Model Patient Safety Management Activities for Nursing Students with Clinical Experience

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임상실습 경험이 있는 간호대학생의 환자안전 관리 활동 구조모형

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Abstract This study is a structural equation modeling study that describes patient safety incident management activities for nursing students with clinical practice experience and uses Ajzen's theory of planned behavior and safety culture climate-safety behavior model as conceptual bases, proposes a hypothetical model of nursing students' patient safety incident management activities based on the literature review, and verifies the appropriateness of the model and hypotheses through the collected data. Data were collected from 251 nursing students with clinical practice experience using a structured questionnaire. The results of this study confirmed that the model is appropriate and that patient safety management attitude, patient safety culture, and safety motivation are predictors of nursing students' patient safety management activities. Therefore, in order to improve patient safety management activities, it is necessary to provide effective patient safety incident management education programs for nursing students so that nursing students can perform correct patient safety management behaviors from the clinical practice site to the clinical practice site after graduation, and it is necessary to explore how to continuously lead such education programs to the practice site.

Key Words : Nursing students, Patient safety, Theory of planned behavior, Structured model

요 약 본 연구는 임상실습 경험이 있는 간호대학생을 대상으로 환자안전사고관리 활동을 설명하고 Ajzen의 계획된 행위이론 및 안전문화 풍토-안전행동모형을 개념적 기틀로 하고, 문헌고찰을 토대로 간호대학생의 환자안전사고관리활동의 가설적 모형을 제시하고, 수집된 자료를 통해 모형의 적합도와 가설을 검증하는 구조방정식 모형 구축연구이다. 연구 대상은 임상실습 경험이 있는 간호대학생 251명을 대상으로 구조화된 설문지를 이용하여 자료수집을 시행하였다. 본 연구결과 모형은 적합한 것으로 확인되었으며 간호대학생의 환자안전관리 활동에 영향을 미치는 예측변수로 환자안전관리 태도, 환자안전문화 및 안전동기임이 확인되었다. 따라서 환자안전관리활동을 향상을 위해서는 임상 실습 현장에서부터 졸업 후 임상에 나가기 전까지 간호대학생이 올바른 환자안전 관리행위를 올바르게 수행할 수 있도록 간호대학생 대상 효과적인 환자안전 사고관리 교육 프로그램이 필요하며 이러한 교육 프로그램이 실무현장까지 연속성있게 이어지는 방안을 모색할 필요가 있겠다.

키워드 : 간호대학생, 환자 안전, 계획된 행동 이론, 구조모형

1. Introduction

1.1 The need for research

Patients who use medical institutions want to receive the best treatment in a safe environment, and medical institutions are obligated to provide safe and high-quality medical services to patients[1]. Patient safety is a relatively recent concept—beginning with the report, "To err is human: Building a safer health system" published by the Institute of Medicine in 2001[2]. This report stated that 44,000–98,000 patients die annually from medical errors in the United States, and the socio-economic losses of the country owing to preventable adverse events were more than half of the total U.S. healthcare expenditures [3].

In South Korea, no large-scale investigation has been conducted on the patient safety status of medical institutions; however, in some hospital-based studies, the occurrence of adverse events was 8.3% and 7.2%, which are similar to the results of a systematic literature review abroad[4]. The number of hospitalized patients who died owing to adverse events was estimated to be as low as 5,469 people per year, which is similar to the number of deaths (6,024 people) from transportation accidents[4]. Thus, patient safety issues should be an important healthcare policy area in South Korea.

As of 2011, an average of 9.2% (approximately 550,000 out of 5,977,578) of people experienced adverse events owing to medical services, and 7.4% of patients (40,695 people) died soon after. Of these numbers, it was estimated that 17,702 deaths (43.5%) could have been prevented with an effective response after the adverse events occurred. Consequently, social interest in patient safety increased, and patient safety emerged as an important healthcare issue[5].

Patient safety accidents occur unintentionally owing to risk factors such as poor communication among medical personnel [6]. About half of the adverse events in medical institutions can be prevented. Developing an effective system to prevent such errors is vital[7]; this system should comprise identifying the causes of the errors and sharing and learning in a collaborative environment to minimize the future occurrence of errors. This practice requires voluntary participation and legal and institutional support. There should be confidentiality when healthcare providers report erroneous incidents, legal-level guarantees against non-punishment, and technical and financial support at the central government level to establish a patient safety culture[8]. In summary, to reduce such patient safety accidents, continuous efforts such as establishing a preventive and patient safety reporting system through root-cause analysis is required so that even if an error occurs, it does not develop into an adverse event[9].

Safety accidents caused by inappropriate nursing activities deteriorate the quality of nursing service[10], and adverse events can directly lead to permanent damage or death of patients[11]; therefore, the role of nurses in patient safety is vital. Consequently, nursing college students require education on patient safety management[12] in their undergraduate curriculum[13]. Patient safety management activities are actions or activities taken to prevent disasters or accidents that may occur to patients, and systematic activities to reduce, eliminate, and prevent risks that occur or may occur within a healthcare organization[3]. Nurses have the largest share of patient safety activities and play an important role in ensuring patient safety through monitoring, surveillance, and patient safety management activities [15, 16]. Activities to ensure patient safety are not optional for healthcare providers, but are essential and should take precedence over any other behavior. It is necessary to systematically examine what factors influence these patient safety management activities. In this regard, a study that identified relevant factors for patient safety among nurses divided them into organizational and personal factors[17]. To date, a review of

previous studies identifying factors related to patient safety management behaviors among nursing students in Korea found that organizational factors include patient safety education[18] and communication[19], Individual factors include knowledge and attitude[20], performance confidence[21], clinical practice satisfaction [18], self-efficacy and performance [22], patient safety competence [23]. In the previous studies, most of the studies applied personal factors as factors related to nursing students' patient safety management behaviors, and there were few studies that analyzed organizational and personal factors together. We believe that it is necessary to examine both organizational and individual factors simultaneously by selecting patient safety culture, communication, and procedures as organizational factors and safety motivation, patient safety attitudes, knowledge, and performance confidence as individual factors.

The Theory of Planned Behavior (TPB) is a theory that provides a relatively good explanation of certain behaviors using individual-level predictors [24]. The theory explains an individual's behavior in terms of core factors consisting of attitude toward the behavior, subjective norms, perceived behavioral control, and behavioral intention [25]. The Theory of Planned Behavior has been used not only in the social sciences but also in various healthcare fields because it can predict individual behavior relatively well despite its simplicity and few measurement concepts [26]. However, it is necessary to examine organizational and individual factors together based on the research that patient safety management activities are carried out in interaction with the organization as well as individual attitudes and will, and that organizational factors act as antecedents to individual behavior [27]. In addition, in recent years, the influence of organizational factors has been emphasized in industrial safety, and a related model is Griffin, Neal, & Hart's safety culture climate-safety behavior model, which is based on organizational climate through an organizational

management theory approach. This model proposes and empirically analyzes that organizational culture climate affects safety motivation and safety knowledge, which in turn leads to safety-related activity performance[28]. Griffin & Neal[28] divided individual safety behaviors into compliance and participation behaviors, and presented a model with safety motivation and safety knowledge as determinants of individual characteristics and compliance and participation behaviors as outcomes. Compliance and participation behaviors are defined as safety-related activities, which are necessary behaviors and improvement activities to maintain safety in the workplace. Griffin, Neal, & Hart's model has been validated in many studies since then, and studies applying Griffin, Neal, & Hart's model to the hospital environment can be found [29].

Therefore, we aimed to verify the factors that affect the patient safety management activities of nursing college students using a structural model approach. Ajzen's[14] Theory of Planned Behavior and Neal et al.'s[15] model of safety climate and safety behavior were utilized in addition to a literature review. The results provide basic data to inform strategies and educational program development to prevent safety accidents and reduce their occurrence.

The purpose of this study was to establish a hypothetical model to identify the factors that affect the patient safety accident management activities of nursing college students and to derive direct and indirect paths between factors by verifying model suitability. First, we identified the factors that influence the patient safety accident management activities of nursing college students based on a literature review, and established a hypothetical model that explains students' patient safety accident management activities. Second, the direct, indirect, and total effects between variables that affect students' patient safety accident management activities were tested to identify the causality between variables and their degree. Third, a model that explains stu-

dents' patient safety accident management activities was tested for goodness-of-fit between the hypothetical model and the actual data.

1.2 Research Objectives

The purpose of this study is to construct a hypothetical model to identify factors that influence nursing students' patient safety incident management activities, and to verify the model fit to identify direct and indirect pathways between the factors. The specific objectives of this study are: first, to identify factors affecting nursing students' patient safety incident management activities based on the literature review, and to build a hypothetical model to explain nursing students' patient safety incident management activities; second, to test the direct, indirect, and total effects of the variables affecting nursing students' patient safety incident management activities to determine the causal relationship and degree of interaction between them. Third, a model to explain the patient safety incident management activities of nursing students is proposed through the goodness-of-fit test between the hypothesized model and the actual data.

2. Research Methods

2.1 Study design

We used Ajzen's[25] Theory of Planned Behavior and Neal et al.'s[28] model of safety climate and safety behavior as a theoretical basis to devise a structural equation model that comprised five items as predictors that explain nursing students' patient safety accident management activities: patient safety management knowledge, patient safety culture, safety motivation, patient safety management attitudes, and self-confidence in performing patient safety management.

2.2 Hypothesized Model of the Study

In order to explain and predict nursing students' safety incident management activities, this study used Ajzen's theory of planned behavior[25] and Neal et al.'s[28] safety culture climate-safety behavior model as a theoretical framework, and added patient safety management attitudes and patient safety management performance confidence as a result of the literature review, and constructed a model consisting of five predictor variables: patient safety management knowledge, patient safety culture, safety motivation, patient safety management attitudes, and patient safety management performance confidence to explain the patient safety management activities of nursing students.

2.3 Research subjects

A questionnaire survey was conducted among third and fourth graders in the nursing department of XXX University in C city. The students had experience in clinical practice, understood the purpose of this study, and agreed to participate. At least 200 participants are required to reduce the sampling error as much as possible when performing a covariate structural analysis[30]; thus, 251 people were recruited considering a 10% dropout rate. Data collection for this study was conducted from April 1, 2022 to April 30, 2020, using a self-report questionnaire. Before distributing the questionnaires, the researcher and research staff personally visited the university, explained the purpose of the study and the contents of the questionnaire, and obtained consent. Data were collected through questionnaires from 251 students who understood the purpose of this study and gave written consent to participate in the study based on their willingness to participate voluntarily. The questionnaire took about 20 minutes to fill out, and the researcher personally collected the questionnaire after completing it.

2.3 Research tools

2.3.1 Safety motivation Measurements

Safety motivation refers to the state in which an individual makes an effort to behave safely and the

importance they attach to safe performance. importance to safety performance[28].

Safety motivation was measured using a tool developed by Vaismoradi et al.[31], which was adapted for Korean by Han[32]. It comprises five questions. The responses to each question were rated on a Likert scale (1 = *not at all* to 5 = *very much*). Higher scores indicate higher safety motivation. The reliability, when the tool was developed, was Cronbach's α = .72. In this study, Cronbach's α = .92.

2.3.2 Patient safety culture

Patient safety culture is defined by the Health and Safety Commission in the United Kingdom and the Agency for Healthcare Research and Quality (AHRQ). Healthcare Research and Quality (AHRQ), an organization's safety culture is the values, attitudes, perceptions, competencies, and behaviors of individuals and groups that determine the organization's The values, attitudes, perceptions, competencies, and behaviors of individuals and groups that determine the methods and proficiency of health and safety management. and types of behaviors that determine how and how well an organization manages health and safety [33].

Patient safety culture was measured. In the adapted version, there are 69 items; however, we used 39 items in this study [18]. The tool is largely divided into four areas: hospital and ward practice environment (18 items), management (4 items), communication and procedure (6 items), and hospital (11 items). The responses to each question were rated on a Likert scale (1 = *not at all* to 5 = *very much*). Higher scores indicate higher patient safety culture recognition. The reliability, when the tool was developed by the Agency for Healthcare Research and Quality in 2004, was Cronbach's α = .72. In this study, Cronbach's α = .82. Adapted by the author for use with nursing students. It was modified to measure patient safety professionalism in two domains: hospital and ward practice environment and communication and procedures. The

revised instrument was checked with two nursing professors and the director of nursing for the content of the revised questionnaire, and the items were confirmed through a preliminary survey. In this study, Cronbach's α = .71.

2.3.3 Patient safety management knowledge

Patient safety management knowledge is the degree of knowledge related to the safety of treating or caring for patients [10] .

Patient safety management knowledge was measured using a tool developed by Park [34], with reference to the International Patient Safety Management Goals and the tool that Choi and Lee[35] modified for nursing college students, with reference to the safety evaluation items developed related to nursing activity. This tool comprises 10 questions, and each question was rated as 1 point for "yes" or 0 points for "no/I don't know." Scores ranged from 0–10, and higher scores indicate higher patient safety management knowledge. In Choi and Lee's study[20], Cronbach's α = .65; in this study, Cronbach's α = .60.

2.3.4 Self-confidence in performing patient safety management

Self-confidence in performing patient safety management is the degree to which a person believes that he or she is capable of performing patient safety management to manage patient safety[21].

Self-confidence in performing patient safety management was measured using a curriculum assessment tool related to patient safety and possible medical fallibility (Patient Safety/Medical Fallibility Assessment), which was developed by Madigosky et al.[36] and modified by Park et al.[37] with reference to the International Patient Safety Management Goals. This tool comprises 10 questions that are answered using a Likert scale (1 = not *very confident* to 5 = *very confident*). Scores range from 10–50, and higher scores indicate higher self-confidence in performing patient safety management. In Park's study[34], Cronbach's α = .85; and in this study,

Cronbach's α = .90.

2.3.5 Patient safety management attitudes

Patient safety management attitudes are an individual's cognitive and behavioral orientation toward protecting patients from unnecessary risk of harm. the cognitive, emotional, and behavioral dispositions of individuals to protect patients from unnecessary risk of harm[20].

Patient safety attitudes were measured using the patient safety attitude tool developed by Choi and Lee[35] for nursing college students after modifying and supplementing the patient safety management importance recognition measurement tool for hospital medical workers [37]. It comprises 10 questions. The responses to each question were rated on a Likert scale (1 = *not at all* to 5 = *very much*). Higher scores indicate higher patient safety attitudes. The reliability, when the tool was developed 37], was Cronbach's α = .86; in Choi and Lee's study[35], Cronbach's α = .67; in Im's study[38], Cronbach's α = .69; and in this study, Cronbach's α = .71.

2.3.6 Patient safety accident management activities

After reviewing the literature related to safety accidents among inpatient children and by investigating the needs for inpatient children safety accident education using the Delphi technique for nurses in Han's study [32], seven areas—falls; damage; electric shock and fire; suffocation and aspiration; poisoning and abuse; kidnapping and disappearance; and medical equipment—were derived, and the details of education management strategy and environmental management strategy were identified as a management strategy for preventing accidents among inpatient children. In Han's study[32], a safety accident management tool for inpatient children with 56 questions in 9 areas—children and guardians, fall education, injury education, burn education, suffocation and aspiration education, medicine and medical device education, kidnapping and disappearance education, environment, and organization—was developed. In this study, a tool for the patient safety accident management activities of nursing college students, which we developed after modifying and supplementing the existing questions, was used. In Han's study[32], Cronbach's α = .89; in this study, Cronbach's α = .96.

2.4 Data Collection Methods

Data were collected from April 1–30, 2022 using self-report questionnaires. Before distributing the questionnaires, the researcher and research staff visited the university, explained the purpose of the research and the contents of the survey, and conducted the survey after obtaining their written consent. It took about 20 minutes to complete the survey. After completion, the researcher collected questionnaires directly.

2.5 Data Analysis Methods

The collected data were analyzed using IBM SPSS Statistics 23.0 program and AMOS 23.0. Participants' general characteristics were analyzed using descriptive statistics. Data normality was tested using univariate skewness and kurtosis. Pearson's correlation coefficient was used to determine multicollinearity. The reliability of the research tool was analyzed using Cronbach's α. For the degree of conformity between the model and the data when verifying the model, the goodness-of-fit index CMIN (χ^2 verification), standard normed χ^2 test (CMIN/df), good-of-fit index (GFI) $\geq$.90, adjusted GFI $\geq$ .90, normed fit index (NFI) $\geq$ .90, comparative fit index (CFI) $\geq$ .90, root mean square residual (RMSR) $\leq$ .05, and root mean square error of approximation (RMSEA) $\leq$ .08 were identified. Bootstrapping was used to verify the significance of the direct, indirect, and total effect of the model.

2.6 Ethical considerations

This study was approved by the Institutional Review Board of K University in Daejeon, Korea

(IRB No. 2018-167-01) after reviewing the research objectives, research methods, protection of human subjects' rights and confidentiality, data management, study description, consent form, and questionnaire.

3. Research findings

3.1 Participants' Sociodemographic Characteristics

The average age of the participants in this study was 24.80±7.47 years, with 220 (87.6%) aged 29 or younger, 217 (86.5%) female, and 182 (72.5%) in the fourth year. Regarding satisfaction with the major, 131 (52.2%) responded that it was a university hospital, 188 (74.9%) responded that it was a clinical training period, and 231 (92.0%) responded that it was a clinical training organization type. The top three desired safety training topics were infection prevention, patient identification, medication management, fall prevention, communication, and video training (Table 1).

3.2 Descriptive statistics and correlation analysis for metrics

As a result of analyzing the descriptive statistics of the measurement variables used in the hypothesized model of this study (Table 2), the absolute values of skewness and kurtosis of all measurement variables did not exceed 3 and 10, respectively, which satisfied univariate normality. The mean of patient safety management knowledge was 7.09± 1.91, patient safety culture was 3.17±0.38, safety motivation was 4.53±0.55, patient safety management attitude was 3.84±0.46, confidence in performing patient safety management was 4.06±0.56, and patient safety incident management activity was 3.83±0.59. On the other hand, the absolute values of the correlation coefficients between the measured variables were distributed from -.01 to .73, with no value exceeding .85, indicating that there was no problem of multicollinearity [40].

Table 1. General characteristics of participants

(N=251)

Variables	Categories	N(%)
Age(year)	≤29	220(87.6)
	30-39	11(4.4)
	≥40	20(8.0)
	Mean±SD	24.80±7.47
Gender	Male	34(13.5)
	Female	217(86.5)
Grade	3rd grade	69(27.5)
	4th grade	182(72.5)
Major Satisfaction	Very unsatisfied	1(0.4)
	Dissatisfaction	8(3.2)
	Moderate	63(25.1)
	Satisfaction	131(52.2)
	Very satisfied	48(19.1)
First time in clinical practice	Yes	6(2.4)
	No	245(97.6)
Clinical practice period	2-6 months	63(25.1)
	≥ 6 months	188(74.9)
Type of clinical practice institution* (multiple response)	Advanced general hospital	67(26.7)
	University hospital	231(92.0)
	General hospital	78(31.1)
	Hospital	45(17.9)
	Specialized hospital	48(19.1)
Experience in taking courses patient safety management education	Yes	231(92.4)
	No	19(7.6)
Contents of course you want to receive in patient safety management education* (multiple response)	Patient identification	199(80.2)
	Communication	167(67.3)
	Drug management	193(77.8)
	Burn education	120(48.4)
	Infection prevention	219(88.3)
	Fall prevention	182(73.4)
	Other	1(0.4)

3.3 Validate measurement model

Based on the results of the confirmatory factor analysis, the convergent validity of the measurement model was evaluated. Among the measured variables, the Standardized Regression Weights (SRW) should be 0.7 and the Squared Multiple Correlations (SMC) should be 0.50 or more to indicate that the individual measured variables are reliable[16]. In addition, if the Average Variance Extracted (AVE) is more than 0.50 and the Construct Reliability (CR) is more than 0.70, it can be considered that there is convergent validity [16], so the convergent validity of this study is secured. To check the discriminant validity of the latent variables, the mean variance

Table 2. Descriptive statistics and normality verification of the measured variables   (N=251)

Variables	Min–Max	Mean ± SD	Skewness	Kurtosis
Patient safety management knowledge	0.00–10.00	7.09 ± 1.91	−0.64	0.52
Patient identification	0.00–1.00	0.26 ± 0.44	1.08	−0.83
Effective communication	0.00–3.00	2.28 ± 0.83	−0.95	0.17
Infection reduction	0.00–2.00	1.45 ± 0.57	−0.43	−0.76
Fall reduction	0.00–1.00	0.91 ± 0.28	−2.93	6.66
Medical fallibility	0.00–3.00	2.19 ± 0.84	−0.70	−0.40
Patient safety culture	2.06–4.33	3.17 ± 0.38	0.07	0.28
Practice environment	2.33–4.06	3.10 ± 0.28	0.04	0.64
Communication	1.67–4.83	3.23 ± 0.55	0.09	0.29
Safety motivation	2.00–5.00	4.53 ± 0.55	−1.43	2.57
Patient safety management attitude	2.73–5.00	3.84 ± 0.46	−0.01	−0.48
Interest	2.00–5.00	4.22 ± 0.63	−0.63	0.01
Willingness	2.00–5.00	4.33 ± 0.69	−0.64	−0.49
Recognition	1.00–5.00	3.02 ± 0.87	−0.12	−0.09
Self−confidence	2.00–5.00	3.80 ± 0.71	0.05	−0.53
Self−confidence in performing patient safety management	2.30–5.00	4.06 ± 0.56	−0.33	−0.10
Self−confidence in coping	2.60–5.00	3.74 ± 0.56	0.33	−0.28
Self−confidence in patient identification	2.00–5.00	4.01 ± 0.71	−0.42	0.15
Self−confidence in infection reduction	2.00–5.00	4.23 ± 0.66	−0.53	−0.08
Self−confidence in Nursing Practice	2.00–5.00	4.28 ± 0.70	−0.64	−0.11
Patient safety accident management activities	2.29–5.00	3.83 ± 0.59	−0.08	−0.29
Fall education	1.67–5.00	3.99 ± 0.77	−0.30	−0.70
Impairment education	1.00–5.00	3.66 ± 0.83	−0.33	−0.24
Video education	1.00–5.00	3.59 ± 0.86	−0.48	0.09
Medicine education	1.00–5.00	4.10 ± 0.71	−0.72	1.10
Kidnapping education	1.75–5.00	3.99 ± 0.66	−0.24	−0.27
Environment education	1.86–5.00	3.88 ± 0.65	−0.04	−0.36
Organization	2.00–5.00	3.62 ± 0.68	0.15	−0.48

extracted values of each latent variable were all greater than the square value of the correlation co-efficient (r) of each latent variable, confirming that the discriminant validity was met. In addition, the absolute value of the correlation coefficient between the measured variables ranged from .001 to .484, and the absolute value was greater than .80, so there was no problem with multicollinearity. Therefore, it was determined that the structural equation model with all variables could be built and analyzed (Table 3).

Table 3. Correlations between variable and construct validity (modified)

	Patient safety management knowledge	Patient safety culture	Safety motivation	Patient safety management attitude	Self−confidence in performing patient safety management	Patient safety accident activities	Average variance extracted	Concept reliability
	r (ρ)	r (ρ)	r (ρ)	r (ρ)	r (ρ)	r (ρ)		
Patient safety management knowledge	0.69*						0.69	0.69
Patient safety culture	−.029 (ρ = .650)	0.91*					0.91	0.95
Safety motivation	.256 (ρ < .001)	.201 (ρ = .001)	0.77*				0.77	0.77
Patient safety management attitude	.324 (ρ < .001)	.226 (ρ < .001)	.459 (ρ < .001)	0.60*			0.60	0.81
Self−confidence in performing patient safety management	.349 (ρ < .001)	.127 (ρ = .044)	.439 (ρ < .001)	.484 (ρ < .001)	0.75*		0.75	0.92
Patient safety accident activities	−.001 (ρ = .994)	.457 (ρ < .001)	.295 (ρ < .001)	.400 (ρ < .001)	.254 (ρ < .001)	0.73*	0.73	0.95

*Diagonal line represents average variance extracted

3.4 Validate the goodness of fit of hypothesized models and analyze their effectiveness

In this study, the model fit was $\chi 2/df=2.40$, GFI= .88(≥.8), AGFI=.83(≥.8) NFI=.88(≥.9), CFI=.92(≥.9), RMR=.06(≤.05), RMSEA=.08 (≤.05 = good fit, .05~ .08=mediocre fit,≥.01=poor fit). Although the NFI index and RMR did not meet the criteria, several other goodness-of-fit indices were considered for the final model (Table 4). The direct, indirect, and total effects of the hypothesized model were analyzed as follows (Table 5). Of the 11 paths, 8 paths were significant for direct effects, 5 paths were significant for indirect effects, and 9 paths were significant when considering direct, indirect, and total effects (Fig. 1). Patient safety management knowledge (β=.212, p=.010), patient safety culture (β =.261, p=.011), and safety motivation had a direct effect (β=.442, p=.023) on patient safety management attitude, and the explanatory power was 42.0%. For patient safety management performance confidence, patient safety management knowledge (β=.144, p=.008), patient safety management attitude (β=.198 p=.036), and safety motivation (β=.337 p=.016) had direct effects, with an explanatory power of 30.0%. For patient safety incident management activities, patient safety management attitude (β=.513, p=.013) and patient safety culture (β=.381, p=.007) had a direct effect, with an explanatory power of 54.7%. The direct effect of safety motivation was not significant (β=.034, p=.663), but the indirect effect (β=.219, p=.019) was significant and the total effect (β=.254, p=.036) was significant. Among

Table 4. Structural modeling fit indices

Model	(p)	/df	GFI	AGFI	NFI	CFI	RMR	RMSEA
Modified model	324.348 (< .001)	2.403	.878	.829	.875	.922	.063	.075

NGFI, Good-of-Fit Index; AGFI, Adjusted Goodness of Fit Index; NFI, Normed Fit Index; CFI, Comparative Fit Index; RMR, Root Mean-square Residual; RMSEA, Root Mean Square Error of Approximation.

Table 5. Verification of the hypothetical model

Endogenous variables	Exogenous variables	RW	SRW	SE	CR	p	SMC	Direct effect β (p)	Indirect effect β (p)	Total effect β (p)
Patient safety management attitude	Patient safety management knowledge	0.053	.212	0.017	3.167	.002	.420	.212 (.010)		.212 (.010)
	Safety culture	0.677	.261	0.196	3.451	< .001		.261 (.011)		.261 (.011)
	Safety motivation	0.520	.442	0.091	5.698	< .001		.442 (.023)		.442 (.023)
Self-confidence in performing patient safety management	Patient safety management knowledge	0.018	.144	0.008	2.147	.032	.300	.144 (.008)	.042 (.018)	.186 (.005)
	Patient safety management attitude	0.100	.198	0.043	2.306	.021		.198 (.036)		.198 (.036)
	Safety motivation	0.200	.337	0.057	3.495	< .001		.337 (.016)	.087 (.019)	.424 (.011)
Patient safety accident management activities	Patient safety management knowledge	−0.033	−.124	0.017	−1.925	.054	.547	−.124 (.098)	.106 (.008)	−.019 (.928)
	Safety culture	1.051	.381	0.223	4.723	< .001		.381 (.007)	.133 (.006)	.514 (.009)
	Safety motivation	0.043	.034	0.111	0.385	.700		.034 (.663)	.219 (.019)	.254 (.036)
	Patient safety management attitude	0.545	.513	0.096	5.669	< .001		.513 (.013)	−.003 (.564)	.509 (.016)
	Self-confidence in performing patient safety management	−0.037	−.018	0.140	−0.264	.792		−.018 (.713)		−.018 (.713)

RW, Regression Weight; SRW, Standardized Regression Weight; SE, Standard Error; CR, Critical Ratio; SMC, Squared Multiple Correlation
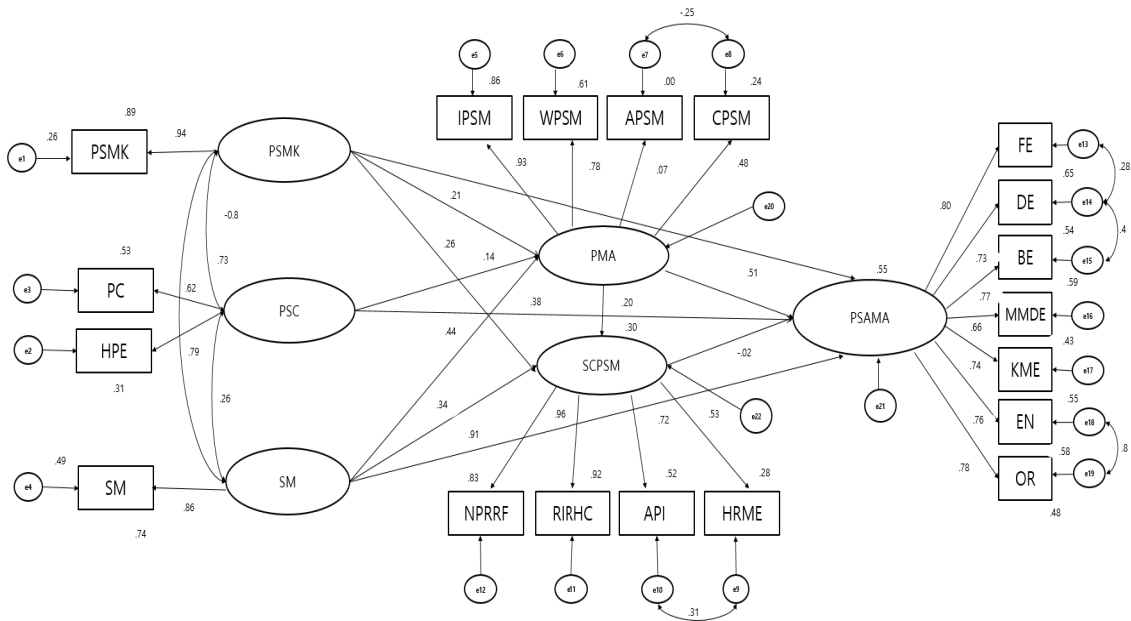
Fig. 1. Path diagram of the model

PSMK : Patient safety management knowledge
HPE: Hospital/ward practice environment
SM : Safety motivation
WPSM: Will for patient safety management
CPSM: Confidence in patient safety management
SCPSM: Self-confidence of patient safety management
API: Accurate patient identification
NPRRF: Nursing performance to reduce the risk of falls
FE: Fall education
BE : Burn education
KME : Kidnapping& missing eduaction
OR: organization

PC : Procedure for communication
PSC, Patient safety culture
IPSM: Interest in patient safety management
APSM: Awareness of patient safety management
PMA: Patient safety management attitude
HRME: How to respond when a medical error occurs
RIRHC: Reduction of infection related to health care
PSAMA, Patient Safety accident management activities
DE: Damage education
MMDE: Medicine, medical device education
EN: environment

the predictors of patient safety management activities, safety culture was the most effective variable.

4. Discussion

Healthcare organizations must provide patients with safe and high-quality healthcare services while using healthcare organizations, and to do so, the role of nurses, one of the   largest occupations among healthcare workers, is important. In particular, nursing students, as prospective nurses, will make up a large proportion of the healthcare workforce for patient safety management, so it is very important to identify factors that affect nursing students' patient safety management. Wang et al (2021)

and Fujita et al (2019) stated that continuous attention to patient safety culture and efforts to improve it are important factors affecting the performance of patient safety management. To predict the patient safety accident management activities of nursing college students, Ajzen's[25] Theory of Planned Behavior, Neal et al.'s [28] model of safety climate and safety behavior, and the results of prior research were applied in this study. A hypothetical model was constructed and the fitness of the model was verified. The model was suitable and the explanatory power for the behavior was 54.6%. In a structural equation model construction study, if the GFI satisfies the criteria and, concurrently, the explanatory power is approximately 40% in social sur-

vey data, it is recognized as a fairly high explanatory power[40]. Our results were higher than the 29.1% and 37.0% explanatory power found previously in studies of nurses' patient safety management activity[10].

Patient safety management attitude in determining behavior, and it has a strong relationship with the execution of individual actions[41]. It is thought that it is necessary to provide theoretical education on patient safety management guidelines and roles of the person in charge. After examining prior studies that analyzed the correlation between patient safety attitudes and patient safety management behavior among nursing college students[42-44], there was a significant positive correlation between patient safety attitudes and patient safety management behavior. This result reflects the need to change patient safety attitudes to enhance the practice of patient safety management behavior of nursing college students. Attitudes toward patient safety tend to be enhanced when experiencing patient safety-related work or receiving patient safety-related education [37]. Therefore, to promote the patient safety attitudes of nursing college students, it is necessary to compulsorily execute patient safety-related education in the course of education and provide an opportunity to experience patient safety work. Furthermore, to improve students' patient safety attitudes, it is necessary to develop a plan and strategy for more effective patient safety education. A variety of effective teaching methods that students can experience and actively participate in should be used—not merely a method of transferring knowledge.

The safety motivation of nursing college students is a predictor that affects patient safety management activities, and safety motivation refers to a state in which an individual strives to act safely and attaches importance to safety behavior[44]. Safety motivation was identified as an important factor for safety activities in the results of prior studies conducted in various fields, such as construction[46], production workers[47], and the medical environ-

ment[33]. In addition, Neal and Griffin[45] indicated that if safety motivation is low, it may be difficult to perform safety behavior. Safety motivation showed a significant positive correlation with patient safety culture and safety accident management activities in a study conducted with nurses[32]. A study conducted among medical institution workers identified a significant positive correlation between safety motivation and safety implementation[48]. Therefore, to promote the patient safety behavior of nursing college students, systematic and specific measures to increase safety motivation should be prepared.

The safety culture perceived by nursing college students is a predictor of patient safety management activities. The interest in patient safety management and patient safety culture of healthcare institutions has increased owing to various factors, such as changes in the awareness of patient safety accidents and safety importance, implementation of medical institution evaluation and certification, and the increase in medical lawsuits[49]. Safety culture was a major factor that influenced patient safety management behavior in several studies[50-52]. In addition, prior studies overseas emphasized that patient safety culture recognition and interest are important factors that promote patient safety [53-54].

Aron and Headrick[55] emphasized that the purpose of reducing preventable medical fallibility and safety accidents cannot be achieved by establishing various state-of-the-art science technologies, medical equipment, and information technology systems alone, without recognizing and improving the organizational culture and emphasizing patient safety first. If patient safety culture is established in medical institutions, patient safety management can be thoroughly performed with patient safety-related reports and study group configurations. In addition, interest in patient safety will increase, thereby reducing patient safety accidents by reducing fallibility and errors in providing medical services. Further, by curbing the number of accidents, emotional losses, such as stress and guilt, among mem-

bers of the group will be decreased[41]. In addition, it can lower waiting time and cost, reduce patient complaints, decrease the waste of various resources, and curb social costs[56].

Studies related to patient safety culture stated that a higher recognition of patient safety culture was associated with fewer accidents[57]. This finding reflects the need to change patient safety attitudes to enhance the practice of patient safety management behavior of nursing college students. Patient safety attitudes tend to be enhanced when experiencing patient safety-related tasks or receiving patient safety-related education[37]. Therefore, it is necessary to designate patient safety-related education as a mandatory course in nursing students' regular curriculum and provide opportunities for them to experience patient safety-related tasks before clinical practice. This orientation may inspire their safety motivation and foster the formation of positive attitudes toward patient safety by introducing and discussing various clinical cases related to patient safety.

5. Conclusion and recommendations

This study identified the factors influencing patient safety management activities among nursing college students and presented effective interventions to promote the patient safety management activities of future healthcare providers. The structural model of this study was suitable to predict students' patient safety management activities. To improve patient safety management attitudes, patient safety culture, and safety motivation-key predictors influencing nursing students' patient safety management activities-effective and continuous patient safety accident management education programs are needed. However, as this study was conducted with nursing college students at some local universities, there is a limit to the generalizability of the results. Replication studies by grade and region are required, and interventional studies are needed

to develop patient safety accident management activity programs for nursing college students and to verify their effectiveness.

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