The Current State of Infectious Disasters Preparedness Around the World: A Qualitative Systematic Review (2007-2019)

Simintaj Sharififar; Katayoun Jahangiri; Amir Khoshvaghti

ABSTRACT

Infectious disasters have specific features which require special approaches and facilities. The main challenge is the rate of spread, and their ability to traverse the Earth in a short time. The preparedness of hospitals to face these events is therefore of the utmost importance. This study was designed to assess the preparedness of countries facing biological events worldwide. A qualitative systematic review was done from PubMed (National Library of Medicine, Bethesda, MD), Scopus (Elsevier, Amsterdam, Netherlands), Web of Science (Thomson Reuters, New York, NY), ProQuest (Ann Arbor, MI), and Google Scholar (Google Inc, Mountain View, CA). Two journals were searched as key journals. The search period was from January 1, 2007 to December 30, 2018. Twenty-one (21) documents were selected including 7 (33%) from Asia, 7 (33%) from Europe, 4 (19%) from USA, 2 (10%) from Africa, and 1 (5%) multi-continental. Forty-six (46) common sub-themes were obtained and categorized into 13 themes (infection prevention control, risk perception, planning, essential support services, surveillance, laboratory, vulnerable groups, education and exercise and evaluation, human resource, clinical management of patients, risk communication, budget, and coordination). Not all articles discussed all the identified categories. There is an extended process required to reach complete preparedness for confronting biological events, including adequate and well-managed budget. Medical centers may have trouble dealing with such events, at least in some respects, but most developed countries seem to be more prepared in this regard.

Key Words: infectious disaster, hospital, preparedness, risk management, epidemic

Biological disasters occur more often now than in the past due to the increased probability of epidemics and pandemics of emerging and re-emerging diseases, as well as bio-terrorism.[1-3] Features of infectious disasters include their contagious nature, high spread, a daily increase in the number of involved victims, and health care service disruption. Managing such disasters requires special approaches and facilities, including drug supply, vaccines, intensive care beds, ventilators, personal protective equipment (PPE), patient-specific care, differences in service delivery for various diseases, specialist personnel, staff education, individual and mass isolation, and other features that distinguish them from other disasters.[3-9] Biological disaster management involves multidimensional and complex considerations. Past and recent epidemic experiences usually involve a sharp decrease in human resources available to provide the required services.[3,10-14] Such a crisis was observed during the 2014 Ebola epidemic in East Africa,[15] and during the outbreak in Sierra Leone, where a decrease in the number of doctors and nurses available was also reported.[10] This decrease is either due to the illness itself, or the inherent fear of it overwhelming the people and staff.[10,15] The number of volunteers, which usually compensates for the shortage of human resources in other disasters, also drops in this type of disaster.[4] Challenges in such disasters range from the likelihood of visiting many panicked people in hospitals on one hand, to a failure to attend to true patients at the health centers on the other hand.[4,8,15] The main challenge of contagious infections is their rate of spread. A biological agent can traverse the Earth in a short time, and become a disaster.[4,16,17] In 2002, an outbreak of severe acute respiratory syndrome (SARS) spread from a Chinese village to 40 countries around the world in 10 days.[4] Another example is the spread of COVID-19 to 32 countries from China (Wuhan) between December 2019 and February 22, 2020.[18]

The preparedness of hospitals to face these events is of the utmost importance. Pursuing different dimensions of hospital preparedness for biological events can help to manage this type of disaster and mitigate the risks they carry more effectively. The unique nature of disease transmission in these disasters has caused rapidly spreading outbreaks globally ranging from epidemics to pandemics, and including bioterrorist threats. In each country, therefore, hospital preparedness can potentially deal with and control these disasters, in

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TABLE 1

Key Words of the Study

(Performance), (Function), (Functions), (Assessment), ("health-unified functions"), ("Executive), (Function AND Executive) (Control), (evaluate), ("exercise"), (Process), (system), (measurement), (operation), ("infection control")
(Biologic), (biological), (epidemics), (pandemic), ("Biologic event"), ("Biologic events"), (Bioterrorism), (bio-terror), ("Bioterrorism event"), ("Bio event"), (disasters), (management), (response)
(agent), ("Biological Terrorism"), ("biological threats"), (bio-terrorism), (scenario), (Warfare), ("hospital bioterrorism"), (Transmission), (infectious), ("epidemic outbreak"), ("secondary transmission"), ("infection disease"), ("infection preventionists"), ("anti-infective therapy"), ("infection transmission"), ("bioterrorism preparedness")
(Hospital), (Hospitals), ("Hospital assessment"), ("hospital performance"), ("hospital readiness"), ("hospital preparedness"), ("hospital resilience"), ("emergency hospital"), ("safety net hospital")
("general hospital"), ("general hospitals"), ("public hospital"), ("private hospital"), (proprietary), (rural), (special), (state), (urban), ("health system"), (health-care), ("non-university hospitals"), ("medical center"), ("population-based medicine"), ("hospital laboratories")

the index countries, and also worldwide. Such local preparedness can improve management and performance in other countries. This study was therefore designed to determine the current state of the preparedness of countries to respond to biological events all over the world. Participants were those countries with any published article regarding their preparedness and response during biological events. The considered outcomes of the present study included information about how to prepare for, and respond to, biological disasters, as well as foreseeable challenges related to their management. This research is a systematic review of resources with any methodology.

METHODS

This article is the result of a systematic review aimed at assessing the preparedness of hospitals to face biological events worldwide. Afterwards, thematic analysis was carried out to discover the factors affecting biological disasters preparedness.

Data Resources

The systematic review was carried out on articles, documents, and reports related to the aim of the research. The search period was from January 1, 2007 to December 30, 2018.

Data resources included PubMed, Scopus, Web of Science, and ProQuest. Considering the search results, 2 journals (the *American Journal of Infection Control* and the *Journal of Hospital Infection*) were also searched as key journals for relevant articles. Google Scholar was also searched separately.

Search Strategy

The search components were: 'performance assessment,' 'bio event,' and 'hospital.' In order to discover the maximum number of articles, equivalent words or phrases were determined by the 3-phase method. Equivalent words were obtained for each phrase in the MeSH and Emtree search engines, and they were added after studying 10 relevant articles. The words were completed or revised after specialists consultation.

The final keywords were selected in 3 groups, as described in Table 1.

According to the search engine, the desired syntax was edited and a search was carried out. Syntax adjustment and limiting was continued until INR 15 was reached. Table 2 is an example of the process in PubMed.

Inclusion Criteria

1) Articles relevant to the study topic and research question;
2) Articles that fully or partially addressed preparedness or response to infectious disasters (epidemic, pandemic, or bioterrorism-related);
3) Articles published between January 1, 2007 and December 30, 2018;
4) Articles dealing with preparedness or response in a country or a geographical area; and
5) All research methods.

Exclusion Criteria

1) Abstracts of congress articles;
2) Articles dealing solely with non-hospital settings;
3) Articles on hospital-acquired infections in non-disasters; and
4) Articles dealing with only 1 hospital.

Note that article language was not an exclusion criterion. To determine the status of all countries (as was the purpose of this study), no articles were deleted due to lack of access to their full text.

Study Selection and Data Extraction

At the end of the search, and after omitting duplicates, 2 members of the research team screened articles, books, documents, and dissertations independently, according to their titles and abstracts, considering the inclusion and exclusion criteria. To

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TABLE 2

Search Syntax in PubMed

SYNTAX

((“Performance assessment“[tiab]) OR (“Performance assessments“[tiab]) OR (“performance test“[tiab]) OR (“Function assessment“[tiab]) OR (“performance preparedness“[tiab]) OR (“hospital function“[tiab]) OR (“hospital functions“[tiab]) OR (“hospital assessment“[tiab]) OR (“health-unified functions“[tiab]) OR (“Executive Functions“[tiab]) OR (“Executive Controls“[tiab]) OR (“hospital evaluate“[tiab]) OR (“exercise evaluation“[tiab]) OR (“hospital evaluation“[tiab]) OR (“hospitals evaluation“[tiab]) OR (“preparedness Assessments“[tiab]) OR (“hospital preparedness“[tiab] AND assessment[tiab]) OR (“Performance Assessments“[tiab]) OR (“performance measurement“[tiab] AND hospital) OR (“hospital operations“[tiab]) OR (“hospital operation“[tiab]) OR (“hospitals operations“[tiab]) OR (“infection control“[tiab] AND hospital[tiab]) OR (“hospital performance“[tiab]) OR (“hospital readiness“[tiab]) OR (“hospital preparedness“[tiab]) OR (“hospital assessment“[tiab])) AND ((epidemics[tiab]) OR (pandemic[tiab]) OR (“Biologic event“[tiab]) OR (“Biologic events“[tiab]) OR (bioterrorism[tiab]) OR (bio-terror[tiab]) OR (“Bioterrorism event“[tiab]) OR (“Bioterrorism events“[tiab]) OR (“Bio event“[tiab]) OR (bio-event[tiab]) OR (bio-events[tiab]) OR (“bioevent disasters“[tiab]) OR (“bioevent disaster“[tiab]) OR (“bioevent triage”) OR (“bioevent management“[tiab]) OR (“biological response“[tiab]) OR (“biological agent“[tiab]) OR (“biological terrorism“[tiab]) OR (“biological threats“[tiab]) OR (bio-terrorism[tiab]) OR (“bioterrorism exercise“[tiab]) OR (“bioterrorism scenario“[tiab]) OR (“biologic terrorism“[tiab]) OR (Terrorism[tiab] AND Biological[tiab]) OR (Agent AND “biological warfare“[tiab]) OR (Agents AND “biological warfare“[tiab]) OR (“biological warfare“[tiab]) OR (“warfare agent“[tiab] AND Biological[tiab]) OR (“warfare agents“[tiab] AND Biological[tiab]) OR (Agent AND Biological) OR (Agents AND Biological) OR (“biowarfare agents“[tiab]) OR (Agent AND Biowarfare) OR (Agents AND Biowarfare) OR (“biowarfare agent“[tiab]) OR (“bioterrorism agents“[tiab]) OR (Agent AND Bioterrorism) OR (Agents AND Bioterrorism) OR (“bioterrorism agent”) OR (“bioterrorism preparedness“[tiab]) OR (“hospital bioterrorism“[tiab]) OR (“biological weapons“[tiab]) OR (“biological weapon“[tiab]) OR (Weapon AND Biological) OR (Weapons AND Biological) (“epidemic outbreak”) OR (“secondary transmission”) OR (“infection disease“[tiab] AND preparedness[tiab]) OR (“infection prevention“[tiab] AND preparedness[tiab]) OR (“infection transmission“[tiab] AND preparedness[tiab])) AND ((Hospital[tiab]) OR (Hospitals[tiab]) OR (Medicine AND Hospital) OR (“hospital resilience“[tiab]) OR (“emergency hospital“[tiab]) OR (“safety net hospital”) OR (“general hospital”) OR (“general hospitals”) OR (“public hospital”) OR (“private hospital”) OR (Hospitals AND proprietary) OR (Hospitals AND rural) OR (hospitals AND special) OR (Hospitals AND state) OR (Hospitals AND urban) OR (infirmary[tiab]) OR (“medical clinic“[tiab]) OR (“regional hospital”) OR (“state hospital”) OR (“voluntary hospital”) OR (hospital-based[tiab]) OR (“hospital-based exercise”) OR (“health system“[tiab]) OR (“hospital departments“[tiab]) OR (“hospital department“[tiab]) OR (health-care) OR (“health emergencies”) OR (“health emergency”) OR (“pre-hospital care”) OR (“hospital modality“[tiab]) OR (“hospital epidemiologists”) OR (“hospital activities“[tiab]) OR (“non-university hospitals”) OR (“emergency service”) OR (“medical center“[tiab]) OR (“medical centers“[tiab]) OR (“medical service“[tiab]) OR (“multiple hospital”) OR (“population-based medicine”) OR (“health-care system“[tiab]) OR (“hospital laboratories”)) AND 1999[PDAT] : 2018[PDAT]

decrease the risk of bias related to individual studies, full texts of remaining titles were analyzed by 2 colleagues using a researcher-produced form. Additionally, to decrease the risk of bias of across studies, any relevant article found was selected without special consideration for the author or publisher. All of the results and reports were considered for this study. Low-quality studies, or those with invalid methodologies, were excluded. Data were extracted from the remaining articles using researcher-produced forms. If there was any disagreement, the paper was reviewed by a third colleague, and the final decision was taken by the research team. The forms (critical appraisal checklist and data extraction tool) were developed and processed during the study.

Data Analysis and Interpretation

After selecting appropriate articles, they were analyzed considering descriptive evaluation (including the type of study, its methodology, findings relevant to the research question, and results). Thematic analysis was used at this phase.

RESULTS

From 1091 articles and documents collated during the search, 433 relevant articles were found, and 21 final articles were entered into the study. Due to the different methods and tools used by the articles, the research team extracted data regarding hospital preparedness and performance in biologic disasters by content analysis. The PRISMA diagram is depicted in Figure 1.

Description of Studies

Most of the reviewed documents were original and cross-sectional studies; 7 articles (33%) about Asian hospitals, 7 articles (33%) from Europe, 4 articles (19%) about USA hospitals, 2 articles (10%) about Africa, and 1 article (5%) studied the hospitals in more than 1 continent. The obtained information is described in Table 3.

Of the documents, 85% were original papers, 20% review articles, 5% dissertations, and 5% were reports. The type of documentation included in the study is as described in Table 3. The results of the systematic review are summarized in Table 4.

DISCUSSION

In this phase of the study, and according to the obtained findings (multi-dimensional findings, and a variety of research methods and tools), our team decided to categorize the investigated items using thematic analysis. The items reviewed in all the documents were extracted, and 46 common sub-themes were obtained. After this, the obtained sub-themes were

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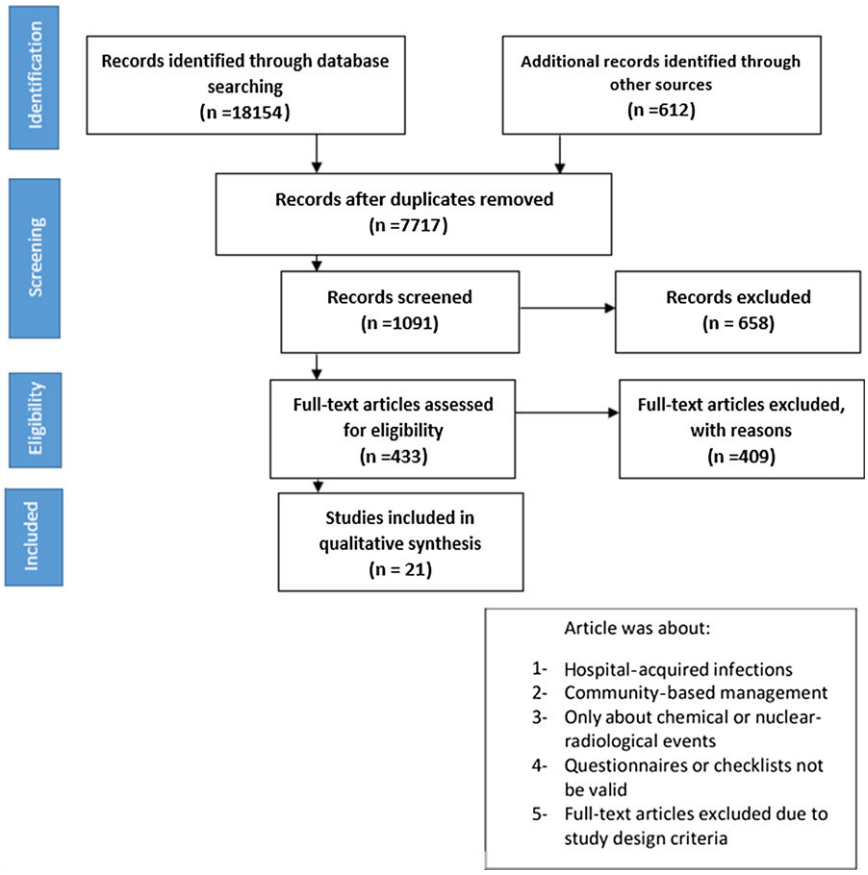
FIGURE 1

PRISMA Diagram of Studies Included in the Systematic Review.



categorized into 13 themes according to similarities and differences. In other words, the articles had evaluated hospitals in 13 general areas. Although all the articles had not discussed all the categories, the reported cases are listed in Table 5 according to the research team's categorization.

Infection Prevention Control (IPC)

IPC data were extracted by thematic analysis,[1,10,11,19,25,27,29,30] as an important factor considered in some articles, which consisted of decontamination, dead body management, laundry, catering, as well as individual and mass isolation. Measures carried out by staff (such as hand washing and use of PPE), and proper isolation of patients (based on the type of illness) affect the performance of hospitals and health centers responding to infectious disasters.[34,35]

Our study showed that challenges confronting IPC around the world are in categories such as access to individual and mass isolation, decontamination measures, hospitalization facilities for patients with highly infectious diseases, biological waste disposal, isolated rooms with ≥ 12 air changes per hour, implementing IPC guidelines on the handling of laboratory samples, infection control in food preparation and hospital cleansing and laundries, access to alcohol and gloves, and managing dead bodies.

TABLE 3

Number of Articles Encoded by World Region and Type of Documents

Setting	Number of Documents	Original Article	Dissertation	Report
Asia	7 (33%)	7 (33%)	-	-
America	4 (19%)	3 (14%)	1 (5%)	-
Europe	7 (33%)	7 (33%)	-	-
Africa	2 (10%)	-	-	2 (10%)
Multi-continental	1 (5%)	1 (5%)	-	-

Risk Perception

Risk perception of infectious disasters is one of the components of the proper preparedness and performance of health systems.

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TABLE 4

Summary of Systematic Review Results

	Author	Year	Research Design	Setting	Analyzed Measures
1.	Al-Shareef, et al. [11]	2016	Cross-sectional	Mecca-Saudi Arabia-Asia	General evaluation of infectious disaster planning, hospital executive structure, knowledge of health personnel and their education.
2.	Almutairi et al. [12]	2016	Cross-sectional	Saudi Arabia-Asia	Physicians' knowledge, attitude, and clinical performance.
3.	Kao, et al. [13]	2017	Review	Taiwan-Asia	Response and preparedness during infectious disasters.
4.	Ungchusak, et al. [19]	2012	Case study	Thailand-Asia	Surveillance, clinical management and drug therapy guidelines, laboratory services, drug treatment, promotion of infection control and surge capacity, non-pharmacological services, access to vaccine.
5.	Adini, et al. [20]	2014	Quasi-experimental	Israel-Asia	Preparedness and capacity to manage pandemic influenza: perceptions of healthcare managers.
6.	Li, et al. [21]	2008	Cross-sectional	China-Asia	Emergency preparedness for public health, response to public health emergencies in the community, drug and equipment stockpiles, emergency diagnosis, medical treatment trends, laboratory diagnosis, staff education, risk communication.
7.	Hui, et al. [22]	2007	Cross-sectional	China-Asia	Preparedness program, laboratory diagnosis capacity, treatment processes of infectious diseases, pharmaceutical stockpiles, personal protective equipment, and staff education.
8.	Droogers, et al. [23]	2018	Cross-sectional	Europe	Preparedness program, strategic plan, risk-based program, commanding system, coordination and monitoring control, risk communication, initial warning; risk assessment and surveillance, vaccines, antivirals and other essential medicines, health care preparedness and response, non-public health interventions pharmaceuticals (NPIs), essential services and continuation of activities, specific groups, rehabilitation and transition phase, international operations capability.
9.	Moen, et al. [24]	2014.	Cross-sectional	Europe	Preparedness and communication, surveillance and diagnosis, response and containment.
10.	Mortelmans, et al. [25]	2017	Cross-sectional	Germany-Europe	Hospital program and decontamination, personal protective equipment, antidotes.
11.	Paganini, et al. [26]	2015	Cross-sectional	Italy-Europe	General information on emergency planning, knowledge about protocols and their implementation.
12.	Mortelmans, et al. [27]	2014	Cross-sectional	Belgium-Europe	Hospital disaster planning, risk perception, access to decontamination units, personal protective equipment, antidotes, access to infectious diseases specialist, isolation measures, and staff education.
13.	Dell'Era, et al. [28]	2016	Cross-sectional	Switzerland-Europe	Preparedness program, drill implementation, education and awareness about programs, decontamination.
14.	Anathallee, et al. [29]	2007	Cross-sectional	England-Europe	Number of wards having isolation room, independent ventilation system, separate access to emergency department and units capable of contagious diseases admission
15.	Grundmann [30]	2014	Review	USA	Monitoring and surveillance, risk management including preparedness, prevention and decontamination, risk communication based on public health policies and access to resources.
16.	Niska, et al. [31]	2011	Cross-sectional	USA	Six fields of disasters, epidemics and pandemics, chemical events, nuclear and biological events, emergency response programs, collaboration planning, drills, simulation and exercise.
17.	Keeble, et al. [32]	2010	Thesis	USA	Incident command system, cooperation memorandum, exercises and drills, key partners, training of first level staff involved in the incident.
18.	Zoutman, et al. [33]	2010	Cross-sectional	Canada	Pandemic influenza program and its testing.
19.	Tartari, et al. [1]	2015	Cross-sectional	Worldwide	Administrative/operational logistic, communication, education and assessment; human resources, resources, infection prevention and control methods and clinical management of patients.
20.	Bazeyo, et al. [10]	2015	Case study	Africa	Survey of the response to Ebola epidemic.
21.	Forrester, et al. [15]	2014	WHO report	Africa	Survey of the current status of response to Ebola epidemic.

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TABLE 5

Extracted Themes and Subthemes as Effective Determinants and Components of Biological Disaster Preparedness

	Themes	Subthemes	Resources
1.	Infection Prevention Control	Decontamination	[1,10,11,15,19,25,27,29,30]
		Dead body management	
		Laundry	
		Catering	
		Isolation	
		Mass isolation	
2.	Coordination	Coordination with the national committee	[13,15,19,30,32]
		Incident command system	
		Coordination with commanders	
		A Strategy for infectious disasters management	
3.	Risk Communication	Communication with the community	[1,13,15,19,23,24,30]
		Effective communication with patients	
		Effective communication with staff	
		Effective communication with policymakers	
4.	Professional Laboratory	Detection of strains	[19,21,22]
		Laboratory safety levels	
		Reference laboratory	
5.	Surveillance	Effective surveillance	[1,15,19,21,30]
6.	Knowledge, Education, Training and Evaluation	Staff training	[1,10-12,15,20-22,26,30,32,33]
		Patient education	
		Educate at-risk people	
		Community education	
7.	Planning	Preparedness plans for the recovery phase (Recovery Announcement, Human Resource Rehabilitation)	[1,11,19-23,26-28,32,33]
		Planning in specific groups	
		Memoranda of Understanding, Guidelines, Protocols	
8.	Financial Resources	Budget	[13,15,27,28,30,32,33]
9.	Human resources	Access to an Infectious Disease specialist	[1,15,21,27]
		Counseling Psychologist	
		Volunteers	
10.	Risk Perception	Risk perception of infectious disasters	[12,27]
11.	Essential Support Services	Surge capacity	[1,11,13,15,19-21,25,27,29]
		Separate access to hospital wards	
		Ventilation	
		Ambulance	
		Special hospital	
		Personal Protective Equipment	
		Surge capacity	
		Equipment	
12.	Vulnerable Groups	Immigrants	[19,23,28]
		Children	
13.	Clinical Management of Patients Medication - Vaccine	Access to medication	[1,21,22,27,30]
		Distribution of medicines	
		Storage	
		Treatment of patients	

Appropriate risk perception is a determining factor in disaster risk reduction implementations. Risk perception was extracted as one of the effective themes influencing hospital preparedness and response[12,27] but only 71% of Belgian hospitals were considered to be at risk of Chemical, biological, radiological and nuclear (CBRN) events.[27] In Saudi Arabia, all physician and nurse participants had high levels of concern about hemorrhagic fever, so they adhered to strict standard measures for infection control.[12] The threat of an epidemic may be frightening, particularly when it causes community collapse due to over-estimation of the risk, or vice-versa (inadequate follow-up and widespread epidemics by under-estimation).[36]

Planning

The sub-themes identified were: preparedness plans for recovery period (recovery announcement, human rehabilitation), programs for special groups, agreements, guidelines, and protocols.[1,11,19-23,26-28,32,33] Some necessary plans included educational programs, contamination prevention, rapid communication, individual and mass quarantine, and rapid

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diagnostic tests.[30,37] It should be considered that real preparedness is much different from the existence of a plan.

Essential Support Services

Essential support services are considered to be a basic element for proper preparedness and performance during biological disasters that include surge capacity measures, PPE, appropriate masks, and isolation facilities.[29,38-41] In our study, essential support services were a major theme, that included the following sub-themes: equipment, separate entrances to wards, ventilation, ambulance, high specialty hospitals, PPE, and surge-capacity.[1,11,13,15,19,21,25,27,29] Our review has shown that there is a wide range of equipment coverage around the world.

Surveillance

There are reports of the implementation and use of modern and multipurpose surveillance systems. There have been monitoring reports of symptoms in specific times and regions, syndromic surveillance systems, pre-diagnostic and non-specific criteria monitoring, and health behavior spectrum monitoring.[42] Surveillance execution is an important element in appropriate preparedness and performance.[19,21,24]

In 36 European countries, routine influenza surveillance was evaluated as appropriate.[24] An extensive study in 125 hospitals, across 45 countries, showed that 68% of hospital staff who were engaged in the management of hemorrhagic fever patients were aware of surveillance system and notification processes. Guidelines for suspected cases were available in 70% of hospitals.[1] In the early days of the largest Ebola epidemic in Africa, no surveillance system was available.[15]

Laboratory

While an appropriate response to biological disasters requires access to laboratory facilities, only 3 studies had evaluated this theme as an aspect of preparedness.[19,21,22,52]

Vulnerable Groups

The vulnerable groups are more susceptible than the general population, even during a natural and uncomplicated disaster. They also have more needs, and will be even greater in complex disasters such as biological events, but as only 3 countries had considered it as an element of preparedness,[43-50] it was one of the issues mentioned the least in the field of disaster management.

Education, Exercise, and Evaluation

Review of articles in the field of biological disaster response reveals the impact of education and exercise.[51,52] Hospitals will not have the appropriate response capacity without effective education.[52] This theme was extracted after thematic analysis, including the sub-themes of: staff education, patient education, vulnerable group training, and community training. Education is one of the challenges of infectious disaster management. Education gaps were clear during the Ebola epidemic in East Africa.[53] The current systematic review showed 11 articles had studied the issue, suggesting the importance and frequency of theme as an element of biological disaster preparedness and response.[1,10-12,15,19,21,22,26,30,32,33]

Human Resource

The number of health care workers drops when biological disasters occur, similar to influenza pandemics.[54-57] Although the degree to which motivation and the number of available workers decrease in biological disasters varies from country to country, the level of motivation is lower for biological disasters than other disasters.[15,16,56] One of the main extracted themes was human resources, including sub-themes of access to an infectious diseases specialist, a counseling Psychologist, and volunteers.[1,15,21,25] Deficiency of specialist human resources, including infectious disease specialists, psychiatrists, and epidemiologists, was observed in several studies.

Clinical Management of Patients

In this study, and based on thematic analysis, clinical management of patients was one of the extracted themes in facing biological disasters.[1,21,22,27,30] This theme included sub-themes of access to distribution and storage of drugs and vaccines, and treatment of patients. The results of our study showed that clinical management of specific patients (chronic renal failure patients in need of hemodialysis), diagnostic guidelines, patient tracking, reserves of vaccines and antibiotics, and other pharmaceutical resources are problematic in some research.

Risk Communication

During intentional or unintentional outbreaks of infectious diseases, communication, information, and guidance are often the most important public health tools in risk management.[58] Effective communication reduces response time in disasters.[59]

It was determined by our research that the following items had encountered some problems: sharing specific information (such as free bed numbers and hospital capacity), training programs, answering frequent asked questions, visual tools for personal protection exercises and educational videos, and intra-hospital communication mechanisms. In African countries, even telephone interference had led to inefficient management in the Ebola pandemic.[1,13,15,19,24,30]

Budget

In spite of the high cost of preparedness and performance measures during infectious disasters, proper budgets are not usually allocated. Researches show that a lack of financial resources acts as a major obstacle to proper preparedness.[27] The amount of funding varies according to each country's context. Our

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study found that in Switzerland, the lack of national funds for enhancing disaster preparedness is one of the main causes of hospital vulnerability to chemical, biological, radiological, nuclear, and burn threats.[28] Funding for biological defense has been increasing in the United States since 2000,[30] but budget strategies for hospital preparedness should be prioritized and rationally reviewed.[32] 70% of hospitals in Ontario, Canada had not received adequate funding for influenza epidemics.[33] At the beginning of the largest Ebola epidemic in east Africa, health care worker salaries were not paid due to the lack of budget.[15]

Coordination

Good evidence of the coordination and command of infectious epidemics has been seen in Taiwan. The Epidemic Command Center is responsible for managing infectious epidemics. Unified command and appropriate coordination has been implemented by: determining 6 geographic areas in the country; designating a respondent hospital, a support hospital, and mass isolation sites such as public spaces or determined hospitals in each area; and connecting all of them to the Center of Infectious Epidemics Control. The above mentioned system can be a model for controlling epidemics and other infectious disasters worldwide.[13]

Infectious disasters differ from other disasters in many respects, such as drug supply, vaccines, and special equipment like PPE; so their management requirements include Memoranda of Agreement (MOA), Memoranda of Understanding (MOU), and cooperative planning with other hospitals, health centers, government, local authorities, and support providers. Coordination with foreign organizations (respondent and supportive) as well as national interdisciplinary coordination can improve management.[60]

Limitations

The limitation of our research was that methodology of studies was not similar. The tools used in different studies were also not similar.

CONCLUSION

Although biological events are one of the most important challenges the world is facing, the road to the complete preparedness and performance necessary to confront such disasters is long. The necessary budget, and its management, have an important role to play in preparedness for, and response to, a biological event. Many developed countries seem to be better prepared. Hospitals will have trouble at least in some respects dealing with such events. Although some studies have shown that prior experience of an infectious disaster would be an effective factor for preparedness, there is no evidence to support that conclusion. Although the present study has reviewed the response and preparedness of hospitals to infectious disasters up to 2019, and findings have been from epidemics such as SARS, MERS, and Ebola, many results might be extended to COVID-19 pandemic. Taiwan's coordination network, which was established for the 2003 SARS epidemic and was modified and tested during the 2009-10 H1N1 influenza pandemic and 2014-2016 Ebola outbreak, is an example to be considered for implementation in the COVID-19 disaster.

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Ethics

This study was approved by the National Committee of Ethics of Iran (code number: IR.SBMU.RETECH.REC.1396.205).

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Conflict of Interest Statement

All authors disclose that there is no actual or potential conflict of interest, including financial and personal, or any other relationships with authorities or organizations that would constitute a conflict, within 3 years of starting the study.

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