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Analysis of the intellectual and social structure of health system response plan to earthquake studies adopting word co-occurrence and narrative approaches

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Abstract:

BACKGROUND AND AIM: Earthquake is a natural disaster severely affecting the societies' health, hygiene, and welfare as such the most effective method to respond to its damages is to develop a readiness plan. This study aimed to discover thematic patterns and co-author relationships extracted from relevant publications to plan an earthquake response.

MATERIALS AND METHODS: This descriptive–analytical study adopted the scientometric approach and used word co-occurrence and social network analysis. The published articles indexed in PubMed were retrieved from 1970 to 2021 using a combination of keywords “earthquake and response.” The data were analyzed in VOSviewer, UCINET, and NetDraw software.

RESULTS: The following six thematic clusters with a social map were extracted: Initial response of the healthcare system, response to probabilistic risks after the hazard, response to mental health and community resilience, response to public health, response to post-traumatic stress disorders, and staff's response to the needs assessment and continuity of diagnostic treatment services. Moreover, social network analysis revealed the great impact of Japanese and Chinese authors and institutes.

CONCLUSION: The present study detected many gaps in the literature on earthquake response, which can contribute to developing a general framework to prepare integrated healthcare earthquake response plans to promote the performance of this system.

Keywords:

Co-authorship network, co-word analysis, earthquake, narrative approach, response plan

Introduction

In the 21st century, earthquakes accounted for 48% of mortalities caused by natural disasters.^[1] Such disasters impact society's health, hygiene, and welfare as such the most effective method to respond to its damages is to develop a readiness plan and train the personnel. For various reasons, including the inadequacy of management processes at supporting the national and regional levels,

there is still a lack of national standards or programs to respond to earthquake hazards in the health system. Health emergency response guide to hazards is provided only the approach of common features of all hazards and also it focuses on the accident command department and describes the duties of each position regardless of the type of hazard. At the majority, the need to develop a model for earthquake's priority hazards yet has been fully felt. Therefore,

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a model developed solely in response to an earthquake is necessary and awareness of it to all departments of the health system can lead to planning for an effective response.^[2,3] Accordingly, authorities need to use planning and management knowledge to respond to and deal with earthquakes and other natural disasters appropriately. The knowledge can be acquired by adopting various approaches such as monitoring credible scientific publications. However, with the growth of different knowledge domains, scientific publications on earthquakes have also rapidly expanded, thereby making the scientific trends hard to follow.^[4] In this regard, scientometric experts have drawn up comprehensive scientific maps by integrating visualization tools and developing different indices. The term “drawing a scientific map” refers to the analysis of publications in a scientific domain from different perspectives to discover the relationships and patterns among scientists, research domains, and countries, evaluate and rank researchers, countries, journals, and subjects accurately, and present an overall view of the evolutionary trends.^[5-7] On the other hand, co-occurrence analyses are quantitative analyses delineating such relationships. The main point in the co-occurrence analysis is the simultaneous occurrence of two scientific components in a set of publications as the larger the number of co-occurrences between two components is, the stronger their relationship will be. The analysis mainly aims to discover the relationships and shared topics among scientific components or social relationships regarding the centrality measures.^[8-11] Several researchers have performed thematic cluster analysis in healthcare during crises by examining the number of publications, citations, and thematic clusters.^[1,12-14] Moreover, Qian and Liu *et al.*^[15,16] publications were examined from the seismological perspective. They revealed a rise in publications, with the highest word occurrence for “earthquake,” as well as close scientific cooperation among disaster-prone countries. Obviously, these studies mainly focused on presenting the quantitative aspects and analyses. It also seems that the extraction of earthquake response programs specifically from research backgrounds in articles has been neglected. The concepts in the articles in this field are derived from real observations and data that should be further interpreted and analyzed qualitatively. In addition to drawing topic networks and social relationships regarding the co-occurrences, this study aimed to identify the strengths, weaknesses, and challenges of the topic and present the elements required for developing a healthcare response plan for earthquake victims.

Materials and Methods

Study design and setting

This research was a descriptive-analytical study using co-occurrences. The thematic clusters and the authors’

social network maps were plotted in VOSviewer, UCINET, and NetDraw software.^[8-10]

Study participants and sampling

According to the authors, the best search strategy was set to be a combination of the keywords (earthquake) AND (response) to detect relevant data published from 1970 to mid-May 2021 in PubMed. It should be noted that searching additional databases with overlapping coverage but fewer precision-enhancing features occurred more indexing the geology and soil engineering in related to the field of the earthquake (such as Web Of Science, Scopus) which resulting data mapping was not successful to processes). Consequently, 1517 articles in English were retrieved.

Data collection tool and technique

To create the word co-occurrence map, screening was used to detect and remove possible errors and repetitive terms, equalize the words, including synonym combinations, and replace them with the MeSH terms in some cases, write some abbreviations in the complete form, and remove ambiguous and meaningless keywords from the 3312 extracted keywords. A thesaurus file has two columns, a label column and a replace by column. The first line in a thesaurus file is a header line containing column headers. With the exception of the first line, each line in a thesaurus file specifies a label (in the label column) and an alternative label (in the replace by column), indicating that the label is to be replaced by the alternative label. The briefs section, some examples are provided for better detail at abbreviation. Subsequently, a refined thesaurus was created in the TXT format. Finally, all the extracted records and the thesaurus were inputted to VOSviewer. To detect the close semantic relations among words and intellectual structures of the publications in each cluster, we adopted the narrative approach to define and rebuild the terms as a narration to extract the foundations of the healthcare system’s earthquake response simply. In the narrative approach, critical information is presented in a simple, straightforward, and concise language (similar to a scientific story) so that it can be understood by readers with different intellectual abilities.^[17,18] After inputting the bibliographical data and the researcher-made thesaurus, nine clusters containing 460 terms were retrieved [Figure 1]. Note that Clusters 6, 7, 8, and 9 were merged and interpreted as Cluster 6 because of the small number of terms included in those clusters.

Ethical consideration

This study was approved by the Ethics Committee of the Isfahan University of Medical Sciences (Code: IR.MUI.RESEARCH.REC.1399.758).

Figure 1 displays a set of terms and their links. The map’s color scheme shows the formation of relevant

Table 1: Top authors by centrality metrics

Authors	Degree	Authors	Closeness	Authors	Betweenness
Nagamine, Masanori	9.000	Suzuki, Yuriko	1.714	Suzuki, yuriko	573.304
Zhang, Kan	9.000	Tomita, Hiroaki	1.711	Tsuji, ichiro	372.500
Bar-on, Elhanan	8.000	Yasumura, Seiji	1.710	Tomita, hiroaki	217.125
Catalucci, Alessia	8.000	Tsuji, Ichiro	1.709	Yasumura, seiji	208.495
Goto, Aya	8.000	Yabe, Hirooki	1.708	Usami, masahide	156.000
Lui, Su	8.000	Abe, Masafumi	1.707	Ushijima, Hirokage	156.000
Marmar, C. R.	8.000	Kamiya, Kenji	1.706	Akashi, Makoto	135.000
Mazza, Monica	8.000	Fukasawa, Maiko	1.706	Kondo, Hisayoshi	92.000
Metzler, t j	8.000	Sakata, Kiyomi	1.706	Abe, Masafumi	58.694
Peleg, Kobi	8.000	Ohira, Tetsuya	1.705	Kamiya, Kenji	38.750

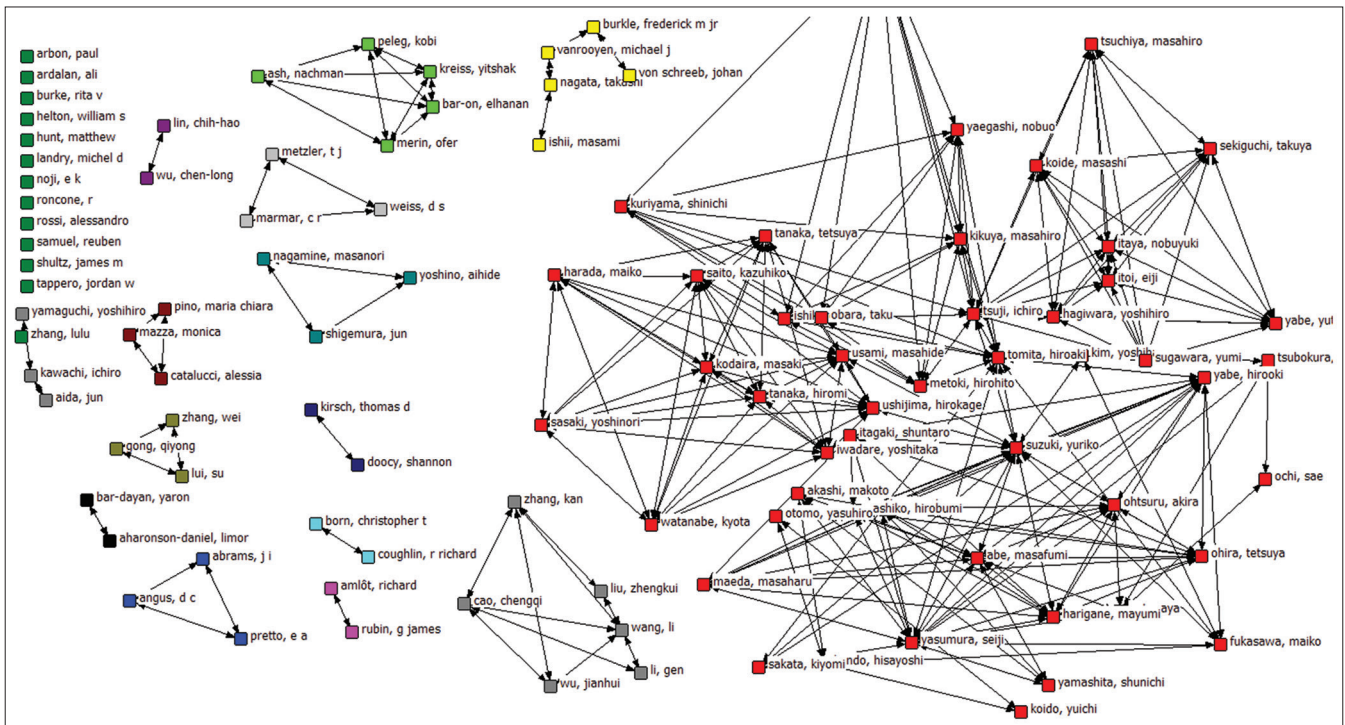
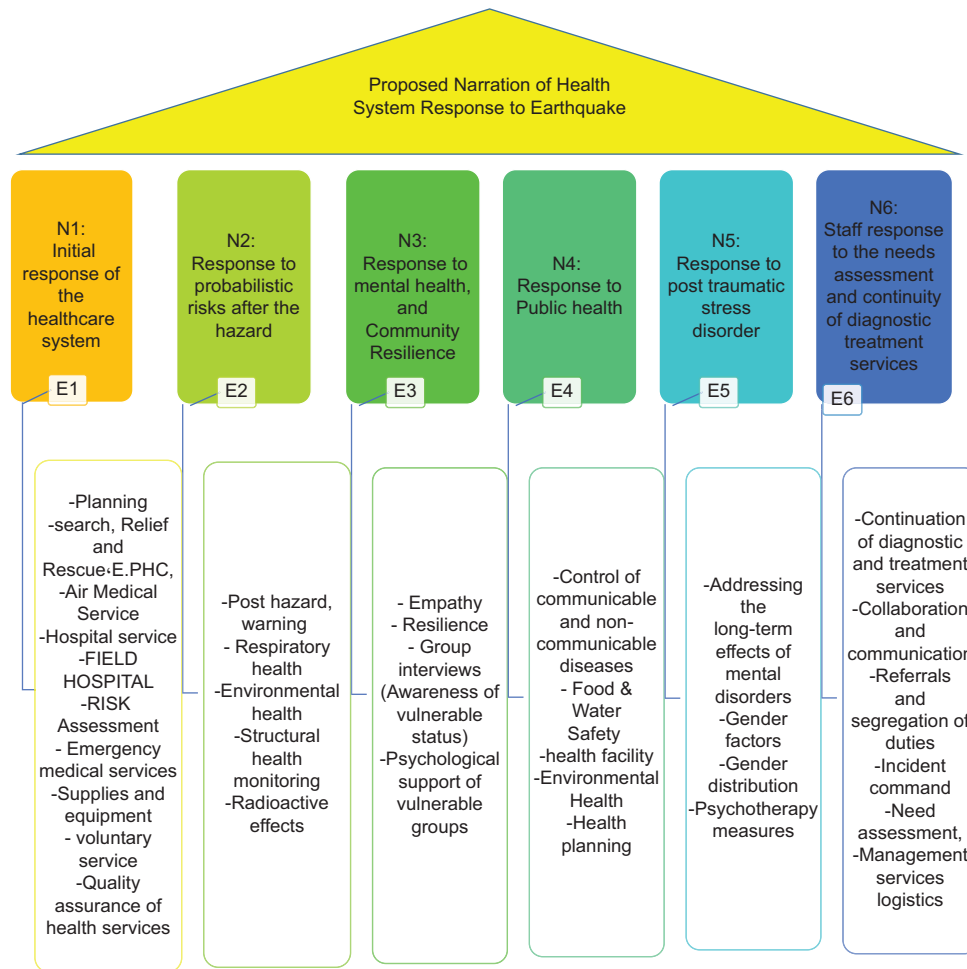


Figure 8: Co-authorship social network based on centrality

Discussion

The clusters' bibliographic results can reveal the fields of research interest and subject gaps. The first response of the healthcare system to earthquakes is the timely evaluation and planning for saving the victims and provision of health-care services, which is in line with other studies.^[1,12,13,19-24] However, a disregarded topic in this cluster is developing an application and disaster simulation, health-care quality assurance, and regional-local treatments, especially for chronic diseases. Moreover, few studies have discussed the application of modern technologies such as drones to provide food and drug services in emergencies, especially in far-away regions,^[25] which was not displayed due to little word co-occurrence in the clusters. The strong link between health force mobilization, military personnel, military hospital, and military medicine nodes near the USA node

can indicate the significance of this country's support before, during, and after disasters. Narration 2 discusses the significance of secondary risks resulting from earthquakes, which can have extensive health-related, environmental, economic, and socio-political impacts, as mentioned in several studies.^[26-30] According to the Sendai framework for disaster risk reduction, raising public awareness can be effective for promoting participation in earthquake response and returning to the initial state.^[31] A research gap in this narration is to plan for deployment and establish level-3 and level-4 laboratory infrastructure, detectability of toxic agents, probabilistic risks such as cyber-attacks on health infrastructure, and the absence of comprehensive programs for dealing with tsunamis (multi-hazard disasters). Narrations 3 and 4 mainly focus on boosting resilience and consider PTSD while prioritizing different groups. Based on the evidence, low- and middle-income



Flowchart 1: Response plan to earthquake extracted from the keywords co-occurrence

countries have feeble mental health systems and cannot meet their societies' compelling mental health needs.^[32-36] Disaster health literacy and psychological self-care in disasters are novel topics disregarded in these papers. Narration 4 expresses various dimensions of public health postearthquake, and numerous publications have noted the necessity of prevention services, vaccination for communicable and noncommunicable diseases, preparation of a medicine packages for chronic patients, especially diabetics, and enhancing health-care facilities' capacity (environment, clean water, and nutrition) to prevent disease outbreaks.^[37-44] A noticeable research gap in this narration is bio-terrorist attack control and prevention, which may occur even by humanitarian food aids with an aggressive approach (e.g., advertisement or human and environment contamination). Another issue is the absence of technology-based plans for tracking services (equitable distribution of food, drugs, health products, clothes, etc.). In narration 6, studies focused on the significance of integrated command and communication, rehabilitation care, preparing healthcare service packages for vulnerable groups,^[24,45-47] health planning for controlling zoonotic diseases,^[48,49]

management of bodies, and referral to medical and dental jurisprudence.^[50-52] A weakness of studies, in this case, is the management of large masses and the use of quadcopters. A significant relationship between earthquakes and the level of scientific publications in earthquake-prone countries has been reported, which is consistent with the findings proposed by Ahmadi, Osareh, and Soheili (2014). The main keywords in this study significantly differ from those extracted by Liu *et al.*, because their study primarily focused on land and fault structure. The social network analysis suggests that Japanese and Chinese institutes and authors (Fukushima Medical University, key laboratory of mental health, institute of psychology, Chinese Academy of Sciences, Beijing, China) and Taiwanese authors (Department of emergency medicine, national Chang Kung university hospital, college of medicine, national Cheng Kung University, Tainan, Taiwan) have the most significant influence in terms of scientific publications. However, in Sweileh and Emer's study, American authors had the most publications on health in natural disasters.^[4,15] This study only examined the research presented in the PubMed database, while some aspects of the health field

in gray resources may have been investigated from the point of view of experts, which has not been retrieved in the data of the present study because the scientometrics software supports bibliographic database files from Web of Science, Scopus, Dimensions, and PubMed, not others dataset.

Conclusion

The results identified the research strengths and weaknesses. The extraction plan can thus be used to change the patterns of applied research. Scholars could differently prioritize the interpretations extracted from the clusters in terms of service providers and organizations. Moreover, decision-makers in the domain of healthcare earthquake response can use them as a guideline to develop a general framework to design an integrated response plan and, thus, promote the function of the healthcare system. Based on the results, it is expected that other issues such as how to deal with tsunamis and cybersecurity, factors Chemical, Biological, Radiological, and Nuclear (CRNE) defense caused by secondary effects, use of aerial operations, and introduction of modern technologies also be included. Finally, attention to the cultural and indigenous factors of the regions at different global and national levels should be given special attention in designing the plan. Other countries, especially underdeveloped and developing countries, must expand their scientific productions on this topic and publish them on global databases. In this way, a complete joint global framework can be developed and shared since specific functions in different domains of earthquake health system response plan design cannot be implemented without needs assessment in vulnerable societies.

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Conflicts of interest

There are no conflicts of interest.

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