

Research Trends on Airborne Pathogen Transmission and Mitigation

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Abstract

INTRODUCTION: A deep understanding of airborne pathogen transmission and mitigation efforts is crucial for designing effective health policies. Therefore, it is necessary to analyze research trends related to airborne pathogen transmission and mitigation strategies to identify the latest developments, especially concerning scientific knowledge.

OBJECTIVES: The study was conducted to get a deeper understanding of research trends related to airborne transmission of pathogens.

METHODS: Bibliometric analysis with the help of VOSviewer and RStudio was considered suitable for use in this study.

RESULTS: Based on the research results, the topic of airborne pathogens is still a hot topic for research. 2021 is the year when the number of publications regarding airborne pathogens peaked, which is due to the covid 19 pandemic condition. Apart from that, this research also found research on the transmission and mitigation of airborne pathogens relatively less.

CONCLUSION: The topic of airborne pathogens is still a hot topic for research.

Keywords: Airborne pathogen, Bibliometric, Mitigation, Transmission, VOSviewer.

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1. Introduction

Global pandemics such as those caused by airborne diseases, including viruses such as SARS-CoV-2, have significantly shifted the public health paradigm. A deep understanding of airborne pathogen transmission and mitigation efforts is crucial for designing effective health policies. Airborne pathogens such as bacteria, viruses, and fungi enter living organisms either directly through breathing or indirectly through contact with surfaces, thereby posing serious threats to human health and economic growth [1-2].

Based on this, analysis of research trends related to airborne pathogen transmission and mitigation strategies is essential to identify recent developments in scientific knowledge. Bibliometric analysis plays an important role in evaluating the impact and direction of scientific

research. By identifying the most relevant and frequently cited scientific publications, we can understand how far a research field has developed and identify centers of excellence in research related to airborne pathogen transmission.

Bibliometric analysis is also a quantitative method for analyzing bibliographic data in articles/journals [3]. Bibliometric analysis is usually used to investigate references to scientific articles cited in a journal, map the scientific field of a journal, and group scientific articles according to a research field [4]. The approach used in the bibliometric analysis is the citation analysis approach to see 1 article cited by 1 other article [5] and the co-citation analysis approach to find 2 or more articles cited by 1 article [6].

Many previous researchers have conducted research using bibliometric analysis, as shown in Table 1.

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Apart from using bibliometric analysis, this research also uses VOSviewer as an additional analytical tool to examine research trends, especially regarding airborne pathogens. VOSviewer enables visual representation of scientific networks and facilitates understanding of the relationships between various research topics [7]. Analysis using VOSviewer can help identify research clusters, relationships between keywords, and the development of critical concepts in scientific literature [8].

Therefore, this study aims to get a deeper understanding of research trends related to airborne pathogen transmission. It is also hoped that this research can guide further research to face global health challenges related to the transmission of airborne pathogens and become a reference for researchers who are looking for topics to research.

Table 1. Previous studies on bibliometric

No	Title	Ref.
1	Involving Particle Technology in Computational Fluid Dynamics Research: A Bibliometric Analysis	[9]
2	Bibliometric Computational Mapping Analysis of Trend Metaverse in Education using VOSviewer	[10]
3	The Use of Information Technology and Lifestyle: An Evaluation of Digital Technology Intervention for Improving Physical Activity and Eating Behavior	[11]
4	Strategies in language education to improve science student understanding during practicum in laboratory: Review and computational bibliometric analysis	[12]
5	How language and technology can improve student learning quality in engineering? definition, factors for enhancing students' comprehension, and computational bibliometric analysis	[13]
6	Mapping of nanotechnology research in animal science: Scientometric analysis	[14]
7	Scientific research trends of flooding stress in plant science and agriculture subject areas (1962-2021)	[15]
8	Introducing ASEAN Journal of Science and Engineering: A bibliometric analysis study	[16]
9	A bibliometric analysis of chemical engineering research using VOSviewer and its correlation with Covid-19 pandemic condition	[17]
10	A bibliometric analysis of materials research in Indonesian journal using VOSviewer	[18]
11	Bibliometric analysis of engineering research using Vosviewer indexed by google scholar	[19]
12	Bibliometric computational mapping analysis of publications on mechanical engineering education using VOSviewer	[20]
13	Research trend on the use of mercury in gold mining: Literature review and bibliometric analysis	[21]
14	Domestic waste (eggshells and banana peels particles) as sustainable and renewable	[22]

No	Title	Ref.
	resources for improving resin-based brakepad performance: Bibliometric literature review, techno-economic analysis, dual-sized reinforcing experiments, to comparison with commercial product	
15	Bibliometric analysis of educational research in 2017 to 2021 using VOSviewer: Google scholar indexed research	[23]

2. METHOD

The bibliometric analysis method with the help of theoretical analysis was used in this research. Theoretical literature research is a research approach related to collecting and analyzing existing literature or writings to understand and develop a conceptual or theoretical framework for a research topic. The method used in this research focuses on reviewing previously published theories, concepts and research findings to form a deeper understanding of a phenomenon. The research procedure is shown in Figure 1. Article data collection was carried out on November 21 2023 from the Scopus database. The research steps consist of identifying the research topic, literature search, literature selection, literature analysis, literature synthesis, preparation of a conceptual framework, and writing a report.

The research theme taken is Airborne Pathogen Transmission and Mitigation. Searches are carried out via the page <https://www.scopus.com/>. Keyword searches are carried out with the prerequisite of finding the keywords, title, and abstract of the article. There are several conditions set during the search process, namely publication of type of articles, articles must be in English, and final articles. The keywords used in this research are (TITLE-ABS-KEY (airborne) AND TITLE-ABS-KEY (pathogenic) AND TITLE-ABS-KEY (transmission) AND TITLE-ABS-KEY (mitigation)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")). The search results found 27 documents spread over the period 2009 to 2024.

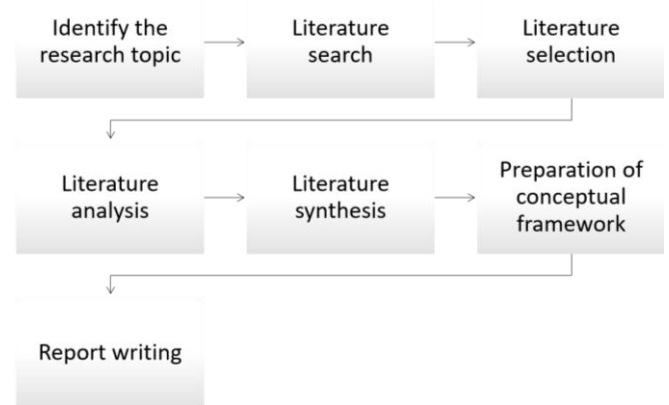


Figure 1. This is a legend. Caption to go below figure

3. RESULTS AND DISCUSSION

3.1. Current Progress of Airborne Pathogen Transmission and Mitigation Research

Figure 2 shows the annual report publication regarding airborne pathogen transmission and mitigation research. Figure 2a shows a visualization network of data distribution of terms that are usually used and discussed in articles with this research theme, Figure 2b shows the development of the number of publications per year, Figure 2c shows the average citations each year, while Figure 2d shows the trend of research topics with the theme. This is based on the frequency of appearance.

It is known that the development of research on airborne pathogen transmission and mitigation is still relatively small, where from 2009 to 2024, 27 Scopus-indexed journal documents were found that discussed this research theme (see Figure 2b). The largest number of documents was found in 2021. In 2009 only 1 document was found in Scopus, in 2013 1 document was found. In 2020 there was an increase in the number of publications to 2 documents until in 2021 the increase occurred significantly, namely 12 documents were found. However, in 2022 there was a decrease in the number of publications to 7 documents and the decline continues until now with details in 2021 7 documents were found, in 2023 3 documents were found, and in 2024 1 document was found.

We conducted a study regarding the number of citations from the total documents found. Figure 2c shows the average number of citations for articles regarding airborne pathogen transmission and mitigation research, both the average total citations per article and the average total citations per year. The highest average number of citations occurred in 2021 with a total of 12 citations with an average citation of 4.69. The top cited articles can be seen in Table 2.

The increase in the number of studies and the number of citations in journal articles regarding the transmission and mitigation of airborne pathogens in Scopus in 2021 can be attributed to the COVID-19 pandemic which was still ongoing at that time. COVID-19 is caused by the SARS-CoV-2 virus, which can spread through the air via droplets and aerosol particles. Airborne spread is a major concern because it can occur in closed environments, such as indoor spaces or public transportation.

We conducted an analysis of topic trends based on terms found in each research document used in this research. We use visualization mapping analysis with VOSviewer and topic trend analysis using RStudio. Based on this analysis, it is known that research on airborne pathogen transmission and mitigation is mostly related to Covid-19 with the topic frequency found reaching 16 times. Research on the transmission and mitigation of airborne pathogens has been widely linked to COVID-19 because the SARS-CoV-2 virus, which causes COVID-19, has significant airborne transmission properties. SARS-CoV-2 can spread through droplets and aerosols produced by infected individuals

[24]. This creates a risk of airborne transmission, especially in closed spaces with poor ventilation. Other words that are usually topics in research themes regarding the transmission and mitigation of airborne pathogens are human, ventilation, transmissions, particle size, air sampling, infection, virus, aerosol, risk, mitigation strategy, model, spread, and droplet.

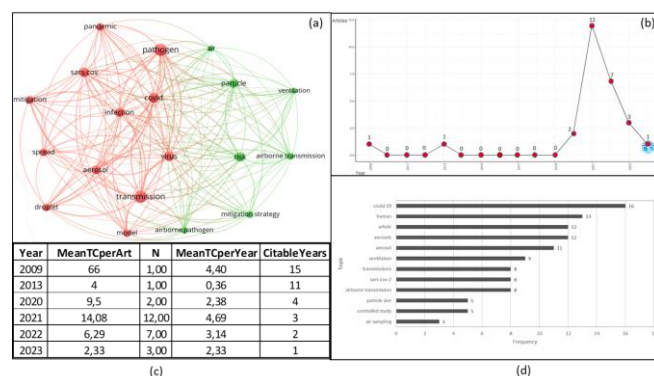


Figure 2. Annual Report Publication (a) Network visualization; (b) Annual Scientific Production Report; (c) Average Citation per Year; (d) Trend Topic. Note. MeanTCperArt: Mean Total Cited per Article; MeanTCperYear: Mean Total Cited per Year.

Table 2. Top Cited Articles on Airborne Pathogen Transmission and Mitigation by Scopus.

Ref.	Title	Citations
[25]	Cold oxygen plasma technology efficiency against different airborne respiratory viruses	66
[26]	Urban flooding events pose risks of virus spread during the novel coronavirus (COVID-19) pandemic	57
[27]	The airborne contagiousness of respiratory viruses: A comparative analysis and implications for mitigation	31
[28]	Modeling of aerosol transmission of airborne pathogens in ICU rooms of COVID-19 patients with acute respiratory failure	25
[29]	Virus spread versus contact tracing: Two competing contagion processes	20
[30]	Quantifying proximity, confinement, and interventions in disease outbreaks: A decision support framework for air-Transported pathogens	17
[31]	Evaluation of the spatter-reduction effectiveness and aerosol containment of eight dry-field isolation techniques	15
[32]	Multiscale Airborne Infectious Disease Transmission	13
[33]	Modelling airborne transmission of SARS-CoV-2 using CARA: Risk assessment for enclosed spaces	10
[34]	Dispersion of virus-laden droplets in ventilated rooms: Effect of homemade facemasks	9

3.2. Journal Source Regarding Research on Airborne Pathogen Mitigation and Transmission

Figure 3 shows the results of Rstudio's analysis of the journal sources most relevant to research on airborne pathogen mitigation and transmission. Based on the results shown in Figure 3, it is known that 10 journal sources are considered to have a high value of relevance to the research theme based on the number of documents found in the journal. The sources in first place were Aerosol and Air Quality Research and Scientific Reports with a total of 2 documents found. Other sources that can be used as a reference for publishing articles about airborne pathogens are the American Journal of Infection Control, Applied and Environmental Microbiology, CFD Letters, Environmental Science and Technology, Frontiers in Bioengineering and Biotechnology, Frontiers in Medicine, Gastrointestinal Endoscopy, and Geoscience Frontiers.

The analysis in this research shows that several sources have a high local impact based on their H-Index values. All journals included in this list have an H-Index value of 1 as shown in Figure 4. These journals are sequentially Aerosol and Air Quality Research, American Journal of Infection Control, Applied and Environmental Microbiology, CFD Letters, Environmental Science and Technology, Frontiers in Bioengineering and Biotechnology, Frontiers in Medicine, Gastrointestinal Endoscopy, Geoscience Frontiers, and Interface Focus.

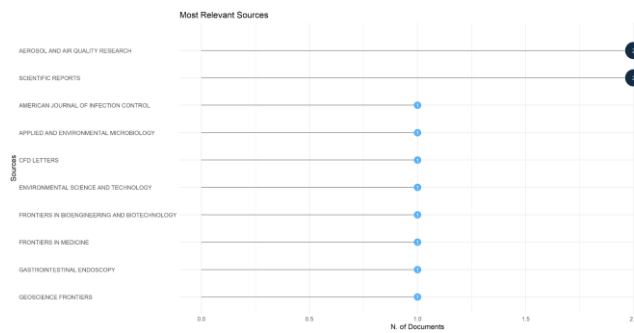


Figure 3. Most Relevant Source.

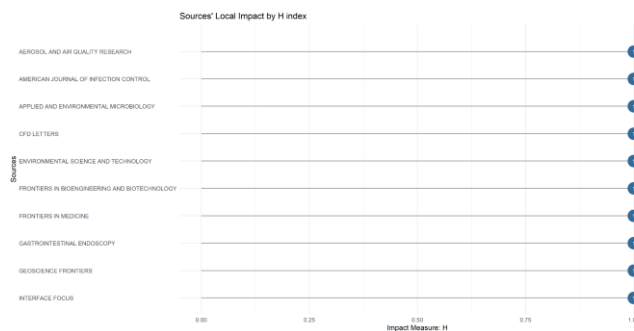


Figure 4. Source local impact.

3.3. Affiliation and Country Analysis Regarding Research on Airborne Pathogen Mitigation and Transmission

In this study, we also analyzed the contribution of affiliates and which countries have published articles on aerosol pathogens. Analysis of the country and affiliation of the article is carried out to provide an overview and reference to future researchers, which countries and affiliations can be used as reference material and study sources to support research on aerosol pathogens.

Figure 5 shows the most relevant affiliates. Figure 5 shows that 10 affiliates are considered relevant to the theme of this research, namely Colorado State University with a total of 7 articles, Ohio State University with a total of 5 articles, the University of Miami with 5 articles, Clemson University with 4 articles, Iowa State University with 4 articles, National Institute of Standards (NIS) with a total of 3 articles, the University of Bristol with 3 articles, the University of Florida with a total of 3 articles, Arizona State University with a total of 2 articles, and National Institute of Diabetes and Digestive and Kidney Diseases with a total of 2 articles.

The final analysis we carried out was country scientific production and country citation as shown in Figures 6a and 6b. Based on the data in Figure 6a which shows country scientific production, it is known that several countries in the world have conducted research on aerosol pathogens including the USA with 50 documents, FRANCE with 10 documents, the UK with 8 documents, EGYPT 4 documents, GERMANY 3 documents, SPAIN 3 documents, AUSTRALIA 2 documents, ITALY 2 documents, SWITZERLAND 2 documents, CHINA 1 document, DENMARK 1 document, GREECE 1 document, JAPAN 1 document, and NORWAY 1 document.

Figure 6b shows the most cited countries. The country most cited in research on aerosol pathogens is the US with a total of 76 citations. After that, France is in second place with a total of 66 citations. Other countries are China with a total of 57 citations, the United Kingdom with a total of 36 citations, Australia with a total of 31 citations, Switzerland with a total of 17 citations, Germany with a total of 4 citations, and Egypt with a total of 1 citation.

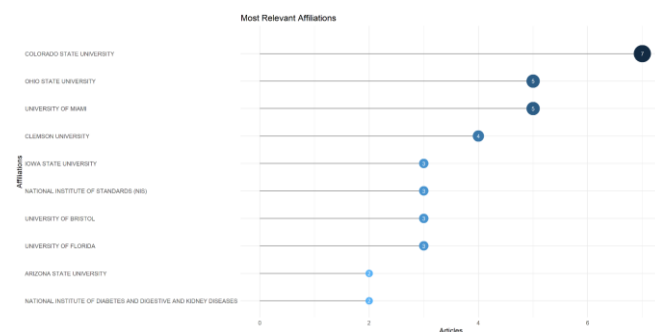


Figure 5. Most Relevant Affiliation.

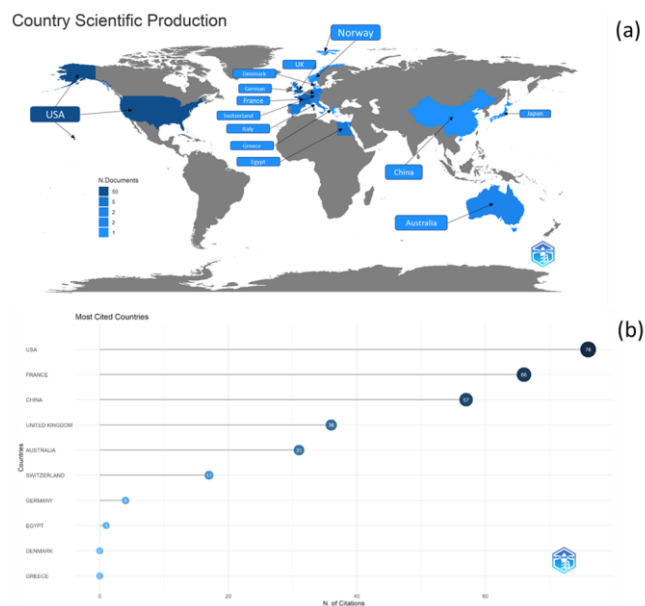


Figure 6. Counties Analysis, (a) Country Scientific Production, and (b) Most Cited Countries.

4. CONCLUSION

This research specifically focuses on identifying research trends regarding airborne pathogen transmission. Bibliometric and VOSviewer methods were used in this research. Bibliometric methods are used to analyze research trends by examining existing literature, while VOSviewer is used to visualize and understand relationships between topics or researchers.

Based on the results of bibliometric analysis, it is known that research on airborne pathogens has been extensively researched in 2021 with a total of 12 documents. Apart from that, it was also found that the development of research regarding the transmission and mitigation of airborne pathogens was still relatively small, where from 2009 to 2024 there were 27 indexed journal documents found. Scopus which discusses the theme of this research. In this research, we also conducted research on the number of citations from the total documents found. Based on the research results, it was found that the highest average number of citations occurred in 2021 at 12 citations with an average citation of 4.69.

Of the many countries that actively contribute to publishing articles on the spread of airborne pathogens, based on research results it was found that the USA is one of the 15 countries that is considered the most productive in providing articles on the spread of airborne pathogens with a total of 50 articles and 76 citations.

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