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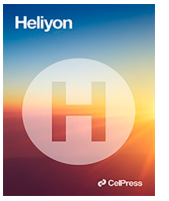

Evaluation of nursing process competencies, nursing quality, and patient safety using virtual simulation with debriefing: A quasi-experimental study

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ABSTRACT

Background: Investing in clinical education is important for adult urgent and emergency surgery and traumatology as it promotes registered nurses' competencies by providing professional development training to respond to urgent or emergency surgeries.
Objective: To examine registered nurses' self-assessment of the effects of virtual video simulation with an immediate debriefing approach on nursing process competencies, nursing care quality, incomplete care, and patient safety in surgical units.
Methods: This study used a quasi-experimental two-group pre- and post-test design. The study was conducted at two provincial hospitals in Cambodia. Participants included registered nurses employed in surgical units. The experimental group ($n = 46$) completed a virtual video simulation and immediate debriefing. The control group ($n = 35$) completed virtual training on the nursing process. Data were collected two months after a successful second-week follow-up using Competency of Nursing Process, Cambodian Nursing Care Quality, Care Left Undone, and Patient Safety scales. Wilcoxon signed-rank test and Mann-Whitney *U* test were used to evaluate the differences before and after the sessions. Generalized linear model was used to compare the differences between the two groups.
Results: The results showed statistically significant improvements in the experimental group on competency, nursing care quality, patient safety, and reducing care left undone after the intervention. However, the control group revealed statistically insignificant differences. In addition, the experimental group provided positive feedback, such as experiencing a real patient scenario, developing critical-thinking, improving communication skills, and having an opportunity to ask questions.
Conclusion: Our study showed that VVS and immediate debriefing have the potential to support in-service training of RNs from diverse backgrounds. Particularly, integrating virtual video simulation and immediate debriefing may to promote competency in the nursing process and improve care outcomes.

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1. Introduction

The COVID-19 pandemic has been a critical time in the global health system. This global pandemic has had horrific outcomes; at the time of writing this paper, Cambodia had more 100,000 COVID-19 cases, and more than 3000 deaths. The pandemic has presented severe challenges for in-service training that registered nurses (RNs) were suspended in face-to-face training [1].

In-service training is an essential investment for promoting the competency of RNs as it provides professional development and nurse job satisfaction in the long run [2]. To expand the competencies and educational outcomes, it is crucial to initiate and innovate new models for clinical training of RNs [3]. Furthermore, clinical training for RNs is organized such that it enhances empowerment and competency among RNs to better undertake their tasks [4], which in turn helps healthcare facilities accomplish their goals [5].

The COVID-19 pandemic disrupted the regular in-service training for nurses and surgical procedures were affected while they handled personal protective equipment, ventilator use, and other oxygen consumables owing to the concern of viral transmission and resource use [6]. However, adult urgent and emergency surgery and traumatology, continued to require immediate intervention, and therefore, acute care surgeries were reported globally [7]. Previous studies reported that RNs have play important roles in assessing, diagnosing, planning, intervening, and evaluating to ensure patients' comfort [8]. In addition, RNs contribute significantly to prevent the risk of contamination during surgical interventions, particularly infection due to anesthesia equipment and oxygen consumables [9]. In this study, Competency in the nursing process refers to RNs have confidence in their knowledge, skills, and attitude to implement the five steps of the nursing process with individual patients [10].

It is thus necessary to continue providing in-service training for RNs with different modalities. One such simulation with debriefing via the Zoom platform (used for video calls) was applied in this study.

2. Background

The COVID-19 pandemic affected both pre- and in-service nursing education worldwide. Investing in clinical education is important for traumatology as it promotes registered nurses' competencies by providing professional development training to respond to urgent or emergency surgeries. Surgical patients face complex conditions and require particular care; therefore, RNs should be competent to manage such urgent surgical situations [11]. Furthermore, RNs' competence is reported as an essential domain for reducing nosocomial infection in surgical units [12]. RNs typically perform skilled professional tasks for patients (such as nursing assessment, medication administration, and patient education); their roles mainly involve treatment-oriented activities and implementation of physician's orders [13,14].

2.1. Virtual video simulation for in-service training

Virtual video simulation (VVS) plays an important role in stimulating motor and decision skills [15]. During the global COVID-19 pandemic, managers and leaders used information and communication technologies' platforms to facilitate daily work. VVS is a new approach that many countries use to support clinical learning gaps. It creates reality on a computer screen and engages a real person operating replicated systems [15]. Previous studies have reported that VVS promotes better performance and competencies in terms of clinical skills, critical-thinking, problem-solving, and decision-making [16]. Another quasi-experimental study that used virtual teleconference platform to support clinical learning activities found that VVS was a very effective way to evaluate the clinical skills of nurse practitioner students [17].

2.2. Debriefing for in-service training

Debriefing is a vital teaching methodology for stimulating the post-training experience. The debriefing process designed for adult learners facilitates all aspects of the experiential learning process [18], which occurs through actual experience, insightful observation, intellectual conceptualization, and effective experimentation [19]. Debriefing assists as an instructional design to improve communication skills, critical-thinking, clinical competence, and readiness to practice in order to gain more experiential learning outcomes [1]. Previous studies have shown that immediate debriefing after VVS allows learners to consolidate the experiences into clinical competence [20,21].

Debriefing aims to summarize learning objectives and offer comments on learners' performance to simplify the comprehension of learning goals [22]. A previous study designed the Debriefing for Meaningful Learning model to boost clinical reasoning; our study in turn found that its impact on psychomotor, cognitive, and affirmative domains could be applied to the nursing process effectively [23].

2.3. Debriefing model for in-service training

The first part of the 3Ds Debriefing Model consists of "defusing," which includes learners expressing their experiences and clarifications after training, thereby becoming ready for further training [24]. The second D, "discovering," includes the learner's conceptualization of the experiences after training through observation that they can verify during dynamic experimentation [25]. The final, D, "deepening," includes helping the learner link a new experience to possible changes in nursing practice within a greater clinical practice environment, thereby helping the learner conceptualize the key lesson [26].

In this study, we used VVS in combination with immediate in-person debriefing to offer a true clinical experience for RNs, thus

providing a realistic environment that repeats actual clinical practice. The program would result the RNs, providing them with the necessary clinical competencies for urgent or emergency surgical interventions.

To our knowledge, no prior study has investigated the effectiveness of a VVS program combined with a debriefing model to evaluate the competence of the nursing process, quality, and patient safety among RNs.

3. Methods

This study aimed to examine the registered nurses' self-assessment regarding the effects of VVS with an immediate debriefing approach on nursing process competencies, nursing care quality, care left undone, and patient safety in surgical units. We hypothesized that the experimental group (intervention group) would have better mean scores for clinical competence in nursing process, nursing care quality, care left undone, and patient safety compared to the control group (CG) after the intervention (VVS with an immediate debriefing).

3.1. Research design

A nonequivalent quasi-experimental two-group pre- and post-test design was conducted to evaluate the nursing process competencies, nursing care quality, care left undone, and patient safety.

3.1.1. Participants and setting

The G* Power software is widely used in research studies to determine the appropriate sample size needed for statistical analysis. In this particular study, an effect size of 0.3, an alpha error of 0.05, and a power of 0.85 were inputted into G* Power to calculate the sample size. As a result, it was determined that a total of 75 participants +10% (overall participants = 83) would be required for the study to achieve sufficient statistical power. The convenience sampling technique was applied to RNs who was available at the study period. After screening for consent, there were 46 RNs in the EG and 35 RNs in the CG (Fig. 1).

Participants from two provincial hospitals (Siem Reap and Battambang provincial hospitals) were invited for and were willing to support this study. Simple random sampling using a lucky draw was used to categorize the hospitals; consequently, the Siem Reap provincial hospital was selected as the EG, and Battambang provincial hospital was the CG. The socio-demographic and clinical experience characteristics of RNs were similar across the groups. The inclusion criteria were as follows: being present at the workplace until completion of their studies, and signing on the consent form. The researchers worked with nursing directors who were employed at each participating hospital and engaged in practical issues of the nursing process related to organizing, implementing, coaching, and feedback during clinical placements.

The CG from Battambang hospital was provided with VVS that lacked content on the nursing process applied to the appendectomy case study. VVS was offered continuously during the study period (July 2022 to August 2022), and all participants were encouraged to join the virtual training platform. The participants in both groups were granted internet fees and two continuing professional development scores (eight points) upon completion of VVS. The link is here (https://player.hihaho.com/95f6829b-9367-4fb7-bae8-ae62d3f89353).

3.1.2. VVS and immediate debriefing

The immediate debriefing process helped promote the RNs' knowledge and confidence, and transform their knowledge into best practice by implementing the nursing process at the surgical unit. The debriefing process in our study covered four themes: discussing the feelings regarding VVS, review of the first evaluation, review of the RN's skills, and review of other significant improvements, which took 2 h (Table 2). The overall duration was 4 h.

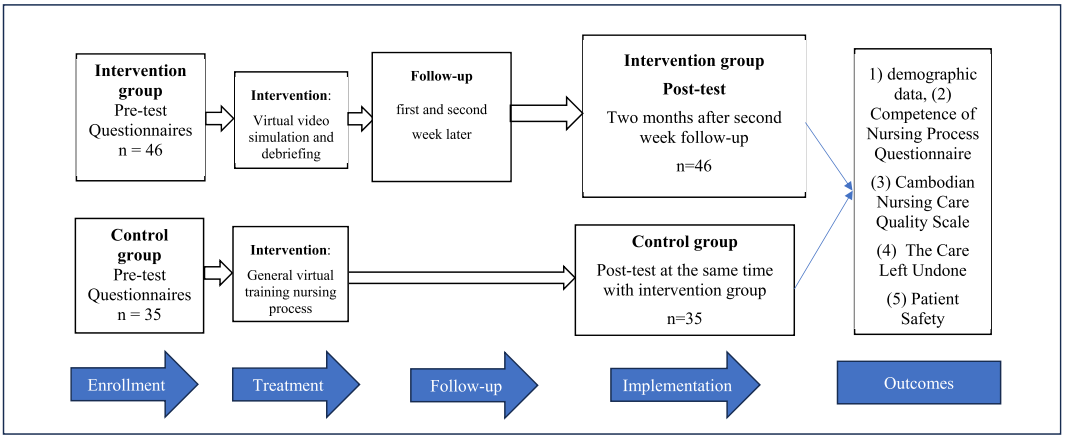

Fig. 1. Overview of the quasi-experimental study.

3.1.3. The control group comparison

The researchers provided virtual training on the nursing process at the Battambang provincial hospital (the CG) but did not offer the content of VVS, and the virtual training was not followed by immediate debriefing. Instead, the overlapping themes were offered in an online platform without debriefing or follow-up. Prior to beginning the virtual training, participants provided their demographic data and they signed informed consent forms individually. At the end of the virtual training, all the participants were required to clear at least 75% of the multiple-choice test which was set as the cut-off grade.

3.1.4. Provisions of VVS and immediate debriefing

The principal investigators were accountable for arranging the technical support, gathering data from the EG and CG, providing virtual training to these groups, and asking questions based on the immediate debriefing (Table 2). The nursing directors from both hospitals were invited to complete the full VVS. All nursing directors were trained in administering educational interventions prior to each round of training. The nursing directors were responsible for providing support to the participants, including collecting online pre- and post-test. The feedback was specifically focused on understanding the participants' thoughts and perceptions regarding their performance during the VVS. The aim was to gather valuable insights that could potentially improve future performances or identify areas of strength and weakness.

3.1.5. Data collection

Data were collected from the EG and CG before VVS, and immediate debriefing began (pre-test) followed by a follow-up (post-test) two months after the second-week. The pre- and post-test questionnaires were sent to participants via Telegram group chats using Google Survey platform.

This study used several instruments to compare the before and after VVS conditions, which was self-administrative questionnaires, including [1] demographic data [2], Competence of Nursing Process Questionnaire [a Likert Scale composed of five domains, including assessment (three item), diagnosis (three item), planning (four item), intervention (four item), and evaluation (three item); its overall Cronbach's alpha was 0.93] [3,10] Cambodian Nursing Care Quality Scale [a 34-item scale with acceptable validity and reliability (Cronbach's alpha = 0.89) [4,8] The Care Left Undone, Cambodian Version, is a checklist that consists of 13 nursing activities that were not completed during the previous shift by an RN [27]; and Patient Safety [a single item graded as "failing," "poor," "acceptable," "very good," or "excellent"] [28]. Based on these responses, Patient Safety analyzed "failing or poor" vs. "excellent, very good, or acceptable" as binaries. This measure has been used previously in the Agency for Healthcare Research and Quality's Hospital Survey on patient safety culture [29]. Feedback is essential for understanding the needs, expectations, and satisfaction of VVS, as well as identifying areas for improvement and opportunities for the next scaling-up training, which was guided by a question, "What would you provide the feedback on using VVS?".

Each participant had their own code, and when the participant submitted the online questionnaire, the researcher realized whether there were any completed points; therefore, the researchers followed up to ask for a refill in the form. RNs who were absent from the entire session (4 h) were excluded from the study to ensure the accuracy and reliability of the study's findings.

3.2. VVS pilot

Two-expert panels frequently met to review and evaluate the feasibility of the VVS. The first expert panel comprised researchers, nursing school faculty, and simulation experts. The second expert panel consisted of clinical preceptors, a nurse educator from a school of nursing sciences, and RNs to review the Khmer version of the contents.

3.3. Validity and reliability/rigour

This study followed the CONSORT checklist for the participants in both groups [30]. At the experimental hospital, a total of 46 RNs were registered to participate in the newly-developed VVS throughout the study period; all of them successfully passed the VVS training and responded to the pre- and post-test. At the CG hospital, 35 RNs enrolled in the study, and all of them were encouraged to responded to the post-test assessment.

The VVS and immediate debriefing were provided to the EG for two sessions (the first and second weeks of July 2022). Telegram chats were created for both EG and CG; the researchers informed each group four weeks prior to the date of the study schedule. In the VVS, the patient was three days post an open appendectomy operation. The video's script contained a case study focused on the patient

Table 1
Description of case scenario on appendectomy (n = 81).

Virtual simulation video clip	Case scenario	Example
2 h	appendicectomy	A 17-year-old female patient with no known drug allergies (NKDA) was transferred from a nearby hospital earlier this morning, requiring a higher level of care. The patient is post-operation three from an open appendectomy. The patient complained of right lower quadrant (RLQ) pain on 9/10, up from 6/10 when she arrived at your facility. The patient is wearing a hospital gown and under multiple blankets. The patient appears uncomfortable.

Table 2
Process and content of Debriefing guide for a simulation case.

Duration of Debriefing	Process and Content of Debriefing
20 min	1. RNs' Feeling about virtual video simulation (VVS) •What do you think about your performance during the VVS?
30 min	2. Review of first evaluation steps •What steps should be reviewed before you start implementing nursing process? (Checking nursing care plan, checking medical prescription)
30 min	3. Review of the skills of RNs •What would be your strength and weakness in implementing the nursing process (discussion on the good and improvement points of performance)
40 min	4. Review other significant improvement •What did you learn during the VVS? •What was unclear and ambiguous to you during the simulation? •Were there any issues that you wish to learn more? At the end of the session was offered some time to ask the questions

complaining of right lumbar quadrant pain (rated 9/10, up from 6/10 when the patient arrived at the hospital). The video was shown via Zoom (Table 1).

The intervention material combined the nursing process, followed by immediate debriefing. The VVS consisted of two teaching hours covering five themes of the nursing process: the patient complaining of pain in right lumbar quadrant (for assessment), the patient rating their pain 9 on a pain scale of 1–10 (for diagnosis), the patient being provided with sufficient analgesic medication to cover patient's pain (for planning), providing the patient with acetaminophen as ordered (for intervention), and selecting all the changes in the patient's assessment (for evaluation). The participants were divided into small groups, which used a nursing care plan that the Minister of Health endorsed in 2015. In each nursing process step, the researcher presented a case scenario of appendicectomy. Each group organized subjective and objective data into a nursing care plan. For instance, based on the provided information, select three additional patient assessments you, as the nurse, would like to complete this time (one or more answers correct): a full set of current vital signs, including an oral temperature, neurological assessment, cardiovascular assessment, respiratory assessment, genitourinary assessment, gastrointestinal assessment, and integumentary assessment. When each group agreed on one or more answers, they then submitted to compare the answers with correct answers if they could provide all correct answers that considered the competency of using the nursing process. We provided the link that participants might access at any time.

3.4. Ethical consideration

This study was approved by National Ethics Committee for Health Research (no. 017 NECHR), and permissions were obtained from each hospital separately. The participants were informed to volunteer to participate and agreed to the online platform. Participants could withdraw from the study at any points. Data anonymity was communicated to all the participants and they were assured that the data would not be used for reasons other than for this study, and that it would be password-protected.

3.5. Data analysis

We used IBM SPSS version 22 (IBM, Armonk, New York, USA) for analyses. The descriptive statistics method assessed the demographic data, and Wilcoxon matched-pairs signed-rank technique was used to compare the pre- and post-intervention scores (p-value of <0.05 was considered significant).Generalized Estimating Equation models were used to evaluate differences in pre- and post-test (time) and group as well as time-group interaction (The purpose is to evaluate if the difference between groups is different at different times, which is a group-by-time interaction effect). The chi-square test of homogeneity was tested the categorical variables.

The pre-test and post-test responses were compared using McNemar's test. Generalized Estimating Equation models were used to evaluate differences in pre- and post-test (time) and group as well as time-group interaction for Care Left Undone items using a binomial logistic model.

The analysis feedback data was to collect recommendations from the participants.

4. Results

4.1. Demographics data

Both groups had more female participants (CG = 68.6%; EG = 52.2%), with an associate degree in nursing (CG = 88.6%; EG = 80.4%), who were practicing nurses (CG = 80%; EG = 84.8%). The average ages of the participants were 30 and 31.5 years in the CG and EG, respectively. These results indicate that the CG (mean = 39.7, ST = 27) had a significantly higher nurse-patient ratio compared to the EG (mean = 16.1, ST = 15.2). The characteristics of both CG and EG were not significantly different ($p > 0.05$), except for the nurse-patient ratio ($p < 0.05$) (Table 3).

4.2. Effects of VVS and immediate debriefing

The mean scores of the EG particioants were higher than those of the CG after the VVS and debriefing intervention (Table 4). For example, in terms of the CNP the mean scores of the EG before and after were 2.3 (0.3) and 4.07 (0.24), respectively and $p < 0.001$; however, in the CG, the mean scores before and after implementation were similar [2.5 (0.29) and 2.53 (0.23), respectively; ($p = 0.328$)]. In addition, an ordinal logistic model using the generalized estimating equations was used to evaluate differences among pre- and post-test (time) settings, group, and time-group interaction for CNP ($p = <0.005$, <0.001, <0.005, respectively).

For the CNCQS the mean scores of the EG before and after the test were 2.46 ($SD = 0.11$) and 4.15 ($SD = 0.33$), respectively ($p < 0.001$). By contrast, the mean before and after test scores in the CG were insignificant ($p = 0.672$) at 2.47 (0.33) and 2.53 (0.35), respectively. An ordinal logistic model using the generalized estimating equations was used to evaluate differences among pre- and post-test (time) settings, group, and time-group interaction for CNCQS ($p < 0.001$, <0.001, <0.001, respectively) (Table 4).

Regarding patient safety, the mean scores of the EG before and after the test were 2.47 (0.65) and 4.00 (0.63), respectively ($p < 0.02$). By contrast, the mean scores for patient safety before and after the test were 2.4 (0.55) and 2.54 (0.5), respectively, in the CG ($p = 0.323$). Additionally, an ordinal logistic model using the generalized estimating equations was used to evaluate among pre- and post-test (time) settings, group, and time-group interaction for patient safety ($p < 0.001$, <0.001, <0.001, respectively).

The care left undone results were within two categories ("done" and "undone") and are given here as the number of nursing activities. For EG participants, the number of nursing activities that were done and left undone before and after the test for nursing tasks in the last shift was significant ($p < 0.001$). For the CG participants, the numbers of activities were insignificant before and after the test (Table 5).

4.3. Feedback of the benefits of using VVS from EG

Forty-six participants from the EG provided feedback on VVS. They felt that the VVS training was easily understandable, advantageous, well-structured, a good tool, and increased the RNs' confidence for using the nursing process with surgical patients. The VVS provided an opportunity to watch a real patient scenario, and gain experience in using skills or surgical procedures that would otherwise be challenging without potentially putting patients at risk, such as managing post-surgical infection. The immediate debriefing provided insightful discussions and allowed the participants to share opportunities for improvement; for example, five participants provided similar scenarios to discuss and seek clarification. They also felt more supportive and confident in mentoring in an in-service training manner.

Furthermore, the participants found the content of the VVS to be resourceful, appropriate, and methodical. Most participants felt that the VVS developed critical-thinking abilities similar to a real patient setting. A key aspect of satisfaction with VVS was that the participants believed that the VVS provided RNs the confidence to manage similar real patient scenarios. Additionally, participants claimed that in many surgical conditions, confidence is directly connected to nursing tasks; for example, strong communication skills are required for interacting with surgical patients.

Feedback on the VVS was positive, although some RNs indicated that the online platform was a puzzling procedure. Three participants specified feedback on the in-service training, expressing that the online platform was difficult to navigate because of weak internet connection, and suggested that the online platform be no longer than 1 h as adult learners find it difficult to concentrate on the content and engage in discussion.

Table 3
Homogeneity of participants' characteristics between control and experimental groups (n = 81).

Variables		Control group (n = 35)	Experimental group (n = 46)	*p*-values
Degree of professional education[1]	ADN	31 (88.6%)	37 (80.4%)	.375
	BSN	4 (11.4%)	9 (19.6%)	
	Master	0	0	
Gender[1]	Male	11 (31.4%)	22 (47.8%)	.137
	Female	24 (68.6%)	24 (52.2%)	
Age in years[2], median (IQR)		30.0 [22]	31.5 [20]	.606
Role of nurses[1]	Staff	28 (80%)	39 (84.8%)	.877
	Team leader	1 (2.9%)	1 (2.2%)	
	Head nurse	6 (17.1%)	6 (13.0%)	
Nurse-patient-ratio[2], mean, ST, median (IQR)		39.7 [27], 35 (56)	16.1 (15.2), 10 [16]	<0.001
Hospitals (Battambang vs Siem Reap)		35	46	.576
Competency of nursing process[3]		2.51 (.28)	2.46 (.33)	.748
Nursing care quality[3]		2.48 (.33)	2.46 (.33)	.214
Patient safety[3]		2.40 (.55)	2.47 (.65)	.134
Care left undone[1]		65.05% (19.92)	67.06% (6.93)	.514

1. Chi-square or Fisher's Exact test, 2. Mann-Whitney *U* test, 3. Wilcoxon signed-rank test, ADN = Associate Degree in nursing, BSN = Bachelor of science in nursing, IQR = Interquartile range.

Table 4
The Wilcoxon signed-rank test and Generalized Estimating Equation Model Effect were computed for pre-and post-test results for Competency of nursing process, nursing care quality, and patient safety (n = 81).

Item responses	Group						GEE Model Effect p-values		
	Control			Experimental			Group	Time	Inter-action
	Pre-test	Post-test	p-value	Pre-test	Post-test	p-value			
I. Competency of Nursing Process: Sub-score Mean values									
Assessment	2.57 (0.55)	2.62 (.50)	0.144	2.30 (.39)	4.03 (.37)	<0.001	<0.001	<0.0005	<0.0005
Diagnosis	2.45 (.54)	2.47 (.40)	0.262	2.30 (.35)	4.18 (.31)	<0.001	<0.0005	<0.0005	<0.0005
Planning	2.58 (.33)	2.55 (.27)	0.333	2.27 (.36)	4.05 (.34)	<0.001	<0.0005	<0.0005	<0.0005
Intervention	2.52 (.36)	2.54 (.31)	.411	2.33 (.39)	4.00 (.31)	<0.001	<0.007	<0.0005	<0.0005
Evaluation	2.44 (.33)	2.49 (.40)	.490	2.31 (.31)	4.08 (.26)	<0.001	<0.0005	<0.005	<0.0005
Total Score	**2.50 (.29)**	**2.53 (.23)**	**.328**	**2.30 (.30)**	**4.07 (.24)**	**<0.001**	**<0.0005**	**<0.001**	**<0.0005**
II. Cambodian Nursing Care Quality Scale: Sub-score Mean values									
Moral commitment	2.46 (.40)	2.47 (.23)	.828	2.55 (.25)	4.22 (.28)	<0.001	<0.001	<0.001	<0.001
Professional commitment	2.52 (.42)	2.51 (.21)	.992	2.50 (.20)	4.26 (.35)	<0.001	<0.001	<0.001	<0.001
Environmental management	2.39 (.48)	2.38 (.25)	.716	2.49 (.28)	4.11 (.48)	<0.001	<0.001	<0.001	<0.001
Quality-safety conscious care	2.61 (.49)	2.58 (.23)	.659	2.45 (.20)	4.15 (.36)	<0.001	<0.001	<0.001	<0.001
Total care	2.52 (.39)	2.55 (.25)	.638	2.55 (.25)	4.04 (.35)	<0.001	<0.001	<0.001	<0.001
Emotional supportive care	2.44 (.51)	2.70 (.39)	.049	2.54 (.33)	4.18 (.40)	<0.001	<0.001	<0.001	<0.001
Information supportive care	2.57 (.55)	2.61 (.53)	.558	2.61 (.52)	4.09 (.46)	<0.001	<0.001	<0.001	<0.001
Patient satisfaction	2.51 (.46)	2.52 (.31)	.894	2.53 (.31)	4.18 (.40)	<0.001	<0.001	<0.001	<0.001
Total score mean value	**2.47 (.33)**	**2.53 (.34)**	**.672**	**2.46 (.11)**	**4.15 (.30)**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
IV. Patient safety	2.40 (.55)	2.54 (.50)	.323	2.47 (.65)	4.00 (.63)	0.02	<0.001	<0.001	<0.001
1. Failing	0	0	0.020	0	0	<0.001	<0.0005	<0.0005	a
2. Poor	23	16		34	0				
3. Acceptable	12	19		12	1				
4. Very good	0	0		0	39				
5. Excellent	0	0		0	6				

Generalized Estimating Equation models were used to evaluate differences in pre- and post-test (time) and group as well as time-group interaction for CNP, CNCQS, and Patient Safety items (ordinal logistic model) and sub- and total scores (linear model).

Table 5
Pre- and post-survey results for Care Left Undone.

Item	Done	Group						GEE Model Effect p-values		
		Control			Experimental			Group	Time	Inter-action
		Pre-test	Post-test	p-value	Pre-test	Post-test	p-value			
1. Surveillance	Yes	14	14	1.000	19	42	<0.001	<0.001	<0.001	<0.001
	No	21	21		27	4				
2. Documentation	Yes	9	15	.238	13	41	<0.001	0.002	<0.001	0.002
	No	26	20		33	5				
3. Medication	Yes	11	12	1.000	11	43	<0.001	0.002	<0.001	<0.001
	No	24	23		35	3				
4. Comfort	Yes	4	10	0.146	15	38	<0.001	<0.001	<0.001	0.139
	No	31	25		31	8				
5. Care plans	Yes	7	5	0.629	15	43	<0.001	0.001	<0.001	<0.001
	No	13	20		31	3				
6. Educating	Yes	6	10	1.000	14	37	<0.001	0.001	<0.001	0.001
	No	19	25		32	9				
7. Position	Yes	9	9	1.000	16	38	<0.001	<0.001	0.003	0.003
	No	26	26		30	8				
8. Oral hygiene	Yes	5	11	0.801	32	32	<0.001	<0.001	<0.001	0.007
	No	30	24		14	14				
9. Pain management	Yes	10	14	0.302	13	32	<0.001	0.865	0.036	<0.001
	No	11	21		23	14				
10. Planning care	Yes	15	12	0.648	18	38	<0.001	0.005	0.013	<0.001
	No	20	23		28	8				
11. Discharge	Yes	9	20	0.424	18	43	<0.001	0.201	<0.001	<0.001
	No	6	15		28	3				
12. Skin care	Yes	11	14	0.648	14	42	<0.001	<0.001	<0.001	<0.001
	No	24	21		32	4				
13. Procedures	Yes	17	15	0.804	21	43	<0.001	0.001	<0.001	<0.001
	No	18	20		25	3				

5. Discussion

Following the VVS and immediate debriefing, pre- and post-test results showed significant increases for CNP, CNCQS, care left undone, and patient safety. The CG, which received online training on the nursing process without VVS and immediate debriefing, showed no significant increases across the scales. Before implementation, both groups had similar levels of competence for nursing care quality, care left undone, and patient safety. These levels improved significantly in the EG following the immediate debriefing. The EG showed significantly higher levels of competency for nursing process, nursing care quality, patient safety, and a decreased care left undone score compared to the CG.

Our findings align with previous studies, which have shown that groups that received video simulation and immediate debriefing showed improved clinical competencies [31,32]. Another study used the debriefing approach immediately after the virtual simulation, which assisted nursing students in gaining knowledge, and solving similar clinical challenges in actual practice [1]. The virtual nursing process training facilitated a constructive opportunity for RNs to develop a more robust understanding of the nursing process and strengthen communication skills compared with the CG, who use a task-oriented approach. This study resilts indicated that the EG ($p = <0.001$) performed better competencies of nursing process than the CG ($p = 0.328$).

Our findings showed that care left undone decreased significantly after implementing VVS and immediate debriefing. RNs reported a decrease in the nursing care quality because they might rush to complete the nursing activities in the nursing care plan properly; therefore, they believed that VVS and immediate debriefing led to improvements in care left undone. A previous study also reported that virtual nursing roles led to a decrease in missed nursing activities [33].

In addition, our findings revealed that for patient safety, the mean scores of EG were significantly higher than that of CG. The possible reasons could be that when the care left undone scores improved in the last shift, the nursing practice indicator was met; therefore, RNs considered patient safety fulfilled. This is supported by a previous study that reported that missing nursing activities are associated with patient safety [34].

The 3D debriefing model assisted in an inquiry-based debriefing process that allowed RNs to develop and express their thoughts in clinical judgment. In addition, the group that received the immediate debriefing approach received a collaborative learning environment to discover comprehensive conceptual knowledge from their colleagues and promote clinical problem-solving [20]. In addition, another previous study indicated that the VVS and immediate debriefing approach demonstrated benefits in learning outcomes, and the instructor's experience was found to be necessary to support the learners [35].

This visual presentation of the case scenario gave the RNs a more comprehensive understanding of the patient's condition and needs. By observing the nurse-patient interaction, RNs could gather valuable information that informed their nursing care plan. Additionally, the debriefing session allowed RNs to reflect on their actions and thought processes, enhancing their ability to think critically in real-life patient care situations.

5.1. Limitations

This study provided strong evidence based on a quasi-experimental design, which offered precise significance of our results. However, this study had the following limitations: First, the CG and EG were invited using convenience sampling from two provincial hospitals, limiting their generalizability. The CG and EG participants had their outcomes measured eight weeks after completing the clinical practice. This may not accurately support the long-term effects, and so it may limit the overall generalization of the findings. Second, the participants were from different hospitals in different cities, and the likelihood of exploring individual groups' differences was low, for example, RN's perception of using nursing process. Third, the self-report measures and a small sample might have less generalizability for our purposes. Finally, there was no follow-up conducted three to six months after the intervention to measure the competency of the nursing process.

6. Conclusions

Our study showed that VVS and immediate debriefing have the potential to support in-service training of RNs from diverse backgrounds. In addition, this approach could be provided to other target populations to expand the nursing process implementation and ensure competent professionals and best practices. This approach has been expended mainly during the COVID-19 pandemic as an innovative teaching method for in-service training. This study's findings support the ongoing interventions using VVS and immediate debriefing to promote competency in the nursing process and improve care outcomes.

Problem

The COVID-19 pandemic disrupted the regular in-service training for nurses and surgical procedures were affected while they handled personal protective equipment, ventilator use, and other oxygen consumables owing to the concern of viral transmission and resource use.

What is already known

In-service training is an essential investment for promoting the competency of RNs as it provides professional development and nurse job satisfaction in the long run. To expand the competencies and educational outcomes, it is crucial to initiate and innovate new models for clinical training of RNs.

What is this paper adds

These findings demonstrated the potential effects on in-service training and can be used as the e-learning material to support continue professional development. Particularly, integrating virtual video simulation and immediate debriefing may improve training with respect to competency, quality, patient safety, and care left undone.

Author contribution statement

Virya Koy: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Richard Henker: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Nicholas Bircherr: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Sunida Preechawong: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Jintana Yunibhand: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Andrew Rauth: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Manila Prak: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

The authors do not have permission to share data.

Declaration of competing interest

National Ethics Committee for Health Research (no. 017 NECHR).

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e20341.

All results are counts. An ordinal logistic model using the Generalized Estimating Equations was used to evaluate differences in pre- and post-test (time) and group as well as time-group interaction for Patient Safety Assessment. [a]The interaction term in this model could not be computed due to singularity of the Hessian matrix. Groups were compared at each point in time using the Mann-Whitney test. There was no difference in pre values ($p = 0.426$). Post values differed significantly ($p < 0.0005$).

References

[1] J.T.C. Fung, W. Zhang, M.N. Yeung, M.T.H. Pang, V.S.F. Lam, B.K.Y. Chan, et al., Evaluation of students' perceived clinical competence and learning needs following an online virtual simulation education programme with debriefing during the COVID-19 pandemic, Nurs Open 8 (6) (2021).

[2] M. Chaghari, M. Saffari, A. Ebadi, A. Ameryoun, Empowering education: a new model for in-service training of nursing staff, J Adv Med Educ Prof 5 (1) (2017).

[3] M. Tolyat, S.A. Vagharseyyedin, M. Nakhaei, Education of nursing profession amid COVID-19 Pandemic: a qualitative study, J Adv Med Educ Prof 10 (1) (2022).

[4] de C. Lira Alb, E.K. Adamy, E. Teixeira, FV da Silva, Nursing education: challenges and perspectives in times of the COVID-19 pandemic, Rev. Bras. Enferm. 73 (2020).

[5] D. Jackson, C. Bradbury-Jones, D. Baptiste, L. Gelling, K. Morin, S. Neville, et al., Life in the pandemic: some reflections on nursing in the context of COVID-19, J. Clin. Nurs. 29 (2020).

[6] J.P. Ermer, J.M.S. Ballester, B.C. Go, B. Philipson, P.E. Gabriel, D.A. Pryma, et al., Endocrine surgical procedures during COVID-19: patient prioritization and time to surgery, J. Surg. Res. (2021) 268.

[7] A.F. Sá, S.F. Lourenço, R. da S. Teixeira, F. Barros, A. Costa, P. Lemos, Urgent/emergency surgery during COVID-19 state of emergency in Portugal: a retrospective and observational study, Brazilian Journal of Anesthesiology (English Edition) 71 (2) (2021).

[8] V. Koy, J. Yunibhand, Y. Angsuroch, S. Turale, Development and psychometric testing of the Cambodian nursing care quality scale, Pac Rim Int J Nurs Res Thail 21 (4) (2017).

[9] R. Cîcî, E. Anuş topdemîr, Perioperative nursing care in cases requiring emergency surgery in COVID-19 infected patients, International Journal of Health Services Research and Policy 5 (3) (2020).

[10] Virya Koy, Jintana Yunibhand, Andrew Rauth, Nicholas Bircher, Manila Prak, Richard Henker, Development and psychometric testing of a competency of nursing process questionnaire, Int J Nurs Sci. 10 (2023) 245–250.
[11] M. Afshar, H. Sadeghi-Gandomani, N. Masoudi Alavi, A study on improving nursing clinical competencies in a surgical department: a participatory action research, Nurs Open 7 (4) (2020).
[12] R. Troughton, V. Mariano, A. Campbell, S. Hettiaratchy, A. Holmes, G. Birgand, Understanding determinants of infection control practices in surgery: the role of shared ownership and team hierarchy, Antimicrob. Resist. Infect. Control 8 (1) (2019).
[13] H. Jiang, H. Li, L. Ma, Y. Gu, Nurses' roles in direct nursing care delivery in China, Appl. Nurs. Res. 28 (2) (2015).
[14] V. Koy, J. Yunibhand, Y. Angsuroch, S. Turale, S. Rojnawee, Registered nurses' perceptions of factors influencing nursing care quality: a structural equation modeling study, Nurs. Health Sci. 22 (1) (2020).
[15] J.M. Padilha, P.P. Machado, A. Ribeiro, J. Ramos, P. Costa, Clinical virtual simulation in nursing education: randomized controlled trial, J. Med. Internet Res. 21 (3) (2019).
[16] S.Y. Liaw, L.F. Wong, S.W.C. Chan, J.T.Y. Ho, S.Z. Mordiffi, S.B.L. Ang, et al., Designing and evaluating an interactive multimedia web-based simulation for developing nurses' competencies in acute nursing care: randomized controlled trial, J. Med. Internet Res. 17 (1) (2015).
[17] S. Luke, E. Petitt, J. Tombrella, E. McGoff, Virtual evaluation of clinical competence in nurse practitioner students, Med Sci Educ 31 (4) (2021).
[18] A.Y. Kolb, D.A. Kolb, Experiential learning theory: a dynamic, holistic approach to management learning, education and development, in: The SAGE Handbook of Management Learning, Education and Development, 2009.
[19] T. Sato, D.D. Laughlin, Integrating Kolb's Experiential Learning Theory into a sport psychology classroom using a golf-putting activity, J Sport Psychol Action 9 (1) (2018).
[20] K. Kang, M. Yu, Comparison of student self-debriefing versus instructor debriefing in nursing simulation: a quasi-experimental study, Nurse Educ. Today 65 (2018).
[21] M. Verkuyl, M. Hughes, L. Atack, T. McCulloch, J.L. Lapum, D. Romaniuk, et al., Comparison of self-debriefing alone or in combination with group debrief, Clin Simul Nurs 37 (2019).
[22] S. Ostovar, A. Allahbakhshian, L. Gholizadeh, S.L. Dizaji, P. Sarbakhsh, A. Ghahramanian, Comparison of the effects of debriefing methods on psychomotor skills, self-confidence, and satisfaction in novice nursing students: a quasi-experimental study, \"J. Adv. Pharm. Technol. Research\"\" (JAPTR)\" 9 (2018).
[23] J. Bae, J. Lee, Y. Jang, Y. Lee, Development of simulation education debriefing protocol with faculty guide for enhancement clinical reasoning, BMC Med. Educ. 19 (1) (2019).
[24] L.C. Lederman, Debriefing: toward a systematic assessment of theory and practice, Simulat. Gaming 23 (2) (1992).
[25] D.A. Kolb, Experiential Learning: Experience as the Source of Learning and Development, Prentice Hall, Inc., 1984, p. 1984.
[26] R.M. Fanning, D.M. Gaba, The Role of Debriefing in Simulation-Based Learning vol. 2, Simulation in Healthcare, 2007.
[27] V. Koy, J. Yunibhand, S. Turale, Comparison of 12 and 24-hours shift impacts on ICU nursing care, efficiency, safety, and work-life quality, Int. Nurs. Rev. 69 (1) (2022).
[28] Koy V. THE LIFESPAN OF NURSING EDUCATION IN CAMBODIA. Belitung Nursing Journal-Belitung Raya Publisher [Internet]. 2(4) 65–69. Available from: http://belitungraya.org/BRP/index.php/bnj/.
[29] Š. Draganović, G. Offermanns, R.E. Davis, Adaptation of the agency for healthcare research and Quality's a ϵ hospital survey on patient safety culture' to the Bosnia and Herzegovina context, BMJ Open 11 (8) (2021).
[30] K.F. Schulz, D.C. Altman, D. Moher, CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials, Italian Journal of Public Health 7 (3) (2010).
[31] L.C. Kiernan, Evaluating Competence and Confidence Using Simulation Technology vol. 48, Nursing, 2018.
[32] S. Raman, L.J. Labrague, J. Arulappan, J. Natarajan, A. Amirtharaj, D. Jacob, Traditional clinical training combined with high-fidelity simulation-based activities improves clinical competency and knowledge among nursing students on a maternity nursing course, Nurs. Forum 54 (3) (2019).
[33] S. Schuelke, S. Aurit, N. Connot, S. Denney, The effect of virtual nursing and missed nursing care, Nurs. Adm. Q. 44 (3) (2020).
[34] A.J. Hessels, M. Paliwal, S.H. Weaver, D. Siddiqui, T.A. Wurmser, Impact of patient safety culture on missed nursing care and adverse patient events, J. Nurs. Care Qual. 34 (4) (2019).
[35] M. Luctkar-Flude, J. Tyerman, M. Verkuyl, S. Goldsworthy, N. Harder, B. Wilson-Keates, et al., Effectiveness of debriefing methods for virtual simulation: a systematic review, Clin Simul Nurs 57 (2021).