

## Development and application of a simulation scenario for transient tachypnea of the newborn nursing care

Ju Hee Hwang<sup>1\*</sup>

<sup>1</sup>Department of Nursing, Kyungdong University, Wonju Munmak, South Korea; simplecode@kduniv.ac.kr (J.H.H.).

**Abstract:** This study was conducted to develop and implement Transient tachypnea scenario of the for nursing student, and examine its effects on nursing performance, communication skill and learning confidence. Using the nonequivalent comparison group post-test non-synchronized design method, the research subjects were composed of total 54 people including 28 subjects for experimental group and 26 subjects for comparison group. Using the IBM SPSS v. 25.0 for data analysis, the differences in the baseline characteristics of both groups were tested through the t-test, X<sup>2</sup>-test, and Fisher's exact test. Results: The results of this study are as follows. As a result of conducting a homogeneity test on the experimental group and comparison group, there was no difference between the two groups. The experimental group who participated in practice education using the Transient tachypnea scenario simulator was statistically significant in nursing performance ( $F=4.092$ ,  $p<.001$ ), communication skills ( $F=2.879$ ,  $p=.002$ ), and learning confidence ( $F=.289$ ,  $p=.001$ ). These findings indicated that simulation based Transient tachypnea scenario education program is effective educational strategy for nursing students to nursing performance and communication skills, learning satisfaction.

**Keywords:** Education, Newborn, Simulation, Students, Tachypnea.

### 1. Introduction

Recently, due to the aging of mothers in South Korea, the rate of preterm births under 37 weeks has been steadily increasing from 7.2% in 2016 to 8.5% in 2020. Additionally, the infant mortality rate in 2020 was 2.5 per 1,000 live births (1.3 for those under 28 days, 1.2 for those over 28 days), with more than half of the deaths occurring in the neonatal period under 28 days [1]. Consequently, the patient safety-centered management system in neonatal intensive care units (NICUs) has become increasingly important. However, due to the conditions of nursing schools, opportunities for clinical practice in NICUs are limited, and direct nursing experiences with neonates are very scarce, necessitating various educational programs at universities to overcome these challenges. Universities should utilize simulation education based on cases frequently encountered by nurses caring for high-risk neonates to provide students with direct and indirect experiences of various clinical situations.

Clinical practice education is essential for improving adaptability to the field after graduation and for forming professional identity as a nurse through direct communication and care for actual patients [2]. However, direct nursing provision by nursing students is highly restricted due to infection prevention and patient safety and privacy protection, leading to observation-focused practice [3]. The COVID-19 pandemic has further necessitated alternative measures as clinical practice was suspended or reduced to ensure student safety and infection prevention. Simulation education has gained attention as a strategy that provides opportunities for nursing practice in an environment similar to the clinical setting, fostering competent and skilled responses in complex and diverse situations [4]. Effective simulation practice operation requires the development of scenarios that reflect cases frequently encountered in actual clinical settings. For pediatric nursing practice, which involves various age groups and

interactions with caregivers, it is necessary to develop diverse scenarios reflecting these interactions and characteristics [5].

Domestic high-risk neonatal nursing simulation learning topics for nursing students have included emergency nursing programs for preterm infants and neonates with meconium aspiration syndrome [6], jaundice and pneumonia nursing care [7], and cases including respiratory distress and apnea nursing care [8-10]. Most previous studies focused on acquiring neonatal resuscitation skills for neonates with respiratory distress, but there was a lack of studies developing and verifying the effectiveness of various disease-specific cases. Therefore, this study aims to address Transient Tachypnea of the Newborn (TTN), a frequent occurrence in NICUs. TTN is caused by inadequate or delayed absorption of fetal lung fluid, resulting in pulmonary edema, and has an incidence rate of 5.7 per 1,000 full-term infants [11]. Therefore, the frequent need for oxygen therapy in TTN cases makes the development of related scenario-based educational programs essential.

This study aims to develop a scenario that can be implemented using High-Fidelity Simulation (HFS) based on frequent TTN cases in NICUs and to verify and evaluate its applicability. The study seeks to confirm the validity of the simulation scenario and enhance the quality of nursing education by providing nursing students with various clinical performance experiences through simulation-based learning.

## 2. Materials and Methods

### 2.1. Research Design & Research Subjects

This study used a non-equivalent control group post-test design to develop a TTN nursing scenario based on the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) and to verify its effects on nursing students' nursing performance, communication skills, and confidence.

The research subjects were third-year nursing students from a university in City Y, South Korea, who had completed pediatric nursing theory courses and agreed to participate in the study. Based on previous studies with significant results using one-sided tests for small groups, a minimum sample size of 21 per group was calculated using G-Power 3.1.4 with  $\alpha = .05$ ,  $1-\beta = .80$ , and effect size  $d = .80$ . Considering a dropout rate of 10-20%, a total of 60 students were recruited, with 30 in the experimental group and 30 in the control group [12]. Data from 54 students (28 in the experimental group and 26 in the control group) were analyzed after excluding 6 students who could not continue or had incomplete questionnaires.

### 2.2. Research Procedure

The development and application of a high-risk neonatal nursing education program for nursing students were based on the ADDIE instructional design model. First, in the analysis phase, needs assessments and individual interviews were conducted with 3 students who had NICU clinical practice experience during pediatric nursing practice, confirming the need for direct and indirect experiences for high-risk neonatal nursing. Previous studies on the development and effectiveness of high-risk neonatal nursing scenarios [5-7, 9-11, 13] were analyzed, and group interviews with 3 NICU nurses were conducted to identify common clinical situations and key nursing skills in NICUs. Second, in the design phase, learning objectives, practice content, and operational plans for simulation education were planned based on the 2018 Korean Nursing Education Accreditation Board's 'Simulation Standard' and the 2014 Korean Pediatric Nursing Society's 'Pediatric Nursing Clinical Practice Education Standard'. A scenario was developed by a team of 1 pediatric nursing professor, 2 NICU nurses, and 1 NICU specialist. The simulation-based practice education program was designed to allow students to experience specific situations they might encounter in clinical settings, reflect on what they learned, and conceptualize it for future application. The learning objectives for the TTN scenario were: 1) To assess and provide nursing interventions for TTN; 2) To report the patient's condition clearly to other healthcare providers; 3) To document nursing activities and outcomes; 4) To perform therapeutic communication with the parents of the newborn. Third, in the development phase, the content derived from the analysis and design

phases was concretized and validated. The program was trialed with 3 students, confirming no difficulties in execution, and was subsequently implemented. Fourth, in the implementation phase, the high-risk neonatal nursing simulation program was applied to students taking the "Pediatric Nursing Practice" course, using TTN cases observed in clinical settings and creating an environment similar to the NICU with HFS.

The TTN scenario was applied from March 4 to March 29, 2024, with 12 students per week. Groups of 3 students formed one team, with 3-4 teams per week. Pre-learning was conducted for 10 minutes, followed by group discussions for thorough scenario analysis. The simulation practice using HFS lasted for 10-15 minutes, followed by 15-20 minutes of nursing record and handover writing, and 20-30 minutes of video debriefing. After all activities, students wrote individual reflection journals. The total application time for the TTN scenario per student was 100-120 minutes.

### 2.3. Research Tools

As the assessment tool, this study used the structured questionnaire

#### 2.3.1. Pre-Test

As A pre-test was conducted to verify the homogeneity of the experimental and control groups. General characteristics and trait-anxiety were measured. General characteristics included gender, age, self-expression, interpersonal relationships, and last semester's grades. Trait-anxiety was measured using Spielberger's tool [14] with 20 items on a 4-point Likert scale, where higher scores indicate higher trait anxiety. Cronbach's  $\alpha$  was .86 in this study.

#### 2.3.2. Post-Test

A post-test was conducted to compare the intervention effects between the experimental group and the control group. The post-test included assessments of nursing performance, communication skills, and learning confidence. Nursing performance was measured using a modified tool based on the checklist provided by the Korean Accreditation Board of Nursing Education for evaluating patient care in oxygen therapy. It consists of 29 items, measured on a 3-point Likert scale, with higher scores indicating better nursing performance. The content validity of this tool was verified by two nursing professors, a head nurse from a pediatric ward, and a pediatric specialist. The Cronbach's  $\alpha$  for this tool was .89. Communication skills were measured using a tool developed by Yoo [15], consisting of 5 items on a 5-point Likert scale, with higher scores indicating better communication skills. The Cronbach's  $\alpha$  for this tool in this study was .85. Learning confidence was measured using a National League for Nursing [16] and revised by Yu [17], consisting of 8 items on a 5-point Likert scale, with higher scores indicating higher learning satisfaction. The Cronbach's  $\alpha$  for this tool in this study was .94.

The control group participated in lectures on the pathophysiology, clinical symptoms, nursing, and treatment of transient tachypnea of the newborn. The researcher organized the control group into teams of three, presenting them with a case of transient tachypnea of the newborn and having them analyze subjective and objective data to formulate nursing diagnoses and care plans using a provided worksheet.

### 2.4. Data Analysis

Using the IBM SPSS v. 25.0 for data analysis, the differences in the baseline characteristics of both groups were tested through the t-test, X<sup>2</sup>-test, and Fisher's exact test

## 3. Results

The First, the baseline characteristics of research subjects are shown as Table 1. The mean ages of experimental group and comparison group were 21.07Y and 21.92Y respectively. The age, gender, self-expression, interpersonal relationship, school grade, and trait-anxiety did not show significant

differences between two groups.

The scores of educational effects on the experimental group and comparison group are as Table 2. First, the scores of nursing performance were 4.14( $\pm$ .51) in the experimental group and 3.82( $\pm$ .56), so the experimental group was statistically-significantly higher. Second, the communication was shown as 4.19 ( $\pm$ .67) in the experimental group and 3.44( $\pm$ .98) in the comparison group, so the experimental group was statistically-significantly higher than the comparison group. Third, the learning confidence was shown as 3.86( $\pm$ .91) in the experimental group and 2.96( $\pm$ .49) in the comparison group, so the experimental group was statistically-significantly higher than the comparison group.

**Table 1.**  
General characteristics of subjects (N=54).

Characteristics	Division	Experimental group(n=28)	Comparison group(n=26)	$\chi^2$ or t	p
		M(SD) or n (%)	M(SD) or n (%)		
Age <sup>+</sup>		21.07(0.66)	21.92(2.15)	1.995	0.051
Gender	Male	1(3.6)	3(11.5)	1.248	0.264
	Female	27(96.4)	23(88.5)		
Self-expression	Good	5(17.9)	7(26.9)	0.987	0.610
	Average	15(53.6)	14(53.8)		
	Poor	8(28.6)	5(19.2)		
Personal relationship	Good	10(35.7)	3(11.5)	.968	0.330
	Average	16(57.1)	20(76.9)		
	Poor	2(7.1)	3(11.5)		
GPA	Under 3.0	2(7.1)	1(3.8)	0.493	0.920
	3.0~below 3.5	7(25.0)	8(30.8)		
	3.5~below 4.0	13(46.4)	11(42.3)		
	Over 4.0	6(21.4)	6(23.1)		
Trait anxiety <sup>+</sup>		2.32(0.25)	2.23(0.23)	0.149	0.885

**Table 2.**  
Qualities of general characteristics of subjects (N=54).

Category	Experimental group(n=34)	Comparison group(n=30)	F	p
	M(SD) or n(%)	M(SD) or n(%)		
Nursing performance	4.14(0.51)	3.82(0.56)	4.092	0.000*
Communication skill	4.19(0.67)	3.44(0.98)	2.879	0.002
Learning confidence	3.86(0.91)	2.96(0.99)	0.286	0.001

#### 4. Discussion

This study aimed to develop a scenario using High-Fidelity Simulation (HFS) based on the frequent occurrence of transient tachypnea of the newborn (TTN) in the neonatal intensive care unit (NICU) and to verify the applicability and effectiveness of the simulation scenario. By applying the simulation-based high-risk neonatal scenario to nursing students, the goal was to allow them to experience clinical situations, thereby enhancing their ability to perform nursing care and communicate effectively in actual clinical settings after graduation.

The scenario was designed to ensure that nursing students could achieve learning objectives by comparing the characteristics observed in newborns with TTN to normal and abnormal ranges, conducting nursing assessments, and providing appropriate interventions. After applying the scenario, nursing performance among the nursing students improved. These findings are consistent with studies

on simulation-based care for newborns with jaundice and pneumonia [8], and the application of nursing education modules for newborn care after admission to the neonatal unit, which showed an increase in nursing performance among nursing students [13]. The positive effect on nursing performance is likely due to the opportunity to experience various scenarios in an environment similar to clinical settings, allowing students to practice repeatedly as needed.

In this study, the application of the simulation-based TTN scenario also considered ways to improve communication skills and learning confidence among nursing students. Based on research indicating that SBAR (Situation, Background, Assessment, Recommendation) handover training significantly enhances reporting confidence [18], the development of simulation education focused on role-playing various clinical situations was considered. Clear and accurate communication between healthcare providers is crucial for ensuring patient safety and improving the quality of care [12]. Structured and standardized communication tools are essential for complex problem-solving [18-19, 21].

The results showed that the application of the simulation-based scenario improved communication skills among nursing students [22]. Given that NICU parents have high demands and children's developmental stages vary, nurses in clinical settings experience more stress in communication than in other wards [20-21]. Therefore, nursing students need sufficient practice in communication regarding children and parents in simulation-based learning. However, there is a lack of studies on changes in communication confidence and skills among students in pediatric nursing simulation research in Korea. Since most of the practical training in pediatric wards involves observation, students have limited experience in communication.

Finally, there was a significant difference in learning confidence between the experimental group, who received simulation education, and the control group, who participated in cooperative learning. Although there is no prior research directly comparing simulation education with cooperative learning, preclinical simulation education enabled the experimental group to gather information, identify problems, and solve them through the nursing process, thereby enhancing their knowledge and skills. The findings support research indicating that simulation education enhances confidence and satisfaction by providing opportunities for debriefing and reflection using videos and worksheets [23]. Simulation-based TTN scenarios, through repeated team-based training, allow students to learn about the content and responses required in clinical communication naturally [17]. By explaining and observing the patient's reactions during the nursing process, students had a closer experience with patients, resulting in positive outcomes.

## 5. Conclusion

This study developed a scenario using HFS based on the frequent occurrence of TTN in the NICU and verified its applicability to nursing students. The experimental group that participated in the simulation-based TTN education program showed significant improvements in nursing performance, communication skills, and learning confidence compared to the control group. Thus, providing nursing students with simulation-based high-risk neonatal care education programs, along with clinical practice experiences, can expand their experience in challenging clinical environments and enhance the quality of nursing education.

## Acknowledgments:

This research was supported by Kyungdong University Research Fund, 2023.

## Copyright:

© 2024 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## References

[1] Health Insurance Review & Assessment Service. The quality of medical care has improved, including the expansion of

- specialists in the neonatal intensive care unit [Internet]. *Wonju: Author*; 2022 [cited 2022 May 25]. Available from: <https://bit.ly/3wihvBP>
- [2] Lofmark, A., Wikblad, K., Facilitating and obstructing factors for development of learning in clinical practice: A student perspective. *Journal of Advanced Nursing.*, 34 (2001), 43-50. <https://doi.org/10.1046/j.1365-2648.2001.3411739.x>
- [3] Shin, S. J., Yang, E. B., Hwang, E. H., Kim, K. H., Kim, Y. J., Jung, D. Y., Current Status and Future Direction of Nursing Education for Clinical Practice. *Korean medical education review.*, 19 (2017), 76-82. <https://doi.org/10.17496/kmer.2017.19.2.76>
- [4] Dewart, G., Corcoran, L., Thirsk, L., Petrovic, K., Nursing education in a pandemic: academic challenges in response to COVID-19. *Nurse Education Today.*, 92 (2020), 104471. <https://doi.org/10.1016/j.nedt.2020.104471>
- [5] Shin, H. S., Lee, Y. N., Rim, D. H., Evaluation of algorithm-based simulation scenario for emergency measures with high-risk newborns presenting with apnea. *Child Health Nurse Research.*, 21 (2015), 98~106. <https://doi.org/10.4094/chnr.2015.21.2.98>
- [6] Yoo, S.Y., Development and effects of a simulation-based education program for newborn emergency care. *Journal of Korean Academy of Nursing.*, 43(2013), 468-477.
- [7] Kim, S. G., Effects of a simulation-based high-risk neonatal care education on learning satisfaction, class participation, learning motivation and clinical competency in nursing students. *Journal of the Korea Academia-Industrial Cooperation Society.*, 16 (2015), 6807-6815. <https://doi.org/10.5762/KAIS.2015.16.10.6807>
- [8] Lee, O. S., Noh, Y. G., The relationship among knowledge of the SBAR, attitudes towards SBAR and critical thinking disposition for nursing students. *Journal of Digital Convergence.*, 17 (2019), 213-220. <https://doi.org/10.22143/HSS21.9.2.82>
- [9] Jung, H. J., Development and application of self-directed simulation education program based on planned behavior theory: MERS scenario experience and nursing intention. *The Journal of Humanities and Social Science.*, 9(2018),547-549. <https://doi.org/10.22143/HSS21.9.2.82>
- [10] Kim, H. Y., Supplement the practice module after applying the practice of nursing simulation for newborns with respiratory disabilities. *The Journal of Educational Research.*, 19 (2021), 105-124. <https://doi.org/10.31352/JER.19.4.105>
- [11] Park, S. N., Kim, Y. S., Stress and satisfaction from simulation-based practice and clinical practice on high-risk newborn nursing. *The Journal of Korean Academic Society of Nursing Education.*, 21 (2015), 86-94
- [12] Kim, M. K., Kim, S. H., Lee, W. S., Effects of a virtual reality simulation and a blended simulation of care for pediatric patient with asthma. *Korean Academy of Child Health Nursing.*, 25 (2019), 496-596. <https://doi.org/10.4094/chnr.2019.25.4.496>
- [13] Sim, M. K., Kim, S. H., Kim, K. H., Effects of simulation-based neonatal nursing care education on communication competence, self-efficacy and clinical competency in nursing students. *Journal of Digital Convergence.*, 20 (2022), 563-571. <https://doi.org/10.1016/j.nedt.2020.104725>
- [14] Spielberger, C. D., Anxiety; state-trait process: Stress and anxiety. *New York: John wiley & Sons.*, (1975), 115-144.
- [15] Yoo, M. S., Development of Standardized Patient Managed Instruction for a Fundamentals of Nursing Course [dissertation]. *Seoul: Yonsei University.*, (2001),1-105
- [16] National League for Nursing. Student satisfaction and self-confidence in learning [Internet]. *Washington, DC: Author*; 2006. Available from: <https://bit.ly/3QWGx1B>
- [17] Yu JH. Factors influencing nursing students' flow experience and clinical competency in simulation based education: based on Jeffries's simulation model [master's thesis]. *Seoul: Sungshin University.*, (2016), 1-83
- [18] Cho, H. H., Nam, K.H., Park, J. S., Jeong, H. E., Juan, Y. J., The effect of simulation training applying SBAR for nursing students on communication clarity, self-confidence in communication, and clinical decision-making ability. *Journal of the Korea Academia-Industrial Cooperation Society.*,21 (2021), 73-81. <https://doi.org/10.5762/KAIS.2020.21.7.73>
- [19] Kim, J. H., Park, H. H., Shin, S. J., Systematic review of korean studies on simulation within nursing education. *The Journal of Korean Academic Society of Nursing Education.*, 19(2013), 307-319. <https://doi.org/10.5977/jkasne.2013.19.3.307>
- [20] Kim, A. S., Park, S. J., (2)Nursing environment, job stress, and turnover intention of pediatric ward nurses. *Journal of the Korea Contents Association.*, 17(2017), 124-132.
- [21] Kim, N. S., Kim, S. J., Song, J. H., Development and Efficacy of Psychiatric Nursing Simulation Practical Training program Using Standardized Patients. *The Journal of the Convergence on Culture Technology (JCCT).*, 8(2022), 67-74. <https://doi.org/10.17703/JCCT.2022.8.4.67>
- [22] Kim, H. J., Kim, S. K., Kim, M. G., The Study on Evaluation of Team Grouping Method using Cooperative Education Program. *The Journal of the Institute of Internet, Broadcasting and Communication(IIBC)*, 10(2010), 125-130.
- [23] Kim, M. J., Kim, S. H., Development and effects a simulation-based emergency airway management education program for nurses in a neonatal intensive care unit. *Child Health Nurse Research.*, 225(2019), 518-527. <https://doi.org/10.4094/chnr.2019.25.4.518>