, and the participants were given ample time to complete the survey form. The accomplished questionnaires were checked for completeness. Data were then processed via the Statistical Package for Social Sciences (SPSS) Software version 23. Frequency count, percentage, rank, and Pearson's *r* were employed to analyze and interpret the data.

RESULTS

Self-Report Infection Control Practice on Vital Signs Equipment

Table 1 shows that after each patient use, only few (18.3%) senior nursing students "almost always" disinfected their BP apparatuses and less than half (37.1%) "almost always" disinfected their stethoscopes 80-100% of the time. However, majority (79.2%) of senior nursing students self-reported that they "almost always" disinfected their thermometers. Moreover, every after 8-hour clinical duty, out of the 202 senior nursing students, less than one-fourth (22.8%) "almost always" disinfected their BP apparatuses and less than half (38.1%) "almost always" disinfected their stethoscopes with alcohol. On the other hand, majority of senior nursing students (78.2%) "almost always" disinfected with alcohol their thermometer every after duty.

Infection Control Practice on Vital Signs Equipment of Fellow Nursing Students

Table 2 shows that, as per observation of their fellow nursing students' infection control practice on vital signs equipment after each patient use, very few (9.4 %) of their fellow nursing students "almost always" disinfected their BP apparatuses, less than one-fourth (17.3%) "almost always" disinfected their stethoscopes and only a little more than half (55.9 %) "almost always" disinfected their thermometers after each patient use. Every after 8-hour clinical duty, it can be gleaned that only a few (11.4% and 19.3%, respectively) of their fellow nursing students "almost always" disinfected with alcohol their BP apparatuses and their stethoscopes and only little over half (53.5%) "almost always" disinfected their thermometers.

Table 1. Self-report Infection Control Practice After Each Patient Use and Every After 8-Hour Clinical Duty

Self-report Infection Control Practice	Almost Never		Rarely		Sometimes		Often		Almost Always	
After Each Patient Use	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
BP apparatus	6	3.0	21	10.4	59	29.2	79	39.1	37	18.3
Stethoscope	2	1.0	7	3.5	32	15.8	86	42.6	75	37.1
Thermometer	1	.5	-	-	6	3.0	35	17.3	160	79.2
Every After Clinical Duty	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
BP apparatus	7	3.5	20	9.9	59	29.2	70	34.7	46	22.8
Stethoscope	0	0	9	4.5	39	19.3	77	38.1	77	38.1
Thermometer	0	0	1	0.5	12	5.9	31	15.3	158	78.2

Table 2. Infection Control Practice of Fellow Nursing Students After Each Patient Use and Every After 8 Hour Clinical Duty

Infection Control Practice of Fellow Nursing Student	Almost Never		Rarely		Sometimes		Often		Almost Always	
After Each Patient Use	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
BP apparatus	15	7.4	50	24.8	70	34.7	48	23.8	19	9.4
Stethoscope	6	3.0	39	19.3	70	34.7	52	25.7	35	17.3
Thermometer	2	1.0	9	4.5	26	12.9	52	25.7	113	55.9
Every After Clinical Duty	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
BP apparatus	14	6.9	38	18.8	73	36.1	54	26.7	23	11.4
Stethoscope	3	1.5	29	14.4	68	33.7	63	31.2	39	19.3
Thermometer	1	0.5	14	6.9	31	15.3	48	23.8	108	53.5

Handwashing Practice Before Using Vital Signs Equipment

The findings in Table 3 show that most of the senior nursing students wash their hands before using their BP apparatus (87.1%), stethoscope (86.1%) and thermometer (90.6%).

Table 3. Practice of Handwashing Prior to Use of Vital Signs Equipment

Vital Signs Equipment	Yes		No	
	f	%	*f*	%
Blood Pressure Apparatus	176	87.1	26	12.9
Stethoscope	174	86.1	28	13.9
Thermometer	183	90.6	19	9.4

Reasons for Non-Disinfection of Vital Signs Equipment

As shown in Table 4, the foremost reason for not disinfecting their vital signs equipment reported by most of the senior nursing students was forgetfulness (77.2%) followed by laziness to do the disinfection process (57.9%). Other mentioned reasons for non-disinfection were lack of time to perform disinfection (44.1%), unreported consequences of noncompliance to disinfection (31.2%), ignorance of disinfection practice (28.7%), indifferent attitude toward disinfection practice (26.2%), clinical instructor not monitoring infection control practice (24.3%), and lack of research on disinfection practice (20.3%). A few reported that absence of documentary guidelines (14.9%), ignorance on the part of the patients (13.9%), absence of

continuous education on disinfection practice (12.9%), lack of awareness about disinfection practice (12.9%), clinical instructors not requiring students to do so (11.9%), clinical instructors not telling students to do so (8.9%), and not seeing classmates or nurses disinfecting the equipment (.5%) were reasons for not disinfecting their vital signs equipment.

Table 4. Reasons for Non-disinfection of Vital Signs Equipment

Reasons for Non-disinfection	*f*	%	Rank
Forgetfulness	156	77.2	1
Laziness to do the disinfection process	117	57.9	2
No time to perform disinfection	89	44.1	3
Unreported consequences of non-compliance to disinfection	63	31.2	4
Ignorance of disinfection practice	58	28.7	5
Indifferent attitude towards disinfection practice	53	26.2	6
Clinical instructor not monitoring infection control practice	49	24.3	7
Lack of research on disinfection practice	41	20.3	8
Absence of documentary guidelines on disinfection practice	30	14.9	9
Ignorance on the part of the patients	28	13.9	10
Absence of continuous education on disinfection practice	26	12.9	11.5
Lack of awareness about disinfection practice	26	12.9	11.5
Clinical instructors not requiring students to do so	24	11.9	13
Clinical instructors not telling students to do so	18	8.9	14
Not seeing classmates or nurses disinfecting the equipment	1	0.5	15

**Multiple responses*

Table 5. Correlation Between Self-Report Practice and Observed Practice of Fellow Nursing Students

	r	*p*-value	Interpretation
Self-report practice and observed practice of fellow nursing students	. 562	.000*	Significant

***p* < .05**

It can be gleaned in Table 5 that the self-report infection control practice on vital signs equipment by senior nursing students and the observed infection control practice on vital signs equipment by their fellow senior nursing students are significantly related with a moderate positive correlation (r = .562; p = .000).

DISCUSSION

Ensuring high standards of infection control practice is an essential consideration in reducing HAIs thereby ensuring patient safety. This study investigated the practice of infection control on vital signs equipment among senior nursing students. In this study, the infection control practice on vital signs equipment of senior nursing students were based on self-report responses of the participants every after patient use and every after 8-hour clinical duty. The participants were also asked to report their observation of the extent of infection control practice on vital signs equipment of their fellow nursing students. It must be noted that in the bivariate analysis, only data on infection control practice after each patient use was used. Disinfection of vital signs equipment after each patient use is considered to be a high standard practice of disinfecting vital signs equipment. This is based on CDC's recommendation that at a minimum, non-critical patient care devices such as the blood pressure cuff should be disinfected with an Environmental Protection Agency (EPA) registered disinfectant when visibly soiled and on a regular basis such as after use on each patient or once daily or once weekly [12]. Moreover, senior nursing students are of particular interest in this study. Nursing students in the Philippines possess their own vital signs equipment. They use these equipment during clinical placements to take the vital signs of their assigned patients. Some of this equipment were acquired during their first year in nursing school hence, have been used constantly for years.

As reported in this study, only less than one-fourth "almost always" disinfected with alcohol their BP apparatuses 80 to 100 of the time after each patient use and after every 8-hour clinical duty and less than half "almost always" disinfected their stethoscopes after each patient use and after every 8-hour clinical duty. These are significant numbers that should not be

neglected and call for immediate action as prior studies have shown that vital signs equipment bear microorganisms that are potentially pathogenic and strains that are antibiotic-resistant [6-10]. On the other hand, majority of the senior nursing students "almost always" disinfected their thermometer with alcohol after each patient use and after every 8-hour clinical duty. Although majority of the participants disinfected their thermometers, we cannot neglect the fact that there is still about 20 percent of the sample that failed to perform high standard disinfection of their thermometers. Moreover, among the three vital signs equipment, BP apparatus was not consistently disinfected both in the self-report data and in the observation of their fellow nursing students' extent of infection control practice on vital signs equipment. It is also noteworthy to find that fellow nursing students had poorer infection control practice on vital signs equipment compared to the self-report data on infection control practice on vital signs equipment. Take for example, whereas more than three-fourths self-reported that they had disinfected their thermometer after each patient use, only a little over half of their fellow nursing students were reported to have disinfected their thermometers after each patient use. Similarly, cleaning or disinfection of thermometers, stethoscopes and BP cuffs were poor among study samples of earlier investigations [8], [11]. Gaps in good infection control practices are also evident in the literature among nursing student population in Taiwan and United Kingdom [14]-[15]. Furthermore, lapses on standard precaution compliance and infection control protocol were nevertheless documented despite the fairly high compliance rates on infection control that were reported in studies conducted among hospital nurses in the Philippines [16]-[17].

Hand hygiene is a well-accepted primary measure of the WHO to reduce HAIs [18]. It is significant to note that in this study, handwashing practice prior to use of vital signs equipment was done by most of the participants. However, there was still about 1 out of 10 senior nursing students that failed to wash hands prior to use of their vital signs equipment. Comparably, though compliance rates on handwashing were found to be above 50 percent of the samples on related studies among nursing students in Saudi and Norway, there were still reports that handwashing was not performed consistently [19]-[21]. Even a much lower rate compared to most published studies on handwashing compliance was reported among nursing staff in the Philippines [22].

This study also discovered several reasons why senior nursing students failed to disinfect their vital signs equipment. Intrinsic factors such as forgetfulness, laziness, and lack of knowledge or awareness on proper disinfection process of vital signs equipment were reported reasons why senior nursing students failed to disinfect their vital signs equipment. Also, external factors like absence of reinforcement to perform disinfection, unreported consequences of noncompliance, lack of guidelines on disinfection process were other explanations to noncompliance to good infection control practice on vital signs equipment of senior nursing students. It was previously reported that doctors and nurses attributed noncompliance with consistent stethoscope disinfection to lack of awareness or ignorance, indifferent attitude and forgetfulness [11]. These findings suggest that nursing schools may lack clear or explicit guidelines on the timing and precise ways of cleaning or disinfecting vital signs equipment especially in relation to the BP apparatus and stethoscope.

Finally, this study found that there is a significant relationship between the senior nursing students' self-report practice and the practice of their fellow nursing students regarding infection control of vital signs equipment. This indicates that the infection control practice of senior nursing students influences the infection control practice of their fellow nursing students vis-à-vis infection control of vital signs equipment. A participant conveyed in this study that not seeing classmates or nurses disinfecting the vital signs equipment was a reason for non-disinfection of the said equipment. These findings are supported by Albert Bandura's Social Learning Theory (1977) stating that a person can learn through directly observing the behavior of others [23]. That even as mere observers, the disposition to reproduce behavior provides humans with a potent mechanism to extract information from the social environment [24]. It can be said that when nursing students observe their classmates disinfecting their vital signs equipment, they also tend to take the initiative in disinfecting their own vital signs equipment. On the other hand, it is argued that if role modeling in medical education is defined as "student's unselective imitation of role models and uncritical adoption of the messages of the learning environment", imitation may perpetuate both desirable and undesirable practices [25]. Therefore,

when nursing students observe that their fellow nursing students do not disinfect their vital signs equipment, they are also more likely to copy the behavior of not practicing good infection control of their own vital signs equipment. Studies have similarly shown that performance of hand hygiene has been attributed to some role modeling effect [15], [26-28].

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that there are lapses on high standard infection control practice on vital signs equipment among senior nursing students. Such practice constitutes a patient safety issue. Moreover, both intrinsic and extrinsic factors contribute to noncompliance with infection control practice on vital signs equipment. This study also concludes that the Social Learning Theory of Bandura is useful in explaining that nursing students can learn the practice of infection control on vital signs equipment through observation or by imitating others perform the behavior.

It is strongly recommended that senior nursing students must learn to self-regulate and must be given constant reminders and reinforcement to disinfect their BP apparatuses, stethoscopes and thermometers after each use. It is also important to cultivate a supportive environment that adheres to strict infection control practice and to model good behaviors as senior nursing students tend to imitate the infection control practice on vital signs equipment of others. To ensure the protection of patients and prevent the possibility of acquiring HAIs through vital signs equipment, clear guidelines must be developed or adopted regarding infection control of vital signs equipment by educational nursing institutions to help bridge the gaps in optimal infection control practice.

Since this is mainly a self-report survey, further observational studies may be conducted to address the limitations and biases of the present design. A comparative study of the practice including knowledge and attitude on infection control of vital signs equipment among nursing students in different year levels may also be conducted. Factors affecting infection control of vital signs equipment may be further explored involving larger samples and other healthcare groups. Although this may seem to be a simple study, data on this investigation provide empirical evidence on the importance of a very simple yet vital nursing procedure that has been given less attention that could lead to potential harm of patients, compromising patient safety.

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