

# Using Newly Developed Software to Enhance the Efficiency of the Nursing Process in Patient Care

## A Randomized Clinical Trial

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The nursing process is a systematic decision-making method of problem-solving that increases the quality of patient care. Implementation of modern technology in nursing can reduce documentation time, make nursing care safer, and improve the quality of patient care. This study aimed to determine the effectiveness of applying newly developed nursing process software on the efficiency of the nursing process in patient care. In this randomized clinical trial, 80 nursing students were randomly allocated into intervention ( $n = 40$ ) and control ( $n = 40$ ) groups. The student in the intervention group used the software to care for patients for two semesters. Students in the control group used routine hospital protocol to care for their patients. Modified Brooking nursing process measuring scale was used to evaluate the effectiveness of software before and after the intervention. The results showed a statistically significant difference in the mean efficiency score of the nursing process in the two groups after the intervention ( $P < .001$ ). Using nursing process software leads to increasing the efficiency of the nursing process in patient care. Thus, providing executive support and electronic resources with relevant training for nursing students can be beneficial in students' education and be a practical application of the nursing process in caring for patients.

**KEY WORDS:** Care, Iran, Nursing, Nursing process, Software, Student

The nursing process is a framework for planning and implementing nursing care for patients, consisting of interrelated, dynamic, ongoing, scientific, and problem-oriented activities.<sup>1</sup> The steps of the nursing process have been written differently by different authors, but the common elements include assessment, diagnosis, planning, implementation, and evaluation.<sup>2</sup> The nursing process is a systematic decision-making method of problem-solving that increases the quality of patient care by emphasizing the independent nurses' performance and implementing holistic nursing care.<sup>3,4</sup> The nursing process has many benefits, which include increasing the efficiency of nursing care, expanding healthcare through health education and prevention, reducing treatment costs, and managing complications associated with chronic illness in patients.<sup>5</sup>

The nursing process is implemented in most healthcare systems in the world.<sup>4</sup> Although the advantages and benefits of implementing the nursing process are well-known, and its education included in the nursing program, unfortunately, this systematic method is not used appropriately or is used to a minimal extent in developing countries like Iran.<sup>6</sup> Failure to implement the nursing process in hospitals can cause many problems, including reduced job satisfaction, reduced scientific and practical nursing practice, reduced quality of nursing care, implementation of one-dimensional care, decreased patient independence, and increased treatment costs associated with unnecessary repeated care.<sup>7</sup> Implementing the nursing process requires completing multiple forms, selecting and marking the list of contents, and following up on the patients. We use paper forms and pencils in the conventional type of nursing process. Although the accessibility and the need for limited facilities are the advantages of this method, there are more opportunities and benefits with the electronic system's development today.<sup>8</sup> The use of technology in nursing education improves nursing students' skills and critical thinking and makes them prepared for safer patient care.<sup>9</sup> Using computer system technology to collect, store, process, and modify clinical data in nursing care can reduce documentation time,<sup>10-12</sup> make nursing care safer and more feasible, and improve the quality of nursing care.<sup>8,11,12</sup> Also, an EHR system can help to improve the standardized nursing care plan and documentation, which, in turn, improves nurse-patient communication.<sup>8,12-14</sup>

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The nursing process has undeniable benefits,<sup>15</sup> and it is not implemented nearly enough in clinical practice.<sup>6</sup> Considering the advantages of using nursing process software,<sup>16</sup> utilizing it can encourage nurses and nursing students to implement the nursing process in their clinical practice. Nowadays, numerous software applications have been used in the nursing process.<sup>8,11,12</sup> However, their main problem is that they were designed to evaluate only part of the nursing process, not all its steps.<sup>11</sup> Therefore, required integrity and continuity in presenting and formulating the nursing process are not protected in these software applications. Also, their effectiveness in the implementation of the nursing process as a whole has not been evaluated.<sup>11,12</sup> Thus, this study aimed to determine the effectiveness of the application of a newly developed nursing process software program on the efficiency of the nursing process in nursing students. We hypothesized that the newly developed nursing process software might positively impact the productivity of the nursing process in nursing students.

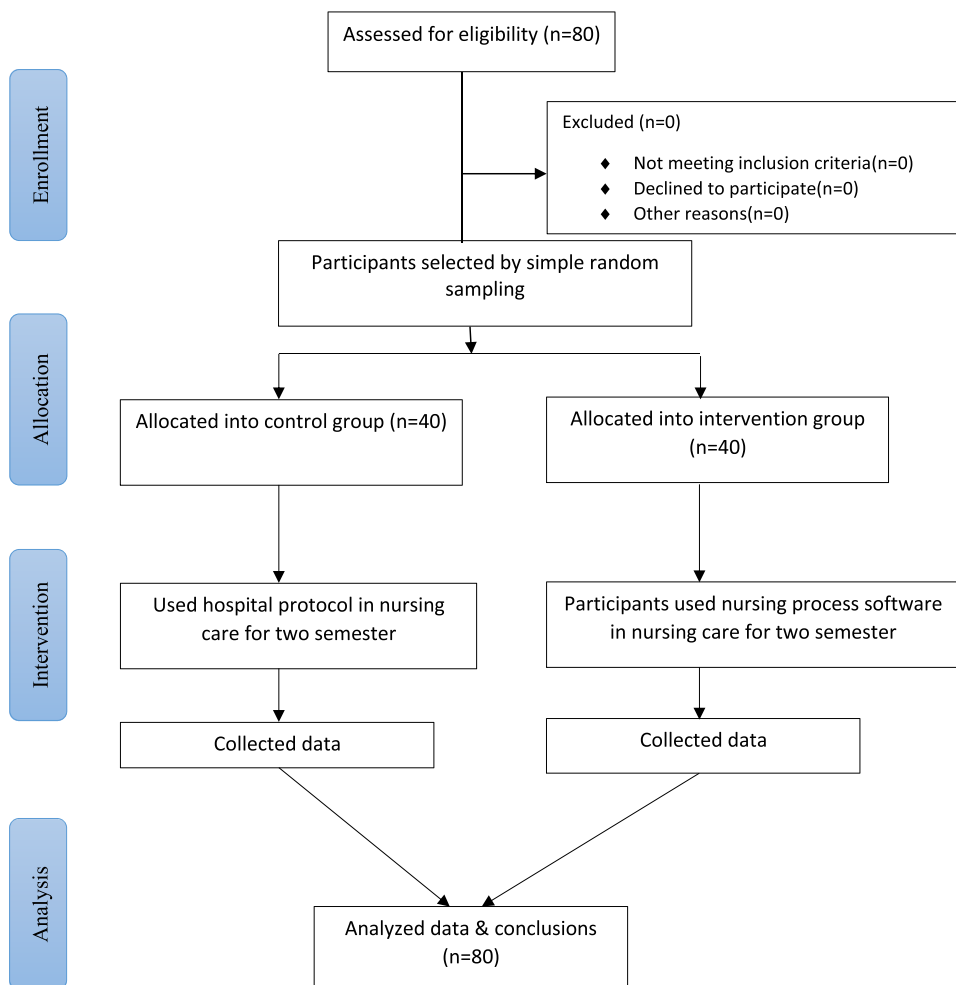
## METHODS

### Study Design

This randomized clinical trial was conducted at Tabriz University of Medical Sciences, Iran, in 2019.

### Study Population

The study population included all nursing students in the seventh and eighth semesters. Based on the pilot study on 15 patients (effect size = 0.7), considering  $\alpha = .05$  and power of 80, the sample size was calculated as 34 students for each group and 68 students for two groups. Given the possibility of a 20% attrition rate, the total sample size was estimated to be 80 students. Participants were selected by simple random sampling and randomly allocated into intervention ( $n = 40$ ) and control ( $n = 40$ ) groups (Figure 1). A computer-generated list of random numbers was used to allocate the participants. The research team prepared 80 envelopes with aluminum covers based on the sample size. They listed each of the random sequences on a card and



**FIGURE 1.** Flow diagram of the study based on CONSORT statement 2012.

put the cards in the envelopes. The outside of the envelopes was numbered in the same way to keep a random sequence. Ultimately, the envelopes were sealed and located in a box sequentially. Every eligible participant picked up a sealed envelope and entered either the intervention or control group. The inclusion criteria include willingness to participate in the study, being undergraduate nursing students at Tabriz University of Medical Sciences in the seventh and eighth semesters, having the International Computer Driving License certificate, and using nursing process software continuously for 2 weeks (at least in four patients). Unwillingness to stay in the study was considered as an exclusion criterion.

### Measures

We used two questionnaires to collect data: sociodemographic characteristics of the participants and a modified Brooking ward nurses self-rating scale (nursing process measuring scale). Brooking<sup>17</sup> designed the primary tool to measure the nursing process. She used American and British literature regarding the nursing process, identified the main themes, and selected them to operationalize the nursing process as a scale. After presenting and modifying the scale and performing its initial validity by an expert panel in the United Kingdom, the scale was implemented in 16 hospital units to check the feasibility of the nursing process. She used various methods to measure the validity and reliability of the scale. Its face and content validity, reliability, internal consistency, and interrater reliability were high and acceptable. The main scale contained 37 questions based on a 6-point Likert scale ranging from 1 (no, never) to 6 (yes, always). The modified scale also includes 37 questions presented with a 5-point Likert scale that scores as follows: 1 = never; 2 = do not know; 3 = yes, sometimes; 4 = yes, usually; 5 = yes, always. This questionnaire consists of five dimensions of general questions (four items), assessment and diagnosis (seven items), planning (nine items), implementation (10 items), and evaluation (seven items).<sup>17</sup>

To be able to use the scale in our study, the researcher, who was an expert with the terminology in the scale and was fluent in English and Persian languages, translated the scale to the Persian language. Then, it was translated back to English by an independent translator who used to live in a native English-speaking country. In the next step, an expert panel was established and reviewed the translation. Then, all required modifications were applied to the scale, and it became ready to use in the study. We used face and content validity to determine the validity of the instrument. Because this is a standard questionnaire, we did some literature review and considered items related to the nature of the research. Then, we asked 10 undergraduate nursing students to complete the questionnaire. We used their comments to clarify and simplify the items of the questionnaire. To

determine the content validity of the questionnaire, we asked 10 faculty members and PhD students in nursing of Tabriz and Shiraz University of Medical Sciences to check the questionnaire. The research team made all the necessary amendments after reviewing their comments. We also measured the content validity ratio of the questionnaire items and the content validity index of its constructs, and they were higher than 0.93 and 0.96, respectively. We used Cronbach's  $\alpha$  coefficient to calculate the reliability of the scale ( $\alpha = .87$ ). Finally, we developed a self-report questionnaire to measure the nursing process. It consists of 20 items and assesses the efficiency of different aspects of the nursing process in nursing students. This questionnaire is based on a five-point Likert scale (1 = never, 2 = rarely, 3 = occasionally, 4 = often, 5 = always). The scores are calculated based on the total scores of items in that group. The scores ranged from 20 to 100. A higher score indicates the higher performance of nursing students in implementing the nursing process.

### Intervention

The participants were nursing students in the final year of their undergraduate program in Tabriz nursing school, and they were in their internship period in medical-surgical units. The nursing students who met the inclusion criteria were randomly allocated into intervention and control groups. We performed an extensive literature review and used the latest international standards based on the North American Nursing Diagnosis Association (NANDA) list (2018-2020),<sup>18</sup> and some nursing textbooks to design and develop the nursing process software. The software contains six steps, and each step is designed separately, and they are (1) assessment, (2) nursing diagnosis, (3) identifying the objectives and expected outcomes, (4) planning, (5) implementation, and (6) evaluation.

The software can process the information of each step independently or dependent on other steps of the nursing process. Also, the software has an intelligent mode; by selecting the assessment step, which is the first stage of the nursing process, the user is faced with a series of categorized items regarding the problems of different body systems. The software automatically provides its nursing diagnoses, expected outcomes, and care planning by selecting each of them. In the implementation stage, the user determines whether the care is done, and if it is not done, the relevant reason is recorded. The achievement or nonachievement of the expected outcomes is specified in the evaluation stage. In the case of nonachievement, the reason is mentioned. Thus, all the steps of the nursing process are completed. This software provides a framework for delivering quality nurse care that the nurse will be able to evaluate his/her care by selecting the relevant items in the evaluation stage in the software. If nursing care was undesirable and the nurse did not

achieve the expected outcomes, the system offers new solutions for the nurse to solve the patient's problem by providing new care.

The software was designed in both computer and Web-based programs. Thus, nursing students could use it online on their smartphones. By using this software, nursing students could access the different steps of the clients' nursing process and enter their information obtained from the assessment. Initially, a trained researcher oriented the students in the intervention group to newly developed software and answered their possible questions. Nursing process software was provided only to nursing students in the intervention group, and they practically used it for 2 weeks to become thoroughly familiar with the software. Then, the student in the intervention group used the software to care for patients for two academic semesters from October 2018 to June 2019. The nursing student in the control group cared for their patients using routine hospital protocol. Nursing students in both intervention and control groups completed the modified Brooking nursing process measuring scale before and after the intervention. The study process is shown in Figure 1 based on the CONSORT (Consolidated Standards of Reporting Trials) statement.<sup>19</sup>

### Ethical Considerations

This study was approved by the research deputy and the institutional review board of Tabriz University of Medical Sciences (institutional review board no. IR. TBZMED. REC.1393.214). We explained the purpose of the study to

the participants. Also, we assured them regarding the confidentiality of their information and privacy. We explained to them that if they decided to participate, they are free to leave the study at any time. Leaving the study will not cause any penalty or loss of benefits. Then, we asked the participants to sign the consent form.

### Data Analysis

Data were analyzed using IBM SPSS 19.0 software (IBM, Armonk, NY, USA). We used Descriptive (mean and SD) and inferential (independent *t* test and paired *t* test) statistics to analyze the data.

### RESULTS

The mean age of the participants was  $23.15 \pm 3.03$  and  $23.08 \pm 3.74$  years in the intervention and the control groups, respectively. The *t* test showed no significant difference between the two groups in terms of age ( $P = .92$ ). Grade point averages of students were  $16.44 \pm 1.17$  and  $16.49 \pm 1.41$  in the intervention and control groups, respectively, which was not statistically significant ( $P = .86$ ). These scores are equivalent to a B+ on a standard A–F letter-grade scale. The students' levels of interest in nursing based on a 10-point scale were  $5.28 \pm 1.61$  and  $5.10 \pm 2.13$  in the intervention and control groups, which were not statistically significant ( $P = .68$ ). There were no significant differences in regard to other sociodemographic characteristics of participants between the two groups; it means two groups were homologous (Table 1).

**Table 1. Sociodemographic Characteristics of Participants**

Variables		Intervention Group	Control Group	P
		n (%)	n (%)	
Gender	Female	23 (57.5)	24 (60)	.82
	Male	17 (42.5)	16 (40)	
Marital status	Single	28 (70)	31 (77.5)	.44
	Married	12 (30)	9 (22.5)	
Semester	Seventh	23 (57.5)	17 (42.5)	.18
	Eighth	17 (42.5)	23 (57.5)	
Students' familiarity with using computers and software	Yes	39 (97.5)	37 (92.5)	.31
	No	1 (2.5)	3 (7.5)	
Students' attitudes toward using computers in their work	Completely agree	11 (27.5)	9 (22.5)	.56
	Agree	18 (45)	19 (47.5)	
	No ideas	6 (15)	6 (15)	
	Disagree	5 (12.5)	2 (5)	
	Completely disagree	0 (0)	4 (10)	
Student ethnicity	Azeri	6 (15)	6 (15)	.64
	Persian	23 (57.5)	21 (52.5)	
	Kurd	4 (10)	3 (7.5)	
	Lur	7 (17.5)	10 (25)	
Student work experience	Yes	16 (40)	15 (37.5)	.82
	No	24 (60)	25 (62.5)	

**Table 2. Mean and SD of Scores of Questionnaire's Items Based on a Likert Scale for Nursing Students in the Intervention and Control Groups Before and After Intervention**

Items	M ± SD (Before Intervention)		P	M ± SD (After Intervention)		P
	Intervention Group	Control Group		Intervention Group	Control Group	
1. Is there a possibility to have a comprehensive assessment in new admitted patients before planning nursing care?	3.70 ± 0.94	3.58 ± 1.06	0.58	3.98 ± 0.73	3.58 ± 0.87	.03
2. Have nursing diagnoses been determined comprehensively?	3.40 ± 0.9	3.58 ± 1.08	0.43	4.08 ± 0.62	3.90 ± 0.74	.25
3. Have nursing diagnoses been arranged according to priority?	3.40 ± 1.03	3.28 ± 0.99	0.58	4.18 ± 0.71	3.60 ± 0.84	.001
4. Have objectives been determined based on nursing diagnoses?	3.43 ± 0.9	3.58 ± 0.98	0.48	4.55 ± 0.60	3.28 ± 1.09	<.001
5. Have the objectives been formulated in sufficient detail (when and how to achieve the objective and who providing care)?	2.60 ± 0.87	2.55 ± 1.15	0.83	3.65 ± 0.92	2.58 ± 1.03	<.001
6. Are nursing care plans consistent with determined objectives?	4.20 ± 0.69	4.30 ± 0.61	0.49	4.50 ± 0.55	4.23 ± 0.77	.07
7. Have nursing interventions been provided in sufficient details?	2.53 ± 1.01	2.58 ± 1.01	0.83	3.65 ± 1	3.35 ± 0.95	.17
8. Is there a possibility to develop a comprehensive care plan for each patient without studying valid and reliable books and literature about nursing process?	2.50 ± 0.78	2.38 ± 0.87	0.50	3.98 ± 0.89	3 ± 1.01	<.001
9. Is it possible to provide comprehensive patient care based on designated plans?	3.65 ± 0.77	3.63 ± 0.95	0.89	3.95 ± 0.71	3.60 ± 0.87	.05
10. Is nursing care provided based on priorities?	3.08 ± 1.05	2.88 ± 1.02	0.39	4.13 ± 0.85	3.28 ± 0.85	<.001
11. Does application of the nursing process approach lead to improving nursing care performance?	3.35 ± 0.83	3.28 ± 0.96	0.71	3.85 ± 0.74	3.20 ± 0.91	.001
12. Is it possible to record nursing interventions?	2.68 ± 0.92	2.48 ± 0.82	0.31	4.40 ± 0.67	2.88 ± 0.91	<.001
13. Is a systematic assessment performed to determine the effectiveness of the care provided to resolve the patient's problems?	3.83 ± 0.90	3.80 ± 0.88	0.90	4.38 ± 0.67	3.18 ± 0.96	<.001
14. Is assessment recorded in care plans or progress reports?	2.43 ± 1.01	2.40 ± 0.81	0.90	4.23 ± 0.8	3.03 ± 0.97	<.001
15. Are care plans modified based on assessment results?	3.23 ± 0.86	3.05 ± 0.75	0.34	4.10 ± 0.78	2.95 ± 0.99	<.001
16. Is application of nursing process easy in patient care?	2.45 ± 0.99	2.70 ± 1.81	0.31	4.10 ± 0.84	2.58 ± 1.02	<.001
17. Is it possible to formulate the nursing process for patients without spending too much time?	2.23 ± 1	2.40 ± 0.87	0.41	4.20 ± 0.76	2.03 ± 0.95	<.001
18. Is there enough time to apply the nursing process approach during the nursing care time?	2.63 ± 0.92	2.63 ± 0.95	1	3.63 ± 0.87	2.53 ± 0.82	<.001
19. Is application of nursing process approach effective in updating your knowledge and performance in patient care?	3.30 ± 0.94	3.25 ± 0.98	0.82	3.73 ± 0.78	3.08 ± 1.05	.002
20. Is there possibility for other healthcare team members to access patient documents in nursing process?	2.18 ± 0.84	2.23 ± 0.70	0.77	4.13 ± 0.82	2.18 ± 0.90	<.001



The results showed no significant difference in the score of the questionnaire items in the control and intervention groups before the intervention. Nevertheless, we found significant differences in the scores of most questionnaire items in the two groups after the intervention ( $P < .05$ ) (Table 2).

Before the intervention, the mean efficiency scores of the nursing process were  $60.75 \pm 6.51$  and  $60.50 \pm 6.09$  in the intervention and control groups, respectively. Independent  $t$  tests showed no significant difference in the mean efficiency score of the nursing process in the two groups before the intervention ( $P = .86$ ). However, the mean efficiency scores of the nursing process were  $81.35 \pm 5.7$  and  $61.77 \pm 5.52$  in the intervention and control groups, respectively, after the intervention. There was a statistically significant difference in the mean efficiency score of the nursing process in the two groups after the intervention ( $P < .001$ ). The paired  $t$  tests indicated no significant difference in the mean efficiency score of the nursing process in the control group before and after the intervention ( $P = .18$ ). Nevertheless, there was a statistically significant difference in the mean efficiency score of the nursing process in the intervention group in the preintervention and postintervention phases ( $P < .001$ ) (Table 3).

## DISCUSSION

This study aimed to determine the effectiveness of applying the nursing process software on the efficiency of the nursing process in nursing students. In this study, the total mean efficiency score of the nursing process was significantly increased in the intervention group after applying the nursing process software. Hence, the effectiveness of applying the nursing process software is determined on students' efficiency in implementing the nursing process. According to the results of the current study, the use of nursing process software in the education and practice of nursing students can have a significant impact on the efficiency of the nursing process and eventually can have a vital role in improving the students' knowledge and skills. Also, it seems to be beneficial in improving the quality of the nursing process, and it can promote the quality of care provided to patients, as well as the health and well-being of patients. In general, it can be said that the nursing process software has a positive

impact on nursing practice and leads nurses to devote more time to direct care.

## LITERATURE REVIEW

In all studies were conducted about nursing process software or their evolution, only part of the nursing process has been discussed<sup>11,12</sup> or had particular content related to hospitalized patients in specific units.<sup>8,11</sup> Most of these studies have used quasi-experimental, descriptive, or mixed-methods designs to evaluate the effectiveness of the software.<sup>8,11,12</sup> These software applications have been implemented in specific units with a limited population, such as students or nurses.<sup>8,11</sup>

A study conducted in Iran showed that nursing students have a positive attitude toward using the software in the nursing process and consider it effective in several areas of nursing care such as prioritizing patient care and problems, completeness of patients' electronic information, and saving nursing students' time.<sup>14</sup> In another study, nursing students confirmed the positive effect of using computer technology for teaching and learning some part of the nursing process (assignment and categorization of nursing diagnosis). However, they believed there is a need for sufficient educational technology resources.<sup>20</sup> Also, the findings of the previous study on the application of nursing process software showed that most benefits of using this tool are related to initial assessment and patient care continuity.<sup>14</sup> A study regarding the application of a computer program for nursing diagnosis showed that this program would help nurses to select correct nursing diagnosis for their patients, promote the efficient performance of the nursing process, and improve the quality of nursing care.<sup>21</sup> Lima et al<sup>22</sup> designed and created the Natus technology to apply the nursing process in neonatal units. It allows nurses to organize nursing care, improve data collection, and help identify diagnoses and select nursing interventions for neonates. A study conducted in Brazil about the computerized nursing process showed that using the system established a new understanding of clinical nursing care and made early error detection possible. The system also provided the possibility of continuous learning and facilitated clinical decision-making for nurses.<sup>23</sup> In the study conducted by Sayadi and Rokhafroz<sup>24</sup> in Iran, a smartphone application for the nursing process was designed according

**Table 3.** Comparing the Mean Efficiency Score of the Nursing Process in Nursing Students Before and After the Intervention

Phases Groups	Before intervention	After intervention	P (Paired t Test)
	(M ± SD)	(M ± SD)	
Intervention group	60.75 ± 6.51	81.35 ± 5.07	<.001
Control group	60.50 ± 6.09	61.97 ± 5.52	.18
P (independent t test)	.86	<.001	

to learning objectives of nursing students in cardiology units, and it was given to 30 nursing students receiving cardiac care field training. The nursing students affirmed that their knowledge, as well as their use of the nursing process, increased significantly in clinical practice.<sup>24</sup>

A recent study reported that nurses designed and validated a smartphone application that contains the nursing process. They implemented the application in neonatal ICUs and found it helpful and safe; the quality of nursing care improved significantly, and all the nurses were satisfied with using it.<sup>25</sup> Although the application of the nursing process is accepted as a standard of care for several developed countries, the rate of its implementation is low among nurses,<sup>4,6</sup> and most participants implement the process incorrectly.<sup>26</sup> A review of the literature showed some factors as a barrier to implementing the nursing process in the clinical practice, including the presence of complicated patients,<sup>11,27</sup> a large number of patients,<sup>26,28</sup> and a low level of education,<sup>14,26</sup> knowledge,<sup>8,14,26</sup> and skills<sup>14,27</sup> of the nurses. Some inhibiting factors related to the nursing process were as follows: the workplace atmosphere, lack of material supply to use the nursing process,<sup>26</sup> and the intangible perception of the nursing process concept, being different perspectives on the nursing process, inadequate support of management systems,<sup>29</sup> and nursing process documentation issues.<sup>8,29</sup>

It should be noted that a lot of nurses' time is devoted to paperwork. Nursing informatics concerning care and work process management is trying to find systems that can minimize time spent on official paperwork activities and maximize the time dedicated to care. Findings of the study by Wang<sup>30</sup> regarding the quality of electronic and paper record systems showed that more forms were used in nursing electronic record systems, and these are not different from paper record systems in terms of completing all the different forms and spending too much time in documentation. In our study, the user can complete the more relevant forms based on the client's condition, and there is no need for completing all parts and forms of the system.

The results of the study by Rajabpoor et al<sup>28</sup> indicated that not enough attention is given to the proper education of the nursing process during the student years based on 90% of nurses and 93.5% of nursing students' perspectives. Similarly, in our study, most nurses (90%) stated that there is neither adequate supervision over implementing the nursing process nor a proper training during their university years. Students are the future nurses. Thus, if they learn the nursing process from the beginning of their education practically and use modern tools in their student years, it will be more convenient for them to accept it, and we can hope that they use this effective method more in clinical practice. When they enter the clinical field as a nurse, they will readily

adopt such tool and benefit more from it.<sup>28</sup> The International Nursing Council recommends using the nursing process in nursing care and its application through the software. Implementing software enables nurses to organize and develop logical thinking in the process of helping patients. It allows them to establish an innovative relationship between clinical assessment, diagnosis, interventions, and nursing outcomes through computer tools.<sup>16,31</sup> When using the nursing process software, there has been an improvement in the patients' admission process and the possibility of personalizing patient care.<sup>32</sup> This leads to reduced time spent identifying nursing diagnoses, unifying functional language in nursing, increasing nursing participation in the nursing process implementation, and enhancing the ability to reduce the mortality rate and complications in patients.<sup>11</sup> Hence, the application of information technology in nursing practice is a facilitator that should be encouraged based on the knowledge and scientific education, and access to this technology should be feasible for professionals and patients.<sup>11,33</sup>

### Limitation

The implementation of the study was only in medical-surgical units and among senior nursing students. Therefore, it is suggested that other studies be conducted on nursing students of other academic semesters and in other hospital units, as well as nurses working in the hospital. The nature of the research was such that the intervention group and researchers could not be blinded. Thus, this was another limitation to this study. Another limitation of the study was that nursing students in both groups were from the same nursing school, and they were attending an internship in the same hospital. We suggest students are recruited in future studies from different nursing schools and participate in various hospitals for their internship period.

### CONCLUSION

The nursing process is the foundation of scientific care, and it is an identity for the nursing profession. Thus, its use can help teach the principles of nursing care to nursing students. Based on the results of this study, the use of nursing process software significantly increases the efficiency of the nursing process in nursing students. Therefore, preparing the proper base by providing executive support and electronic resources with relevant training for students can be beneficial in students' education and practical application of the nursing process in nursing care. As a result, it leads to improving patient safety and the quality of care.

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