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An analysis of the factors of medical errors perceived by nurses
－Factor exploitation and model construction－

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Abstract

In order to identify the factors that nurses having experienced medical errors considered likely to lead to medical errors and to find out the inter-relations among factors and explain their perception formation by model construction, we surveyed 1,053 nurses who were working in eight randomly-selected hospitals each having more than one clinical department.

We conducted exploratory factor analysis to find out a small number of latent background factors from a large number of items that are manifest factors, and also used Structural Equation Models. For the identification of factors, 23 items were input to extract factors by factor analysis; multiple linear regression analysis was applied. Data analysis used for factor analysis and multiple linear regression analysis; moreover SEM which is able to show cause and effect relations in phenomena and concept structures, was used.

As the result of verifying the independence between the years of nursing experience with five years set as the separator and the experience or non-experience of medical accidents by the Chi-square test showed a significant difference between nurses with less than five years and nurses with five years or more of experience. With less than five years of experience working as a nurse, five factors of "Poor physical conditions," "Unable to concentrate," "Inferior working environment," "Tasks which easily lead to confusion," and "Looking- Back" were extracted from nurses, while the four factors of "Management of health," "Variant services," "Difficult judgment," and "Demotivation" were extracted from nurses with five years or more of experience working.

In the adopted models, factors are divided into ones associated with the individual aspects of a nurse and ones associated with working environments. In both models for nurses with or without at least five years of experience, a cause-and-effect relation is drawn from factors associated with working environment through to factors associated with personal aspects. It was presumed that nurses with less than five years of experience perceived the factors of medical errors to lie in the very working environment in which they were working, while nurses with five years or more of experience perceived medical errors to be attributable to interpersonal relations. It is important to, based on the results of this study, not only attempt to improve the work environment and interpersonal relations but also be thoroughly committed to the creation of smooth relationships.

Key words

accident and error factors, perception, Structural Equation Modeling, working environment, interpersonal relationships

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Introduction

Due to recurring accidental misidentification of patients[1)·2)], there is a growing awareness of medical accidents including medical suits[3)] among general citizens, and the guidelines for medical safety provided by the Ministry of Health and Welfare or Nursing associations also recommend that full use be made of safety guidelines or risk management. The reports on medical accidents[4)] deal with remedial treatments, nursing care, medical devices, and medication, and the job categories of concerned parties, nurses and assistant nurses accounted for 40%, which is the second place after doctors.

To understand the background of medical errors (accidents/errors), who recognizes that there are cumbersome nursing services and a working environment in which nurses are forced to manage multiple services, resulting in a single nursing service being interrupted. Also, it is assumed that a change and interruption will occur even in a scheduled nursing service.

Many reports on safety exist, including a study by Yamaguchi et al., which discusses the training of uttering a vocal alert at the time of injection[5)], a study by Adachi et al., which deals with the existence of urgent and pressing psychological situations leading to violation of rules[6)], and a study by Shimamori et al., which deduces that too much reliance on experience is the cause of accidents[7)] based on a survey targeted at pharmacists. Overall, these studies discuss the importance of organization of cumbersome clinical services, reduction of psychological stress in nurses[8)], and decrease of factors that may confuse nurses in forming judgments about nursing services[9)].

For the event of an individual medical error, guidelines are independently prepared and certain results have been achieved. However, we find no studies that suggest preventive measures for medical errors based on the perception of nurses who are actually working in clinical situations that have caused a medical error.

For this reason, in order to present new suggestions for prevention of medical errors that nurses are likely to experience, we decided to target at nurses who had experienced medical errors, identify the factors of medical errors that nurses are susceptible to by exploring their perception of medical errors, and show the causal models of perception formation (model).

Definitions of terms

1. Medical accident

Of the events that arise out of a medical act, leave some degrees of injury or damage, or cause some kinds of unfavorable and visible symptoms, the term "medical accident" refers collectively to those events which are unpredictable at the current medical level (force majeure events) and attributable to errors by medical personnel (faults). (Example: Events requiring treatments by doctors.)

2. Medical error

Of the errors made in the course of a medical act, refers to those errors whose adverse effects can be avoided by humans, in which doctors or other healthcare workers are involved in the possible prevention of their occurrence, and which are latent or produce no symptoms identifiable by observations or with human eyes. (Example: Errors requiring only reporting to a doctor and observations).

3. Operational definitions for the study

For the purpose of this study, an incident or event that emerges under certain circumstances, such as a medical error, is termed an "event." Also, of the individual events that bring about a medical error, a subordinate concept composing a question is termed an "item," and a background factor or dominant concept related to medical errors that is comprised of a group of items is termed a "factor."

Objectives of the Study

The following two objectives were set up for the study:

1. To identify the factors that nurses having experienced medical errors consider likely to lead to medical errors.
2. To find out the inter-relations among factors and explain their perception formation by model construction.

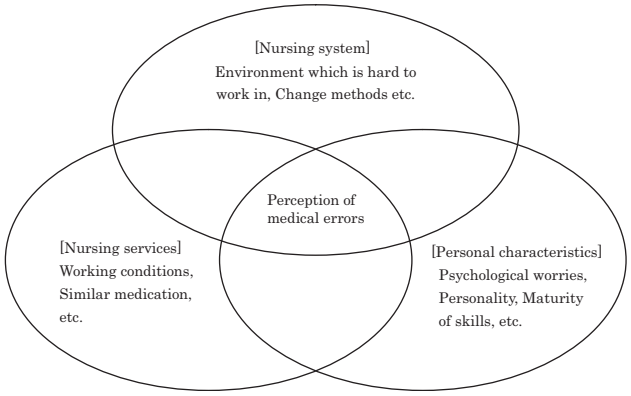

Figure 1. Framework of perception of medical errors

Methods

1. Framework of perception of medical errors

Fig. 1 shows the conceptual framework of factors based on the literature on medical errors[10-12]. In this study, we conducted exploratory factor analysis to find out a small number of latent background factors from a large number of items that are manifest factors, and also used Structural Equation Models (SEMs) to predict the relationship of individual items and factors that exist behind the items.

2. Subjects

Referring to the area classification[2] by the Japan Council for Quality Health Care, prefecture A was selected from the Chubu district and prefecture B from the Chugoku district. As a criterion for selection of a hospital, candidate hospitals were checked to ensure that they had taken measures to prevent medical errors such as preparing guidelines and providing education and training for nurses. The survey was targeted at the nurses, assistant nurses, public health nurses, and midwives who were working in the eight randomly-selected hospitals each having more than one clinical department regardless of their working styles. This study was performed to pursue the underlying factors that bring about medical errors in clinical services. It is therefore important to gauge how those factors are perceived by nurses who have experienced medical errors. Although the events that causes medical errors may not be identical but differ, there are not a few cases in which identical events, such as misidentification of drugs to be dispensed or patients with the same names, occur in a process. Because of this, this study was directed to those nurses who had experienced both a medical accident and an error or one of these.

3. Data collection method and survey period

As the survey method, distribution and collection were left to the nursing department, and data were gathered by delivering and collecting the questionnaire sheet. The survey period was from August 2009 to the end of January 2010.

4. Organization of the questionnaire sheet

The items on the questionnaire sheet were prepared from three categories in accordance with the conceptual diagram of this study (Fig. 1). With reference to the question items in Konishi and Sato[13・14] et al., the number of questions was 23 (Table 1). For each of the questions from (a) "Perception concerning nursing services" to (c) "Perception concerning nursing systems" in 2) Perception concerning the factors of medical errors" shown below, the subjects were requested to choose one option by its number from among the four Likert scale options from "Agree" through "Disagree," and the number thus chosen was rated as positive 4 through negative 1. For 3) Experience or no experience of medical errors", the subjects were requested to answer whether they had experienced medical errors in the past. The specific organization of the question sheet was as follows:

1) Sample characteristics of the subjects

Sex, age, job category, and years of experience 4 items

2) Perception concerning the factors of medical errors

(a) Perception concerning nursing services 5 items

(b) Perception related to the aspects of a personal Characteristics 11 items

(c) Perception concerning nursing systems 7 items

In this study, (a), (b), and (c) were used as arbitrary classification codes.

3) Experience or no experience of medical errors

5. Data analysis method

Descriptive statistics was used for experience/

Table 1. The question items for medical errors

Items(Sentences)	Category	Code
Options: (4. Agree 3. Somewhat agree 2. Somewhat disagree 1. Disagree)		
(1) Change in method (I think that happened because the prior method was changed.)	Nursing service	(a)
(2) Interruptions (I think that happened because the service act was interrupted.)	Nursing system	(c)
(3) Time lag between judgment and action (I think that happened because there was a time lag between judgment and action)	Nursing system	(c)
(4) Absent-minded by other patients/matters (I think that happened because absent-minded by other patients/matters during the service.)	Nursing service	(a)
(5) The service method or procedure differed among hospitals or wards (I think that happened because the service method or procedure differed among hospitals or wards.)	Nursing system	(c)
(6) Lack of preparation (I think that happened because there was lack of preparation.)	personal characteristic	(b)
(7) Not used (I think that happened because familiarity to work occurred and kept me from paying caution or attention.)	personal characteristic	(b)
(8) Depression (I was mentally depressed.)	personal characteristic	(b)
(9) Out of physical balance (I was out of physical balance.)	personal characteristic	(b)
(10) Frustration (I was frustrated.)	personal characteristic	(b)
(11) Felt physical fatigue (I felt physical fatigue.)	personal characteristic	(b)
(12) Bad teamwork (I think that happened because of the bad teamwork.)	Nursing system	(c)
(13) The influence of personal traits (I think that happened because of the influence of the personal traits of an personal such as impatience and strong anxiety.)	personal characteristic	(b)
(14) Behaved thoughtlessly without knowledge of the atmosphereor situation (I think that happened because I behaved thoughtlessly without knowledge of the atmosphere or situation.)	personal characteristic	(b)
(15) Immature skills (I think that happened because my skill was immature.)	personal characteristic	(b)
(16) Existence of patients with the same first and family name (I think that happened because patients with the same first and family name existed.)	Nursing service	(a)
(17) Medications with similar names (I think that happened because there were Medications with similar names.)	Nursing service	(a)
(18) Unable to understand the situation after taking leaves (I think that happened because I was uncertain about the situation as a novice or after taking leaves.)	Nursing system	(c)
(19) Poor clinical working conditions (I think that happened because there are poor clinical working conditions compared with other job categories.)	Nursing system	(c)
(20) Hands moved unconsciously (I think that happened because my hands moved unconsciously.)	personal characteristic	(b)
(21) Unable to concentrate on work due to bothering team members (I think that happened because I was unable to concentrate due to bothering team members.)	Nursing service	(a)
(22) Felt sympathy for the patient in charge (I think that happened because I felt sympathy for the patient in charge.)	personal characteristic	(b)
(23) Absence of consistent order system (I think that happened because there was absence of consistent order Nursing system.)	Nursing system	(c)

no experience of medical errors and the attributes of subjects.

For the factors of medical errors perceived by nurses who have experienced medical errors, the Chi-square test was conducted to confirm whether or not there were any differences in perception between nurses who had worked as a nurse for less than five years and ones who had worked as a nurse for five years or over[2)·15)]. For the identification of factors perceived by nurses with less than five years and not less than five years of experience, 23 items were input to extract factors by factor analysis. Next, multiple linear regression analysis was applied to see how factors are related with each other, followed by the construction of models to examine the association among factors as well as perception formation. When a model was unsatisfactory, its suitability was improved by

Table 2. Hospital characteristics

Number(%)

Hospitals*	Total number of beds	Number of nurses	Response rate	Number of male	Number of female	N.A	Number of clinical departments	Average length of stay in hospital, day
A	277	255	129 (50.6)	8	121	0	14	14
B	330	235	181 (77.0)	6	173	2	14	24
C	442	422	303 (71.8)	12	290	1	22	17
D	254	200	134 (67.0)	3	131	0	16	18
E	258	209	138 (66.0)	10	128	0	21	13
F	311	213	94 (44.1)	2	92	0	21	18
G	434	339	195 (57.5)	24	171	0	24	16
H	190	120	111 (92.5)	2	109	0	17	18

*Four hospitals (ID; A-D) are in A prefecture, the rest (ID; E-H) are in B prefecture

repeating the deletion and addition of insignificant paths based on the modification indices. As the indices with which to determine suitability, GFI, AGFI, CFI, NFI, TLI, RFI, IFI, RMSEA, AIC, and Chi-square values were employed, but the Chi-square values were used for reference only because rejection would take place[16] when the number of samples exceeds 500. SPSS ver16 was used for factor analysis and multiple linear regression analysis of data; moreover AMOS ver17, which is able to show cause and effect relations in phenomena and concept structures, was used for SEM data analysis. The cut-off point was 0.3[17].

6. Ethical considerations

As the ethical considerations for the study, the intent, objectives, and method of the study, freedom of participation, and the right to decline were written on paper, and the acceptance of the subjects was confirmed by their submission of the survey sheet. Additionally, the subjects were requested to complete the survey sheet in person by complete anonymous entry and seal it by themselves in strictest confidence before submission. The study was conducted after obtaining approval of the Ethics Committee in Prefectual University of Hiroshima (No.7 issue).

Results

1. Sample characteristics

The number of people to whom we distributed the survey was 1,687, the number who experienced medical errors was 1,053 and it was these people who were the subject of our search. The Cronbach alpha as a measure for internal consistency of the questions in general was 0.9. The outline of the hospitals was as shown in Table 2. The hospitals were small- and mid-sized institutions ranging in size from 190 to 442 beds.

There was no significant discrepancy between the age composition in this study and the age composition nationwide[15]. The ratios of the job categories were 0.6% for public health nurses, 4.0% for midwives, 91.7% for nurses, 3.0% for assistant nurses, and 0.7% for non responders (Table 3).

As for experience or no experience of medical accidents by nurses with less than and not less than five years of experience working as a nurse, those who had experienced medical accidents accounted for 27.0% of all nurses, and those who had experienced medical errors for 68.0%. The result of verifying the independence between the

Table 3. Sample characteristics

Demographics		Number	%
Sex			
	Male	66	5.3
	Female	984	94.5
	No answer	3	0.2
Age, y			
	20−29	254	24.1
	30−39	359	34.1
	40−49	285	27.1
	>49	131	12.4
	No answer	24	2.3
Type of job			
	public health nurses	6	0.6
	midwives	42	4.0
	nurses	966	91.7
	licenced practical nurses	32	3.0
	No answer	7	0.7

Table 4. Ratios of experienced medical errors %

Experienced / Not experienced		Total numbers	Less than 5 years	5 years or over	P*
Accidents	Yes	27.0	19.4	27.5	0.05
	No	73.0	80.6	72.5	
Errors	Yes	68.4	63.5	59.8	n.s
	No	31.6	36.5	40.2	

*Comparison was conducted between "Less than 5 years" and "5 years or over" by chi-square test

years of nursing experience with five years set as the separator and the experience or non-experience of medical accidents by the Chi-square test showed a significant difference ($p<0.01$) between nurses with less than five years of experience (less than five years) and nurses with five years or over of experience (five years or over). Of the nurses with less than five years of experience working as a nurse, 19.4% had experienced medical accidents and 63.5% had experienced medical practice, while of the nurses with five years or over of experience working as a nurse, 27.5% had experienced medical accidents and 59.8% had experienced medical errors. Medical errors include medical accidents and in this latter case there was a significant difference between nurses with less than five years experience and those with five years or over. Therefore we conducted separate analyses for these two categories of nurses (Table 4).

2. Exploratory factor analysis and SEMs of medical errors

1) Examination for factor extraction

In the extraction of factors, the number of factors was determined after confirming the factor formation of the 23 items by the principal factor analysis. Next, the likelihood method was applied to take or leave items by promax rotation, during which time seven items with a value of less than 0.4 were excluded for nurses with less than five years of experience, and six items were excluded for nurses with five years or over of experience.

Table 5. Factor analysis of nurses working for less than 5 years

Naming	Questionnaire code	Items	Factor Loading Factor1	Factor2	Factor3	Factor4	Factor5
Poor physical and psychological conditions	(b)	Out of physical balance	0.88	−0.07	−0.04	−0.01	0.01
	(b)	Felt physical fatigue	0.76	−0.04	0.09	0.12	−0.13
	(b)	Depression	0.69	−0.03	−0.07	−0.02	0.26
	(b)	Frustration	0.51	0.11	0.09	0.00	0.02
Unable to concentrate	(b)	Felt sympathy for the patient in charge	−0.07	0.84	−0.15	0.10	−0.04
	(c)	Absence of consistent order system	0.07	0.75	−0.14	0.01	0.00
	(a)	Unable to concentrate on work due to bothering team members	0.09	0.67	0.12	−0.07	0.03
	(b)	Hands moved unconsciously	−0.15	0.57	0.08	0.02	0.06
Inferior working environment	(a)	Absent-minded by other patients/matters	−0.04	−0.09	0.74	0.03	0.06
	(c)	Interruptions	0.07	−0.09	0.69	−0.01	−0.06
	(c)	Poor clinical working conditions	0.17	0.33	0.44	−0.06	−0.20
Tasks which easily lead to confusion	(a)	Existence of patients with the same first and family name	0.09	0.06	−0.11	0.88	−0.02
	(a)	Medications with similar names	−0.02	0.00	0.16	0.71	0.01
Looking-Back	(b)	Immature skills	0.16	−0.02	−0.12	−0.05	0.62
	(b)	Behaved thoughtlessly without knowledge of the atmosphere or situation	−0.09	0.20	−0.08	0.04	0.57
	(b)	Lack of preparation	0.01	−0.10	0.15	0.00	0.53
Correlation				0.48	0.56	0.27	0.40
					0.53	0.37	0.48
						0.44	0.45
							0.36

Table 6. Factor analysis of nurses working for 5 years or over

Naming	Questionnaire code	Items	Factor Loading Factor1	Factor2	Factor3	Factor4
Management of health	(b)	Out of physical balance	0.88	−0.02	−0.04	−0.05
	(b)	Felt physical fatigue	0.81	−0.05	0.07	−0.13
	(b)	Depression	0.71	−0.01	−0.11	0.12
	(b)	Frustration	0.62	0.09	0.04	0.00
	(b)	The influence of personal traits	0.42	0.06	0.10	0.08
Service variances	(c)	Interruptions	−0.10	0.81	0.01	−0.03
	(a)	Absent-minded by other patients/matters	0.13	0.61	−0.06	−0.04
	(c)	Time lag between judgment and action	0.02	0.60	−0.04	0.04
	(a)	Change in method	0.01	0.53	0.05	−0.02
	(c)	The service method or procedure differed among hospitals or wards	0.01	0.40	0.06	0.10
Impossibility to judge	(a)	Medications with similar names	−0.04	0.04	0.82	−0.07
	(a)	Existence of patients with the same first and family name	−0.08	−0.01	0.74	0.05
	(c)	Unable to understand the situation after taking leaves	0.09	−0.01	0.59	0.04
	(b)	Immature skills	0.22	−0.05	0.42	0.02
Demotivation	(a)	Unable to concentrate on work due to bothering team members	0.07	−0.03	−0.05	0.76
	(b)	Felt sympathy for the patient in charge	−0.03	−0.03	0.06	0.75
	(c)	Absence of consistent order system	−0.04	0.07	0.03	0.60
Correlation				0.49	0.46	0.57
					0.46	0.45
						0.53

Lastly, the remaining items for both groups of nurses were finalized by promax rotation.

2) Results of factor analysis on nurses with less than/not less than five years of experience who had experienced medical errors (Table 5, Table 6)

In the case of nurses with less than five years of experience, five factors consisting of respective items were extracted, and the Cronbach alpha as a measure for internal consistency was 0.86. The factors were labeled "Poor physical and psychological conditions," "Unable to concentrate," "Inferior working environment," "Tasks which easily lead to confusion," and "Looking-Back" in this order. The Cronbach alpha values for the factors were 0.82, 0.79, 0.67, 0.80, and 0.60 in the same order. Next, for nurses with five years or over of experience, four factors were extracted and the Cronbach alpha as a measure for internal consistency was 0.90. The factors were labeled "Management of health," "Variant services," "Impossibility to judge," and "Demotivation" in this order. The Cronbach alpha values for the factors were 0.83, 0.74, 0.76, and 0.75 respectively.

3) Nurses' perception formation models for medical errors

With the results of factor analysis, the correlations among items and factors were examined on the assumption of cause-and-effect models after the relations among factors had been confirmed by multiple linear regression analysis. As a result, an interactive cause-and-effect relation was observed between factors 1 and 5, so the extraction of the most influential factors was examined through the models, considering the necessity to find out which factor has the greatest influence on which factor in the cause-and-effect relationship. In order to improve the suitability of the model, the top two items in terms of loading were defined as observed factors[18], and the observed factors were switched in turn. In the adopted models, factors were divided into ones related to nursing services and systems for which nurses were working and ones related to the personal characteristics of nurses, and for both of nurses with less than and not less than five years of experience, a cause-and-effect relation was drawn from factors related to working environment to factors related to personal

aspects.

(a) Perception formation model of nurses with less than five years of experience for medical errors (Fig. 2)

For nurses with less than five years of experience, a rate of contribution corresponding to a pass coefficient of 0.5 or more was observed in the composite items of each factor, and the indices as a measure of suitability were: RMSEA=0.04, GFI=0.97, and AGFI=0.94. Each of the other indices showed 0.9 or higher with AIC=88.73, and even in the Chi-square test that does not show a significant difference as long as the suitability is high, no significant difference (40.73, p=0.11) was identified, resulting in the model showing the highest suitability.

To describe the subordinate items of each factor, the factor 1 included "Frustration (0.72)" and "Out of physical balance (0.66)." The factor 2 was broken down into "Absence of consistent order system (0.86)" and "Felt weakness for the patient in charge (0.75)" the factor 3 into "Poor clinical working conditions (0.62)" and "Interruptions (0.52)" the factor 4 into "Medications with similar names (0.84)" and "Existence of patients with the same first and family name (0.80)" and the factor 5 into "Lack of preparation (0.60)" and "Immature skills (0.57)."

The model shows a correlation between "Inferior working environment" (factor 3) and "Tasks which easily lead to confusion" (factor 4), as well as a cause-and-effect relation of the factor 3 with "Poor physical and psychological conditions" (factor 1), "Unable to concentrate" (factor 2), and "Looking-Back" (factor 5). In "Less than 5 years", inferior working environment was the caused of medical errors. The most influential factor and item in terms of a correlative relationship were "Poor clinical working conditions" in factor 3 and "Medications with similar names" in factor 4. The most influential factor and item in terms of a cause-and-effect relationship were "Frustration" in factor 1, "Absence of consistent order system" in factor 2, and "Lack of preparation" in factor 5.

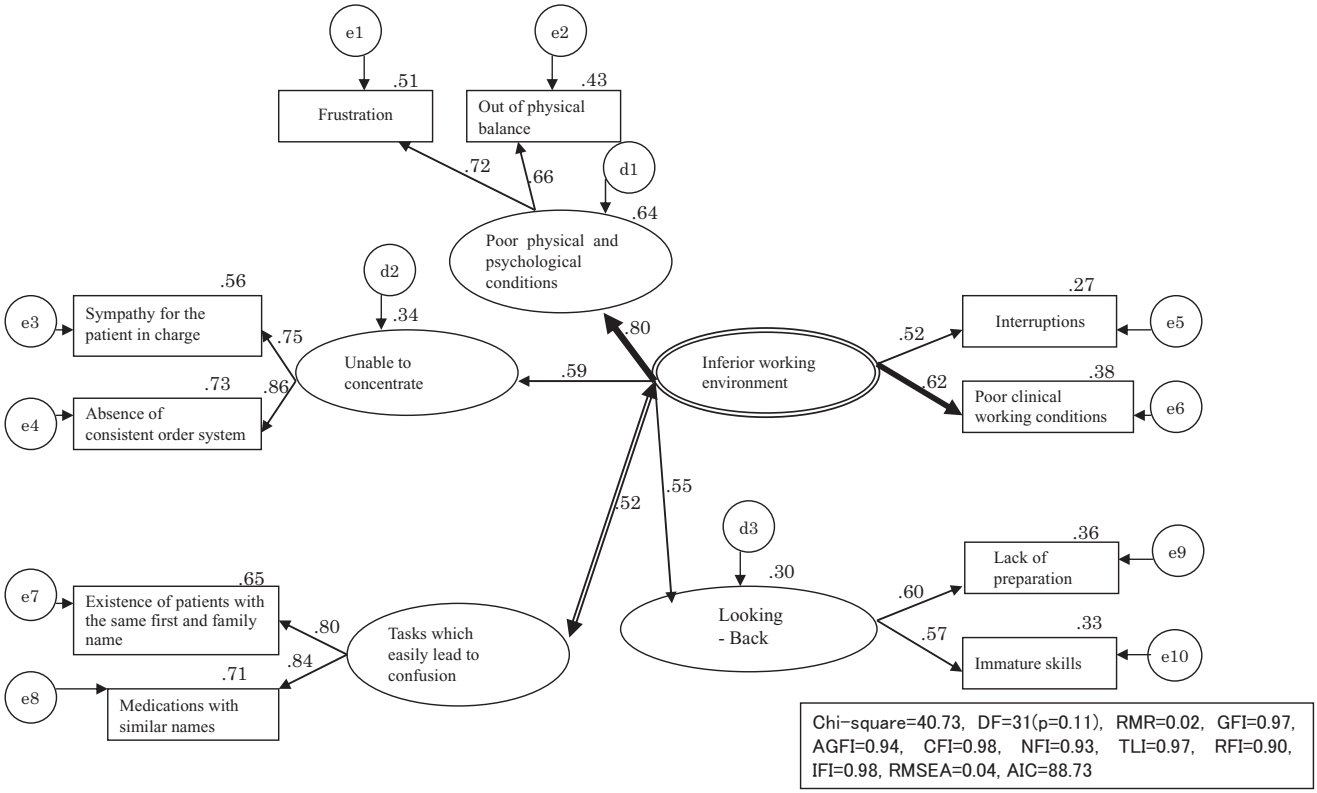

Figure 2. Model of nurses working for less than 5 years

＊e(1-10) is error variable, d(1-3) is disturbance variables. Both are treated as variables which are not directly observed but have an influence on observed variables. "⟵" is cause and effect, "⟷" is correlation, and "⬭" is cause.

(b) Perception formation model of nurses with five years or over of experience for medical errors (Fig. 3)

For nurses with five years or over of experience, a rate of contribution corresponding to a pass coefficient of 0.4 or higher was seen in the composite items of each factor, and also in the Wald test to demonstrate correlations, every path coefficient was at the significant level of 1%. The indices as a measure of suitability were 0.04 for RMSEA, 0.99 for GFI, and 0.98 for AGFI, and the other indices also showed 0.9 or higher, making the model highly suitable with AIC=80.40.

To describe the subordinate items of each factor, factor 1 included "Frustration (0.78)" and "Felt physical fatigue (0.69)." Factor 2 was broken down into "Absent-minded caused by other patients or matters (0.49)" and "Change in method (0.41)," factor 3 into "Impossible to understand the situation as a novice or after taking leaves (0.74)" and "Medications with similar names (0.66)," and factor 4 into "Unable to concentrate due to bothering team members (0.70)" and "Absence of consistent order system (0.64)."

The model shows a correlative relation between "Variant services" (factor 2) and "Impossibility to judge" (factor 3), and a cause-and-effect relation of factor 2 with "Management of health" (factor 1) and "Demotivation" (factor 4). In "5 years or over", variant services was the caused of medical errors. The most influential factor and item in terms of a correlative relationship were "Absent-minded caused by other patients or matters" in factor 2, and "Impossible to understand the situation as a novice or after taking leaves" in factor 3, while the most influential factor and item in terms of a cause-and-effect relationship were "Frustration" in factor 1 and "Unable to concentrate due to bothering team members" in factor 4.

Discussion

As for the identification of factors of medical errors, countermeasures have been discussed independently for each item. However, there has been no attempt to organize and conceptualize individual items as background factors based on

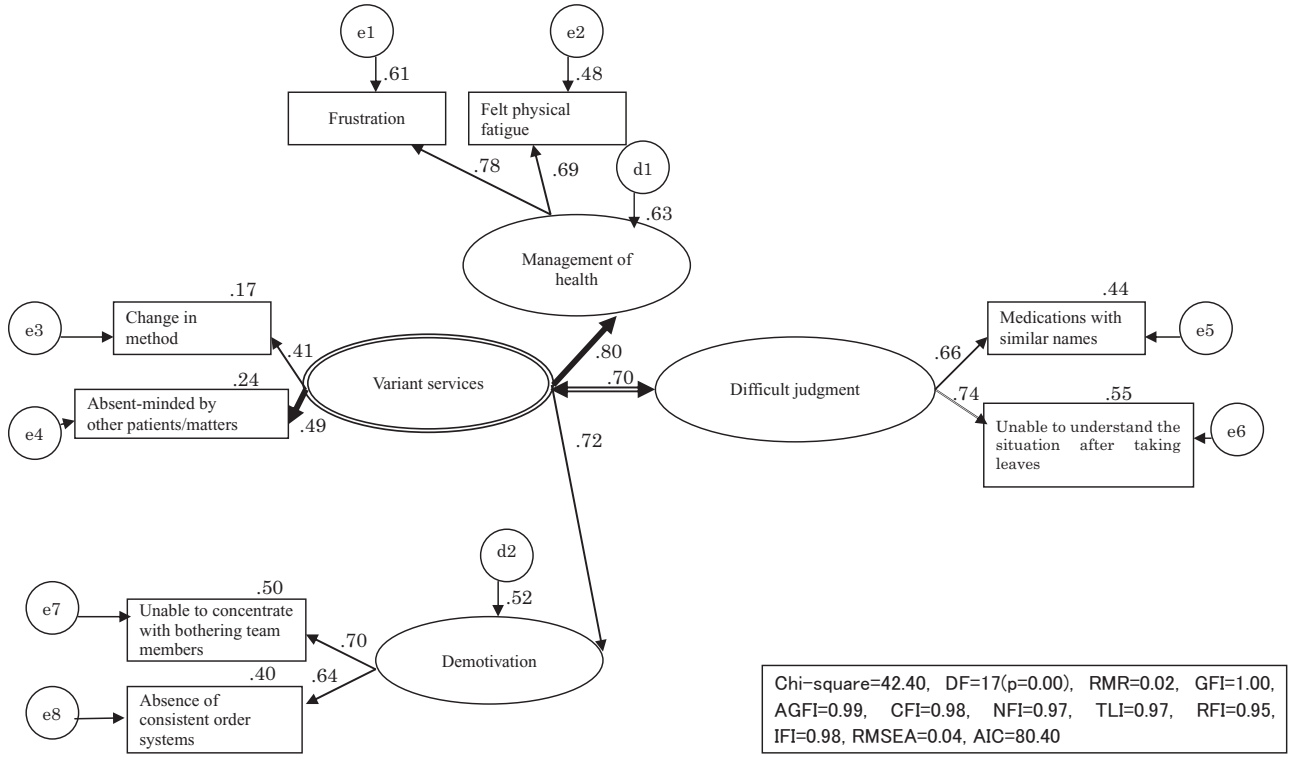

Figure 3. Model of nurses working for 5 years or over

＊ e (1-8) is error variable, d(1-2) is disturbance variables. Both are treated as variables which are not directly observed but have an influence on observed variables. "⟵" is cause and effect, "⟷" is correlation, and "⬭" is cause.

the perception of medical errors by workers who have experienced them. This study attempted to present the concept, construct the models that visualize the correlations among factors.

For nurses with less than five years of experience, the factors "Poor physical and psychological conditions," "Unable to concentrate," "Inferior working environment," "Tasks which easily lead to confusion," and "Looking-Back" were extracted. The medical scene where a nurse is working is in extremely cumbersome conditions, where it is not uncommon to see different job categories of nurses involved in the performance of a single instruction. It became evident that the factors in medical errors caused by nursing systems, nursing services and personal characteristics are complex in nature and may relate to a number of different items in the three areas. Hence, nurses are placed in a situation where they suffer "poor physical and psychological conditions" and are "unable to concentrate" on services. In addition, there exist "tasks which easily lead to confusion" that lead nurses to misidentification.

From these facts, it was presumed that the nurses were aware of the experience of medical errors and the "inferiority of their own working environment" in which they were exposed to anxiety about medical errors[19]. In the case of nurses with less than five years of experience, they are naturally expected to have an enthusiastic attitude of attending to the services while taking their own measures against medical errors even in a working environment that they are not yet familiar with, and this is considered to have emerged as "looking- back".

Next, in the model for nurses with less than five years of experience, five factors and ten items stood out. Since the factors 3 and 4 are correlated with each other, it is considered that the nurses perceived the items causing medical errors to lie in the "existence of patients with the same first and family name", and further the "poor of clinical working conditions" or the "interruptions". The items associated with the factor 3 are "frustration", "out of physical balance", "absence of consistent order system", and "sympathy for the patient in charge", each of which suggests an environment in which nurses are unable to concentrate on services. However, "looking- back" on "lack of preparation" or "immature skills" can be taken as indicating that nurses have the inner desire to prevent medical errors, so the existence of this factor representing that nurses hold to an attitude toward work is worth noting from the standpoint of preventing medical errors.

In the case of novice nurses, a tendency toward close errors due to excessive stress or impatience is seen in metal and physical aspects, in addition to experience-related aspects such as lack of knowledge or skills[20]. Nursing services involve high levels of quality requirements, provide a less allowance of self control for working at one's own pace, and further allow trouble to occur in situations where social support is less available[21]. From the above, it is suggested that the "working environment" has problems for nurses with less than five years of experience, making us realize that it is important to provide a work environment that allows one to take measures to cope with stress[22], including the way that handling stress is perceived.

In the case of nurses with five years or over of experience, the factors that would be likely to cause medical errors are "Management of health," "Variant services," "Impossibility to judge," and "Demotivation." For nurses with five years or over of experience, management of health comes first among the background factors that bring about medical errors. The inclusion of the item "the influence of personal traits" resultingly suggests that preventive measures against medical errors are being implemented under the responsibility of an individual. The existence of factors such as the importance of "service variances" and "impossibility to judge" the situation results in accounting for the existence of factors that demotivate nurses. Next, in the model for nurses with five years or over of experience, four factors and eight items were graphically drawn. Since factors 2 and 3 are correlated with each other, the "medications with similar names", situations in which one is "unable to understand the situation

after taking leaves", and further being "absent-minded by other patients or matters" and "change in method" were perceived to be items that cause medical errors.

Furthermore, as items that would be likely to be connected with medical errors, feelings of "frustration", "physical fatigue", "absence of consistent order system" and situations in which one is "unable to concentrate on work due to bothering team members" were perceived by nurses with five years or over of experience. In particular, the items of "absent-minded caused by other patients or matters" and being "unable to concentrate on work due to bothering team members" have a significant influence.

In the case of mid-career nurses, the contents and volume of services increase as years of experience increase, and this could be combined with the added responsibility to push a nurse beyond the acceptable capacity[19]. It is an experienced nurse who can manage such widely "service variances". On the contrary, however, there are not a few factors that make nurses burn out, and it has been reported that a burnout is connected with the social environment and subsequent behavioral characteristics and related with demotivation as well[23]. Also, it has been pointed out that burnout gives rise to cynism and consequently leads to medical errors[24]. There is another argument that the existence of bothering team members such as staff and chief nurses[25] matters, and even insufficient communication have been pointed out[26]. In the case of nurses with five years or over of experience, the possible factors behind medical errors would include the contents of services, anxiety for them, hesitation about being followed-up, and the existence of human relations[27] as occupational formalities, so it is important to reduce the burden on a single staff through the distribution of services, improved communication, and reduced communication errors by preparing specific rules[27]. This suggests that nurses with five years or over of experience were possibly more affected by human relations as they accumulated years of experience and had problems with "interpersonal relationships".

Conclusion

1. Five factors of "Poor physical and psychological conditions," "Unable to concentrate," "Inferior working environment," "Tasks which easily lead to confusion," and "Looking- Back" were extracted from nurses with less than five years of experience working as a nurse, while the four factors of "Management of health," "Service Variances," "Impossibility to judge," and "Demotivation" were extracted from nurses with five years or over of experience working as the same.
2. In the adopted models, factors are divided into ones associated with the personal aspects of a nurse and ones associated with working environments such as nursing services and system. In both models for nurses with or without at least five years of experience, a cause-and-effect relation is drawn from factors associated with working environment through to factors associated with personal aspects. It was presumed that nurses with less than five years of experience perceived the factors of medical errors to lie in the very "working environment" in which they were working, while nurses with five years or over of experience perceived medical errors to be attributable to "interpersonal relations".

It is important to, based on the results of this study, not only attempt to improve the work environment and interpersonal relations but also be thoroughly committed to the creation of smooth relationships.

Limitations of the study

This study investigated factors in medical errors from the point of view of nurses' awareness. Therefore in did not analyze direct relationships with medical errors and cannot specify the causes of such errors.

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看護師における医療過誤要因の意識分析
―要因探索とモデル作成―

大内　　隆

要　　旨

本研究は、医療事故または過誤経験のある看護師を対象に、看護師の医療事故または過誤に対する意識を探索することにより、その要因の特定と要因間相互の関連性およびその構造をモデル作成によって説明することを目的にする。

方法は、潜在的な要因を探索的因子分析を用いて見出し、その背後にある要因の関係は、共分散構造分析（SEM）を用いて示した。対象は中部、中国地方から医療事故または過誤防止のための対策を講じている複数診療科をもつ８病院を選定し、そこに勤務する看護師に行った。有効回答数は1053名であった。データの解析には因子分析と重回帰分析を行い、さらに現象や構成概念の因果関係を示す共分散構造分析を用いた。

結果、看護師経験５年未満と以上の医療事故の意識に有意差が見られた。５年未満は心身不調、集中不可能、労働環境不良、錯誤業務、振り返りが抽出され、５年以上は体調管理、業務変動、状況判断不能、士気消失が抽出された。モデルは、５年未満、５年以上とも労働環境から個人要因に関わる要因に因果関係が導かれ、５年未満は、自分の働く労働環境そのものに、５年以上は対人関係に医療事故または過誤の要因のあると意識していた。本結果をふまえ、職場環境の改善や人的交流を図り、スムーズな人間関係作りを徹底して行うことが重要であることが示唆された。