International Journal of Bio-Science and Bio-Technology
Vol.7, No.6 (2015), pp.221-230
http://dx.doi.org/10.14257/ijbsbt.2015.7.6.22

Classification and Workload, Nursing Time of Advanced Nursing Practices by Infection Control Nurse Practitioners

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Abstract

The aim of this study was to classify the advanced nursing practices of infection control nurse practitioners (ICNPs) and to measure the time and frequency of these practices to calculate the workload. Nineteen practices were classified as advanced nursing practices of ICNPs. The categories for the main activities of the ICNPs were management, surveillance and epidemic investigation, and education and training. The calculated relative value scale (RVS) scores for the advanced nursing practices ranged from 100 to 386.1, with an average of 266.7 points. The mean score of the frequency of the practices was 2.63 on a 5-point Likert scale. It was noted that 9 of the practices can be completed within 60 minutes, while 10 practices take over 60 minutes. The practices of ICNPs are considered to be cost-effective in decreasing healthcare-associated infections and improving the quality of healthcare services in hospitals. Therefore, the creation of an advanced nurse practitioner system for infection control is necessary.

Keywords: *Infection control nurse practitioner (ICNP), Advanced nursing practice, Resource based relative value scales (RBRVS), Frequency, Nursing time*

1. Introduction

Healthcare-associated infections (HAIs) are critical threats to patient safety. HAIs not only have an impact on the quality of health care, in aspect of physical effects such as a disability or a death; they are also economic burdens on the healthcare system as they can lead to increased hospital stays and extra healthcare costs [1-5]. The efficacy of infection control programs to decrease HAIs was well studied in the 1980s [6]. It was determined that among the most important factors of infection control and decreasing HAIs, a full-time infection control nurse (ICN) and a ratio of one full-time ICN to 250 beds were the most important [6].

In the Republic of Korea, the first full-time ICN was appointed at Seoul National University Hospital (SNUH) in 1991 [7, 8]. Throughout the 1990s, ICNs were employed at only university-affiliated hospitals or tertiary-care hospitals. However, in recent years, the number of ICNs, including both full-time and part-time nurses, has increased. In 2012, there were 500 ICNs working in Korea. The Ministry of Health and Welfare's policies and regulations have promoted the development of infection prevention activities and increased the appointments of ICNs [7-9].

In Korea, in 1995, accreditation was established for controlling the quality of medical care at tertiary-care hospitals. In 2002, medical laws were passed to regulate infection

ISSN: 2233-7849 IJBSBT

surveillance and control at hospitals with more than 300 beds. In 2010, accreditation for the quality of all medical care was put into place. These were very important strategies for infection prevention in Korea [8]. These laws demonstrate the desires of the Korean government to prevent HAIs. However, the most important human factor in infection control and prevention activities, full-time ICNs, has been very limited, with only 1.5 ICNs in hospitals with more than 500 beds in 2010 [8, 9]. This ratio of ICNs to patient beds does not meet the guidelines established in the 1980s in the United States, which specify the need for one full-time ICN for every 250 beds [6].

In Korea, the first educational program for ICNs was established in 1993 at Seoul National University Hospital. It was a 1-month program [8]. Since then, various educational programs for ICNs have been developed by the Korea Association for Infection Control Nurses (KAICN), the Korea Society of Nosocomial Infection Control, and the Korea Center for Disease Control and Prevention. Certification for ICNs was first accepted in 2002 by the Korean Association Infection Control Nurses. A graduate-level educational program for infection control nurse practitioners (ICNPs) was established at colleges of nursing in 2003, and the first license for a nurse practitioner specializing in infection control was established in 2006. The proactive activities of ICNPs in Korea have been the driving force for developing an infection control structure and infection control and prevention programs. In addition, these activities have focused on the prevention of HAIs to improve the quality of health care and to achieve a safe environment for patients. Among the six categories of infection control activities of ICNPs (surveillance, epidemic investigations, teaching, environmental monitoring, operation of employee health programs, and revisions or changes to infection control policies), education for hospital employees and surveillance are the most commonly performed by Korea's ICNs [8, 10].

However, the nature and content of infection prevention and control are changing, and the role of ICNPs is expanding in response to demands for higher quality health care. However, there are not enough studies showing the outcomes of their practical roles in Korea's healthcare system. Basic research is needed on the productivity or effectiveness of ICNPs in Korea. Therefore, this study was performed to determine the activities of ICNPs as the basic research prior to fee development.

The aims of this study are as follows: Classify the advanced nursing practices of ICNs, use the resource-based relative value scale (RBRVS) to score advanced ICN practices, and measure the timing and frequency of those practices.

2. Research Method

2.1 Classification of Advanced Nursing Practices

Through a literature review, the most common practices of ICNPs were selected. These practices were classified based on their significance, frequency, difficulty, and professionalism. A clinical panel was organized to classify and describe these practices. The panel was comprised of four ICNPs and a professor who specialized in clinical nursing. In this study, 19 practices were classified as advanced nursing practices of ICNPs, and each practice was then classified according to three stages: preparation, practice, and retrospective. The preparation stage is the stage before ICNPs come into contact with patients or healthcare workers. The practice stage is when the ICNPs perform these practices near patients or health care workers. Lastly, the retrospective stage is when the ICNPs finish the practices. The selected practice of ICNPs in this study was based on previous research [11].

2.2 Measuring the RBRVS

After classifying the advanced practices of the ICNPs, the relative value scale (RVS) score for each practice was determined. Data collection proceeded after obtaining informed consent from the participants at five tertiary-care hospitals. They were also notified that they could withdraw from the study at any time. This survey was administered between October and December 2013, and the questionnaires were delivered to and collected from the ICNPs in person. Incomplete and nonresponse questionnaires were excluded in this study. A total of 32 subjects were recruited for investigation on relative value scale.

The resource based relative value scale (RBRVS) is used to calculate a medical fee for the national health insurance (NHI) system of Korea. Resources include the consuming time, relative value scale, other staffs' workload, resource for specific medical service. However, in our study, workload is the nursing time and relative value scale that based on the physical skill and effort, mental effort, and stress required for the performance of each practice. Resource based relative value score obtained by multiplying the nursing time and relative value scale. That is, in our study, workload means RBRVS score.

Relative value score was measured using the magnitude estimation method. After establishing the standard advanced nursing practices, the relative value scale of each practice was measured in comparison with a standard practice. In general, a practice that had a relatively low workload, high frequency, and small deviation was considered to be a standard practice. The practice of "notification of an infectious disease designated by law" was selected as the standard practice among the 19 advanced nursing practices of ICNPs. Among the surveyed relative value scale, the extreme responses at both ends of the scale were adjusted according to the 3% Winsorized mean.

2.3 Investigating Nursing Time and Frequency

Nursing time was investigated by one-on-one observations during working hours for a month by four ICNPs who were experts in infection control activities and skills. This time was measured by dividing it into preparation time, practice time, and retrospective time and was measured in units of minutes.

Taking into consideration overtime work, the working time in the evening or at night was partially measured based on the nursing record. Before measuring the working time, researchers explained the purpose of the study and asked for assent. Advanced nursing practices that did not occur during the measurement period were analyzed using experience time.

The frequency of advanced nursing practices was estimated using statistical data reported by the ICNPs using a 5-point Likert scale (1: almost never done for a year; 2: done more than one time per one year; 3: done more than one time per month; 4: done more than one time per week; 5: done almost every day).

3. Results

3.1 Classified Advanced Nursing Practices of ICNPs

There were 32 ICNPs who completed the survey. They were all women with an average age of 32.6 years (30.1 ± 6.90). In addition, the average length of time working as a nurse was 9.2 years, and the average length of time working in infection control was 3.2 years.

Nineteen practices were classified as advanced nursing practices of ICNPs by nursing experts on infection control and the research team. The main practice categories were management, surveillance and epidemic investigation about HAIs, and education and

training for patients, families, and employees. The advanced nursing practices were classified into 3 domains and 19 practices.

The management domain of advanced nursing practices was including four activities: “notification of an infectious disease designated by law”, “a follow-up management of employees exposed to infectious diseases”, “development of infection control guidelines” and “quarantine advisory for infected patients”.

The surveillance and epidemic investigation domain was including nine activities: “HAIs surveillance: planning”, “HAIs surveillance: data collection”, “HAIs surveillance: analysis and interpret”, “HAIs surveillance: dissemination”, “environmental surveillance for a contamination check”, “epidemic investigations ”, “surveillance of hand hygiene practices”, “surveillance of isolation practices”, and “surveillance of infections associated to invasive catheters or operations”,

The education and training domain was including six activities: “prevention education related to invasive catheters”, “training on personal protective equipment use”, “prevention education related to hospital infectious diseases”, “hand hygiene education”, “quarantine and reverse-quarantine education”, and “patient and family education about specific infectious diseases” (Table 1).

Table 1. Relative Value Scale Scores for Infection Control Nurse Practitioners

Advanced nursing practices		Relative Value Scale (RVS)			
Domain	Practices	Technical Skill	Mental effort	Stress	Mean
Management	Notification of an infectious disease designated by law	100.0	100.0	100.0	100.0
	A follow-up management of employees exposed to infectious diseases	208.3	275.3	247.5	243.7
	Development of infection control guidelines	154.3	491.7	508.3	384.8
	Quarantine advisory for infected patients	191.7	295.8	262.5	250.0
Surveillance & epidemic investigation	Healthcare-associated infection surveillance: planning	270.8	312.5	320.8	301.4
	Healthcare-associated infection surveillance: data collection	358.5	370.8	337.5	355.6
	Healthcare-associated infection surveillance: analysis and interpret	345.8	420.8	391.7	386.1
	Healthcare-associated infection surveillance: dissemination	344.2	380.8	394.2	373.1
	Environmental surveillance for a contamination check	170.8	166.7	152.8	163.9
	Epidemic investigation	343.1	374.1	387.9	368.4
	Surveillance of hand hygiene practice	370.8	276.7	258.3	301.9
	Surveillance of isolation practices	358.3	380.8	274.2	337.8
	Surveillance of infections associated to invasive catheters or operations	325.0	337.5	340.8	334.4
Education & Training	Prevention education related to invasive catheters	250.7	259.3	245.5	251.8
	Training on personal protective equipment use	190.3	203.1	182.8	192.1

Prevention education related to hospital infectious diseases	209.7	208.6	181.0	199.8
Hand hygiene education	217.2	214.5	196.6	209.4
Quarantine & reverse-quarantine education	215.5	215.5	198.3	209.8
Patient & family education about specific infectious diseases	203.1	211.7	194.8	203.2
Mean	254.1	289.3	267.1	266.7

3.2 Relative Value Scale (RVS) Scores of Advanced Nursing Practices by ICNPs

The calculated scores of the RVS for the 19 advanced nursing practices ranged from 100.0 to 386.1, with an average score of 266.7 points. The means for technical skill, mental effort, and stress were 254.1, 289.3, and 267.1. Respectively, the mean score for mental effort was the highest among the three domains. The RVS scores were highly distributed in the "surveillance and epidemic investigation" domain for technical skill, mental effort, and stress. The mean RVS score for "notification of an infectious disease designated by law" was the lowest, and "healthcare-associated infection surveillance: analysis and interpret" had the highest score (Table 1).

3.3. Frequency and Nursing Time of Advanced Nursing Practices by ICNPs

The relatively low frequency practices were "environmental surveillance for a contamination check" and "patient and family education about specific infectious diseases". The practices being performed most frequently were "HAI surveillance: data collection", "HAI surveillance: analysis and interpretation", "HAI surveillance: dissemination", "surveillance of hand hygiene practices", and "quarantine advisory for infected patients" (Table 2).

Regarding the preparation time for each practice, "surveillance of isolation practices" was the lowest at 3.14 minutes, and highest were "development of infection control guidelines" and "epidemic investigation." Regarding the practice time for each practice, the least amount of time was "environmental surveillance for a contamination check," and the most amount of time was "development of infection control guidelines." Regarding the retrospective time for each practice, it was the lowest for "notification of an infectious disease designated by law" and the highest for "HAI surveillance: data collection." The total nursing time for the most time-consuming practice was the "development of infection control guidelines" (Table 2).

Nine practices were completed within 60 minutes, while one practice took over 240 minutes. The other 9 practices took 61 to 240 minutes to complete.

Table 2. Frequency and Nursing Time of Advanced Nursing Practices of Infection Control Nurse Practitioners

Domain	Advanced nursing practices	Frequency mean(±SD)	Nursing time (minute)			
			Preparation time	Practice time	Retrospective time	Total
Management	Notification of an infectious disease designated by law	2.52(±1.20)	5.42	12.14	4.85	22.41
	A follow-up management of employees exposed to infectious diseases	2.59(±0.35)	10.14	20.85	16.12	47.11
	Development of infection control guidelines	2.14(±0.44)	25.15	245.71	10.21	281.07

	Quarantine advisory for infected patients	3.66(±1.14)	10.01	37.14	27.14	74.29
Surveillance & epidemic investigation	Healthcare-associated infection surveillance: planning	2.24(±0.77)	10.85	25.28	10.29	46.42
	Healthcare-associated infection surveillance: data collection	4.07(±0.96)	10.29	77.14	30.00	117.43
	Healthcare-associated infection surveillance: analysis and interpret	3.21(±0.94)	17.42	45.00	20.29	82.71
	Healthcare-associated infection surveillance: dissemination	3.07(±0.84)	15.57	142.85	22.43	180.85
	Environmental surveillance for a contamination check	1.55(±0.63)	7.71	10.14	5.42	23.27
	Epidemic investigation	2.24(±0.87)	25.14	59.01	26.42	110.57
	Surveillance of hand hygiene practice	3.42(±0.65)	15.14	51.42	24.28	90.84
	Surveillance of isolation practices	2.86(±0.95)	3.14	17.14	15.71	35.99
	Surveillance of infections associated to invasive catheters or operations	2.52(±0.87)	12.57	18.57	13.00	44.14
Education & training	Prevention education related to invasive catheters	2.45(±0.84)	15.42	42.55	16.51	74.48
	Training on personal protective equipment use	2.24(±0.57)	12.01	34.28	15.11	61.40
	Prevention education related to hospital infectious diseases	2.45(±0.91)	15.42	40.10	16.42	71.94
	Hand hygiene education	2.62(±0.72)	5.42	34.28	10.57	50.27
	Quarantine & reverse-quarantine education	2.59(±0.82)	15.00	24.28	8.71	47.99
	Patient & family education about specific infectious diseases	1.62(±0.82)	12.85	15.01	5.04	32.90
	Mean	2.63	12.87	50.15	15.71	78.74

3.4 Workload of Advanced Nursing Practices by ICNPs

Table 3 presents workload of the ICNPs. In the workload, “development of infection control guidelines” was the highest practice (108,155.71 point) and “notification of an infectious disease designated by law” was the lowest practice.

Table 3. Workload of Infection Control Nurse Practitioners

Domain	Advanced nursing practices	RVS	Nursing Time	Workload (RVS*Time)
Management	Notification of an infectious disease designated by law	100.0	22.41	2,241.00
	A follow-up management of employees exposed to infectious diseases	243.7	47.11	11,480.71

	Development of infection control guidelines	384.8	281.07	108,155.71
	Quarantine advisory for infected patients	250.0	74.29	18,572.52
Surveillance and epidemic investigation	Healthcare-associated infection surveillance: planning	301.4	46.42	13,990.99
	Healthcare-associated infection surveillance: data collection	355.6	117.43	41,758.11
	Healthcare-associated infection surveillance: analysis and interpret	386.1	82.71	31,934.33
	Healthcare-associated infection surveillance: dissemination	373.1	180.85	67,475.14
	Environmental surveillance for a contamination check	163.9	23.27	3,813.95
	Epidemic investigation	368.4	110.57	40,733.99
	Surveillance of hand hygiene practice	301.9	90.84	27,424.60
	Surveillance of isolation practices	337.8	35.99	12,157.42
	Surveillance of infections associated to invasive catheters or operations	334.4	44.14	14,760.42
Education & Training	Prevention education related to invasive catheters	251.8	74.48	18,574.06
	Training on personal protective equipment use	192.1	61.40	11,794.94
	Prevention education related to hospital infectious diseases	199.8	71.94	14,373.61
	Hand hygiene education	209.4	50.27	10,038.3
	Quarantine & reverse-quarantine education	209.8	47.99	6,685.28
	Patient & family education about specific infectious diseases	203.2	32.90	20,999.96
	Mean	266.7	78.74	

4. Discussion

HAIs have been one of the most concerning risks regarding patient safety and serious economic burdens on healthcare systems. In the United States, approximately 1 in 25 hospital patients have at least one HAI. In 2007, the overall annual direct medical costs of HAI for U.S. hospitals ranged from USD 35.7 billion to USD 45 billion [2]. In Korea, the extra costs related to postoperative surgical site infections were USD 1,868 [4], hospital stays were longer (0.6 to 20.4 days per case), and the extra costs was estimated as USD 629~1,960 per case [5].

In modern acute-care hospitals, immune-compromised, elderly patients requiring very complicated care are increasing, which is requiring highly skilled, invasive medical technology. Therefore, infection risks are increasing. In addition, there have been significant changes in infectious diseases, new infectious disease have emerged, and bioterrorism is a new threat to infection control activities. Therefore, the roles of ICNPs are changing and expanding to meet new requirements and challenges. Moreover, the importance of ICNP's activities is increasingly being recognized.

Therefore, many healthcare authorities have emphasized the prevention of HAIs. Effective infection control programs could reduce more than 30% of HAIs cost-effectively [6]. There are four essential factors of cost-effective infection control programs: ICNs, hospital epidemiologists, surveillance, and effective infection control

methods. In particular, ICNPs have been recognized as one of the most essential factors for HAI prevention [6]. Therefore, ICNP's effective activities are very important to decrease HAIs and to protect patients' safety, health care workers, and hospital environments.

In the United States, the recommended practices of ICNs are the identification of infectious disease processes, surveillance and epidemiologic investigation, preventing/controlling the transmission of infectious agents, employee/occupational health, management and communication (leadership), and education and research [12-13]. The percentages of time (mean) spent on each of these activities are 44.5% for collecting, analyzing, and interpreting data on the occurrence of infections; 15% for policy development and meetings; 12.9% for daily isolation issues, and 13% for teaching infection prevention and control policies and procedures [14]. In Korea and the United States, among all ICNP activities, surveillance has been reported as the most important and highest proportion of activities of ICNs [8, 10, 15-16]. However, we were unable to find any economic analyses of the practices of ICNs in the United States and Korea.

An advanced nurse practitioner system was introduced in Korea in 2003, and ICNPs were included in this. However, Korea's advanced nurse practitioner system has not seen much development, and few studies have been done on infection control programs and on the activities of ICNPs [7-9].

Therefore, in this study, we first performed basic survey on ICNP activities in Korea. The mean score of relative value scale was the highest in the domain of "surveillance and epidemic investigation." These findings show that surveillance and epidemic investigation is a unique, specified, and specialized activity of ICNPs, so these are the evidences of an advanced nursing practice of ICNP, and related to other studies results revealed that the major activities were surveillance [8, 10]. The highest RVS score for technical skills was for the practice of "surveillance and epidemic investigation"; it was particularly high for "surveillance in hand hygiene practices" (Table 1). In most clinical settings, patients care is done continuously, so when discerning hand hygiene practices for patient care as a spot practice, it was very difficult to determine whether it was done before or after patient contact. The RVS scores for mental efforts and stress were high for the practices of "HAI surveillance: analysis and interpretation" and "surveillance and epidemic investigation." There was also a high score for "development of infection control guidelines" in the "management" domain. These findings are related to the fact that the activities of data analysis and interpretation are required for statistical knowledge and that ICNPs are responsible for the development of infection control guidelines that meet accreditation standards. Moreover, these findings are related to the finding of other studies that surveillance and policy making are main activities of ICNPs [8, 10, 17]. The RVS score of the domain of "education and training" was mid-range, which means that these activities are relatively tolerable to ICNPs.

Regarding the frequency and time of ICNPs practices, the highest frequencies and the most consuming nursing times were highest in the domain of "surveillance and epidemic investigation." This finding showed that surveillance and epidemic investigation is a unique, specified, and specialized practice of ICNPs. This result was the evidence of an advanced nursing practice of ICNP, and is related to other studies' results that a major activity of ICNPs is surveillance [8, 10, 17]. The most frequent practice of ICNPs was found to be "HAI surveillance: data collection". Data collection for surveillance is time-consuming practice because ICNPs must carefully review medical records, interview the health care workers of their patients, and observe each patient's condition and the health care workers' patient care practices to gather information about each HAI case. This finding matched the results of another study that surveillance is the main activity of ICNPs [17].

ICNPs spend the most time in the "development of infection control guidelines" in "HAI surveillance: dissemination". To develop the infection control guidelines, ICNPs must systematically and literally review the evidence-based guidelines and the updated and revised hospital-based guidelines and then reviewed in the infection control committees. This process is time-consuming.

Moreover, the time spent for specific practices were measured first in this study. These findings are very significant for determining the cost of ICNPs practices and the cost-effectiveness of ICNPs practices. In Korea, to improve the current system, nurses must demonstrate the effectiveness of advanced nursing practices. In addition, ICNPs must be able to demonstrate that advanced nursing practice is beneficial to the public healthcare system.

Our research has classified 19 advanced ICNP practices and has showed what practices are performed the most often by conducting a survey on the nursing time and frequency of those practices. The practices of ICNPs are an important method to decrease healthcare-related infections and to improve the quality of service in hospitals. Therefore, the development of an advanced nurse practitioner system for infection control is necessary.

Acknowledgments

This study was supported by National Research Foundation of Korea (NRF) grant funded by the Korean government (NRF-2011-0024586).

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