Mutual Impacts of the COVID-19 Pandemic and the Recent Earthquakes: A Scoping Review of the Lessons Learned

Nasrin Sayfouri1, Mohammad Heidari2 and Seyedeh Samaneh Miresmaeeli3

1School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran; 2Community-Oriented Nursing Midwifery Research Center, Nursing and Midwifery School, Shahrekord University of Medical Sciences, Shahrekord, Iran and 3Department of Health in Emergency and Disaster, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran

Abstract

Objective: The aim of this study was to review the articles dealing with the mutual impacts of the coronavirus disease 2019 (COVID-19) pandemic and the recent earthquakes to elicit the various scopes of the lessons learned including the challenges, the successful measures, and the recommendations.

Methods: To detect the relevant studies published between February 1, 2020, and June 9, 2021, PubMed, Web of Science, Scopus, and Google Scholar were searched. Having considered specific inclusion/exclusion criteria, 18 studies were included.

Results: Seven major earthquakes have occurred concurrently or before the pandemic era in Albania, Croatia, Haiti, Great East Japan, Mexico, Nepal, and Utah. Thematic analysis revealed 5 themes for the “challenges” (management inefficiency, increased life-threatening, economic, socially related, and dual psychological challenges); 4 themes for the “efficient response measures” (health-care services measures, government measures, community-based cooperative activities, and disaster management response); and 3 major themes with 7 sub-themes for the “recommendations” including “the mitigation phase” (identifying probable natural disasters), “the preparedness phase” (preparing necessary equipment), and “the response phase” (mental care response measures, health-care-related COVID-19 measures, economic improvement measures, recognizing community-based capabilities, and government-related boosting measures).

Conclusions: It is suggested that these scopes of the mutual impacts of the COVID-19 pandemic and the earthquakes be studied in systematic reviews.

An Overview to the Contradictory Nature of Coronavirus Disease 2019 and Earthquake Co-occurrence

A concern has aroused since the onset of coronavirus disease 2019 (COVID-19) pandemic regarding the challenges encountered during emergency response in a natural disaster, such as an earthquake, which usually necessitates evacuation, transportation, or mass gathering in the affected areas. The challenges arise when the assemblies may contrast prevention strategies, including physical distancing and home isolation. Staying at a shelter during the COVID-19 pandemic would likely lead to an outbreak. The occurrence of earthquakes coincident with the pandemic may prevent the effective practice of such measures, and consequently cause an increase in the virus spread.1,2 In this context, the impact(s) of the virus spread and disaster management phases are mutual because, apart from the problems pertinent to COVID-19 spread caused by the disaster management measures, the infecting nature of the pandemic can undoubtedly affect the speed and efficiency of the measures.

Yet, the mentioned issues are still pertinent to only the response phase of disaster management activities. More complex issues can also be envisaged with respect to mitigation, preparedness, and recovery phases of disaster management plans with regard to the concurrence of COVID-19 and earthquakes. As different earthquakes have occurred from the onset of the COVID-19 pandemic, a plethora of studies might have been conducted having openly or indirectly dealt with different aspects of the mutual influences of the pandemic and the occurred earthquakes. The current study has endeavored to review these articles to elicit the various areas of the lessons learned having been revealed therein.

Synopsis of the Previous Review Studies

The published review studies on the coincidence of COVID-19 and disasters shows that, in a systematic review,1 the types of health-care responses to coincidence of COVID-19 and all
Another review study,4 has aimed to propose disasters have been probed. Earthquake events constituted only from Sakamoto et al, 2020.

| Table 1. Evacuation status under the condition of the COVID-19 pandemic |
|---------------------------------------------------------------|
| Surveillance and information-sharing (public assistance) | Starting time of surveillance | In the case of COVID-19, which is regarded as an infection that is spread through contact or droplets, there is a risk of rapid spread from infected persons. Therefore, a system is required that enables postdisaster surveillance to be carried out simultaneously with the establishment of evacuation centers. |
| Method of implementing surveillance | Continuous implementation of measures without omissions, even for small-scale evacuation centers and evacuees who are dispersed, is essential. |
| Method of sharing information | A system for ensuring that information reaches evacuees, including those who are dispersed or in small-scale evacuation centers, is necessary. |
| Evacuation center environment and stockpiled supplies (public assistance) | Evacuation space | 6m² per person is required for securing 2 m of social distance. The number of individuals who can be accepted at evacuation centers will be approximately one-third of the number usually accepted, making it more difficult to secure evacuation space. |
| Spaces for isolation | Because droplets are the infectious agent, securing space for isolation is the most critical issue. |
| Stockpiled supplies | During pandemics, masks and alcohol disinfectants are in short supply. Therefore, evacuees need to bring these items with them. |
| Community disaster risk reduction and community leadership (self-help and mutual assistance) | Sanitary environment | Hand hygiene that extends beyond conventional practices is necessary and is performed according to individual evacuees’ judgments and sense of responsibility. |
| Autonomous activity | Self-governance entailing residents’ leadership is challenging to implement in the case of dispersed evacuees. |

Note: Adapted from Sakamoto et al, 2020.

In a review study,7 the past occurrences of complex disasters entailing a combination of natural disasters and infectious diseases have been compiled and systematically organized. In this study, the evacuation measures that specifically relate to COVID-19 have been discussed. The adapted version of a more detailed table in this study,7 is seen in Table 1 below. Considering the review studies mentioned above, it seems that the idea of reviewing the mutual impacts of the consequences of COVID-19 and the recent earthquakes has not yet been investigated.

Purpose of the Current Review

The present study is, therefore, a scoping review that has attempted to pinpoint the beneficial findings of the studies focusing on the reciprocal impacts of COVID-19 spread and the concurrent earthquakes or those occurred previously but the consequences of which still affect COVID-19 management and spread and are simultaneously affected by the pandemic. The scoping type of review was adopted in this study due to the reasons that: (1) a scoping study usually maps the key concepts underpinning a research area and the main sources and types of evidence available when an area is complex or has not been reviewed comprehensively before6; (2) this type of review provides a mechanism for summarizing and disseminating research findings to policy-makers, practitioners, and consumers who might otherwise lack time or resources to undertake such work themselves; (3) in the current study, this review type can address current matters and approaches related to the concurrence of earthquake and a pandemic and offer new perspectives on the matter or point out areas for further research.10

Methods

This scoping review was carried out based on a framework including the following 5 stages: Identify the question; Identify the relevant studies; Study selection; Charting the data; and Collating, summarizing, and reporting the results.

Identify the Question

Based on the purpose of the study, the questions seeking for the lessons learned, as the results of the mutual impacts of the COVID-19 and the earthquakes, were determined to be as follows: (1) What was the nature of the challenges experienced as the results of the mutual impacts of the earthquakes and the COVID-19 pandemic? (2) What was the nature of the successful measures to manage the reciprocal impacts of the 2 disasters? and (3) What is the nature of the recommendations offered to remove/alleviate the challenges?

Identify the Relevant Studies

The search strategy was determined to look for studies published between February 1, 2020, and June 9, 2021. The search operators included Boolean operators (AND, OR, and NOT), parenthesis, and truncation and the keywords were the terms associated with
Table 2. Search query used to detect the relevant studies

| Search operators (AND, OR and NOT), parenthesis, and truncation | Search terms used |
|---------------------------------------------------------------|-------------------|
| Boolean operators                                            | TS = (COVID-19 OR Coronavirus OR “Corona Virus” OR “2019 Coronavirus” OR “2019 Coronavirus Disease Crisis” OR Coronavirus OR SARS-CoV-2 OR SARS coronavirus OR severe acute respiratory syndrome coronavirus 2) AND (Earthquake)) |

Table 3. Databases used and the number of the studies retrieved

| Database            | Number of records |
|---------------------|-------------------|
| PubMed              | 34                |
| Scopus              | 15                |
| Web of Science      | 49                |
| Google Scholar      | 30                |
| Total               | 128               |

“COVID-19,” which are usually found online as well as the term “earthquake” (Table 2).

To detect the relevant studies, the databases including PubMed, Web of Science, Scopus, and Google Scholar were searched using their particular searching procedure. A total of 128 studies were retrieved (Table 3).

Inclusion/Exclusion Criteria

The inclusion criteria to maintain the relevant studies to be reviewed were as follows: the studies that were related to the mutual impacts of a particular known earthquake and the COVID-19 pandemic regardless of the exact chronological co-occurrence of the 2 phenomena. In other words, the studies that had embarked on any mutual impact of COVID-19 pandemic and any past or currently occurred earthquake were included in the review process. Gray literature was not included in this review. Moreover, specific study designs were not considered as an inclusion criterion.

The studies with the following features were excluded from the study: (1) the articles that were related to the earthquakes having occurred during the COVID-19 era, but have not scrutinized any impact of one over the other,\(^11,12\) and (2) studies related to mass disasters during the pandemic.\(^13\) It is worthwhile to mention that, in our study, as any other scoping study, exclusion of the studies undergone the screening process.

Study Selection

A total number of 128 studies found as the result of search query underwent the screening process.

Screening Process

To screen the records found, first, having considered the inclusion and exclusion criteria, the titles and the abstracts of all the records found in Table 3 were reviewed independently by 2 team members to exclude the irrelevant ones. Following their agreement on the included studies, the major researcher performed an in-depth assessment on the articles’ full-texts separately to determine their eligibility. The other members re-checked the eligible studies and discussed the inconsistencies until they were all resolved. According to PRIZMA in Figure 1, after removing the duplicates, applying the exclusion criteria, and assessing the full texts for eligibility, out of the primary 128 records found during search strategy, 18 studies were finally included in the scoping review process.

Charting the Data

Data Extraction

Having read the 18 studies, it was observed that between February 1, 2020, and June 9, 2021, the COVID-19 impacts have been associated with 7 major earthquakes having occurred concurrently with or before the pandemic era. In the selected articles’ texts, these 7 earthquakes have been mostly based on their locations, including (alphabetically) Albania, Croatia (Zagreb), Haiti, Great East Japan Earthquake (GEJE), Mexico (La Crucecita, Oaxaca), Nepal (Gorkha), and Utah State (Magna city). Table 4 below shows the features of the 7 earthquakes underscored in the reviewed studies as well as the purposes of the 18 selected studies illustrating how any particular study deals with the associated earthquake.

Table 4, therefore, provides both a familiarization with the included studies and their associated earthquakes as well as delivering a quick access to the required and basic information necessary to follow the results and the discussion of the present study. In the next step, a main data extraction form was developed (Appendix 1). The articles were classified based on the 7 earthquakes for which a brief description as well as all the relevant information units of the articles were inserted in the slots of the table. To increase the rigor of the data extraction process, 2 of the researchers of the current study were involved in the search strategy, but all 3 were engaged in the primary data extraction. The major author was in close contact with the other co-authors in an attempt to resolve any ambiguity arising during the process. When an idea required more inspection or contemplation, it was discussed among the 3 authors to reach agreement. The major author, however, rechecked any data extracted by the other 2 and tried to settle consensus whenever necessary.

Results

Collating, Summarizing, and Reporting the Results

Due to the qualitative and discourse analytic nature of the present study, thematic analysis\(^14,15\) was adopted on the extracted data to derive the codes, categories, and themes. Using the data from the main data extraction form (Appendix 1) as well as reading, pondering, and reflecting on the published articles and the extracted information repeatedly, the major author in collaboration with the corresponding author of the present study embarked on the coding process. Due to the large number of table developed on the coding and category-deriving details of individual studies for each earthquake, it was decided that 2 samples of such details, that is, the coding procedure of the extracted data of the articles related to 2011 Great East Japan Earthquake are shown in Appendix 2. All the derived codes have been incorporated in Appendix 3 based on the earthquakes and the articles.

Categories of the Lessons Learned

The next step was reviewing the information available in the tables from a broader scope, that is, maintaining the categorical scopes of all topics in terms of each earthquake. A sample of the process of subcategory and category derivation of the same codes of Japan’s Earthquake is also depicted in Appendix 4 to illustrate what was
done for the other cases. Through reading, reflecting, and re-reading, the codes of all Challenges, Successful Measures, Public Cooperation, and Recommendations, Table 5 (below) was created presenting all categories of the research question topics with respect to each earthquake, together with the frequency of each information category already detected in the studies.

To find the general scopes of all the information found in the current scoping review study that are expected to appear as the answers for the 3 research questions, the information in the major columns of Table 5 were supposed to be induced into broader scopes, that is, appropriate themes.

It is necessary to mention that the column of public cooperation, which was originally the topic of the fourth research question, was decided by the present authors to be incorporated into the successful measures topic due to the proximity of the 2 topics. The research questions were, therefore, reduced to 3 as was observed above in the introductory section. The results of the final round of the thematic analysis, showing the answers of the research questions, can be seen in Figures 2. The title of this topic was then changed into efficient response measures.

Themes of the Lessons Learned
Research Question 1
What was the nature of the challenges experienced as the results of the mutual impacts of the earthquakes and the COVID-19 pandemic?

To answer the first research question, that is, to discover the nature of the challenges experienced as the result of the mutual impacts of the earthquakes and the COVID-19 pandemic in the selected studies, the 23 categories related to this topic (Table 6) were postulated deeply to find the possible underlying themes.

The researchers of this study, finally, agreed on the emerging 5 themes including, management inefficiency challenges, increased life-threatening challenges, economic challenges, socially related challenges, and dual psychological challenges (Table 6) together with their frequencies and the related earthquake locations.

Research Question 2
What was the nature of the efficient response measures to manage the reciprocal impacts of the 2 disasters?

Regarding the second research question, Table 7 depicts 4 themes emerging from the 10 categories associated with the topic of efficient response measures. These 4 themes are: health-care services measures, government measures, community-based cooperative activities, and disaster management response.

Research Question 3
What is the nature of the recommendations offered to remove/alleviate the challenges?

Table 8 provides information to answer the third research question dealing with the nature of the recommendations made in the reviewed studies. The 23 information categories tended themselves to be re-arranged into 3 major themes with 7 sub-themes for the Recommendations including “the mitigation phase” (including, identifying probable natural disasters), “the preparedness phase” (including, preparing necessary equipment), and “the response phase” (including, mental care response measures, health-care-related COVID-19 measures, economic improvement measures, recognizing community-based capabilities, and government-related boosting measures) (Table 8).

Discussion
This section elaborates on the most significant scopes (themes and categories) of the lessons learned in the relevant studies concerning
| No | Earthquake location       | Date of occurrence | Magnitude | Major earthquake features underscored in the reviewed study/studies                                                                 | Purposes of the associated studies                                                                 | Publication date |
|----|--------------------------|-------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------|
| 1  | Albania                  | Nov 26, 2019      | 6.3       | Affected 202,000 people, including 51 victims, 17,000 displaced, 989 million Euros in damage.                                     | To evaluate the long-term impacts of the earthquake and the COVID-19 events in the Albanian economy.           | 2020            |
| 2  | Croatia (Zagreb)         | March 22, 2020    | 5.5       | Despite extensive damages, Croatia has survived due to well-organized public health system and coordinated outbreak response.        | [To illustrate the dual management of the pandemic and the earthquake by the health-care system].            | 2020            |
| 3  |                         |                   |           | The health disruption experienced by the high-risk cardiovascular patients due to the COVID-19 and the earthquake                     | To report how outpatient cardiovascular rehabilitation in Zagreb was adapted to the emerging conditions due to the COVID-19 pandemic and the large earthquake. | 2021            |
| 4  |                         |                   |           | The exacerbation of existing mental health disorders and contribution to “new” stress-related mental health disorders and disorders   | The dual mental pressures of COVID-19 and earthquake.                                                      | 2020            |
| 5  |                         |                   |           | The concurrence of meteorological and geological hazards interacting with COVID-19 impacts which will challenge the resilience of societies and systems | To discuss the issue of the cascading crises during the spread of COVID-19 pandemic.                          | 2020            |
| 6  |                         |                   |           | The psychotic disorders during the time of the 2-fold simultaneous trauma; the COVID-19 pandemic and the devastating earthquake in Zagreb | To describe the functioning mode of 2 Day Hospitals for Early Intervention and Psychotic Disorders at Psychiatric Hospital “Sveti Ivan” during the outbreak of the COVID-19 pandemic. | 2020            |
| 7  |                         |                   |           | Mixed impact of the COVID-19 pandemic and the earthquake on traffic flow                                                         | To introduce the application of Intelligent Transport Systems (ITS) which can particularly be used in cases of postdisaster occurrences such as flood, fire, or earthquake. | 2020            |
| 8  | Haiti                    | 2010              | 7         | Following Haiti earthquake, a cholera epidemic that killed thousands of residents was inadvertently started by United Nations’ aid workers. | To enlighten how the lesson learned in Haiti earthquake helped apply COVID-19 risk-reduction strategy during relief measures following Tropical Cyclone (TC) Harold. | 2021            |
| 9  | Japan (Great East Japan Earthquake) | 2011           |           | After Japan Earthquake, pharmacists worked with local pharmaceutical wholesalers and other professionals to establish a supply system for drugs and sanitary materials | To show that the experience of the 2011 Great East Japan Earthquake (GEJE) will provide helpful information to better define the role of pharmacists in ongoing COVID-19 pandemic and future disasters. | 2020            |
| 10 |                         |                   |           | The residents of Fukuhsima are experiencing COVID-19 pandemic following 2011 Japan disaster, a complex disaster of earthquake, tsunami, and nuclear accident which caused subthreshold PTSD. | To discuss the effects of subthreshold PTSD in a previous disaster on an exacerbation of PTSD symptoms in another disaster. | 2021            |
| 11 |                         |                   |           | The effects of 2011 Japan Earthquake and Covid-19 pandemic on industrial supply chains                                              | A public policy analysis of mandatory annual disclosures for listed companies.                               | 2021            |
| 12 | Mexico (La Crucetica, Oaxaca)         | June 23, 2020    | 7.4       | During COVID-19 crisis, the earthquake triggered a tsunami which caused intertidal organism mortality.                             | To describe the details of the rapid response survey of the vertical coseismic deformation, tsunami, geologic effects, and lessons from working in the field during the COVID-19 crisis. | 2021            |
| 13 | Nepal (Gorkha earthquakes) | 2015             | 7.6       | Nepal’s already strained health system was worsened by the damages due to the Gorkha earthquakes; and is inevitably going to be impaired by the current pandemic | To explore how the long-term impacts due to the earthquakes are compounded by the evolving current pandemic. | 2020            |
| 14 |                         |                   |           | The fundamental role Nepalese women played in the country’s response to the natural disaster.                                     | what lessons we can learn when confronting the country’s response to current COVID-19 global epidemic.      | 2020            |

(Continued)
the mutual impacts of the COVID-19 pandemic and the earthquakes.

**Significant Scopes of the Lessons Learned by the “Challenges”**

It is seen that among the 5 challenges, management inefficiency has been discussed more frequently \((f=13)\) compared with the other challenges concerning the mutual impacts of COVID-19 and earthquake. These challenges appear to be more pronounced in the Nepal Earthquake because this idea has been debated more frequently \((f=9)\) in the articles dealing with Nepal’s Gorkha Earthquakes, 2015 (Table 6). The first theme of Table 6 seemingly indicates that, according to the information presented in the selected articles, the frailty of simultaneous management of COVID-19 outbreak prevention and the aftermath of the earthquakes has been due to the “ineffectiveness of health system,” “the government inability to manage the impacts of the pandemic,” “the country’s unpreparedness for an infection outbreak” due to involvement with 2015 earthquake response, and “inability to attract humanitarian response” (Table 6). Conversely, concerning Croatia Earthquake (2020), only “reduction of health care availability” has been attributed to management inefficiency challenge (Table 6).

The increased life-threatening challenges have been more frequently stated for Croatia’s simultaneous entanglement with the pandemic and the earthquake \((f=3)\) with respect to “acceleration of morbidity and mortality.” The reason might be due to the chronological concurrence of the 2 disasters during 2020 (Table 4). The Economic challenges seems to be more noticeable in Japan because the 2 disasters made “detrimental impacts on the businesses” \((f=4)\). From the 9 socially related challenges, “travelling challenges” and “impacts of lockdown on rebuilding” have been mentioned 2 times each in the studies related to Mexico and Nepal, respectively. The category of “disruption of COVID-19 prevention protocols” during earthquake occurrence has been addressed by Ishiwatari et al. mainly under the idea of “staying home or going out,” arguing that this contradiction can be removed by the government if the evacuation measures are inevitable. Then, the requirement of social distancing should be lifted “to avoid direct threats to human life on a large scale.”

The fifth scope of the challenges emerged in our study is the pressing psychological challenges including “dual psychological pressures” and “exacerbation of PTSD” during and after the dual disasters of the pandemic and the earthquakes in Croatia and Japan, respectively (Table 6). Psychological aftermath of disasters has frequently been argued in other studies when only 1 disaster had occured.5,17,18

**Significant Scopes of the Lessons Learned by the “Efficient Response Measures”**

Table 7 denotes that among the 4 response measure types proved to be efficient, the measures undertaken by the health-care system were more probed in the studies \((f=12)\) while all are related to Croatian health-care system. As far as the information presented in the related reviewed studies are concerned, they have shown considerable coordination in their responses, have provided rehabilitation services for CV patients as well as tele-psychiatry modalities.21

Community-based activities are usually triggered by the residents’ internal motivation. That is why these activities are characteristically implemented fruitfully. Table 6 shows that the public’s contribution to efficient response measures during the concurrence of a pandemic and an earthquake is related to their compliance with the preventive measures which was remarkably observed by the residents during Mexico 2020 earthquake and tsunami.20

The idea of focusing on the significance of health system response compared with other responses was also focused in
Table 5. Information categories and their frequencies presented for each earthquake

| Earthquake location | Challenges                                                                 | Successful measures/response | Public cooperation | Recommendations                                                                 | f |
|---------------------|-----------------------------------------------------------------------------|------------------------------|-------------------|--------------------------------------------------------------------------------|---|
| Albania             | Economic decline in Postearthquake period due to COVID-19                   | 2 NA                         | NA                | Ongoing reforms to system of economic governance                              | 1 |
|                     |                                                                             |                              |                   | Providing economic basis for loss compensation through social productivity and sustainable economic development | 2 |
| Croatia             | Reduction in health-care availability                                     | 2 coordinated outbreak response | 2 Conscientious public compliance with social distancing and other preventive measures | 1 |
|                     | Acceleration of morbidity and mortality                                     |                              |                   | Identification of probable natural disasters and advancing preparation accordingly | 1 |
|                     | Lifestyle deterioration of less resilient people                           | 1 Outpatient rehabilitation measures for cardiovascular (CV) patients | 7                 | Provision of psychological first-aid through telemedicine                      | 2 |
|                     | Dual psychological pressures                                               |                              |                   | Radar detector for real-time traffic data collection in extraordinary situations | 2 |
| Haiti               | NA                                                                          | Not allowing the foreigners to enter the country (Risk Reduction Strategy; lesson learned from the postearthquake cholera epidemic) | 1 NA              | Strict COVID-19 inspection of the entering national/international disaster-response personnel | 2 |
|                     |                                                                             |                               |                   | Well-publicized, strongly supported masking campaign                           | 1 |
| Japan               | Inefficient engagement of the pharmacists                                  | 2 NA                         | NA                | Possible pharmacists’ roles during COVID-19 pandemic                           | 5 |
|                     | Ineffective supply system distribution                                     | 1                             |                   | Consciousness raising to mitigate the psychological impacts of the 2 disasters | 3 |
|                     | Exacerbation of initial symptoms of subthreshold PTSD                       | 3                             |                   | Establishing remote mental care support system                               | 1 |
|                     | Detrimental impacts of the 2 disasters on businesses                       | 4                             |                   | Possible businesses-sustaining measures                                        | 4 |
|                     | Increased risk of infection transmission in evacuation centers              | 1                             |                   | Possible community empowerment measures at evacuation centers                  | 2 |
| Mexico              | Travelling challenges                                                      | 2 NA                         | Observing all essential preventive measures                                   | 7 |
| Nepal               | Earthquake impacts worsening due to the pandemic                           | 1 Innovations in effective child protection | 2 Similar citizen-centric initiatives/politics in both crises                  | 3 |
|                     | Inefficiency of Nepal’s health system                                       | 1                             |                   | Immediate measures to support the health system                                | 1 |

(Continued)
Table 5. (Continued)

| Earthquake location | Challenges                                                                                     | Successful measures/response | Public cooperation | Recommendations                                                                 | f |
|---------------------|------------------------------------------------------------------------------------------------|------------------------------|-------------------|---------------------------------------------------------------------------------|---|
|                     | Escalation of vulnerability and poverty due to mobility restrictions                            |                              |                   | Recognizing the women’s capabilities for local mitigation planning of coronavirus impacts by remembering their key role in Nepal’s postearthquake recovery and resilience | 2 |
|                     | Risk of COVID-19 explosion due to poverty                                                      |                              |                   | Determining citizen-driven local Ombudsman to monitor the responses, use of funds, and recovery measures | 2 |
|                     | Impact of lockdown on economy, health, and rebuilding                                         |                              |                   | Community-based civil society campaign to monitor government budget and expenditure, to conduct media scrutiny, focused on the conduct and performance of officials handling the response at national and local level | 2 |
|                     | Government’s inefficiency to alleviate the impacts of the pandemic                             |                              |                   | Citizen-driven forms of participatory and accountability politics to reveal governance weaknesses | 1 |
|                     | Nepal, unprepared for an infection outbreak due to being involved with 2015 earthquake        |                              |                   | Embracing more responsibility by government actors in the absence of international interference | 1 |
|                     | Lack of international humanitarian response                                                    |                              |                   |                                                                                  |   |
|                     | Utah NA capability of our duty seismologists to work remotely                                 | 1                             | NA                | Prior provision of necessary materials                                             | 4 |
|                     |                                                                                  |                              |                   | Providing rapid and accurate information for the public                           | 2 |
|                     |                                                                                  |                              |                   | Providing continuous lines of data from aftershock stations (multi-layered communication network) | 1 |
|                     |                                                                                  |                              |                   | Having a plan, practicing it, and updating it!                                   | 1 |

Table 6. Themes derived from the challenges mentioned in the selected studies with their frequencies and the related earthquake locations

| No | Categories (derived from the challenges)                        | Related location | Themes of the challenges                      | f |
|----|-----------------------------------------------------------------|------------------|-----------------------------------------------|---|
| 1  | Reduction in health-care availability                          | 2                | Management inefficiency challenges             | 13|
| 2  | Inefficient engagement of the pharmacists                      | 2                |                                               |   |
| 3  | Ineffective health-care supply system distribution             | 1                |                                               |   |
| 4  | Inefficiency of Nepal’s health system                          | 1                |                                               |   |
| 5  | Government’s inefficiency to manage the impacts of the pandemic| 4                |                                               |   |
| 6  | Nepal, unprepared for an infection outbreak due to being involved with 2015 earthquake response | 2                |                                               |   |
| 7  | Lack of humanitarian response                                  | 1                |                                               |   |
| 8  | Acceleration of morbidity and mortality                        | 3                | COVID-19-health-related challenges             | 6 |
| 9  | Increased risk of infection transmission in evacuation centers | 1                |                                               |   |
| 10 | Risk of COVID-19 explosion due to poverty                      | 1                |                                               |   |
| 11 | Impact of lockdown on health due to absence of effective testing, tracking, and tracing strategies | 1                |                                               |   |
| 12 | Economic decline in postearthquake period due to COVID-19      | 2                | Economic challenges                           | 9 |
| 13 | Detrimental impacts of the 2 disasters on businesses           | 4                |                                               |   |
| 14 | Reduction of rebuilding budget due to lockdown                 | 2                |                                               |   |
| 15 | Escalation of vulnerability and poverty due to mobility restrictions | 1                |                                               |   |

(Continued)
Table 6. (Continued)

| No | Categories (derived from the challenges) | Related location | Themes of the challenges |
|----|----------------------------------------|------------------|-------------------------|
| 16 | Lifestyle deterioration of less resilient people | Croatia | Socially related challenges |
| 17 | Disruption of prevention protocols | Croatia | |
| 18 | Travelling challenges | Mexico |
| 19 | Disruption of traffic flow | Nepal |
| 20 | Earthquake impacts aggravation due to the pandemic | Nepal |
| 21 | Impact of lockdown on rebuilding | Nepal |
| 22 | Dual psychological pressures | Croatia | Dual psychological challenges |
| 23 | Exacerbation of initial symptoms of subthreshold PTSD | Japan |

Table 7. Themes derived from the categories related to the efficient response measures found in the selected studies

| No | Categories (efficient response measures) | Related location | Themes |
|----|------------------------------------------|------------------|--------|
| 1  | Coordinated outbreak response | Croatia | Health-care system measures |
| 2  | Outpatient rehabilitation measures for CV patients | Croatia | |
| 3  | Tele-psychiatry modalities | Croatia |
| 4  | Not allowing the foreigners to enter the country | Haiti | Government’s measures |
| 5  | Strict health protocols for all humanitarian cargos | Haiti |
| 6  | Innovations in effective child protection | Nepal |
| 7  | Similar citizen-centric initiative/politics in both crises | Nepal | Community-based cooperative activities |
| 8  | Public compliance with preventive measures | Croatia |
| 9  | Observing all essential preventive measures | Mexico |
| 10 | Capability of seismologists to work remotely | Utah | Disaster management response |

Table 8. Themes derived from the categories found in the recommendations in the selected studies

| No | Categories (derived from the recommendations) | Related location | Sub-themes | Major themes |
|----|-----------------------------------------------|------------------|------------|--------------|
| 1  | Identification of probable natural disasters and advancing preparation accordingly | Croatia | Identifying probable natural disasters | Mitigation phase |
| 2  | Radar detector for real-time traffic data collection in extraordinary situations | Croatia | Preparing necessary equipment | Preparedness phase |
| 3  | Expecting more earthquakes | Utah | Mental care response measures | Response phase |
| 4  | Provision of psychological first-aid through telemedicine | Croatia | |
| 5  | Consciousness raising to mitigate the psychological impacts of the 2 disasters | Japan |
| 6  | Establishing remote mental care support system | Japan | |
| 7  | Strict COVID-19 inspection of the entering national-national disaster-response personnel | Haiti | Healthcare-related COVID-19 curbing measures |
| 8  | Well-publicized, strongly supported masking campaign | Haiti |
| 9  | Use of pharmacists’ potentials during COVID-19 pandemic era | Japan |
| 10 | Possible community empowerment measures at evacuation centers | Japan |
| 11 | Immediate measures to support the health system to curb COVID-19 pandemic | Nepal |
| 12 | Possible business-sustaining measures | Japan | Economic improvement measures |
| 13 | Ongoing reforms to system of economic governance | Albania |
| 14 | loss compensation through social productivity | Albania |
| 15 | Recognizing the women’s capabilities for local mitigation planning by remembering their role in Nepal’s postearthquake recovery and resilience | Nepal | Recognizing Community-based capabilities |
| 16 | Determining citizen-driven local Ombudsman to monitor the responses, use of funds, and recovery measures | Nepal |
| 17 | Community-based civil society campaign to monitor government budget and expenditure, to conduct media scrutiny, focused on the conduct and performance of officials handling the response at national and local level | Nepal |
| 18 | Citizen-driven forms of participatory and accountability politics to reveal governance weaknesses | Nepal |
| 19 | Embracing more responsibility by government actors in the absence of international interference | Nepal | Government-related boosting measures |
| 20 | Providing rapid and accurate information for the public | Utah |
| 21 | Providing continuous lines of data from aftershock stations (multi-layered communication network) | Utah |
| 22 | Having a plan, practicing it, and updating it! | Utah |
the study by Sohrabizadeh et al. indicating the required attention which should be paid on the 4 phases of emergency management, on the part of the health system policy-makers and administrators.3

**Significant Scopes of the Lessons Learned by the “Recommendations”**

The recommendation detected in the selected studies (Table 8) can help prevent the challenges of the mutual impacts of the COVID-19 pandemic and the earthquakes in the 3 phases of Mitigation, Preparedness, and Response. The recommendation categories more frequently dealt with in the articles include: “utilization of pharmacists’ potentials during COVID-19 pandemic era” suggested by Hashimoto et al. because pharmacists proved to be very efficient in a variety of services during the 2011 Earthquake, but during the pandemic era there was a lack of full use of their services. They could have established a supply system for drugs and sanitary materials during the pandemic similar to their services during Great East Japan Earthquake, including “helping insightfully the confused on-sight health care professionals with checking the ingredients of the drugs,” “suggesting available alternatives to prescriptions,” and “raising awareness of the evacuees to observe sanitation in the sites.”27

**Conclusion**

Table 4 shows that the number of studies carried out on three earthquakes, namely, Croatia (n = 6) and Nepal as well as Japan (both n = 4) have been more than the other four. This shows the influences these earthquakes still have on different aspects of people’s lives or the lessons which people have learned from the negative or positive features of these disasters. As a scoping review study deals with detecting the general scopes of the information presented and not on the details, several systematic reviews are necessary to be conducted on different aspects of the findings of the present review study. One such study can be investigating the reason(s) behind the fact that from 35 categories offered as Recommendations to enhance the three phases of disaster management cycles, 32 categories are related to the Response Phase.

**Supplementary Material.** To view supplementary material for this article, please visit [https://doi.org/10.1017/dmp.2022.71](https://doi.org/10.1017/dmp.2022.71).

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![Figure 2. The 4 phases of comprehensive emergency management (Hoyle Sr, 2010).](image-url)
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