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Mapping trends and hotspots in research on global influenza vaccine hesitancy: A bibliometric analysis

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Abstract

Background and Aims: Influenza is one of the most widespread respiratory infections and poses a huge burden on health care worldwide. Vaccination is key to preventing and controlling influenza. Influenza vaccine hesitancy is an important reason for the low vaccination rate. In 2019, Vaccine hesitancy was identified as one of the top 10 threats to global health by the World Health Organization. However, there remains a glaring scarcity of bibliometric research in that regard. This study sought to identify research hotspots and future development trends on influenza vaccine hesitation and provide a new perspective and reference for future research.

Methods: We retrieved publications on global influenza vaccine hesitancy from the Web of Science Core Collection database, Scopus, and PubMed databases from inception to 2022. This study used VOSviewer and CiteSpace for visualization analysis.

Results: Influenza vaccine hesitancy-related publications increased rapidly from 2012 and peaked in 2022. One hundred and nine countries contributed to influenza vaccine hesitation research, and the United States ranked first with 541 articles and 7161 citations. *Vaccines-Basel* was the journal with the largest number of published studies on influenza vaccine hesitations. MacDonald was the most frequently cited author. The most popular research topics on influenza vaccine hesitancy were (1) determinants of influenza vaccination in specific populations, such as healthcare workers, children, pregnant women, and so on; (2) influenza and COVID-19 vaccine hesitancy during the COVID-19 pandemic.

Zhengyu Zhang and Songjia Tang have contributed equally to this work and shared the first authorship.

Conclusions: The trend in the number of annual publications related to influenza vaccine hesitancy indicating the COVID-19 pandemic will prompt researchers to increase their attention to influenza vaccine hesitancy. With healthcare workers as the key, reducing vaccine hesitancy and improving vaccine acceptance in high-risk groups will be the research direction in the next few years.

KEYWORDS
bibliometric, data visualization, influenza, vaccine hesitancy

1 | INTRODUCTION

Influenza is one of the most widespread respiratory infections and poses a major threat to health worldwide. According to the World Health Organization (WHO), there are 3–5 million cases of severe influenza and about 290,000–650,000 deaths globally each year.[1] Current evidence suggests that certain populations, including young children, the elderly, and chronically ill patients, are at high risk for influenza-related deaths.[2] Vaccines are key to preventing and controlling influenza. The 2019–2020 influenza vaccination program is thought to have prevented 7.5 million influenza infections, 3.7 million influenza-related medical appointments, 105,000 influenza-related hospitalizations, and 6300 influenza-related deaths.[3] However, despite recommendations by the WHO and the US Centers for Disease Control and Prevention (CDC), influenza vaccination rates exhibit significant heterogeneity across different regions globally.[4] An increasing body of evidence suggests that vaccination rates among the general public are very low, with many countries reporting coverage levels below 50% of the targeted populations.[5] Moreover, vaccination rates are low among high-risk groups such as pregnant women[6] and children.[5]

In recent years, significant emphasis has been placed on identifying potential barriers to vaccine acceptance. Factors such as insufficient awareness of the disease risk,[7] concerns about vaccine safety and reports of vaccine adverse events,[7] lack of vaccination,[8] lack of regular health care sources, availability and affordability of vaccines,[9] and lack of recommendations from medical personnel,[10] have been identified as reasons for vaccine hesitancy. In 2019, the World Health Organization (WHO) officially defined vaccine hesitancy as the delay or refusal to vaccinate due to a lack of knowledge about vaccine safety, effectiveness, and the diseases they protect against. This designation positioned it as one of the top 10 global health threats.[11]

Schmid et al.[4] highlighted that influenza vaccines have special characteristics compared to other standard vaccines, such as vaccine effectiveness varies annually and the requirement for yearly vaccination. Despite the declaration of influenza vaccination as a priority healthcare goal in many countries, it is typically recommended to target only specific risk groups, such as children. Thus, influenza vaccine hesitancy exhibits distinct features. Additionally, the emergence of the COVID-19 pandemic in late 2019 disrupted healthcare services globally and heightened concerns about vaccines in general.[12,13] Despite sporadic outbreaks of seasonal influenza in numerous countries, the persistent threat posed by influenza vaccine hesitancy remains a significant public health concern.

To our knowledge, no bibliometric studies have been conducted regarding influenza vaccine hesitation. Accordingly, based on the Web of Science Core, Scopus, and Pubmed databases, we conducted a bibliometric analysis of the existing literature on influenza vaccine hesitancy. This study utilized VOSviewer and CiteSpace analytical software to (I) conduct bibliometric analyses of influenza vaccine hesitancy studies; (II) generate visual knowledge maps; (III) present the current research landscape of influenza vaccine hesitancy; (IV) identify research hotspots and development trends; and (V) provide a valuable reference for future research in this area.

2 | MATERIALS AND METHODS

2.1 | Data sources and data extraction

In this study, data were retrieved from the Web of Science Core Collection database (WoSCC), Scopus, and PubMed databases from inception until December 31, 2022. The search strategy used was a topic-based search using the keywords “influenza,” “vaccine,” and “hesitancy.” We restricted the document type to “Article.” Articles not published in English were also excluded, with no time limit. Two authors (ZZ and YY) worked together to assess the search results, and if necessary, a third author (HQ) was consulted for arbitration. After removing duplicates, we obtained 1416 articles. All retrieved records were downloaded in “plain text” format, and relevant information was extracted for further analysis. The data used in this study came from a public database; thus, the approval of the ethical committee was not required. The flowchart is shown in Figure 1.

2.2 | Data analysis and visualization

VOSviewer (version 1.6.19) was used for visualization analysis in this study. It is well-established that VOSviewer can provide a

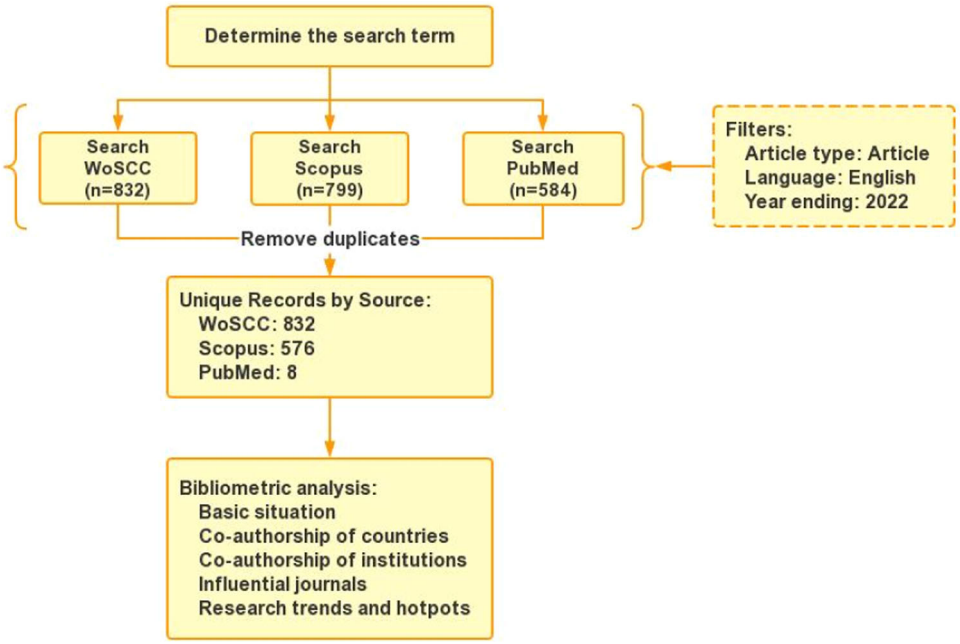


FIGURE 1 Flowchart of study used in the analysis.

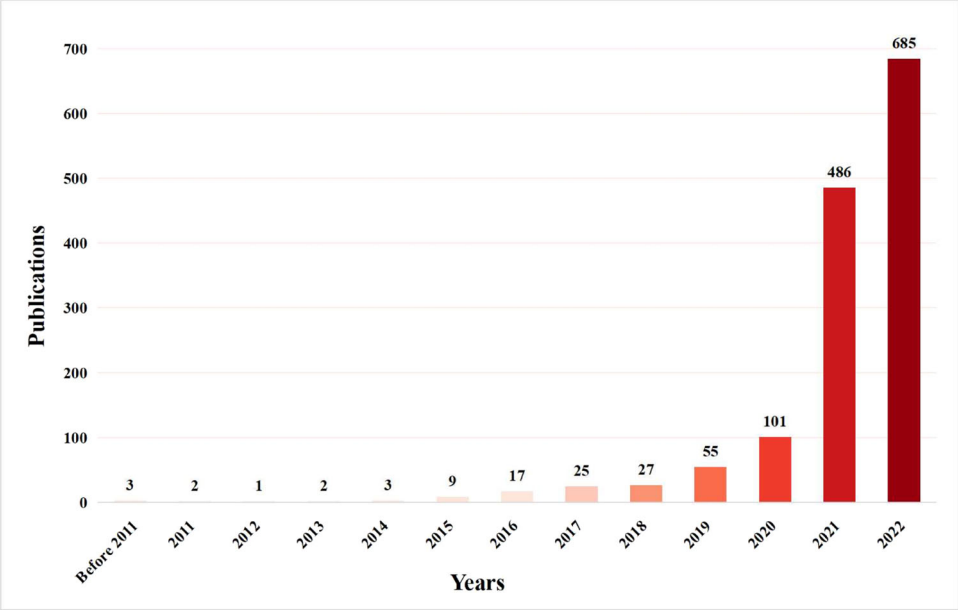


FIGURE 2 The annual number of publications in the research topic.

variety of visualization modes (network visualization, overlay visualization, and density visualization), which were used for the coauthorship of countries, institutions, authors, and co-occurrence of keywords in this study. CiteSpace software was used to conduct a bibliometric analysis of the publications on influenza vaccine hesitancy, calculate betweenness centrality (BC) for countries, institutions, and authors, and the bursts of keywords. Moreover, Microsoft Word 2019 was used for descriptive statistics, including ranking, frequency, and citation analysis. The web tool MapInSeconds (https://www.mapinseconds.com/) was used to visualize the geographical distribution of publications.

3 | RESULTS

3.1 | The trend of annual publications

In August 1994, Wrenn et al. published the first article on Influenza vaccine hesitancy titled "Influenza and pneumococcal vaccination in the emergency department: is it feasible?."[10] The annual number of publications on influenza vaccine hesitancy is shown in Figure 2. It was found that the number of publications experienced a significant surge after 2019, with the number of publications in 2022 being 14 times higher than that in 2019.

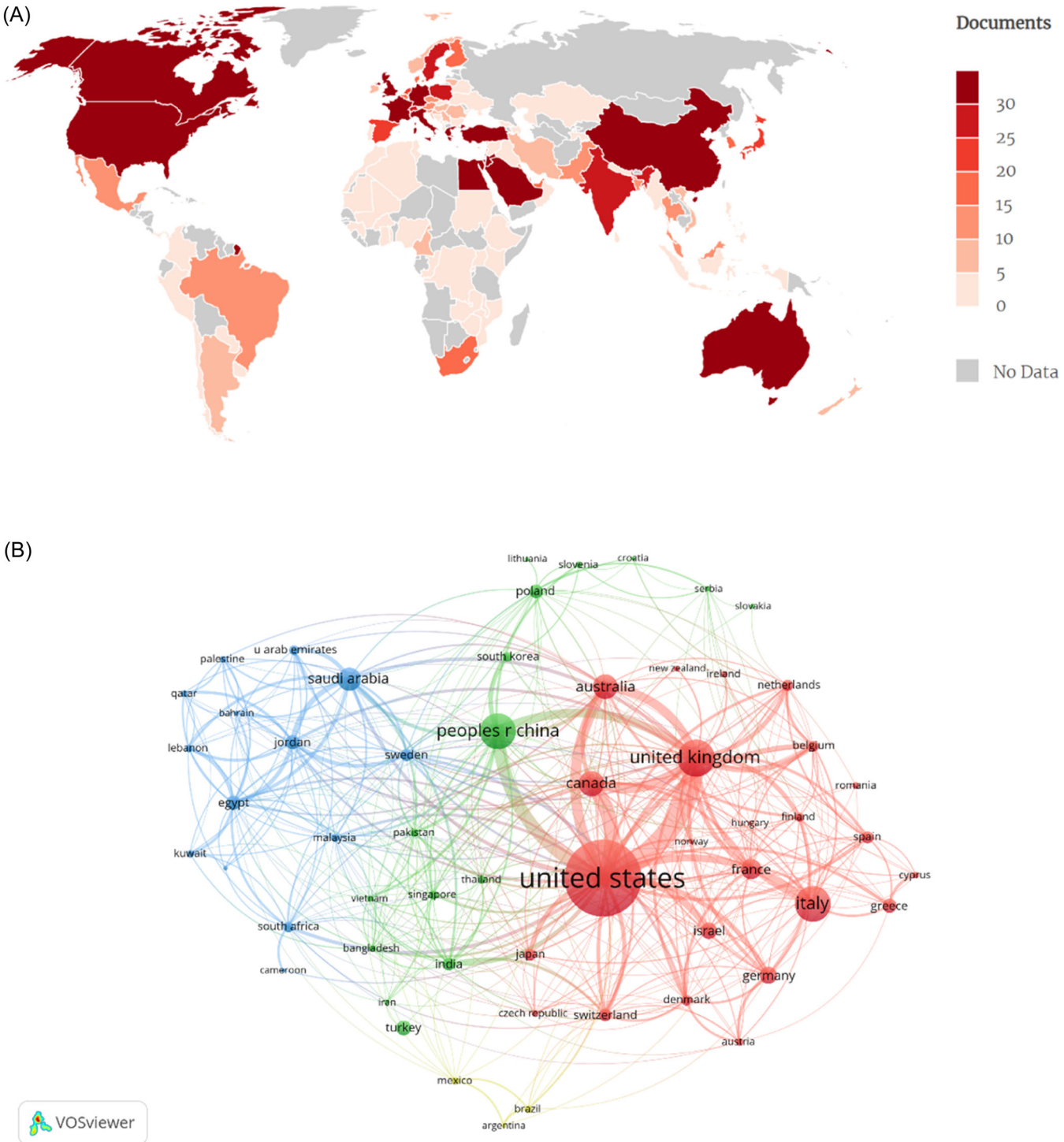


FIGURE 3 Cooperation map of countries. (A) Geographical distribution map of global publications. (B) Visualization map of cooperation relationships of countries.

TABLE 1 The top 10 countries publishing influenza vaccine hesitancy.

Rank	Country	Continent	Documents	Citations	BC
1st	United States	North America	541	7161	0.28
2nd	United Kingdom	Europe	157	3611	0.17
3rd	People Republic of China	Asia	151	2405	0.04
4th	Italy	Europe	148	1737	0.11
5th	Canada	North America	86	1200	0.02
6th	Auatralia	Asia	78	815	0.04
7th	Saudi Arabia	Asia	73	1002	0.05
8th	France	Europe	57	1212	0.06
9th	Germany	Europe	45	573	0.01
10th	Israel	Asia	40	402	0.01

Abbreviation: BC, betweenness centrality.

TABLE 2 The top 10 institutions with highest number of publications on influenza vaccine hesitancy.

Rank	Institution	Country	Documents	Citations	BC
1st	University of Washington	United States	38	1704	0.18
2nd	University of London	United Kingdom	33	1530	0.22
3rd	Emory university	United States	28	213	0.08
4th	Peking university	People Republic of China	26	279	0.02
5th	Dalhousie University	Canada	25	574	0.06
6th	Johns Hopkins University	United States	24	624	0.08
7th	University of Michigan	United States	21	229	0.05
8th	University of California, Los Angeles	United States	19	263	0.03
9th	University of Maryland	United States	18	652	0.01
10th	University of Colorado	United States	18	209	0.02

Abbreviation: BC, betweenness centrality.

TABLE 3 The top 10 authors with highest number of publications on influenza vaccine hesitancy.

Rank	Author	Country	Documents	Citations	BC
1st	Pierre Verger	France	10	477	0.00
2nd	Heidi J Larson	United States	9	1311	0.00
3rd	Dube Eve	Canada	9	558	0.01
4th	Justin Gatwood	United States	8	84	0.00
5th	Freimuth Vicki S	United States	7	582	0.00
6th	Quinn Sandra C	United States	7	532	0.00
7th	Bonanni Paolo	Italy	7	206	0.00
8th	Betsch Cornelia	Germany	7	161	0.00
9th	Omer Saad B	United States	7	105	0.00
10th	Peretti-Watel Patrick	France	6	568	0.00

Abbreviation: BC, betweenness centrality.

3.2 | Analysis of countries

One hundred and nine countries participated in research on influenza vaccine hesitancy. Figure 3A depicts the coauthorship of countries, where areas in gray represent no published articles, while darker shades of red indicate a higher number of publications. The United States was the leading country in this field, with the highest number of publications ($n = 541$) and citations ($n = 7161$) (Table 1). BC is a measure that signifies the importance of nodes within a collaborative network, with BC values greater than 0.10 generally indicating a bridging role. The United States had a central role in the global cooperation network (BC = 0.28) and closely collaborated with the United Kingdom and Canada, as depicted in Figure 3B.

3.3 | Analysis of institutions

The top 10 institutions were predominantly located in North America and Europe, with seven in the United States (Table 2). The University of Washington in the United States led in terms of the number of publications, with 38 publications and 1704 citations, followed by the University of London in the United Kingdom (33 publications, 1530 citations), Emory University in the United States (28 publications, 213 citations) (Table 3). The University of London (BC = 0.22) and the University of Washington (BC = 0.18) demonstrated significant BC and played crucial roles in this field (Figure 4).

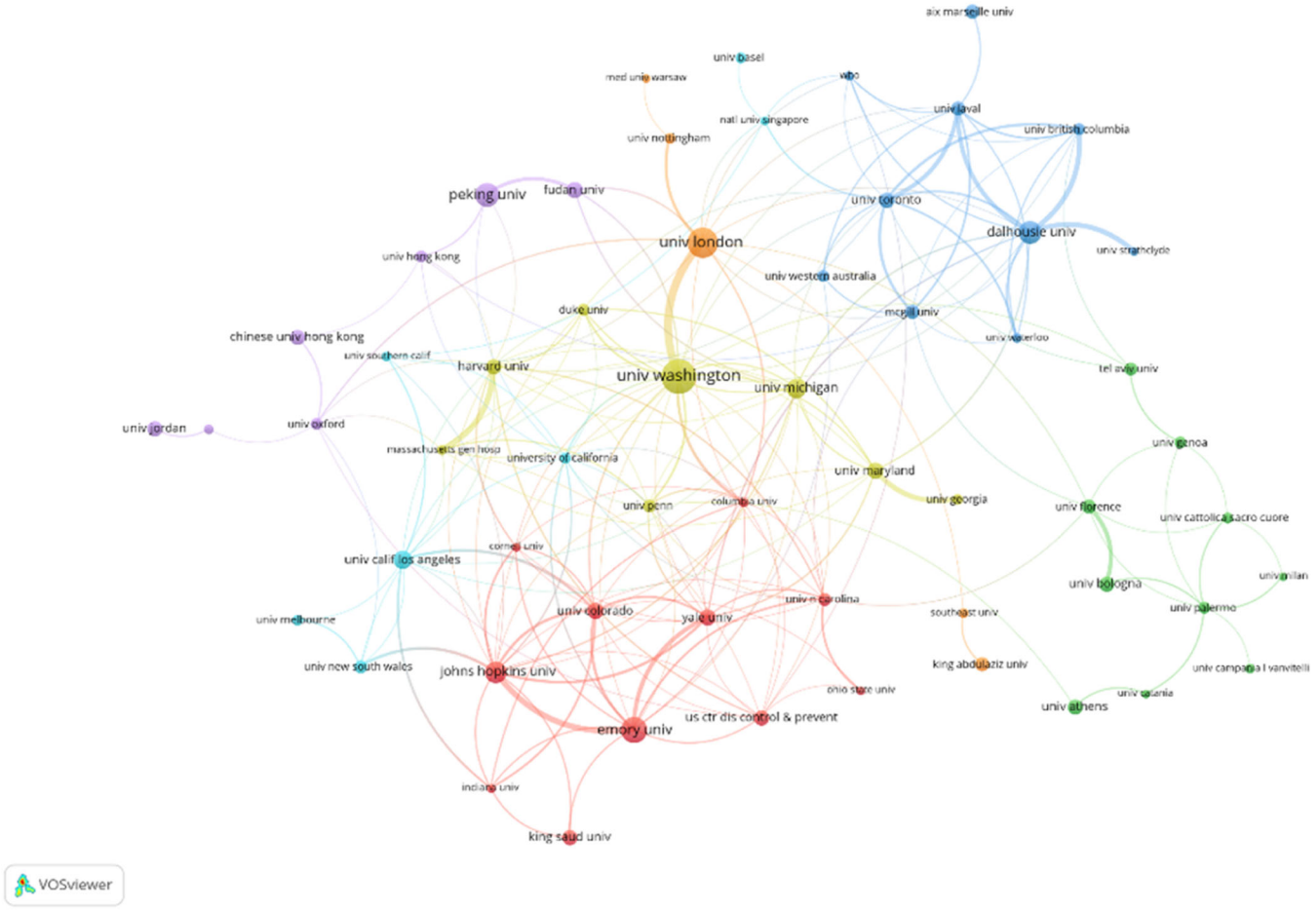


FIGURE 4 Visualization map of cooperation relationships of institutions.

3.4 | Analysis of authors

The top 10 prolific authors in the field of influenza vaccine hesitancy are shown in Table 3. The most prolific author was Pierre Verger, with 10 published articles with 477 citations. In terms of total citations, Heidi J Larson ranked first with 1311 citations. Similar to the institutional rankings, all authors in the top 10 were from Europe and North America. It is worth noting that the author's cooperation network was relatively sparse and fragmented, with a lack of cooperation among research groups (Figure 5).

3.5 | Analysis of journals

Table 4 lists the top 10 journals by number of publications and citations. *Vaccines-Basel* (267, 18.9%) was the most published journal, followed by *Vaccine* (167, 11.8%) and *Human Vaccines & Immunotherapeutics* (123, 8.9%). Nevertheless, the ranking of cited journals was not in accordance with the ranking by the number of publications. *Vaccine* was the most influential journal with 4213 citations, much higher than *Vaccines-Basel* (1306 citations). In contrast to the results of existing comparative journal studies,[14,15] among journals that published influenza vaccine hesitancy, non-OA journals had higher citation metrics and OA journals had higher output. The density visualization of the journal co-citation network is shown in Figure 6, where journals with higher citation density shown in red, and those with lower density appear in blue. Taking both the number of publications and citations into account, it can be inferred that *Vaccine*, *Human Vaccines & Immunotherapeutics*, *and Vaccines-Basel* were the most popular journals in the study of influenza vaccine hesitancy over the study period.

3.6 | Analysis of reference

It is well-established that when two or more references are cited by more than one article, the two references share a co-citation relationship. Publications with many citations are generally articles with high academic value and great professional influence. Of the 42,204 cited references, the top 10 most frequently cited references are shown in Table 5 and are valuable publications in the field. "Vaccine hesitancy: Definition, scope and determinants" published by MacDonald[16] has been cited the most frequently, indicating that

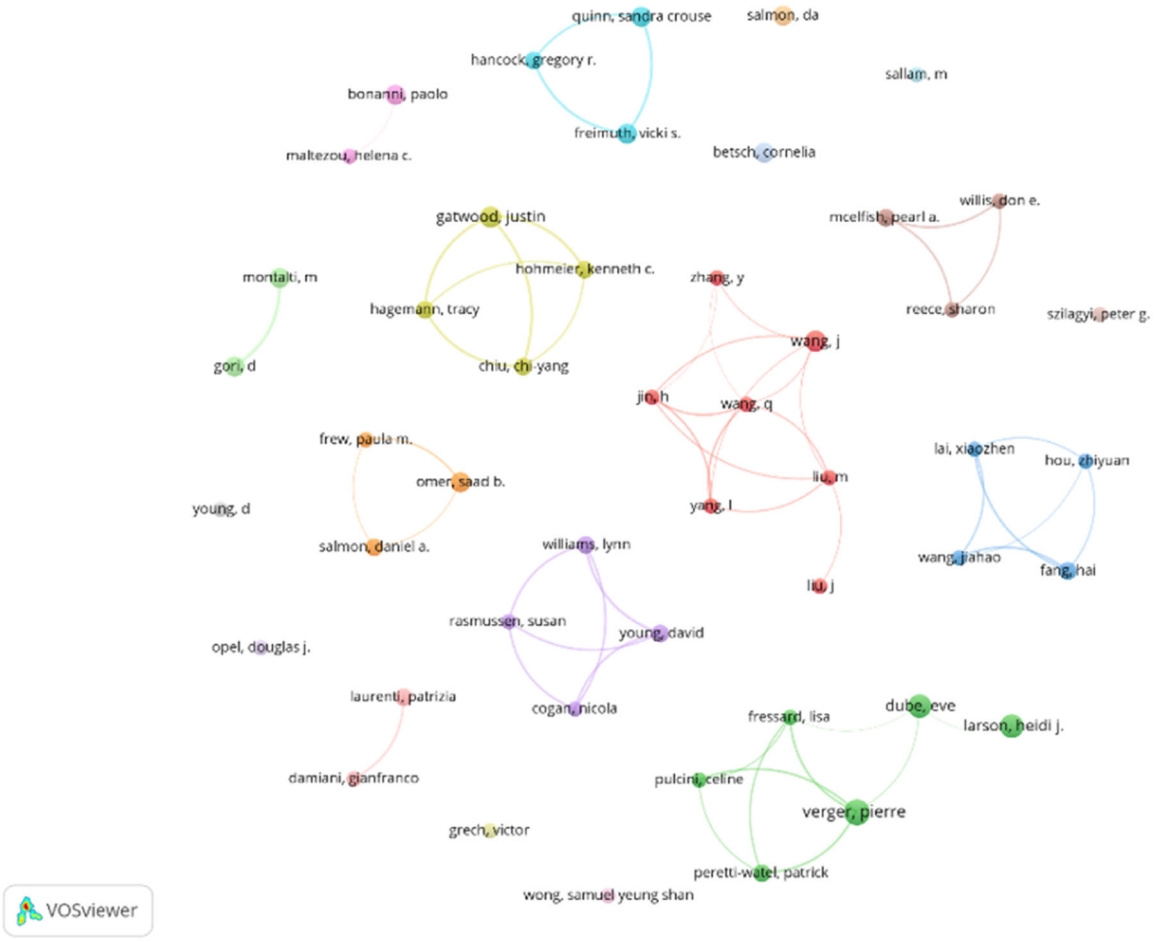


FIGURE 5 Visualization map of cooperation relationships of authors.

most scholars in this field have recognized the academic value of this literature.

3.7 | Analysis of keyword

Keywords can reflect the hotspots and frontiers in a particular field. In this analysis, the keyword clustering map generated by VOSviewer identified five clusters based on keywords that appeared more than 10 times in the literature (Figure 7). The largest cluster, represented in red, mainly investigated the determinants of influenza vaccination for specific populations, such as healthcare professionals and pregnant women. The second largest cluster in green focused on the attitudes of children and pregnant women toward COVID-19 vaccination. The blue cluster examined the awareness of influenza and COVID-19 vaccines among healthcare workers during the COVID-19 pandemic. The yellow cluster sought to improve vaccinators' knowledge and belief in vaccines and their vaccination intention. The purple cluster analyzed the impact of the health behaviors of vaccinators, the safety and immunization effectiveness of vaccines, and public health policies on COVID-19 vaccination.

4 | DISCUSSION

In this study, we conducted a bibliometric analysis of publications related to influenza vaccine hesitancy to identify hotspots and trends in influenza vaccine hesitancy. Our analysis included an examination of the earliest literature on influenza vaccine hesitancy, which was published in 1994 and focused on vaccination rates, intentions, and reasons for refusal among emergency department patients and physicians. Interestingly, 57% of emergency department patients and 89% of emergency department physicians were not vaccinated against influenza due to the hesitancy among emergency department physicians about assuming the primary care task of providing such immunizations. This study highlighted the importance of healthcare providers in promoting vaccination.[10] Before 2011, research on influenza vaccine hesitancy was scarce. The annual number of publications related to influenza vaccine hesitancy increased from 2012, with a significant surge after 2019, thus indicating that the study of influenza vaccine hesitancy is experiencing a rapid growth stage and represents a research hotspot for the coming years. The surge in research activity after 2012 can be attributed to the (H1N1) pdm09 epidemic, which was the most recent global influenza pandemic. According to estimates from the CDC, the (H1N1)

TABLE 4 The top 10 journals with highest number of publications and citations on influenza vaccine hesitancy.

Rank	Publication journal	Documents	IF	Cited journal	Citations	IF
1st	Vaccines-Basel[a]	267	4.961	Vaccine	4213	4.169
2nd	Vaccine	167	4.169	Vaccines-Basel[a]	1306	4.961
3rd	Human Vaccines & Immunotherapeutics[a]	123	4.526	Human Vaccines & Immunotherapeutics[a]	1198	4.526
4th	International Journal of Environmental Research and Public Health[a]	50	4.614	PLoS One[a]	981	3.752
5th	PLoS One[a]	43	3.752	Pediatrics[a]	610	9.703
6th	Frontiers in Public Health[a]	33	6.461	New England Journal of Medicine	493	176.077
7th	BMC Public Health[a]	29	4.135	Lancet	483	202.728
8th	Expert Review of Vaccines	22	5.683	BMC Public Health[a]	472	4.135
9th	Vaccine:X[a]	14	0.000	JAMA-Journal of the American Medical Association	372	157.377
10th	Pediatrics[a]	10	9.703	Mmwr-Morbidity and Mortality Weekly Report[a]	357	35.301

[a]Open Access.

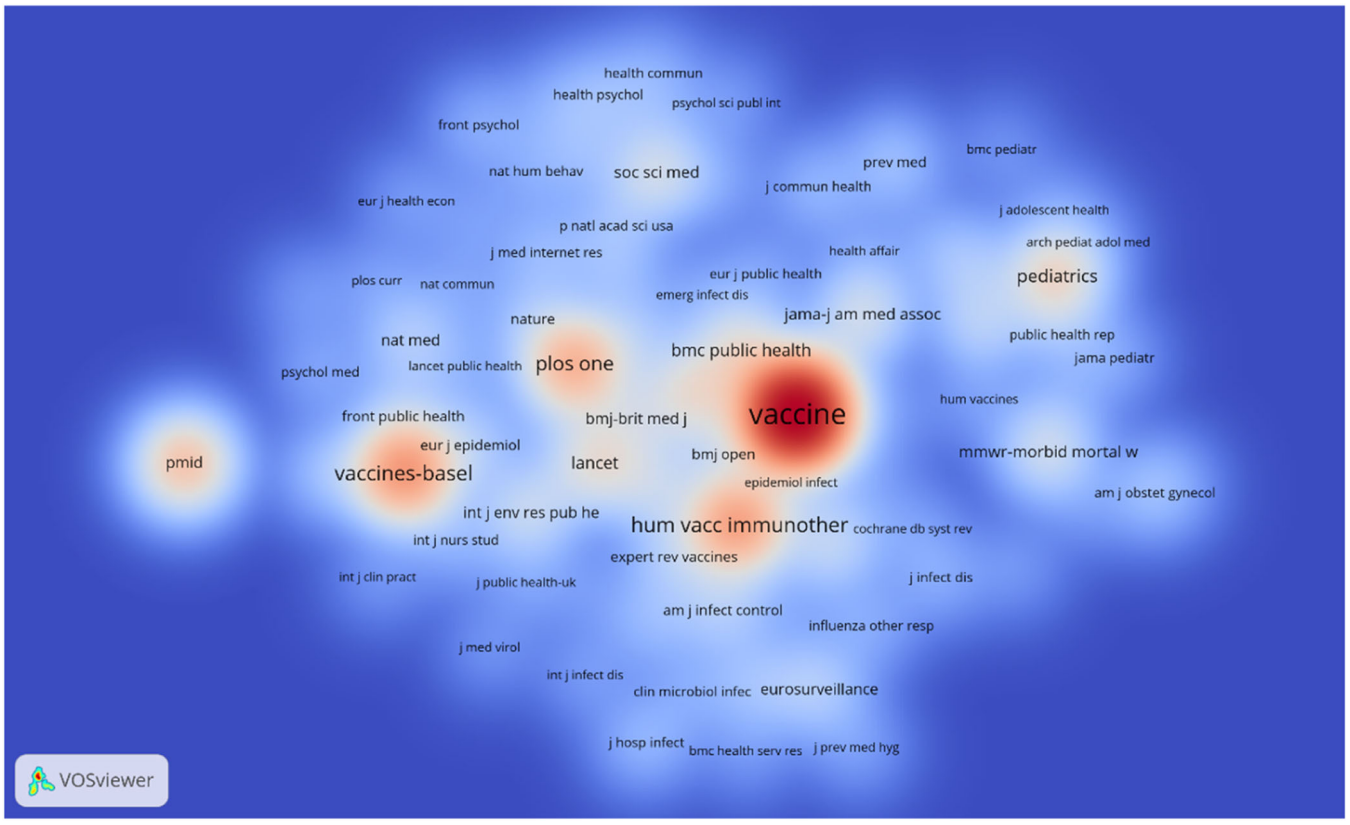


FIGURE 6 Journal density map based on the co-citation network.

pdm09 virus caused a significant number of fatalities, ranging from 151,700 to 575,400 worldwide during its initial year of circulation. This pandemic served as a catalyst for influenza vaccination campaigns in numerous countries.[17–19] Additionally, there was an increased research focus on understanding vaccination intention during this period.[20,21] The increase in publications after 2019 may be attributed to the COVID-19 pandemic affecting influenza vaccination.[22,23]

TABLE 5 The top 10 references with highest number of citations on influenza vaccine hesitancy.

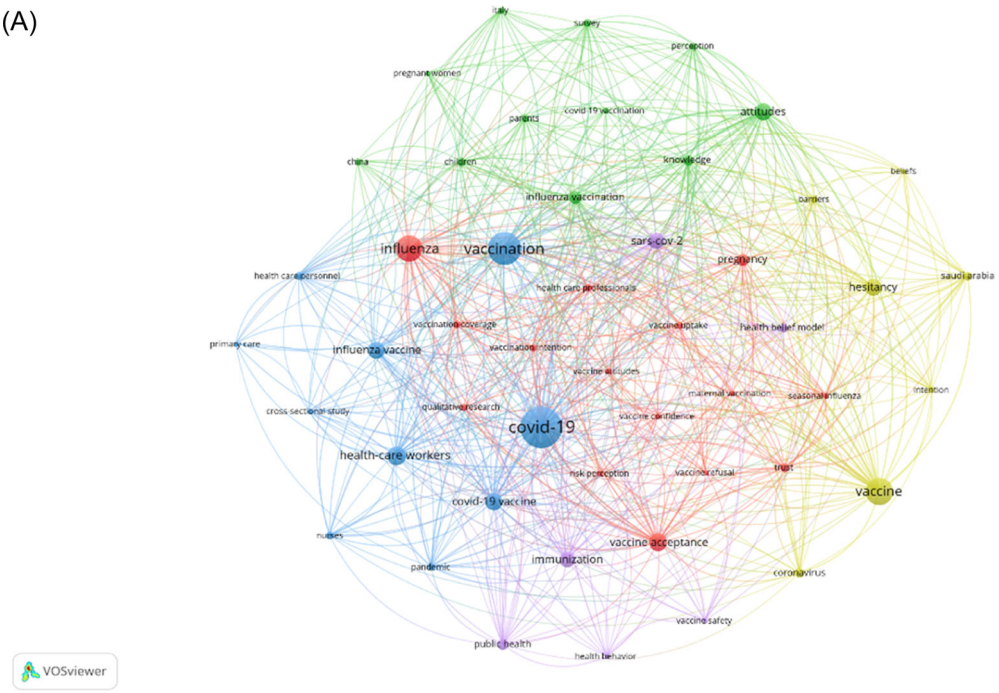
Rank	Author	Title	Journal	Year	Citation
1st	MacDonald NE	Vaccine hesitancy: Definition, scope and determinants	Vaccine	2015	291
2nd	Larson HJ	Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007-2012	Vaccine	2014	143
3rd	Lazarus JV	A global survey of potential acceptance of a COVID-19 vaccine	Nature Medicine	2021	122
4th	Schmid P	Barriers of Influenza Vaccination Intention and Behavior - A Systematic Review of Influenza Vaccine Hesitancy, 2005-2016	PLoS One[a]	2017	110
5th	Dube E	Vaccine hesitancy: an overview	Human Vaccines & Immunotherapeutics[a]	2013	99
6th	Dror AA	Vaccine hesitancy: the next challenge in the fight against COVID-19	European Journal of Epidemiology	2020	98
7th	Paterson P	Vaccine hesitancy and healthcare providers	Vaccine	2020	86
8th	Fisher KA	Attitudes Toward a Potential SARS-CoV-2 Vaccine: A Survey of U.S. Adults	Annals of Internal Medicine	2016	83
9th	Sallam M	COVID-19 Vaccine Hesitancy Worldwide: A Concise Systematic Review of Vaccine Acceptance Rates	Vaccines-Basel[a]	2021	76
10th	Reiter PL	Acceptability of a COVID-19 vaccine among adults in the United States: How many people would get vaccinated?	Vaccine	2020	64

[a]Open Access.

COVID-19 is an infectious respiratory disease that shares the same routes and means of transmission as the influenza virus, and the combination of COVID-19 and seasonal influenza in winter can lead to co-infection cases, leading to worse clinical outcomes.[24,25] Dadashi et al.[26] reported that the prevalence of influenza infection among confirmed COVID-19 patients was 0.8%, the co-infection rate of influenza virus in China and the United States was 3.1% and 0.7%, and the overall influenza vaccine coverage rate for the 2019/2020 influenza season was 1.43% in China and 51.8% in the United States, respectively. Therefore, the co-infection of COVID-19 and seasonal influenza may be related to the higher prevalence of influenza in patients with low vaccination rates. Encouragingly, studies by Kong et al. demonstrated that the COVID-19 pandemic prompted a more active global influenza vaccination intention, with an increase observed in all regions in the 2020/2021 influenza season.[23] However, influenza vaccine hesitancy still exists. The belief held by certain individuals who decline the influenza vaccine, that it is less important amidst the COVID-19 pandemic, adds to the hesitancy surrounding influenza vaccination. In addition, reports of adverse events from COVID-19 vaccines have increased concerns among the population about the immunization effectiveness and safety of other vaccines.[12] Many countries have reported decreasing influenza infection rates during the 2020/2021 influenza season due to public health measures such as mandatory mask-wearing.[25,27,28] Accordingly, low worry and perceived risk of vaccine-preventable diseases may be major factors accounting for vaccine hesitancy in the next influenza season. More worryingly, current evidence suggests that influenza vaccination rates in countries such as the United States and Italy have declined in the 2021/2022 and 2022/2023 influenza seasons.[29–31] Influenza vaccination rates are inadequate, and the risk of influenza pandemic may increase. Hence, reducing influenza vaccine hesitancy and promoting vaccination should be priorities for the next influenza season.

Our study showed that the United States contributed the most to influenza vaccine hesitancy research in terms of the number of publications, total citations, and international cooperations in the field, which may be related to the significant public and private funding support and strong research cultural foundation in the United States.[32] Europe and North America have been the leaders in research in the global influenza vaccine hesitancy field, with 9 out of the top 10 institutions located in North America and Europe and the University of Washington being the most important contributing institution, which may be due to several reasons. First, public health policies in North America and Europe have provided free influenza vaccination programs for high-risk populations, and well-established primary healthcare systems have protected the accessibility and convenience of vaccination.[29,33] Second, rich countries pay more attention to healthcare and are therefore more likely to provide funding to health development research infrastructure and fund research activities,[32] positioning American and European institutions at the forefront of research on influenza and influenza vaccines.[34] Third, close cooperation between Europe and North America facilitates the exchange of resources and methods to enhance their research influence. Fourth, democratic countries with broad freedom of speech, such as the United Kingdom and the United States, are more susceptible to anti-vaccine movements, which can contribute to public vaccine hesitancy and consequently attract increased attention from researchers in these countries.[35] Despite this, limited

(A)



(B)

Keywords	Year	Strength	Begin	End	2011 - 2022
coverage	2011	19.55	2011	2022	
immunization	2011	12.89	2011	2020	
attitudes	2011	13.36	2014	2022	
recommendations	2014	6.95	2014	2020	
refusal	2014	6.94	2014	2019	
health care workers	2013	19.12	2015	2022	
barriers	2015	7.53	2015	2022	
hesitancy	2016	22.75	2017	2022	
knowledge	2018	9.35	2018	2022	
vaccine acceptance	2019	6.92	2020	2022	

FIGURE 7 Visualization map of keywords on influenza vaccine hesitancy. (A) Clustering co-occurrence map of keywords. (B) The top 10 keywords with the strongest citation bursts.

cooperation among research groups suggests that progress in this area necessitates increased cross-disciplinary cooperation.

Vaccine, *Vaccines-Basel*, and *Human vaccines & Immunotherapeutics* are the most favored by researchers in the influenza vaccine hesitancy field. Academic achievements related to influenza vaccine hesitancy are more likely to be published in these journals, and researchers interested in influenza vaccine hesitancy are also more likely to find what they need to read in these journals. MacDonald et al.[16] published an article in this journal titled "Vaccine hesitancy: Definition, scope and determinants," which was the most cited article on the development of influenza vaccine hesitancy research. The article defines vaccine hesitancy as a delay in acceptance or refusal of vaccination despite the availability of vaccination services and divides the determinants of vaccine hesitancy into contextual, individual and group, and vaccine/vaccine-specific influences.

We found that articles about influenza vaccine hesitancy focused primarily on high-risk populations, such as children, older adults, and pregnant women, which are associated with an increased risk of death or adverse pregnancy outcomes if they contract influenza. The infection and prevalence rates of influenza virus are the highest among children, especially young children and children with high-risk diseases, who are more susceptible to pneumonia, asthma exacerbations, dehydration, and neurological complications.[36–38] Moreover, children represent the most important transmitters of influenza,[39] and vaccinating children can effectively reduce community transmission of influenza. Concerns about vaccine safety are the main reasons parents may refuse to vaccinate their children against influenza. Healthcare workers play a vital role in addressing childhood vaccine hesitancy, as their knowledge, confidence, and recommendation of vaccines have a positive impact in reducing hesitancy,[40] helping to

increase immunization coverage among children under 18 years of age.[41,42]

Influenza vaccination for individuals aged 65 and older is a cost-effective strategy for preventing disease. It effectively reduces emergency hospital admissions, and hospitalizations related to influenza complications, and prevents deaths in this high-risk population, aged 65 and older, resulting in savings in social and public health costs. Consequently, North America and some European countries prioritize individuals over 65 for free influenza vaccination services. According to data from the OECD,[43] only the United Kingdom and South Korea have achieved the target of 80% influenza vaccination coverage among people aged 65 and older between 2018 and 2022. Among this older age group with access to free vaccination services, the primary reason for influenza vaccine hesitancy is a low perception of disease severity and risk of infection.[4,44]

Brittany et al reported that influenza infection in pregnant women led to an increased risk of hospitalization and aggravated pregnancy complications.[45] The WHO recommends annual vaccination for pregnant women at any stage of pregnancy.[1] However, previous studies have shown that influenza vaccination coverage is extremely low in pregnant women. In this respect, only 1.2% of pregnant women in France were vaccinated against influenza between 2009 and 2018,[40] compared with more than 50% of people over 65 years old.[43] The primary factor behind pregnant women not receiving the influenza vaccine is the absence of vaccination recommendations from healthcare providers. Research conducted by Im JH et al. demonstrated the positive effect of healthcare workers on influenza vaccination among pregnant women, highlighting their role in promoting vaccination in this vulnerable population. When healthcare workers' recommendations for influenza vaccination increased from 4.8% to 49.7%, the influenza vaccination rate among pregnant women increased from 4.0% to 59.3%.[46]

Healthcare workers encompass a broad category of professionals, including doctors (specialists, pediatricians, and general practitioners), nurses, various healthcare practitioners, and technicians.[47] They face an elevated risk of contracting influenza, potentially serving as carriers of the virus to vulnerable patients. Healthcare workers play a pivotal role in diminishing the impact of disease outbreaks, serving as role models for preventive measures, and encouraging others to receive vaccinations. Consequently, healthcare workers were among the first to be recommended for immunization, prompting numerous countries to institute vaccination programs tailored to their needs. Despite these efforts, vaccination rates remain suboptimal, ranging from 8.84% to 83.6% among healthcare workers [48–53] among healthcare workers. Concerns about vaccine safety and perceived low risk of disease are major factors leading to vaccine hesitancy among healthcare workers. Apprehensions about vaccine safety and a perception of low disease risk are key factors contributing to vaccine hesitancy within this group. Notably, vaccine hesitancy among healthcare workers can diminish their willingness to recommend influenza vaccines to the public. This hesitancy among healthcare workers poses a significant obstacle to the public's access and acceptance of influenza vaccinations.[21] Given the influential role of healthcare workers in shaping public vaccine acceptance, educational programs for healthcare workers should concentrate on addressing distrust and misconceptions regarding vaccination.

5 | CONCLUSION

Through the visualization of bibliometrics, the research progress, research hotspots, and research frontiers on influenza vaccine hesitancy after 2011 were described. The findings of this study further add to the available body of evidence and provide a reference for influenza vaccine hesitancy. Due to the impact of the COVID-19 pandemic, the number of influenza vaccine hesitancy publications is currently increasing rapidly. The United States is the leader in the research on influenza vaccine hesitancy. The University of Washington and the University of London have worked closely on influenza vaccine hesitancy, are at the center of the global research collaborative network of influenza vaccine hesitancy, and are the preferred partner institutions in this research field. To date, the field of influenza vaccine hesitancy has not produced authors with global influence, and there has been a lack of cooperation between research groups at various institutions. Improving awareness of influenza and influenza vaccine among healthcare workers is key to reducing influenza vaccine hesitancy. The effect on influenza vaccine hesitancy caused by the Covid-19 pandemic on the subsequent influenza season, especially for high-risk groups, will be the focus of researchers.

This study also has some limitations. First, the data were retrieved from the WOSCC, Scopus, and PubMed databases, which primarily feature English-language journals. Consequently, there is a potential language bias in the findings, as publications on vaccine hesitancy from non-English-language journals may have been overlooked. Second, our study relies on published literature, and some developing countries might face challenges in conducting relevant research due to healthcare policies and limited resources. Third, there is a possibility of errors in the analysis stemming from variations in data formats across different databases. For instance, discrepancies in institution names, spellings, or abbreviations could have introduced errors when analyzing institution nodes. Moreover, considering the rapid growth of influenza vaccine hesitancy research, it is uncertain whether new high-quality articles have been excluded as the field continues to expand.

AUTHOR CONTRIBUTIONS

Zhengyu Zhang: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; visualization; writing—original draft. **Songjia Tang**: Data curation; formal analysis; investigation; methodology;

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article. The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

TRANSPARENCY STATEMENT

The lead authors Xiaoxin Wu, Qian Hong, and Yuan Yuan affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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