

## RESEARCH ARTICLE

# Safety Management Status among Nurses Handling Anticancer Drugs: Nurse Awareness and Performance Following Safety Regulations

Kyeong Weon Jeong<sup>1</sup>, Bo-Young Lee<sup>2</sup>, Myung Soon Kwon<sup>3\*</sup>, Ji-Hye Jang<sup>4</sup>

## Abstract

This study identified the actual conditions for safe anticancer drug management among nurses and the relationship between level of awareness and performance of anticancer drug safety regulations in terms of preparation, administration, and disposal. The respondents were 236 nurses working with chemotherapy in wards and outpatient clinics in five hospitals in and near Seoul. Safety regulations provided for the anticancer drug the Occupational Safety Health Administration (OSHA, 1999), as modified for an earlier study, were used. The results showed that the level of awareness and performance on the anticancer drug safety regulations indicate their preparation ( $3.38 \pm 0.55$ ,  $2.38 \pm 0.98$ ), administration ( $3.52 \pm 0.46$ ,  $3.17 \pm 0.70$ ), general handling and disposal ( $3.33 \pm 0.54$ ,  $2.42 \pm 0.90$ ) on a scale 0 to 5. Also, there were significant differences in job positions, work experience, type of preparation, and continuing education and a positive relationship between the level of awareness and nursing performance. Thus, nurses should receive continuing education on the handling of anticancer drugs to improve the level of performance following safety regulations.

**Keywords:** Awareness - performance - anticancer drug - drug safety regulation

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## Introduction

Although the treatment of cancer has been continually developing, the number of patients with cancer has increased. In 2012, the number of people suffering from cancer was 224,177 (Jung et al., 2014; National Cancer Information Center, 2012). Increasing mortality from cancer accounts for 28.3% of total mortality over the past 10 years (Statistics Korea, 2013). There are various treatment available for cancer, but these are mainly surgery, chemotherapy, and radiotherapy. Surgery and radiotherapy are topical treatments for localized cancer without metastasis; the systemic treatment is chemotherapy for both early stage and end stage cancers (Kim, 1997). As the quality life for these patients has improved with the increase use of chemotherapy, the toxic effects of chemotherapy have garnered more attention by not only the patients, but also the medical people who use that treatment.

Anti-cancer drugs for chemotherapy works directly on the DNA in cancer cells and prevents the synthesis of the processor as well as any cell division. It produces a cytotoxic effect and 70% to 80 % of patients are administered the drugs more than once during their cancer treatment period. Although anti-cancer drugs have benefits for curing cancer, they do have side effects, such as hair loss, infertility, gastric ulcer, and bone marrow

suppression since the drugs work on even normal healthy cells that grow fast, such as bone marrow, epithelium, and embryonic tissue, rather than only working on the malignant cells (Belcher et al., 1997). Lungs, heart, genitourinary, and the kidneys can be deleteriously affected by anti-cancer drugs as well (Kim et al., 2004; Nixon and chulmeister, 2009). This toxicity of these anti-cancer drugs can damage patients getting chemotherapy, but also the nurses who are administering the drugs (Ladeira et al., 2014).

The Occupational Safety and Health Administration (OSHA) provides safety regulations for the preparation, administration, transportation for waste disposal, stage, education, and training (OSHA, 1999). OSHA suggests personal protectors, such as gowns, latex gloves, and masks. And a local ventilation system for these anti-cancer drugs as well as administering the anti-cancer medicines in ways that prevent any deleterious effects from the medicines. These procedures are emphasized by OSHA, and oncology nurses in the USA abide by the regulations (OSHA, 1999; Polovich et al., 2005). However, Shin and Lee (1996) states that 65.8% of respondents who are exposure to anticancer drugs say that there are no local ventilation systems for nurses who are handling anti-cancer drugs in South Korea. Indeed, 98.5% of these professional must dilute the anticancer drug without any local ventilation system. The research

<sup>1</sup>Department of Nursing, Kangdong Sacred Heart Hospital, <sup>2</sup>Department of Nursing, Hallym Polytechnic University, <sup>3</sup>Department of Nursing, Hallym University, <sup>4</sup>Department of Nursing, Hanyang University, Korea \*For correspondence: [kwon1314@hallym.ac.kr](mailto:kwon1314@hallym.ac.kr)

shows that nurses utilizing anticancer drugs have a higher possibility of mutation in their urine and a realization of urine abnormality than do nurses not dealing with anticancer drugs (Kim, 1995). Kim (1995) demonstrates that the increasing duration of dealing with anticancer drugs without gowns in nurses is commensurate with the growing sister chromatid exchanges. Also, certain alterations of health status in nurses' dealing with the anticancer drugs appeared and were reported as ten symptoms, including nausea, skin eruptions, chronic throat stimulation, pruritis, palpitation, hair loss, coloration, a reduced number of white blood cells and platelets, and decreased libido (Shin, 1996).

Given these studies, undue exposure to these anticancer drugs is plausible when nurses administer them (Rioufol et al., 2014). That exposure can cause such adverse effects as nausea, vomiting, allergy reactions, gastrointestinal symptoms, infections, and serious chromosomal aberrations, abortion, and fetal deformities.

Due to the increasing number of patients with cancer, there are many cases when of administering the anti cancer drug is performed in oncology units as well as in general internal medicine units. Yet, only oncology nurses are informed on the safety of anticancer drug through only one-time education. The safety regulations of anticancer drugs should be given to all nurses, not just oncology nurses. Thus, this study seeks to learn the actual conditions, awareness, and performance level of cancer drug safety management and prepare basic data to help legislate legislation for more safety for anticancer drugs. The purpose of this study is to identify the general management characteristics and the current anticancer drug management and analyze the relationship between such variables in terms of recognition and the performance level of the safety regulations for anticancer drugs.

## Materials and Methods

### *Subjects*

This study was conducted in five hospitals in and near Seoul. The subjects included 236 nurses working in hospital units and outpatient units designated for chemotherapy delivery. Permission of the Nursing Department of each hospital, was obtained after explaining the purpose and methods of the study, which was performed from September 6, 2010 to September 25, 2010, by collecting mailed modified questionnaires from enrolled nurses.

### *Research tools*

Initially, a pre-test was given to 15 nurses who handle anticancer drugs in a surgical unit to learn the level of safety rules awareness and their actual performance, using a modified questionnaire developed by Choi (2002) and used by Park (dissertation). Questions on general information and the actual handling state of anticancer drugs in the eventual modified questionnaire were corrected by referring to the results of this pre-test.

This research tool included 6 questions on general information and 7 questions on the actual state of anticancer drug safe management while handling. Duration, frequency, formation, and exposure or non-

exposure time to anticancer drugs was investigated. In actual states of safe management of anticancer drug, the use of personal protective equipments, kinds of masks, wearing of gloves, kinds of gloves, wearing of gowns, and goggles, and use of a spill kit were asked of the nurses. Also, 4 questions on education of safety, 16 questions on level of awareness and actual performance in anticancer drug preparation, 14 questions on anticancer drug administration, and 5 questions on general handling and disposal of drug were included as part of the research tool. The degree of awareness indicates the degree of knowledge of safety rules for anticancer drug handling. The answers to each question are applied to a 4-point likert scale with a meaning 'I do not know it at all'; 2 meaning 'I know it a little'; point 3 meaning 'I know it generally'; and point 4 meaning 'I know it well'. The level of performance extends to following the rules of anticancer drug safety rules. These answers were graded on a 4-point likert scale with point 1 meaning 'I never practice the safety rules'; point 2 meaning 'I do not generally practice the safety rules'; point 3 meaning 'I generally practice with the safety rules'; and point 4 point meaning 'I practice the safety rules well'.

After adding the scores, the total indicates the level of recognition and performance of the safety rules. Higher scores refer to a higher level of recognition and performance of the safety rules. The reliability of this study was tested with Cronbach's  $\alpha$ . anticancer drug preparation awareness and the level of performance were .92 and 0.97, respectively. Anticancer drug administration awareness and the level of performance were 0.88 and 0.94, respectively. General handling and drug disposal awareness and the level of performance were 0.69 and 0.83 respectively. Subjects on general characteristics and frequency were calculated as percentages. The level of awareness and performance of the anticancer drug safety rules by nurses using chemotherapy were analyzed with a t-test and One-way ANOVA. Post-tests were assessed with the Duncan test. Pearson correlation was used to identify the relationship between level of awareness and performance of safety rules.

## Results

### *General and anticancer drug handling characteristics*

Regarding the general characteristics, 47.5 % in working units account for most internal medicine units; 33.5% with less than 3 years of working experience are the highest; most types of duty account for 98.7% in shift work. In terms of anticancer drug handling characteristics, less than 1 year to 5 years of handling anticancer drug by nurses accounted for 50%, the highest. One to two assigned patients with chemotherapy for nurses account for 78%. Three to four assigned patients to nurses were 16.5% and 5.5% accounted for more than five patients' assigned to nurses. Preparation of anticancer drugs was held in pharmacy, units, and both were 21.2%, 3.0% and 75.8%, respectively. Subjects with exposure experience accounted for 61.0%. Preparing anticancer drug and eating food in the same place totaled 8.9%. In terms of safe management education, 61 % of respondents were

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receiving the education during nursing school and 69.9% while working in the hospital. Further 70.8 % of nurses want more practical education on the safe management of anticancer drugs (see Table 1).

*The level of awareness and performance related to safety rules for anticancer drug preparation*

i) The level of awareness and performance for safe

management when preparing anticancer drugs. The total average for level of awareness and performing safe management was 3.38 ( $\pm 0.55$ ) and 2.38( $\pm 0.98$ ). There were significant differences in marital status, position, and work experience for degree of awareness of preparation of anticancer medicine in the subjects' general characteristics. Unwed nurses were more like to know the safety rule than married nurses ( $t=-2.51, p<0.05$ ).

**Table 1. General Characteristics and Characteristics Related to Anticancer Drug Handling**

Characteristics	Classification	Nurses (%)
Place of work	Inpatient	
	internal medicine	112(47.5)
	hematology and oncology	17 (7.2)
	bone marrow transplantation	1 (0.4)
	surgical unit	76 (32.2)
	other	28 (11.9)
	outpatient	
Academic background	surgical outpatient clinic	2 (0.8)
	diploma degree	149 (63.1)
Marital status	bachelor's degree	87 (36.9)
	unwed	174 (73.7)
Position	married	62 (26.3)
	general nurse	217 (91.9)
Work experience	charge nurse	17 (7.2)
	other	2 (0.8)
	less than 3 years	79 (33.5)
	3 to 5 years	59 (25.0)
Type of work	5 to 10 years	47 (19.9)
	more than 10 years	51 (21.6)
	shift work	233 (98.7)
Total time handling t anticancer drugs	fixed work	3 (1.3)
	less than a year	56 (23.7)
	1 to 5 years	118 (50.0)
Frequency of handling a anticancer drug	5 to 10 years	62 (26.3)
	less than one day per week	111 (47.0)
	2- to 3 days per week	91 (38.6)
The number of patients getting an anticancer drug	more than 4 days per week	34 (14.4)
	1 to 2 patients per day	184 (78.0)
	3 to 4 patients per day	39 (16.5)
Type of preparation	more than 5 patients per day	13 (5.5)
	one type	57 (24.2)
	two types	179 (75.8)
Anticancer drug exposure experience	yes	144 (61.0)
	no	92 (39.0)
The route of anticancer drug exposure (multiple answers)	when IV line is changed	92 (21.6)
	when the anticancer drug is removed	88 (20.7)
	when the anticancer drug is connected and administered with a needle	76 (17.8)
	when the IV set is connected to the bottle of the anticancer drug	73 (17.1)
	when the anticancer drug is spilled and cleaned up	39 (9.2)
	when the anticancer drug is mixed	31 (7.3)
	inhalation	15 (3.5)
	when dealing with waste products	12 (2.8)
	when dealing with waste products	12 (2.8)
Eating food in the preparing place	yes	21 (8.9)
	no	215 (91.1)
Safety education in school	yes	144 (61.0)
	no	92 (39.0)
Safety education at work	yes	165 (69.9)
	no	71 (30.1)
Desire for safety education for practical work	yes	167 (70.8)
	no	69 (29.2)
Total		236 (100)

The level of awareness in charge nurses was higher than for general nurses ( $t=-4.23$ ,  $p<0.001$ ). Nurses with less than three years' work experience were less likely to be aware of the safety rules than nurses with more than 3 years' working experience ( $F=7.69$ ,  $p<0.001$ ). For actual handling condition and education on preparing anticancer drugs, nurses who were educated on the anticancer drug safety rules at work were more likely to be cognizant than nurses who did not learning anticancer medicine safety rules at work ( $t=3.82$ ,  $p<0.001$ ). The level for performing

these safety rules was less on average than the degree of awareness at  $2.38(\pm 0.98)$ . There are significant differences in academic background and safety rules education in terms of actual performing the safety rules. In terms of academic background, nurses with a Diploma degree were more likely to abide by the safety rules than are nurses with a Bachelor's degree ( $t=2.01$ ,  $p<0.05$ ). Nurses with continuing education in anticancer drug safety rules were more prepared for using anticancer drugs according to the safety rules than were nurses without that education

**Table 2. General Characteristics and Awareness and Performance of Safety Rules for Anticancer Drug Preparation (n=236)**

Classification	Awareness			Performance		
	Mean±SD	t/F	p-value	Mean±SD	t/F	p-value
Workplaces						
hemato oncology/ internal medicine ward	3.40±0.51	0.38	0.683	2.32±1.01	2.42	0.091
surgery ward	3.33±0.63			2.34±0.96		
others	3.40±0.47			2.73±0.85		
Academic background						
diploma degree	3.38±0.51	0.30	0.767	2.47±0.98	2.01	0.046
bachelor's degree	3.36±0.60			2.21±0.96		
Married or not						
not married	3.32±0.55	-2.51	0.013	2.37±0.98	-0.17	0.866
married	3.52±0.50			2.40±0.98		
Positions						
ordinary nurse	3.35±0.55	-4.23	<0.001	2.37±0.97	-0.37	0.710
charge nurse	3.70±0.33			2.46±1.05		
Work experience						
less than 3 years	3.17±0.56a	7.69	<0.001	2.37±0.97	0.04	0.991
less than 3-5 years	3.41±0.54b	(a<b)		2.38±0.95		
less than 5-10 years	3.44±0.55b			2.35±1.02		
more than 10 years	3.61±0.41b			2.41±1.01		
Total period handling anticancer drugs						
less than 1 year	3.29±0.53	1.82	0.165	2.34±0.97	0.35	0.705
less than 1-5 years	3.36±0.56			2.43±0.98		
less than 5-10 years	3.48±0.52			2.31±0.99		
Frequency of handling anticancer drugs						
less than 1 day per week	3.32±0.56	2.90	0.057	2.37±1.01	0.10	0.906
2-3 days per week	3.48±0.46			2.40±0.97		
more than 4 days per week	3.28±0.67			2.32±0.92		
Numbers of anticancer patients on duty						
1-2 persons per day	3.34±0.55	2.07	0.128	2.38±1.00	0.31	0.737
3-4 persons per day	3.53±0.51			2.43±0.89		
more than 5 persons per day	3.45±0.47			2.18±0.88		
Types of preparation of anticancer drug						
1 type	3.50±0.49	1.95	0.052	2.52±1.05	1.31	0.193
2 types	3.34±0.56			2.33±0.95		
Experiences of exposure to anticancer drugs						
yes	3.33±0.56	-1.82	0.070	2.38±0.90	0.03	0.973
no	3.46±0.52			2.37±1.09		
Preparation place for eating foods						
yes	3.30±0.73	-0.49	0.630	2.29±1.01	-0.43	0.665
no	3.38±0.53			2.39±0.98		
Safety education in school						
yes	3.37±0.57	-0.21	0.835	2.35±1.01	-0.49	0.628
no	3.39±0.51			2.42±0.93		
Safety education at work						
yes	3.46±0.52	3.82	<0.001	2.48±0.99	2.55	0.011
no	3.18±0.55			2.13±0.91		
Desire for practical education on safety						
yes	3.37±0.55	-0.22	0.829	2.44±0.96	1.53	0.128
no	3.39±0.55			2.23±1.00		
Total	3.38±0.55			2.38±0.98		

**Table 3. General Characteristics and Awareness and Performance of Safety Rules for Anticancer Drug Administration (n=236)**

Classification	Awareness			Performance		
	Mean±SD	t/F	p-value	Mean±SD	t/F	p-value
Workplaces						
hemato oncology/ internal medicine ward	3.52±0.46	1.26	0.287	3.24±0.60ab	3.69	0.026
surgery ward	3.49±0.50			3.00±0.82a	(a<ab<b)	
others	3.64±0.36			3.30±0.71b		
Academic background						
diploma degree	3.53±0.46	0.12	0.907	3.25±0.63	2.21	0.028
bachelor's degree	3.52±0.47			3.04±0.79		
Married or not						
not married	3.49±0.47	-1.82	0.071	3.16±0.68	-0.59	0.554
married	3.52±0.50			2.40±0.98		
Positions						
ordinary nurse	3.49±0.47	-5.17	<0.001	3.17±0.66	0.01	0.993
charge nurse	3.85±0.26			3.17±1.06		
Work experience						
less than 3 years	3.36±0.48a	5.87	0.001	3.07±0.66	0.84	0.473
less than 3-5 years	3.58±0.43b	(a<b)		3.24±0.65		
less than 5-10 years	3.54±0.48b			3.23±0.63		
more than 10 years	3.68±0.38b			3.19±0.86		
Total period handling anticancer drugs						
less than 1 year	3.36±0.47a	4.39	0.014	3.04±0.74	1.22	0.299
less than 1-5 years	3.57±0.46b	(a<b)		3.21±0.69		
less than 5-10 years	3.57±0.45b			3.22±0.68		
Frequency of handling anticancer drugs						
less than 1 day per week	3.49±0.47b	3.15	0.044	3.15±0.75	1.43	0.242
2-3 days per week	3.61±0.40b	(a<b)		3.25±0.65		
more than 4 days per week	3.34±0.55a			3.02±0.65		
Numbers of anticancer patients on duty						
1-2 persons per day	3.49±0.47	1.62	0.200	3.19±0.70	1.63	0.199
3-4 persons per day	3.61±0.46			3.21±0.63		
more than 5 persons per day	3.66±0.39			2.84±0.88		
Types of preparation of anticancer drug						
1 type	3.69±0.36	3.75	<0.001	3.41±0.71	2.98	0.003
2 types	3.47±0.48			3.10±0.68		
Experiences of exposure to anticancer drugs						
yes	3.47±0.48	-2.44	0.016	3.09±0.69	-2.37	0.018
no	3.61±0.43			3.31±0.70		
Preparation place for eating foods						
yes	3.50±0.59	-0.19	0.852	3.11±0.77	-0.45	0.652
no	3.52±0.45			3.18±0.69		
Safety education in school						
yes	3.53±0.48	0.21	0.834	3.20±0.67	0.87	0.386
no	3.51±0.44			3.12±0.74		
Safety education at work						
yes	3.61±0.43	4.47	<0.001	3.30±0.63	4.65	<0.001
no	3.32±0.49			2.86±0.75		
Desire for practical education on safety						
yes	3.52±0.47	-0.24	0.808	3.20±0.64	0.91	0.362
no	3.53±0.45			3.11±0.82		
Total	3.52±0.46			3.17±0.70		

( $t=2.55$ ,  $p<0.05$ ) (Tables 2).

ii) The level of awareness and performance related to safety rules for proper anticancer drug administration. The full averages of the level of awareness and performing safety rules when nurses administrate anticancer medicine were 3.52 ( $\pm 0.46$ ) and 3.17 ( $\pm 0.70$ ) respectively (Table 3). There are significant differences in terms of the position at work, the handling duration of an anticancer drug, handling frequency of an anticancer drug, type of

preparation for an anticancer drug, exposing experience for the anticancer drug, education at work on level of awareness of anticancer drug. Per the position level at work, charge nurses administering the anticancer drug were more likely to recognize the safety rules than were general nurses ( $t=-5.17$ ,  $p<0.001$ ). Nurses with more than 3 years of work experiences had higher awareness of the safety rules than nurses with less than 3 years work experience ( $F=5.87$ ,  $p<0.01$ ). Nurses' handling an

**Table 4. General Characteristics and Awareness and Performance of Safety Rules for Anticancer Drug General Handling and Disposal (n=236)**

Classification	Awareness			Performance		
	Mean±SD	t/F	p-value	Mean±SD	t/F	p-value
Workplaces						
hemato oncology/ internal medicine ward	3.33±0.56	0.47	0.624	2.53±0.90	2.37	0.095
surgery ward	3.29±0.52			2.35±0.89		
others	3.40±0.46			2.17±0.90		
Academic background						
diploma degree	3.32±0.53	-0.41	0.686	2.48±0.90	1.21	0.227
bachelor's degree	3.34±0.55			2.33±0.90		
Married or not						
not married	3.29±0.54	-1.82	0.070	2.47±0.91	1.43	0.154
married	3.43±0.51			2.28±0.87		
Positions						
ordinary nurse	3.29±0.53	-3.08	0.002	2.43±0.88	0.55	0.586
charge nurse	3.68±0.49			2.32±1.07		
Work experience						
less than 3 years	3.16±0.52a	5.31	0.001	2.34±0.96	0.58	0.627
less than 3-5 years	3.31±0.48ab(a<ab<bc<b)			2.54±0.77		
less than 5-10 years	3.41±0.60bc			2.45±0.89		
more than 10 years	3.52±0.49c			2.40±0.96		
Total period handling anticancer drugs						
less than 1 year	3.21±0.56	2.71	0.069	2.18±0.95	2.69	0.07
less than 1-5 years	3.32±0.54			2.50±0.89		
less than 5-10 years	3.44±0.50			2.49±0.83		
Frequency of handling anticancer drugs						
less than 1 day per week	3.27±0.60	1.96	0.144	2.35±0.95	2.50	0.084
2-3 days per week	3.41±0.44			2.58±0.86		
more than 4 days per week	3.27±0.54			2.24±0.77		
Numbers of anticancer patients on duty						
1-2 persons per day	3.29±0.56	2.00	0.137	2.48±0.91	1.84	0.161
3-4 persons per day	3.48±0.39			2.24±0.80		
more than 5 persons per day	3.32±0.57			2.15±1.03		
Types of preparation of anticancer drug						
1 type	3.45±0.60	2.00	0.047	2.67±1.02	2.44	0.016
2 types	3.29±0.51			2.34±0.84		
Experiences of exposure to anticancer drugs						
yes	3.29±0.51	-1.44	0.151	2.44±0.81	0.39	0.696
no	3.39±0.58			2.39±1.03		
Preparation place for eating foods						
yes	3.30±0.55	-0.19	0.848	2.54±0.84	0.64	0.526
no	3.33±0.54			2.41±0.91		
Safety education in school						
yes	3.33±0.53	0.15	0.878	2.42±0.93	-0.09	0.927
no	3.32±0.56			2.43±0.86		
Safety education at work						
yes	3.42±0.50	4.20	<0.001	2.50±0.91	2.08	0.039
no	3.11±0.57			2.24±0.86		
Desire for practical education on safety						
yes	3.32±0.54	-0.45	0.654	2.46±0.92	0.99	0.322
no	3.35±0.54			2.33±0.85		
Total	3.33±0.54			2.42±0.90		

anticancer drug less than 1 year were less likely to know the antidrug safety rules than were nurses dealing with the drugs more than 1 year ( $F=4.39$ ,  $p<0.05$ ). Nurses handling an anticancer drug less than once a week or 2 to 3 days per week were more likely to be aware of the safety rules than were nurses handling an anticancer drug more than 4 days per week ( $F=3.15$ ,  $p<0.05$ ). Nurses' preparing an anticancer drug ( $t=3.75$ ,  $p<0.001$ ), nurses now exposed to an anticancer drug ( $t=-2.44$ ,  $p<0.05$ ), and nurses with

safety education given at work ( $t=4.47$ ,  $p<0.001$ ) had more awareness of the anticancer drug safety rules than did the other nurses.

In terms of level of performing safety rules for anticancer drug administration, there were significant differences based on the kind of unit, academic background, type of preparation for the anticancer drug anticancer drug exposure experiences, and safety education at work. Units doing anything else unit had

**Table 5. Correlation between Awareness and Performance of Safety Rules when Handling Anticancer Drug**

Classification	Performance on safety rules (p-value)
Awareness related to safety rules for anticancer drug preparation	0.236(<0.001)
Awareness related to safety rules for anticancer drug administration	0.558(<0.001)
Awareness related to safety rules for general handling and disposal	0.346 (<0.001)

the highest level of recognition for safety recognition, followed by the internal medicine unit. The surgical unit had the lowest level of recognition regarding safety recognition ( $F=3.69$ ,  $p<0.05$ ). Nurses with a diploma were more likely to follow the safety rules than nurses with a Bachelor's degree when administering an anticancer drug ( $t=2.21$ ,  $p<0.05$ ). In terms of preparing an anticancer drug, nurses with preparing a type of anticancer drug were more likely to perform according to the anticancer drug safety rules ( $t=2.98$ ,  $p<0.01$ ). Nurses with exposure to an anticancer drug were less likely to perform using the safety rules than were nurses without any exposure to an anticancer drug ( $t=-2.37$ ,  $p<0.05$ ). Nurses with education on the safety rules given at work had a higher level of performing according to the rules than did nurses without that education ( $t=4.65$ ,  $p<0.001$ ) (see Tables 3).

*iii) The level of awareness and performance regarding safety rules for general handling and disposal.* With regard to the subjects' general handling and disposal, the average level of awareness and performance were  $3.33(\pm 0.54)$  and  $2.42(\pm 0.90)$  (Table 4). There were significant differences in terms of the position at work, duration of work experience, type of preparation, and education on safety rules related to general characteristics and safety regulations. Per the level of position, charge nurses were more likely to be aware of general management and waste discard regulations than were general nurses ( $t=-3.08$ ,  $p<0.01$ ).

More experienced nurses had a higher level of awareness in terms of general handling and waste management ( $F=5.31$ ,  $p<0.001$ ). Nurses with safety education were more likely to have an awareness of anticancer drug handling and waste discard management ( $t=4.20$ ,  $p<0.001$ ). Regarding the level of performance according to safety regulations and general characteristics, there were significant differences in type of preparation and safety education at work. Nurses with one type of preparation for an anticancer drug had a higher level of performance than nurses with two types of preparation for an anticancer drug ( $t=2.44$ ,  $p<0.05$ ). Nurses receiving safety education at work were more likely to abide by safety regulations for general handling of an anticancer drug and its waste management ( $t=2.08$ ,  $p<0.05$ ) (see Tables 4).

#### *Relationship between level of awareness and performance of anticancer drug safety regulations*

There was a statistically significant positive relationship between the level of awareness and performing anticancer drug safety regulations when nurses were preparing an anticancer drug ( $r=0.236$ ,  $p<0.001$ ), when they were administering an anticancer drug ( $r=0.558$ ,  $p<0.001$ ), and when they were generally handling and anticancer drug and the waste from that drug ( $r=0.346$ ,  $p<0.001$ ) (Table 5).

## Discussion

Actual condition of safety management for nurses delivering an anticancer drug: A total of 236 nurses were included in this study. Internal medicine unit for the working unit was the highest at 47.6 %, less than three years of work experience for nurses accounted for 33.5 %, and 98.7% of the nurses worked shift duty as inclusive participants. Regarding the duration of handling an anticancer drug, 50 % of these nurses were handling the drug within 1 year to 5 years. Over the last three months, the frequency of nurses who were handling an anticancer drug less than one day per week was 47.0% and the most. Nurses exposed to an anticancer drug were 61.1% and higher than nurses with no exposure to the drug. General nurses accounted for 91.9%. Nurses with less than three years were 33.5 %. This study shows that nurses with exposure to an anticancer drug totaled 61%. Although this statistic demonstrates that there was less frequency of exposure to an anticancer drug than in the past when comparing Doo (dissertation), Park (dissertation), Kim et al. (2004), and Choi's (2002) exposure results of 75.2%, 87.2%, 82.4%, and 83.3% respectively, over 50% of exposure experiences still indicated a high exposure level to anticancer drugs. Of the selected group, 144 of respondents who said they have exposure to an anticancer drug were mostly exposed when they change intravenous lines and remove an anticancer drug. Doo's (dissertation) study also shows that 83.7% of nurses are exposed to an anticancer drug when they remove the drug. Kim et al. (2004) identified 62.3% of nurses who were exposed to an anticancer drug when the anticancer drug was removed. When they removed the anticancer drug, 60% of nurses in Seoul and 62.3% in D city were exposed to the anticancer drug. Thus, nurses should be careful when handling the anticancer drug as they remove the drug (Polovich et al., 2005; Rioufol et al., 2014).

Type of preparation for anticancer drugs both in pharmacy and in the units accounted for the most exposure. Preparation in the pharmacy alone was more and preparation at the units alone was the least. Although the five hospitals that participated in this study have installed a BSC (Biological Safety Cabinet) local ventilator in their pharmacies to prepare the anticancer drug, there are no BSC and protective gears in the actual units for these drugs. Time of preparation for the anticancer drug at pharmacy has increased. However, preparation in the units without protective facilities and equipment should not be done. Wearing protection is encouraged since wearing protective gown, gloves, and masks are included for safety of people preparing the anticancer drug when a medical institution is conducting an evaluation. Yet more specific instruction should be developed and added onto the evaluation list, such as a safe process for preparation,

administering the anticancer drug, and especially for proper waste management.

For the level of recognition of safety regulations when preparing, in this study, the total average was 3.38 ( $\pm 0.55$ ). This average was higher than other studies; Seo (2010) was 3.17 ( $\pm 0.49$ ); Doo (dissertation) showed 3.11 ( $\pm 0.57$ ); and Park (2003) indicated 3.08 ( $\pm 0.46$ ). Generally, enrolled nurses were aware of the safety regulations in this study. For the level of performing the safety regulations, the total average was 2.38 ( $\pm 0.98$ ). This score was lower than the 3.27 ( $\pm 0.33$ ) in Seo's study (2010), the 2.64 ( $\pm 0.54$ ) in Doo's study (2005) and the 2.04 ( $\pm 0.63$ ) in Park's study (2003), which were a relatively similar level as the average score here. This average indicates a low level of performing safety anticancer drug regulations. In Seo's study (2010), the subjects were enrolled in tertiary hospitals and an oncology hospital in Seoul and near Seoul. This location could influence the level of performing anticancer drug safety regulations. It is likely that the level of performing these regulations would be higher since these hospitals specialize in oncology. However, any hospitals' handling anticancer drugs should provide an education program on the anticancer drug safety regulations regardless of its size and characteristics.

The average for the level of awareness of safety regulations when administering an anticancer drug was 0.52 ( $\pm 0.46$ ) compared with 3.18 in Doo's study (2005) and 3.60 in Choi's study (2004). The level of awareness for these regulations was good when administering the anticancer drug. The average level for performing the safety regulations was 3.17 ( $\pm 0.70$ ) and similar to the results of Doo (2005) and Choi (2004) at 3.00 and 3.19, respectively.

Regarding the level of awareness for safety regulations, the average was 3.33 ( $\pm 0.54$ ). Enrolled nurses generally were aware of the safety regulations for anticancer drugs. The degree of practice was 2.42 which was lower than the level of awareness for general handling and disposal. The level of performing safety regulations by nurses with safety regulation education and type of preparation for anticancer drug was higher than for other nurses.

The relationship between the level of awareness and performing anticancer drug safety regulations showed a statistically positive relationship ( $r=0.236$ ,  $p<0.001$ ). This result shows that a higher level of awareness leads to higher level of performing those safety regulations. Also, there was a statistically significant positive relationship between the level of awareness and performing anticancer drug safety regulations ( $r=0.558$ ,  $p<0.001$ ). This result demonstrates that a higher level of awareness leads to a higher level of performing the safety regulations. There was a statistically significant positive relationship between the level of awareness and performing the safety rules for general and waste management ( $r=0.346$ ,  $p<0.001$ ). This result confirms that a higher level of awareness leads to a higher level of performing the actual safety regulations.

Hong (2006) demonstrated that there is a positive relationship between before education ( $r=0.070$ ,  $p<0.001$ ) and after education ( $r=0.570$ ,  $p<0.001$ ) for the relationship of awareness and practice regarding anticancer drug safety regulations. Also a study by Keat et al (2013) and

Kyprianou et al (2010) showed a positive relationship between safety-related knowledge and the practices for handling cytotoxic anticancer drugs. These results are congruent with the results of this study in which a higher level of awareness led to a higher level of performing the safety regulations. This result indicates that safety education is crucial to increasing the actual practice at work. Also, as a side effect from exposure to the anticancer drug, cautions that with such anticancer drug management, the proper method for administering the drug should be included in the education content. There should be periodical education to refresh the knowledge rather than just one-time learning.

Given these results, I would suggest the following proposals. First, regular monitoring of hospitals giving harmful medicine such as anticancer drugs and as well as monitoring the health status of patients and medical people are needed. Secondly, each hospital should provide all goods and equipment regarding anticancer drug handling. Third, periodical safety education for new nurses and nurses who are handling any anticancer drug is necessary with oncology nurses as the educators. Fourth, for nurses and pregnant nurses who have exposure to anticancer drugs for a long time, rotation duty should be considered. Lastly, the preparation of the anticancer drug should be done in the pharmacy in each hospital. In any case where the anticancer drug must be prepared in the units, BSC should be installed and shared among all the units.

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