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Identifying the preparedness components in COVID-19: Systematic literature review

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Abstract:

In 2019, the COVID-19 pandemic posed a major challenge to the world. Since the world is constantly exposed to communicable diseases, comprehensive preparedness of countries is required. Therefore, the present systematic review is aimed at identifying the preparedness components in COVID-19. In this systematic literature review, PubMed, Scopus, Web of Science, ProQuest, Science Direct, Iran Medex, Magiran, and Scientific Information Database were searched from 2019 to 2021 to identify preparedness components in COVID-19. Thematic content analysis method was employed for data analysis. Out of 11,126 journals retrieved from searches, 45 studies were included for data analysis. Based on the findings, the components of COVID-19 preparedness were identified and discussed in three categories: governance with three subcategories of characteristics, responsibilities, and rules and regulations; society with two subcategories of culture and resilience; and services with three subcategories of managed services, advanced technology, and prepared health services. Among these, the governance and its subcategories had the highest frequency in studies. Considering the need to prepare for the next pandemic, countries should create clear and coherent structures and responsibilities for crisis preparedness through legal mechanisms, strengthening the infrastructure of the health system, coordination between organizations through analysis and identification of stakeholders, culture building and attracting social participation, and service management for an effective response.

Keywords:

COVID-19, epidemics, pandemics, preparedness, systematic literature review

Introduction

Epidemic threats and severe epidemics are inherently catastrophic.[1] A catastrophe or crisis is an event causing harm, leading to ecological disruptions, loss of human life, deterioration of health or health services, aside from requiring an extraordinary response.[2] Crises are constantly changing; therefore, it is necessary to develop national programs for crisis management as well as building strong structures and updating them.[3]

Governments have a responsibility to make every effort to build the necessary capacity and preparedness for a rapid and effective response to public health emergencies, and to take appropriate measures, through laws and regulations, to prevent, mitigate, and prepare for disasters and reduce their risks.[4]

Preparedness, as one of the most important phases of the risk management cycle, causes a more immediate, effective, and efficient response to the epidemic.[5]

The United Nations (UN) and the World Health Organization (WHO) describe preparedness as the ability (knowledge of capacity and organizational systems) of

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governments, specialists, accountable organizations, communities, and individuals to anticipate, detect, and respond effectively and recover from possible, imminent, or existing emergencies. It defines health, specific hazards, events or situations, meaning the creation of mechanisms allowing national authorities, multilateral organizations, and relief organizations to be aware of the risks and to quickly deploy staff and resources in a crisis situation.[6]

COVID-19 is a major challenge for the health care system.[7] With the outbreak of COVID-19, the issue of society's ability to cope with an acute health crisis was once again considered, and in this regard, it is essential to recognize the factors determining a country's ability to cope with the spread of the virus.[8]

Over the past two decades, the outbreak of multiple epidemics from SARS to Ebola has tested the ability of countries to respond to the threat of disease and provided an opportunity to improve preparedness systems. However, when the human-to-human coronavirus emerged in China in 2019, many countries were unprepared to deal with it. The COVID-19 pandemic is undoubtedly unparalleled in scope and impact worldwide. The 2019 Global Security Index report identifies gaps in pandemic preparedness, including prevention, diagnosis, and response to health emergencies. However, countries recognized as the most prepared, according to the report, such as the United States, were worse off during COVID-19, compared to other countries that performed well and responded well, such as New Zealand. This suggests that the criteria used to determine pandemic preparedness may not be indicative of a country's preparedness,[9] and how the COVID-19 pandemic is managed in some countries indicates that their preparedness is just a program on paper.[10]

It is therefore important to have accurate criteria for national preparedness to assess global resistance and resilience in the face of an epidemic because current evaluation systems focus on existing legal frameworks and do not pay close attention to other essential capabilities enabling preparedness and accountability.[11] Preliminary research results of databases on the preparedness and response of countries against COVID-19 showed that the preparedness program of different countries and the measures taken afterwards, ranging from vaccine and drug production programs to non-pharmacological measures such as social distancing, quarantine, communications, and education[12] have provoked different responses in different countries.[13–16] Due to the lack of specific components and elements of epidemic preparedness, a comprehensive and complete model for epidemic management has not been defined; thus different approaches have been adopted at the international, national, regional, and local levels, ultimately leading to inefficient management, and this process has become prolonged. Therefore, this study was designed and conducted to determine and clarify the dimensions of preparedness due to the lack of a preparedness model against COVID-19. This study was conducted to identify the factors that systematically affected (which did not exist before) preparedness.

Materials and Methods

This study has been conducted by systematic review method with content analysis approach. Studies examining various aspects of the Covid-19 preparation program were included in the systematic review process and other that focused solely on aspects of the COVID-19 pandemic other than preparedness, such as vaccine development, clinical trials, and death analysis, complications of the disease, description of patients' characteristics, treatment methods, protective equipment, education and the like, and papers not written in English or Farsi and papers the full text of which was not available were excluded from the study. These studies were conducted by searching Iranian electronic banks including University Jihad Scientific Database (SID), Iranian Scientific Information and Document Research Institute (Iran Doc), and foreign scientific databases including PubMed, Scopus, Web of Science, Science Direct, and ProQuest. Reputable national programs and sites for disaster and disease management, such as the World Health Organization (WHO), the American Federation of Disaster Management (FEMA) and grey literatures, as well as a reference list of published studies to increase sensitivity and select more studies were checked out.

According to PRISMA diagram 2009 [Figure 1], systematic search was performed from December 2019 to December 2021 in search databases using preparedness and COVID-19 as keywords. Since the word "preparedness" is one of the steps defined in the disaster risk management cycle according to the authoritative references of disaster management, it is not considered a synonym for COVID-19 according to the website of the World Health Organization. Several papers in valid databases used the terms "coronavirus", "corona virus", "SARS-CoV-2", and "nCov-2019" Table 1. The original PubMed key and then the search term in other databases were dedicated.

After extracting the papers, the titles and abstracts of each paper were initially reviewed to relate the topic and after removing irrelevant and duplicate papers, the full text of the selected papers were studied by two researchers.

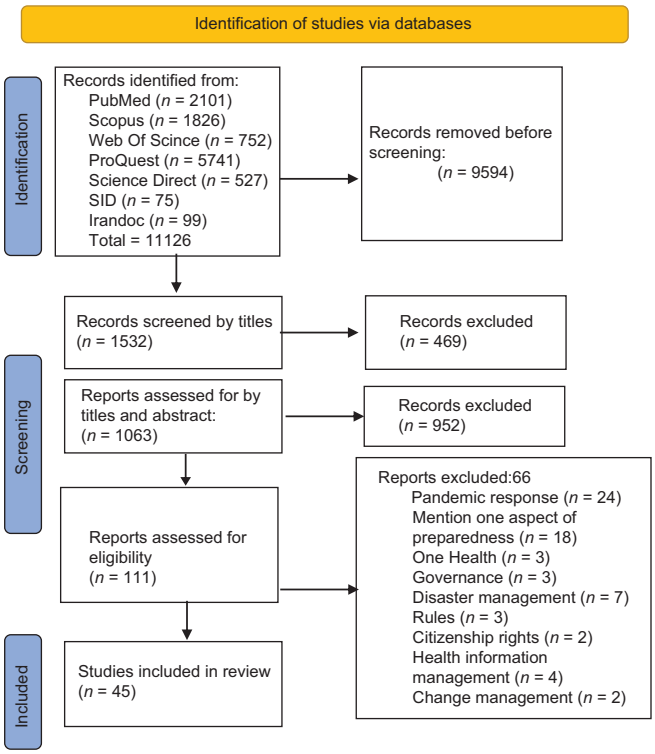

Figure 1: PRISMA flowchart of systematic review of identifying the preparedness components in COVID-19

To collect data based on the research question, a data extraction form was designed. This form included sections of the specifications of each paper including first author, year of publication, paper title, type of paper, study method, and study findings. At this stage, two PhD students in health services management were responsible for selecting content and extracting data. The main features of the studies and their results are shown according to the variables defined in Table 2. Finally, the components of preparedness were identified from the findings and the results of the studies were entered into a systematic review via content analysis.

Study risk of bias assessment

The STROB checklist is used to assess the quality of observational studies. In this study, the STROB tool was changed according to the nature of the study, including 11 items and the answers of yes, no, and uncertain. Papers that have a score of 0–3 are weak, 4–7 average, and 8–11 strong. Two members of the research team independently reviewed the quality of the full text of the extracted papers, and disagreements were determined by a third person (supervisor of the research team).

Results

According to the PRISMA flowchart, out of 11,126 papers found using search syntax in databases, 10,063 papers were deleted due to duplication and lack of relevance. Subsequently, the abstract of 1,063 papers was read and 952 cases were deleted due to lack of inclusion criteria and the full text of 111 papers was carefully reviewed and critically reviewed using the evaluation checklist (STROB), of which 24 cases due to the response to the pandemic, 18 cases of non-payment of preparedness components, 3 cases of One-Health, 3 cases of governance, 7 cases of crisis management, 3 cases of laws and regulations, 2 cases of civil rights, 4 cases of health information management, and 2 cases of change management were left out. Finally, 45 cases were included in the study.

Table 1: Syntax steps to identify components of COVID-19 preparedness

Data base	Syntax
PubMed	(((((((COVID-19[Title/Abstract]) OR ("SARS-CoV-2"[Title/Abstract]) OR ("nCoV-2019"[Title/Abstract]) OR ("corona virus"[Title/Abstract]) OR (coronavirus[Title/Abstract])))))) AND (preparedness[Title/Abstract])) AND ("English"[Language]))) AND (("2019"[Date - Publication] : "2021"[Date - Publication]))

Table 2: The preparedness components in COVID-19 based on a systematic review

Category	Subcategory	Examples from the code/data
Governance	Characteristics	Political and Economic Stability - Consistent governance, Experienced Leadership - Accountability and Transparency
	Responsibilities	Planning - Information and Communication Management - Logistics and Support - Risk Management
	Rules and Regulations	Existence of law -universal health coverage- promotion of syndromic care system-promotion of continuous public health-
Society	Resiliency	Educated society - Digital literacy society - Trust in governance
	Culture	Orientation ethics-responsibility-participation
Services	Managed services	Providing comprehensive services - Service prioritization - Service flexibility - Service integration
	High technology	Technology development - the use of robots - digital health
	Prepared health services	Designation of ready hospitals - Establishment of National Infectious Diseases Hospitals - Promotion of infection control

Among the 45 papers that were analyzed in the study, 24 were case studies, 10 review papers, 3 were research papers, 2 operational and strategic plans, and 6 were gray papers. Programs from China, Portugal, Australia, Canada, Saudi Arabia, India, New Zealand, Malaysia,

Taiwan, Italy, Belgium, Bangladesh, South Asia, Mexico, Brazil, Hanoi, Egypt, Nigeria, European countries, Southeast Asia and Africa were studied in the present study [Table 3].

The findings of the studied papers were analyzed by content analysis method and the three main groups and eight subcategories are described in Table 2.

Discussion

Based on the studies included in this systematic review, the components of COVID-19 pandemic preparedness are divided into three main categories and eight subcategories: governance (governance characteristics, rules and regulations, governance responsibilities), society (resiliency and culture), and services (managed services, high technology-prepared health centers) [Table 3].

Governance

Governance characteristics, emergency governance responsibilities, and emergency laws and regulations have been identified as the key governance components effective in preparing for COVID-19 epidemic.

Government characteristics

According to a study reviewing four studies, political and economic stability in governance and society has had a significant impact on preparedness against COVID-19, that is, politically stable countries with economic security had better preparedness and better performance in response to the COVID-19 pandemic.[8,17,18,29] Some studies show that countries with sovereignty that are compatible with democratic and integrated change[17] in the COVID-19 pandemic were prepared to respond in a timely manner.[3,22,28,30,37,42] This type of government has the ability to gain the people's trust and support, being more prepared to respond with the necessary reactions in the face of any change.[3,18,21,22,38,46] Experienced leaders and all-round leadership capable of mobilizing, and guiding the people and the consensus of all elements of the government[3,9,23,27,33] as well as accountability and transparency have been other governance characteristics in countries prepared for confronting COVID-19.[21-23,25,36]

Coordinated governance, on the other hand, succeeds in preparing against COVID-19 since without proper coordination, contradictory, inconsistent, and even inappropriate actions may be taken.[3,54,55]

Governance responsibilities

In this systematic review, we also address governance responsibilities, identified as another governance factor in COVID-19 preparedness. These responsibilities include planning, risk management, information and communication management, logistics and support, training and evaluation and monitoring.

Planning

One of the first and most important responsibilities of the government in the preparation phase is planning, which should be done with the analysis and participation of stakeholders and the approach of the whole society and the whole government[3,5,8,9,17,19,21,23,25,27,30,31,36,43,48-50,53,56] and One Health. This successful experience of preparation has been emphasized in many studies due to the transmission of disease from animal to human and the impact of the environment on the COVID-19 pandemic.[8,19,21,22,34,41,45,54] Planning against epidemics such as COVID-19, which has affected all sectors of society and institutions, will play a key role in preparing the system by identifying and analyzing stakeholders and participating in and coordinating with them.

Risk management

In most studies, risk management has been cited as an important component of COVID-19 preparedness.

Risk management such as risk assessment, risk communication, risk perception, and integration of disaster risk management and emergency management of health emergencies are among the key tasks of the government to prepare for the COVID-19 pandemic.[12]

Risk identification and analysis, identification of all hazards threatening health and the source of disease entry, transmission and risk information, and communication with the community to understand the risk by them and participation are necessary to eliminate the risk.[3,5,8,9,17,22,23,25,26,28-31,34,36,38,39,42,46-49,52-54,56]

Information and communication management

One of the lessons learned from the COVID-19 pandemic was the need for immediate information feeding around the world.[18]

Information and communication management in the preparation phase includes a set of measures facilitating access to valid data and data sharing by strengthening information technology,[9,21,46,50,51,56,57] coherent and accessible databases for professionals, establishing policymakers, and through two-way communication, cross-sectoral coordination, and appropriate use of cyberspace, social networks, mass media, and the establishment of credible information bases, informing the public in a timely manner about accurate, credible, and reliable of information.[5,20,24,30,41,43,44,51,56]

According to the findings of the papers included in this study, producing content for a wide audience, preparing indicators of social vulnerability at the community level,

Table 3: The findings of the analyzed articles

Author & year	Aim	Type of study	Design	Finding	Suggestion
Lixia Wang[17] 2020	To review the public health actions taken during the fight against COVID-19 in China, to generate a model for prevention and control public health emergency	Qualitative	Case study	The success in fighting against COVID-19 in China can be attributed to adaptable governance to changing situations; culture of moral compliance with rules; trusted collaboration between government and people	Using adaptable governance to changing situations and artificial intelligence; B-Block chain; C-Cloud computing; D-Big data
Fahim Aslam[18] 2020	Providing solutions which are already available to be utilized in the right manner	Qualitative	Review	Strengthening public health systems, establishing global health, monitoring service, e-healthcare systems, bridging gaps between poverty and education, promoting safe hygiene practices, and research and development in health care	To imply the solutions that would address the needs of the low- and middle-income countries during future pandemics
Pedro[3] Miguel Alves Ribeiro Correia 2020	Present the main facts related to the fight against the pandemic from the perspective of the Portuguese governance	Qualitative	Case study	Collaboration between the different crisis management stakeholders, good mitigation practices, governmental collaboration and coordination, highlight the legality value, the accountability value towards the citizen by all the technical and medical information, the reliability value of the citizens in the government actions and decisions, government transparency and accountability, sustainability of national health system, using coproduction practices and telemedicine, innovative technologies have been key to success in responding to the pandemic.	Reduce uncertainty, strengthen mitigation measures, use lessons learned, express organizational values, maintain national health systems to meet the needs of citizens, use co-production methods and telemedicine
Evangelia Petridou[19] 2020	Lessons learned extracted from China to inform the Cypriot response to the COVID-19 pandemic	Qualitative	Case study	Liberal democracy, using the experiences of other countries to improve national policies, using new technologies, gaining skills and training, attention to experts, developing guidelines, risk communication, trusting the national government, protecting public health and the care system health, community participation, free flow of information, closer communication especially through international networks with the help of the World Health Organization, play an important role in preparing for the COVID-19 pandemic.	To improve preparedness for future crises, recording lessons and using them should be part of the managers' program
Ingrid[20] Johnston 2020	Provides an overview of some of these issues, highlighting examples to forecast longer-term impacts	Qualitative	case study	Important factors in preparedness include promoting public health, legal support, information and communication management, cooperation and inter-sectoral coordination, One-Health approach, general government approach, stakeholder participation, capacity building, structure reform, training and education, identifying specific vulnerable communities and education.	Increasing public health budgets at different levels of the country Training and capacity building of the public health workforce Establish an independent government agency to provide scientific advice and training, and coordinate the control of diseases

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Table 3: Contd...

Author & year	Aim	Type of study	Design	Finding	Suggestion
Jennifer[9] Cable 2020	To explain lessons from past pandemics have shaped our current disease preparedness and response efforts	Qualitative	Review	Risk Management, promoting public health, community involvement, infrastructure improvement, strengthening International Health Regulation, comprehensive logistics leadership and support, sustainable national investment for preparedness, presenting expert protocols and purposeful preparedness, determination of infection control methods, telehealth, advanced technology, correct criteria for measuring preparedness, simulation, international cooperation, research development and importance to epidemiology are emphasized in this article.	Pay the appropriate fee to the treatment staff Identify possible long-term effects of the epidemic Promoting the links between human, economic and social health
Dalibor Petrović[8] 2020	Explain a better prepared health system of the country, the application of more rigorous measures and interest concerns the existence of performance patterns across European countries.	Mix method	A multiple-criteria decision making approach	Stability of governance and society, promoting public health, community compliance, capacity building, all-society approach, building trust, risk management, legal support, stakeholder participation, information management and increasing system resilience are essential for preparedness.	-
Juliet Nyasulu[21] 2020	To identify priorities, restructure essential services to accommodate physical distancing	Qualitative	Case study	Health system flexibility, logistics, trust building, electronic services, transparency, prioritization of services, information management, flexible services, all government approach, development of protocols, identification of vulnerable communities, Increasing resilience, virtual training and coordination are important factors for preparedness against COVID-19.	Identify priorities, restructure essential services to accommodate physical distancing, promote task shifting at primary level, optimize the use of mobile-/web-based technologies
Andrea RENDA[22] 2020	To argue that the pandemic was predictable, and yet the level of preparedness shown by countries around the world, including most advanced economies, was wildly insufficient.	Qualitative	Review	Information management, determining human resource needs, stakeholder coordination, risk management, social participation, logistics, capacity building, laboratory network development, training, development of infection prevention and control protocols, training and simulation, epidemiology and commissioning and activation of emergency operations centers at national levels, development of research, control of entry borders, strengthening International Health Regulation capacity are emphasized in this article for preparedness.	The lessons learned from these months of lockdown become the foundations of a new approach to risk governance

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Author & year	Aim	Type of study	Design	Finding	Suggestion
Kenneth Timmis[23] 2020	Lessons learned about crisis preparedness and management, and the need for international benchmarking to reduce deficits	Qualitative	Review	Development of laboratory equipment, capacity building, electronic services, long term planning, information management, One-Health approach, logistics, financial support, ongoing research, increasing health literacy, program update, practice and training	Take scientifically-founded pandemic predictions seriously into account in policy elaboration, streamline and institute changes in healthcare systems that impose an evolutionary trajectory that increases coherence, efficiency and preparedness
Algaissi, Abdullah[24] 2020	Review the experience learned during the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) epidemic in Saudi Arabia	Qualitative	Case study	Digital health, extensive information, use of cyberspace, financial support, establishment of a national laboratory, expansion of IPC in hospitals, designation of hospitals ready to receive patients, reform of laws, establishment of a specialized command center, global coordination and participation, improving biosafety development of research	Building biocontainment laboratories
Sanjay Zodpey[25] 2020	To review the global situation, contextualizes India's disease control efforts, and outlines the possible way forward by identifying specific actions	Qualitative	Case study	Determining a national institution with broad powers, laboratory development, determining ready hospitals, capacity building, logistics, information and communication management, stakeholder participation, health promotion, strengthening the care system, identifying high-risk groups, updating guidelines and actions, coordination of national and local governments, community-based monitoring, pharmaceutical research and education	The metrics for the decision-making will have to be developed decisions will have to be driven by data
Evelien Belfroid[5] 2020	To identify and seek consensus from national-level preparedness experts from EU/EEA countries	Mix method	Scoping review and Delphi	Dedicated budget, information management, capacity building, identification of stakeholders, development of laboratory services, development of standards at the national and hospital level, strategy for communication with all stakeholders, preparation of guidelines for public preparation, determination of tools assessing the quality of preparedness, strengthening International Regulation, strengthening the care system and early warning	Providing a framework for development of preparedness evaluation incorporating the recommendations in guidelines assess a country's level of preparedness
Hemin Choi[26] 2020	To describe the major cluster transmissions in SARS-CoV-2 hotspots in South Korea (such as a religious sect, a call center, logistics facilities, and nightclubs)	Qualitative	Case study	Public participation, health promotion, logistics, laboratory network development, trust building, information and communication management, risk management and identifying vulnerable groups	Public health systems should build more capacity, in order to effectively deal with unpredictable new waves of outbreaks

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Author & year	Aim	Type of study	Design	Finding	Suggestion
Godwell Nhamo[27] 2020	To determine the key interventions that made New Zealand one of the unique countries to successfully overcome the COVID-19 pandemic	Qualitative	Case study	Expansion of laboratory network, information and communication management, logistics, all government approach, existence of law, confidence building, characteristics of governance, education and strengthening the care system	Standardizing terminology, communication tools, guidelines, and actionable protocols for practice. Replacing structurally bureaucratic management and low-value interventions with pragmatic local, community-based practice and scientifically sound practice
Ching-Fu Lin[28] 2020	To offer an anatomy of Taiwan's regulatory actions taken in response to the global COVID-19 pandemic	Qualitative	Case study	Existence of law, information management, risk management, trust building, logistics, strong civil society, determining ready hospitals, increasing capacity, prioritizing services, big data technology, electronic health, determining the exact job description, and creating a national disease control network	Revised the CDC Act and relevant regulations provide a well-functioning framework to prepare for and respond to another public health emergency
Emanuele Torri[29] 2020	To provide a general and qualitative perspective on the pandemic response implemented by the Department of Prevention	Qualitative	Case study	Extensive coverage of services, laboratory network expansion, risk management, smart technology, stability of governance, considering the epidemic as a health problem, developing and updating guidelines, identifying injury groups, strengthening the care system, adaptation of regional strategies - accurate determination of job descriptions	Driving and organizing boot-on-the-ground prevention and surveillance to protect vulnerable groups and the general population; Continuing to reshape the public health risk assessment and management system to ensure optimal epidemic response capacity.
Yen, Wei-Ting[30] 2020	To examines the reasons behind Taiwan's effective COVID-19 response	Qualitative	Case study	Characteristics of government, information and communication management, people's cooperation, digital governance, trust building, all-government approach, law protection, people's compliance with laws, e-health, research development, digital literacy of society, community-oriented program, centralized command center, using the opinion of experts, partnership with the private sector	Continuing education and capacity building of public health workers.
Rongxin He[31] 2020	To descript the Belgian COVID-19 responses process according to the WHO's Health Emergency and Disaster Risk Management Framework	Qualitative	Case study	Existence of law, stakeholder participation, risk management, information management, logistics, financial support, formation of a national institution of crisis management, training, structure reform, determining the exact job description, inter-sectoral coordination	Intensive cooperation between stakeholders established based on an existing multi-sectoral emergency organization framework

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Author & year	Aim	Type of study	Design	Finding	Suggestion
Raaj Kishore[32] Biswas MSc 2020	To analyses situation on the pandemic preparedness of Bangladesh	Qualitative	Case study	Strengthen IHR guidelines, risk management, stakeholder analysis, existence of law, information management, efficient supervision, logistics, equitable distribution of resources, health system promotion, development of necessary protocols, community participation, characteristics of governance	Change in health leadership coordination with professional bodies enabling multi-sectorial partnerships appropriate utilization of existing resources
Sunil Kumar Raina[33] 2020	To extract Lessons from COVID-19 and OMAG position paper on epidemic preparedness	Qualitative	Review	Epidemic information service program, flexible services, risk management, law support, health infrastructure, government characteristics, community participation, infection prevention protocols, technology, capacity building, strengthening the care system, formal structure, preparation of a policy document for readiness for epidemic, creation and strengthening of institutional capacities, development of research, decentralization in the implementation of new or existing guidelines, development of training and division of tasks	Awareness on health literacy close monitoring data-driven decision making coordinated efforts from all relevant stakeholders
Amitabha Sarkar[34] 2020	To discuss appropriate plan for epidemic preparedness, strategies for prevention and control measures, and adequate response management mechanism	Qualitative	Situation and policy analysis	Inter-sectoral coordination, cooperation of experts in all fields, use of policy makers in the opinion of experts, epidemiology promotion, Information and communication management, risk management, identification of population and vulnerable areas, laboratory network development, allocation of resources to local authorities, participation society, education, sovereignty coordination and international monopoly	Active participation of the community in the process of governance response epidemiological management of the population with the adoption of mitigation policies
Mishal S Khan[35] 2020	Explain the role of national public health agencies.	Qualitative	Situational analysis	Information management, One-Health approach, strengthening national accountability, strengthening International Health Regulation, Practice and Simulation	Timely, transparent and informative communication of synthesized data from NPHIs will facilitate sustained data sharing with NPHIs from external organizations
Lekhraj Rampal[36] 2020	To describe the epidemiological trends of COVID-19 pandemic across six South-East Asian nations	Qualitative	A real-time consensus review	A strong health system with global health coverage, the approach of the whole government and the whole society, updating the COVID management guide, smartphone application, risk communication, information management, laboratory development, adequacy of infrastructure, hospital preparation, determining the accident commander, determining preparedness indicators, socio-economic resilience and public health vulnerabilities, strengthening the IHR, One Health approach, strong epidemiological work, strong monitoring	Information and scientific evidence sharing, rigorous research in transmission dynamics and possible factors (particularly host and environmental factors) associated with COVID-19 across Medical Association of South East Asian Nations (MASEAN) countries should be accelerated

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Author & year	Aim	Type of study	Design	Finding	Suggestion
GRID COVID-19 Study Group %J BMJ global health[37] 2020	To describe India's response to combat the pandemic during the initial months	Qualitative	Case study	Characteristics of government, existence of Law, creation of emergency fund, increase of laboratory capacity, logistics, information and communication management, technology development, political commitment, internet banking services, online training, electronic health services and research development	International and cross-border collaborations should be enhanced multisectoral and multipronged capacity building initiatives
Zhebin Wang[38] 2020	To examine the health system resilience of selected countries and analyze their strategies and measures in response to the COVID-19 pandemic.	Mix method	Situational analysis	Flexible health system, risk management, financial support, logistics, public participation and communication to build trust, resilient health systems, build sustainable systems for unknown threats, ability to separate threats and maintain performance, strengthening international cooperation and public participation, evaluating the performance of the health system for improvement, appropriate monitoring and feedback system and strengthening the main capacities of the IHR	Health system strengthening and health security efforts should be pursued in tandem, as part of the same mutually reinforcing approach to developing resilient health systems
Riyanti Djalante[39] 2020	Building resilience against biological hazards and pandemics: COVID-19 and its implications for the Sendai Framework	Viewpoint	None	The need for an emergency management and health risk management (Health-EDRM) framework, flexible health systems, integrating disaster risk management into health care delivery, considering a pandemic as a disaster, information management, using artificial intelligence and other new technologies, scientists' participation in social networks and social science interaction, risk management, global protocols, health promotion, further involvement of health sciences with disaster management and early warning systems	Prepare inclusive early recovery plans; Strengthen community-level preparedness and response coupled with laying the essential foundations for rapid and sustained recovery and sustainable development
G. Ippolito[40] 2020	To contribute the development of robust common reference systems, able to coordinate national preparedness plans,	Qualitative	Case study	Development of reliable and more effective cooperation between countries, One-Health approach, development of research, education and training, information management, cooperation of experts and policy makers, establishment and consolidation of national reference centers in the field of infectious diseases with high impact, development and update protocols and programs, standardize and optimize organizational practices, develop laboratory networks, multidisciplinary and interdisciplinary strategies	The establishment of a new European model, with a revamped capability to issue centralized guidance, able to put the health issues at the center of the stage, while fostering a decentralized plans and programmers implementing capacity, adapting them to specific circumstances

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Author & year	Aim	Type of study	Design	Finding	Suggestion
Philip M. Alberti[41] 2020	Argue for a health equity framework to pandemic preparedness	Qualitative	Case study	Strong public health infrastructure, logistics, universal health coverage, smartphone technology, determining essential services, providing fair and fast access to quality health care, extensive preparation of location maps and details of health care providers and clinics, training, standards and safety programs for public transportation, involvement of trusted organizations and community leaders to develop and disseminate messages	Preparedness and downstream rapid response efforts that put social and health equity at the forefront
Karina Furtado Rodrigues[42] 2020	To understand how the National System of Protection and Civil Defense functions in response to COVID-19	Mix method	Theory development	Risk management, logistics, legal support, financial support, use of experiences, appropriate public health system, stability and coordination in decision-making, integrated governance, One-Health approach, flexibility to reduce risk and increase disaster preparedness	The establishment of a network of multidisciplinary health care workers competent in various tasks such as community education and testing, in a multi-disease focused approach
Mauricio Hernández-Ávila[43] 2020	To report lessons learned in Mexican Pandemic Influenza Preparedness and Response Plan	Qualitative	Case study	Utilization of experiences, information and communication management, planning, financial support, sustainable source for support, strengthening laboratory infrastructure, capacity building, development of protocols, international cooperation, establishment of an effective monitoring and detection system	Developing an effective surveillance system; Access to emergency funding Strengthening information systems; Access to life-saving medication
Young Kyung Yoon[44] 2020	To derive suggestions for short-, mid-, and long-term strategies for medical resource management beyond the COVID-19 pandemic	Qualitative	Systematic narrative review	Temporary facilities, capacity building, hospital readiness, logistics, planning for equitable distribution of resources, national and local cooperation, national leadership, research and development, preparation and implementation of a plan to establish national hospitals for infectious diseases in all regions of the country, designing a system for training qualified human resources as medical specialists in epidemics, training personnel to use personal protective equipment and simulation	public health authorities and hospitals should prepare detailed short- and long-term evidence-based pandemic preparedness plans for the large resurgence of COVID-19 nationally, with local or regional epidemics
Gisele Umviligihozo[45] 2020	To assessment Sub-Saharan Africa preparedness and response to the COVID-19 pandemic	Qualitative	Review	Information management, laboratory capacity development, interdepartmental coordination, use of experience, research development, capacity building, training, expansion of social participation, infrastructure improvement, financial support and trust building	Leverage novel medical/research capacity upon the existing structures that were put in place over many decades of fighting other public health threats such as Ebola, HIV, TB and malaria.

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Author & year	Aim	Type of study	Design	Finding	Suggestion
Aengus Collins[46] 2020	To consider the key factors in the eruption of the crisis, as well as the lessons that should be learned from it.	Qualitative	Review	Risk Management, trust building, One Health approach, technology development, flexibility, global emergency fund, capacity building, interaction with People and structure reform	Invest in resilience, sharply restricting air travel as early as possible, science-policy integration, build state capacity, better communication
Nila Larisse Silva de Albuquerque[47] 2020	To compare the content of the Brazilian National Contingency Plan to the WHO guidelines.	Communication	Communication	Logistics, risk management, information and communication management, laboratory capacity development, logistics, maintenance of essential services such as health and water purification, energy supply, food production, national prevention plan, command structure of the emergency Operations Center, development Infection Prevention and Control strategies, mapping vulnerable populations and public and private health centers	-
WHO[48] 2019	To improve public health preparedness and response in the WHO European Region 2018–2023	Qualitative	Plan	Stakeholder participation, risk management, legal support, supervision use of experiences, information and communication management, community participation, strengthening and maintaining infrastructure develop a national program to manage PPE supply, establish screening and triage areas in all health care centers, allocating more flexible budgets, mapping pharmacies and public and private suppliers, increasing the capacity of clinical care according to the epidemiological scenario, providing comprehensive medical, nutritional, psychosocial and palliative care for patients with COVID-19, Pellet Information form and process in the Emergency Operations Center (EOC) to support operations, prepared space, personnel and resources to increase patient care needs, identify trusted community groups to engage, evaluating IPC capacity at all levels of the health care system, training and equipping multidisciplinary (community-based) rapid response teams, vulnerable population mapping - practice and simulation and research development	Building and maintaining States Parties' core capacities required by the IHR strengthening event management and compliance with the requirements under the IHR measuring progress and promoting accountability

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Author & year	Aim	Type of study	Design	Finding	Suggestion
WHO[49] 2020	To explain COVID-19 strategic preparedness and response plan	Qualitative	Plan	Information management, determining human resource needs, stakeholder coordination, risk management, social participation, logistics, capacity building, laboratory network development, training, development of infection prevention and control protocols, training and simulation, interdepartmental coordination, epidemiology and commissioning and activation of emergency operations centers at national levels, development of research, control of entry borders and strengthening IHR capacity	-
Zen Yang Ang[50] 2021	Sharing the Malaysia's lessons and to improve future pandemic preparedness	Qualitative	Case study	Whole of government and whole of society approach, whole nation collaboration, information and risk communication, COVID-19 surveillance, targeted screening approach, digital technology, developing Guidelines	Using the experiences of countries in response to epidemics
Hassane Alami[51] 2021	Describe and discuss the experience of the HSSS in the Canadian province of Quebec in the management of COVID-19 crisis.	Qualitative	Case study	(Re) investing in and strengthening social policies, strengthening the health sector, strengthening public health, implementing a reliable health and social information system, implementing an integrated, functional and efficient telehealth network, promoting inter professional work, inter-disciplinary, and inter-sectoral in workforce training, promoting the health and well-being of health care providers, ensuring better drugs and medical equipment production capacities, promoting pluralistic governance and adaptive leadership, strengthening independence and agility of knowledge based agencies, improving communication and trust in government and institutions	To identify the capacities and conditions that are essential for HSSS to be able to prevent, detect and respond in a timely and effective manner to future health crises, conduct a comparative research and analyses integrated into mutual learning processes, as well as genuine policy discussions on the management of the COVID-19 crisis in different countries

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Author & year	Aim	Type of study	Design	Finding	Suggestion
Sudhvir Singh[52] 2021	Resetting international systems for pandemic preparedness and response	Qualitative	Panel	Strengthening of International Health Regulations, international financial support, established effective multisectoral coordination, surveillance system, effective national coordination, strengthening WHO	Pandemic threat should be elevated to the highest leadership level and pandemic preparedness and response treated as the responsibility of the whole of government and society; Stronger leadership and better coordination are needed at national, regional, and international levels; paying attention to the impact of inequalities, , update national preparedness plans against the targets; Create an International Pandemic Financing Facility, Prioritize epidemics
Victoria Haldane[53] 2021	How countries can strengthen national pandemic preparedness and response systems	Mixed method	Review and Semi-structured interview	Whole-of-government approach, engaging with communities, participating in purchasing partnerships to secure resources, Previous partnerships with communities leveraged for outbreak response and risk communications, use the views of experts to form inter-sectoral committees, transparent and accountable partnership with the private sector, active case tracing strategies, social supports, establish mechanisms for monitoring and evaluations at country level, accountability, build resilient health and social protection systems, conduct multisectoral active simulation exercises, targeted and long-term social protection of vulnerable populations should be integral to a whole-of-society approach	Apply public health and social measures systematically, comprehensively, and with community partnership, strengthen the engagement of local communities as key actors in pandemic preparedness, building a resilient society and health system, universal health coverage, invest in biomedical, public health, and social sciences research
Akin Abayomi[54] 2021	Describes how the lessons learned from the Ebola outbreak in 2014 informed the emergency preparedness of the State ahead of the COVID-19 outbreak and guided response in Nigeria	Qualitative	Case study	Use of lesson learned, strengthening of surveillance, early warning and information management, infection and prevention and control, coordination and communication, social support, Logistics, rapid response teams, a technical and multi-disciplinary team, risk management, One- Health approach, expansion of laboratory network, financial support, training,	To expand its preparedness to be more resilient and future proof to respond to disease outbreaks; Lessons and identified best practices from the past and present should be shared with other states and countries

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Author & year	Aim	Type of study	Design	Finding	Suggestion
Hanaa Abu El Sood[55] 2021	Review and discuss the preventive and control measures that have been implemented by the Egyptian MOH in response to the COVID-19 pandemic and to share Egypt's experience with public health practitioners and authorities to enable better response to such events in the future	Mixed method	Case study	Crisis management, enhancing surveillance systems and contact tracing, Case and hospital management, raising community awareness, quarantine and entry points, multi sectoral coordination, enhancing surveillance systems, expansion of laboratory network, contact tracing,	Cooperation of all departments in disease control and evaluation of activities performed after the pandemic
Badu Sarkodie[56] 2021	Provide an overview of preparedness and response to COVID-19 pandemic in Ghana over the period January to December 2020.	Qualitative	Case study	Logistics and infrastructure development, general and specialized education, public and stakeholder participation, infection prevention and control, information and communication management, revision of emergency preparedness and response plans, formation of technical, emergency committees and rapid response teams, participation of all organizations with definition of responsibilities, case management and risk communication, existence of legal and political framework, risk communication, social mobilization, development of clinical guidelines and protocols, development of infrastructure to maintain suspicious cases and isolation of approved cases in all health centers, partnership and cooperation with the private sector	Pandemic management and complex public health emergencies require multiple disciplines, sectors, and government apparatus. Additionally, good governance and leadership are crucial for effective, efficient, and successful management of pandemics and other complex public health emergencies
Minh Van Hoang[57] 2021	Examination the COVID-19 preparedness and responses of the Hanoi primary healthcare system and identified enabling factors and barriers to implementation	Mixed methods	Case study	Community preparedness, emergency operations coordination, emergency public information and warnings, information sharing, care and support for cases or isolated cases, laboratory testing, surveillance and epidemiological survey, volunteer management	Further coordinated efforts such as evaluation, coordination, communication, and volunteer management are required for more efficient COVID-19 preparedness and response

documenting and having a national source of information and laws, lessons learned, past national and international experiences, as well as other aspects of information and communication management are included in the preparation stage.[3,5,8,9,17,18,20-27,31,33,35-37,39,41,43,44,46,47,49,50,54] Identifying, training, and appointing spokespersons, guiding and raising awareness about public and social health practices, identifying trusted community groups (such as local influencers like religious leaders, health workers, community volunteers) and local networks to interact with them are also included and should be done in the preparation phase.[49]

Logistics

In most papers, logistics and support are mentioned as one of the key responsibilities of the government and they can be divided into three categories: economic and financial support, human and equipment resources, and increasing capacity and access. Sustainable national investment, a dedicated budget, and the creation of an emergency fund for an epidemic are surefire ways to finance for pandemic preparedness.[5,9,23,36,38,46,52] To provide equipment, financial support from industries and researchers for localization of medical equipment and equipment production due to the extraordinary

need for medical equipment such as oxygen generators and ventilators and personal protective equipment that cannot be provided by medical equipment companies alone are necessary.[9,18,23,25,33,44,51,53,54,56] Moreover, creation of flexible supply chain networks and the existence of a strategic warehouse for medical equipment and personal protective equipment should be considered at this stage.[9,21,25,29,30] Provision of work force[9,21,25,31,37,42,44,48,49] expansion of the laboratory network, and the establishment of a national laboratory are other necessary measures that must be followed in the preparation phase.[5,18,23–27,29,33,36,37,43,47,49,54,55,57] Grounding for the continuation of services and supply of essential needs like food, energy, and water should be done in coordination with agencies and UN partners, in addition to design and implementation of efficient systems for public assistance and social services.[21,41,47–49] Fair and prompt access to health care equipment and supplies by reviewing and preparing maps of all health service delivery centers and developing a national plan for managing the supply of personal protective equipment are other responsibilities of the government for preparation.[9,26,28,38,41,43,44] The development of efficient and dynamic business models for business continuity due to the closure of many activities during the pandemic and the availability of safe transportation has been mentioned too.[3,18,34,41]

Research and technology development

Technology forces governments to pursue new ideas at the time of threats, given the speed of change.[34]

Advanced technology, big data, intelligent technology, and artificial intelligence (AI) are the requirements for preparing for pandemics such as COVID-19, imposing many restrictions on activities and face-to-face visits to receive services.[3,9,17,18,21,23,28,29,33,36,37,39,46] Artificial intelligence and machine learning can be employed to understand patterns of disease progression and provide early warning or preventive measures based on the data entered into the system. An example of this initiative can be seen among the countries of South Asia where digital immunization data, health care bills, and medical prescriptions to reduce travel and access to health care are generated at home.[18] By creating a smartphone application, digital governance allows the detection and tracing of viruses and the route of transmission, as well as monitoring and other services.[17,30,37,41,50] Electronic banking, financial technologies, and capacity building for online services should also be provided in the preparation phase.[21,37,41,43]

The need to improve research to identify viruses, mutations, drugs, and enable vaccine production, and diagnostic methods has been emphasized in papers as an important step in preparation.[9,18,24,25,30,33,37,44,48,49] Epidemiological research, the development of the National Center for Infectious Diseases and the formation of the Research Council should also be considered since they play a special role in the preparation phase.[36,57]

Education

Training including community education,[3,5,9,20,21,31,33,37,44,48,49,56] hygiene and infection control in medical settings through general and specific educational instructions[9,20,25,36,42,44,48,49] as well as practice and simulation in the preparation stage have been emphasized in major papers.[5,20,23,35,44,48,49,53] On the other hand, promoting the education of the vulnerable and uneducated population to comply with health protocols in the form of daily actions using infographic content, brochures, videos, and advertisements is another important aspect of preparedness.[18,51,53,54]

Evaluation and monitoring

According to the findings of the papers, without assessment of preparedness, we cannot be sure that the measures taken are effective in the response phase. Determining the criteria for measuring and measuring the quality of preparedness by considering international indicators and establishing a monitoring and feedback system are other important responsibilities at the preparation stage.[5,9,22,23,36,38,43,48,49,53]

Rules and regulations

Data suggests that the existence of a law for national emergencies and its review and legal protection of the requirements of the preparedness program are necessary.[8,17,20,22,24,27,28,30,31,33,37,42,48,56] Moreover, extensive powers in the highest levels of government for planning and decision-making, existence of a strong national institution, consideration of a pandemic as a national security issue, formation of a national health protection committee with the membership of all health authorities, and a common understanding between leaders, policymakers, and scientists are required. Delegation of authority from the national level to the local level plays a significant role in the implementation of preparedness programs.[8,22,25,37,46,53,54,56] In the reviewed studies, as an essential infrastructure, universal health coverage means access to the required quality of health services for all members of society without imposing financial problems,[48] and continuous improvement of public health, strengthening of the syndromic care system, international health regulations, and justice in health are factors for preparing the community for an effective response to COVID-19.[3,8,9,18,20,25,26,29,36,38,41,50-52,54,55,57]

Society

Society is another component of paper-based preparation. The culture and resilience of the community plays a key role in pandemic preparedness. Implementation of

preparedness programs will not be possible without the cooperation of society.

Social culture plays a significant role in the fight against COVID-19. Traditional, rooted culture is a factor in following social rules and complying with moral standards. In such societies, people, by adhering to ethical standards, collective participation, and responsibility while respecting citizenship rights, have helped the government prepare for and respond to the COVID-19 pandemic, and actively and spontaneously joined emergency management against the epidemic.[3,8,9,17,18,20,26,30,33,35,36,38,41,47,49,51,53,54,56,57] On the other hand, according to the reviewed papers, the resilient community is much more prepared to deal with the COVID-19 pandemic.[38,39,53,55] An educated society, their digital literacy, trust, and belief in governance are important signs of resilience, and through trust, a resilient society has extensive cooperation with the government that can improve its response to COVID-19.[8,17,18,21,23,26-28,30,36,38,46] Development of communication strategies should be based on behavioral models of society and considering that people's behavior plays a key role in controlling the disease, people in society show different behaviors based on information and trust.[12,51,53]

Services

Managed, technology-based services and ready-to-provide health centers are other important components of preparedness. During the COVID-19 pandemic, the way of delivery of many services changed. Consequently, the papers reviewed in this study showed flexibility in providing services, compiling and updating the COVID-19 management guide, determining essential services, prioritizing services, and integrating some services, besides the cooperation of specialists in various fields of medicine in providing services to cover the services required for COVID-19 patients and non-patients is essential.[9,20-22,25,29,33,36,38,39,41,43,44,46,50,53]

In the current generation, the digitalization of health care is essential since social media and smartphones are an integral part of everyday life messages and news that can be transmitted quickly so that everyone is aware of the problems.[18] Furthermore, providing e-health services, medical consultations and telemedicine services, and the development of digital care are due to the limited number of face-to-face visits to health centers, especially among at-risk individuals such as the elderly, special patients, and vulnerable populations. A pandemic must be provided with the possibility of using robots in medical centers to help the medical staff in the preparation phase.[3,9,18,23,24,28,30,37,51] Having a shared platform or web-based service with health organizations around the world may enable immediate updates of clinical signs and features.[18]

Other pillars of services are health centers, which must be prepared to provide services, prepare a complete and comprehensive map of medical centers and information for access.[41,47,48] Creation of screening and triage areas in all health service centers,[48,56,57] development and expansion of infection control standards at the national and hospital level,[9,33,36,47,49,54,56] establishment of special centers for scientific counseling for infectious diseases,[20] establishment of national hospitals for infectious diseases,[44] increasing the capacity of clinical care according to the epidemiological scenario, the existence of centers for comprehensive medical, nutritional, psychosocial and palliative care for patients with COVID-19 and the establishment of long-term and temporary health care centers have been mentioned in the studies.[5,9,21,24,25,33,43,48,49]

Two years after the COVID-19 pandemic, some countries are still unprepared; therefore, a comprehensive understanding of the components of preparedness is necessary to respond to subsequent pandemics and no systematic review has been conducted to identify these components. The present study has identified these components by systematic review and reviewing the actions of different countries. Unfortunately, the main studies on COVID-19 preparedness are few and many papers are available concerning the review and gray papers. Preparation and response measures, on the other hand, are not well separated.

Conclusion

The world has experienced three pandemics in this century, among which COVID-19 has opened a new window in terms of pandemic management with its unique features, particularly in terms of preparedness to deal with such crises. Given the severity and extent of the effects of the pandemic, there is a need to look at it as a crisis and plan to use all the country's capacity to manage it.

Given the socioeconomic conditions of the country as well as the impact of international sanctions, the best way to manage epidemics and reduce the financial and human burden on the health system is to be prepared for crises. Therefore, legal protections, crisis structure reform, strengthening the health system infrastructure, surveillance system, using advanced technologies to provide all services, rapid alert system, and strengthening communications should be considered by policymakers.

Stakeholders' analysis and the approach of the whole government and the society along with explaining the

description of duties, responsibilities, coordination, and cooperation between all organizations are all necessary for planning and implementing programs. On the other hand, people's participation through the use of information networks, education, promotion of public health literacy, and building trust and resilience play a key role in supporting the society in implementing the instructions and preparing for pandemics. Obviously, evaluation and monitoring the countries' preparedness before crises will lead to effective responses.

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Conflicts of interest

There are no conflicts of interest.

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