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Development, Psychometric Testing, and Use of a Disaster Nursing Competency Scale in Iran: A Mixed Methods Study

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Abstract

Nurses play an important role during disaster response and recovery. Few tools are available to assess the relative competence of nurses in disaster. This study aimed to develop, test, and evaluate a disaster nursing competency scale. This was an exploratory mixed methods study. In the qualitative phase, 35 Iranian nurses and managers with experience in disaster relief were asked about the skills they need to respond effectively to a disaster event. From the qualitative data, a 50-item questionnaire was developed. In the quantitative phase, exploratory factor analysis was conducted with 400 samples followed by a test-retest reliability assessment with 30 nurses. The developed and validated instrument was applied to 200 nurses in Iran to assess their competency. From content analysis of the qualitative data, 5 main themes emerged. In the quantitative phase, exploratory factor analysis loaded 50 items into 4 domains named management, legal and ethical, specific personal, and technical competence. Use of the tool showed that nurses estimated their competence overall at 70.28%. Findings demonstrate the necessity for new domains in disaster nursing competencies; which may be applicable as a useful tool and guideline to improve nursing education and practice.

According to the Annual Disaster Statistical Review in 2019, a total of 348 natural disasters affected over 69 million people, killing an additional 11,804 and costing a total of US $132 billion.[1] The impact of disaster events appears to be increasing. For example, in Iran the number of reported floods in 2015 was 5 times higher than the 2005-2014 annual average.[2,3]

According to United Nations Office for the Coordination of Humanitarian Affairs (OCHA) report, in April 2020 deadly flooding occurred in Iran that affected 29 cities in 18 provinces, 1900 cities have been affected as of 9 April at 8:00 UTC. In Shiraz, flash floods killed at least 20 people and injured 94. Additionally, an emergency situation was declared due to the flash flooding in Dezful located in Khuzestan Province, in south-west Iran.[4] Nurses are key members in disaster teams, and require disaster nursing competence (knowledge, skill, and behavior) to engage effectively in response/relief and recovery operations.[5]

Nurses comprise the largest component of the health-care workforce and play a key role in emergency preparedness and response, and, consequently, their role in disaster response is very significant.[6] At the scene of a disaster, the nurse plays a major role in applying advanced nursing techniques to trauma patients. Their work continues until the patient is discharged from care and "returned to normal life."[7] Nurses must, therefore, develop the ability to participate effectively in providing disaster health-care services and delivering a systematic and efficient health response to disasters.[8]

However, according to Ahayalimudin and Osman (2016), more than 80% of nurses who volunteered to assist during disasters had no previous experience in disaster response. The World Health Organization (WHO) recommends that all nations, should prepare health-care workers for their role in disaster relief. However, most nurses are not properly trained or prepared to assist during disasters.[9] Nurses require distinct competencies in disaster nursing, acquired through education and training, and occasionally through real-world experience, to be able to deal with the complexity and scope of disaster health care.[10] Nurses need to be competent to provide effective care during these difficult and complex events.[11]

Competency refers to a combination of the essential knowledge, abilities, skills, and values that are necessary for a person in a specific role, in a given situation.[12] Lack of consensus regarding definitions terminology and related characteristics poses a challenge to the designers of disaster health competencies.[13,14] Competency sets have been developed over the past decade for health professionals' involved in disaster response; however, disaster nursing core competencies have been limited or not verified.[15] Further effort is needed to standardize competency

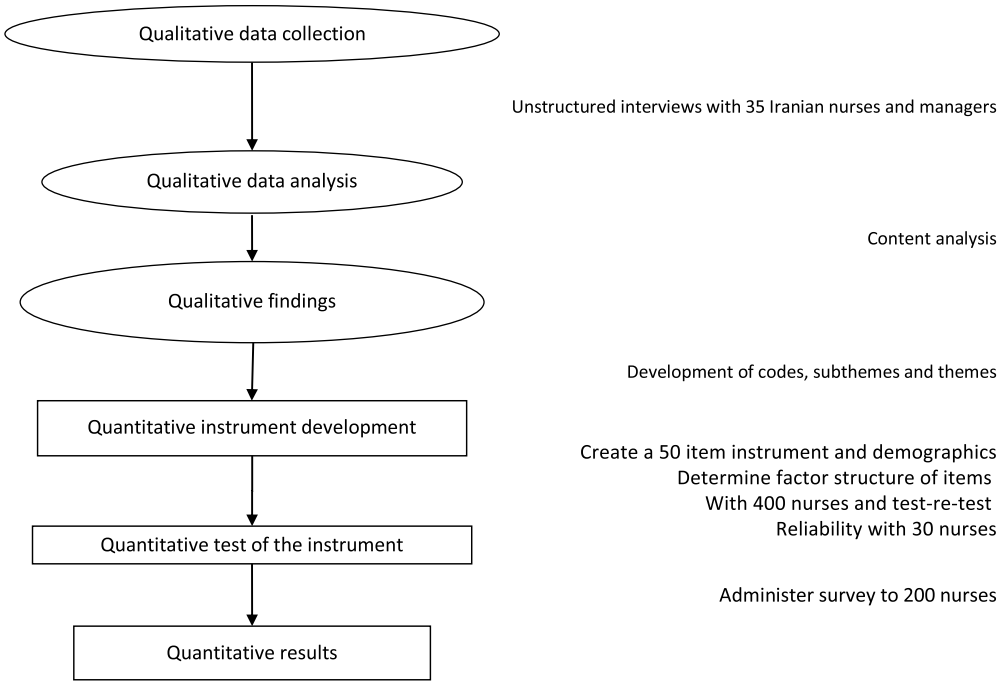


Figure 1. Exploratory sequential design of the study. A visual diagram of phases of the study and integration of the results.

sets and associated education in disaster health and the development and validation of a consensus competency-framework for universal disaster nursing education is necessary.[16,17]

Assessing nurses' disaster health competence is crucially important to identify areas of required professional development and educational needs, and also to make sure that nurses' competencies are put to the best possible use in disaster relief. Despite attempts to clarify the different aspects of disaster nursing competence, debate still continues.[18] With the exception of the International Council of Nurses (ICN) Core Competencies in Disaster Nursing (Version 2),[19] there are no common global competencies recommended for nurses participating in disaster relief. The disaster nursing literature identifies few robust tools to measure important fundamental competencies.[20] In Iran, disaster nursing is poorly defined, required competencies have not been clearly stated, and educational opportunities are scarce. Iranian disaster reports and published papers have not identified any instrument that can be used for assessing disaster nursing competencies; and the development of a scale for assessing nurse competencies has not been considered in the Iranian health system. This study explored various aspects of disaster nurse competencies in the Iranian health-care system. The study generated and tested the items for a scale that could be used to measure the achievement of nursing competencies.

Design

The present article originated from a bigger mixed methods project with some qualitative and quantitative aspects of the study reported previously.[11,21] This exploratory mixed methods study aimed to briefly report on the whole study findings to explore emergency nurse's views concerning expected competencies of disaster nurses and develop a quantitative instrument for assessing nurses' competence in disaster response. This design is particularly useful when the aim of the study is to develop a tool and the mixed method approach provides a better understanding of the research problem than either approach alone.[22] A visual diagram of phases of the study and the integration of the results can be seen in Figure 1.

Qualitative Phase

In this phase, researchers explored participants' perceptions and experiences about the competence that nurses need for participation in disaster response using a content analysis method. Purposeful sampling with maximum variations (in age, education level, and occupation) was used and 35 Iranian nurses and managers with recent experience of the medical response to disasters participated.

The mean age of the 35 participants was 37.5 y, and 30 of them were men. Participants had between 7 and 28 y of nursing experience in, and recent experience of, the medical response to disasters (Table 1).

Face-to-face unstructured interviews explored the participants' experiences and their perceptions of the competencies required by nurses in a disaster setting. The time and place of the interview were arranged according to participants' preferences. At the beginning of interviews, written informed consent was obtained from the participants. After 30 semi-structured interviews, data were saturated, and 5 more were completed to confirm the chosen categories. The interviews lasted 40-100 min with a mean length of 1 h and were recorded using a digital voice recorder. Each interview began with the question, "Please tell me about your experience of providing care in a disaster." Nurses' responses were clarified and expanded upon by follow-up questions. The interviews were transcribed word by word, and qualitative conventional content analysis was conducted. The data obtained were simultaneously processed using the 5-step content analysis method of Granheim and Lundman.[23] Transcripts were read line-by-line, the important sentences and phrases were underlined, and the main ideas derived from them were labeled as codes.

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Table 1. Demographic characteristics of participants in the qualitative stage

Parameter	Number	Percent
Educational level		
Bachelor	25	71/4
Master	6	17/1
PhD	1	2/9
General physician	3	8/6
Workplace		
Emergency	23	65/7
Hospital	12	34/3
Maneuver participation		
Yes	29	82/9
No	6	17/1

Overlapping codes were assimilated, and primary categorization of data was performed. Data reduction continued in all analysis units until the main categories emerged.[24] Two researchers' expert in qualitative research reviewed the transcript and consensus was achieved. When similar categories emerged, they were merged into main themes. Five themes emerged from the qualitative study: (1) management, (2) legal and ethical, (3) team work, (4) specific personal, and (5) technical competence (Table 2).

Quantitative Phase

The first step was development of a prototype tool, with the assistance of an expert panel. An item pool was extracted from the qualitative interviews. This initial item pool was comprised of 140 items in 5 categories. Then an extensive literature review was completed, and some items (25 items) that were not extracted from the qualitative study were added to the pool, resulting in 165 items in this phase. In the next step, the 165 items were discussed and assessed in a focus group with 14 emergency nurses; as a result, 38 items were merged with other items or deleted. The demographic characteristics of participants is presented in Table 3.

The developed prototype tool with 127 items was sent to 14 experts, 10 of them were PhD qualified nurses and 4 were experts in scale development. Feedback from this expert panel was used to identify items that should be merged or deleted. Two independent reviews were carried out to select the questions that were appropriate, accurate, and interpretable. Items were either accepted, rejected, or modified based on a majority opinion.

Regarding the 127 items in the first draft of the prototype tool, a total of 40 comments were received from experts. The researchers held a meeting to discuss these comments. As a result of the discussion, a total of 47 items were accepted, and their wording was revised as suggested; 28 items were merged into 13 items. Another 67 items were regarded as irrelevant by 8 experts or did not meet the criteria for a consensus and were deleted as suggested. The prototype tool was reduced from 127 to 60 items after these steps and was ready for psychometric testing.

Step 2 was psychometric testing. Ten emergency nurses were asked to evaluate the questionnaire and score the importance of each item on a 5-point Likert scale to calculate the Item Impact Score. The same emergency nurses were also asked about the relevancy, ambiguity, and difficulty of the items; and some minor changes were made to the preliminary tool. For calculating the Content Validity Ratio (CVR), the expert panel was asked to evaluate each item using a 3-point Likert scale: 1 = essential, 2 = useful but not essential, and 3 = unessential.

Table 2. Themes, main categories, and subcategories emerged in the qualitative phase

Theme	Main category	Subcategory
Management	Disaster scene coordination	Psycho-emotional stress management
		Scene safety
	Management of human and other resources	Assessment of required human and other resources
		Operational coordination and management of resources
Legal and ethical	Professional ethics in the disaster context	Ethical commitment
		Observing ethics
	Adherence to legal requirements	Familiarity with the legal requirements
		Observing requirements
Team work	Knowledge about duties and organizational hierarchy	
	Unity of command	
Specific personal competence	Physical ability	
	Self-management	Emotional self-control
		Adapting to conditions
	Meta competence Critical thinking ability	
	Communication skills	Communication with other health profession
		Communication with patient
Technical competence	Specific knowledge	Basic knowledge in nursing
		knowledge about the disaster
	Applying knowledge	Documentation of care
		Psycho-motor skills
		Triage skill
		Ongoing assessment
		Disaster specific treatment skills
		Physical care
		Psychological care

Table 3. Demographic characteristics of emergency nurses in the quantitative phase

Characteristics	Demographics	($n = 14$)
Education level	Bachelor	10 (9.1)
	Master	4 (22.7)
Work area	Emergency nursing	5 (45.4)
	Disaster medicine	4 (4.6)
	Disaster management	3 (13.6)
	Disaster education	2 (59.1)
Work experience (y)	5-10	5 (22.7)
	11-15	7 (45.4)
	16-20	1 (4.6)
	over 20	1 (18.2)

For calculating of the Content Validity Index (CVI), the same panel was asked to evaluate the items according to a 4-point Likert scale on relevancy, clarity, and simplicity. In this step, 4 items returned a CVI less than 0.79 and were deleted. The pilot version

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Table 4. Reliability of the factors

Domain	Factor	No. of questions	Cronbach's α ($N = 50$)	ICC (95% CI) ($N = 50$)
1	Management competency	12	0.91	(0.93 - 0.97)
2	Ethical and legal competency	6	0.82	(0.89 - 0.96)
3	Personal competency	9	0.88	(0.86 - 0.90)
4	Technical competency	23	0.97	(0.95 - 0.98)

Abbreviations: CI, confidence interval; ICC, interclass correlation coefficient.

of the tool, consisting of 56 items, was prepared for construct validity testing. Exploratory Factor Analysis (EFA) was used for assessing the construct validity of the tool. In the first stage, the adequacy of sampling was evaluated by the Kaiser-Meyer-Olkin (KMO) Test; which was 0/941. The KMO value is between 0 and 1, and higher values show better factor analysis.[25] In addition, to determine whether the obtained correlation matrix was significantly different from 0, the Bartlett Sphericity test was used. Its value was 14,400 ($P < 0.001$) and demonstrated the ability of the items to be used to perform the analysis factor.

In this step, 6 items were deleted from the tool due to a factor loading below 0.4, and cross-loading. The prototype tool, with 50 questions, was then distributed to 430 nurses, comprising the nursing population working in emergency wards of the tertiary hospitals in 6 disaster prone cities in Iran. Four hundred nurses completed their assigned task and completed the questionnaire.

Their age ranged from 23 to 54 y (M = 33.6 y; $SD = 6.6$), and their work experience ranged from 2 to 30 y (M = 9.2; $SD = 6.2$).

Exploratory factor analysis loaded the 50 remaining items into 4 domains named management, legal and ethical, specific personal competence, and technical competence. Teamwork competence was merged with the personal domain in the quantitative phase resulting in 4 domains at the completion of this phase.

For reliability analysis, internal consistency was evaluated by Cronbach's alpha coefficient. The Cronbach's alpha was 0 .96 overall and ranged from 0.91 to 0.97 for the categories (Table 4).

In addition, a sub-sample of disaster nurses ($n = 30$) completed the questionnaire twice, with a 2-wk interval to examine the stability of the scale by calculating the interclass correlation coefficient (ICC). The ICC was 0.99. Weller (2012) assert that an ICC of 0.4 or above is considered acceptable indicating an appropriate stability.[25]

The final tool consists of 2 parts. The first part addresses the demographic characteristics of the user and the second part consists of 50 questions, 44 of which, rated on a 5-point Likert scale from very high (5) to very low (1), assess the management competency (questions 1-12), specific personal competency (13-21), and technical competency (22-44) and, 6 of which (45-50), rated on a 4-point Likert scale from rarely (1) to always (4) assess the level of ethical and legal competency of nurses in disaster health relief.[16] The minimum and maximum attainable scores in all domains are 50 and 244, respectively; obtaining a higher-than-average score indicates the optimality of nurses' disaster health competencies.

At the end of the quantitative phase, the questionnaire, consisting 50 items, was distributed among 200 nurses from 6 educational hospitals in Isfahan (a state in the central part of Iran) in 2015, using convenience sampling. The inclusion criteria were: Registered Nurse with at least 1 y of clinical experience and working in an emergency ward.

Ethical Considerations Ethics Committee at Isfahan University of Medical Sciences approved the study (No 390133). The participants were informed about the study and assured of confidentiality and anonymity. Participants in all stages of study gave written consent, and it was made clear that a participant could leave the study at any time without penalty.

Table 5. Mean (SD) of disaster nurses' competencies in different domains in the utilization phase

Competency domain	Mean (SD)
Management competency (12 questions)	42.53 (8.87)
Legal and ethical competency (6 questions)	19.77 (3.19)
Specific personal ability (9 questions)	32.73 (6.11)
Technical competence (23 questions)	77.92 (16.64)
Total (50 questions)	172.96 (30.32)

Tool Utilization Phase

The quantitative stage of research has 2 main phases, the first phase was tool design and the second phase was tool use. In the previous section, the steps and methods of designing questionnaire were described. Following the steps of the second phase, use of tool is presented.

In these phases, the finalized instrument was distributed to 200 nurses that working in emergency wards. The results related to administering the questionnaire can be seen in Table 5.

The results of the utilization phase demonstrated that participants evaluated their competence in the moral and legal domain more highly than their competence in the other domains, while in the specific personal and technical competencies domains, they demonstrated the lowest competence. Based on the results, it seems that nurses do not demonstrate sufficient competence to perform many technical procedures or to work safely and effectively with the tools and equipment typically used in disaster situations

Discussion

The current mixed-methods study is among the first to develop and use a disaster nursing competence tool in Iran. The first qualitative phase explored the meaning and domains of disaster nursing competence including: management of the nursing response, legal and ethical performance in disaster situations, team work, and specific personal and technical competencies. These domains were re-confirmed in the quantitative phase through exploratory factor analysis. The only exception was the teamwork domain, which was deleted, because the relevant questions had a high correlation with the management competency; therefore, these domains were integrated under the management competency domain. The management domain demonstrated that nurses require competence in the assessment and management of health response(s) to a disaster situation. In line with previous research, this competence

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consists of resource assessment and management, particularly when resources are very limited,[26,27] identifying the level and type of external assistance that may be required,[28,29] scene management, and ability to work with other members of a disaster team.[30,31] In the research reported here, this domain was assessed by 12 questions presented in a 5-point Likert scale (rating from a little = 1 to very high = 5). The total scores ranged from 12 to 60. The mean (SD) of the management competency score was 42.53 (8.2) or 70.88% (out of 100%). This indicates that nurses assess themselves as having reasonable competency in this domain. When analyzing the individual questions, "I am skillful to inform casualties and their family in the disaster scene" (mean score = 3.78) and the question "I am familiar with the Incident Command System in the disaster scene" (mean score = 2.53) had the highest and lowest scores, respectively. Legal and ethical competency used a 1- to 5-point Likert scale (from a little to very high). The total score ranged from 23 to 115. The mean (SD) of nursing competency in this domain was 7.92 (16.64) or 67.75% (out of 100%) indicating a moderate level of competency. The question "I am skillful in selection of an appropriate serum and IV therapy for large numbers of trauma patients" with a mean of 3.93 and the question "I am skillful to do the isolation and elimination process in bioterrorism, biological, and nuclear attacks" with a mean 2.36 had the highest and lowest scores, respectively.

Conclusions

This research study developed a tool consisting of 50 questions in 4 domains to measure nurses' competency in a disaster health. The questionnaire was tested for acceptable reliability and validity. Based on nurses' self-report; nurses generally claim that they have a satisfactory level of competency in disaster response. Their reported skills were relatively higher in the legal and ethical domain and lower in the technical domain where they need clinical skills to work with specific disaster tools and procedures. The findings of the study must be considered within its limitations. In the qualitative phase our participants had experience in natural disasters, such as earthquake and flood emergencies. Moreover, we used a self-report approach to gather nurses' responses that might be differ from what nurses actually do in a real disaster situation. In addition, the results were obtained in a specific setting, and use in other settings will require conducting similar studies in other health systems and countries.

The disaster nursing competency scale developed in this research will provide information about disaster nursing competence and identify disaster nursing training priorities in Iran. The scale may provide a disaster nursing competency framework suitable for customization within other health systems and contexts. The research also contributes to our understanding of the knowledge, attributes, and skills that are required for nursing in disaster response and recovery and should generate additional research and educational interventions.

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