Designing and Psychometric Evaluation of the Competency Inventory for Postgraduate Students of Intensive Care Nursing

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Abstract

Background: Today, the role of expert clinical nurses is highlighted because their presence is necessary for guaranteeing the quality of nursing care provided for the patients. However, there are no proper instruments for measuring the clinical competence of postgraduate students in intensive care nursing.

Objectives: The present study aimed at development and psychometric evaluation of the clinical-competence inventory for postgraduate students of intensive care nursing.

Patients and Methods: A methodological study was conducted at state nursing schools of Iran. The participants were postgraduate students of intensive care nursing, who were being trained at 16 nursing schools throughout Iran, during year 2014. After examining some relevant texts, the first draft of the inventory was designed with 60 items. In order to confirm its face and content validity, a panel of experts and students examined the inventory. The final draft, which contained 44 items, was distributed among postgraduate students of intensive care nursing, and 217 students answered the inventory. The construct validity was verified using exploratory factor analysis. The reliability of the inventory was verified using consistency tests.

Results: Firstly an instrument with 60 items was developed. Next, the face and content validity of the instrument was assessed by 15 students and 11 experts. Overall, 16 items were removed through validity assessment and 44 items remained in the final draft. The content validity index of the final draft was 0.90. Moreover, the content validity ration of 44 items ranged between 0.75 and 1. The Cronbach's alpha coefficient of the inventory was 0.95 and the intraclass correlation coefficient (ICC) of the test-retest results was 0.96. To examine the construct validity of the final draft, it was administered for 217 postgraduate students of intensive care nursing and five factors, with Eigenvalues above one and loading level equal to or above 0.4, were extracted through exploratory factor analysis.

Conclusions: The inventory developed in this study is a suitable index for evaluating the efficacy of postgraduate students in the field of intensive care nursing.

Keywords: Psychometric, Inventory, Clinical Competence, Students, Intensive Care Nursing

1. Background

In order to provide high quality care, the treatment team must be trained professionally (1). Besides, the nurses' competency has a close relationship with patient outcomes and safety issues such as medical mistakes, hospital infections, deaths, complications after surgery, and taking out the tracheal tube in an unplanned manner at the intensive care unit (ICU) (2, 3). Furthermore, the rising rate of turnover in the nursing workforce makes the necessity of evaluating the nurses' clinical competency more evident (4), especially in the field of intensive care.

In year 2005, taking an outcome-based perspective, Taiwan nursing accreditation council (TNAC) compiled a collection of the main competencies necessary for nursing students (5). However, such a collection is not appropriate for use as a tool for evaluating the intensive care nurses' competency. Unfortunately, lack of exclusive and standard inventories in this field is a considerable challenge that can be attributed to the lack of attention, both in clinical settings and in nursing researches, to the clinical competence of postgraduate students in the field of intensive care nursing.

All over the world, there is a continuous need for new nursing workforce for ICUs and nurse training courses meet this need (6). In order to train expert clinical nurses, postgraduate courses on intensive care nursing have been officially developed since 2008 in Iran, and since the 1980s in some other countries (7). It is worth mentioning that

competency in intensive and critical care nursing is a multi-dimensional concept. The five major dimensions, which have been identified, include knowledge base, skill base, attitude base, experience base, and individual base (8). Applying all these diverse dimensions to nurse training makes the gap between what the students actually learn in academies and what they need in action more evident (1). What matters is that the teachers of intensive and critical care nursing and the clinical supervisors should be able to evaluate the nurses' and the students competency (6).

There are no reliable and valid tests capable of evaluating the competency of ICU and CCU nurses (8). In this regard, there are instruments such as the "physiological-biological knowledge test" (9), while there is an instrument for evaluating competency standards of critical care nursing (10). Various attempts have been made to develop proper tests for evaluating nurses' competency (11-14). However, a few studies have addressed the main requisite competencies of nursing students (15-17). Considering the fact that intensive care nursing is one of the nursing specialties with unique features, general instruments of evaluating intensive care nurses' competency are not applicable and there is still a need to develop an appropriate instrument capable of evaluating ICU nurses' competency (18).

2. Objectives

This study aimed to develop and examine the psychometric properties of a competency inventory to evaluate the competencies of postgraduate students of intensive care nursing.

3. Patients and Methods

3.1. Study Design

A methodological study was conducted with two stages; first for developing and then, to validate the instrument.

3.2. Development of the Instrument

In order to prepare the instrument, a purposeful search was carried out about the clinical competency of ICU nurses. Accredited papers with keywords such as psychometric evaluation, inventory, clinical competency, nursing student, and intensive care nursing were extracted from two databases, namely 'ScienceDirect' and 'PubMed', in order to develop comprehensive definitions for the related concepts and to prepare the inventory. The literature was carefully examined and the competencies

needed for an intensive care nurse were extracted and listed as the first draft. The first draft of the inventory was then carefully reviewed by a panel of experts in regards to their extent of coverage and their relevance to the specified objectives. This panel consisted of 11 university professors in the field of intensive care nursing. The panel members examined all the items and presented their comments and suggestions.

3.3. Validity Assessment

In order to confirm the face and content validity of the instrument, two panels of 11 experts and 15 students examined the inventory. To determine the content validity index (CVI), experts rated all items on a four-point Likert scale of not relevant = 1, fairly relevant = 2, almost relevant = 3, and totally relevant = 4. In order to confirm the face validity, 15 students were interviewed to find out about the items' relevance, ambiguity and complexity. Accordingly, the necessary changes were implemented and irrelevant items were eliminated from the first draft of the inventory. Next, the final draft was prepared and passed to the experts to rate the items on a five-point Likert scale (always, frequently, sometimes, rarely and almost never), and it was then tested for construct validity and reliability.

Exploratory factor analysis (EPA) was used to verify the construct validity. Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity were used to evaluate the sufficiency of the sample and appropriateness of the factor analysis model, respectively (12, 13). The number of factors for the parts of the instrument was determined by an Eigenvalue criterion of > 1 and Scree plot.

3.4. Reliability Assessment

The reliability of the inventory was approved using internal and external consistency tests. The internal consistency was evaluated using Cronbach's alpha. The external consistency was evaluated using the test-retest method. For this purpose, 12 postgraduate nursing students were asked to complete the inventory over a 15-day period.

3.2. Ethical Considerations

We gained approval for the study from the ethical committee of Baqiatallah University of Medical Sciences (ethical approval code: T/340/98), Tehran, Iran. The study was based on informed (oral) consent, because asking for a signature could compromise anonymity, and made participants reluctant to participate. All of the participants declared their willingness to participate in this study. Having explained the objectives of the study, the researchers promised to keep the participants' information confidential.

3.3. Data Analysis

The data were analyzed using the 13th version of the SPSS software. All the statistical tests were also two-sided and P < 0.05 was considered to be statistically significant.

4. Results

4.1. The First Draft of the Inventory

The first draft of the instrument that was developed through a literature review contained 60 items. A panel of experts carefully examined the items in regards to their extent of coverage and their relevance to the specified objectives.

4.2. Face and Content Validity

The face validity of the instrument was assessed by 12 students and 5 items were eliminated due to ambiguity or as they were irrelevant or repetitive. Moreover, 55 items were revised for clarity.

In the content validity assessment, CVR of all the items was between 0.59 and 1. Therefore, 13 items that had a CVR of < 0.59 were deleted. Also three items were deleted as they had a CVI less than 0.75. Overall, 16 items were removed through validity assessment and 44 items remained in the final draft. The CVI of the final draft was 0.90. Moreover, the CVR of the remaining 44 items ranged between 0.75 and 1.

4.3. Reliability

The Cronbach's alpha coefficient of the inventory was 0.95 and the intraclass correlation coefficient of the test-retest results was 0.96.

4.4. Construct Validity

To examine the construct validity of the final draft, it was administered to 250 postgraduate students of intensive care nursing, who were spending one of their five semesters at nursing schools of Iran. This part of the study was carried out from November 2013 to September 2014. The final draft of the inventory was sent to the students through ordinary mail and e-mail, and finally 217 (86.8%) candidates responded to the inventory and returned it to the researcher. On average, the participants were 32.1 ± 5.38 years old (ranging from 23 to 47 years) and they had 1.05 ± 6.13 months of work experience in nursing (ranging from 2 to 331 months). Most of the participants (58.3%) had not passed an intensive care training course before they started their postgraduate course (Table 1).

Table 1. Participants' Characteristics

Characteristics	No. (%)
Gender	
Male	98 (45.17)
Female	119 (54.83)
Age	
23 - 30	96 (44.24)
31 - 40	104 (47.93)
41 - 47	17 (7.83)
Semester	
Semester 1	30 (13.83)
Semester 2	100 (46.08)
Semester 3	4 (1.85)
Semester 4	59 (27.19)
Third Year	24 (11.05)
Passing intensive care training course	
Yes	87 (40.10)
No	130 (59.90)

Eigenvalues of above one and the scree plot were used to determine the number factors in the instrument. Answers with factor loadings equal to or above 0.4 were considered acceptable. In this regard, five factors and 44 items with eigenvalues above one and loading level equal to or above 0.4 were extracted (Table 2). The scree plot also confirmed the existence of five factors (Figure 1).

To calculate the after measured reliability of the inventory, the grades obtained from the two periods (repeat about two weeks later) were compared using the intraclass correlation coefficient (ICC). Following Baumgartner and Chung, ICCs equal to or above 0.4 were considered acceptable (Table 3).

Table 4 shows the ICC, Cronbach's alpha, mean, standard deviation and number of items for each factor. Arranging the factors in order of relevance to competency, gave the following results: 1- care management (1st factor), 2- individual management (3rd factor), 3- technical competency (2nd factor), 4- human-oriented care (4th factor), and 5- scholarship-oriented care (5th factor).

The EPA was carried out using varimax rotation to determine the basic factorial structure. The KMO equaled 0.90, which confirmed the sufficiency of the sample. The results of Bartlett's test of sphericity (correlation between the content of the questionnaire is not always zero) were also significant ($\chi^2 = 4343.415$, P value < 0.001), indicating the appropriateness of the factor analysis as well as the sig-

Table 2. Results of Exploratory Factor Analysis Using Rotated Component Matrix

| Factors and Items (% of Cumulative Variance = 52.66)	Rotated Component Matrix				
Care Management (Factor1) (% of Variance = 33.9)					
17. You provide comfort for the patients.	0.67				
21. You train the patients and their families for the home care program.	0.60				
19. You meet the needs of the patients and their families.	0.58				
16. You immediately recognize and report changes in the patients' health status.	0.57				
15. You record the results of checking the patients and their problems.	0.55				
10. You manage your time at the clinic.	0.55				
20. You take notice of the outcomes of your nursing measures.	0.53				
18. You help the patients in caring for themselves.	0.51				
3. You respect the patients' rights (e.g. the right to privacy and the right to rejection of treatment).	0.50				
14. You use a variety of sources (the patients, their families, their previous profiles, etc.) to gather information.	0.50				
6. You deliver an accurate report of the patient's condition to the treatment team.	0.50				
9. You apply theoretical knowledge while providing nursing care for the patients.	0.48				
5. You prioritize your nursing duties based on the patients' needs.	0.46				
22. You execute painkilling programs as the doctor prescribes.	0.46				
2. You do not exceed your limit while interacting with the patients.	0.44				
7. You cooperate with other members of the treatment or consultation team.	0.42				
45. You take precautionary measures to avert or minimize the risk of injury to yourself and the patients.	0.40				
Technical Competency (Factor2) (% of Variance = 5.52)					
26. You take good care of the tracheotomy.		0.75			
27. You take good care of the chest tube.		0.71			
29. You take good care of the arterial roads and the central vein.		0.68			
28. You feed the nasogastric tube correctly and take good care of it.		0.68			
25. You perform the upper-airway-suction technique correctly.		0.65			
31. You carefully check the arterial condition.		0.59			
24. You perform sterilizing techniques while working on wounds and dressings.		0.55			
30. You perform physiotherapy (respiratory and organic) when necessary.		0.42			
Individual Management (Factor3) (% of Variance = 4.67)					
36. You can make wise decisions and manage the situations at the clinic.			0.75		
11. You are fast enough while providing nursing care for the patients.			0.64		
37. You are able to manage nursing measures in emergency conditions.			0.63		
35. You have motivation for and interest in providing nursing care for the patients.			0.61		
34. You can act responsibly.			0.51		
38. You consider all aspects of the patients' problems.			0.51		
12. You apply the clinical principles to improve the patients' health status.			0.49		
40. You are familiar with the monitoring instruments.			0.49		
23. You take the necessary measures to stop the patients' health status deteriorate.			0.45		
8. You carefully observe and examine the changes in the patients' health status.			0.44		
32. You take the necessary measures while performing CPR.			0.44		
Human-oriented Care (Factor4) (% of Variance = 4.59)					
33. You consider the inpatients of ICU as human beings with physical, mental, social, etc. aspects.				0.65	
39. You encourage the patients' families to cooperate in caring for the patients.				0.61	
47. You provide comfort for the patients at the final stages of their lives.				0.50	
46. You encourage the patients to continue receiving treatment.				0.50	
Scholarship-oriented Care (Factor5) (% of Variance= 3.96)					
41. You are able to undertake a research project.					0.86
43. You are able to write a scientific paper.					0.79
42. You are able to search the material and papers you need on the Internet.					0.74
44. You provide nursing care based on the latest accredited scientific sources (evidence-based nursing).					0.57

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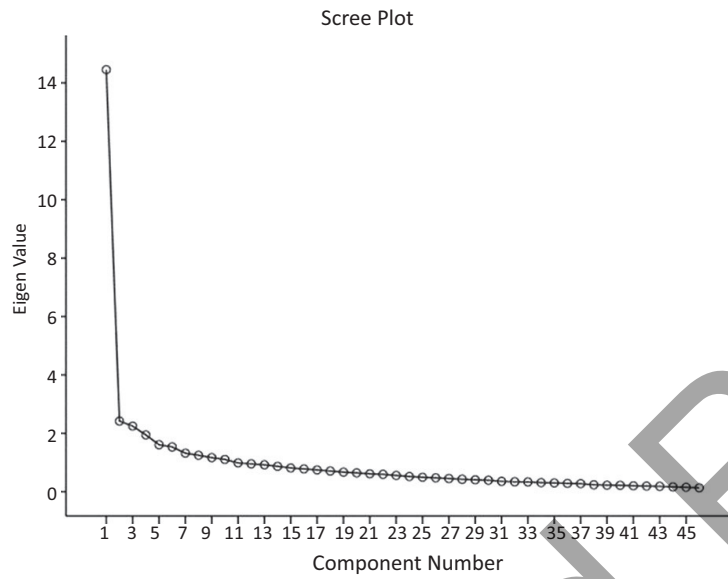
Figure 1. The Scree Plot

Table 3. Correlation Coefficients Between Five Factors (n = 217)[a]

Factor	(A1)	(A2)	(A3)	(A4)	(A5)
Care Management (A1)	1				
Technical Competency (A2)	0.67	1			
Individual Management (A3)	0.72	0.62	1		
Human-oriented Care (A4)	0.65	0.56	0.67	1	
Scholarship-oriented Care (A5)	0.36	0.29	0.34	0.38	1
Total Scale	0.91	0.81	0.96	0.78	0.53

[a] All correlation coefficients are statistically significant (P < 0.001).

Table 4. Intraclass Correlation Coefficient, Cronbach's Alpha Values, Means, and Standard Deviations of Five Factors

Factor	ICC	Cronbach's Alpha	Mean $\pm$ SD	Number of Items
Care Management	0.97	0.90	74.48 $\pm$ 7.46	17
Technical Competency	0.89	0.88	35.27 $\pm$ 4.50	8
Individual Management	0.96	0.87	48.0 $\pm$ 4.99	11
Human-oriented Care	0.85	0.79	17.18 $\pm$ 2.40	4
Scholarship-oriented Care	0.97	0.80	14.67 $\pm$ 3.17	4
Total	0.96	0.95	189.62 $\pm$ 18.39	44

nificant correlation between the variables.

5. Discussion

The influence of expert clinical nurses on the patients' health status, status of nursing profession, patient outcomes, status of clinical units and various organizational levels is undeniable. An expert clinical nurse, as a member of the treatment team, can help with assessing the quality of services provided in hospitals as well as innovating economical care methods (19). Developing an instrument to evaluate the clinical competency of postgraduate students of intensive care nursing can highlight the importance of the role of nurses in hospitals. This study aimed at presenting the stages of development and psychometric evaluation of the clinical-competency inventory for postgraduate students of intensive care nursing. The findings of the study verified the acceptability of the psychometric features of the inventory. Thus, the presented instrument can be used to evaluate the clinical competency of postgraduate students of intensive care nursing in academic systems. In fact, the capacity of postgraduate students of intensive care nursing in regards to the five factors (care management, technical competency, individual management, human-oriented care, and scholarship-oriented care) can help improve nursing care and enhance the quality of academic curricula. Based on Lofmark et al. (15), developing an awareness of clinical competency and identifying the students' attitudes towards it can help provide safer and more efficacious nursing care in various medical centers.

In the present study, for the purpose of examining the content validity of the inventory, besides the qualitative examination of the content by the panel members, the CVI was calculated, ultimately causing the elimination of 16 items from the inventory. The average scale-content validity index (S-CVI/Ave) of the inventory equaled 0.9, which was acceptable. In this regard, if S-CVI/Ave is equal to or above 0.9, it can be considered acceptable (20).

Based on the results of EPA, the KMO index was calculated. The KMO index equaled 0.9, which was acceptable. In this regard, if KMO index is above 0.80, it can be considered acceptable (21). Actually, higher values for KMO index indicate higher quality of factor analysis. Based on the results of the analyses, the items of the inventory were classified under five factors. It seems that getting satisfactory results can be attributed to carefulness in the choice of the items of the inventory.

An instrument's reliability guarantees its consistency in measurement. It should also be noted that an instrument's reliability and its validity are closely connected. Moreover, in order to be considered valid, an instrument first needs to have an acceptable level of reliability. However, an instrument's reliability does not depend on its validity (22). In this study, Cronbach's alpha was measured for each one of the inventory's factors. Besides, the internal consistency of the entire instrument was also measured using Cronbach's alpha. Cronbach's alpha must be equal to or above 0.7 to be considered acceptable (23). Therefore, based on the results of the data analyses presented in Table 4, it can be concluded that each one of the inventory's factors showed an acceptable level of reliability and the entire instrument was internally consistent. In this study, the total ICC equaled 0.96. Considering the fact that ICC must be equal to or above 0.4 (24, 25), the entire instrument had an acceptable level of reliability.

The final draft of the inventory contained 44 items and covered five factors, including care management, technical competency, individual management, human-oriented care, and scholarship-oriented care. The first factor (care management) consisted of 17 items and its rotated component matrix showed values between 0.40 and 0.67. This factor focuses on the nurse's capacity in examining various situations related to the patients as well as prioritizing and organizing the nursing care provided for the patients at ICUs. The high value of Cronbach's alpha for this factor indicates that the students have an enormous capacity in this regard. Based on the findings of a similar study conducted in Finland, graduating nursing student can start working at ICUs immediately after finishing their course of study (6).

The second factor (technical competency) consisted of eight items and its rotated component matrix showed values between 0.42 and 0.75. This factor focuses on the nurse's capacity in performing intensive care nursing techniques. Because of the specialized nature of the nursing care provided at ICUs and CCUs, technical competency is of utmost importance at these units (26).

The third factor (individual management) consisted of 11 items and its rotated component matrix showed values between 0.44 and 0.75. This factor focuses on the nurse's moral attitude, sense of responsibility, and personal motives. Moral competency can play a key role in preventing or lowering mental stress, providing proper nursing care, and avoiding harm to the patients (27, 28).

The fourth factor (human-oriented care) consisted of four items and its rotated component matrix showed values between 0.50 and 0.65. This factor focuses on the nurse's humane attitude towards the patients. Human-oriented care is mostly about mutual understanding. In this regard, maturity and attitude are two important dimensions of an ICU nurse's competency (29).

The fifth factor (scholarship-oriented care) consisted of four items and its rotated component matrix showed values between 0.57 and 0.86. This factor focuses on the nurse's capacity to use evidence-based findings while providing nursing care. Having referred to this factor, some

similar studies deduced that nursing students should be provided with research opportunities and research grants to help them continually increase their professional knowledge and improve their professional skills (1, 30).

Competency in intensive and critical care nursing is a multi-dimensional concept (31) and the best method of evaluating this competency is to use a combination of various methods (8, 32, 33). The findings of this study were similar to the study conducted by Lakanmaa et al. on the development and psychometric evaluation of a basic-competence scale for intensive and critical care nursing.

In the present study, an instrument was developed to evaluate the clinical-competencies of intensive care nurses and postgraduate students of intensive care nursing. The clinical-competency inventory for postgraduate students of intensive care nursing had an acceptable level of validity and reliability. Therefore, this instrument can be used for similar studies conducted on similar subjects and communities. Besides, this inventory can be used to evaluate the efficacy of the curricula of both universities and other training centers. More importantly, the instrument designed in this study can be used as a guide for educational planning and developing more efficacious syllabi.

There were some limitations in the present study. First, the items in the first draft of the inventory were extracted from the literature. Perhaps it was better to extract such items from interviews with relevant stakeholders such as intensive care nurses, nurse educators and the senior students in the field. Second, due to the large sample size and self-report method used for data collection, missing data for each item was relatively significant.

Acknowledgments

Footnotes

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