

Structural Equation Model of Clinical Nurses' Willingness to Perform Basic Life Support (BLS) in South Korea

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임상간호사의 기본소생술 수행의지에 관한 구조방정식 모형 분석

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Abstract This study was conducted to develop a model that explains the factors influencing the clinical nurses' willingness to perform Basic Life Support and to verify the appropriateness of the model. The participants were 550 clinical nurses working at a university hospital in Korea. The data were collected from self-reported questionnaires from October 2012 to February 2013. A total of 520 questionnaires were analyzed using the SPSS/WIN 20.0 and Amos version 18.0 software packages. The results indicated that the clinical nurses' knowledge of basic life support had a direct impact and their clinical experience had an indirect impact on their willingness to perform basic life support at the scene. These variables together explained 19.5% of the variance in the nurses' willingness to perform Basic Life Support. The clinical experience was correlated significantly with knowledge ($r=.61, p<.001$). To increase the clinical nurses' performance of Basic Life Support, knowledge and clinical experience should be reinforced by continuous in-service education on Basic Life Support, considering the disease status of hospitalized patients.

요약 본 연구는 국내 임상간호사를 대상으로 기본소생술 수행을 설명하기 위한 가설적 모형을 설정하고 실증적 자료검증을 통해 예측모형을 구축함으로써 국내 임상간호사의 기본소생술 수행 능력 향상을 위한 이론적 기틀을 제공하고자 한다. 본 연구는 2012년 10월 25일부터 2013년 2월 25일 까지 3차 의료기관 임상간호사 520명을 대상으로 설문조사를 시행하였으며, 수집된 자료는 SPSS win 20.0와 AMOS 18.0 프로그램을 이용하여 분석하였다. 연구 결과 간호사의 기본소생술의 지식은 임상경험에 의해 직접적인 영향을 받았고, 임상경험은 기본소생술 수행의지에 간접적인 영향을 미쳤다. 지식과 임상경험의 기본소생술 수행의지에 대한 설명력은 19.5%이었다. 임상경험은 지식과 유의한 상관관계가 있었다($r=.61, p<.001$). 따라서, 임상간호사의 기본소생술 수행의지를 높이기 위해 입원 환자의 질병 상태를 고려한 지식과 임상경험의 지속적인 교육이 필요하다.

Keywords : Basic life support; Nurses; Perform; Structural equation model; Willingness

1. Introduction

As a professional, a nurse requires knowledge and

skills and must make prompt, correct clinical judgments and decisions. Nurses' decision-making in clinical practice is a fundamental means to establish a

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therapeutic relationship with patients and is crucial to successful nursing performance because it affects nursing practice[1,2]. Nurses' clinical decision-making is an activity in which they intensively use their knowledge, and the results of their decision-making may depend on how they address and use their knowledge and skills[3]. When nurses are presented with new information, they make a clinical decision based on cases similar to those they have experienced[4]. Theoretical knowledge may become personally meaningful to nurses directly through experiences; consequently, they develop memory necessary to make a clinical judgment and can continue to make good use of their memory[5]. In particular, because nurses can witness a case of cardiac arrest, which requires immediate first aid, at any time, they are required to acquire knowledge and skills concerning Basic Life Support (BLS). However, the knowledge or skill concerning BLS that they acquire would be useless if it were not applied as needed. Nurse have the opportunity to discover the cardiac arrest and to perform BLS for the first time more than any other health care providers. If ill preparedness of nurses responding to an in-hospital BLS event may result in a delay to intervention and consequently the lower in the patient's chance of survival[6]. Therefore, special attention and effective training for staff nurses as the first responders is needed to ensure high-quality BLS in clinical emergencies[7].

South Korea began to provide training about internationally recognized BLS to 193 healthcare providers in 2005 and saw the number of the trainees rapidly increase to 27,816 by 2014[8]. It is not known whether the increase in the number of the trainees is correlated with BLS performance in an in-hospital. However, it is important "how much nurses know about the patient" when they make a decision about a specific nursing activity; thus, knowledge is very important when nurses make clinical decisions[9]. According to Benner's[4] decision-making model, nurses may make a clinical decision through pattern

matching and similarity assessment. Because nurses have examples based on their own experiences, they may compare new information with their own experience in making a decision. When they are given new information through education, they may make a decision based on either a particular experience or similar cases.

The literature review regarding BLS in South Korea revealed that BLS performance is correlated with personal characteristics, knowledge, and experiences. Oh and Han[10], Choi[11] reported that age, hospital location, ward, experience in emergency rooms (ERs) or intensive care units (ICUs), and total career significantly affected knowledge of BLS. Kim et al[12] reported that experience in BLS also had significantly more knowledge. It also found that BLS performance and self-confidence in BLS differed significantly according to total career, the period of issued BLS certification, hospital location, or ward[11,13-15]. Although many researchers have reported an association between BLS experience and knowledge and between BLS knowledge and self-confidence in performing it in terms of demographic and environmental characteristics, few researchers have analyzed the direct and indirect effects of nurses' demographic characteristics and experience in, knowledge of, and self-confidence in performing BLS. This study aimed to develop and test a hypothetical structural model to determine how nurses' demographic characteristics, clinical experience, knowledge, and self-confidence directly and indirectly affect their willingness to perform BLS.

2. METHODS

2.1 Design

This study is a covariance structure analysis study to test the fit of the model and build a hypothetical model in the willingness to perform BLS of the Korean clinical nurses as a cross sectional survey [Fig 1].

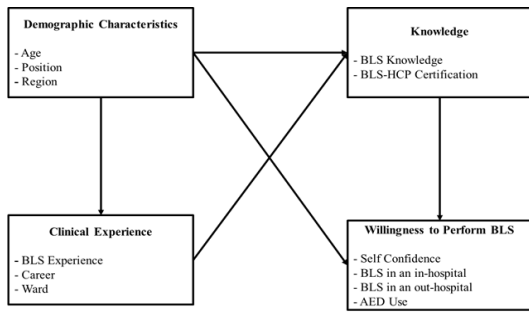


Fig. 1. Hypothetical model of clinical nurses' willingness to perform BLS

2.2 Participants

Sample size calculates at least 5 times to 10 times per parameter in the structural equation model[1]. The parameter is 31 items in the study. Therefore, sample size calculated at least 155 to 330 persons. This study selected clinical nurse 550 persons working in 5 tertiary hospitals which located metropolitan or nonmetropolitan, South Korea by convenience sample. A total of 550 questionnaire packets were distributed and 520 questionnaires were analyzed in this study (95.0% response rate). Data collected from 25 October, 2012 to 25 February, 2013.

2.3 Instruments

In the structural equation model, all of the variables were considered continuous so there would be no issues with statistical processing. The questionnaire was composed of four areas: demographic characteristics, clinical experience, knowledge, and willingness to perform BLS. The demographic characteristics included: age, position, and hospital location (Metropolitan or non-Metropolitan area). A higher score of position indicates a higher position, and a higher score of hospital location indicates a more densely populated Metropolitan area.

Clinical experience had a total of three sub-sections (including experience in BLS, career, and ward). The experience in BLS included the frequency of and the type of BLS they experienced, the range of this scale was 1-8 points. The higher the score, the more

experience in BLS. The reliability in the present study was evidenced by Cronbach's α of 0.772. Career was considered a continuous variable and those scoring higher on ward were more likely to work in ERs or ICUs.

The knowledge had two sub-sections (such as knowledge of BLS and BLS-HCP certification). The knowledge of BLS was developed by Uhm et al[16]. This is a 15-item inventory. Each question was answered yes/no, and the range was 0-15 points. It means a higher score indicating more knowledge. The K-R (Kuder-Richardson) 20 in Uhm's study was 0.720. K-R 20 was 0.712 in this study.

The willingness to perform BLS had a total of four sub-sections: self-confidence in BLS, the willingness to perform BLS in an in-hospital /out-of-hospital, and the willingness to use an AED. The self-confidence in BLS was measured using a questionnaire developed by Uhm et al[16]. It consisted of 5 items with 5 Likert scale. A higher score indicates a higher level of self-confidence. The Cronbach's α for this scale in Uhm's study was 0.87; in this study was 0.899. The three remaining sub-sections had one item respectively, with a higher score indicating a greater willingness to perform BLS.

2.4 Data analysis

Data analysis was performed using SPSS/WIN 20.0 and Amos version 18.0 software packages. Statistical analyses included descriptive statistics, Pearson's correlation, and Cronbach's α . In order to the validity of the used tool, we checked the factor analysis about all items and factor score is less than .50 variables was removed.

We calculated χ^2 , $Q(\chi^2/df)$, goodness of fit index (GFI) and root mean square error of approximation (RMSEA) as an absolute fit index, non-normed fit index (NNFI) and comparative fit index (CFI) as an incremental fit index, and adjusted goodness of fit index (AGFI) as a simplicity fit index[1]. A p -value<.050 was considered significant in order to fit

of the hypothetical model, path coefficient estimates and effectiveness analysis.

3. RESULTS

3.1 Demographic statistics and correlation

The majority of respondents were women (99.0%), mean age was 30.68 years (5.67). The majority of respondents in age, position and region were 25 to 30 years (45.2%), staff nurse (87.1%), non-Metropolitan areas (72.5%), respectively. The mean career was 9.49 years (5.30). 182 nurses (35.0%) worked at ERs or ICUs. 81 nurses (15.6%) had BLS-HCP certification. In the willingness to perform BLS, 407 nurses (78.3%) responded "I will perform BLS if witnessing a cardiac arrest in an in-hospital", and 385 nurses (74.0%) responded "I will perform BLS if witnessing a cardiac arrest in an out-of-hospital", "I will use AED for cardiac arrest patients" was 244 nurses (46.9%) in Table 1. In the clinical experience, the mean score of experience in BLS, BLS knowledge, self-confidence in the perform BLS were 3.78 (2.25), 7.68 (3.15), 21.47 (4.10), respectively[Table 1].

In the study, statistic of skewness and kurtosis in the multivariate joint distribution was 8.84, critical ratio (CR) was 5.96, degree of freedom was 2, significance level (α) was 0.05, and it was satisfied the multivariate normal distribution due to not exceed 5.99 in critical value. The range of r such as correlation coefficients of the used variables in hypothetical model were 0.11 to 0.59. The study was not problem of the multicollinearity among independent variables because of the result of the multicollinearity test which the correlation coefficient between all variables did not exceed .85, variables were no less than 0.1 in tolerance and Variation Inflation Factor (VIF) did not exceed 10[1].

Table 1. Descriptive statistics of clients (N=520)

Variables	N(%)	Mean(SD)
Demographic characteristics		
Age(years)	<25	80 (15.40)
	25~30	235 (45.20)
	>30	205 (39.40)
		30.68 (5.67)
Gender	Male	5 (1.00)
	Female	515 (99.00)
Position	Staff nurse	453 (87.10)
	Charge nurse	51 (9.80)
	Head nurse	16 (3.10)
Region	Metropolitan	143 (27.50)
	Non-Metropolitan	377 (72.50)
Career(years)		9.49 (5.30)
Clinical experience		
Ward	ERs/ICUs	182 (35.00)
	non ERs/ICUs	338 (65.00)
BLS experience		3.78 (2.25)
Knowledge		
BLS knowledge		7.68 (3.15)
BLS-HCP certification	Yes	81 (15.60)
	No	439 (84.40)
Willingness to perform BLS		
Self confidence		21.47 (4.10)
BLS in an in-hospital	Yes	407 (78.30)
	No	113 (21.70)
BLS in an out of hospital	Yes	385 (74.00)
	No	135 (26.00)
AED use	Yes	244 (46.90)
	No	276 (53.10)

ER: Emergency room; ICU: Intensive care unit;

BLS: Basic life support;

BLS-HCP: Basic life support health care provider;

AED: Automatic external defibrillator

3.2 Reliability and validity evaluation

The structural model in this study is shown in Figure 1 based on the findings from the literature review. As an attempt to test goodness-of-fit of the measurement variables for the structural model before the goodness-of-fit test of the model, Cronbach's α was estimated to assess the internal consistency with the objective of assessing homogeneity between exogenous and endogenous variables. First, Cronbach's α was .485 for the three measurement variables of the demographic characteristics: age, position, and hospital location. Second, Cronbach's α was .306 for the three measurement variables of clinical experience: experience in BLS, career, and ward. However, it was

.562 when career was removed. Third, Cronbach's α was .524 for the four measurement variables of the willingness to give BLS: willingness to give BLS in an in-hospital involving cardiac arrest, willingness to give BLS in an out-of-hospital involving cardiac arrest, willingness to use an AED, and self-confidence in BLS. Finally, Cronbach's α was .523 when hospital location was removed from the area of the demographic characteristics and career was included in the area based on the finding from the literature review that career might serve as an important variable.

Based on these results, the structural model was modified as follows. The demographic characteristics, or the endogenous variables, were conceptualized as age, position, and career; among the endogenous variables, clinical experience was conceptualized as ward and experience in BLS, and knowledge was conceptualized as knowledge of BLS and BLS-HCP certification. Willingness to perform BLS was conceptualized as self-confidence in BLS, willingness to perform BLS in an in-hospital/out-of-hospital, and willingness to use an AED. The modified model is shown [Fig 2].

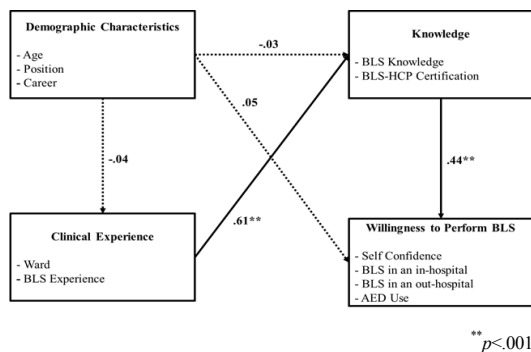


Fig. 2. Modified model of clinical nurses' willingness to perform BLS with parameter estimates in South Korea

3.3 Modified model of reliability and validity evaluation

The goodness-of-fit test of the modified model was performed using the critical ratio (CR) and the modification index (MI), considering the findings from the literature review. To improve the goodness-of-fit of the model, hospital location was removed from the demographic characteristics, and career was shifted from clinical experience to the demographic characteristic section. Here, because negative variance could occur in the error term and cause a skewed coefficient of the latent variable, the error term of the exogenous variable was fixed at 0.005. In the modified model after the reconceptualization, all of the goodness-of-fit indexes met the recommendations: $\chi^2 = 99.16$ ($p < .001$), $\chi^2/df = 2.48$, GFI = .99, AGFI = .95, RMSEA = .05, CFI = .93, and TLI = .91 [1] [Table 2].

Parameter estimates and their significance in assessing the path coefficient of the modified model are presented in Table 3. In regard to the squared multiple correlation (SMC) among endogenous variables, a t-test was performed to assess the significance of each parameter estimate, with the significance level set at 0.05.

Two of the five paths in this study were significant, and the direct, indirect, and total effects of the predictors on the endogenous variables in the structural model are presented in Table 3. The three paths between the endogenous variable (demographic characteristics) and the endogenous variables (clinical experience, knowledge, and the willingness to perform BLS) were all insignificant ($p < .050$) [Table 3].

However, nurses' willingness to perform BLS was significantly correlated with their knowledge and

Table 2. Comparison of fitness of statistics for the modified model

Indices	(P-value)	Df	χ^2/df	GFI	AGFI	RMSEA	CFI	NFI	NNFI (TLI)	PNFI
Acceptable value			2-3	≥ 0.9	≥ 0.9	≤ 0.1	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.6
Hypothetical model	355.23 ($P < .001$)	49	7.25	.90	0.84	0.11	0.69	0.67	0.59	0.49
Modified model	99.16 ($P < .001$)	40	2.48	0.99	0.95	0.05	0.93	0.90	0.91	0.65

Table 3. Parameter statistics in modified model

Endogenous variable /Exogenous variable	Standard estimate	CR	t-value	SMC (R ²)	Direct effect	Indirect effect	Total effect
Clinical experience				.002			
Demographic characteristics	-.04		-.81		-.04	.	-.04
Knowledge				.365			
Demographic characteristics	-.03		-.45		-.03	-.03	-.06
Clinical experience	.61		3.83**		-.61**	.	.61**
Willingness to perform BLS				.195			
Demographic characteristics	.05		.84		.05	-.03	.03
Knowledge	.44		3.10**		.44**	.	.44**
Clinical experience					.	.27*	.27*

SMC: squared multiple correlation; BLS: Basic life support

* $p < .050$, ** $p < .001$

clinical experience ($p < .050$); their knowledge directly affected their willingness to perform BLS ($p < .050$), with the total effects increased by the indirect effects through the medium of clinical experience ($p < .050$).

Knowledge ($\beta = .44$, $p < .050$) directly affected nurses' willingness to perform BLS and accounted for 19.5%. Clinical experience ($\beta = .61$, $p < .050$) affected nurses' knowledge and accounted for 36.5% [Table 3].

4. Discussion

This study aimed to give a comprehensive explanation of the effects of nurses' demographic characteristics (age, position, career), knowledge (knowledge of BLS, BLS certification), and clinical experience (ward, experience in BLS) on their willingness to perform BLS (self-confidence, willingness to give BLS in an in-hospital/ out-of-hospital, willingness to use AED) in a modified model and to provide the basic data required to develop a strategy to improve their ability to perform BLS.

The respondents' general characteristics and the findings from the model test can be summarized as follows. The respondents scored lower on knowledge of BLS than observed in previous studies[12,14,17-19]. The rate of the respondents with BLS certification (15.6%) in this study was higher than that (11.7%) of the previous research[14]. BLS in this study refers to the program developed for healthcare providers by the American Heart Association (AHA). South Korea

requires tertiary hospitals to provide BLS training on a regular basis once or more biennially[20]. Although nurses in clinical areas except critical care units that rarely see cardiac arrests, they should keep skill and knowledge in BLS. However, it is known that knowledge and skill retention decline rapidly after initial training. To maintain knowledge and skills, refresher training invariably is required[21].

Self-confidence in BLS in this study was higher than that found by Jun[22]. This difference is probably because the respondents in this study had a longer career on average, longer career in ICUs, and more experience in BLS than those in Jun[22]. Therefore, self-confidence in BLS performance is affected by actual experience in BLS, not simply by career.

The respondents' willingness to use an AED (46.9%) in this study was lower than that of Lee[13] or Jun[22] and were somewhat similar to that of Nikolaou et al[19]. The reasons for this result are that a manual defibrillator, instead of an AED, is generally used at hospitals and considered a task specific to doctors[23,24].

In shockable rhythm such as VF and pulseless VT, time is the most important factor for survival. The shorter the time from arrest to defibrillation, the better the outcomes will be[25].

Traditionally doctors play an important role in managing patients with cardiac arrest, especially during defibrillation. However, the survival rate is higher if defibrillation is done at an early stage by nurses before the arrival of a resuscitation team. Education about

ECG rhythms requiring an electric shock and about how to use a defibrillator significantly improved self-confidence in coping with a situation requiring an electric shock. Based on this evidence, it is necessary both to give nurses a chance to receive education about how to use a defibrillator correctly and to require them to use a defibrillator and discuss the scope of their clinical tasks on an institutional basis such that using a defibrillator can be considered routine[24].

The test of the modified model in this study found that clinical experience directly affected knowledge of BLS, accounting for 36.5%, and that knowledge directly affected the willingness to perform BLS, accounting for 19.5%. Based on these results, it cannot be said that only clinical experience or exposure to a situation involving cardiac arrest and first aid is sufficient to become self-confident in BLS or to give high-quality BLS[26]. In other words, an actual case of cardiac arrest may not allow nurse practitioners to acquire BLS; however, hands-on experience may affect their knowledge, thus consequently changing their willingness to give BLS. It is, however, impossible to know whether the respondents in this study attempted to acquire knowledge, or required by the experience and whether they had already acquired BLS knowledge that was reinforced by clinical experience. Without knowledge, a nurse would have difficulties in clinical practice; however, infinite knowledge would cause one to make a clinical decision based solely on fragmented knowledge. To perform clinical practice appropriate for a situation, one must have practical knowledge, interpersonal skills, and clinical skills related to assessment, diagnosis, and treatment[27].

And best of all, resuscitation training must reflect current evidence-based guidelines and be based on in-hospital scenarios, including the recognition of the sick patient[28]. Olejniczak et al[29] reported that three benefits of simulation-based training are socializing to the professional role, developing competence and confidence in self-performance, and learning in a safe and supportive environment. Nurses with real code

experience reported higher self-efficacy scores compared with nurses with no experience[30]. Therefore, BLS training should be structured using cardiac arrest simulation of in-hospital scenarios. The initiation of evidence-based alternative teaching and training strategies is the best way to improve performance after BLS training[31]. Excellent practical skills of clinical nurses is not born with innate but acquired through clinical experience and training. Therefore, it is important to provide continuing education or training opportunities through clinical experience based knowledge and knowledge based clinical experience.

The study had several limitations. First, we cannot tell the retention of knowledge because of this study as a cross-sectional study collected data at one point regardless of the time basic life support training. Although it is important to perform basic life support exactly, we are not measured how to perform basic life support accurately. Despite these limitations, we achieved statistically significant evidence about the factors for improving willingness to perform basic life support.

5. Conclusion

The results of the study turned out that factors associated with willingness to perform BLS were clinical experience and knowledge. Therefore, it is important that improving willingness to perform high quality BLS is simulation through code experience-based scenario when clinical nurses face sudden cardiac arrest in the future. For the continuity of the high quality BLS training effect is repeated education periodically, too. In addition, it is need some strategies to evaluate by an objective tool after nurses take part in code experience to the ongoing development of systemic retraining program.

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