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Prioritization of health emergency research and disaster preparedness: a systematic assessment of the coronavirus disease 2019 pandemic*

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1. Introduction

The current coronavirus disease 2019 (COVID-19) outbreak that suddenly spread from China to the other parts of the world has become a center of attention to the research world, scientists, government agencies, nongovernmental organizations, and individuals. Large behavioral, health, and state measures were undertaken to alleviate the outbreak and prevent the virus from persisting in the human population in China and around the world. However, the efforts to mitigate or reduce the spatial distribution of the virus have become mirage. How these unprecedented interventions, including travel restrictions, had affected by COVID-19 spread in our world remains unclear and to be

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absolute concerns to the world leaders and the research community. In the past few days in the year 2019, the world witnessed the appearance of a new human pathogen that has achieved the requisite zoonotic spillover to cause an epidemic, a third highly pathogenic betacoronavirus [1]. COVID-19 is a new member of a community that includes previously known zoonotic pathogens such as severe acute respiratory syndrome coronavirus (SARS-CoV), which triggered epidemics in China in 2002–03, and Middle East respiratory syndrome coronavirus (MERS-CoV), which affected Saudi Arabia and neighboring nations between the year 2012 and 2013.

Today, 200 countries and territories around the world and 2 international conveyances, namely, Holland America’s MS Zaandam cruise ship and the Diamond Princess cruise ship harbored in Yokohama, Japan, have been affected by this pandemic. Numerous etiologic studies have been conducted to find out the detailed biological features of COVID-19. Following the global outbreak and spread of the virus, the World Health Organization (WHO) on January 11, 2020 announced the outbreak of the COVID-19 as the sixth major public health emergency in the world [2]. Therefore to avoid the spread of this new coronavirus around the world, there is a need for cooperation between healthcare workers and decision-makers, research scientists, governments, and the public. This has also suggested that all the subjects potentially exposed to this hazard should be isolated for 14 days and that isolation is the safest way to control this epidemic.

To enhance and establish the diagnosis, treatment, and preventive strategies against this viral infection, extracting knowledge from basic and clinical research relevant to COVID-19 may be crucial. A great number of epidemiologic and clinical data have been published, and much work has also been done in combating this disaster. These studies were retrieved from the scientific database for easy visualization and research trend on this pandemic using bibliometric techniques. Bibliometric analysis is a method of investigating scientific achievements in a particular field of science through secondary analysis of the knowledge of published articles; hence, it can help researchers appreciate the earlier and existing knowledge on COVID-19 efficiently and predict and choose forthcoming advance directions, research evolution, and possible future research plans [3,4]. In this chapter, we report on the research trend on COVID-19 between January 2020 and March 2020 and the research evolution and response to the health emergency of the ongoing COVID-19 global pandemic, pursuant to prioritizing health emergency and disaster preparedness for COVID-19.

The remaining sections of the chapter are organized to provide an overview of COVID-19 data retrieval from data sources, data treatment or normalization, data analytics for productivity indices, intellectual domain, conceptual framework collaboration, and/science mapping of COVID-19 research landscape. This chapter also presents sections that explain the results of the analysis as well as discuss the implications of the results. It concludes with the key findings of the study and recommends future prospects for health emergency research and disaster preparedness.
1.1 Methods

1.1.1 COVID-19 data sources

We have an interest in information/research evolution and response to health emergency using COVID-19 as an ongoing global pandemic. For this purpose, we retrieved COVID-19-related documents from the Scopus database and the Web of Science (WoS) core collections from January 01, 2020, to March 23, 2020 (19:39:27 GMT+2) according to the modified method of the “Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)” [5]. No exclusion criteria were considered in order to map the various information and research response to COVID-19 pandemic from vast research landscapes. The databases searched were as follows:

1. Scopus: TITLE-ABS-KEY (COVID-19 OR coronavir*) AND PUBYEAR > 2019
2. Web of Science Core Collection: TOPIC: (COVID-19 or coronavir*) Timespan: 2020. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC. The search protocol and data treatment are presented in Fig. 24.1. Data were downloaded as tab-delimited (Win, UTF-8), BibTeX (bib), and comma-separated (CSV Excel) file formats for preanalytic treatments.

2. Data analytics

Data retrieved from the two databases were combined, de-duplicated, and normalized for bibliometric attributes such as authors’ names, affiliations (institutions, country), article source, and keyword synonymic forms. The normalized data were analyzed for descriptive performance indices/rates in terms of documents, authors, productivity, journal source, institution, country, total citations, intellectual domain, and collaboration index. We mapped the most cited documents related to the COVID-19 pandemic and identified the conceptual framework through multidimensional scaling analysis of author-keywords co-occurrences [3].

3. Evaluation of collaboration network in health emergency research

Collaboration networking during health emergencies is necessary for various reasons, for instance, to pool inadequate resources together to achieve desired results, for intellectual and knowledge sharing, and for technical know-how and skill transfer required to halt health emergencies such as outbreaks and pandemics. For this study, we assessed collaboration regarding efforts channelled toward combating ongoing COVID-19 pandemic from the author-, institution-, and country-wise. In all cases, the network
has a simple bipartite vector form typical of authors $\times$ Articles, institutions $\times$ Articles, and countries $\times$ Articles. Mathematically,

\[ \text{Collaboration, Network} = C \times C^T \]
where Network is a symmetrical matrix \((C = C^T)\) and \(C\) is a bipartite network matrix. The edges/nodes of the network imply authors/institutions/countries and the associated curves the basis/means of collaboration among the nations. The network visual presentation was according to the Jaccard’s similarity index normalized Fruchterman force-directed layout [6].

4. Analytic platforms
The open ware analytic platforms of R and python were employed in this study. Data analysis was done based on the integrated usage of the bibliometrix package in Rstudio v.3.6.2, ScientoPy package, and Excel 2016 [7,8].

5. Results
This research systematically analyzed the distribution of the articles, stratified by geography, organization, journals, relevant sources, and more. This study also analyzed keyword frequency and then used bibliometric mapping methods to illustrate research trend and evolution on COVID-19. Results were examined to better clarify this field’s structure and research hotspot and trends in COVID-19 study and the need for health emergency research and disaster preparedness prioritization. This study also provides information on most influential themes and keywords to develop elated themes of research on COVID-19. The evidence presented in this study demand that utmost caution should be observed in interpreting bibliometric dataset of global research on COVID-19 based on the limited number of databases consulted. The information in Tables 24.1 and 24.2 present the research information and the hierarchy of languages used in COVID-19 pandemic research communication between January and March 2020 with a total number of 12 languages. The English language ranked first with about 96.45% (788 out of 817) of published articles on COVID-19 followed by Chinese with about 9 articles (1.1%) that published research on COVID-19 during the same period. German, French, and English-French ranked third, fourth, and fifth with the total number of articles of 7, 3, and 2, respectively. More so, Dutch, Croatian, English-Norwegian, Icelandic, Norwegian, and Spanish ranked fifth with one article each published on COVID-19 during the same period. The total documents published on COVID-19 were 817 research-related articles, 3028 authors, 4677 author appearances, 125 single-authored documents, and 2903 multiple-authored documents. Different research document types were evaluated, which include articles (341); article, book chapter (1); article, early access (31); book chapter (13); correction (6); data paper (1); editorial (31); and other document types on COVID-19 during the period of investigation (Table 24.1). COVID-19 research witnessed a collaboration index of 4.71 within the short period.
Table 24.1  Main Information about CoVid-19 pandemic from 01/01/2020 to March 23, 2020.

| Feature                                           | Count/rate |
|---------------------------------------------------|------------|
| Documents                                         | 817        |
| Sources (journals, books, etc.)                   | 335        |
| Keywords plus (id)                                | 2142       |
| Author’s keywords (de)                            | 1180       |
| Average citations per documents                    | 1.005      |
| Authors                                           | 3028       |
| Author appearances                                | 4677       |
| Authors of single-authored documents              | 125        |
| Authors of multiauthored documents                | 2903       |
| Single-authored documents                         | 201        |
| Documents per author                              | 0.27       |
| Authors per document                              | 3.71       |
| Coauthors per documents                           | 5.72       |
| Collaboration index                               | 4.71       |

**Document types**

| Document Type                          | Count |
|----------------------------------------|-------|
| Article                                | 341   |
| Article, book chapter                  | 1     |
| Article, early access                  | 31    |
| Book chapter                           | 13    |
| Correction                             | 6     |
| Data paper                             | 1     |
| Editorial                              | 51    |
| Editorial material                     | 76    |
| Editorial material, early access       | 22    |
| Erratum                                | 9     |
| Letter                                 | 69    |
| Letter, early access                   | 9     |
| News item                              | 48    |
| Note                                   | 74    |
| Reprint                                | 1     |
| Review                                 | 49    |
| Review, early access                   | 11    |
| Short survey                           | 5     |

Table 24.3 presents the most productive authors on COVID-19; it shows the top 20 authors who have published on COVID-19 and their percentages. The growth of the top productive authors was evaluated based on the number of articles shares in the total number of documents from January to March 2020. It reveals that Wang Y., Li Y., Na N.
Table 24.2 Language of publication of COVID-19 research and information from 01/01/2020 to 23/03/2020.

| Language         | Frequency | % of 817 |
|------------------|-----------|----------|
| Chinese          | 9         | 1.10     |
| Croatian         | 1         | 0.12     |
| Dutch            | 1         | 0.12     |
| English          | 788       | 96.45    |
| English, French  | 2         | 0.24     |
| English, Norwegian| 1        | 0.12     |
| English, Spanish | 2         | 0.24     |
| French           | 3         | 0.37     |
| German           | 7         | 0.86     |
| Icelandic        | 1         | 0.12     |
| Norwegian        | 1         | 0.12     |
| Spanish          | 1         | 0.12     |

Table 24.3 Most productive authors of COVID-19 research and information from 01/01/2020, to 23/03/2020.

| R | Authors     | Articles | % of 817 |
|---|-------------|----------|----------|
| 1 | Wang Y.     | 29       | 3.55     |
| 2 | Li Y.       | 24       | 2.94     |
| 3 | Na N.       | 21       | 2.57     |
| 4 | Chen Y.     | 19       | 2.33     |
| 5 | Wang X.     | 19       | 2.33     |
| 6 | Mahase E.   | 18       | 2.20     |
| 7 | Li X.       | 17       | 2.08     |
| 8 | Wang W.     | 17       | 2.08     |
| 9 | Zhang L.    | 17       | 2.08     |
| 10| Li J.       | 16       | 1.96     |
| 11| Zhang J.    | 16       | 1.96     |
| 12| Wang L.     | 15       | 1.84     |
| 13| Yang Y.     | 15       | 1.84     |
| 14| Shi Z.      | 14       | 1.71     |
| 15| Wang J.     | 14       | 1.71     |
| 16| Chen J.     | 13       | 1.59     |
| 17| Zhang Y.    | 13       | 1.59     |
| 18| Liu Y.      | 11       | 1.35     |
| 19| Memish Z.   | 11       | 1.35     |
| 20| Wang M.     | 11       | 1.35     |
and Chen Y., and Wang X. ranked first, second, third, and fourth among the most productive authors in the area of COVID-19, with 29 (3.55%), 24 (2.94%), 21 (2.57%), and 19 (2.33%) articles, respectively. Mahase E. ranked fifth with about 18 (2.2%) articles; Li X., Wang W., and Zhang L. ranked sixth with 17 (2.08%) articles each; and Li J. ranked seventh with about 16 (1.9%) articles on COVID-19 during the same period.

More so, the discipline-based COVID-19 research and information is presented in Table 24.4. Among all the disciplines evaluated, virology and microbiology ranked first and second with published research of about 40 (5 h-index) and 27 (2 h-index) articles, respectively. While immunology, infectious diseases, veterinary sciences, general and internal medicine, and pharmacology and pharmacy ranked third, fourth, fifth, sixth, and seventh with about 22 (2 h-index), 21 (3 h-index), 15 (1 h-index), 14 (6 h-index), and 11 (1 h-index) articles, respectively. These are the most influential or the most productive fields in COVID-19-related studies between January and March 2020.

The contribution of various nations toward research aimed at this pandemic based on published articles is investigated in this study. The global distribution of scientific articles indirectly informed health emergency research tailored toward COVID-19 and may overlap with availability/advancement of analytical tools and the capacity of researchers from various nations in both developed and developing countries [9]. Among the top countries, China and the United States of America ranked first and second in the most productive countries, with a total of 181 and 69 published articles, accounting for about 22.15% and 8.45% of the total articles, respectively, published on COVID-19 within the

| Table 24.4 | Discipline-based COVID-19 research and information from 01/01/2020, to 23/03/2020. |
|-------------|---------------------------------|
| **Subject** | **Documents** | **h-index** |
| Virology    | 40                | 5            |
| Microbiology| 27                | 2            |
| Immunology  | 22                | 2            |
| Infectious Diseases | 21          | 3            |
| Veterinary Sciences | 15      | 1            |
| General & Internal Medicine | 14    | 6            |
| Pharmacology & Pharmacy | 11     | 1            |
| Biochemistry & Molecular Biology | 9        | 1            |
| Research & Experimental Medicine | 8        | 1            |
| Public, Environmental, & Occupational Health | 7     | 1            |
| Oncology    | 5                 | 1            |
| Biotechnology & Applied Microbiology | 4     | 0            |
| Cell Biology | 4                 | 0            |
| Tropical Medicine | 3       | 0            |
| Chemistry   | 2                 | 0            |
| Dentistry, Oral Surgery, & Medicine | 2       | 0            |
| Environmental Sciences & Ecology | 2       | 0            |
survey period (Table 24.5). The United Kingdom, Korea, Italy, Germany, and Saudi Arabia ranked third, fourth, fifth, and sixth with about 28 (3.43%), 24 (2.94%), 18 (2.2%), 15 (1.84%), and 15 (1.84%) articles, respectively.

Furthermore, China has the highest single-country authors and multiple-country authors of about 145 (17.75%) and 36 (4.41%), respectively. The United States, the United Kingdom, Korea, and Italy ranked second, third, fourth, and fifth with about 61 (7.47%), 23 (2.82%), 21 (2.57%), and 15 (1.84%) single-country authors, respectively. Other information on most productive countries on COVID-19 are presented in Table 24.5; readers may refer to the information in Table 24.5. High research outputs from China, the United States, the United Kingdom, and Korea may be attributed to the fact that they are the most affected countries by this pandemic as well as the countries with funding available for research on COVID-19. Also, the world leaders and research scientists are looking for a solution for the pandemic, which might trigger the need for research on the pandemic [10,11].

### Table 24.5  Country productivity based on corresponding author’s countries of COVID-19 research and information from 01/01/2020, to 23/03/2020.

| Rp | Country         | Articles | % of 817 | Freq (%) | SCAs | SCA% of 817 | MCAs | % of 817 |
|----|----------------|----------|----------|----------|------|-------------|------|----------|
| 1  | China          | 181      | 22.15    | 36.49    | 145  | 17.75       | 36   | 4.41     |
| 2  | The United States | 69       | 8.45     | 13.91    | 61   | 7.47        | 8    | 0.98     |
| 3  | The United Kingdom | 28      | 3.43     | 5.65     | 23   | 2.82        | 5    | 0.61     |
| 4  | Korea          | 24       | 2.94     | 4.84     | 21   | 2.57        | 3    | 0.37     |
| 5  | Italy          | 18       | 2.20     | 3.63     | 15   | 1.84        | 3    | 0.37     |
| 6  | Germany        | 15       | 1.84     | 3.02     | 10   | 1.22        | 5    | 0.61     |
| 7  | Saudi Arabia   | 15       | 1.84     | 3.02     | 10   | 1.22        | 5    | 0.61     |
| 8  | France         | 12       | 1.47     | 2.42     | 8    | 0.98        | 4    | 0.49     |
| 9  | Switzerland    | 12       | 1.47     | 2.42     | 11   | 1.35        | 1    | 0.12     |
| 10 | Canada         | 11       | 1.35     | 2.22     | 4    | 0.49        | 7    | 0.86     |
| 11 | Singapore      | 11       | 1.35     | 2.22     | 11   | 1.35        | 0    | 0.00     |
| 12 | Japan          | 9        | 1.10     | 1.82     | 8    | 0.98        | 1    | 0.12     |
| 13 | Netherlands    | 9        | 1.10     | 1.82     | 3    | 0.37        | 6    | 0.73     |
| 14 | Taiwan         | 8        | 0.98     | 1.61     | 7    | 0.86        | 1    | 0.12     |
| 15 | Spain          | 7        | 0.86     | 1.41     | 6    | 0.73        | 1    | 0.12     |
| 16 | India          | 6        | 0.73     | 1.21     | 5    | 0.61        | 1    | 0.12     |
| 17 | Hong Kong      | 5        | 0.61     | 1.01     | 5    | 0.61        | 0    | 0.00     |
| 18 | Sweden         | 5        | 0.61     | 1.01     | 5    | 0.61        | 0    | 0.00     |
| 19 | Thailand       | 5        | 0.61     | 1.01     | 2    | 0.24        | 3    | 0.37     |
| 20 | Australia      | 4        | 0.49     | 0.81     | 2    | 0.24        | 2    | 0.24     |
| 21 | Brazil         | 4        | 0.49     | 0.81     | 4    | 0.49        | 0    | 0.00     |
| 22 | Finland        | 4        | 0.49     | 0.81     | 3    | 0.37        | 1    | 0.12     |
| 23 | Portugal       | 4        | 0.49     | 0.81     | 1    | 0.12        | 3    | 0.37     |

Freq, frequency of publication; MCAs, multiple-country articles; Rp, rank in terms of articles; SCAs, single-country articles.
The information in Fig. 24.2 presents country collaboration networks on COVID-19 research during the period of the survey. The function estimates and good-of-fit show that the output on COVID-19 research evolved in the past few months of its spread. In addition to the effects on human health, COVID-19 can wreak havoc on the global economy, which can linger with continuous adverse impact on the development and other global environments, which is likely accounting for the increased number of articles related to the research on COVID-19 and with a possible increase in the nearest future [12,13]. The result from this study reveals that China, the United States, the United Kingdom, Saudi Arabia, Germany, Switzerland, Canada, and Italy ranked first, second, third, fourth, fifth, sixth, seventh, and eighth, respectively, in terms of collaboration on COVID-19 research during the study period. Other countries including Japan, Sweden, Netherlands, Nigeria, Thailand, and South Africa are also identified for their collaboration studies on this pandemic between January and March 2020. This study also reveals that the top collaborative nations are the countries that this pandemic affected most, especially in the first 2 months when COVID-19 started, while few studies are from countries recently hit by the pandemic, including Croatia, Austria, Tanzania, Sudan, New Zealand, Russia, and Chile, among other nations.

Authors from China, the United States, the United Kingdom, Germany, and Korea ranked first, second, third, fourth and fifth with about 498, 71, 17, 14, and 9 citations, respectively (Table 24.6). High research outputs and citations received by these nations are attributed to the fact that these regions of the world were seriously affected by the
pandemic, especially in the area of disease monitoring and control as well as in searching for a way out of its spatial distribution and infection [14–16]. This might have also encouraged researchers in the area to focus on the cure for COVID-19, which might have influenced research on COVID-19, yielding more research output on the mode of transmission, the most vulnerable age groups, and other genetics-related uses around the pandemic, as well as mitigation with possibly more publications will emanate from this country on COVID-19-related issues [14,16,17]. The information in S1 Table reveals the top 10 manuscripts per citations of COVID-19 research during the survey period. The paper titles and fundamental information provided about the pandemic include “Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China”, “China novel coronavirus investigating and research team. a novel coronavirus from patients with pneumonia in China, 2019”, “A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster”, “Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China”, “A pneumonia outbreak associated with a new coronavirus of probable bat origin”, “Epidemiological and clinical

| Post | Country               | Total citations | Mean article citations |
|------|-----------------------|-----------------|------------------------|
| 1    | China                 | 498             | 2.751                  |
| 2    | The United States     | 71              | 1.029                  |
| 3    | The United Kingdom    | 17              | 0.607                  |
| 4    | Germany               | 14              | 0.933                  |
| 5    | Korea                 | 9               | 0.375                  |
| 6    | Netherlands           | 8               | 0.889                  |
| 7    | Japan                 | 5               | 0.556                  |
| 8    | Taiwan                | 5               | 0.625                  |
| 9    | Finland               | 4               | 1                      |
| 10   | Saudi Arabia          | 4               | 0.267                  |
| 11   | Switzerland           | 4               | 0.333                  |
| 12   | Canada                | 3               | 0.273                  |
| 13   | Ethiopia              | 3               | 1.5                    |
| 14   | Italy                 | 3               | 0.167                  |
| 15   | France                | 2               | 0.167                  |
| 16   | Greece                | 2               | 2                      |
| 17   | Singapore             | 2               | 0.182                  |
| 18   | Argentina             | 1               | 1                      |
| 19   | Colombia              | 1               | 0.5                    |
| 20   | Egypt                 | 1               | 0.5                    |
| 21   | Malaysia              | 1               | 1                      |
| 22   | Spain                 | 1               | 0.143                  |
| 23   | Thailand              | 1               | 0.2                    |
characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study”, “First case of 2019 novel coronavirus in the United States”, “Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding”, “A novel coronavirus outbreak of global health concern”, and “The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health - The latest 2019 novel coronavirus outbreak in Wuhan, China.”

Table 24.7 presents the most influential and relevant sources of research on COVID-19 between January and March 2020. The result from the study reveals the top journals or sources with the most published research articles on COVID-19-related studies. These relevant sources cover a range of subjects in their respective articles. The Lancet and the Journal of Medical Virology ranked first and second with about 38 (4.65%) and 32 (3.92%)
articles on COVID-19, respectively. *BMJ, Nature, Lancet, Eurosurveillance,* and *Chemical and Engineering News* ranked third, fourth, fifth, sixth, and seventh with about 31 (3.79%), 30 (3.67%), 17 (2.08%), 15 (1.84%), and 13 (1.59%) articles, respectively. Other relevant sources on COVID research and their respective statistics are presented in Table 24.7.

Fig. 24.3 presents Lotka’s model of scientific productivity on COVID-19 during the survey period. Lotka’s model presents the frequency of authors’ publications in a specified field. It shows authors making contributions in the field and the ratio of all contributors who make one contribution in the field with a significant percentage [18,19]. The estimated value of n for the dataset is calculated using Lotka’s model. The Beta value in COVID-19 is 2.44 for all author data, which provides the best fitting value for the dataset. Fig. 24.3 shows the log-transformed Lotka’s model plot with a P-value, R², Beta coefficient, and constant C of 0.02, 0.97, 2.44, and 0.58, respectively. P-value is the number of authors producing n papers and C is a constant characteristic of a particular subject area. Other statistics about the collaboration network in COVID-19 research and information is presented in S2. Basically, the network diameter 6 and 4 showed that the collaboration based on authors’ coupling and country is typical of acquaintanceship.

The top author’s coupling cluster is presented in Fig. 24.4; this explains the author’s coupling on COVID-19-related research during the period of study. Other pointers of
concepts and frameworks often related to COVID-19 could be detected via country collaboration (Fig. 24.2), conceptual framework (S1 Figure), and co-occurrence of terms and keywords (Fig. 24.4). Bibliographic coupling exists when two publications co-reference a third document in their contents. It indicates a probability that the two documents present a related subject matter. Two documents are scientometrically coupled when they cite one or more publications in common. This is an indicator that such an area of interest is very important and can be a research hotspot in the field, for instance, COVID-19.

The information in Fig. 24.5 presents co-occurring keywords, which reflect research on pressing and emerging issues facing the world, especially the COVID-19 pandemic. Research conducted between January and March 2020 was chosen for RStudio analysis with a time slice of months. From each slice, the top most-occurred or re-occurring items were picked. The nodes represent keywords, and each node’s size correlates to the keywords’ co-occurring frequency. The color of the lines between keywords reveals chronologic order: red, yellow, green, and pink. The maximum frequency was
“coronavirus, COVID-19, 19-nCoV, SARS-CoV 2, MARS-CoV, novel coronavirus, Wuhan, China, MERS, Pneumonia, and zoonosis” (cluster #1: comparative symptomatology of SARS-CoV-2 [novel coronavirus] and MERS-CoV), followed by SARS-CoV, outbreak, epidemic, infection, SARS, severe acute respiratory syndrome, and virology (cluster #2: perceptivity studies from SARS-CoV outbreak and epidemic). While cluster #3 (antigenic structural studies for vaccine production) comprises of virus, antiviral, phylogenetic analysis, spike protein, and nucleocapsid protein and cluster #4 (antibody therapeutic target studies) consist of infectious bronchitis, neutralizing antibody, bat, ace 2, and angiotensin-converting enzyme 2. Most nodes marked with blue circles represent a good relationship between keywords and its centrality, and these keywords are very important in COVID-19 research and its occurrences. In other words, these nodes represent emerging trends in the field of COVID-19, with the strongest bursts.

Institutional collaboration networks are evaluated in this study where the size of the circle represents the research efforts/outcomes in term of documents published by
different affiliations (Fig. 24.6). The link between two circles denotes the strength of bidirectional collaboration between them quantified via their coauthored documents. The sum of all links a circle possessed represents the overall strength of the collaborations the corresponding institution has made with other institutions [4]. Among the top collaborative institutions are the University of Toronto, Chinese University of Hong Kong, Wuhan University of Virology, Fudan University, Peking University, and Guangzhou Medical University. Furthermore, studies have shown that in different university ranking systems, the number of citations has more than 20% share [20–22]. Therefore many institutions encourage their researchers to publish high-quality and influential research articles that reach the broadest possible audience or receive high citations [23]. Consequently, the published literature has revealed increased visibility through the availability of research outputs via open-access repositories, broader access outcomes, and higher citation effects [23–26]. The research visibility improved both the report and the researcher’s citation and chronologically h-index.

The study identified four thematic evolutionary thrust areas in COVID-19 emergency research prioritization: the first cluster (bottom right: epidemiologic studies of infectious bronchitis virus including coronavirus) consists of coronavirus, infectious bronchitis virus, and epidemiology followed by the second cluster (top right: elucidation of historical respiratory viral outbreaks) that consists of MERS and SARS. More so, the third
cluster (top left, namely, zoonoses and phylogenetic analysis) comprises zoonoses and phylogenetic analysis, and the fourth cluster (bottom left) consists of zoonosis and influenza (influenza zoonosis) (Fig. 24.7). These domains of research have received progressively more attention in the past few months since the beginning of COVID-19. Thus to analyze the thematic evolution of this pandemic, Figs. 24.4 and 24.6 show several findings (prevailing themes) that sought to find solutions in an effort to halt the COVID-19 pandemic. Research related to COVID-19 contributes to scientific advancements and provides the needful information on the disease.

**FIGURE 24.7** Thematic evolution of COVID-19 research. MERS, Middle East respiratory syndrome; SARS, severe acute respiratory syndrome.
6. Discussion

This study offers a conceptual representation of COVID-19 research progression, and it has been noted that studies in this area have disciplinary and multidisciplinary emphasis (combining two or more fields) in which new knowledge is gained through interaction and incorporation of new ideas, views, tools, and techniques across different fields. More so, interdisciplinary work frequently involves institutions, organizations, scientists, and nations.

This study attempted to provide concise quantitative and qualitative overview of the world prioritization of health emergency research and preparedness using publications of COVID-19 between January and March 2020 as a model scenario. The results indicate that researchers from around the world started publishing the articles just immediately after the occurrence of COVID-19 and the number of articles in this field is still growing quickly. This new virus is a concern for the world, as it has affected various sectors globally, including global economy, health, migration, airlines, and other vital sectors since the inception of COVID-19 [26–29]. As reflected in the study, all the continents have been affected and almost all activities have been grounded [30,31].

The development of a multidisciplinary task force involving researchers, institutional leaders, infectious disease and infection prevention specialists, and technology experts is a critical step in addressing global concerns and developing open and productive communication on COVID-19. An initial needs-based assessment was done of the current state to determine the necessary operational processes for outbreak management, the existing informatics structure to support these processes, and the gaps that needed to be bridged in a timely fashion. Doing so allowed us to expediently assess studies on COVID-19 between January and March 2020. This study revealed that globally, China and the United States ranked first and second, respectively, in all the research productivity measures including production, citations, authors, and single- and multiple-country authors of COVID-19 research during the study period. Other counties including Korea, Italy, Germany, Canada, and Saudi Arabía also ranked high in the research on COVID-19. This also reveals most of the nations are most affected especially in the first month of inception of the COVID-19, while other countries that are less affected have a low record of novel studies on this pandemic. However, the result from this study suggests the need for those countries lagging in research or scientific findings to put more effort into finding solutions before they get hit by the pandemic, especially nations from Africa.

As of March 31, 2020, the number of confirmed COVID-19 cases globally is 784,392, with the number of recorded deaths of about 37,780 and recoveries of 167,035. Therefore prioritization of health emergency research and disaster preparedness for COVID-19 and its impact on global health and economy is paramount [14]. COVID-19 is affecting territories and 200 countries around the world and 2 international conveyances, i.e., Holland America’s MS Zaandam cruise ship and the Diamond Princess cruise ship.
harbored in Yokohama, Japan [32]. Due to the obvious impact of COVID-19, various sectors have been grounded globally, lives have been lost, and businesses are collapsing, and nations under lockdown are disrupting activities in all spheres of life.

One of the ways for prioritizing health emergency and disaster preparedness for COVID-19 is to balance the need to concentrate on the pandemic while ensuring high-quality healthcare and non-new infection-related operations and research on pandemic to provide support to all facets of the population and sectors [14,16,33]. Finally, in an evolving pandemic environment, face with challenges for developing guidelines or protocols that typically require inputs and approvals from multiple stakeholders with emerging research outcomes, it is unavoidable that proper dissemination of the guideline/protocols to sustain the rapid reduction of the spread and impact of health emergency such as COVID-19 will encounter many obstacles [11,34]. The COVID-19 pandemic has revealed the importance of a multidisciplinary team of health workers or approach in combating health emergencies and disasters and prior building of strong and consolidative health systems capable of sustaining unanticipated health emergencies and disasters. The most significant mitigation strategy and disaster preparedness for the challenges around COVID-19 is the establishment of a 24-hour information platform that included representation from the WHO Information Services. The information received from the center will be very useful for researchers and scientists for further analysis and evaluation of the issues around COVID-19. This will immensely contribute to the mitigation and preparedness strategies for the pandemic. More so, it will enable real-time identification of failures and successes, a focus on evolving needs, and feedback for subsequent interventions.

7. Conclusion

This study assessed global research evolution, prioritization, and preparedness toward health emergencies and disasters using the COVID-19 pandemic as a typical model based on productivity indices, conceptual frameworks, discipline, and collaboration networks. The study unveiled global research efforts made by researchers from different nations, disciplines, institutions, and fields. Fundamental research prioritization was noticed in China, the United States, the United Kingdom, Saudi Arabia, Germany, Switzerland, Canada, and Italy, as well as from disciplines, namely, virology, microbiology, immunology, infectious diseases, veterinary sciences, general and internal medicine, and pharmacology and pharmacy. The various conceptual frameworks and thematic areas, given the research priorities during the period, were (1) epidemiologic studies of infectious bronchitis virus including coronavirus, (2) elucidation of historical respiratory viral outbreaks, (3) zoonoses and phylogenetic analysis, (4) influenza zoonosis, (5) comparative symptomatology of novel coronavirus (SARS-CoV-2) and MARS-CoV, (6) perceptivity studies from SARS-CoV-1,2 outbreaks, (7) antigenic structural studies for vaccine production, and (8) antibody therapeutic target studies.
Generally, study revealed a skewed health emergency research response and prioritization only from the affected nations, which could have informed prior research preparedness from the then-unaffected countries to support decision-making and possible implementation to mitigate the pandemic. Although COVID-19 research has received progressive attention since the beginning of the pandemic, the number of studies included in this study might not be exhaustive of COVID-19 research based on the limited number of databases consulted and the fact that new studies are being published daily. However, this study recommends integrative and multidisciplinary research priority and preparation toward health emergencies and disasters from all experimental and nonexperimental biases of knowledge from affected and unaffected nations.

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Conflicts of interest
The authors declare no conflict of interest. The funders had no role in the design of the study; the collection, analyses, or interpretation of data; the writing of the manuscript; or the decision to publish the results.

Appendix A. Supplementary data
Supplementary data to this chapter can be found online at https://doi.org/10.1016/B978-0-323-90769-9.00033-5.

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