



Decision-making on Hospital Emergency Evacuation in Disasters and Emergencies: Findings From a Systematic Review

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Abstract

Context: Disasters are increasing worldwide, with more devastating effects than ever before. Hospitals must maintain their normal functions or have an evacuation plan due to the rate of damages at the time of a sudden disaster. The present study was conducted to determine the effective determinants and components in hospital evacuation decision-making.

Evidence Acquisition: In this systematic review study, which was conducted in 2016, bibliographies, citation databases, and other available records such as international guidelines, documents and reports of organizations and academic dissertations were used to find an answer to the following question: What are the effective components in hospital evacuation decision-making? Finally, 34 articles were included in this systematic review. This systematic review article was checked with PRISMA checklist.

Results: The common factors affecting hospital emergency evacuation decision-making were classified into 4 general categories and 40 subcategories, which have been explored during thematic analysis. These 4 categories included hospital infrastructure consequences, threat, internal factors, and external factors. Level of risk was the most important component of threat category and it was mentioned in most of the reviewed literature. Loss of electricity and water, communication and transportation, resources such as staff, and removing patient devices were the most mentioned factors in hospital infrastructure consequences, external factors, and internal factors, respectively.

Conclusions: Different variables affect the process of hospital emergency evacuation decision-making. Thus, further studies are needed to develop a decision-making tool for hospital emergency evacuations in Iran.

Keywords: Hospital Evacuation, Decision-Making, Disasters, Emergencies

1. Context

The percentage of disasters and their devastating concerns is increasing worldwide. It was reported that 3.3 million people died in disasters globally from 1970 to 2010 (1, 2). Despite advances in science and technology, it is not yet possible to forecast unexpected events such as earthquakes. In the critical situations following disasters, mortality and morbidity as well as the demand for health care services suddenly increase (3).

Health system has a special place among other organizations involved in crisis management because it is the

first and foremost need at the time of crises during disasters and unexpected circumstances (4). Hospitals, as key elements in providing preparedness in emergency situations, must remain fully functional at the time of disasters and major incidents (5). They are fundamental resources for successful management of disasters (6).

The vulnerability of hospitals in disasters results in instabilities in providing health care (7). Hundreds of hospitals and other health care facilities are destroyed or lose their function in natural disasters worldwide every year (8). Different studies have shown that many health care

centers have been evacuated urgently due to fire, incidents related to Hydro- meteorological changes, terrorist threats, and other natural disasters (9-20).

Emergency evacuation of the hospitals is markedly different from other buildings. Transferring patients who may be in critical conditions is highly unsafe and is one of the causes for the difficulty of the process of hospital evacuation. It is crucial to move patients who require supportive services safely without any disruption in the permanent treatment cares that they receive (16). There are reports of mortality in emergency hospital evacuation (21). Also, 2 cases of death have been reported during hospital evacuations in Iranian hospitals in 2016.

The process of decision-making is too complex and these complications increase during crises (22). Avoidable evacuations are costly, upsetting, and unpopular, but waiting too long to leave can be devastating. Therefore, proper and fast decision-making about emergency evacuation is vital (23). Despite the essential importance of timely decision for hospital evacuation, only rare studies have been steered in this area. Besides, most studies merely concentrated on describing instances or reporting the evacuation-related experiences of health care providers and patients. The results of some studies have provided insight into decision-making by nursing home administrators to shelter in place or evacuate when a hurricane approaches.

Nevertheless, no review study has been conducted on decision- making about hospital evacuation in response to all hazards. The novelty of this systematic review was that it aimed at enhancing our knowledge of factors affecting sound and swift decision-making on emergency hospital evacuation in response to all hazards. Developing the skills and knowledge of hospital managers in decision- making during an emergency evacuation increases the safety of the patients in disasters and incidents. In fact, increasing the basic knowledge of hospital managers in this case is accounted as a new emergency. Therefore, this study aimed at determining the effective components in hospital evacuation decision- making.

2. Evidence Acquisition

2.1. Data Sources

The present study was a systematic review of publications and documents relating to defining effective factors in hospital decision- making process. The latest search was conducted in April 2016. Articles, checklists, guidelines, reference books, and relevant dissertations published during January 1, 2000 to April 15, 2016 were extracted. The searched databases were PubMed, Scopus, Proquest, Web

of Science and Google Scholar. Also, we searched the Iranian databases such as SID, Iranmedex and Magiran, but we did not find any articles related to our research question. Reading the references of the included papers and using snowball method were other mechanisms for finding more articles.

2.2. Search Strategy

The search strategy was the same for all databases. To find as many articles as possible, the following terms (using Medical Subject Headings (MeSH)) were used: (health AND center) OR hospital OR “rural health center”) AND (evacuation OR “Emergency Shelter*”OR “Evacuation Shelter*”) OR (decision* OR intention OR resolve* OR determine* OR rule* OR “decision make*”) AND (Disaster* OR Emerge*).

2.3. Selection of Articles and Documents

Two authors independently reviewed relevant documents to decrease selection bias of the included papers in the systematic review study. The titles and abstracts of the extracted articles and documents were screened to select relevant articles.

The selected publications were then read in full, and duplicates were excluded.

2.4. Inclusion Criteria

Included articles were those published in academic journals, with a main focus on decision- making during hospital evacuation, and those conducted within the scope set by the research question.

2.5. Exclusion Criteria

Excluded articles were those published prior to 2000, appeared in nonacademic journals, and those that were not related to our research question. Moreover, the articles were excluded if their full text was not available or if they were not in English.

Then, descriptive and thematic analyses were done for the included articles and the literature. Thematic analysis and categorizing the criteria were done through consulting the experts and supervisors. Finally, PRISMA checklist appraisal tool was completed for this review to decrease publication bias.

3. Results

In total, 240 articles and relevant records were identified by searching and 34 papers were included by determined criteria.

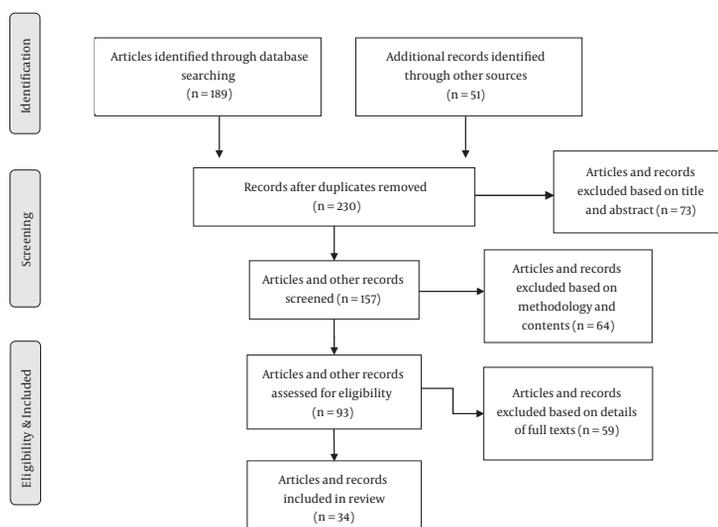


Figure 1. Flow Diagram of the Search and Selection of Papers

3.1. Descriptive Analysis

The largest numbers of papers were from the United States (78%), followed by Turkey (3%), Sweden (6%), and Australia (3%). Most papers (57%) were published in 2013 onwards. This has been due to the perceived need for research in this area; especially after the emergency evacuation experiences of health centers related to Katrina and Sandy hurricanes in the United States, interest in conducting research on this topic has been increased.

With respect to methodology, most of the papers (54%) were qualitative and 24% were review articles. Given that the scientific evidence in this area is partial, conducting qualitative research would be helpful. The summary of results is described in [Table 1](#).

3.2. Thematic Analysis

According to literature review and consulting with scholars and experts, the factors affecting the hospital emergency evacuation decision-making were classified into 4 general categories and 40 subcategories ([Table 2](#)).

Decision-making is a complex process, and this complexity and difficulty is due to a combination of several factors that are simultaneously involved in the decision-making situation (22). Also, decision-making is different in disasters and in critical situations; it is associated with the uncertainty of stressful and dynamic environment (57). One of the disaster features is that it occurs unexpectedly. Technical limitations make accurate forecast of the disaster difficult. Moreover, uncertainty at the time of occurrence and insufficient information about the severity and extent of the impact are the features of the disaster (58).

The hospital emergency evacuation planning has been considered as a subject of scientific research in the recent years (59). Most of the reviewed studies highlighted that hospital emergency evacuation decision-making or shelter in place is full of complexity and uncertainty. Unnecessary hospital emergency evacuation is costly, destructive, and unacceptable. Both options of shelter in place and hospital emergency evacuation have the potential of death, injury of patients and personnel, and intensifying treatment conditions of the patients or the injured (25, 28, 45, 47, 48).

McGlowan emphasized that emergency evacuation process is sometimes dancing with danger (45). Historical record of hospital evacuation clearly reveals that uncertainty affects all aspects of emergency evacuation decision-making. Factors affecting the selection of decisions are dynamic and have an uncertain nature (60). Conducting the emergency evacuation following a disaster requires fast and correct decisions (61). The present systematic review suggests improving the quality of decisions, and effective measures to achieve this are as follow: having previous experience of disaster, (30) increasing knowledge of management, (50, 57) encouraging group decision-making in emergency evacuation, (62) and being equipped with the supportive systems of decision-making (22) when the legal aspects of emergency evacuation decision-making is concerned (27, 51).

Level of risk, the most important component of threat category, was mentioned in the most reviewed literature. A linear relationship was found between the threat, decision, and consequences of emergency evacuation (63). Also, the findings demonstrated that the nature of the

Table 1. Papers Analyzed for the Systematic Review of the Literature

| Author | County | Year | Type | Methodology | Source of components |
|---------------------------|-----------|------|---------------------------|------------------------------|--|
| McGinty et al. (24) | USA | 2016 | Systematic review Article | Systematic review | Literature review |
| McGinty et al. (25) | USA | 2016 | Original Article | Qualitative | Semi structured interview |
| McGinty et al. (26) | USA | 2016 | Original Article | Qualitative review | Semi structured interviews |
| Hershey et al. (27) | USA | 2016 | Original Article | | Literature review |
| Vugrin et al. (28) | USA | 2015 | Original Article | Case study | - |
| Von-maszewski et al. (29) | USA | 2015 | Original Article | Simulation | - |
| Ricci et al. (30) | USA | 2015 | Original Article | Qualitative | Literature review, Semi structured interviews |
| Hicks et al. (31) | USA | 2015 | Review Article | Review | Literature review |
| Khorram-Manesh et al. (6) | Sweden | 2014 | Original Article | Qualitative | interviews |
| Bish et al. (32) | USA | 2014 | Original Article | Quantitative | - |
| Salcedo et al. (33) | Mexico | 2014 | Review Article | Review | Literature review |
| King et al. (34) | USA | 2015 | Survey | Cross-sectional survey | - |
| Rojek et al. (7) | Australia | 2013 | Systematic review Article | Systematic review | Literature review |
| Nero et al. (35) | Sweden | 2013 | Original Article | Qualitative | Literature review, Risk and vulnerability analysis |
| Hassol et al. (36) | USA | 2013 | Letter to Editor | - | - |
| Downey et al. (37) | USA | 2013 | Original Article | Qualitative | Interview |
| Park et al. (38) | USA | 2012 | Report | Qualitative | Literature review, Expert Judgment |
| Childers et al. (39) | USA | 2010 | Original Article | Qualitative review | Expert panel; Literature review |
| Fennell (40) | USA | 2009 | Original Article | Qualitative and Quantitative | Conceptual framework analysis |
| Bagaria (41) | USA | 2009 | Original Article | Review | Literature review |
| Dosa et al. (42) | USA | 2007 | Original Article | Qualitative | Interview and Focus Groups |
| Augustine et al. (43) | USA | 2005 | Original Article | Case study; Simulation | Case study |
| Taffe et al. (44) | USA | 2006 | Original Article | Qualitative | Conceptual framework Analysis |
| McGlown (45) | USA | 2001 | Original Article | | Literature review and Focus Groups |
| Milsten (46) | USA | 2000 | Original Article | Review | Literature review |
| Zaenger et al. (47) | USA | 2010 | Original Article | Qualitative | Literature review, structured interview |

threat (50) was the main factor of emergency evacuation decision-making in the calculation of the risk for the safety of the patients and the personnel (6, 7, 23, 26, 32-35, 40, 44, 45, 51, 52, 64).

Emergency evacuation order is issued according to the threat's conditions. Assessing the risk for patients and personnel is highly important, and to avoid incorrect calculation, an interdisciplinary group should estimate the potential risks for infrastructure based on reliable information (35, 44).

Collecting data and fully understanding the situation is one of the most important part of risk assessment. The findings of this study emphasized that decision-making support tools (22), information technology and computer applications (61, 65), and decision-making maps (66) increase situational awareness and provide insight for decision-makers.

Assessing hospital infrastructure empowers the decision-makers to estimate the degree of vulnerability and its potential consequences (55). This finding helps to determine that whether medical care can be continued in disasters or not. According to the decision-making instruc-

tion, self-assessment of the hospital critical infrastructure is highly important (49). Survey tool was divided into 8 parts as follow: urban water, steam, electricity, natural gas, chiller / boiler, electrical vital support equipment, IT and telecommunications, and security. Safety transfer of the patients to alternative health care centers under threat conditions is also a challenging task (36, 50, 67).

In several review papers on the lesson learned of the hospital emergency evacuation, support, equipment, human resources, information management, communications, removing patient devices, transportation, resources such as staff and intersector and interinstitutional coordination were emphasized in the success of an emergency evacuation (6, 7, 9, 23, 35, 36, 43, 46, 68, 69). The mentioned factors are prerequisites for hospital evacuation.

Another important and effective factor in emergency evacuation decision-making is political considerations (30). Disasters cause stress for an organization and its personnel, but political consequences resulting from a disaster are inevitable (57). During clinical experience and hospital management, we observed political aspects of decision-making. Berwair in 2012 presented this aspect

Table 2. Effective Determinants and Components of Decision- making on Hospital Emergency Evacuation

| Determinates | Components | Citation |
|--------------------------------------|---|--|
| Threat | Geographical situation (31, 48, 49) | Hicks (2015), Goestehius (2014), Zane (2010) |
| | Hospital size (31) | Hicks (2015) |
| | Disaster type (40, 45, 50) | Mcglown (2001), Fennell (2009), Glick (2012) |
| | Disaster severity (35, 45, 51) | Mcglown (2001), Nero (2013), Koeing (2016) |
| | Level of risk (7, 32, 33, 40, 44, 45, 50-52) | Mcglown (2001), Rojek (2013), Bish (2014), Fennell (2009), Salcedow (2014), Toffe (2005), Koieng (2016), Rega (2009), Glick (2012) |
| | Duration (38, 49, 51) | Park (2012), Zane (2010), Koeing (2016) |
| | Potential patients casualties (23, 38, 44) | Park (2012), Toffe (2005), Aidini (2012) |
| Hospital infrastructure consequences | Potential structural impacts (31, 33, 37, 46) | Milsten (2000), Hicks (2015), Downey (2013), Scalcedow (2014) |
| | Loss of electricity (36, 45, 47, 49) | Mcglown (2001), Zane (2010), Hassol (2013), Zanges (2010), |
| | Loss of Water (45-47, 49) | Mcglown (2001), Zane (2010), Zaneger (2010), Milsten (2000) |
| | Loss of heating packages (HVAC) (45-47, 49) | Mcglown (2001), Zane (2010), Zaneger (2010), Milsten (2000) |
| | Loss of generators (45, 53) | Mcglown (2001), Biflower (2013) |
| | Loss of gas (47, 49) | Zane (2010), Zaneger (2010) |
| | Boilers/Chillers (49) | Zane (2010) |
| External factors | Community awareness (37) | Downey (2013) |
| | Physical Access (36, 44, 47, 49) | Toffee (2005), Zane (2010), Hassol (2013), Zaneger (2010) |
| | Transportation (36, 39, 41, 42, 44, 49, 53, 54) | Toffee (2005), Biflower (2013), Zane (2010), Hassol (2013), Childers (2010) Voyer (2016) Dosa (2007) Bagaria (2009) |
| | Traffic condition (6, 14, 49) | Zane (2010), Khorammanesh (2014), |
| Bagaria (2009) | Security (38, 47, 49, 51) | Zane (2010), Park (2012), Koieng (2016), Zaneger (2010) |
| | Destination Capability (23, 38, 49) | Park (2012), Aidini (2012), Zane (2010) |
| | Political Pressure (23, 30, 37) | Ricci (2015), Downey (2013), Aidini (2012) |
| | National resiliency (23) | Aidini (2012) |
| | Coordination with Authorities (7, 23, 47) | Aidini (2012), Zaneger (2010), Rojek (2013) |
| | Information management (23, 43, 54) | Aidini (2012), Voyer (2016) Augustine (2005) |
| | Legal considerations (27, 30) | Hershey (2016), Ricci (2015) |
| | Political considerations (55) | Berwari (2012), |
| | Agreements with other hospitals (31) | Hicks (2015) |
| Internal factors | Incident command system (6, 37) | Khorammanesh (2014) Downey (2013) |
| | Resources (7, 38, 44, 47, 49-51, 53) | Park (2012), Zane (2010), Biflower (2013), Rojek (2013), Toffee (2005), Koieng (2016), Glick (2012), Zaneger (2010) |
| | Experience background (26, 30, 56) | Ricci (2015), Kim (2015), McGinty (2016) |
| | Corporate memory (30) Risks of Evacuation (55) | Ricci (2015) Berwari (2012) |
| | Costs (22, 30-32, 43, 48) | Goestehius (2014), Bish (2014), Olmez (2014), Ricci (2015), Hicks (2015), Augustine (2005) |
| | Number of patients (49) | Zane (2010) |
| | Entry, exit routes within the hospital (49) | Zane (2010) |
| | Special needs (50) | Glick (2012) |

as the blame game. Decision- makers are always blamed in case of not conducting an emergency evacuation when needed, or doing it when it was not needed. In most of the disaster situations, decision- makers are not able to accurately identify the options. They encounter a gray area between the 2 choices and this point is one of the important challenges in making decisions about hospital emergency evacuation (55).

Technical support of technology for decision-making (70) such as computer-based models (54), computer simulations (29, 71-73), computer-based role games according

to the hospital emergency evacuation scenarios (74-76), decision-making support systems (77), table top exercises, and repeating them regularly (78) will be facilitating cases of the complex and difficult process of emergency evacuation decision-making.

Overall, despite using supporting tools, the responsibility to make a decision for evacuation still remains at the discretion of hospital managers. Studying and learning critical thinking skills are effective in increasing the power of initiative and creativity of managers (79, 80).

This study revealed the lack of similar documenting

tools for reporting hospital evacuation cases. Also, there was no database for registry of the mentioned cases. We have a similar situation in Iran, and thus providing such database helps the researchers to analyze and disseminate the lessons learned to promote decision-making skills during hospital evacuations.

3.3. Limitations

Only English articles were included in the literature review of this article. Also, access to some documents of international organizations was impossible.

4. Conclusions

Fast decision-making and reasoning play an important role in effective management of disasters. Appropriate decision-making plays a key role in reducing the intensity of negative consequences of the disaster. The current review showed that different variables affect the process of hospital emergency evacuation decision-making. However, due to the complexity, uncertainty, and inadequacy of information in an emergency situation, quantifying the concept of decision-making is difficult. It is hoped that the outcome of this study contribute to the development of a decision-making tool to facilitate hospital emergency evacuation in cases of disaster and emergency in Iran.

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