Patient Safety & Quality Improvement Journal
http://psj.mums.ac.ir
PSQI

Differences in Near Miss Incident Reports Across Clinical Experience Levels in Nurses: Using National Wide Data Base from the Japan Council for Quality Healthcare

Naomi Akiyama (PhD)[1*], Tomoya Akiyama (MS)[2], Kenshi Hayashida (PhD)[3], Junko Igawa (Associated degree)[4], Tomomi Matsuno (Associated degree)[4], Riju Kono (MS)[4], Takeru Shiroiwa (PhD)[5], Keisuke Koeda (MD)[1], Katsuya Kanda (PhD)[6]

[1] *School of Medical, Iwate Medical University, Morioka, Iwate, Japan*
[2] *School of Nursing, Iwate Medical University, Moriola, Iwate, Japan*
[3] *Department of Medical Informatics and Management, Hospital of the University of Occupational and Environmental Health, Kitakyushu, Fukuoka, Japan*
[4] *Department of Nursing, Kyoto University Hospital, Kyoto, Kyoto, Japan*
[5] *Center for Outcomes Research and Economic Evaluation for Health, National Institute of Public Health, Wako, Saitama, Japan*
[6] *Aino University, Ibaraki, Osaka, Japan*

ARTICLEINFO

Article type:
Original article

Article History:
Received: 01-Jan-2019
Accepted: 10-Feb-2019

Key words:
Clinical experience level
Medical error
Nurse

ABSTRACT

Introduction: Medical incidents occur frequently, necessitating a more effective prevention policy. Nurses have the highest employment rates in the healthcare occupations; therefore, they are a key to improving patient safety. Most reports of errors have focused on medicine errors by nurses or patient falls; however, the effects of different types of error and nurses' experience have not been examined. The present study aimed to elucidate the factors that influence differences in reported near-miss incidents across clinical experience levels and department assignments.

Materials and Methods: A quantitative study was conducted using published data from the Japan Council for Quality Health Care. We analysed clinical experience level by near miss types.

Results: A total of 17,105 cases were analysed (14,896 drug near misses, 1,857 medical device near misses, and 162 nursing near misses). Participants had a mean of 7.4 years of experience and a mean of 2.3 years within the department. Statistically significant differences between clinical experience level, events, drug administration, and medical devices used were observed. However, no differences were found in terms of nursing care near misses. Length of department assignment was related to the "human factors" in participants at Novice/Advanced beginner levels, as well as "environment/facilities and devices" in those at Competent and Proficient/Expert levels. The percentage of "environment/facilities and devices" that caused near misses with drugs and medical devices increased as clinical experience increased.

Conclusion: The present study described the characteristics of clinical experience levels, providing meaningful information useful for developing new educational paradigms for effective training.

►*Please cite this paper as:*
Akiyama N, Akiyama T, Hayashida K, Igawa J, Matsuno T, Kono R, Shiroiwa T, Koeda K, Kanda K. Differences in Near Miss Incident Reports Across Clinical Experience Levels in Nurses: Using National Wide Data Base from the Japan Council for Quality Healthcare. Journal of Patient Safety and Quality Improvement. 2019; 7(2): 56-63. Doi: 10.22038/psj.2019.37331.1204

* *Corresponding Author:* Naomi Akiyama, School of Medical, Iwate Medical University, Morioka, Iwate, Japan. Tel: +810196515111; Email: nakiyama@iwate-med.ac.jp

Introduction

Medical errors often occur, thus warranting more effective prevention policies. Prevention and reduction of serious medical incidents are considered common issues worldwide (1). Medical errors affect a patient's quality of life, which can increase the economic burden in society (2). Twenty-three per cent of European Union citizens claim to have been directly affected by medical errors, and 50–70% of such adverse events can be prevented through comprehensive systematic approaches to patient safety (3). Given that nurses comprise the largest segment of healthcare professions, they are critical to improving patient safety.

The most common incident reports from nurses comprise errors involving medication, nursing care (including patient falls), and medical devices. Medication errors are associated with nursing competence, prescription and patient-related factors, organised medication work, nursing processes, and safety culture (4). Another study indicated that both individual and organisational factors are major determinants of medication errors (5). In terms of nurse-related factors, years of clinical experience and department assignment may be key variables. Regarding medical devices errors, the Chief Medical Officer's report suggests that 400 people will die or become seriously injured during adverse events involving medical devices (6). Few studies have examined medical device errors. Errors resulting from medical devices are also related to a lack of user competency and problems with the storage environment (6). Finally, regarding nursing care errors, patient falls are a frequently reported incident. Various errors have been reported by nurses that are related to several nursing practices, such as burns during footbaths or showers (7), blood transfusion to the wrong patient (8), and failure to check oxygen levels (9). However, a few reports have examined nursing care errors, excluding patient falls. In Japan, serious accidents, such as patient misidentification in the operating room (reported in 1999) and erroneous medication administration during ventilation (reported in 2000) have occurred. Since 2004, the Department of Adverse Event Prevention has been implementing the Project to Collect Medical Near Miss/Adverse Event Information from hospitals nationwide. The aim of this project was to prevent problematic events and promote medical care safety (10,11). The Japan Council for Quality Healthcare (JCQHC) reports are generated from obliged and voluntarily participating medical institutions. The aim of the present study was to assess factors that may cause differences in reported near miss incidents as a function of incident type, considering clinical experience level and time spent in a particular department, using published data from the JCQHC.

Methods

Data sources

The JCQHC website includes published data on medical near miss events. Specifically, we used 'case information' data. Data were collected from relevant medical institutions. The following parameters were used for cases: a) if the action in question had been completed, the patient would have died or had a serious adverse reaction; b) related to medication names and shapes; c) derived from medications; d) derived from medical equipment; and e) corresponding to the theme specified from each collection period. All cases reported after January 1, 2010, were eligible for analysis.

Sample data

Data from April 2014 to March 2017 were collected from the JCQHC. Eight event types were assessed: medication, blood transfusion, treatment/procedure, medical device, drainage or other tube, examination, nursing care, and others (10). We downloaded data from three near miss types in March 2018: medication, medical device, and nursing care. These were chosen given the high occurrence rates observed in the JCQHC annual reports (10). Data included the type of near miss, information about the person involved (i.e., job, years of clinical experience, and years with the particular department), and factors that caused the incident.

The SHELL model of human factors developed and advocated principally in the aviation literature by Hawkins and Orlady (12), clarifies the scope of human factors and helps understand the relationships between system resources/ environment and the human component. Hence, this model is useful for explaining the background factors underlying each incident. Thus, we used a concept derived from the SHELL model in order to obtain background factors. The name SHELL is derived from the four domains in the model: software (procedure, protocol, and training), hardware (machines and medical instruments), environment (operating theatre, wards, and consultation room), and liveware (human factors: doctors, nurses, and other health care professionals, or patients). For this study, environment and hardware were combined into a single category, while liveware was divided into two categories (condition of the person involved; action of the person involved), for a total of four categories. Each of the four categories was

assessed using multiple-choice items: software (4 items), environment/hardware (7 items), liveware: condition of the person involved (6 items), and liveware: action of the person involved (7 items). If any item within a category was labelled as 'yes', the category counted as applying to that item. When multiple medical staff members were involved in the incident, we focused on the first person involved.

Analytical approach

Considering differences due to the length of experience as a nurse, we categorized nurses by three levels: Novice/Advanced beginner level, Competent level, and Proficient/Expert level. Additionally, considering the department assignment years, clinical experience was categorized into seven levels based on years and department assignment. These levels were defined with reference to Benner's 'From novice to expert' theory, which indicates that nurses acquire and develop skills by passing through five levels of proficiency (13). The starting level, 'Novice', is defined as a nurse with one year of experience. 'Advanced beginner A and B' are the second and third levels, respectively, where experience ranges from one to three years. Here, nurses were categorized depending on whether the department assignment period was less than or more than one year. The advanced beginner A group had the same experience as the advanced beginner B group, but the assignment period of group A was shorter than group B, and advanced beginner A had moved to new wards within one year. 'Competent A and B' are the fourth and fifth levels, respectively, with clinical experience ranging from three to five years and categorized depending on whether years in the department assignment were less than or more than one year. 'Proficient/Expert A and B' are the sixth and seventh levels, respectively, that include nurses with more than five years of experience, categorized depending on whether the department assignment period was less than or more than one year. The Competent A and Competent B groups had the same clinical experience range, but the length of department assignment for Competent A nurses was shorter than among Competent B nurses. The same rule applied to Proficient/Expert A and Proficient/ Expert B. We analysed clinical experience level by near miss types.

The present study data differed widely in terms of the number of reported cases based on near miss type. We calculated differences as percentages of total near misses based on the type and clinical experience using a Fisher's exact test or χ^2 test. All statistical analyses were performed using JMP Statistical software version 12.0. A p-value < .05 was considered statistically significant.

Results

Sample characteristics

There were 15,069 near miss medication cases, 1,873 near miss medical device cases, and 163 near miss nursing care cases. A total of 190 cases were excluded from the analysis because the department assignment years were longer than the clinical experience years. Thus, a total of 17,105 cases were analysed (14,896 medication near misses, 1,857 medical device near misses, and 162 nursing care near misses). The mean years of experience was 7.4 years, and the mean years within the department was 2.3 years.

Comparing four domains of the SHELL model between each clinical experience level by differences in near miss type

Table 1 indicates differences in near miss type based on clinical experience level using the four domains of the SHELL model as variables: software, environment/hardware, liveware: condition of the person involved, and liveware: action of the person involved. The tables present data from each domain. Tables 2, 3, and 4 present data adapted from each domain from Table 1. The results shown in Table 2 are discussed in detail below.

Factors influencing incidents at the Novice/ Advanced beginner levels

No nursing care near misses were observed for the Advanced beginner A level. Thus, we compared Novice and Advanced beginner B levels. Significant differences were observed within the liveware: condition of the person involved ($p < .001$) domain for all near miss types, while no significant differences were found for software, environment/hardware, and liveware: action of the person involved (Table 2). When comparing near misses across the Novice, Advanced beginner A, and Advanced beginner B levels, Novice rates were highest within the three medication near miss items, including 'lack of knowledge' (37.8%), 'delayed reporting' (7.6%), and 'misjudgement' (20.8%); 'delayed reporting' (7.3%) was the highest among Novices in regard to medical device near misses. Novice rates were also the highest for 'Neglected to check' among nursing care near misses. Rates among Advanced beginner A nurses were the highest for 'education/training' (41.9%), 'system' (16.3%), 'busy working conditions' (61.0%), 'neglected to check' (95.1%), and 'inadequate documentation' (7.3%). Rates among Advanced beginner B nurses were the highest for 'inadequate rules' (21.4%) and 'patient side' (19.3%).

Table 1. Differences in near miss types for clinical experience levels –Four domains of The SHEL model–

	Drug[a]				Medical device[a]				Nursing care[b]		
	Novice N n=2,867	Advanced beginner A n=252	Advanced beginner B n=3,199	p-value	Novice N n=276	Advanced beginner A n=25	Advanced beginner B n=365	p-value	Novice N n=60	Advanced beginner B n=32	p-value
Software	986 (34.4)	86 (34.1)	1,042 (32.6)	0.317	95 (34.4)	8 (32.0)	117 (32.1)	0.815	21 (35.0)	13 (40.6)	0.653
Environment/Hardware	578 (20.2)	59 (23.4)	641 (20.0)	0.448	105 (38.0)	5 (20.0)	131 (35.9)	0.171	20 (33.3)	16 (50.0)	0.178
Liveware: Condition of the person involved	1,897 (66.2)	164 (65.1)	1,734 (54.2)	<0.001	163 (59.1)	19 (76.0)	185 (50.7)	0.009	45 (75.0)	17 (53.1)	0.039
Liveware: Action of the person involved	2,755 (96.1)	245 (97.2)	3,068 (95.9)	0.548	245 (88.8)	20 (80.0)	312 (85.5)	0.302	54 (90.0)	27 (84.4)	0.506
		Competent A n=291	Competent B n=1672	p-value		Competent A n=34	Competent B n=810	p-value	Competent A n=2	Competent B n=43	p-value
Software	–	60 (20.6)	494 (29.5)	0.002	–	11 (32.4)	64 (35.6)	0.845	0 (0.0)	1 (9.1)	1.000
Environment/Hardware	–	33 (11.3)	357 (21.4)	<0.001	–	6 (17.6)	75 (41.7)	0.011	0 (0.0)	3 (27.3)	1.000
Liveware: Condition of the person involved	–	153 (52.6)	873 (52.2)	0.943	–	19 (55.9)	95 (52.8)	0.852	2 (100.0)	3 (* 100.0)	0.128
Liveware: Action of the person involved	–	276 (94.8)	1,582 (94.6)	1.000	–	27 (79.4)	151 (83.9)	0.617	2 (100.0)	11 (100.0)	1.000
		Proficient /Expert A n=1,496	Proficient /Expert B n=5,119	p-value		Proficient /Expert A n=167	Proficient /Expert B n=810	p-value	Proficient /Expert A n=14	Proficient /Expert B n=43	p-value
Software	–	461 (30.8)	1,738 (34.0)	0.025	–	44 (26.3)	319 (39.4)	0.002	3 (21.4)	15 (34.9)	0.511
Environment/Hardware	–	345 (23.1)	1,404 (27.4)	<0.001	–	55 (32.9)	386 (47.7)	<0.001	4 (28.6)	15 (34.9)	0.754
Liveware: Condition of the person involved	–	791 (52.9)	2,674 (52.2)	0.680	–	78 (46.7)	380 (46.9)	1.000	6 (42.9)	21 (48.8)	0.765
Liveware: Action of the person involved	–	1,403 (93.8)	4,836 (94.5)	0.310	–	146 (87.4)	689 (85.1)	0.471	13 (92.9)	40 (93.0)	1.000

n = (%). a) X^2 test, b) Fisher's exact test.
For each item, only event causes are posted in the table.

Table 2. Differences in near miss types for the Novice/Advanced beginner levels

	Drug[a]				Medical device[a]				Nursing care[b]		
	Novice N	Advanced beginner A	Advanced beginner B	p-value	Novice N	Advanced beginner A	Advanced beginner B	p-value	Novice N	Advanced beginner B	p-value
Software	n=986	n=86	n=1,042		n=95	n=8	n=117		n=21	n=13	
Education/training	377 (38.2)	36 (41.9)	330 (31.7)	0.003	38 (40.0)	1 (12.5)	46 (39.3)	0.246	15 (71.4)	4 (30.8)	0.034
System	57 (5.8)	14 (16.3)	118 (11.3)	<0.001	2 (2.1)	2 (25.0)	9 (7.7)	0.032	1 (4.8)	0 (0.0)	1.000
Inadequate rules	144 (14.6)	17 (19.8)	223 (21.4)	<0.001	14 (14.7)	0 (0.0)	18 (15.4)	0.275	1 (4.8)	2 (15.4)	0.544
Others	470 (47.7)	24 (27.9)	439 (42.1)	<0.001	44 (46.3)	5 (62.5)	46 (39.3)	0.316	5 (23.8)	8 (61.5)	0.038
Environment/Hardware	n=578	n=59	n=641		n=105	n=5	n=131		n=20	n=16	
Computerized system	72 (12.5)	7 (11.9)	82 (12.8)	0.970	14 (13.3)	1 (20.0)	7 (5.3)	0.076	1 (5.0)	0 (0.0)	1.000
Drug	257 (44.5)	29 (49.2)	297 (46.3)	0.691	1 (1.0)	0 (0.0)	4 (3.1)	0.458	0 (0.0)	0 (0.0)	1.000
Medical device	15 (2.6)	2 (3.4)	15 (2.3)	0.869	69 (65.7)	2 (40.0)	91 (69.5)	0.375	2 (10.0)	0 (0.0)	0.492
Facility	32 (5.5)	4 (6.8)	40 (6.2)	0.841	9 (8.6)	1 (20.0)	11 (8.4)	0.732	2 (10.0)	2 (12.5)	1.000
Other items	25 (4.3)	3 (5.1)	25 (3.9)	0.875	5 (4.8)	0 (0.0)	9 (6.9)	0.584	2 (10.0)	3 (18.8)	0.637
Patient side	71 (12.3)	10 (16.9)	124 (19.3)	0.003	4 (3.8)	0 (0.0)	6 (4.6)	0.773	4 (20.0)	9 (56.3)	0.038
Others	122 (21.1)	4 (6.8)	96 (15.0)	0.001	11 (10.5)	1 (20.0)	10 (7.6)	0.565	9 (45.0)	4 (25.0)	0.301
Liveware: Condition of the person involved	n=1,897	n=164	n=1,734		n=163	n=19	n=185		n=45	n=17	
Lack of knowledge	717 (37.8)	36 (22.0)	483 (27.9)	<0.001	67 (41.1)	12 (63.2)	65 (35.1)	0.050	22 (48.9)	2 (11.8)	0.009
Deficiency in technique/skill	438 (23.1)	40 (24.4)	358 (20.6)	0.157	55 (33.7)	5 (26.3)	56 (30.3)	0.690	10 (22.2)	3 (17.6)	1.000
Busy working conditions	905 (47.7)	100 (61.0)	996 (57.4)	<0.001	51 (31.3)	4 (21.1)	66 (35.7)	0.344	9 (20.0)	6 (35.3)	0.318
Under unusual physical condition	49 (2.6)	9 (5.5)	59 (3.4)	0.089	2 (1.2)	0 (0.0)	4 (2.2)	0.577	1 (2.2)	0 (0.0)	1.000
Under unusual psychological condition	506 (26.7)	43 (26.2)	442 (25.5)	0.719	33 (20.2)	4 (21.1)	38 (20.5)	0.995	4 (8.9)	2 (11.8)	0.662
Others	425 (22.4)	27 (16.5)	381 (22.0)	0.191	36 (22.1)	2 (10.5)	40 (21.6)	0.446	15 (33.3)	7 (41.2)	0.568
Liveware: Action of the person involved	n=2,755	n=245	n=3,068		n=245	n=20	n=312		n=54	n=27	
Neglected to check	2,512 (91.2)	233 (95.1)	2,732 (89.0)	<0.001	213 (86.9)	18 (90.0)	272 (87.2)	0.925	41 (75.9)	13 (48.1)	0.023
Neglected to observe	465 (16.9)	50 (20.4)	585 (19.1)	0.061	63 (25.7)	6 (2.4)	109 (34.9)	0.063	16 (29.6)	10 (37.0)	0.615
Delayed (neglected) reporting	209 (7.6)	6 (2.4)	105 (3.4)	<0.001	18 (7.3)	0 (0.0)	6 (1.9)	0.003	9 (16.7)	1 (3.7)	0.153
Inadequate documentation	137 (5.0)	18 (7.3)	115 (3.7)	0.009	6 (2.4)	1 (0.4)	6 (1.9)	0.700	1 (1.9)	0 (0.0)	1.000
Inadequate coordination	575 (20.9)	57 (23.3)	666 (21.7)	0.569	45 (18.4)	7 (2.9)	54 (17.3)	0.188	12 (22.2)	5 (18.5)	0.779
Inadequate (neglected) explanation to the p	242 (8.8)	19 (7.8)	322 (10.5)	0.051	6 (2.4)	0 (0.0)	11 (3.5)	0.414	5 (9.3)	5 (18.5)	0.289
Misjudgment	572 (20.8)	47 (19.2)	536 (17.5)	0.006	40 (16.3)	3 (1.2)	43 (13.8)	0.706	20 (37.0)	8 (29.6)	0.653

n = (%). a) X^2 test, b) Fisher's exact test.
For each item, only event causes are posted in the table.

Factors influencing incidents at the Competent level

Few statistically significant results were observed within the Competent level (Table 3), with the exception of two categories: software (p = .002) for medication near misses and environment/hardware for medication (p < .001) and medical device near misses (p = .011), for which the rate for Competent B was higher than that for Competent A. Significant differences for medication near misses were found for 'busy working conditions' (p = .008), 'under usual psychological conditions' (p = .010), and 'inadequate (neglected) explanations to the patient' (p = .048), for which rates were higher for Competent B than for Competent A. Only rates for 'inadequate documentation' (p = .048) were higher for Competent A.

Factors influencing incidents at the Proficient/ Expert level

Differences as a function of Proficient/Expert level are shown in Table 4. Differences were found within two medication and medical device categories: software and environment/hardware. Proficient/Expert B demonstrated higher rates than Proficient/Expert A in the software domain for 'inadequate rules' (p = .020) for medication near misses and 'system' (p = .041) for medical device near misses. In the liveware: condition of the person involved domain, 'busy working conditions' (p = .017) and 'inadequate coordination' (p = .009) for medication near misses demonstrated higher rates for Proficient/Expert B. Environment/hardware showed significant differences in 'computerized system' (p = .044) for medical device near misses. For the liveware: action of the person involved domain, Proficient/Expert A showed higher rates than did Proficient/Expert B, including 'lack of knowledge' (p < .001) and 'deficiency in technique/skill' (p = .002) for medication near misses and 'inadequate (neglected) explanations to the patient' (p = .005) for medical device near

Table 3. Differences in near miss types for the Competent level

	Drug			Medical device			Nursing care		
	Competent A	Competent B	p-value	Competent A	Competent B	p-value	Competent A	Competent B	p-value
Software	n=60	n=494		n=11	n=64		n=0	n=1	
Education/training	18 (30.0)	191 (38.7)	0.207	4 (36.4)	18 (28.1)	0.721	0 (0.0)	0 (0.0)	-
System	5 (8.3)	57 (11.5)	0.663	0 (0.0)	13 (20.3)	0.194	0 (0.0)	0 (0.0)	1.000
Inadequate rules	15 (25.0)	119 (24.1)	0.874	5 (45.5)	20 (31.3)	0.490	0 (0.0)	0 (0.0)	1.000
Others	29 (48.3)	177 (35.8)	0.066	2 (18.2)	20 (31.3)	0.491	0 (0.0)	1 (100.0)	1.000
Environment/Hardware	n=33	n=357		n=6	n=75		n=0	n=3	
Computerized system	6 (18.2)	46 (12.9)	0.420	0 (0.0)	4 (5.3)	1.000	0 (0.0)	0 (0.0)	1.000
Drug	10 (30.3)	148 (41.5)	0.267	0 (0.0)	2 (2.7)	1.000	0 (0.0)	0 (0.0)	1.000
Medical device	2 (6.1)	11 (3.1)	0.303	5 (83.3)	50 (66.7)	0.659	0 (0.0)	0 (0.0)	1.000
Facility	3 (9.1)	30 (8.4)	0.751	0 (0.0)	10 (13.3)	1.000	0 (0.0)	0 (0.0)	1.000
Other items	1 (3.0)	17 (4.8)	1.000	1 (16.7)	8 (10.7)	0.519	0 (0.0)	0 (0.0)	1.000
Patient side	4 (12.1)	73 (20.4)	0.360	0 (0.0)	4 (5.3)	1.000	0 (0.0)	3 (100.0)	1.000
Others	8 (24.2)	53 (14.8)	0.206	0 (0.0)	8 (10.7)	1.000	0 (0.0)	0 (0.0)	1.000
Liveware: Condition of the person involved	n=153	n=873		n=19	n=95		n=2	n=3	
Lack of knowledge	49 (32.0)	220 (25.2)	0.090	8 (42.1)	32 (33.7)	0.599	1 (50.0)	1 (33.3)	1.000
Deficiency in technique/skill	30 (19.6)	124 (14.2)	0.087	5 (26.3)	26 (27.4)	1.000	1 (50.0)	0 (0.0)	0.400
Busy working conditions	70 (45.8)	502 (57.5)	0.008	5 (26.3)	40 (42.1)	0.304	1 (50.0)	2 (66.7)	1.000
Under unusual physical condition	6 (3.9)	34 (3.9)	1.000	0 (0.0)	2 (2.1)	1.000	0 (0.0)	0 (0.0)	1.000
Under unusual psychological condition	20 (13.1)	193 (22.1)	0.010	3 (15.8)	16 (16.8)	1.000	0 (0.0)	0 (0.0)	1.000
Others	32 (20.9)	195 (22.3)	0.752	3 (15.8)	19 (20.0)	1.000	0 (0.0)	0 (0.0)	1.000
Liveware: Action of the person involved	n=276	n=1,582		n=27	n=151		n=2	n=11	
Neglected to check	244 (88.4)	1,411 (89.2)	0.677	22 (81.5)	125 (82.8)	0.790	2 (100.0)	5 (45.5)	0.462
Neglected to observe	32 (11.6)	230 (14.5)	0.223	3 (11.1)	43 (28.5)	0.060	0 (0.0)	2 (18.2)	1.000
Delayed (neglected) reporting	9 (3.3)	51 (3.2)	1.000	0 (0.0)	1 (0.7)	1.000	1 (50.0)	1 (9.1)	0.295
Inadequate documentation	18 (6.5)	59 (3.7)	0.048	0 (0.0)	3 (2.0)	1.000	1 (50.0)	0 (0.0)	0.154
Inadequate coordination	58 (21.0)	398 (25.2)	0.150	8 (29.6)	34 (22.5)	0.462	1 (50.0)	1 (9.1)	0.295
Inadequate (neglected) explanation to the pa	19 (6.9)	175 (11.1)	0.042	0 (0.0)	2 (1.3)	1.000	0 (0.0)	2 (18.2)	1.000
Misjudgment	43 (15.6)	249 (15.7)	1.000	8 (29.6)	22 (14.6)	0.089	1 (50.0)	3 (27.3)	1.000

n = (%): analyses conducted using Fisher's exact test.

For each item, only event causes are posted in the table.

Table 4. Differences in near miss types for the Proficient/Expert level

	Drug[a)]			Medical device[b)]			Nursing care[b)]		
	Proficient /Expert A	Proficient /Expert B	p-value	Proficient /Expert A	Proficient /Expert B	p-value	Proficient /Expert A	Proficient /Expert B	p-value
Software	n=461	n=1,738		n=44	n=319		n=3	n=15	
Education training	163 (35.4)	682 (39.2)	0.132	24 (54.5)	145 (45.5)	0.264	2 (66.7)	3 (20.0)	0.172
System	51 (11.1)	211 (12.1)	0.572	2 (4.5)	53 (16.6)	0.041	0 (0.0)	3 (20.0)	1.000
Inadequate rules	119 (25.8)	546 (31.4)	0.020	12 (27.3)	91 (28.5)	1.000	1 (33.3)	2 (13.3)	0.442
Others	164 (35.6)	495 (28.5)	0.004	11 (25.0)	74 (23.2)	0.850	0 (0.0)	8 (53.3)	0.216
Environment/Hardware	n=345	n=1,404		n=55	n=386		n=4	n=15	
Computerized system	39 (11.3)	201 (14.3)	0.162	6 (10.9)	16 (4.1)	0.044	0 (0.0)	1 (6.7)	1.000
Drug	109 (31.6)	570 (40.6)	0.002	0 (0.0)	2 (0.5)	1.000	0 (0.0)	1 (6.7)	1.000
Medical device	12 (3.5)	47 (3.3)	0.869	32 (58.2)	299 (77.5)	0.004	0 (0.0)	0 (0.0)	1.000
Facility	6 (1.7)	40 (2.8)	0.347	2 (3.6)	21 (5.4)	0.754	1 (25.0)	4 (26.7)	1.000
Other items	10 (2.9)	50 (3.6)	0.623	8 (14.5)	35 (9.1)	0.222	0 (0.0)	0 (0.0)	1.000
Patient side	67 (19.4)	268 (19.1)	0.879	2 (3.6)	5 (1.3)	0.213	3 (75.0)	8 (53.3)	0.603
Others	114 (33.0)	310 (22.1)	<0.001	10 (18.2)	28 (7.3)	0.017	0 (0.0)	3 (20.0)	1.000
Liveware: Condition of the person involved	n=791	n=2,674		n=78	n=380		n=6	n=21	
Lack of knowledge	233 (29.5)	574 (21.5)	<0.001	35 (44.9)	152 (40.0)	0.449	1 (16.7)	2 (9.5)	0.545
Deficiency in technique/skill	94 (11.9)	219 (8.2)	0.002	15 (19.2)	67 (17.6)	0.747	0 (0.0)	4 (19.0)	0.545
Busy working conditions	386 (48.8)	1435 (53.7)	0.017	27 (34.6)	135 (35.5)	1.000	4 (66.7)	12 (57.1)	1.000
Under unusual physical condition	31 (3.9)	105 (3.9)	1.000	1 (1.3)	7 (1.8)	1.000	0 (0.0)	0 (0.0)	1.000
Under unusual psychological condition	118 (14.9)	361 (13.5)	0.319	12 (15.4)	42 (11.1)	0.334	0 (0.0)	0 (0.0)	1.000
Others	184 (23.3)	681 (25.5)	0.224	16 (20.5)	89 (23.4)	0.659	3 (50.0)	6 (28.6)	0.367
Liveware: Action of the person involved	n=1,403	n=4,836		n=146	n=689		n=13	n=40	
Neglected to check	1,213 (86.5)	4,123 (85.3)	0.281	120 (82.2)	563 (81.7)	1.000	5 (38.5)	19 (47.5)	0.750
Neglected to observe	181 (12.9)	559 (11.6)	0.174	42 (28.8)	159 (23.1)	0.166	4 (30.8)	15 (37.5)	0.749
Delayed (neglected) reporting	41 (2.9)	112 (2.3)	0.203	5 (3.4)	20 (2.9)	0.788	0 (0.0)	2 (5.0)	1.000
Inadequate documentation	53 (3.8)	208 (4.3)	0.449	7 (4.8)	18 (2.6)	0.179	0 (0.0)	4 (10.0)	0.561
Inadequate coordination	263 (18.7)	1,062 (22.0)	0.009	26 (17.8)	125 (18.1)	1.000	1 (7.7)	9 (22.5)	0.419
Inadequate (neglected) explanation to patient	105 (7.5)	396 (8.2)	0.435	7 (4.8)	7 (1.0)	0.005	4 (30.8)	9 (22.5)	0.712
Misjudgment	222 (15.8)	668 (13.8)	0.062	21 (14.4)	98 (14.2)	1.000	5 (38.5)	17 (42.5)	1.000

n = (%) a) X^2 test, b) Fisher's exact test

For each item, only event causes are posted in the table.

misses. A comparison of the clinical experience levels showed that Novice/Advanced beginners demonstrated statistically significant differences across all items within factors, while the Competent level had few significant differences. No significant differences in nursing care were observed at the Proficient/Expert level, similar to the Competent level. For the Proficient/Expert level, 'education/training' did not show a significant difference, but 'inadequate rules' (p = .020) within medication near misses and 'system' (p = .041) within medical device near misses showed significant differences.

Discussion

Near misses reported by Novice/Advanced beginner nurses

In the Novice/Advanced beginner group, 17

out of 24 items showed statistically significant differences, which was the highest among the experience levels we investigated. Novice nurses frequently reported a 'lack of knowledge' regarding medication and nursing care near misses. Lack of familiarity with various medications is one of the leading risk factors for a medication error (5). 'Delayed reporting' during medication and medical device near misses was also the most frequent incident among Novice nurses. Less experienced nurses may be reluctant to report medication errors, perhaps owing to a fear of being blamed or being perceived as a troublemaker (14). Few reports have specifically examined nursing care near misses; thus, our interpretations are speculative regarding the high rates of 'lack of knowledge' and 'neglected to check' reported by Novice nurses. Prior to engaging in nursing care, a nurse assesses a patient's condition, both by what can be readily observed and what can be inferred. Even Advanced beginner nurses have limited theoretical knowledge and lack the adequate experience necessary to identify and interpret subtle clinical symptoms related to a patient's physical or psychological condition (15). Novice nurses adjust to unfamiliar procedures or situations, which could manifest in a near miss event (15). Novice nurses need help and should seek the advice of experienced registered nurses (RNs) (16). Within a collegial and friendly workplace, novice nurses may feel more comfortable obtaining assistance to avoid near miss events.

Years of nursing experience is a key factor underlying medication errors (17). Advanced beginner A nurses reported high endorsement of five items. These nurses have more experience than do Novices but worked in their current department for less than one year. Advanced beginner A nurses had high rates of 'neglected to check' and 'inadequate documentation' when experiencing medication near misses. These nurses also felt that they would benefit more from 'education/training'. Responses on these items were higher than those observed among Novice nurses. While an Advanced beginner working in a new department could have less assignment experience than a Novice, more is still expected of Advanced beginners. While knowledge of a particular unit and workflow patterns influenced near misses among Novice nurses in a prior study (12), our results suggest that Advanced beginner A nurses need to pay attention to these issues as well. Within the first year of moving to a new department, expert RNs and administrators need to be vigilant with their Advanced beginner A nurses in terms of proper patient checks and documentation.

Near misses reported by Competent nurses

We had a relatively small sample of nurses within the 'Competent' level; thus, few statistically significant differences were found across the survey items. The percentages of 'busy working conditions' and 'inadequate explanations to the patient' among Competent B nurses were higher than those among Competent A nurses. As years of clinical experience and time within the department increase, the role of a Competent B nurse is expected to expand into a leadership position. However, Benner suggested that Competent nurses lack the speed and flexibility possessed by a nurse at a proficient level (13). In this case, feeling too busy at work was a key risk factor for near miss errors (17).

The JCQHC data were divided in a way such that 'busy working conditions' was considered a human factor event. Environment/hardware encompassed medication and medical device near miss events that showed significant differences within the Competent level. Organisational factors in terms of the environment/hardware could be a contributor to perceived 'busy working conditions'. Organisational factors can include a heavy workload, the need to multi-task (18), and/or a high nurse-to-patient ratio. RN staffing levels have been associated with negative patient outcomes, including hospital mortality or respiratory failure (19,20). However, since the present analysis included secondary data from the JCQHC, we were unable to identify additional details regarding organisational factors. Nevertheless, it appears that Competent nurses might be more susceptible to near miss errors when they perceive themselves to be too busy.

Near misses reported by Proficient/Expert nurses

Statistically significant differences were observed for eight medication near miss items and five medical device near miss items. However, nursing care errors (similar to the Competent level) were not observed in the present study. Kendall-Gallagher and Blegen reported that nursing experience was positively related to medication administration error rates, but no significant relationships were observed between patient fall rates and skin condition rates as a function of experience (21); these findings are in keeping with the present study's findings.

Although not prominently observed in our sample of Novice/Advanced beginner and Competent nurses, near misses in reference to medical devices were higher among Proficient/Expert nurses. Medical devices are used in hospitals on a routine basis (22). However, we could not obtain data on details

regarding the factors that caused each incident. Future studies should address potential causes and risk factors for medical device near misses among Proficient/Expert level nurses.

The percentage of near miss reports was higher for Proficient/Expert A relative to Proficient/Expert B nurses in terms of the 'lack of knowledge' and 'deficiency of technique/skill' items for medication near misses, as well as 'inadequate explanations to the patient' and 'computerized system' items for medical device near misses. Certain treatments, medicines, and devices are only relevant to specific diseases or medical departments. A lack of knowledge and deficiency in skill tend to be regarded as an inexperienced nurse problem; however, our results suggest that such issues also apply to nurses who have just recently moved to a new department. Thus, more adequate on-the-job training and education are necessary for experienced nurses who have changed departments. This can focus on improving 'efficacy and side effects of medications specific to the clinical department', 'teaching patients how to use medical devices', and 'the use of the department's computerized system'. Furthermore, while medication errors tend to be the most common (and perhaps most dangerous) errors, our results suggest that many types of near misses should be accounted for, especially based on the level of clinical experience of a particular nurse and the time spent working within a specific department.

A few study limitations should be noted. First, the data we used were published by the JCQHC for their specific project purposes. Thus, the data we could obtain on the medication, medical device, and nursing care near misses were highly skewed. Furthermore, each medical institution usually collects incident reports. However, only 12% of all hospital institutions in Japan provided data for the JCQHC project. Thus, incident reports from a larger sample of hospitals would be extremely helpful. Nevertheless, despite this relatively small data pool, significant results were found in terms of near misses as a function of experience level and time spent within a particular department.

Conclusion

The present study showed differences in reported medical incident near misses as a function of years of clinical experience and time spent within a particular department. In terms of medication near misses between Novice/ Advanced beginner and Proficient/Expert levels, time spent in a department appeared to be meaningful. Medical device near misses were also observed within the Proficient/Expert level. The percentage of incidents involving environment/ hardware for medication and medical device near misses increased as years of clinical experience increased. Liveware near misses occurred only at the Novice/Advanced beginner level and not the Competent or Proficient/Expert levels. Overall, these results could have important implications for developing a new educational system for on-the-job nurse training.

Acknowledgements

This work was supported by JSPS KAKENHI (Grant Number JP 15K20689P).

Conflicts of Interest

The authors declare no conflicts of interest associated with the manuscript.

References

1. Jha AK, Prasopa-Plaizier N, Larizgoitia I, Bates DW. Patient safety research: An overview of the global evidence. BMJ Qual Saf 2010; 19: 42-7.
2. Andel C, Davidow SL, Hollander M, Moreno DA. The economics of health care quality and medical errors. J Health Care Finance 2012; 39: 39-50.
3. World Health Organization. Data and statistics. [cited March 2018]. Available from: http://www.euro.who.int/en/health-topics/Health-systems/patient-safety/data-and-statistics
4. Metsälä E, Vaherkoski U. Medication errors in elderly acute care–a systematic review. Scand J Caring Sci 2014; 28: 12-28.
5. Karavasiliadou S, Athanasakis E. An inside look into the factors contributing to medication errors in the clinical nursing practice. Health Sci J 2014; 8: 32-44.
6. Department of Health Expert Group (Chairman, CMO). An organisation with a memory: Report of an expert group on learning from adverse events in the NHS chaired by the Chief Medical Officer. [cited June 2000]. Available from: http://webarchive.nationalarchives.gov.uk/20130105144251/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4065086.pdf.
7. JCQHC. Burns during a footbath or shower. [cited February 2014]. Available from: http://www.med-safe.jp/pdf/No.87_MedicalSafetyInformation.pdf
8. JCQHC. Blood transfusion to wrong patient. [cited January 2016]. Available from: http://www.med-safe.jp/pdf/No.110_MedicalSafetyInformation.pdf
9. JCQHC. Failure to check oxygen remaining. [cited November 2010]. Available from: http://www.med-safe.jp/pdf/No.48_MedicalSafetyInformation.pdf
10. JCQHC. Project to Collect Medical Near-miss/ Adverse Event Information 2015 Annual Report. [cited 2016]. Available from: http://www.med-safe.jp/pdf/year_report_english_2015.pdf.
11. OECD Reviews of health care quality: Japan 2015. Paris: OECD publishing; 2015:1-211.
12. Hawkins FH, Orlady HW, eds. Human factors in flight. 2nd ed. England: Avebury Technical; 1993.
13. Benner P. From novice to expert. AJN 1982; 82:402-7.
14. Vrbnjak D, Denieffe S, O'Gorman C, Pajnkihar M. Barriers to reporting medication errors and near

misses among nurses: A systematic review. Int J Nurs Stud 2016; 63: 162-78.
15. King L, Clark JM. Intuition and the development of expertise in surgical ward and intensive care nurses. J Adv Nurs 2002; 37: 322-9.
16. Ebright PR, Urden L, Patterson E, Chalko B. Themes surrounding novice nurse near-miss and adverse-event situations. J Nurs Adm 2004; 34: 531-8.
17. Seki Y, Yamazaki Y. Effects of working conditions on intravenous medication errors in a Japanese hospital. J Nurs Manag 2006; 14: 128-39.
18. Esi Owusu Agyemang R, While A. Medication errors: types, causes and impact on nursing practice. Br J Nurs 2010; 19: 380-5.
19. Numata Y, Schulzer M, van der Wal R, Globerman J, Semeniuk P, Balka E, et al. Nurse staffing levels and hospital mortality in critical care settings: Literature review and meta-analysis. J Adv Nurs 2006; 55: 435-48.
20. Kane RL, Shamliyan TA, Mueller C, Duval S, Wilt TJ. The association of registered nurse staffing levels and patient outcomes: Systematic review and meta-analysis. Med Care 2007; 45: 1195-204.
21. Kendall-Gallagher D, Blegen MA. Competence and certification of registered nurses and safety of patients in intensive care units. Am J Crit Care 2018; 18: 106-13.
22. Polisena J, Gagliardi A, Urbach D, Clifford T, Fiander M. Factors that influence the recognition, reporting and resolution of incidents related to medical devices and other healthcare technologies: A systematic review. Syst Rev 2015; 4: 1-11.