

RISK MANAGEMENT IN THE HEALTHCARE INDUSTRY: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

This paper seeks to scrutinize existing studies on risk management spanning from 1993 to November 2023, aiming to offer insights for future research and pinpointing limitations in past studies. Although research interest in the field began to escalate in 2005, the highest number of studies occurred in 2021. Researchers have increasingly prioritized the medical industry, especially in the aftermath of the Covid-19 pandemic. For this bibliometric analysis, we utilized a Web of Science database containing 5146 articles, introduced into VosViewer software. The extracted data from Web of Science include the progression of citations and publications, the most cited papers, and the number of documents published by country. Using the software, we conducted co-author analysis and examined the most frequently used keywords. The most cited papers from the database were analyzed, along with the journals in which they were published. The analysis also reveals the countries with the highest number of published documents. This study serves as a valuable resource for those undertaking future research in medical industry risk management, shedding light on trends and suggesting directions for future exploration in the field.

KEYWORDS: *bibliometric analysis, bibliometric indicators, citation analysis, medical industry, risk management.*

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1. INTRODUCTION

The healthcare industry is one of the most complex and essential fields of modern society. It faces a number of unique challenges, from the rapid evolution of medical technology to demographic changes and economic pressures. In this context, risk management becomes essential in order to ensure the provision of quality medical services, the protection of patients and medical staff, as well as maintaining the financial viability of health institutions (Clauson et al, 2018).

Risk in the healthcare industry can be defined as the likelihood of an undesirable event occurring that can affect the health of patients, the professional integrity of medical staff, or the financial stability of the organization (Coronado and Wong, 2014). It can range from medical errors, infections, to risks related to patient data confidentiality or litigation (Coronado and Wong, 2014).

Risk management involves identifying, assessing, and prioritizing risks, followed by the application of resources to minimize, monitor, and control the probability and/or impact of undesirable events (Salih et al., 2019). In the healthcare industry, this process is complicated by the interdisciplinary nature of the field, the variety of stakeholders involved, and the rapidity with which medical knowledge changes.

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The aim of this bibliometric analysis is to explore and synthesize the existing scientific literature on the topic of risk management in the healthcare industry. By identifying and analysing existing research, the paper aims to provide a comprehensive perspective on how risk management is approached and implemented in this vital sector. Through bibliometric analysis, we intend to offer a comprehensive view of research in this field, thereby contributing to the improvement of practices and the development of knowledge.

The first part of this paper performs a synthesis of the current state of research on risk management in the healthcare industry, highlighting relevant perspectives from the literature. The second part will focus on the objectives and research methodology used, providing a detailed analysis of how they have been applied to gather the necessary data. Finally, the third part of the paper will present the results obtained, highlighting their implications and future directions for research within the healthcare industry.

2. LITERATURE REVIEW

The research on risk management in the healthcare industry reflects a complex and constantly evolving field, with significant contributions from researchers around the world. A general examination will be made of the most important concerns related to risk management in the healthcare field, considering several relevant documents in the domain. (Braveman and Gottlieb, 2014). Risk management in the medical industry has become a topic of increased interest in the specialist literature in recent years, with heightened attention to bibliometric analyses that offer a perspective on the evolution and trends in this field.

One of the main research areas focuses on patient safety and the quality of medical care. This aspect includes the analysis of infections associated with medical care, the evaluation of organizational models for health safety, and the development of methods to improve the quality of care.

The use of artificial intelligence (AI) has become an important direction in improving patient safety. AI offers innovative solutions for the prediction, prevention, and early detection of adverse events. Studies have shown that AI can have a significant impact in areas such as adverse drug events, diagnostic errors, and the insufficient detection of decompensation, through the collection and analysis of new and already available data (Bates et al., 2021). Integrating AI into clinical workflows and electronic health record systems is challenging, but it can improve patient outcomes and administrative efficiency (Davenport and Kalakota, 2019). Additionally, AI has the potential to transform disease diagnosis and minimize human errors in medical practice (Alowais et al, 2023). These technologies, including machine learning algorithms, allow for a more accurate and complex assessment of risks, compared to traditional rule-based approaches (Bates et al., 2021).

An additional pertinent aspect discussed in the literature is the imperative need for patient-centred strategies to prevent adverse events. Despite the passage of two decades since the Institute of Medicine's "To Err Is Human" report, safety issues persist, emphasizing the requirement for innovative approaches and technologies to enhance safety both within and outside hospitals. Addressing this, AI and digital technologies present promising solutions by improving communication between patients and healthcare providers, thereby reducing the occurrence of preventable adverse events (Bates et al., 2021).

Within the specialized literature, an important facet to consider is the evaluation and management of information security-related risks. As technology continues to advance, cyber-attacks have become more frequent, leading to patient reluctance in providing data to medical institutions and complicating research studies. Fernández-Alemán et al. (2013) conducted a study focusing on the security and confidentiality of information in the healthcare field, investigating various approaches and technologies used to protect patient data in accordance with national regulations. Their findings

revealed that many electronic health record systems do not meet the necessary standards of security and confidentiality (Fernández-Alemán et al., 2013).

Furthermore, we assert that the risk assessment matrix is an indispensable tool in risk management, widely employed for identifying, analysing, and prioritizing risks. This involves hazard identification, analysis, and evaluation of all potential risks, culminating in the development of a risk matrix to compare and define threats requiring immediate control. Research efforts are concentrated on selecting the most appropriate methodological approaches and evaluating the adequacy of existing control measures, thereby contributing to a more efficient and precise management of risks in the healthcare field (Pascarella et al., 2021).

In recent years, there has been a growing interest in research within the field of risk management in the medical industry. Researchers are increasingly conducting bibliometric analyses to discern trends in the field. Bibliometric analysis entails collecting and scrutinizing quantitative and qualitative data from scientific publications (Verbeek et al., 2002).

A study conducted by Aladayleh et al (2023) used bibliometric analysis to investigate global research trends on the effect of COVID-19 risks in sustainable facility management domains. The results highlight the contributions of authors from 51 countries and the identification of 73 keywords organized into six clusters. (Aladayleh et al, 2023). Kheir et al. (2022) addressed the identification and analysis of risk in the development of medical devices among start-ups, proposing a broader risk management framework. The study emphasizes the importance of an integrated approach to risk management in the context of medical device development.

Xu and Xu (2023) conducted a bibliometric analysis of decision-making in health management, covering publications from the period 1998-2021. Their analysis identified 581 documents and highlighted research trends and the intellectual structure of the field. Their analysis also identified the major research areas and provided insight into future research directions.

Păduraru et al. (2022) carried out an analysis of the trends manifested in research literature in the field of health management, with an emphasis on bibliometric characteristics and various influencing factors. Their analysis covered publications from the period 1967-2020 and identified 250 analysed articles, published in 139 journals. The most common focal topics were healthcare management systems and their challenges.

Bibliometric analysis indicates that the most recent significant work in the field of risk management in the medical industry was written in 2015 by Bradea, Delcea, and Păun (2015). This finding underscores a notable gap in the specialized literature, as there are no subsequent studies that provide an updated perspective on this topic. Consequently, there is a deficiency in recent data and assessing current trends in the medical sector, which may limit the ability of professionals and researchers to effectively respond to emerging challenges and changes in risk management in this vital field.

3. RESEARCH METHODOLOGY

The aim of this research is to perform a detailed analysis and synthesize the trends in risk management in medical industry, evaluating existing research thus contributing to the foundation of future scientific investigations and to the optimization of practices in this sector.

The research aims to find answers to the following questions.

- What are the most frequently used keywords in the research studies within this domain, and how have they changed over the last years?
- How has the research in this area evolved over time, particularly with respect to significant shifts in approaches and methods?
- What are the characteristics of co-author networks, and how do collaborations among researchers and institutions manifest within this field?

Bibliometric analyses are important tools in understanding the evolution of a field of study, identifying trends, and significant papers (Ensslin et al., 2015). By analysing the specialized literature, a clear picture can be obtained of how research in the field of health risk management has developed, what the main themes addressed are, and what the emerging research directions are. Bibliometric analysis is a widely used methodology in many research fields, for example, medicine, information science, circular economy, or industrial engineering (Bevilacqua et al., 2019).

For this bibliometric analysis, we conducted a systematic search in the Web of Science (WoS) database on November 1, 2023. The query used to extract the papers was:

("health* industry"OR"health care industry"OR"medical industry"OR"health* economy" OR "health care economy"OR"health* sector*"OR"health care sector*"OR"health* cent*"OR"health care cent*"OR"health* organi*"OR"health care organi*"OR"medical organi*"OR"health* management"OR"health* service*"OR"health* field*"OR"health* compan*"OR"health* firm*"OR"health care management"OR"health care service*"OR"health care field*"OR"health care compan*"OR"health care firm*")AND("risk management"OR"risk control"OR"risk administration"OR"risk assessment"OR"risk mitigation"OR"risk analysis"OR"risk evaluation"OR"risk identification").

In the process of developing the query, we included both "healthcare" and "health care," because, after a detailed analysis of published papers, we noticed that authors use both forms. Additionally, we identified all synonyms for the "healthcare industry" to ensure comprehensive coverage of the field. Regarding "risk management," we included keywords that are closely related to the field and represent recognized stages in the risk management process, in order to capture a wide range of approaches and relevant studies in this sector.

Initially, the total number of papers identified in the research was 5558, including proceedings papers. After excluding proceeding papers, the number decreased to 5146. We chose to retain only articles and not proceedings papers because published articles often offer a higher quality of research, reflecting completed studies, in contrast to proceeding papers which may more often include research in preliminary stages or work in progress. This selection ensures a more rigorous and relevant analysis for the objectives of our study.

The papers were filtered so that only those written in English remained and only the papers that were part of the following types of documents were included: "Article", "Review article" and "Early access". After applying these criteria, 5146 papers were retained for analysis. The selected papers range from the year 1993 to 2023, specifically until November 1, 2023.

We chose the WoS database because it is one of the most comprehensive academic databases, providing access to a wide range of journals from various disciplines, including health and management. WoS includes only journals that go through a rigorous review process, thus ensuring that the included papers are of high quality and relevant to their field of study (Chadegani, 2013). Also, it is compatible with several bibliometric analysis software, such as RStudio, VOSviewer, Graphia or Cytoscape, thus facilitating the process of data analysis and visualization.

We analysed the data extracted from WoS with the VOSviewer software because it is a tool specifically created for bibliometric analysis, offering specific functionalities for the visualization and analysis of co-authors, keywords, and other types of bibliometric data (Jan van Eck and Waltman, 2023). It provides clear and coloured graphical representations, facilitating the identification of relationships and trends in the dataset. This allows for a quick and efficient visual interpretation of the data. VOSviewer is compatible with the data format exported from Web of Science, which makes the process of importing and analysing data much simpler (Jan van Eck and Waltman, 2023)

4. RESULTS AND DISCUSSIONS

In the following section of our study, we will focus on the descriptive and evaluative assessments of the 5146 documents, selected through our review process of the specialized literature. This analytical approach will allow not just an understanding of the volume and distribution of the relevant scientific documents, but also an appreciation of their quality and impact on the field under investigation. The analysis will contribute to the identification of patterns, gaps, and predominant research directions, thereby providing a solid foundation for future academic inquiries.

Table 1 presents the distribution of the types of documents analysed in a bibliometric analysis, along with the number of records for each type and the corresponding percentage within the sample composed of 5146 documents. This analysis provides a perspective on the composition of the sample and the relevance of each type of document within the bibliometric study. Articles are the main source of information in the field of study or subject of research in question. It is important to emphasize that articles have a significant influence on the specialized literature and, therefore, can play a crucial role in defining trends and developments in the field. "Review Article" accounts for 11.388% of the total, indicating that syntheses and critical evaluations of existing research are also a significant element in the analysed sample. These articles provide a deeper understanding of the development of a research field and significant contributions. Finally, "Early Access" represents only 1.814% of the total sample.

Table 1. The types of documents analyzed

Document type	Record Count	% of 5146
Article	4559	88.59%
Review Article	500	9.71%
Early Access	87	1.69 %

Source: Authors based on data extracted from WOS

Figure 1 illustrates the evolution of publications and citations in the field of risk management within the health industry from 1993 to 2023. It provides a graphical perspective on changes in research production and impact in this field over the span of three decades.

Up until the year 2005, the number of publications on this subject was relatively stable, averaging up to 50 articles published per year. The initial interval is characterized as a period of consolidation of the knowledge base in the field of risk management within the healthcare industry. Starting with the year 2005, there is a notable increase in the number of publications, approaching 80 papers per year. We associate this rise with greater attention given to this subject, possibly as a consequence of events or significant changes within the medical industry that have highlighted the importance of risk management. Noteworthy is the fact that the number of publications reached a peak in the year 2021, with over 600 papers published that year, reflecting a concentration of research efforts during this period. The observed growth can be attributed to the COVID-19 pandemic, as it has sparked academic interest and led to an intensification of research activities.

In the context of citation analysis, there is an upward trend starting from 2003, with an initial count of 100 cumulative citations, peaking in 2021 with a total of 544 citations, followed by a peak in 2022 with 18303 citations, and by 2023 there is a decrease to up to 13193 citations as of November 1, 2023. The increase in citations between 2020 and 2022 indicates a growing recognition of the value of research in the field of risk management within the health industry and its impact on both the academic community and the industry itself, especially following the emergence of the SARS COV 2 virus.

In Table 2, the top 10 authors with the most significant contributions from the studied documents are presented. The first three positions are occupied by Leslie W.D., Muhammad S., and Khan S. First author, Leslie W.D., is affiliated with University of Manitoba, Faculty of Medicine, Winnipeg - Canada, having published 31 documents, a large part of which appeared in the Journal of Bone and Mineral Research. Muhammad S. is in second place with 26 published documents. He is affiliated with the University of Peshawar (Pakistan), and most of his documents focus on risk management in healthcare industry. Khan S. has 25 published documents and is also affiliated with the University of Peshawar. One of the topics addressed by Khan is related to the risks in the medical industry when the effects of pollution or natural disasters occur. He also emphasizes in one of his articles the effects of the Covid-19 pandemic, such as depression or anxiety.

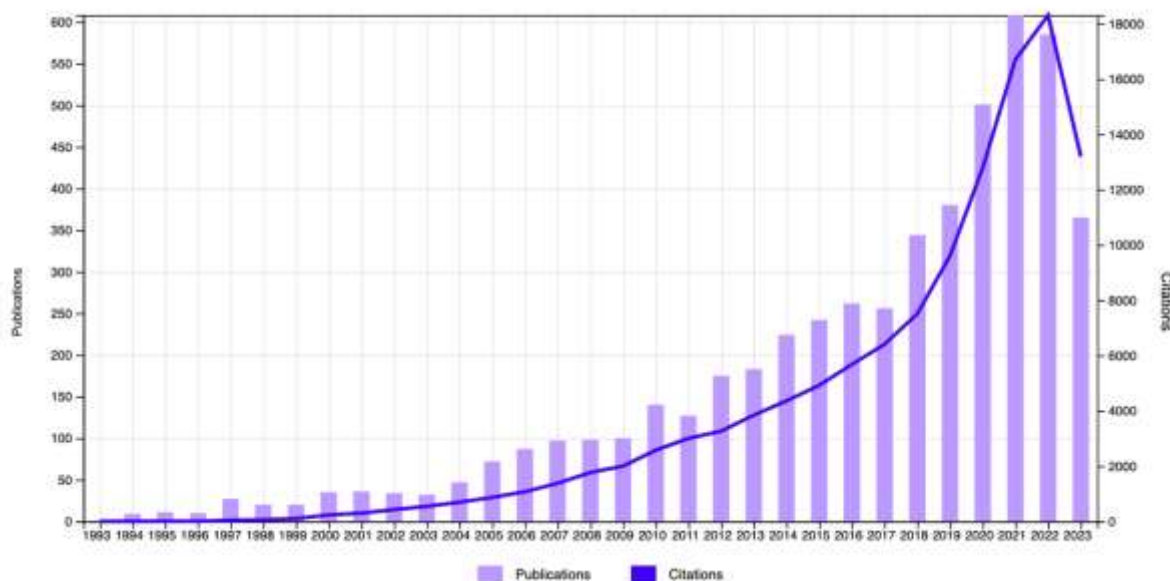


Figure 1. The evolution of publications and citations in the field
 Source: authors based on data extracted from WOS

Table 2. Top 10 authors with significant contributions in the studied field

Position	Authors		
	Name	Documents	Percent
1.	Leslie W.D.	31	0.605%
2.	Muhammad S.	26	0.507%
3.	Khan S.	25	0.488%
4.	Lix L.M.	18	0.351%
5.	Kanis J.A.	17	0.332%
6.	Peiris D.	16	0.312%
7.	Rehm J.	16	0.312%
8.	Bradshaw D.	15	0.293%
9.	Norman R.	15	0.293%
10.	Patel A.	15	0.293%

Source: Authors based on data extracted from WOS

On the other hand, the authors with the fewest published papers are those in the last three positions.

All of them have published 15 papers each. In eighth place is Bradshaw D., affiliated with the South African Medical Research Council, in seventh place is Norman R., affiliated with the University of Greenwich, who managed to write 11 papers with Bradshaw D., and the last place is occupied by Patel A. from the University of New South Wales Sydney.

In the top 10 institutions with the most significant contributions to risk management in the healthcare industry (Table 3), mostly universities from the United States of America (USA) and United Kingdom (UK) are included. In first place is the University of London with 185 papers, representing 3.608% of the total, followed by the World Health Organisation with 166 papers (3.237% of the articles), and in third place, the University of California System with 130 papers, meaning 2.535%. At the bottom of the top ten list are King's College London with 74 papers, the University of New South Wales Sydney with 71 documents, and in last place is Imperial College London with 69 documents, representing 1.346%.

Table 3. Top 10 institutions with significant contributions in the studied field

Position	Institution		
	Name	Documents	Percent
1.	University of London	185	3.608%
2.	World Health Organization	166	3.237%
3.	University of California System	130	2.535%
4.	Harvard University	101	1.970%
5.	University of Sydney	96	1.872%
6.	University of Toronto	87	1.697%
7.	Centers For Disease Control Prevention USA	75	1.463%
8.	King S College London	74	1.443%
9.	University of New South Wales Sydney	71	1.385%
10.	Imperial College London	69	1.346%

Source: Authors based on data extracted from WOS

Figure 2 represents the top ten countries with the most publications out of a total of 155 countries. These represent approximately 50% of the total number of countries. In first place is the USA with 1328 documents, representing approximately 25% of the total number of countries with publications, followed by the UK in second place with 827 articles, and Australia in third place. We consider that the USA and the UK have contributed the most because, as mentioned above, universities and national organizations have contributed directly to research in the field of risk management in the health industry. The last positions are occupied by the Netherlands, Switzerland, and Germany which also had a significant contribution, totalling a percentage of 16.5% and contributing with 574 documents, together.

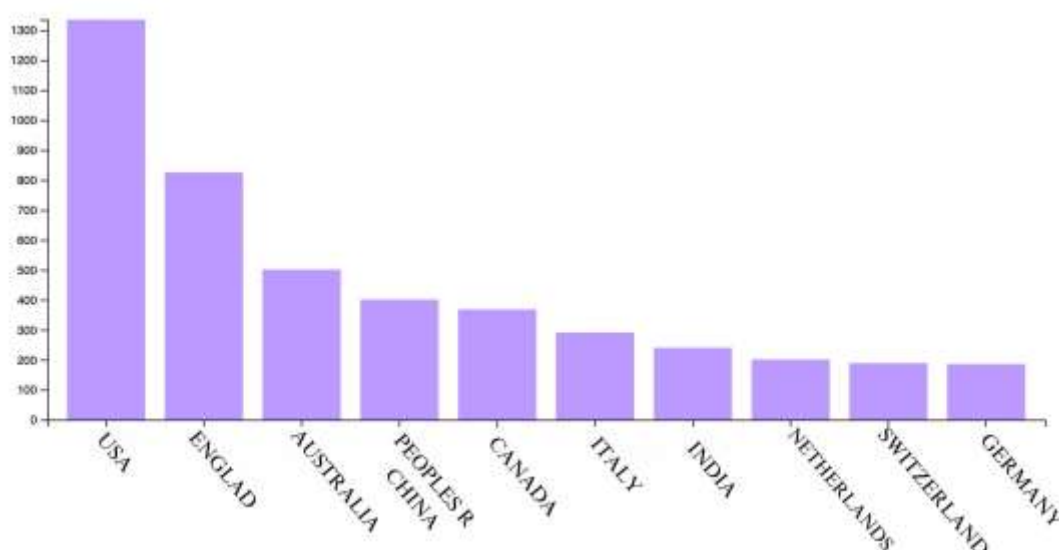


Figure 2. Number of documents published by country

Source: authors based on data extracted from WOS

Table 4 displays the distribution of documents in journals, showing the top 10 out of 2044 journals. These contain only 559 papers out of the 5146 papers analysed. The first two positions are occupied by *Budapest Medical Journal Open* and *International Journal of Environmental Research and Public Health*, each containing 98 papers, representing about 2%. In third place is *Environmental Science and Pollution Research* with 69 papers, representing 1.3%. The journals in the last three positions have also made significant contributions to research in the field. These are *BMC Health Services Research*, *Chemosphere* and *Risk Analysis* with 38.33, and 32 papers respectively.

The prevalence of medical and risk assessment journals in Table 4 shows an academic focus on health and safety. *PLOS ONE* accepts research from over two hundred subject areas, including natural sciences, engineering, medicine, and the social sciences and humanities. The inclusion of journals like *PLOS ONE* and those focused on the environment underscores the need for interdisciplinary collaboration and integrated approaches, which are vital for a thorough examination of research effects on human health and the environment. The variety of journals indicates the acknowledgment of connections between public health, the environment, and other areas of study.

Table 4. Distribution of documents in journals

Position	Name	Number of documents	Percent
1	Budapest Medical Journal Open	98	1.911%
2	International Journal of Environmental Research and Public Health	98	1.911%
3	Environmental Science and Pollution Research	69	1.346%
4	Science of the Total Environment	52	1.014%
5	Plos One	49	0.956%
6	Human and Ecological Risk Assessment	46	0.897%
7	Environmental Monitoring and Assessment	44	0.858%
8	Bmc Health Services Research	38	0.741%
9	Chemosphere	33	0.644%
10	Risk Analysis	32	0.624%

Source: Authors based on data extracted from WOS

In the following part of the paper, are analysed the co-authorship, co-citations, and co-occurrence of keywords in the selected documents.

Figure 3 shows the co-authorship network map among countries. A total of 8 clusters have been formed, with 844 links. Lithuania has the fewest collaborations in terms of research in risk management in the health industry, with just 5 documents published in co-authorship. Of these 5 documents, the majority are collaborations with authors from Germany and the United Kingdom.

The USA is at the opposite end, with a total of 1253 documents produced in co-authorship, most frequently with the UK, Australia, and People's Republic of China. Due to the USA's large investments made in academic research, and the high level of interest in academic research regarding the medical industry, the engagement is very high.

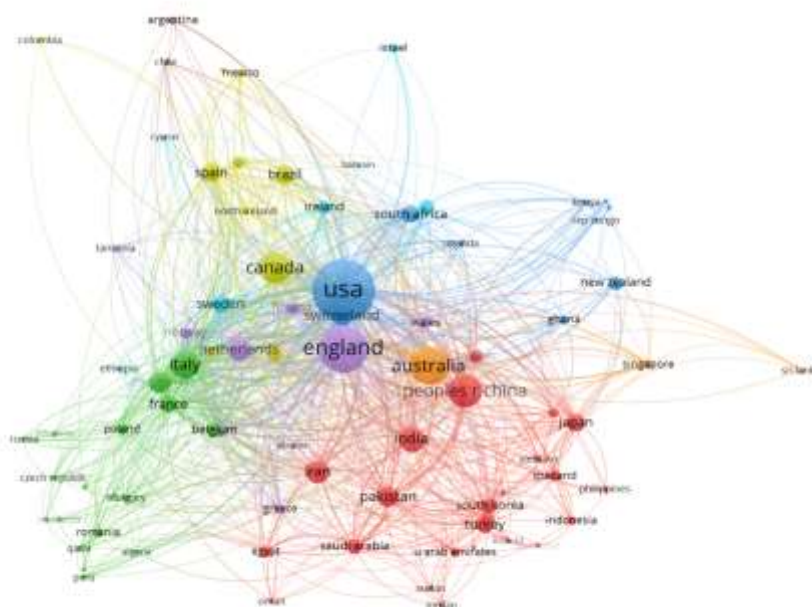


Figure 3. Co-authorship network visualization map for countries
Source: authors with Vosviewer based on the data extracted from WOS

Figure 4 illustrates the interconnections between keywords on the network visualization map. A minimum threshold of 40 appearances was established for keywords, and out of a total of 23516, only 149 surpassed this number.

The analysis highlighted 4 clusters. The results indicate, in the red cluster, a strong connection between "risk assessment", "risk management", "impact", "quality", "care", "health", and "prevention".

The green cluster is dedicated to topics related to the risks generated by exposure to pollution and contamination, an aspect also supported by numerous journals on environmental topics included in the top sources.

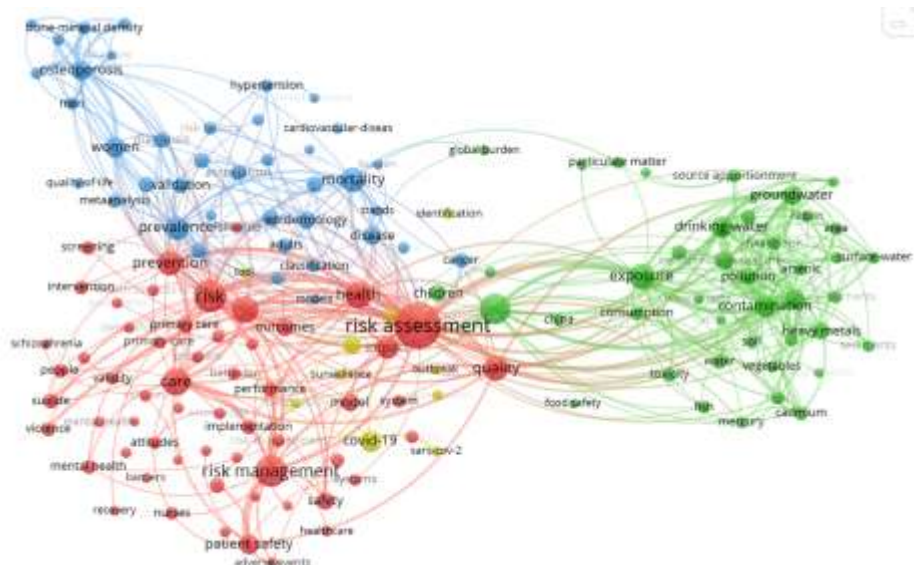


Figure 4. Network visualization map of co-occurrence of keywords
 Source: authors with Vosviewer based on the data extracted from WOS

In the fourth cluster, there is a close link between the terms "covid-19", "transmission", "surveillance" and "health policy". Authors have increasingly begun to associate the keywords "Covid 19" with "risk management" from the beginning of SARS COV 2 virus pandemic.

In Figure 5, the map of country co-citation is represented. Four clusters and 7162 links have formed. The largest clusters are the United States of America and England. The United States has the strongest connections with Canada, Switzerland, and the Netherlands. The next cluster is that of England, having strong links with Australia and Scotland. The third cluster presents the links that Germany has with Austria, Argentina, Belgium, Israel, Italy, and Germany, as well as with Mexico despite the geographical distance. The last cluster represents the strong connections between Peoples R China, Japan, Iran, India, Egypt, South Arabia, Pakistan, Malaysia, Thailand, Nigeria, and also with Romania.

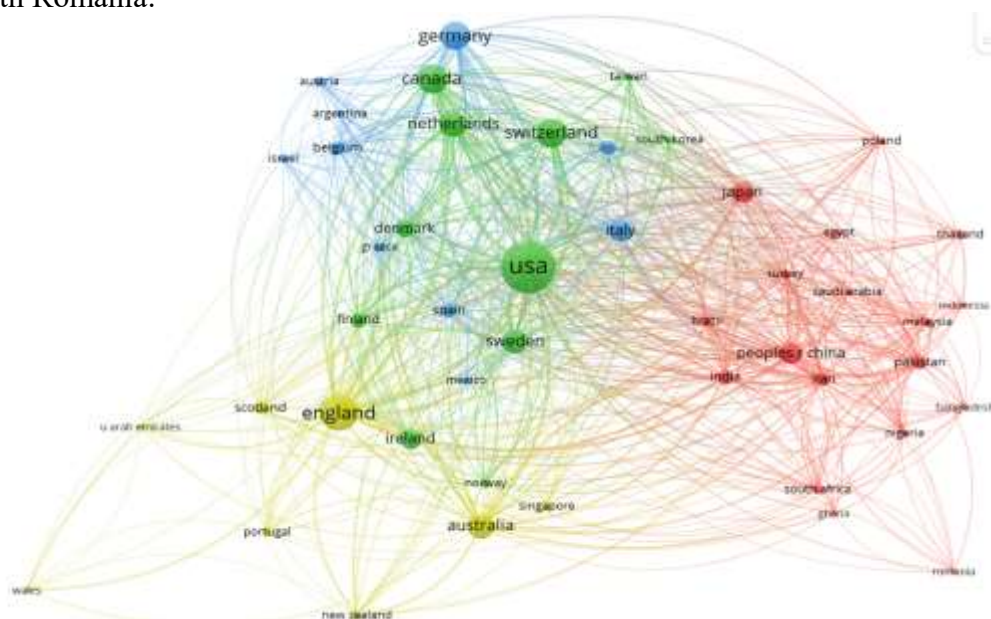


Figure 5. Country co-citation analysis
 Source: authors with Vosviewer based on the data extracted from WOS

The most cited papers from the database are represented in Table 5. The publication titled "2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines" by Arnett et al. (2019) has garnered an impressive total of 3563 citations, indicating its significant impact in the specialized literature and its relevance in the field of cardiovascular disease prevention. This guide offers evidence-based recommendations for the primary prevention of cardiovascular diseases. These guidelines include strategies for managing risk factors such as hypertension, high cholesterol, diabetes, and obesity, as well as recommendations for a healthy lifestyle, including diet, physical activity, and smoking cessation. The guide emphasizes the importance of individual risk assessment to guide therapeutic decisions and promotes personalized approaches in the prevention of cardiovascular diseases. The same number of citations was also reached by the complete version of the report, underscoring the ongoing importance of these guidelines for medical practitioners (Arnett et al., 2019). The article "The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds" by Van den Berg et al. (2006), with 2743 citations, and the paper "Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife" by the same authors, with 2662 citations, are also recognized as being extremely influential in research concerning the toxicity of substances and their effects on human health and wildlife (Van den Berg et al., 2006). The paper "Falls in older people: epidemiology, risk factors and strategies for prevention" by Rubenstein (2006), with 1982 citations, has made a valuable contribution to the understanding of falls in the elderly, providing epidemiological data, identifying risk factors and prevention strategies, thus being an important resource for health care professionals in the field of geriatric care.

In the ranking of the most cited papers, papers from medical journals are present, with the first entry from a journal not related to the medical industry appearing at position 94. This is the Journal of Construction Engineering and Management, and the paper is titled "Construction Safety Risk Mitigation" which has been cited 162 times.

Table 5. The most cited papers from the analyzed database

No.	Paper Title and Authors	Journal name	No. of citation
1.	Arnett, D.K., Blumenthal, R.S., Albert, M.A. et al. (2019). ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines	Circulation	3563
2.	Van den Berg, M., Birnbaum, L.S., Denison, M. et al. (2006). The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds	Toxicological Sciences	2743
3.	Van den Berg, M., Birnbaum, L., Bosveld, A.T.C. et al. (1998). Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife	Environmental Health Perspectives	2662
4.	Rubenstein, L.Z. (2006). Falls in older people: epidemiology, risk factors and strategies for prevention	Age and Ageing	1982
5.	Boström, C.E. Gerde, P., Hanberg, A. et al. (2002) Cancer risk assessment, indicators, and guidelines for polycyclic aromatic hydrocarbons in the ambient air	Environmental Health Perspectives	1359

No.	Paper Title and Authors	Journal name	No. of citation
6.	Siris, E.S., Miller, P.D., Barrett-Connor, E. et al. (2001), Identification and fracture outcomes of undiagnosed low bone mineral density in postmenopausal women - Results from the National Osteoporosis Risk Assessment	Jama-Journal of the American Medical Association	923
7.	Siris, E.S., Chen, Y.T., Abbott, T.A. et al. (2004) Bone mineral density thresholds for pharmacological intervention to prevent fractures	Archives of Internal Medicine	743
8.	Kanis, J.A., McCloskey, E.V., Johansson, H. (2008). A reference standard for the description of osteoporosis	Bone	741
9.	Cohen, A.J., Anderson, H.R., Ostro, B. (2005). The global burden of disease due to outdoor air pollution	Journal of Toxicology And Environmental Health-Part A	713
10.	Reginster, J.Y., Burlet, N. (2006). Osteoporosis: A still increasing prevalence	Bone	622

Source: Authors based on data extracted from WOS

In the field of health, the repeated presence of certain recognized authors indicates a significant influence and impact that these researchers have in this domain. This likely reflects the high quality and relevance of their work for the scientific community, suggesting that these contributions provide valuable perspectives, innovations, or solutions to existing challenges in health. On the other hand, this focus on a limited group of authors could also suggest a potential limitation in the diversity of approaches and ideas.

Reflecting on the concerns in the field of risk management in the health industry, we observe that this discipline has undergone significant changes, driven by both technological progress and global events such as the COVID-19 pandemic. In this context, it is essential to steer towards risk management models that integrate advanced technologies and lay the foundation for a rapid response in crisis situations (Moe et al., 2021). The use of artificial intelligence and big data analysis for risk anticipation becomes a promising area for research (Obermeyer and Emanuel, 2016). Another important research direction is the evaluation of the effectiveness of health education programs to improve preventive behaviors and the adoption of a healthy lifestyle. Recent studies show that educational interventions can have a positive impact on the management of individual and collective risk (Viswanath and Kreuter, 2007).

CONCLUSIONS

This study is using the bibliometric analysis to identify current trends in the specialized literature of risk management in the medical industry. A total of 1542 papers were extracted from the Web of Science database, applying several inclusion and exclusion criteria. We observed that this study is not the only one on the topic of risk management in the medical industry, but we differentiated ourselves by using a unique string and a different publication and citation period than other studies. It can be seen as an initial result, a significant increase in publications and citations in the field during and post the Covid-19 pandemic. The emergence of keywords closely related to the COVID-19 pandemic clearly indicates the current direction of scientific interest and the need to address the complex issues arising from public health crises. By combining international efforts and focusing on interdisciplinary collaboration, the scientific community can adapt and respond more effectively to the upcoming challenges in the health sector. It was also noted that trends in risk management in the medical industry have been delineated. Research in the field of health risk management has

highlighted those terms such as risk management, risk assessment, health, and care have been among the most used keywords, reflecting a focus on the evaluation and management of risks in the health sector. The research has evolved from predominantly quantitative approaches to more holistic and interdisciplinary methods, integrating perspectives from various fields. Regarding collaboration, co-author networks in this field demonstrate an increase in interdisciplinary and interinstitutional collaborations, with an emphasis on knowledge sharing. This trend underlines the importance of synergy between different specializations and institutions in advancing research.

Regarding future research directions, to deepen the research, it is necessary to expand the database, possibly including proceeding papers or searching in other databases, such as Scopus. These would assist in identifying additional aspects in the field and in optimizing risk management in the medical industry, being completed with a systematic review.

Future research could identify the social and economic impact that technology has on research in the field of management in the health industry. Investments in research and development are vital to face emerging challenges and to ensure a resilient and adaptable health industry to future changes.

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