A Bibliometric Network Analysis
of Collaboration in Covid-19 Handling

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Abstract. This study aims to determine the dynamics of research trends on collaboration in COVID-19 handling based on co-authorship of country, co-occurrence of author keywords, and citations of authors, sources, and countries. Accordingly, bibliometrics is used as an instrument to reveal the emphasis and tendencies of scientific discourse as outlined in the articles contained in the Scopus database. Together with bibliometrics; VOSviewer 1.6.16 is used to visualize a network based on articles published with certain keywords. This study is not to look at the implementation of policies and actions taken by each country but to see the development of research topics related to collaboration in handling Covid-19 using bibliometric data. This study shows that there are 154 relevant publications related to collaboration in handling Covid-19 dated from 2020 to February 20, 2022. The United States is the country having the most productive and the most collaborative country that published articles related to collaboration in COVID-19 handling. The term Covid-19 is the node that appears the most in the title, keyword, and abstract; it emerges 91 times out of 508 keywords while the term collaboration itself is still rarely seen from the appearance of keywords, only represented by 7 occurrences. However, judged from the overlay of these nodes, they are widely discussed in the 2020s. Judged from the citation, Nguyen d. became the most cited author with the number of 284 citations. Journal of Medical Virology became the most cited journal related to the collaboration on COVID-19 handling, while The United States became the country that the most cited articles. The limitation of this study is only using one database namely Scopus.

Keywords: bibliometric analysis · collaboration · Covid-19 handling · VOSviewer

1   Introduction

The Covid-19 pandemic is a surprising disaster in human history around the world. Almost all countries and regions in the world have been affected by Covid-19. Indonesia was among them, which officially announced its exposure to Covid-19 in March 2020. Covid-19 emerged unexpectedly as a new reality that changed many daily patterns and assumptions [1] in addition to changing economic policies ranging from the global level to the corporate level [2]. This unpredictability has created an atmosphere of shock and unpreparedness in all countries, no matter big countries or small countries, rich countries

or poor countries, developed countries or developing countries, federal countries or unitary countries [3]. Covid-19 also provides an understanding that exposure to Covid-19 is taking place with increasing frequency and unexpectedness [4], confronting the world with challenges that are unimaginable in every place where Covid-19 is infected [5]. In this condition, Covid-19 can be interpreted as a pandemic with the widest outbreak area in human history. This meaning directly states that Covid-19 is a world problem, which in global connectedness, slants the continuous movement of goods, services, and people [6]. The pandemic has presented a new reality, that is, its solution requires global joint efforts, and thus reflects responses framed by the initial requirements of "no supreme authority, no world government, no Leviathan that maintains order" [1]. But what happened was the opposite, where the initial response from almost all of these countries was to take protective actions to protect their respective people. Every country puts itself first. For example, when the COVID-19 pandemic hit Europe, the countries on this continent, which had been working together for a long time, closed their borders and focused on the sustainability of their respective countries [1]. A more specific example, Poland at the beginning of the emergence of Covid-19 used a strict lockdown mechanism [2]. The COVID-19 pandemic has revealed the fact that the world is not together, on the contrary, it shows, on the one hand, an imbalance in the ability of countries to act and react, and on the other hand, the opportunity to gain an advantage for certain groups [3]. This fact also shows eternal competition and conflict in the reality between nations [1].

When exposure to Covid-19 reached its culmination point in various countries such as South Korea, India, and the United States, there was an awareness that the handling of Covid-19 cannot be done separately country by country because the world is closely connected [1]. The fast-paced character of Covid-19 is forcing countries to cooperate globally. Covid-19 is promoting an unprecedented level of global collaboration in crisis management [5] and in turn, requires joint decision-making [1]. This response at the same time illustrates the view that in the future, pandemic response readiness is determined by effective collaboration within and between countries based on the mutual recognition that regional and national boundaries are irrelevant for handling infectious diseases [7].

In addition, as time has passed, there has been an understanding that the handling of Covid-19 is not solely related to the health aspect. The pandemic has had implications for almost all aspects of life, from the economy to tourism, arts and sports, and political affairs [8], having a territory, politics, and governance dimensions [3], and along with implications on the economic and social dimensions [9]. Increasing unemployment, increasing layoffs, and widespread poverty show the need for every country to deal with Covid-19 through increasing herd immunity and strengthening the Covid-19 handling system in the form of strengthening the health system, economic recovery, and social safety nets. That is why handling Covid-19 requires every country to respond with appropriate policies and actions. Sometimes difficult choices must be faced, including when conditions arise, where when handling Covid-19 leads to strengthening the health system, there is a setback in economic development [10], In addition, the globalization factor raises the tension of interests between commercial, national, and global society [6, 11]. This tension raises hidden contradictions between the sovereign interests of the state and the borderless world shaped by the growing interdependence between the scientific community and economic actors [6].

Effective policy implementation requires collaboration within and between countries. Policymakers must take measures to deal with Covid-19 while building new collaborations and networks within and between countries [7], which not only covers the government actors and institutions, but also includes all stakeholders including the government, and the private sector, community, and media. Public-private collaboration determines effective responses to extreme events [12]. In other words, the effectiveness of handling Covid-19 requires the formation of collaborative networks between and between nations [7]. All of this has given rise to a global effort to find ways to understand and deal with Covid-19. Much of this search effort is in the hands of academics, and as such, academics' research and publication patterns have been greatly influenced by the current crisis [8]. Along with that, the overall dynamics of Covid-19 became the focus of attention of academics, and in turn, was recorded in a series of research articles.

In summary, the Covid-19 pandemic increased research productivity by an enormous amount and with an enormous number of articles appearing every day with new articles related to Covid-19 [13], reflecting the concerns, conclusions, and advice from experts who can be seen as the key to the successful handling of Covid-19 [1, 13]. The efforts, developments, and challenges in handling Covid-19, as recorded in scientific articles, are interesting to study and examine trends. That is the purpose of this article, namely, to map the trend of publications regarding collaboration in handling Covid-19.
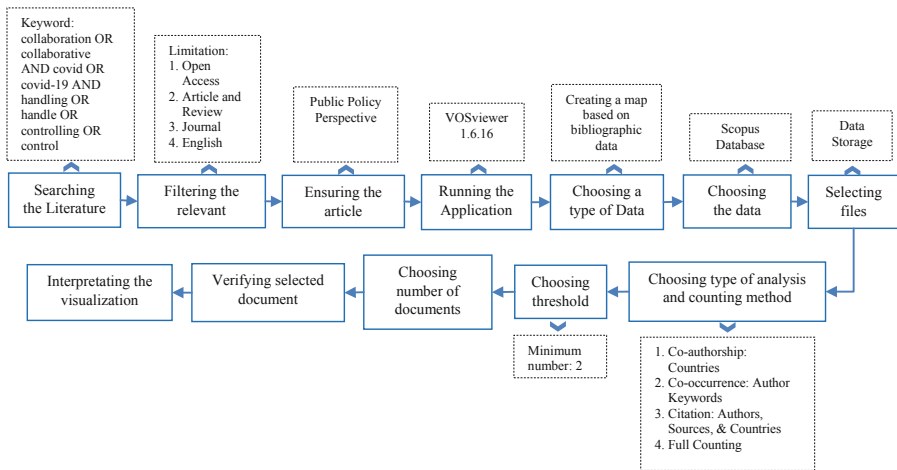
2 Methods

This study was conducted to observe the development of research on collaborative handling of COVID-19 using bibliometric data which is used to find out the research area through the author's bibliographic information from published articles [14]. In short, bibliometrics functions to describe, evaluate, and control research activities [15]. The data used is the Scopus database which is one of the most famous databases in the world. A literature search using the keywords collaboration OR collaborative AND covid OR covid-19 AND handling OR handle OR controlling OR control found in abstracts, titles, and keywords totalled 1,176 documents dated from 2020 to February 20, 2022. After the first stage of the search, the second stage of the search was carried out by limiting the writing from accessibility, document type, source type, and language used to 734 documents. With this limitation, the Boolean in this study is TITLE-ABS-KEY (collaboration OR collaborative AND covid OR covid-19 AND handling OR handle OR controlling OR control) AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SRCTYPE, "j")).
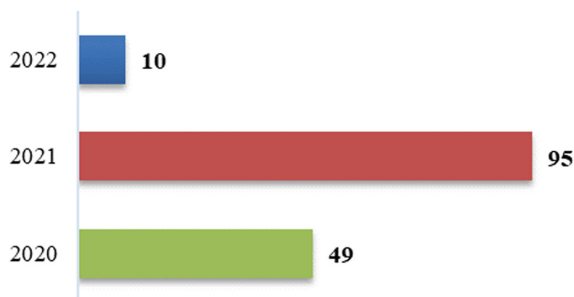
The third stage is carried out by looking at writings that only focus on publication titles related to collaboration in handling Covid-19 from the perspective of handling policies. This third stage is carried out with the help of the Mendeley application which one of its functions is to find relevant papers based on what you're reading [16] at this stage, 154 documents relevant to this study were obtained. After the literature search is used, the next stage is network construction and network visualization analysis using the VOSviewer 1.6.16 application which is a tool for creating the networks [17]. This visualization will be seen from Co-authorship, Co-occurrence, and citation as in Table 1 while the workflow in this study is illustrated in Fig. 1.

Table 1. Visualization of This Study

Type of analysis	Unit of Analysis	Type of Visualization
Co-authorship	Countries	Network Visualization
Co-occurrence	Author Keywords	Network, Overlay, and Density Visualization
Citation	Authors, Sources, and Countries	Network Visualization

Fig. 1. Workflow of Data Collection and Analysis

Fig. 2. Research Topics Trend related to Collaboration in Handling Covid-19

3   Results and Discussion

3.1   Research Topic Trend

The development of research topics on collaboration in handling Covid-19 dated from 2020 to February 20, 2022, can be seen in Fig. 2.

Covid-19 which some countries have occurred since the end of 2019 or early 2020. In 2020, there are 49 relevant articles related to collaboration in handling Covid-19. This number has increased rapidly by almost 2-fold in 2021, namely as many as 95 publications. While entering the second month of 2022, the number of publications related to this Covid-19 collaboration has shown the number of 10 articles published in the Scopus database.

This collaboration is important not only in cases of handling Covid-19 but also in cases of natural and non-natural disasters [18] which can not only be resolved by the government but also requires the participation of various parties involved [19–22]. The development of this research topic shows that Covid-19 is an interesting issue when viewed from a collaborative camera and even these writings can be a reference for alternative solutions when the Covid-19 issue at any time turns into another issue.

3.2 Collaborative Countries

Collaboration is not only interpreted in solving public problems, but can also be seen in publications between authors, institutions, and countries. In this study, the authors only present collaborations between countries to which the authors are affiliated. The collaborative network of countries is illustrated by the co-authorship of country visualization in VOSviewer. This collaboration between countries is interesting because it shows that Covid-19 is an issue that occurs in all countries in the world.

Figure 3 can explicitly show which countries publish the most articles related to collaborative handling of Covid-19 on the Scopus database marked with the largest node. The node indicates the country in which the article was published. The bigger the node, the more the country will publish articles related to collaboration in handling Covid-19. There are 81 countries that publish articles, but only 45 authors collaborate with authors from different countries. This collaboration between countries can also be
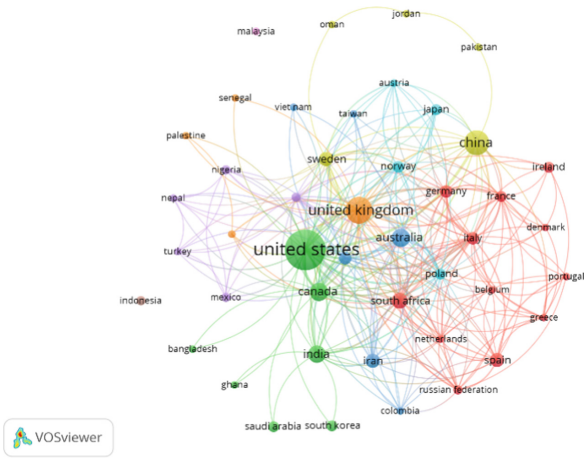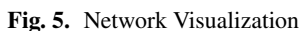

Fig. 3. Publication Collaboration Network among Countries

Fig. 4. Most Productive Countries

Fig. 5. Network Visualization

seen that the most productive countries in publications related to collaboration issues in handling Covid-19 are presented in Fig. 4.

3.3 Keywords Visualization

This keyword visualization is seen from the author's keywords in publications related to collaboration in handling Covid-19. Author keywords in academic papers can be considered as a key element to understanding the contents of the paper [23]. Figure 5 shows the keywords that appear the most in research titles in the Scopus database.

There are 508 keywords and 45 of them form a cluster. This cluster shows a set of related keywords. Covid-19 was the keyword that appeared most often, 91 times, while collaboration was only found 7 times. This shows that even though the research title contains the word collaboration, the author's keywords do not necessarily include the word. This means that collaboration is not the focus of the research content, the background of the research topic, or even the author's point of view on previous studies (Fig. 6).
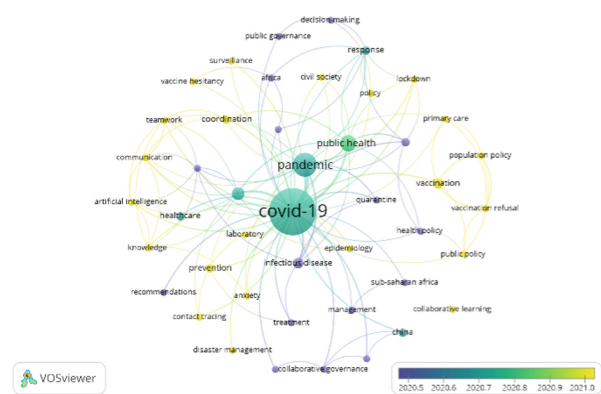
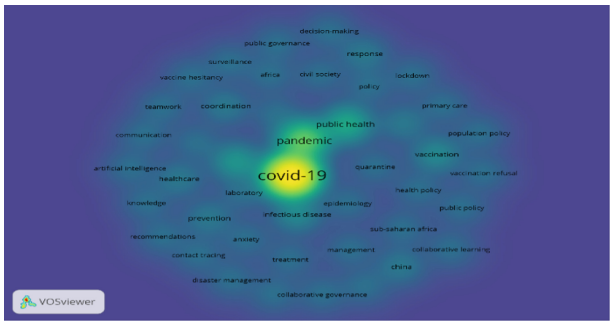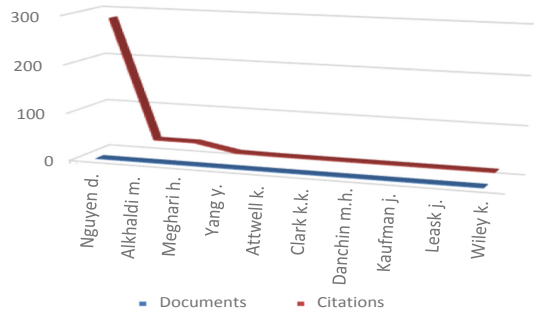**Fig. 6.** Overlay Visualization

Fig. 7. Density Visualization

Overlay visualization shows how recently keywords were discussed and published. The most recent terms related to collaboration in handling COVID-19 are shown in yellow, namely in 2021, including public policy, vaccine hesitancy, anxiety, artificial intelligence, communication, coordination, knowledge, teamwork, vaccination, vaccination refusal, prevention, disaster management, civil society. Society. The interesting thing is that Collaboration and collaborative governance have been widely discussed since the 2020s. This means that collaboration in handling Covid-19 has become an interesting issue in research.

Density visualization can see the density of keywords that have been discussed by previous studies. The denser the keywords, the yellower the visualization color, which indicates that the keyword has been widely discussed and has become the focus of previous research. From this visualization, it is possible to find out which research focus is still rarely studied so that it can find research gaps and novelty in a study. In Fig. 7, Covid-19 is the most closely related term, indicating that in this study of collaboration in handling Covid-19, the term covid-19 is the most central term and has been studied a lot compared to collaboration itself.

Fig. 8. Top 10 Most Cited Authors

3.4 Most Influential Authors

The most influential author can be seen from the number of citations to the author. Figure 8 shows the most cited authors and the number of documents published. There are 952 authors who publish articles related to collaboration in handling Covid-19 and 12 networks of writers who collaborate with each other in publications.

Nguyen d. being the author with the most citations shows the author is the most influential in publications related to collaboration in handling Covid-19 with a total of 284 citations.

3.5 Most Influential Journal

Regarding publications with the keyword collaboration in handling Covid-19, Table 2 shows the source of the publication. The Journal of Medical Virology with a total of 279 citations became the most popular source for the publication of articles and became one of the most influential journals. This journal is a United States journal from Wiley-Blackwell publisher which covers infectious diseases and virology.
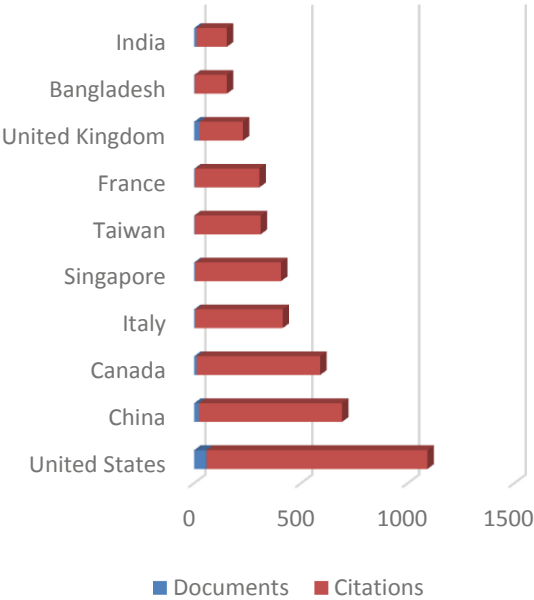
3.6 Most Influential Countries

The most influential Country is the United States with a number of publications of 57 documents and 1,035 citations. This means that the United States is the most popular and influential country in publications related to collaboration in handling Covid-19. In addition, documents written by US-affiliated Authors serve as references for authors from other countries in publications (Fig. 9).

Table 2. Top 10 most Cited Sources

No	Source	Citations
1	Journal of Medical Virology	279
2	Frontiers in Public Health	154
3	American Journal of Tropical Medicine and Hygiene	62
4	Journal of Religion and Health	41
5	Global Public Health	36
6	International Journal of Environmental Research and Public Health	18
7	PLOS One	16
8	Medical Journal of Australia	14
9	Journal of The American Medical Directors Association	10
10	Jmir Public Health and Surveillance	8

Fig. 9. Top 10 most Cited Countries

4 Conclusion

The unpredicted covid-19 pandemic requires every country to respond with an appropriate policy and action. In so doing, every country realizes that effective policy implementation requires the establishment of collaboration within any country and among countries as well. In line with this, they are also aware that collaboration is to spur not

only among the government but also all of the stakeholders such as government, private sector, community, media, and other stakeholders. This study is not to look at the implementation of policies and actions taken by each country but to see the development of research topics related to collaboration in handling Covid-19 using bibliometric data. This study shows that there are 154 relevant publications related to collaboration in handling Covid-19 dated from 2020 to February 20, 2022. The United States is the country having the most productive and the most collaborative country that published articles related to collaboration in COVID-19 handling. The term Covid-19 is the node that appears the most in the title, keyword, and abstract; it emerges 91 times out of 508 keywords while the term collaboration itself is still rarely seen from the appearance of keywords, only represented by 7 occurrences. However, judged from the overlay of these nodes, they are widely discussed in the 2020s. Judged from the citation, Nguyen d. became the most cited author with the number of 284 citations. Journal of Medical Virology became the most cited journal related to the collaboration on COVID-19 handling, while The United States became the country that the most cited articles. The limitation of this study is only using one database namely Scopus.

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