The Impact of Nurses Training and Applying Functional and Nonstructural Hospital Safety in Preparedness of Razi and Day Hospitals in Disasters Based on Hospital Safety Index

Joanna Salevaty [1*], Hamid Reza Khankeh [2,3], Asghar Dalvandi [1], Vahid Delshad [1]

1. Department of Nursing, University of Social Welfare and Rehabilitation, Tehran, Iran.
2. Department of Health in Emergency and Disaster, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.
3. Department of Clinical Sciences and Education, Karolinska Institute, Stockholm, Sweden.

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ABSTRACT

Background: Hospitals in Iran are not prepared for disasters; the aim of this study was to determine the effect of training functional and nonstructural hospital safety to nurses and their intervention on hospital preparedness in psychiatric Razi Hospital and Day Hospital in Tehran based on Hospital Safety Index (HSI).

Materials and Methods: This semi-experimental study included nurse managers of Razi and Day hospitals as study sample. Research tool was checklist of hospital safety. Validity and reliability of the checklist was determined 93%. At first the checklist was filled out, then preparedness plan including a 1-day workshop about disaster management, functional and nonstructural safety and a table tab maneuvers held. Then, after two months, nonstructural and functional safety of the hospitals was re-evaluated by HSI checklist. Data were analyzed by using Excel file of the tool.

Results: Findings showed that scores in most items of nonstructural and functional safety in HSI checklist significantly increased in two hospitals after workshop and nursing performance. Before intervention, these scores were 0.40 and 0.56 for Razi and Day hospitals, respectively which increased to 0.57, 0.86 after training.

Conclusion: Results showed that teaching nonstructural and functional safety to nurses and using these principles by nurses can promote hospital safety and preparedness. Comparison between hospitals showed that allocating more budget and executive power to the nurses can increase further the hospital preparedness. Given the key role of nurses in disaster preparedness, it is recommended to teach and apply functional and nonstructural safety of hospitals to nursing managers.

1. Introduction

Disasters have always had a tremendous impact on health, and social welfare [1]. When a disaster happens, hospitals and health organization should be able to serve the injured and treat them [2]. Hospitals, because of their vast and complex resources, are considered the most important centers in facing the extraordinary events [3]. These centers are crucial organizations for diagnosis, treatment, and follow up of the injured which run by health care providers 24 hours a day, 7 days a week [4].

A wealth of scientific evidence shows that there is a direct link between hospital preparation and mortality/morbidity rate due to disasters. In disasters, the whole

*** Corresponding Author:**
Joanna Salevaty, MSc
Address: *Department of Nursing, University of Social Welfare and Rehabilitation, Tehran, Iran.*
E-mail: *juanawood@gmail.com*

hospital working condition will change; therefore, with proper assessment of possible events, hospitals can be prepared for disasters. Disaster risk assessment includes determining vulnerability and the probability of disasters. It enables us to identify these hazards and plan to control them [1].

The World Health Organization, based on studies in central and southern America introduced and provided an instrument named Hospital Safety Index (HIS). It includes 3 fields of structural, nonstructural, and functional safety which determines the ability of hospitals to deliver services in disasters. Structural safety encompasses the safety of the building (the walls, foundations, and columns); nonstructural safety entails the safety of architectural components (laboratory equipment, furniture, electronic and air condition systems), and functional safety involves operational systems (emergency operation center, contingency programs, electronic and water supplement systems) [5].

According to this instrument, these 3 safety areas are effective on hospital risk assessment. Despite the importance of structural and nonstructural safety of the building, previous studies have shown that the most impact of disasters on hospitals has focused in the functional field and damaged its service system. Furthermore, as changing structural components of the hospital is costly and 80% of hospital safety burden is due to nonstructural safety measures, it is better for the hospitals to focus on the safety of nonstructural and functional fields. Regarding the increasing number of incidents, outcome of disasters and the pivotal role of health services before, during, and after such incidents, preparation of health care givers is essential and nurses, as the largest group of health care providers, are usually the first people who provide the injured with health services [6]. Nurse's professional and technical advice should be used in all phases of crisis cycle i.e. reduction, preparedness, response, and recovery [7].

Most of the nurses have little experience in disaster nursing. Lack of knowledge is a barrier in crisis response and education is one of the fundamental keys of nursing work power in disasters [8]. The secretary of Disaster Committee in Imam Khomeini Hospital, Amirsalari states that in most references about crisis management and leadership, one of the responsibilities of nurses is leading action teams. Because, one of the principle elements in hospital investigation and development is to identify its vulnerabilities and managing them; this research, along with training nonstructural and functional safety principles to nurses, tried to determine the impact of this training on reducing vulnerability and increasing preparedness of hospitals based on HSI.

2. Materials and Methods

This research is of semi-experimental and interventional (before and after) type and the study population comprised all nurse managers in Razi and Day hospitals, including metrons, supervisors, and head nurses. Study sample included all nurse managers who were chosen by census method. The method of gathering data was HSI checklist which was developed and introduced by WHO. This index contains 145 items in the fields of structural, nonstructural, and functional safety. Functional safety questions start form question 1 to 61 and nonstructural safety form questions 62 to 132. This instrument is used for rapid screening and evaluation and does not have the limitations imposed by other methods (such as interventional approach) like overlooking functional vulnerability or requiring costly technology and methodological knowledge. To determine the validity of the Iranian version of the index (developed in Shariati Hospital in 2010), in three fields, the form and content of the final version was evaluated and endorsed by academic faculties. The result of test-retest performed in Shariati Hospital by two separate research groups showed its 93% consistency [5, 9, 10].

Functional safety evaluation form is scored in 3 levels of low, medium, and high safety. It consists of 11 questions on "organizing crisis committee," 24 questions on "operational program in response to domestic and foreign dangers," 8 questions on "probable medical operation program," 8 questions on "accessibility of operational program for preserving and repairing vital services" and 10 questions on "access to medicines and equipment needed in emergency conditions" and forms a total of 61 questions in this section.

Nonstructural safety evaluation form has 3 safety levels of high, medium, and low and contains 31 questions on critical systems consisting of 8 questions on electrical systems, 7 questions on telecommunication systems, 5 questions on water reserve systems, 4 questions on fuel (natural gas, gasoline and gasoil) storage, and 7 questions on medical gas (oxygen, nitrogen, etc.). The part concerning heating, cooling and air conditioning in important sections of the hospital consists of 7 questions, mobile and immobile office equipment 3 questions, laboratory and medical equipment and diagnosing and treatment requirements contain 12 questions, and architectural elements like doors, entrances, stairs, windows,

and so on contain 18 questions which form a total of 71 questions of nonstructural safety field.

The data are rated based on low, medium, and high level of safety shown by numbers of 0, 1, and 2 and the total sum obtained, which is between 0.0 and 1.0 is categorized in 3 levels of A, B, and C which indicates the safety level of concerned hospital. After gathering the aforementioned information and completing the HSI, in a 1-day workshop, which lasted 6 to 8 hours and contained a round-table maneuver, the researcher taught the principles of functional and nonstructural hospital safety to nursing managers in Razi and Day hospitals. The educational package contained the manual volume of hospital safety index questionnaire which is in accordance to WHO approved manual and is seen by the principal of Disasters Committee of rehabilitation and prosperity.

After training, with help of nursing managers nonstructural and functional safety measures applied and supervised by nursing preparedness office of the hospitals. After two months, the HSI checklist once again was filled out and the obtained scores before and after the training and its impact on the level of nonstructural and functional safety principles were evaluated. Descriptive statistics were used in reporting redundancies and demographic variables. The Microsoft Excel file of the HSI was used to weigh and determine scores and hospital safety levels.

3. Results

Table 1 descriptively presents the safety rate of Razi Hospital before and after training which shows the safety rate of 0.23 for "disaster committee" item before training and 0.68 after it. Safety score of "operation plan" before training was 0.33 and after training increased to 0.60. Safety rate of "contingency plan for medical treatment" before training was 0.19 and after training reached 0.44. Safety rate regarding "critical services" before and after training were 0.44 and 0.75, respectively and safety score of "availability of medicines and supplies" before and after training were 0.5 and 0.55, respectively.

Table 1 presents the safety rate of Day Hospital before and after training which shows the safety rate of 0.18 for "disaster committee" item before training and 0.73 after it. Safety score of "operation plan" before training was 0.44 and after training rose to 0.80. Safety rate of "contingency plan for medical treatment" before training was 0.19 and after training reached 0.62. Safety rate of "critical services" before and after training were 0.5 and 1.0, respectively and safety score of availability of medicines and supplies before and after training were 0.70 and 0.95, respectively.

In Table 2 safety rates of nonstructural components of Razi Hospital are presented before and after training. The safety scores in "critical system" were 0.23 and 0.68 before and after training, respectively. Safety rate in heating, cooling, and air conditioning before and after training was 0.57. Before and after training safety rate regarding "office equipment" was 0.0. Safety rate in "medical equipment" before and after training was 0.33 and safety rate of "architectural elements" before and after training was 0.64.

Safety rates of nonstructural components of Day Hospital before and after training for nurses regarding "critical system" were 0.69 and 0.85, respectively. Safety rate in heating, cooling and air conditioning before and after training were 0.86 and 1.0, respectively. Before and after training, the safety rates regarding "office equipment" were 0.29 and 1.0, respectively. Safety rate for "medical equipment" before training was 0.71 and after training it reached 1.0 and finally, safety rates of "architectural

Table 1. Safety scores of functional categories in Razi and Day hospitals before and after training.

Functional score	Razi hospital		Day hospital	
Nurses training	Before training	After training	Before training	After training
Disaster committee	0.23	0.68	0.18	0.73
Operational plan	0.33	0.60	0.44	0.80
Contingency plan for medical treatment	0.19	0.44	0.19	0.62
Plans for critical services	0.44	0.75	0.50	1.00
Availability of medicines and supplies	0.50	0.55	0.70	0.95

Table 2. Safety scores of nonstructural components of Razi and Day hospitals before and after training.

Nonstructural	Razi hospital		Day hospital	
Nurses training	Before training	After training	Before training	After training
Critical system	0.45	0.60	0.69	0.85
HVAC	0.57	0.57	0.86	1.00
Office equipment	0.00	0.00	0.29	1.00
Medical equipment	0.33	0.33	0.71	1.00
Architectural elements	0.64	0.64	0.80	0.81

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elements" before and after training were 0.80 and 0.81, respectively.

In Table 3 total safety rates in Razi and Day hospitals before and after training are presented which indicates that before training, Day Hospital possessed the highest safety score of 0.56 and the safety level of medium. after that Razi Hospital possessed the score of 0.40 with medium safety level. After training, Day Hospital reached the score of 0.86, with the high safety level, while Razi Hospital with safety rate score of 0.57 and safety level of medium was the lowest rated hospital after training.

4. Discussion

This research was performed with the aim of investigating the impact of training nurses and applying functional and nonstructural safety measures in Razi and Day hospitals on HSI in 2014 and the following results were obtained.

In Table 1, the rate of safety of functional components of Razi Hospital before and after training are shown, in which the lowest rate was gained for "medical operations" before and after training which were 0.19 and 0.44, respectively. Thus, after training it changed from low level of safety to medium level. The highest score in this field was gained by the "availability of medicine and equipment" which before training was 0.5 at medium safety level and did not change that much after training. This item covered 72 hours medical reserve, sterilizing and surgery, repairing equipment, 72 hours medical gases, mechanical ventilator, electromedical equipment, reviving equipment, personal security equipment, presenting cardiac and respiratory reviving algorithm, and triage tags, which due to the fact that Razi Hospital is a psychiatry facility, it lacks most of medical equipment; and because of low budget for supplying required equipment its progress before and after training was at a low rate. The highest score after training belonged to "preserving and repairing critical services" with 0.75 and high level safety which was due to its large establishment. This hospital possessed various resources for reserving water and fuel and portable generators, but the old age of the equipment and constant water and electric outage, breaking communication systems, and not connecting the sewage system to public system and using sumps instead, made the research team to send an application to the municipality through the hospital for establishing a connection to the public sewage system after the training.

Mehrabadi (2005) reported that although a crisis management team has been established in most hospitals, it did not have that much efficiency and required training programs for preparing hospital personnel has not yet been performed. Therefore, constant personnel training against crisis in accordance to research and findings based on disaster committee should be considered [11].

Kavari in his research in 2005 reported the informing measures for disaster in Shiraz Medical University hospitals that was done aiming at evaluation of informing measures of personnel at the time of crisis showed that

Table 3. Total safety scores in Razi and Day hospitals before and after training.

Hospitals	Score before training	Score after training
Razi	0.40	0.57
Day	0.56	0.86

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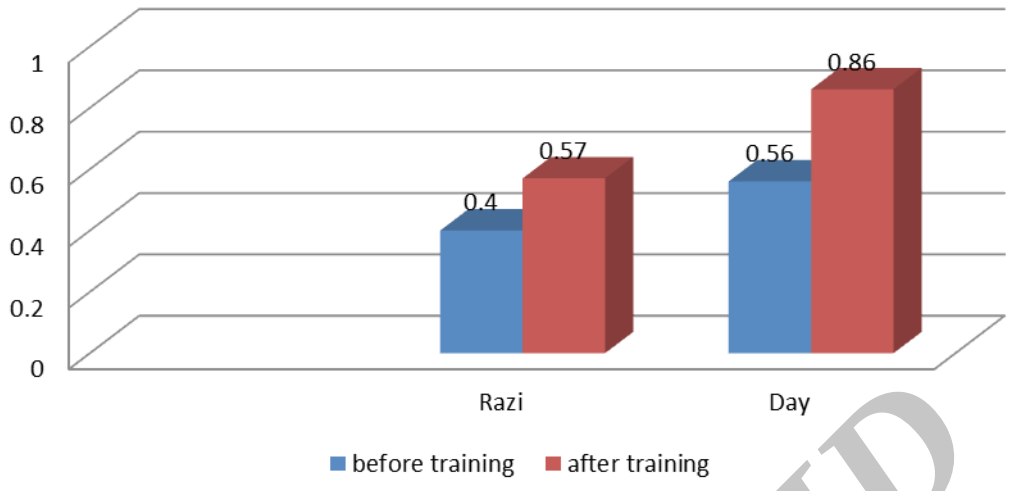

Figure 1. Comparison of safety hospital scores before and after training.

only 11.1% of studied hospitals possessed disaster committee and only 50% of their nursing personnel completed the required trainings for emergency exit at the time of crisis. He stated that hospital managers, before disasters should train their personnel and undertake the required informing measures for disaster conditions so that they be able to perform their duties at the time of disaster based on a systematic program [12].

Shultz (2003) in his research entitled "investigating hospital evacuation after Northridge earthquake" stated that a combination of problems, like shortage of operation beds, manpower and shortage of economic resources are the main problems of hospitals in times of disaster caused by natural or man-made disasters. These problems were due to lack of a thorough preparedness for disasters and necessitated increasing hospitals safety which accorded to the findings of the research based on shortage of budget and manpower [13].

In Table 1, the rates of safety of functional components of Day Hospital before and after training are presented. It shows that the lowest safety rate before training was related to "crisis committee" with 18.0 and a low level of safety; this was due to the fact that the meetings were not held regularly, members of different parts of the hospital except security and laboratory units were absent and there was no documented responsibility statement. However, after training and forming the members of disaster committee managed by emergency supervisor and performing the different surveys and giving statement of responsibilities to each section and drawing required charts, the rate of disaster committee reached 0.73 and the level of safety increased. The highest safety score before training belonged to "availability of medicine and equipment" at 0.70 with a high safety level, which was caused by an equipped pharmacy and presence of medical engineering office for substituting broken equipment with new ones and enjoying a medical equipment storage room for emergencies that holds enough equipment. After training nursing managers and their checking all the medical equipment and medicine stock in each shift and reporting any kind of breaking and shortages or problems in each shift and recording them in special books which were given to each section for this purpose, the rate of safety reached 0.95 with a high safety level. The lowest safety functional level in Day Hospital after training belonged to "medical probability operation program" with score of 0.62 and medium safety level that lacked separation of the entire documented risk program and after training only was written about earthquake, fire, and disease outbreak.

The highest functional safety score after training belonged to "preserving and repairing critical services" with the score of 1.0 indicating high level of safety. However, the procedure of supplying medical gases, fire protection system, and reserving water had some problems that required programs written by emergency supervisor and approval of maintenance section. Milesten (2000) in an article entitled "response of hospitals in public disasters" investigated the incidents taken place in America for the last 22 years and reported the main challenges of hospitals as weakness in management and communication, ill structure, shortage of water, decontamination, and resourcing. He concluded that preparedness programs undertaken by hospitals should be developed and enhanced so that matched to the findings of this research [14].

In Table 2, the scores of nonstructural components of Razi Hospital, before and after training are shown. The lowest safety belonged to "administrative equipment" before and after training as 0.0 with low safety level which despite constant suggestions of nursing care for strengthening the equipment, glasses and shelves, the maintenance unit did not undertake any action. The highest score was gained by "architecture components" as 0.64 with medium safety level which includes safety of doors, windows, entrances, roofs, traffic, hallways, stairs, parquets, accessing ways of the hospital, safety tabloids, etc. These matters were considered because of the special conditions of the hospital and the fact that it is a psychiatry center.

In 2001, California seismic safety commission in identifying the damages of 1994 northridge earthquake, aiming at increasing nonstructural and structural safety of establishments stated that damages caused by nonstructural components had caused closure of 10 important hospital establishment and evacuation and transmission of their patients. These hospitals mostly did not have that much of structural damages; but it was mainly due to damages in water supplement systems that made them unusable.

Other damages to these establishments included windows breaking, damages to lamps, damages in suspending weights of the lifts and outage of emergency power due to problems in distribution and controls. These damages collapsed these hospitals and they lost the ability to admit the injured and subsequently the number of casualties increased. This commission tired to solve nonstructural and structural problems of hospitals in order to prepare them for facing earthquakes and other crises through focusing on weak points and vulnerabilities, which concurs to findings of our research in mainly focusing on nonstructural safety of hospitals [15].

Safety level of nonstructural components of Day Hospital in Table 2 shows that before and after training the lowest safety score belonged to "office equipment" as 0.29 with low safety level, which after training of head nurses of different sections, pleading for strengthening equipment to hospital management and after management concern, all computer equipment, shelves, beds and trolleys were promoted and in cases of breaking, substituted, the safety score increased to 1.0. The highest score of nonstructural safety before training belonged to" air conditioning systems" as 0.86 with high safety level, because they were renewed the previous year and all patient rooms and sections spaces enjoyed splits.

In Table 3, the value of total safety level in Razi and Day hospital are shown before and after training in which the safety score of Day Hospital before training was 0.56 (the highest) and medium safety level, while Razi Hospital held the score of 0.40 with medium safety level. Total safety score of Day Hospital after training reached 0.86 and got the highest safety level, and then came Razi Hospital with 0.57 and a medium safety level, which indicates increasing safety levels of hospitals by training safety principles to nurses and application of these principles by them.

However, this difference may be due to the budget that Day Hospital management had allocated for nursing office and also cooperation of the maintenance units with the nurses in Day Hospital at the time of intervention and regarding the authority that the management had bestowed them for surveying and calling maintenance and services units in various meetings.

Hsu et al. (2006) in a research entitled "qualification of health services personnel in times of crisis training" stated that it's been a long time that training health and treatment personnel was considered a principle part of preparedness for disasters and the necessity of training in this research was based on those findings. In a research that Durate (2006) performed with the aim of preparing Colorado nurses for facing disasters, the final results stated that these nurses were not prepared to face natural disasters and researchers suggested anti-disaster trainings for them which concurred to findings of the research [16].

The study performed by Bazregar et al. (2009) on the impact of applying disaster management based on cooperation on the level of hospital preparedness with the aim of evaluating the required abilities of nurses at times of crisis in Shahid Rajai hospital showed that total preparedness of this hospital from 29.56 on pretest reached 86.84 in posttest, indicating that cooperation based management, along with increasing preparation of hospital to respond to natural disasters, develops the cooperation of concerned parties and strengthens the important role of nurses. It also shows the role of nurses in increasing hospital preparedness for disasters, which is in agreement with the findings of the research [17].

In the research performed by Abbasi (2009) with the aim of analyzing hospital preparedness in responding the injured and the wounded of natural disasters in Golestan Province hospitals, it was found that despite possessing appropriate equipment and instruments, these hospitals lacked the required preparedness for responding crisis

and it was necessary to take appropriate measures in the fields of commanding system, trainings regarding disaster, developing information systems, organizing manpower, and performing maneuvers related to crisis. In this research, the attempt to perform trainings and maneuvers were undertaken to increase safety aspects of the hospital [18].

Extraordinary events and disasters are inevitable. In hospitals, the nurses, owning to their special role and responsibility can be considered as the most important element in hospitals disaster management, because instructions like disaster management, incidents and emergencies are among the most important duties of the nurses and informing them about disaster management, is the key to success in hospital disaster management [19].

Nurses and caregivers not only play an important role in direct contact with the patients, but also can perform an effective role in undertaking natural disaster programs because of their familiarity to the services performed, duties of different sections, and the location of equipment and resources. Nurses should have passed special trainings in the field of components and processes of hospital disaster program and taking care of injured patients in natural disasters. These personnel are needed to not only be aware of their role in the program, but also of the role that other participants have. This fact prevents the other people leave the major duties and perform other responsibilities.

Disaster nursing, in the fields of management, care giving, hygiene, training, and research and its role in various fields of caretaking as well as close relation of nurses' activities with other medical professions, indicate the importance of their role at times of crisis. Our country, on one hand, is prone to different natural crises and has a strong need for this field of nursing, and on the other hand, is facing different problems like lack of manpower, especially nurses and sometimes equipment and facilities. Therefore, performing plans with the aim of developing disaster nursing knowledge and training them is of pivotal importance [20]. All the studies mentioned, including this one shows the necessity of training nurses and performing workshops and maneuvers for increasing preparedness and safety of the hospitals.

5. Conclusion

In conclusion, this research aimed to train and apply nonstructural and functional hospital safety principles on preparedness of nurses for natural disasters in Razi and Day hospitals based on HSI in 2014. Findings of this research indicated that training nurses would increase hospital preparedness and safety for natural disasters. It also shows that involvement of nurses in hospital functional and nonstructural preparedness would end in increasing HSI level. Also, in Day Hospital, because of budget specified for nursing and the fact that the head of disaster committee and emergency section supervisor is one person, he possessed necessary authority for performing maintenance and functional matters in different sections of the hospital more than other hospital in two fields of nonstructural and functional safety. Therefore, it can be stated that bestowing administrative power to nurses and allocating budget for disaster committee in each hospital can end in more preparedness for disasters. Furthermore, the necessity of evaluating nonstructural and functional courses and holding training courses in a regular manner and re-evaluation are also important for any training program.

The limitations of this research are lack of sample application, the succinct nature of trainings because of research timetable and schedule of hospitals and lack of cooperation on the part of maintenance units with nursing management in some cases. It is suggested that in further research, samples were included, hospitals with more cooperative maintenance units are chosen, and an analysis of the impact of functional and nonstructural principles in imagery incidents is performed and finally the impact of training on other managers of treatment facilities studied and their performance compared to nursing managers.

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