

# BIBLIOMETRIC ANALYSIS ON COVID-19 IN THE CONTEXT OF MIGRATION HEALTH

Created: 30 March 2020 | Published: 20 April 2020 | Status: Under Review

## BACKGROUND

On 31 December 2019, a cluster of pneumonia of unknown etiology was reported in Wuhan City, Hubei Province of the People's Republic of China (World Health Organization [WHO], 2020a). On 11 March 2020, the World Health Organization (WHO) announced that the pathogen known as the Coronavirus Disease 2019 (COVID-19) constituted a pandemic - "an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people" (World Health Organization [WHO], 2020c).

The rising number of COVID-19 cases disrupted movement of people within a country and across international borders. Stringent containment measures restricted travel, work practices, and daily life activities. While everyone has been affected, the elderly and persons with underlying health conditions have been reported to have a higher risk for infection than others (Liu, Chen, Lin, & Han, 2020). Migrants and refugees, particularly those residing in crowded settings, are also at risk given that this group has limited access to health services. Further, their work opportunities have been greatly affected by the pandemic.

Ensuring the integration of migrants and refugees in the response to COVID-19 requires knowing and understanding the existing scientific evidence. This mapping activity aims to identify and assess research publications on COVID-19 focusing on migration, migrants and human mobility; specifically mapping research productivity on COVID-19 in the context of migration health by author, country, institution/ organization, health theme, and migrant topic (i.e. migrant type and type of movement).

Results from this mapping activity will provide guidance to MHD colleagues and the public on concerns relevant to COVID-19 and migration health by making this available in the Migration Health Research Portal. The COVID-19 page in the portal will feature key publications.

## METHODOLOGY

The bibliometrics analysis methodology was applied to analyze the bibliometric data (i.e. author information, citation, and publication information) of publications on COVID-19 and migration health. Bibliometric analysis is a method that uses quantitative analysis to understand research productivity by author/ researcher, country, and institution/ organization.

## CITATION DATABASE

SciVerse Scopus, a citation database of peer-reviewed literature developed by Elsevier, was used to retrieve publications on COVID-19 and migration health. Scopus provides a comprehensive overview of global research output in different disciplines and covers 100% of MEDLINE publications. The advantage of Scopus over other citation databases was extensively discussed in previous studies (Bakkalbasi, Bauer, Glover, & Wang, 2006; Falagas, Pitsouni, Malietzis, & Pappas, 2008; Sweileh et al., 2018).

## SEARCH STRATEGY

### INCLUSION STEP

The search strategy was developed from 19 to 29 March and updated on 30 March 2020. Two search queries were developed for COVID-19 and migration health. For the COVID-19 search query, the identification and selection of keywords were based on reviewing the WHO COVID-19 repository (World Health Organization [WHO], 2020b) and bibliometric studies on COVID-19 (Hossain, 2020) (Chahrour et al., 2020). The COVID-19 search query was applied in the publication title to minimize false positive results.

A separate search query was developed for migration (health). The search query was grouped into three main topics: 'international', 'migration and migrant', and 'mobility and travel.' The first two topics adopted the search strategy developed for global migration and health (Sweileh et al., 2018). The 'mobility and travel' terms were captured using synonymous and related terms to mobility (i.e. 'movement', 'displaced', 'displacement', 'travelling', and 'traveler'). The migration (health) search query was then applied in the title, abstract and keywords of publications.

The search queries for COVID-19 and migration (health) were combined using the Boolean operator "AND." The search results of these queries contain all publications on COVID-19 with 'migration', 'migrant' and 'mobility' terms. It should be noted that while the analysis intends to capture publications on COVID-19 and "migration health", the search query on migration health largely focused on migration-, migrant- and mobility-related terms as the health aspects of migration are effectively subsumed in the COVID-19 search query.

### EXCLUSION STEP

Exclusion steps were applied to the search strategy to eliminate irrelevant publications or false positive results.

Using the built-in filter in Scopus the following restrictions were applied:

1. Publication year restricted to 2020
2. Language restricted to English
3. Excluded publications indexed in irrelevant subject areas (e.g. Physics and Astronomy, Veterinary, Earth and Planetary Science, Chemistry, and Engineering). Scopus classifies retrieved publications based on the field and scope of the sources or publishing journal. Irrelevant subject areas were identified after careful review of the retrieved publications.

Three reviewers (L, A, B) performed title and abstract (if available) screening of the retrieved publications. To facilitate the review process, the publications were divided among the three reviewers. The reviewers discussed among themselves the publications they identified as "excluded" or "uncertain" until a consensus was reached on whether to include or exclude a publication. At this stage, publications with no reference to terms related to 'migrant', 'migration', 'mobility' or 'travel' in the title and abstract (if available) were excluded. Unique terms in the publication and the source title that were deemed irrelevant (e.g. birds) were applied in the exclusion step.

## VALIDITY OF THE SEARCH STRATEGY

In every step of the search query, the search results were reviewed to check the publication yield. The search strategy was adjusted if known relevant publications were not captured in the search. Careful screening of the title and abstract was done to ensure validity of search results.

## DATA ANALYSIS AND VISUALIZATION

The Scopus search output was exported into several formats: Microsoft Excel, csv and BibTex. The manual review and tagging of retrieved publications were done using the Excel file. The built-in analysis feature of Scopus was used to generate summarized results of leading authors, sources/ journals, institutions/ organizations/ affiliations, countries, publication type, and subject areas. Further analysis of authors, sources, and publication information was done using Biblioshiny, an open source web-interfaced bibliometrics tool that uses the R programme (Aria & Cuccurullo, 2017).

Bibliometric information exported from Scopus include the following:

1. Author names (with number of publications by author)
2. Publication title (with number of citations by publication)
3. Publication year (with number of publications by year)
4. Source name or title (with number of publications by source)
5. Institution or organization name (with number of publications by institution/ organization)
6. Country name from author affiliation address in Scopus (with number of publications by country)
7. Publication type (with number of publications by type)
8. Subject area (as defined by Scopus)
9. Author and index keywords
10. Abstract (if available)

VOSviewer version 1.6.15 (van Eck & Waltman, 2010) was utilized to analyze and visualize the networks of co-authorship relations between author, countries, and institution, and co-occurrence relations between keywords.

Full counting method was selected in creating the co-authorship and co-occurrence keyword network maps for easy interpretation of links. In the keywords map, this counting method means that every keyword is counted and has the same weight, regardless of the number of keywords given to an article (Perianes-Rodriguez, Waltman, & van Eck, 2016).

A threshold number (i.e. number of occurrences of keywords and number of co-authored publications) was set for each type of map. To present a clean map, VOSviewer thesaurus files were prepared to standardize terms and exclude generic or out of scope terms. In the keyword maps, for example, coronavirus related-terms, country names, and generic study types (e.g. male, middle-aged, procedures, controlled study, and health survey) were excluded.

In creating the visualization network maps, the layout attraction and repulsion parameters were set to 1 and 0, respectively. The clustering resolution and minimum cluster size parameters were set to 1.25 and 1, respectively. Further, the association strength was selected to normalize the strength of the links between items.

Network visualization was selected in the creation of all network maps. Table 1 lists the bibliometric data used for the three visualization network maps created in this study. A network refers to a set of items, represented by circles, linked together by lines. A network may contain one or several clusters represented by different colors. The maps generated only present those networks with the largest set of links or connections. The size of the circle represents the more frequently occurring keyword or the highest number of co-authored publications in the retrieved publication set from Scopus. The strength of links indicates the number of publications that two authors have co-authored (in the case of co-authorship links) or the number of publications in which two keywords occur together (in the case of co-occurrence links). The distance between two items in the visualization indicates the relatedness (i.e. co-authorship or co-occurrences) of items. The shorter the distance between two items, the stronger the relatedness. Colors represent clusters of items that are relatively strongly related to each other.

**Table 1.** Bibliographic data used in creating the visualization network map using VOSviewer

Links*	Items**	Network
Co-authorship	Institutions/ Organizations	Institution collaboration
	Authors	Author collaboration
	Countries	Country collaboration
Co-occurrences	Keywords	Keyword co-occurrences network

\*A link, represented by the connecting lines, is a connection or a relation between two items in a visualization network map.

## RESEARCH THEMES AND SUBTHEMES

Two reviewers (A and B) classified publications into six thematic clusters or research themes: (1) Public health intervention; (2) clinical management; (3) candidate therapeutics and vaccine; (4) disease epidemiology and modelling; (5) diagnostic testing and strategies; (6) impact assessment and policy analysis. Full-text articles were reviewed if needed to ensure proper tagging or classification of the publications.

Below is a description of each of the themes and the subthemes or topics identified:

1. Public health intervention

*Description:* Publications that cover topics on any combination of program elements or strategies related to addressing COVID19-related health concerns among populations (i.e. population-level strategies).

*Subthemes:* policy response; point of entry screening; thermal scanning; airport screening; review of travel history; travel bans or restrictions; social distancing; quarantine; personal protective equipment or PPE; case identification; contact tracing; counselling services; mental health care; health education; training; social support; health care; and, health promotion.

2. Clinical management

*Description:* Publications that cover topics on characterizing the disease based on observing actual patients (i.e. distinct from diagnostic testing); treatment algorithms; management of patients; preventing and controlling infections (i.e. patient level management).

*Subthemes:* clinical characterization; clinical examination; clinical guidance; symptomatology; and, patient management (i.e. prevention and control)

3. Candidate therapeutics and vaccine

*Description:* Publications that cover topics on the use of potential therapeutics (existing therapeutics) and vaccines or the development of new ones.

*Subthemes:* therapeutics; vaccine

4. Disease epidemiology and mathematical modelling

*Description:* Publications that cover topics on disease etiology, transmission, distribution, and potential determinants (may include classical epidemiological approaches or other mathematical modelling)

*Subthemes:* disease transmission; disease etiology; disease distribution (frequency, patterns); disease determinants (causes, risk factors); animal reservoir; zoonotic infection; mathematical modelling; modelling study; exposure variables; travel history; crowdsourced data

5. Diagnostic and testing strategies

*Description:* Publications that cover topics on diagnostic tests and procedures.

*Subthemes:* RT-PCR; polymerase chain reaction; antibody testing; rapid diagnostic tests; Cepheid's COVID-19 test; phylogenetic analysis; genome sequencing; diagnostic imaging; radiological findings; lung pathology; differential diagnosis

6. Impact assessment and policy analysis

*Description:* Publications that cover topics on socio-economic and health impact of COVID-19 on other disease prevention and control; health policy analysis and health diplomacy.

*Subthemes:* cost-effectiveness analysis; cost-benefit analysis; socio-economic impact; health policy analysis

## MIGRATION TOPIC AND COUNTRY COVERAGE

The topics related to migration, migrant and mobility were identified based on migrant type, type of movement, and other terms related to travel. These topics include:

1. Migrant type – foreign students, tourists, migrant workers, migrants, travelers (non-specific)
2. Type of movement – internal movement (within a country) and international movement (across international borders)
3. Other terms related to travel and mobility – travel (i.e. travel or transportation by land, sea or air), mobility (any form of movement)

Country coverage refers to the country or countries as the main topic of the publication (i.e. where the study was implemented or where the data used in the study came from). Tagging of publications by country coverage and migration topic was done by reviewing the abstract and full article (if needed and available).

## RESULTS

### Number, type, and subject area of retrieved publications

The search retrieved a total of 43 publications from 23 different sources on COVID-19 and migration health from 1 January 2020 to 30 March 2020. Majority of the retrieved publications were research articles<sup>1</sup> (69.8%, n=30) followed by editorials<sup>2</sup> (9.3%, n=4), notes<sup>3</sup> (9.3%, n=4), letters<sup>4</sup> (7%, n=3) and reviews<sup>5</sup> (4.7%, n=2). Nearly all publications were in the area of medicine (95.3%, n=41)<sup>6</sup>, followed by immunology and microbiology (27.9%, n=12). Only a few of the publications were in environmental science (n=4), health professions (n=4), neuroscience (n=3), social sciences (n=3), biochemistry, genetics and molecular biology (n=1), decision sciences (n=1) and nursing (1). Note that subjects are not mutually exclusive.

The study flowchart shows the steps in the search strategy and the number of retrieved publications in each step (Figure 1). The complete search strategy is available in the appendices section.

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<sup>1</sup> Scopus definition: Original research or opinion.

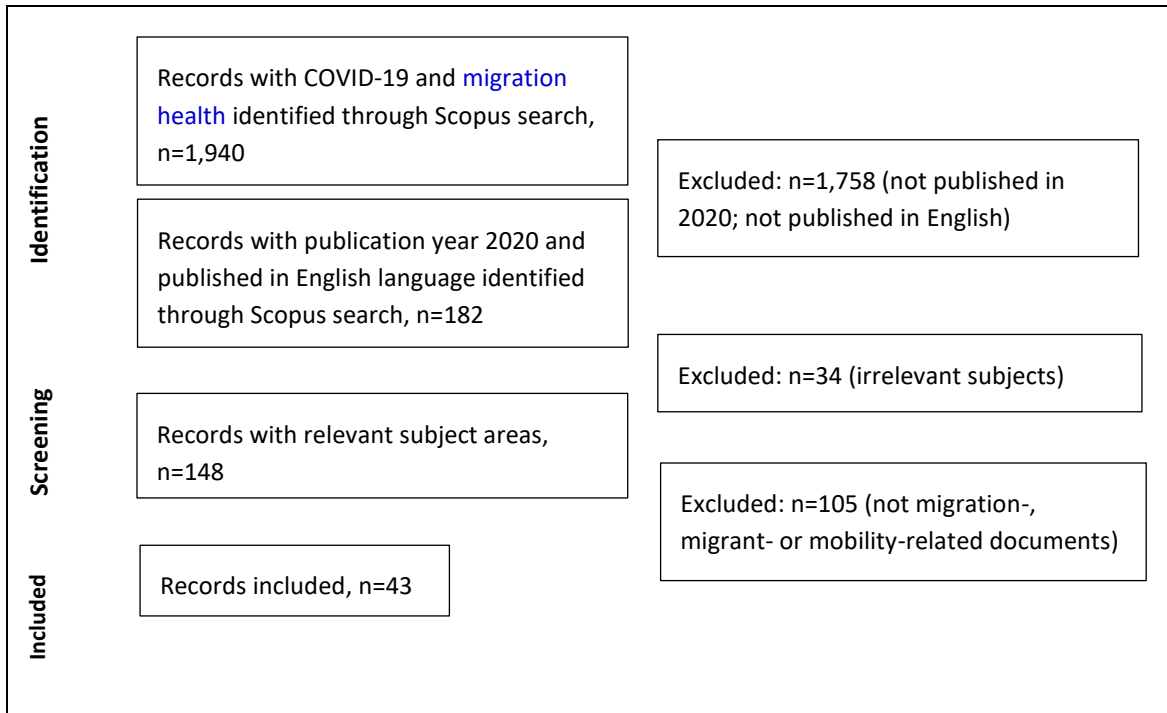
<sup>2</sup> Scopus definition: Summary of several articles or provides editorial opinions or news.

<sup>3</sup> Scopus definition: Note, discussion or commentary.

<sup>4</sup> Scopus definition: Letter or correspondence with the editor.

<sup>5</sup> Scopus definition: Significant review of original research, also includes conference papers. The two review articles in this study pertain to the following topics: (1) an overview of the COVID-19 outbreak; and, (2) a review of publications on the effects of SARS, MERS, and other coronavirus infections on pregnant women and their infants. Reviews refers to an article with a significant review of original research, also includes conference papers. (Elsevier, 2017).

<sup>6</sup> Denominator, n=43. Note that subject areas are not mutually exclusive. Thus, total percentages of the subject areas is more than 100%.



**Figure 1.** Search and Selection Flow Chart

### Most active authors

A total of 405 authors were found in the retrieved publications, with a mean of nine authors per publication. Only four of the publications were single-authored publications while the remaining were multi-authored ( $\geq 2$  authors) publications.

The top active authors shown in Table 2, co-authored three publications in COVID-19 and migration health. Three of the authors were from Hong Kong and had co-authored the same publications (Table 3). The collaboration of these authors is shown in Figure 2. Research collaboration and networking are represented by the connected lines. The lines indicate the number of co-authorship links. The thicker lines mean that these authors have co-authored more publications together than other links

**Table 2.** List of most active authors in COVID-19 and migration health, 1 January to 30 March 2020

No.	Author	N	C	Country	Affiliation*
1	He, Daihai	3	2	Hong Kong	2013-2020 Hong Kong Polytechnic University, Kowloon, Hong Kong
2	Nicastri, Emanuele	3	2	Italy	2000-2020 IRCCS Istituto Nazionale Malattie Infettive Lazzaro Spallanzani, Rome, Italy
3	Yang, Lin	3	2	Hong Kong	2014-2020 Hong Kong Polytechnic University, Kowloon, Hong Kong
4	Zhao, Shi	3	2	Hong Kong	2017-2020 Hong Kong Polytechnic University, Kowloon, Hong Kong

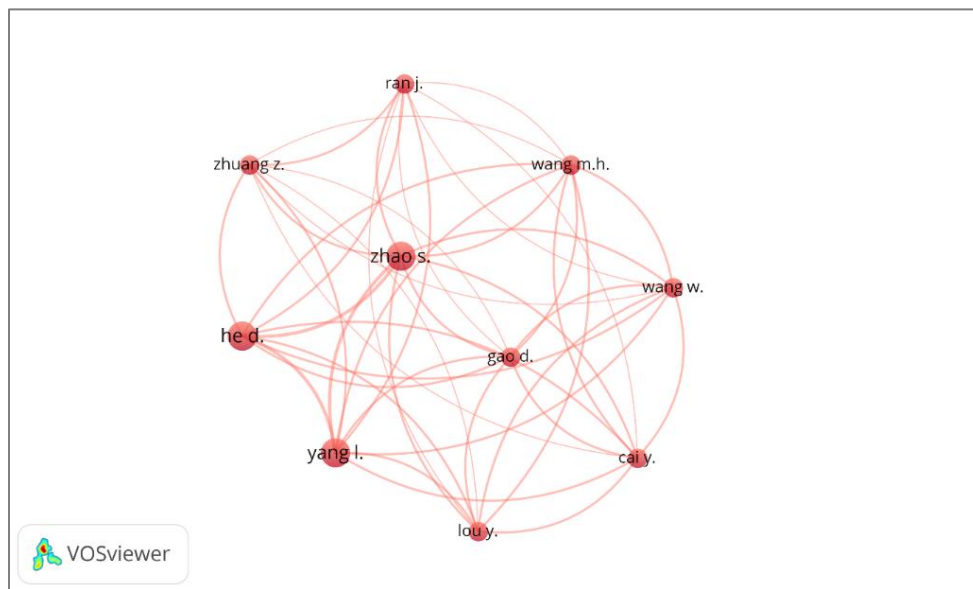
\*Taken from the Scopus author profile on 30 March 2020.

N= total number of publications; C = total number of citations

**Table 3.** List of publications co-authored by the active authors in COVID-19 and migration health, 1 January to 30 March 2020

Authors	Title	C
Zhao S., He D., Yang L.	The association between domestic train transportation and novel coronavirus (2019-nCoV) outbreak in China from 2019 to 2020: A data-driven correlational report (S.; Zhao et al., 2020)	2
Zhao S., Yang L., He D.	A conceptual model for the coronavirus disease 2019 (COVID-19) outbreak in Wuhan, China with individual reaction and governmental action (Lin et al., 2020)	0
Zhao S., Yang L., He D.	Quantifying the association between domestic travel and the exportation of novel coronavirus (2019-nCoV) cases from Wuhan, China in 2020: a correlational analysis (Shi Zhao et al., 2020)	0
Nicastri E.	2019-novel Coronavirus severe adult respiratory distress syndrome in two cases in Italy: An uncommon radiological presentation (Albarelo et al., 2020)	2
Nicastri E.	First cases of coronavirus disease 2019 (COVID-19) in the WHO European Region, 24 January to 21 February 2020 (Spiteri et al., 2020)	0
Nicastri E.	Differential diagnosis of illness in patients under investigation for the novel coronavirus (SARS-CoV-2), Italy, February 2020 (Bordi et al., 2020)	0

C = total number of citations



**Figure 2.** Network visualization map of authors in COVID-19 and migration (linked by co-authorship)

### Most active country authors' affiliation

The authors of retrieved publications came from 31 countries. The country information in Scopus were taken from the authors' affiliated institution or organization address in the retrieved publications. The United States of America ranked first in the list of most active countries with 14 publications, followed by China with ten publications. China has the highest number of citations at 1125 (Table 4).

The largest set of international collaboration with a minimum productivity of two publications in the field of COVID-19 and migration health revealed three clusters consisting of 13 countries (Figure 3). The red cluster consists of Italy, Belgium, Denmark, France, and Germany. The green cluster consists of United Kingdom, Switzerland, Brazil, and Colombia. The blue cluster consists of USA, China, Canada, and Hong Kong. The thickness of the line connecting countries represents the strength of research collaboration whereas the circles represent the number of co-

authored publications as presented in Table 4. The USA has co-authored 14 publications with seven countries; China has co-authored five publications with five countries; and the United Kingdom has co-authored nine publications with nine countries.

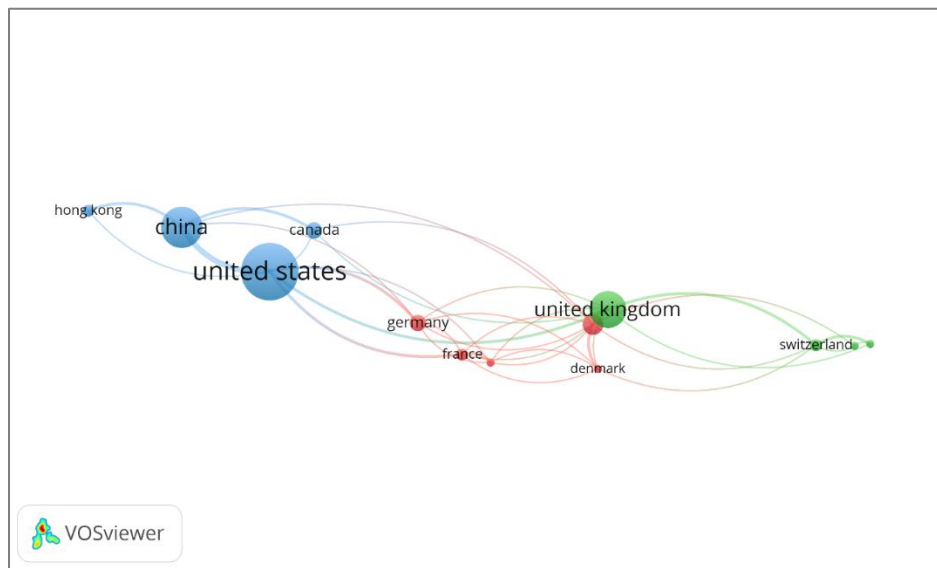
**Table 4.** List of most active\* country authors' affiliation\*\* in COVID-19 and migration health, 1 January to 30 March 2020

No.	Country	N	%, N=43	C
1	United States of America	14	32.6	3
2	China	10	23.3	125
3	United Kingdom	9	20.9	3
4	Italy	5	11.6	2
5	Canada	4	9.3	4
6	Germany	4	9.3	3
7	France	3	7.0	3
8	Hong Kong	3	7.0	0
9	Switzerland	3	7.0	0

\*countries with two or more publications.

\*\*This is based on the recorded author affiliation address from the retrieved publications.

C = total number of citations



**Figure 3.** Network visualization map of countries in COVID-19 and migration health (linked by co-authorship)

### Preferred Journals

The retrieved publications were published in 23 journals. The most preferred journals were the Euro Surveillanc Bulletin (14%, n=6) and Travel Medicine and Infectious Disease (14%, n=6). Table 5 shows the list of top journals with two or more publications and the corresponding publisher and subject areas.

**Table 5.** List of top journals in COVID-19 and migration health, 1 January to 30 March 2020

No.	Journal	N	% N=43	Publisher	Subject Area
1	Euro Surveillanc Bulletin <i>Europeen Sur Les Maladies Transmissibles Europeen Communicable Disease Bulletin</i>	6	14.0	European Center for Disease Prevention and Control	<i>Medicine</i> : Public Health, environmental and occupational health; epidemiology



					<i>Immunology and Microbiology: Virology</i>
2	Travel Medicine and Infectious Disease	6	14.0	Elsevier	<i>Medicine: Public health, environmental and occupational health; infectious diseases</i>
3	Lancet	5	11.6	Elsevier	<i>Medicine: General medicine</i>
4	Journal of Travel Medicine	3	7.0	Oxford University Press	<i>Medicine: Public health, environmental and occupational health; Infectious diseases</i>
5	MMWR Morbidity and Mortality Weekly Report	3	7.0	US Department of Health and Human Services	<i>Medicine: epidemiology; health professions: health information management; Social sciences: health (social science); environmental science: health, toxicology and mutagenesis</i>
6	International Journal of Infectious Diseases	2	4.7	Elsevier	<i>International Journal of Infectious Diseases</i>
7	Lancet Psychiatry	2	4.7	Elsevier	<i>Medicine: Psychiatry and Mental Health; Neuroscience: Biological Psychiatry</i>

### Most Active Institutions

The most productive institutions or organizations (i.e. with three or more publications) are shown in Table 6. The University of Hong Kong ranked first with eight publications (including those from the HKU Li Ka Shing Faculty of Medicine).

**Table 6.** List of top institutions or organizations in COVID-19 and migration health, 1 January to 30 March 2020

No.	Institution/ Organization	n	%, N=43	Country
1	The University of Hong Kong (HKU)	4	9.3	Hong Kong
2	HKU Li Ka Shing Faculty of Medicine	4	9.3	Hong Kong
3	The Chinese University of Hong Kong	3	7.0	Hong Kong
4	Hong Kong Polytechnic University	3	7.0	Hong Kong
5	Center for Disease Prevention and Control (CDC)	3	7.0	USA
6	University College of London (UCL)	3	7.0	United Kingdom
7	University of California, Los Angeles	3	7.0	USA
8	London School of Hygiene & Tropical Medicine	3	7.0	United Kingdom
9	Harvard T.H. Chan School of Public Health	3	7.0	USA
10	IRCCS Istituto Nazionale Malattie Infettive Lazzaro Spallanzani	3	7.0	Italy

The largest set of institutional collaboration with a minimum of two co-authored publications revealed one cluster consisting of four institutions based in Hong Kong and China: Chinese University of Hong Kong, Hong Kong; Shenzhen Research Institute of Chinese University of Hong Kong, China; Li Ka Shing Faculty of Medicine, University of Hong Kong; and, Hong Kong Polytechnic University, Hong Kong (Figure 4).



**Figure 4.** Network visualization map of institutions that published in COVID-19 and migration health (linked by co-authorship)

### Most cited articles

The top ten cited articles are shown in Table 7. The article that received the highest citation presents the medical findings of patients with unexplained pneumonia who travelled from Wuhan to Shenzhen, China.

**Table 7.** List of most cited articles in COVID-19 and migration health, 1 January to 30 March 2020

Title	Journal	C	Publication type
A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster (Chan et al., 2020)	The Lancet	124	Article
Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study (W. Liu et al., 2020)	The Lancet	46	Article
Incubation period of 2019 novel coronavirus (2019-nCoV) infections among travellers from Wuhan, China, 20-28 January 2020 (Backer, Klinkenberg, & Wallinga, 2020)	Euro surveillance: bulletin European sur les maladies transmissibles = European communicable disease bulletin	12	Article

The first case of 2019 novel coronavirus pneumonia imported into Korea from Wuhan, China: Implication for infection prevention and control measures (Kim et al., 2020)	Journal of Korean Medical Science	9	Article
The next big threat to global health? 2019 novel coronavirus (2019-nCoV): What advice can we give to travellers? – <i>Interim recommendations January 2020, from the Latin-American society for Travel Medicine (SLAMVI) (Biscayart et al., 2020)</i>	Travel Medicine and Infectious Disease	7	Editorial

C=number of citations

### Research themes

Almost half of the retrieved publications were on disease epidemiology and mathematical modelling (43.5%, n=30). Most of the publications under this research theme cover topics on disease determinants, transmission and distribution. Other themes included the following: public health interventions (24.6%, n=17); clinical management (17.4%, n=12); diagnostic and testing strategies (13%, n=9); and, candidate therapeutics and vaccine (1.4%, n=1). There were no publications on impact assessment and policy analysis. The classification of themes and subthemes was not mutually exclusive – one publication may be classified under two or more themes.

### Migration, Migrant and Mobility

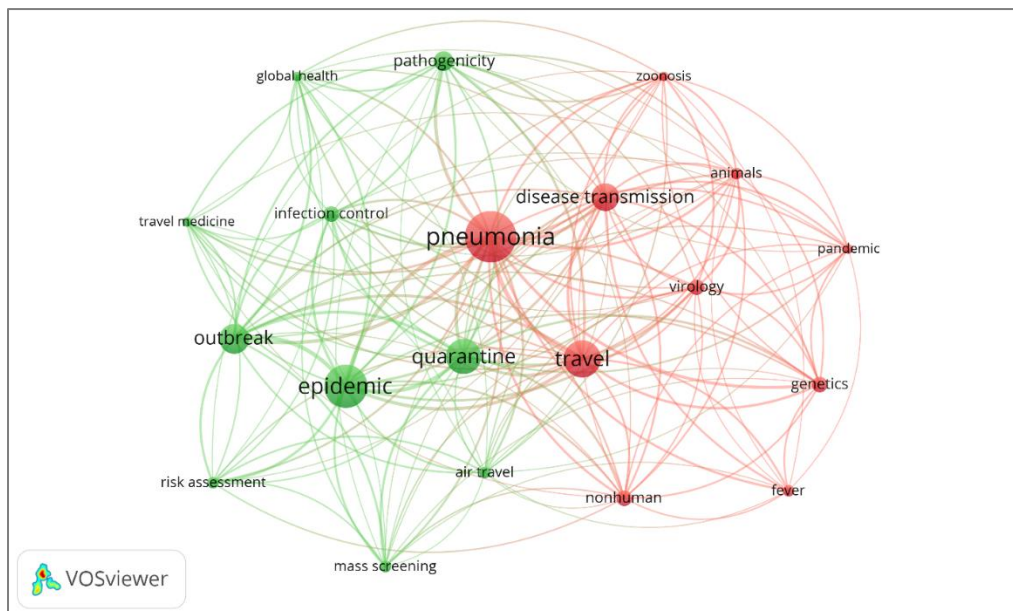
There were nine publications that mentioned ‘travelers’ but did not specify whether tourist or migrant. Only four of the retrieved publications pertain to a specific migrant group. See Table 8. The rest of the retrieved publications pertain to travel and mobility within and across international borders.

**Table 8.** List of publications that pertain to specific migrant groups, 1 January to 30 March 2020

Title	Migrant group	Research Themes
The first two cases of 2019-nCoV in Italy: Where they come from? (Giovanetti, Benvenuto, Angeletti, & Ciccozzi, 2020)	Tourists	- Diagnostic and testing strategies - Disease epidemiology and mathematical modelling
Mental health care for international Chinese students affected by the COVID-19 outbreak (Zhai & Du, 2020)	Foreign students	- Public health intervention
The neglected health of international migrant workers in the COVID-19 epidemic (Liem, Wang, Wariyanti, Latkin, & Hall, 2020)	Migrant workers	- Public health intervention
Prediction of epidemic spread of the 2019 novel coronavirus driven by spring festival transportation in China: A population-based study (Fan et al., 2020)	Migrants	- Disease epidemiology and mathematical modelling

### Visualization of keywords

Mapping of frequently occurring keywords with minimum occurrences of five revealed two clusters (red and green) consisting of 20 keywords (Figure 5). The most frequently occurring keyword (represented by the size of circles) was pneumonia (n=26) followed by epidemic (n=22), travel (n=19), quarantine (n=18), outbreak (n=15), and disease transmission (n=14). Three of the most frequently occurring keywords – pneumonia, travel, and disease transmission – were associated with virology, animals, nonhuman, zoonosis, fever, genetics, and pandemic (red cluster). The keyword epidemic is associated with outbreak, quarantine, mass screening, air travel, travel medicine, global health, infection control, and risk assessment (green cluster). The lines represent the co-occurrence links between two keywords.



**Figure 5.** Co-occurrence network visualization map of keywords in COVID-19 and migration health

### LIMITATIONS

This is the first bibliometric study of publications on COVID-19 and migration health. Although there have been several bibliometric studies on COVID-19 (Chahrour et al., 2020; Hossain, 2020), there were none done in the context of migration health. At the start of the year, the research community across the globe has focused its efforts in coming up with useful scientific evidence on COVID-19. This is evidenced by the increasing number of publications on COVID-19 from January 2020 to March 2020.

Despite the comprehensive coverage of Scopus, this study has several limitations that is inherent in a bibliometric study: (1) The Scopus citation database is a comprehensive database and covers many disciplines. However, there are some scientific sources or journals that are not indexed in Scopus. Therefore, there are relevant publications that were missed because they were published in non-indexed journals. (2) New publications may have been missed due to possible time lag in the Scopus indexing. (3) The Scopus yield or search results will depend on the overall search strategy. The search query for COVID-19 was applied on the publication title. Therefore, any relevant publication with no COVID-19 related terms in the publication title will be missed. Also, relevant publications written in languages other than English were excluded. (4) Results obtained reflect how publication information were recorded and presented in Scopus. For example, active institutions, author names, and countries with different spellings will be spread out in the results. Another possible scenario is that certain publications indexed as a 'research

article' may be a 'letter to editor' upon reviewing the full text. (5) COVID-19 research is a growing field. Thus, the results at the time of search may change in time. Also, any change of information or indexing of the retrieved publications will affect the search results. (5) Lastly, a bibliometric analysis uses the bibliographic attributes or metadata (i.e. authors' names, title, keywords, etc.) of retrieved publications to describe the scope of research. This method does not synthesize the research findings.

## DISCUSSION

Findings from the bibliometric analysis of publications on COVID-19 in the context of migration and health present the gradually developing research landscape in this field. As the pandemic continues to unfold, the number of relevant research articles (n=30) and commentaries on original research (i.e. editorial, letter, note, background review) (n=13) have been published on each of the key thematic clusters (except on impact and policy analysis). This finding highlights the importance of considering the migrant- and migration-health-related concepts in research and scientific communications.

The most productive authors in this specific area come from Hong Kong, whose geographical proximity to and socio-economic ties with China (the first reported place of origin of the virus) were likely contributing factors in their early contributions to the field. The countries and institutions with the highest number of publications also suggest how the pandemic has developed in the past three months. Although China was initially observed as the epicenter of the early outbreak, the United States and a few European countries have seen an increasing number of confirmed cases in the last few weeks. While establishing a direct correlation between the number of confirmed cases and the research productivity may not be necessary, the finding on the most productive countries suggests a geographic outlook of the early developments in the global scientific knowledge base on COVID-19 specific to migration health. This information can help researchers, practitioners, and policy makers especially those coming from resource-limited settings in maximizing the research productivity of existing networks and reaching out to relevant experts if needed. The inclusion of vulnerable populations such as migrants and displaced populations in COVID-19 research is critical given the potentially differential impact of the pandemic in these settings. The diversity of subject areas of the top journals on COVID-19 and migration health – which ranged from journals on disease epidemiology, travel medicine, infectious diseases, general medicine, and psychiatry – also provides insights into the importance of approaching COVID-19 as a complex health problem from a multidisciplinary perspective.

Despite the large number of global publications on COVID-19, the coverage of migrant and migration and health aspects of the pandemic in the current scientific knowledge base has so far been limited to concepts related to “travel and mobility or movement within and across international borders” – primarily viewing population movement as an important factor in disease transmission and suppression strategies. Only a small number of publications (n=4) have systematically considered specific migrant groups (i.e. tourists, foreign students, migrant workers, and migrants) in examining relevant themes on public health interventions, disease epidemiology, clinical management, as well as diagnostic and testing strategies (Table 8).

Other than identifying the relevant migrant population groups examined in the extant literature, the scope of the current bibliometric analysis (i.e. ending in the screening of abstracts), precludes providing more insights on the study types, specific variables and outcome measures investigated and the research findings in the publications included in the analysis. Nevertheless, the common constructs covered in the relevant publications to date can be inferred from the network visualization map of the keywords.

### **Implications for migrants and migration and health research**

Classifying the two clusters of keywords that emerged from the bibliometric analysis into meaningful categories within a migration health context can provide insights into the role of migrant-, and migration-and-health-related concepts in the literature (Table 9) especially when understood through the lens of the six thematic clusters. For

example, the red cluster highlights the potential role of travel-related constructs in disease epidemiology and clinical management, whereas, the green cluster relates to concepts on public health interventions.

Fitting the keywords to the six thematic clusters provides a rudimentary but clear-cut approach in coding the common keywords in the bibliometric findings, which can provide additional insights on the current state of research productivity on COVID-19 related to migrants and migration health. It is clear from the findings that the migration angle in the current literature largely focuses on mobility (i.e. migration, travel) as a key factor in understanding disease transmission and an important aspect in developing public health interventions.

**Table 9.** Matching the keyword clusters from the analysis with the relevant research themes

Cluster	Keywords	Research Themes
Red	travel, disease transmission, virology, animals, nonhuman, zoonosis, genetics, pandemic	Disease epidemiology (i.e. disease etiology, transmission, distribution, and potential determinants)
	pneumonia, fever	Clinical management (i.e. pathology, clinical presentation, patient-level management)
Green	epidemic, outbreak, quarantine, mass screening, air travel, travel medicine, global health, infection control, risk assessment	Public health interventions (i.e. population-level strategies)

## RECOMMENDATIONS

From these findings, studies on diagnostics and therapeutics in the context of migrants, and migration health are lacking in the current knowledge base. Moreover, the studies involving specific migrant populations were limited to tourists, foreign students, migrant workers, migrants, and foreign travelers. Most of the studies investigated cases of COVID-19 in the context of population movement (Fan et al., 2020; Giovanetti et al., 2020; Kim et al., 2020), which did not necessarily aim to describe the epidemiology of the disease in the migrant setting. To strengthen the current knowledge base, more studies that examine health-related outcomes in specific migrant groups (Liem et al., 2020; Zhai & Du, 2020) should be explored especially when sound historical and epidemiological data become available in different migrant populations. This need highlights the importance of capturing the important variables that can more widely cover the different populations affected by COVID-19. In other words, viewing COVID-19 through a migration lens should not be limited to the role of movement in the dynamic importation of cases in a pandemic but should aim for a more inclusive research strategy that considers the migrant populations as well as their relevant interests.

## CONCLUSION

To strengthen the current knowledge base on COVID-19 and migration health, the scientific and research community should consider examining specific health-related outcomes in specific migrant groups as well as other relevant variables that can impact on migrants (i.e. structure and process measures). Investigations on COVID-19 and migration health should not be limited to the role of movement/mobility in the dynamic importation of cases in a pandemic; a more inclusive research strategy integrating the relevant interests of migrant populations is suggested.

**Disclaimer:** This paper has not been externally peer-reviewed; it should not replace individual clinical judgement and the sources cited should be checked. The views expressed here represent the views of the authors and not necessarily those of IOM. The views are not a substitute for professional medical advice.

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## APPENDICES

### SEARCH COMPONENT

Search component	Description	Definition
Population	Publications pertaining to all migrant groups (including internal migrant groups, asylum seekers and refugees).  This includes all forms of movement within countries and across international borders.	IOM defines a migrant as a “person who moves away from his or her place of usual residence, whether within a country or across an international border, temporarily or permanently, and for a variety of reasons.”(International Organization for Migration [IOM])
Interest	Publications pertaining to the COVID-19 disease.	

### SEARCH STRATEGY AND NUMBER OF RETRIEVED PUBLICATIONS

#### 1. COVID-19 disease

Key concept	Related terms/ Notes	Search string	ID	# output
COVID-19	COVID-19, COVID-2019, Coronavirus 2019, Coronavirus disease 2019, Coronavirus 2, Coronavirus outbreak, coronavirus disease 2019, severe acute respiratory syndrome coronavirus 2, SARS-CoV-2, nCov, 2019-nCov, novel/new/ emerging / Wuhan coronavirus, corona	TITLE (covid* OR "covid-19" OR "SARS-CoV-2" OR ncov OR "2019-nCov" OR corona OR coronavirus)	1	21,779

#### 2. Migrant and Migration

Key concept	Related terms/ Notes	Search string	ID	# output
International	International, overseas, cross-border, non-citizen/s, non-national/s, transnational/s, expatriate/s, alien/s, transient/s	TITLE-ABS-KEY (international OR overseas OR cross-border OR non-citizen* OR non-national* OR foreign* OR transnational* OR expatriate* OR alien* OR transient*)	2	
Migration & migrant	emigrant/s or immigrant/s, immigration/s, migrant/s, migration, migratory.	TITLE-ABS-KEY (*migrant* OR *migrat*)	3	
Mobility & travel	Mobile, mobility, movement, displaced, displacement, travel/s, travelling, traveler/s	TITLE-ABS-KEY (Mobile OR mobility OR movement* OR displace* OR displacement OR travel*)	4	
		2 OR 3 OR 4 OR 5	5	7,034,127

### 3. COVID-19 and Migration

Key concept	Related terms/ Notes	Search string	ID	# output
CoVID-19 & Migration, Migrant		1 AND 5	6	1,940

### 4. LIMITATIONS

Key concept	Related terms/ Notes	Search string	ID	# output
Publication Year, 2020		LIMIT-TO (PUBYEAR, 2020 )	8	186
Language, English		LIMIT-TO (LANGUAGE, "English" )	10	182
		( TITLE ( covid* OR "SARS-CoV-2" OR ncov OR "2019-nCov" OR corona OR coronavirus ) ) AND ( TITLE-ABS-KEY ( mobile OR mobility OR movement* OR displace* OR displacement OR travel* ) OR TITLE-ABS-KEY ( *migrant* OR *migrat* ) OR TITLE-ABS-KEY ( international OR overseas OR cross-border OR non-citizen* OR non-national* OR foreign* OR transnational* OR expatriate* OR alien* OR transient* ) ) AND ( LIMIT-TO ( PUBYEAR, 2020 ) ) AND ( LIMIT-TO ( LANGUAGE, "English" ) )		

### 5. VALIDATION CHECKING 1 - EXCLUSION OF IRRELEVANT SUBJECT AREAS

Screening was done by reviewing the retrieved publications indexed in the irrelevant subject areas. The exclusion of subject areas was applied in the strategy after verification.

Key concept	Related terms/ Notes	Search string	ID	# output
Irrelevant subjects	Subjects on the following: <ul style="list-style-type: none"> <li>- Chemistry</li> <li>- Chemical engineering</li> <li>- Computer Science</li> <li>- Earth and Planetary Science</li> <li>- Energy</li> <li>- Engineering</li> <li>- Material Science</li> <li>- Pharmacology, Toxicology and Pharmaceutics</li> <li>- Physics and Astronomy</li> <li>- Veterinary</li> </ul>	( EXCLUDE ( SUBJAREA, "PHYS" ) OR EXCLUDE ( SUBJAREA, "CHEM" ) OR EXCLUDE ( SUBJAREA, "ENVI" ) OR EXCLUDE ( SUBJAREA, "MATE" ) OR EXCLUDE ( SUBJAREA, "ENGI" ) OR EXCLUDE ( SUBJAREA, "CENG" ) OR EXCLUDE ( SUBJAREA, "EART" ) OR EXCLUDE ( SUBJAREA, "VETE" ) OR EXCLUDE ( SUBJAREA, "COMP" ) OR EXCLUDE ( SUBJAREA, "PHAR" ) OR EXCLUDE ( SUBJAREA, "ENER" ) )	12	148
		TITLE ( covid* OR "SARS-CoV-2" OR ncov OR "2019-nCov" OR corona OR coronavirus ) ) AND ( TITLE-ABS-KEY ( mobile OR mobility OR movement* OR displace* OR displacement OR travel* ) OR TITLE-ABS-KEY ( *migrant* OR *migrat* ) OR TITLE-ABS-KEY ( international OR overseas OR cross-border OR non-citizen* OR non-national* OR foreign* OR transnational* OR expatriate* OR		

		alien* OR transient* ) AND ( LIMIT-TO ( PUBYEAR , 2020 ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) AND ( EXCLUDE ( SUBJAREA , "PHYS" ) OR EXCLUDE ( SUBJAREA , "CHEM" ) OR EXCLUDE ( SUBJAREA , "MATE" ) OR EXCLUDE ( SUBJAREA , "ENGI" ) OR EXCLUDE ( SUBJAREA , "CENG" ) OR EXCLUDE ( SUBJAREA , "EART" ) OR EXCLUDE ( SUBJAREA , "VETE" ) OR EXCLUDE ( SUBJAREA , "COMP" ) OR EXCLUDE ( SUBJAREA , "PHAR" ) )		
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Sample list of irrelevant publications by subject type:

Subject area	Publication title
Physics and Astronomy	Boosting the Energy Efficiency of a Nanosecond Pulsed Corona Plasma System with a Multiple Wire Plasma Reactor Design and experimental evaluation of innovative wire-to-plane fins' configuration for atmosphere corona-discharge cooling device
Materials Science	A model beyond protein corona: Thermodynamics and binding stoichiometries of the interactions between ultrasmall gold nanoclusters and proteins Exploiting protein corona: coating of black phosphorus nanosheets enables macrophage polarization via calcium influx
Pharmacology, Toxicology and Pharmaceutics	Community pharmacist in public health emergencies: Quick to action against the coronavirus 2019-nCoV outbreak How Corona Formation Impacts Nanomaterials as Drug Carriers

6. VALIDITY CHECKING 2 – CHECKING FALSE NEGATIVE

Checking relevant publications found in the WHO repository. See sample list of relevant journal articles found in the WHO repository (published in 2020) with remarks:

Title	Source Title	Remarks
Prediction of Epidemic Spread of the 2019 Novel Coronavirus Driven by Spring Festival Transportation in China: A Population-Based Study	International Journal of Environmental Research and Public Health	Found in Scopus. Included in the final retrieved publications, n=48.
Initial Public Health Response and Interim Clinical Guidance for the 2019 Novel Coronavirus Outbreak - United States, December 31, 2019-February 4, 2020	MMWR Morb Mortal Wkly Rep	Found in Scopus. Included in the final retrieved publications, n=48.
Response to COVID-19 in Taiwan	JAMA	An article-in-press with full title Scopus, "Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing." <u>Publication type – note. No available abstract. No migration terms in the title.</u> This was not captured in the final retrieved publications. This was captured in the initial query for COVID.
<a href="#">A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster</a>	The Lancet	Found in Scopus. Included in the final retrieved publications, n=48.

7. VALIDITY CHECKING 3 – CHECKING FALSE POSITIVES AND DUPLICATES

Specific terms in the title or source of excluded publications were applied in the exclusion step.

Key concept	Related terms/ Notes	Search string	ID	# output
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Irrelevant sources	Apply the unique terms in the 'source title' exclusion step:	SRCTITLE ("critical care" OR "antimicrobial" OR radiology OR military OR bioscience OR occupational OR thrombosis OR oncology OR "vox sanguinis" OR poverty OR bioscience OR pathogens OR india OR poverty OR "molecular medicine" OR dental OR pediatria OR anesthesia OR "critical care" OR planning OR ophthalmology OR histotechnology OR transfusion OR pathogens OR translational OR methods OR resource)	13	
Irrelevant publications	Apply the unique terms in the 'publication title' exclusion step	TITLE ("clinical features" OR "common cold" OR "RT-PCR" OR "Cryo-Em" OR taxi OR stark OR "old lessons" OR Taiwan OR "note from" OR "asymptomatic carrier" OR "reproductive" OR "regulations" OR panic OR upgraded OR "emerging viruses" OR "genetic evolution" OR "emotional impact" OR recurrence OR "North England" OR "high-performing" OR "one world" OR australia OR "knife*" OR seasonal OR "active monitoring" OR shadows OR "general population" OR "what we know" OR hindsight OR "early lessons" OR error OR "strategies shift" OR "Q&A*" OR globalised OR error OR "next epidemic" OR "past pandemics" OR "what next" OR fear* OR "preliminary prediction" OR 31 OR "management perspective" OR "imaging features" OR USA OR "mobile phone*" OR "wenzhou governance" OR traumatization OR similarity OR retraction* OR quickly OR gold OR "china coronavirus")	14	
		( TITLE ( "first case" OR "asymptomatic contact" ) AND SRCTITLE ( "new england" ) ) OR ( TITLE ( urgently ) AND SRCTITLE ( psychiatry ) ) OR ( TITLE ( clinicians ) AND SRCTITLE ( jama ) ) OR ( TITLE ( response ) AND SRCTITLE ( bmj ) ) OR ( TITLE ( potential OR mers* OR updates OR economic OR reference ) AND SRCTITLE ( "medical virology" ) ) OR ( TITLE ( "potential scenarios" OR "rapid establishments" OR france ) AND SRCTITLE ( "Euro" ) )		
		13 OR 14	15	
		12 AND NOT 15	16	43

Sample list of irrelevant publications:

Source title	Titles of retrieved publications
Molecular Pharmaceutics	How Corona Formation Impacts Nanomaterials as Drug Carriers
Academic Radiology	Corona Virus International Public Health Emergencies: Implications for Radiology Management

8. Review of existing bibliometric studies

Title	Objective	Search Terms	Database & coverage	Findings
Bibliometric analysis of PubMed literature on Coronavirus Disease 2019 (Chahrour et al., 2020)	To explore the activity and trend of COVID-19 research worldwide since its outbreak in December 2019.	Novel coronavirus 2019, coronavirus 2019, COVID 2019, COVID 19	PubMed & WHO, Dec 2019 to March 16, 2020	- 194 articles, 81 journals - researches on the new coronavirus pneumonia mainly focus on virology and epidemiology, but lack of relevant research results such as treatment and prognosis.
Current Status of Global Research on Novel Coronavirus Disease (COVID-19): A Bibliometric Analysis and Knowledge Mapping	Evaluated the contemporary scientific literature to assess the evolution of knowledge on COVID-19, identify the leading research	Coronavirus, covid, covid-19, wuhan, china, Chinese, novel	Web of Science, 2019 to 2020	- 371 records - Major areas identified through evaluating keywords and text data included genetic, epidemiological,

(March 3, 2020) (Hossain, 2020)	stakeholders, and analyze the conceptual areas of knowledge development in this domain.			zoonotic, and other biological topics associated with COVID-19.
SARS-CoV, MERS-CoV and now the 2019-novel CoV: Have we investigated enough about coronaviruses? – A bibliometric analysis (letter to the editor) (Bonilla-Aldana et al., 2020)	To assess the current state of CoV-related literature worldwide.	Coronavirus	Science Citation Index (SCI), Scopus, and PubMed January 1951–January 2020	- USA and China have primary roles in CoV research, with USA leading the scientific production with nearly a third of the articles