

Characteristics of Nurses in Japanese Hospitals Who Detect Errors of One-self and Others

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Abstract

Background: Nurses who often detect errors in medical practice are highly esteemed for their capacity to prevent medical accidents. However, information on particular characteristics of such nurses is limited at this time. The aim of this study was to identify characteristics of nurses who are able to detect errors during medical practice, both their own and those of others.

Methods: Anonymous questionnaires were distributed to 2908 nurses in 11 Japanese hospitals whose working career was three years and longer to collect information regarding experiences in detecting errors of one's own making and errors of others during medical practice, the actual experiences of making errors, social skills, a safety climate in the wards, and general characteristics of the participants. The valid response rate was 64.0 %. Principal component analysis was used to form composite measures using a smaller set of error experiences (clinical errors). Multiple logistic regression analysis was performed to determine factors related to experiences in detecting errors.

Results: Of the participants, 77.4% had experienced detecting their own errors, and 84.1% had experienced detecting errors of others. Significant factors related to the experience of detecting one's own errors were: having experienced their own errors detected by others, clinical errors, feedback and communication about errors, and a medical accident. Significant factors related to the experience of detecting errors of others were: the experience of having their own errors detected by others, experience of detecting one's own errors, communication openness, night shift duty, experience as a safety committee member, and planning skills.

Conclusion: Experiencing errors plays a role in detecting future errors of one's own making and of others. Adequate feedback is preferable for detecting one's own errors. Open communication in the ward is recommended for detecting errors of others, as one facet of medical safety control.

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Introduction

Since nurses care for patients directly during clinical practice, there is a higher probability that their errors will be directly linked to medical accidents with patients than those of other medical staff [1]. In order to prevent medical accidents, nurses should be aware of conditions in which they are prone to make errors and validate the operations mutually. For such situations, there is an abundance of research on training for risk prediction in order to enhance the ability to prevent occurrences of errors [2,3].

Although all of hospitals implement full-scale preparations for the prevention of errors, it is impossible to preclude every occurrence. It also goes without saying that nurses need to be vigilant in detecting errors before they become accidents and those nurses who often detect errors in medical practice are highly esteemed for the ability to prevent medical accidents [4,5]. In a process of restoration of errors during clinical practice, if someone has made an error, another person detects the error, indicates it, and corrects it [6]. Consequently, the error is restored before it becomes linked to a medical accident. In the sector of medical safety management in hospitals, such nurses play a salient role. However, information on particular characteristics of such nurses is limited at this time.

The aims of this study were to identify characteristics of nurses who are able to detect errors during medical practice, both their own and those of others and to make findings that can be adopted for medical safety management in hospitals.

Conceptual Framework: Occurrence and Detection of Errors

A medical error is defined as an adverse event or a near-miss that is preventable within the current state of medical knowledge [7]. It is the worst fear of all health care professionals. As nurses deliver direct care to patients, nurses are more likely to be involved in errors than other health care professionals. Every nurse knows that it is inevitable that she or he will make or detect an error at some time [8]. In Japan, among 30,271 near-misses in 2015, 27,148 cases (89.7%) originated with nurses [9].

Studies of errors during clinical practice have focused on medication errors. Some researchers have shown that the occurrence of errors during clinical practice is related to both the individual and the work environment characteristics [10-13]. As such, individual characteristics related to occurrence of errors during clinical practice included gender [14], age [15], and years of experience [15-18]. For

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example, female nurses had a significantly higher number of medication errors than male nurses [14]. Nurses at the age of 35 or younger and those employed for two years or less made significantly more errors [15]. Among 27,148 near-misses in Japan in 2015, 10,840 cases (39.9%) originated with nurses who had begun working within the previous two years [9].

Previous studies have emphasized the importance of “safety culture” factors in reducing the occurrence of errors, which included staff perceptions of non-punitive response to errors, roles of the ward nurse manager and hospital norms [14,17,18]. These findings provide hospital administrators with valuable information on identifying factors worthy of consideration in the promotion of patient safety in wards. In addition, understanding characteristics related to detecting errors will also be of service for developing interventional strategies to reduce errors and accidents.

There have been some studies delving into factors relevant to occurrences of errors [19]. However, little attention has been given to individual characteristics related to the experience of detecting errors. Given the situation in which the implementation of preventative measures for errors has not proven to be wholly successful, detecting errors before they become accidents is of utmost importance and begs further investigation. In Japan, among 784,190 medical near-misses and incident reports, 245,730 (31.3%) had been detected before the error reached the patient, and the potential accident was prevented [9].

Again, nurses who often detect errors are highly esteemed. In this regard, some researchers have tried to examine the particular characteristics of such nurses. One report emphasized the experience of nurses who detected errors caused by others, their age, and their years of nursing experience [4]. However, much remains to be determined in regard to the characteristics these nurses possess that have high ability to often detect errors during clinical practice.

The first step in restoring an error is to detect its occurrence [6]. Thus, the research framework of this study was developed to clarify the factors related to individual characteristics of nurses to detect errors during clinical practice in Japanese hospitals, including perceptions of a climate of safety in the ward, which is one of the attributes of work environment.

Materials and Methods

Study design, setting and participants

A descriptive and correlational design was adopted. The subject hospitals comprised 11 institutions, excluding two psychiatric hospitals, among 13 hospitals having 300 and more beds in Wakayama Prefecture, Japan. With regard to the medical safety management in the 11 subject hospitals, a training program for medical safety had been provided, and a system to submit incident reports had been established in all hospitals. The medical safety sector was streamlined and full-time risk managers were appointed in 10 hospitals.

Two thousand, nine hundred and eight registered nurses (including part-time workers) participated in the study, all of whom were working at the 11 subject hospitals and all of whom had three or more years career experience.

Data collection

A cross-sectional survey was conducted from January to March in 2015. An anonymous questionnaire was designed to collect information regarding experiences of detecting one's own errors and errors of others in medical practice, actual experience of making errors, social skills, a safety climate in the ward, and general characteristics of the participants. Questionnaires with return envelopes were distributed to nurses who agreed to participate in this study by staff in charge at each hospital. The sealed questionnaires were mailed to the research team after completion.

Variables and instruments

An error was defined as a preventable adverse event or near-miss in daily medical practice, including medication errors and patient falls [7], which were detected before reaching the patient, or that had no effect on the patient even after it reached the patient, based on a Japanese guideline [20].

Experience of detecting errors of oneself and others in medical practice

Nurses were asked to answer whether they had experienced detecting errors that they had made themselves or had been made by others during the previous six months using the frequency categories: None, Once, Two to Four Times, Five times and More. They were also asked about experiences that they had had regarding their own errors being detected by others using the same frequency categories, and who detected the own errors using 8 examples; colleague, senior associate, junior fellow, manager, doctor, hospital pharmacist, patient and electronic health record system.

Actual experience of making errors

A nurse would experience a lot of errors during the course of the day. However, we think there are common errors among such errors, and then have used scales showing errors that nurses were prone to make among the operations at a ward. Thirteen errors were listed, such as, “calling a patient by the wrong name” [21]. Some of these were insignificant, but were included in “errors” in this study, because such an error frequently becomes the first step of the accident. Nurses were asked to answer whether they had experienced making errors in clinical practice during the previous six months using a three-point scale (0=zero times, 1=once, 2=twice and more).

Social skills

There is growing evidence that poor non-technical skills can be a major cause of error in healthcare [22]. Non-technical skills, or human factors, play an important role in improving team function and improving these skills can drive improvements in patient safety and outcome. In this study, the social skills were used as one of the non-technical skills.

Kikuchi's scale of social skills: 18 items (KiSS-18) is often used as a scale to help put social skills into prospective [23]. The scale consists of 6 subscales: Basic Skills (3 question items); Advanced Skills (3 question items); Emotional Management Skills (3 question items); Offense Management Skills (3 question items); Stress Management Skills (3 question items); and Planning Skills (3 question items) [24]. For each question item, the respondent selected one answer among 5 choices of “Always so,”

"Generally so," "Hard to say," "Generally not so," and "Always not so." Each selected answer was rated from 1 to 5 points. The points of each answer were summed up as the score. A high score shows a high ability to make amiable interpersonal relationships. Cronbach's alpha was 0.919 for six subscales of this scale.

Safety climate in the ward

A safety climate in the ward was defined as having two levels: an Organization-level and a Workgroups-level [25]. The draft 12 domains and 44 items were originally adopted from the Scales for Patient Safety Culture (Japanese version) verified through the Agency for Healthcare Research and Quality [26]. In this study, the focus was on the workgroups-level. Six domains (1=Communication Openness, 2=Feedback and Communication about Error, 3=Non-punitive Response to Error, 4=Organizational Learning – Continuous Improvement, 5=Overall Perceptions of Patient Safety, 6=Teamwork within Units) and 20 items were used from the original scales excluding domains related to ward administration and between wards. Each item in No. 1 and No. 2 domains was rated for the level of frequency using a five-point Likert scale ranging from 1 (never) to 5 (always). Each item in No. 3 to No. 6 domains was rated for the level of agreement using a five-point Likert scale ranging from 1 (disagree strongly) to 5 (agree strongly). A high score indicates a positive perception of a safety climate. Cronbach's alpha was 0.709 for six domains of this scale.

General characteristics

The individual characteristics included: gender, age, job status and position, night shift duty, years of nursing experience, experience of participating in a medical safety course, experience as a safety committee member, and experience of a medical accident.

Ethical consideration

Anonymous questionnaires, with a cover letter explaining the study purpose and data confidentiality, assured privacy of participants, and stated voluntary participation, were mailed to the hospitals that agreed to participate in this study (all of subject hospitals). The return of a completed questionnaire was considered to imply consent. This study protocol was approved by the Ethical Committee of Wakayama Medical University (No.1549).

Data analysis

The general characteristics of the participants, actual experience of making errors, social skills, safety climate in the ward, were summarized using descriptive statistics.

Having or not having experienced the detection of errors, not their frequency, was the focus of detecting errors caused by oneself or by others in this study. Z tests were performed to identify differences in ratios of detecting the errors according to the individual characteristics.

Errors during clinical practice contained a variety of content. To form composite measures using as few items of experience of making errors as possible, principal component analysis was carried out for identifying a number of correlated items from the 13 question items.

Mann-Whitney U was used to examine differences in the median scores between the two groups of participants: those who had

experience of detecting errors and those who had no experience of detecting errors because clinical errors were not normally distributed (Shapiro-Wilk, $p < 0.001$). Student's t-test was used to examine differences in the mean scores between two groups because 6 subscales of KiSS-18 and 6 domains of safety climate in the ward were regarded as being normally distributed from the histogram, although it statistically showed no normality (Shapiro-Wilk, $p < 0.001$).

Exploratory data analysis was used to extract important variables related to the experience of detecting errors. Multiple logistic regression analysis (Stepwise methods) was performed to determine factors related to experience of detecting errors. In the independent variables, dummy variables were created for individual scores. The individual score was divided into two categories: higher than mean or yes (1) and lower than mean or no (0). The odds ratios (ORs) and 95 % confidence intervals (CIs) were examined.

All statistical analyses were performed using the SPSS ver. 19 for Windows (SPSS Japan). The level of statistical significance was set at $p < 0.05$.

Results

Participants' characteristics

A total of 2232 questionnaires were mailed back to the research team (response rate 76.8%). Among these, 371 questionnaires were excluded because of numerous items with response failure. Total 1861 participants were analyzed in this study (valid response rate 64.0%).

The participants' characteristics are shown in Table 1. Most of the participants were females (90.7%) and their mean age was 37.8 (standard deviation: SD 9.3) years. They had an average of 14.7 (SD 8.8) years of nursing experience. Of the participants, 83.0% responded as staff, and 79.3% answered as having night shift duty. Among those who had night shift duty, 82.5% were full-time workers. As to experience, 82.1% responded as having experienced participation in a medical safety course, 27.6% answered as having experience as a safety committee member, and 13.1% responded as having experienced a medical accident.

Experience of detecting errors of oneself and others in medical practice

A total of 1441 (77.4%) participants had experienced detecting their own errors once or more than once; that is, at least once, and 1565 (84.1%) had experienced detecting errors of others at least once. A total of 1358 (73.0%) had experienced having their own errors detected by others at least once. Among those who detected the own errors, the colleague was most common (40%). Others, in descending order, were senior associates (35%) and junior nurses (18%).

Among those who had experienced detecting errors of others at least once, 1226 (78.3%) had experienced having their own errors detected by others at least once and among those who had not experienced detecting errors of others, 119 (42.3%) had experienced having their own errors detected by others at least once. Among those who had experienced detecting errors of others, 1267 (81.0%) had experienced detecting their own errors and among those who had not experienced detecting errors of others, 161 (57.3%) had experienced detecting their own errors. These also reveal significant differences.

Variable ^a		n	%	Detect an error					
				Own self		P*	Others		P*
				n	%		n	%	
Gender	Male	172	9.3	140	81.4	0.063	145	84.3	1.000
	Female	1670	90.7	1287	77.1		1404	84.1	
Age	≤37	938	51.6	750	80.0	0.029	784	83.6	0.726
	38≤	865	48.4	647	74.8		733	84.7	
Job Position	Staff	1495	83.0	1164	77.9	0.254	1234	82.5	0.006
	Manager	306	17.0	230	75.2		275	89.9	
Night Shift	Yes	1444	79.3	1140	78.9	0.003	1244	86.1	<0.001
	No	376	20.7	271	72.1		283	75.3	
Years of Nursing Experience	≤14	998	55.8	790	79.2	0.105	824	82.6	0.285
	15≤	790	44.2	595	75.3		677	85.7	
Experience of Participating in a Medical Safety Course	Yes	1506	82.1	1166	77.4	0.704	1287	85.5	0.002
	No	328	17.9	251	76.5		255	77.7	
Experience as a Safety Committee Member	Yes	505	27.6	393	77.8	0.757	448	88.7	0.003
	No	1327	72.4	1023	77.1		1089	82.1	
Experience of a Medical Accident	Yes	243	13.1	209	86.0	<0.001	212	87.2	0.078
	No	1617	86.9	1231	76.1		1352	83.6	

Table 1: Comparisons of experience of detecting errors by individual characteristics (N=1861).

^a Unmarked or missing data were not included in the analysis.

*Z test

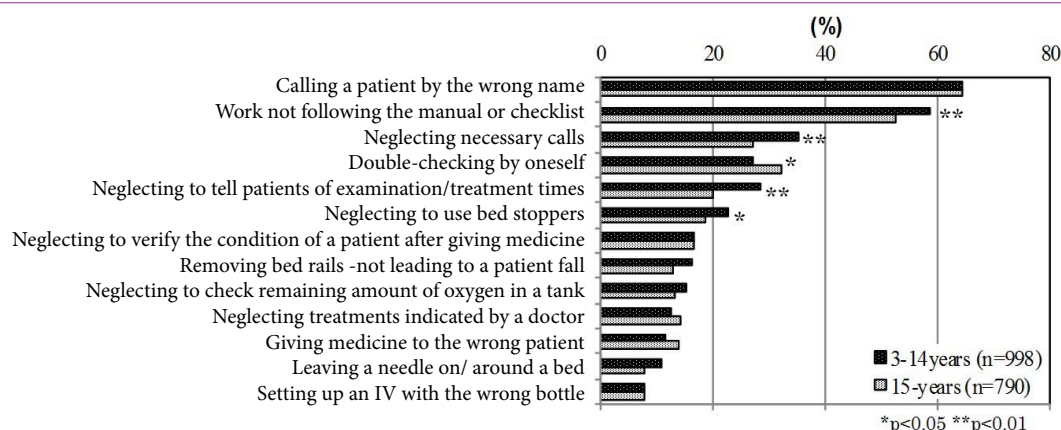


Figure 1: Prevalence of errors experienced in medical practice according to years of nursing experience.

Actual experience of making errors

Examination of 13 errors experienced during clinical practice revealed the frequencies of the errors. The most common was “calling a patient by the wrong name” (64.6%). Other errors, in descending order, were “work not following the manual or checklist” (55.8%), “neglecting necessary calls” (31.7%) and “double-checking by oneself” (29.7%).

The participants were divided into two groups according to years of nursing experience: a Short Group (3 to 14 years) and a Long Group (15 years and more). Prevalence of the errors, “work not following the manual or the checklist,” “neglecting necessary calls,” “neglecting to tell patients of examination/ treatment times” and “neglecting to use bed stoppers” were more common in the Short Group than those in the Long Group (Figure 1).

The results of principal component analysis using the 13 items of experience of making errors showed 3 principal components with eigen value ≥ 1 (Table 2). The first component was comprised of 10 items. It was related to the treatment of patients, and was consequently designated as “clinical errors”. The second component was comprised of 2 items, and was designated a “mistake in administering medicine”. The third component was comprised of 1 item, and was designated as “errors related to beds”. In this study, ten items, corresponding to clinical errors, were used as the composite measures. The points were summed up. A high score means a higher number of clinical errors. Cronbach’s alpha was 0.750 for the scale, “clinical errors.”

Relationships between detecting errors and individual characteristics

As shown in Table 1, the prevalence of those who had experienced

Variable	Component		
	1	2	3
Neglecting to tell patients of examination/ treatment times	0.676	-0.133	-0.380
Neglecting necessary calls	0.651	-0.291	-0.226
Neglecting to verify the condition of a patient after giving medicine	0.595	-0.110	-0.339
Neglecting treatments indicated by a doctor	0.540	0.031	-0.027
Work not following the manual or checklist	0.540	-0.305	0.008
Calling a patient by the wrong name	0.539	-0.127	-0.125
Removing bed rails – not leading to a patient fall	0.499	-0.041	0.475
Leaving a needle on/ around a bed	0.494	0.093	0.219
Neglecting to check remaining amount of oxygen in a tank	0.494	0.035	0.188
Double-checking by oneself	0.413	-0.286	0.233
Giving medicine to the wrong patient	0.464	0.635	-0.144
Setting up an IV with the wrong bottle	0.465	0.628	-0.111
Neglecting to use bed stoppers	0.498	0.100	0.537
Accumulation contribution ratio 44.9%	28.4%	8.7%	7.8%

Table 2: Results of principal component analysis using 13 items of experience of making errors (N=1861).

detecting their own errors was significantly higher in the group whose age was 37 years and less. Its prevalence was also significantly higher in the group who had night shift duty, and who had experienced a medical accident.

The prevalence of those who had experienced detecting errors of others was significantly higher in the group whose job position was manager, who had night shift duty, who had experience participating in a medical safety course, and who had experience as a safety committee member.

Table 3 shows the comparisons of individual scores according to experience of detecting errors. Those who had experienced detecting their own errors had significantly higher scores in clinical errors, generally lower scores in the subscales of KiSS-18 and lower scores in the subscales of patient safety culture, non-punitive response to errors and overall perceptions of patient safety.

Those who had experienced detecting errors of others had significantly higher scores in the clinical errors, generally higher scores in the subscales of KiSS-18, higher score in the subscale, communication openness, and lower scores in the subscales of patient safety culture, non-punitive response to errors and overall perceptions of patient safety.

Multiple logistic regression analysis was performed with experience of detecting errors as the dependent variable (Table 4). In the results concerning having experienced detecting one's own errors (Table 4a), overall prediction of the model was 80.8%. Significant factors related

Variable ^a	Experience of detecting an error					
	Own self ^b		P	Others ^c		P
	Yes	No		Yes	No	
	Median (IQR)			Median (IQR)		
Experience of Making Errors*						
Clinical Errors	4 (2-7)	2 (0-4)	<0.001	3 (2-6)	2 (1-4)	<0.001
	Mean ± SD			Mean ± SD		
KiSS-18**						
Basic Skills	9.4±2.4	9.6±2.3	0.184	9.5±2.3	9.0±2.5	0.001
Advanced Skills	10.1±1.9	10.4±1.7	0.002	10.3±1.8	9.8±1.9	<0.001
Emotional Management Skills	9.2±2.0	9.6±1.8	0.001	9.4±1.9	9.0±2.0	0.005
Offense Management Skills	9.2±1.9	9.6±1.8	<0.001	9.3±1.9	9.1±1.9	0.037
Stress Management Skills	9.4±1.9	9.8±1.7	<0.001	9.5±1.9	9.3±1.9	0.058
Planning Skills	9.8±2.0	10.2±1.8	<0.001	9.9±1.9	9.5±2.1	0.001
Patient Safety Culture**						
Communication Openness	10.0±2.1	10.2±2.1	0.073	10.2±2.1	9.5±2.1	<0.001
Feedback and Communication about Error	12.0±2.3	12.0±2.3	0.972	12.0±2.3	12.0±2.3	0.699
Non-punitive Response to Errors	9.4±2.2	10.0±2.3	<0.001	9.5±2.2	10.0±2.2	0.001
Organizational Learning-Continuous Improvement	11.7±1.8	10.8±1.6	0.204	10.7±1.8	10.8±1.7	0.439
Overall Perceptions of Patient Safety	13.3±2.2	13.8±2.1	<0.001	13.3±2.2	13.9±2.1	<0.001
Teamwork within Units	15.8±2.4	15.9±2.5	0.463	15.8±2.4	16.0±2.4	0.131

Table 3: Comparisons of individual scores by experience of detecting the errors.

^a Unmarked or missing data were not included in the analysis.

^b Own self Yes=1441 (77.4%), No=420 (22.6%)

^c Others Yes=1565 (84.1%), No=281 (15.1%)

IQR interquartile range, SD standard deviation

* Mann-Whitney U test, ** T test

a. Own self (N=1831)					b. Others (N=1740)				
Item	95% CI			P	Item	95% CI			P
	OR	Lower	Upper			OR	Lower	Upper	
Experience of detecting errors					Experience of detecting errors				
Detected by others	7.34	5.72	9.42	<0.001	Detected by others	4.23	3.09	5.78	<0.001
Experience of Making Errors					By oneself	1.76	1.27	2.43	0.001
Clinical Errors	2.45	1.88	3.20	<0.001	Patient Safety Culture				
Patient Safety Culture					Communication Openness	1.78	1.32	2.40	<0.001
Feedback and Communication about Error	1.29	1.00	1.67	0.049	Characteristics				
Characteristics					Night shift	2.06	1.51	2.82	<0.001
Experience of a medical accident	1.58	1.04	2.40	0.028	Experience as a Safety Committee Member	1.73	1.22	2.45	0.002
P<0.01 Overall prediction of the model 80.8%					KiSS-18				
OR odds ratio, CI confidence interval					Planning Skills	1.58	1.17	2.13	0.003
					P<0.01 Overall prediction of the model 85.3%				
					OR odds ratio, CI confidence interval				

Table 4: Factors related to experience detecting errors.

to having experienced detecting one's own errors were: experience having their own errors detected by others, clinical errors, feedback and communication about errors, and having experienced a medical accident.

In the results concerning experience of detecting errors of others (Table 4b), overall prediction of the model was 85.3%. Significant factors related to experience of detecting errors of others were: experience having their own errors detected by others, experience of detecting their own errors, communication openness, night shift duty, experience as a safety committee member, and planning skills.

Discussion

Detecting one's own errors and those of others

Among the clinical errors, errors, such as, "calling a patient by the wrong name" and "neglecting to do something" were frequent. They are human errors and not always preventable in daily medical practice [10]. However, "work not following the manual or checklist" was problematic, because such operation increases the likelihood of developing the errors. As well as mutual checks, continuing education and training for medical safety is preferable.

Prevalence of some kinds of errors was more frequent in the Short Group. This result corresponded to one of the earlier reports illustrating that nurses with 3 to 10 years of experience had a high odds ratio of experiencing errors compared with those 10 years and longer [27]. In general, younger nurses are the staff members most active in direct patient care. This fact may account for younger nurses' increased likelihood of experiencing errors.

The ratio of having experienced detecting errors of others in this study was 84.1%. This ratio was higher than one found in an earlier study (69.3%) in which participants included nurses with careers of 2 years or less [4,5]. The ratio of having the experience of having one's own errors detected by others was 73.0%, and the errors detected by a colleague, senior associate or junior fellow. These may come from the fact that nurses always care for patients not individually but a team collaborating with others. The ratio of having experience having the own errors detected by others was less than that of having experienced detecting errors of others. This may come from that the errors of nurses with careers of 2 years or less, who were not included in this study, were also a target to be detected by others.

Those who had experienced detecting errors of others had experienced having their own errors detected by others. This corresponded to an earlier report showing a relationship between nurses detecting errors of others and having their own errors detected by others [4,5]. Those who had experienced detecting errors of others had also experienced detecting their own errors. These results imply that the experiences of having experienced their own errors detected by others and detecting their own errors were important for detecting the errors of others.

Factors related to detecting one's own errors

In this study, individual characteristics, which were suspected of being related to the experience of detecting errors, were clinical errors, subscales of KiSS-18, domains of safety climate in the ward, and general characteristics. Clinical errors were composite measures of 10 items among 13. Principal component analysis uncovered three underlying components. Two components, mistakes in administering medicine and errors related to beds, refer to errors occurring in the specific occasions. Excluding these two components may be more suitable for estimating the experience of making errors during clinical practice as a whole.

The experience of having one's own errors detected by others was related to the experience of detecting one's own errors. Those who assume or misunderstand their own ability have difficulty in detecting their own errors [28]. The experience of having one's own errors detected by others will enhance the ability to realize one's own activities [29] and lead to increased ability to detect one's own errors.

Experience of clinical errors and of medical accidents was also related to experience of detecting one's own errors. After making a clinical error or a medical accident, a nurse will strive to be more aware of the working conditions in order to perceive and prevent a recurrence. This individual action creates an opportunity to learn from clinical errors and medical accidents, and thus enhances the ability to detect one's own errors.

Feedback and communication of errors are factors related to the experience of detecting one's own errors. When an error happens in a ward, the ward staff will endeavor to examine the contents, the causes and the background of the error, debate measures to prevent a recurrence, and then enforce appropriate actions. This work-group action also creates an opportunity to enhance the ability to detect one's own errors [30].

Night shift duty, lower social skills, lower non-punitive response to errors and overall perceptions of patient safety were related to experience of detecting one's own errors although these factors were not adopted in the model. Those who have night shift duty [31], and who have lower social skills seem to be predisposed to making errors, but also have the potential for detecting their own errors. Overall perceptions of patient safety are important. Some hospitals improve their culture of safety by creating a non-punitive response to error as evidenced by results of the Agency for Healthcare Research and Quality's Hospital Survey on Patient Safety Culture [32], but in this study, punitive responses to errors supported the contention that it induces nurses to detect their own errors. Further study is necessary.

Factors related to detecting errors of others

The experience of having one's own errors detected by others was related to the experience of detecting the errors of others. This experience will enhance the ability to realize one's own activities [29] and lead to the detection of other's errors, as we have discussed in the factors related to detecting one's own errors section.

The experience of detecting one's own errors was also related to the experience of detecting errors of others. This result concurs with an earlier report [4]. The experience of detecting one's own errors may promote an environment in which nurses check themselves during daily clinical practice enabling them to check activities of others and to perceive or detect errors of others.

Communication openness in a patient safety culture consists of items such as being able to point out an error or an infraction without discomfiture, asking questions freely and feeling at ease when asked a question. Communication openness was a factor related to the experience of detecting errors of others. This result corresponded to an earlier report showing that it is important to be able to ask a question until receiving a sound answer without fear [5]. People often hesitate to point out errors of others. However, in the case of nurses, it is essential that they ask questions or point out any potential error as soon as they suspect there is something out of the norm in order to restore it. It is recommended that open communication in the ward be promoted in order to restore errors easily [33].

Night shift duty was also a factor related to experience of detecting errors of others. Those who have night shift duty are more likely to make an error than those who do not due to lack of sleep [31,34]. Nursing management for nurses' health having night shift is recommended to prevent medical errors [35]. Among those who have night shift duty, there were many full-time workers and their working hours appeared to be long. These conditions may create a situation in which nurses on night shift duty are prone to error easily, but can also increase the opportunity to detect errors of others.

Experience as a safety committee member is related to experience of detecting errors of others. A safety committee member has the capacity to examine incidents in the ward, enforce appropriate actions and evaluate such actions. These activities enhance the ability to detect errors of others.

Planning skills are related to the experience of detecting errors of others. Planning skills are the thinking skills that help an individual develop strategies to solve problems for the purpose of accomplishing goals [36]. This skill helps a nurse to think about how to complete a task before attempting to begin it. Thus, a nurse with high planning skill has many chances to scrutinize the operations of others.

Job position, and experience of participating in a medical safety course were related to the experience of detecting errors of others, although these factors were not adopted in the model. Managers have a role to guide and check the activities of staff nurses. This provides them with opportunities to detect others' errors. Those who have participated in medical safety courses may have a high sensitivity to detect errors of others occasioned by the course.

Our results show the experiencing errors can increase the possibility to detect future errors during medical practice, both their own and those of others. Nurses should note that detecting errors is the keystone to restoring an error, and confirm one's own actions and those of others. After making a clinical error, a nurse endeavors to be more aware of working conditions to prevent a recurrence. Using such keen awareness, she or he checks every day to make sure that someone is working to manual or checklist in the ward to detect and prevent errors during medical practice. It is also necessary to improve one's social skills.

The restoration process of an error first begins with detecting it [6]. Our results show the characteristics of nurses who are able to detect errors during medical practice, both their own and those of others. A person in charge medical safety management in hospitals should put these characteristics to practical use. The experience of having one's own errors detected by others is important to detect one's own errors [34]. To make use of such experience, adequate feedback is important after making an error [37]. To detect errors of others, having experienced having one's own errors detected by others and that of detecting one's own errors are salient. In addition, it is preferable to promote open communication in the ward where errors are mutually confirmed and easily pointed out without having to worry about deterioration in personal relationships. It is also recommended that situations where errors are prone to be made - such as night shift duty - be realized, that serving on safety committees be encouraged, and that abilities to detect problems at work with the help of Social Skills Training, etcetera, be enhanced.

Limitations of This Study

The nurses were asked about their experiences of detecting their own errors and those of others. In the case of detecting errors of others, the information was not clear as to whether he or she had been the nurse who indicated the error or not. We are, however, sure that nurses will indicate errors of others when they detect them.

Conclusions

Among 1861 nurses working in 11 hospitals of which the number of beds was 300 and more, in Wakayama Prefecture, Japan, and whose working career was three years and longer, 77.4% had experienced detecting their own errors once or more than once, and 84.1% had experienced detecting errors of others once or more than once. In the results of multiple logistic regression analysis regarding experience of detecting one's own errors, significant factors related to it were: having experienced their own errors detected by others, clinical errors, feedback and communication about errors, and experience of a medical accident. In the results concerning having experienced detecting errors of others, significant factors related to it were: experience having their own errors detected by others, experience of detecting one's own errors, communication openness, night shift duty, experience as a safety committee member, and planning skills. Experiencing errors play an important role in detecting future errors

of one's own making and of others. Moreover, adequate feedback is desirable for detecting one's own errors, and open communication in the ward is recommended for detecting errors of others, as one facet of medical safety control.

Competing Interests

The authors declare that they have no competing interests.

Author Contributions

MU, AI, KY, and IM were responsibility for Study design and manuscript preparation. MU, and IM were for data collection. MU, AI, and IM were for analysis.

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