

Review Article

From Errors to Excellence: Mapping a Decade of Patient Safety Research through Bibliometric Analysis (2015-2024)

Sharun N V¹, Rohini T², Ramya Jyothi Yelisetty³

¹Associate Professor, College Of Nursing, AIIMS, Mangalagiri, Andhra Pradesh, India

²Principal, Institute of Nursing Sciences and Research, INSeR, Malabar Cancer Centre, MCC, Kerala, India

³Assistant Professor, Department of Hospital Administration, AIIMS, Mangalagiri, Andhra Pradesh, India

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I N F O

Corresponding Author:

Sharun N V, College Of Nursing, AIIMS, Mangalagiri, Andhra Pradesh, India

E-mail Id:

sharun@aiismangalagiri.edu.in

Orcid Id:

<https://orcid.org/0009-0000-7977-0005>

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A B S T R A C T

Introduction: Patient safety has become a central concern in global healthcare, driven by the persistent occurrence of medical errors and adverse events. Over the past decade, research in this field has expanded significantly across disciplines, aiming to improve clinical protocols, safety culture, and health system performance. Bibliometric analysis offers a robust method for quantitatively mapping the evolution, trends, and collaborative networks in patient safety research, providing critical insights for policy, practice, and future scholarship.

Methods: This bibliometric study analysed 8433 documents published between 2015 and 2024, retrieved from Scopus and Web of Science. The final dataset was analysed using Biblioshiny (R Studio), VOSviewer, and CiteSpace to conduct performance analysis, science mapping, and trend identification. Key metrics included annual growth rate, citation analysis, authorship patterns, journal productivity, and keyword co-occurrence networks. Bradford's and Lotka's Laws were applied to assess source and author productivity.

Results and Discussion: The annual growth rate of publications was 2.23%, indicating sustained interest in patient safety. "The Journal of Patient Safety" was the most prolific source, while "BMJ Quality & Safety" led in citation impact. The most influential author was LEE S, with an h-index of 17 and 919 citations. Although the United States accounted for 27.7% of publications, countries like the Netherlands and the United Kingdom demonstrated higher citation efficiency and international collaboration. Keyword analysis revealed five major thematic clusters: clinical outcomes, human factors, education and tools, system performance, and demographic context. Emerging topics such as burnout, safety culture, and healthcare costs indicate evolving research priorities post-COVID-19.

Conclusion: This study offers a decade-long panoramic view of global patient safety research, highlighting a maturing field characterized by thematic diversity, evolving priorities, and the need for stronger international collaboration.

Keywords: Patient Safety, Bibliometric Analysis, Safety Culture, Quality Improvement, Research Trends

Introduction

Patient safety has become a pivotal concern in healthcare systems worldwide. As medical errors continue to pose significant risks to patient well-being, healthcare providers and researchers alike strive to implement strategies that foster a culture of safety within clinical settings.¹ Over the past decade, there has been an exponential growth in research dedicated to improving patient safety, focusing on various domains such as clinical protocols, technological interventions, and safety culture transformations. To understand the evolution and trajectory of this growing body of knowledge, bibliometric analysis serves as a powerful tool to systematically map and evaluate trends in scientific literature.

Concept of Bibliometric Analysis

Bibliometric analysis is a quantitative research method used to analyze academic literature and measure the impact of publications within a particular field.² This approach leverages citation data to uncover trends, collaborations, and influential works in the scientific community. By employing bibliometric tools such as VOSviewer and CiteSpace, researchers can visualize co-authorship networks, keyword clusters, and citation patterns, thereby identifying emerging research themes and gaps.³ Unlike traditional reviews, bibliometric analysis provides a macroscopic view of research dynamics, making it an invaluable method for assessing the intellectual structure and evolution of a field over time.⁴⁻⁶

Significance of Bibliometric Analysis in Patient Safety Research

Patient safety research is inherently interdisciplinary, spanning fields such as nursing, medicine, informatics, and health policy. Conducting a bibliometric analysis on this topic is significant for several reasons, like identifying research trends, assessing research impact, understanding knowledge gaps, promoting collaborative networks etc. Given the increasing emphasis on achieving zero harm in healthcare, understanding the scientific progression in patient safety research is crucial. This bibliometric analysis aims to provide actionable insights for policymakers, healthcare administrators, and academic researchers by mapping the decade-long evolution of research efforts focused on reducing errors and improving patient outcomes.

Methodology

This bibliometric analysis on patient safety research from 2015 to 2024 followed a structured approach to systematically collect, analyse, and visualise data from peer-reviewed publications. The methodology comprised multiple steps, including data collection, cleaning, analysis, and visualisation.

Data Source

The primary data source for this analysis is the SCOPUS and Web of Science, widely regarded as comprehensive and high-quality bibliographic databases.

Search Strategy

The search strategy was developed in collaboration with a health science librarian to ensure comprehensive retrieval of relevant publications. The search terms used included combinations of keywords such as: "Patient Safety", "Healthcare Safety" etc. Search queries were tailored to include variations of these terms using Boolean operators (AND, OR) to maximize retrieval. The time frame was set from January 1, 2015, to December 31, 2024.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Articles published between 2015 and 2024
- Articles focusing on patient safety (Clinical Trial, Meta-Analysis, Randomized Controlled Trial, Reviews including Systematic Reviews, Conference proceedings, editorials, book chapters etc)

Exclusion Criteria:

- Non-English language publications

Data Cleaning and Pre-processing

The retrieved data were exported from Scopus (6790 documents) in "BibTex" format and Web of Science (6469 documents) in "Plain text file" format. It was then converted in to Excel file ("xlsx" format) for initial cleaning. Duplicate entries were removed, and data fields such as author names, titles, publication years, and keywords were standardised. Both the file were merged by importing into "R software" and 8426 duplicate documents were removed from the database and 8433 documents were retained for the analysis. The cleaned dataset was then imported into Biblioshiny (through R Studio), VOSviewer and CiteSpace for further analysis.

Objectives of the Bibliometric Analysis in the domain of "Patient Safety".

The primary objectives of this bibliometric analysis are as follows:

- To identify key themes and trends in patient safety research from 2015 to 2024.
- To assess the most influential authors, institutions, and countries contributing to patient safety literature.
- To map collaboration networks among researchers and institutions.
- To evaluate the citation impact of seminal works in the field.

- To identify gaps and emerging areas for future research in patient safety.

Bibliometric Tools Used

Three primary bibliometric tools were used in this analysis:

- **Biblioshiny (through R Studio R.4.3.1):** For gathering Annual scientific production, relevant sources and authors, research trends etc.
- **VOSviewer (version 1.6.20):** For generating visual maps of co-authorship, keyword co-occurrence, and citation networks.
- **CiteSpace (6.3.R1):** For identifying citation bursts, collaborative networks, and thematic clusters over time.

Analysis Process

The analysis process involved the following steps:

- **Performance Analysis:** Measuring the number of publications, citations, and authors.
- **Science Mapping:** Visualizing collaboration networks, co-occurrence of keywords, and citation patterns.
- **Trend Analysis:** Identifying emerging themes and areas of focus within patient safety research.

Ethical Considerations

Since this analysis relies on publicly available bibliographic data, no ethical approval was required. However, proper attribution and citation were maintained throughout the study to ensure academic integrity.

Delimitations

Only two data base considered for the analysis. Cited references were missing in the data.

Results and Discussion

Out of 8433 documents, 4649 are research articles (55%). Annual Growth Rate is 2.23% that shows Steady increase, showing sustained interest in patient safety. Average Citations per document is 7.391 which shows Moderate impact and scope for improvement. 17.6% (1484) of documents are solo works, suggests substantial individual contributions. Co-authors per document is 4.34, which signifies healthy collaboration among researchers. However, International Co-authorships is limited to 12.33% (Patient safety research may be nationally contextual), which opens an opportunity to expand multinational studies.

The annual scientific output in patient safety research (Figure 1) has shown a consistent upward trajectory over the past decade, peaking significantly in 2024 with 982 publications. This reflects an increasing global emphasis on patient safety practices, especially in the aftermath of systemic healthcare challenges exposed by the COVID-19 pandemic. The data also highlights moments of temporary

decline, possibly linked to shifts in research priorities or delays in dissemination, such as in 2018 and 2020. Overall, the field demonstrates maturity and growing momentum, warranting further investment in cross-national collaborative work.

The Citation Impact Analysis (Figure 2) revealed that while articles from 2015 to 2018 accrued the highest total citations over time, the citation intensity (measured as mean citations per article per year) was most notable for 2020 (1.42) and 2018 (1.41). This may reflect increased global discourse on patient safety triggered by the COVID-19 pandemic and growing health system reforms. Articles from 2023 and 2024, although recent, will require more time to accumulate a representative citation profile.

Most relevant Sources

The Journal of Patient Safety (Figure 2) emerged as the leading publication venue, contributing 261 articles (nearly three times more than any other source) emphasizing its prominence in shaping the field's discourse. So the researcher may get the most relevant "Patient Safety" literature from the "Journal of Patient Safety" or even can opt for publishing the "Patient Safety" related articles. The top 10 journals represent a balanced mix of interdisciplinary platforms (e.g., BMJ Open, BMC Health Services Research) and specialty-focused journals (e.g., Anaesthesia, British Journal of Nursing), reflecting the diversity of patient safety scholarship. Moreover, journals like BMJ Quality & Safety and the International Journal for Quality in Health Care underscore the policy-oriented and systems-level dimensions of patient safety research."

Bradford's Law of Scattering

Bradford's Law of Scattering, proposed by Samuel C. Bradford in 1934, articulates a distribution pattern of literature across journals within a specific field, suggesting that a small number of journals publish the majority of relevant articles, while the remaining articles are dispersed across a larger number of journals. This law is mathematically expressed as a ratio of $1:n:n^2$, where 'n' represents the number of journals in successive zones of productivity.⁷⁻¹⁴

Our analysis also justifies the Bradford's Law of Scattering as the majority of the articles were published only few Journals (Figure 3) like Journal of Patient Safety, BMJ Open, BMC Health Services Research, British Journal of Nursing etc.

When evaluating the scholarly impact of patient safety literature over the last decade (Table 2), "BMJ Quality & Safety" stands out as the most influential journal, with the highest m-index (2.727), h-index (30), and total citations (2481). While "Journal of Patient Safety" contributed the

highest volume of publications (n=261), it trails slightly in citation velocity. Open-access journals like BMJ Open and PLOS ONE also demonstrated strong performance, enhancing accessibility and citation reach. These findings

suggest that while quantity plays a role in visibility, journals emphasising methodological rigor and policy relevance garner sustained citation impact.

Most Relevant Authors

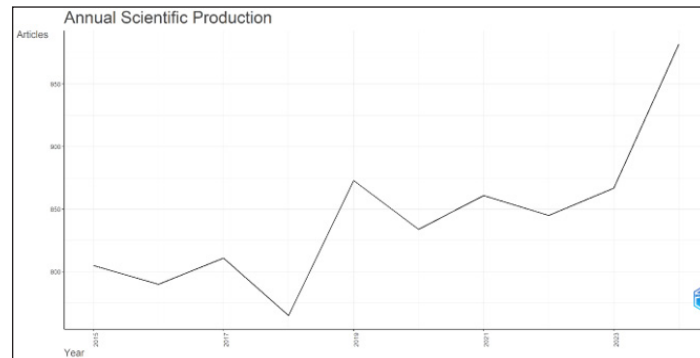


Figure 1. Graph showing trends in annual scientific production of “Patient Safety” domain over the last decade (2015-2024)

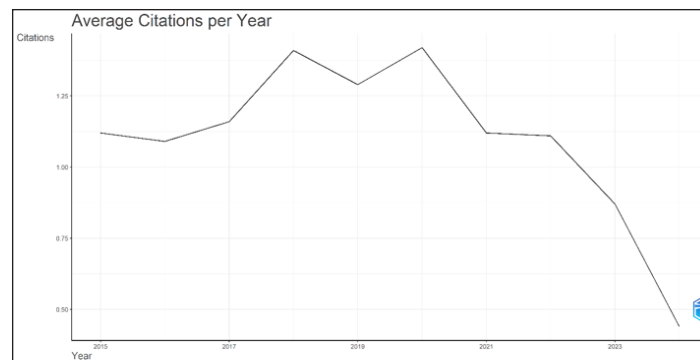


Figure 2. Graph Showing Average Citation per year

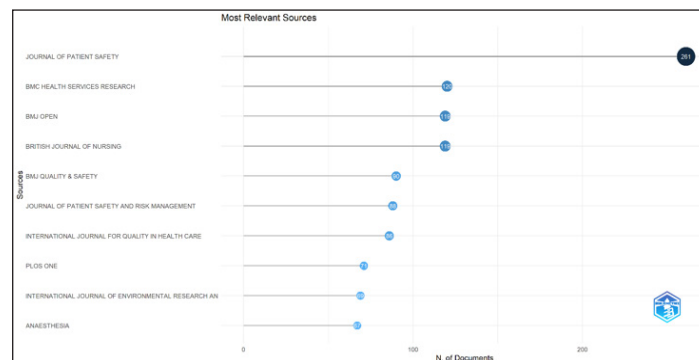


Figure 3. Most relevant sources of the Patient safety domain based on the number of scientific publications

Table 1. Summary of Bradford's law

Aspect	Description
Introduced By	Samuel C. Bradford (1934)
Purpose	Identify core journals that contribute most articles
Zones	Divides sources into three zones based on productivity

Core Concept	A small number of journals publish a large proportion of research articles
Practical Use	Optimizing journal collections, focusing on core literature

Table 2. Top 10 journal and its impact matrix

Source	h_index	g_index	m_index	TC*	NP**
BMJ QUALITY & SAFETY	30	47	2.727	2481	90
BMC HEALTH SERVICES RESEARCH	25	35	2.273	1730	120
BMJ OPEN	25	41	2.273	2156	119
JOURNAL OF PATIENT SAFETY	24	34	2.182	2269	261
INTERNATIONAL JOURNAL FOR QUALITY IN HEALTH CARE	21	35	1.909	1308	86
PLOS ONE	19	43	1.727	1947	71
JOURNAL OF NURSING MANAGEMENT	17	28	1.545	864	46
INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	16	29	1.778	1049	69
BMC MEDICAL EDUCATION	14	21	1.273	501	34
JOINT COMMISSION JOURNAL ON QUALITY AND PATIENT SAFETY	13	22	1.182	561	67

*Total citations of all articles.** Number of Publications

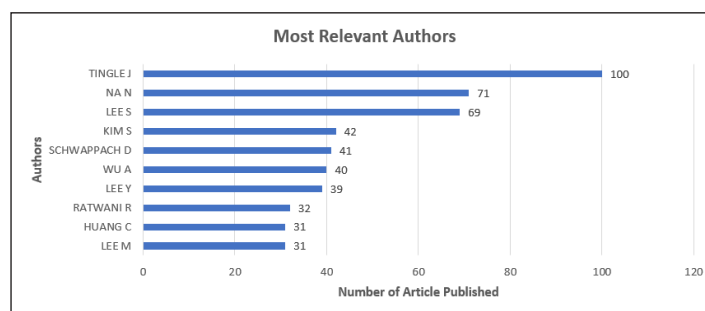


Figure 4. Most relevant authors based on the number of scientific publications (2015-2024)

Lotka's Law

Lotka's Law, introduced by Alfred J. Lotka in 1926 (Table 3), describes the frequency of publication among authors in a given field, positing that the number of authors publishing 'n' papers is approximately $1/n^2$ of those publishing just one paper. This inverse square relationship highlights a common phenomenon in scientific productivity, where a small fraction of authors contributes a significant portion of the total publications Huang (2024).¹⁵ The law has been validated across various disciplines, demonstrating its applicability in fields such as medicine, law, and business.^{14,16-20} Even in our analysis, it is found that the "Patient Safety" articles are largely published by only a few authors like Tingle J, Na N, Lee S etc which validates Lotka's Law in "Patient Safety" Literature.

Key Insights from Lotka's Law

- **Highly Productive Authors Are Rare:** Only a small percentage of authors in any given field are highly productive, meaning they contribute a large number of publications.

- **Most Authors Publish Few Papers:** The majority of authors contribute only 1 or 2 papers to a given field over their career.
- **Author Productivity is Skewed:** Lotka's Law highlights the skewed distribution of author productivity, with a few prolific authors driving much of the scientific output.

Among the top contributors to patient safety research (Table 4), LEE S emerges as the most prolific and impactful author, with the highest h-index (17), m-index (1.545), and total citations (919) across 69 publications. DONALDSON L and BATES D also demonstrated notable scholarly influence, balancing both citation strength and publication volume. The presence of recognised patient safety experts like PRONOVOST P and VINCENT C further reinforces the field's foundation in systems thinking, healthcare leadership, and safety innovation. Authors with rising m-index values, such as CARSON-STEVENSON A, represent emerging voices likely to shape the next phase of patient safety scholarship. Our analysis reveals that the authors who have the most publications in the specific field like "Patient Safety" may

not necessarily make the impact. However, LEE S found to be among Top 3 authors in terms of volume of publication as well as the impact matrix.

Most relevant affiliations of Authors

The USA emerged as the leading country in terms of publication volume, contributing 27.7% of all patient safety research between 2015 and 2024 (Figure 6). However, with only 6.1% of its publications involving international collaboration, its focus appears domestically oriented. In contrast, Canada, the United Kingdom, and Australia demonstrated significantly higher international collaboration rates (26.9%, 20.9%, and 22.2% respectively), underscoring their active participation in global patient safety discourse. While countries like Iran and Brazil contributed steadily, their low international engagement highlights potential areas for strengthening research visibility and cross-border knowledge exchange.

While the USA leads in total citations (19,038), countries such as the United Kingdom, Australia, and the Netherlands stand out for their high citation efficiency, with average citations per article of 15.2, 14.1, and 16.5, respectively. This suggests that although these countries publish fewer articles compared to the USA, their research garners greater scholarly attention and impact. Notably, the Netherlands ranks highest in average citations, underscoring its strength in producing high-quality, influential patient safety literature.

Among the most globally cited patient safety articles, Hall et al. (2016) in PLOS ONE stands out with nearly 1,000 citations and the highest normalized impact (90.12), indicating both widespread adoption and sustained influence (Table 5). Panagioti et al. (2018), published in JAMA Internal Medicine, achieved an exceptionally high annual citation rate (80.75), reflecting the impact of rigorous evidence synthesis. Notably, impactful papers were not limited to elite journals—works such as Garcia et al. (2019) in Medicina and Boamah et al. (2018) in Nursing Outlook show that relevance and applicability also drive citations. This diversity in outlets underscores the multidisciplinary and inclusive nature of patient safety research dissemination.

The world cloud (Figure 7) derived from bibliometric analysis via Biblioshiny interface (Keywords Plus, Number of words 50, Ellipticity 0.65, Font size 1) showed the interrelated concepts of “Patient Safety” literature where focus may be needed for further study. It reveals that patient safety

research is anchored in studies examining adverse events, system errors, and institutional quality. Key contextual factors include healthcare settings such as hospitals and surgical units, with nurses appearing prominently as both subjects and implementers of safety practices. Commonly employed strategies include checklists, questionnaires, and educational interventions, underscoring the field’s reliance on structured tools. Moreover, frequent terms such as ‘culture,’ ‘leadership,’ and ‘communication’ reflect the significant emphasis on organisational behaviour and safety climate. Geographically, contributions are concentrated in the United Kingdom and United States, suggesting a Western dominance in research output and policy-driven studies.

Trend Topic

Trend topic analysis reveals a clear chronological progression in patient safety research. Early studies (2015–2017) focused on foundational standards and clinical risk, while the mid-decade period (2017–2020) emphasised institutional quality improvement and error management. Post-2021, there is a noticeable pivot toward behavioural and systemic resilience, evidenced by rising interest in burnout, safety culture, and COVID-19. Looking ahead, emerging topics like bias, speaking up, and healthcare costs suggest a growing intersection between patient safety, ethics, economics, and technology.

Co-occurrence network

The co-occurrence network analysis (Figure 8) revealed three major thematic clusters. Cluster 1 emphasised frontline clinical safety, with terms like ‘nurses,’ ‘communication,’ and ‘mortality’ playing key bridging roles. Cluster 2 centered around institutional safety strategies, highlighting nodes such as ‘hospitals,’ ‘education,’ and ‘quality improvement.’ Cluster 3 represented methodological and demographic contexts, with ‘human,’ ‘questionnaire,’ and ‘patient safety’ emerging as highly influential. Notably, nodes such as ‘hospitals,’ ‘patient safety,’ and ‘education’ exhibited high betweenness centrality, positioning them as key connectors across clusters. The common terminologies that are used to explain co-occurrence network analysis of different concepts associated with Patient safety literature is explained in the Table 7. Collaboration Network (Figure 9) among authors also provides an insight about how the prominent authors have collaboration in “Patient Safety” research.

Table 3. Summary of Lotka’s Law

Aspect	Description
Introduced By	Alfred J. Lotka (1926)
Purpose	To describe the distribution of author productivity
Key Concept	Few authors contribute most of the research output
Formula	$f(x) = C / x^2$
Practical Use	Identifying prolific authors and understanding productivity distribution

Table 4. List of most relevant authors based on impact matrix (2015-2024)

Rank	Author	h_index	g_index	m_index	TC	NP
1.	LEE S	17	27	1.545	919	69
2.	DONALDSON L	15	24	1.364	892	24
3.	BATES D	12	28	1.091	822	28
4.	KIM S	12	21	1.091	508	42
5.	LEE Y	11	15	1	297	39
6.	PRONOVOST P	11	25	1	671	29
7.	SHEIKH A	11	20	1	699	20
8.	VINCENT C	11	23	1	567	23
9.	WU H	11	15	1	291	30
10.	CARSON-STEVENS A	10	21	0.909	449	30

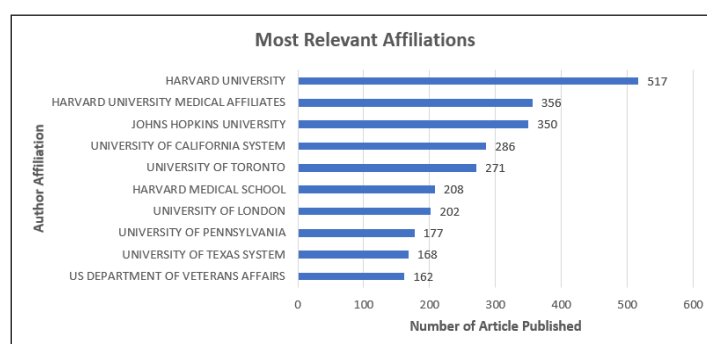


Figure 5. Most relevant affiliations based on the number of scientific publications (2015-2024)

Table 5. List of top 10 high-impact journal articles

S.No	First Author	Year	Journal	Title	Total Citations (TC)	Citations per Year (TC/Year)	Normalized Citations
1	Hall L ²¹	2016	PLOS ONE	Healthcare staff wellbeing, burnout, and patient safety: A systematic review	986	98.60	90.12
2	Panagioti M ²²	2018	JAMA Intern Med	Association between Physician Burnout and Patient Safety, Professionalism, and Patient Satisfaction: A Systematic Review and Meta-analysis	646	80.75	57.45
3	Braithwaite J ²³	2015	Int J Qual Health Care	Resilient health care: turning patient safety on its head	305	27.73	24.77
4	Donaldson L ²⁴	2017	The Lancet	Medication Without Harm: WHO's Third Global Patient Safety Challenge	285	31.67	27.29
5	Welp A ²⁵	2015	Front Psychol	Emotional exhaustion and workload predict clinician-rated and objective patient safety	249	22.64	20.22

6	Boamah S ²⁶	2018	Nurs Outlook	Effect of transformational leadership on job satisfaction and patient safety outcomes	249	31.13	22.14
7	Garcia C ²⁷	2019	Medicina (Lithuania)	Influence of burnout on patient safety: systematic review and meta-analysis	227	32.43	25.10
8	Mitchell J ²⁸	2016	BMJ Qual Saf	Patient safety incident reporting: A qualitative study of thoughts and perceptions of experts 15 years after 'To Err is Human'	224	22.40	20.47
9	Müller M ²⁹	2018	BMJ Open	Impact of the communication and patient hand-off tool SBAR on patient safety: a systematic review	220	27.50	19.57
10	Bates D ³⁰	2018	Health Affairs	Two decades since to err is human: An assessment of progress and emerging priorities in patient safety	211	26.38	18.76



Figure 6. Word cloud shows the inter related concepts in Patient Safety literature

Table 6. Summary of Emerging Clusters from the analysis of key words

Cluster	Keywords	Focus Area
Clinical Outcomes	adverse events, mortality, medical errors, procedures, hospital	Risk and harm in healthcare
Human Factors	communication, attitudes, perceptions, teamwork, leadership	Safety culture, non-technical skills
Education & Tools	education, curriculum, checklist, questionnaire	Training and assessment methods
System Performance	quality, management, performance, quality improvement	Institutional and systemic safety strategies
Demographic Context	adult, middle aged, female, male, aged	Target populations and segmentation

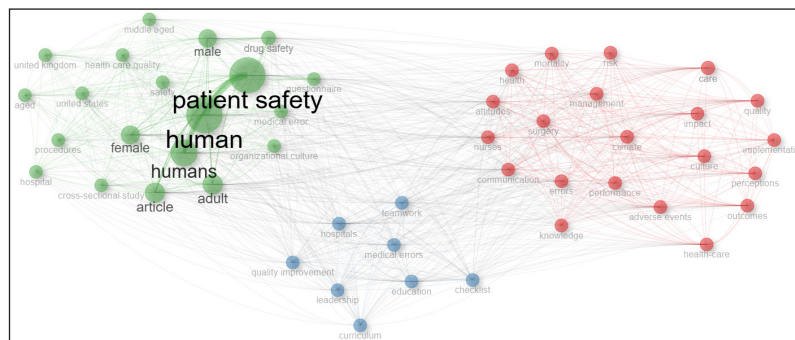


Figure 7. Map showing co-occurrence network of three identified cluster

Table 7. Technical terms in Co-occurrence network analysis

Metric	Meaning
Cluster	Thematic group of terms forming tightly connected topics.
Betweenness Centrality	Indicates bridging terms—important connectors across topics.
Closeness Centrality	How quickly a term can reach all others—efficiency in communication.
PageRank	Relative importance of a node based on its connection strength and influence.

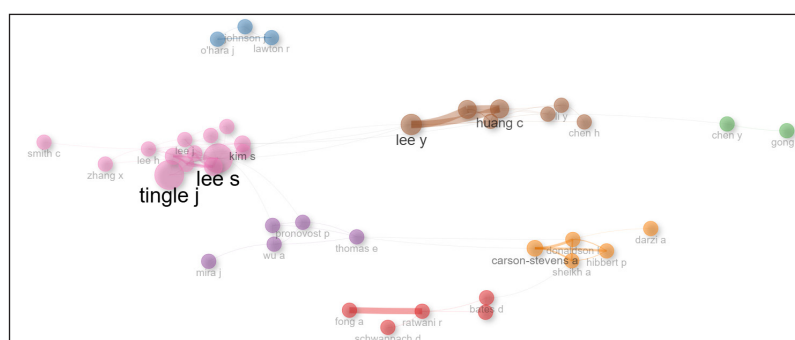


Figure 8. Map showing collaboration network among authors

Conclusion

Bibliometric analysis in the field of patient safety is an emerging and valuable methodology for understanding research trends and gaps. Compared to global contributions, developing countries like India have shown limited involvement in this domain. Moreover, despite nurses being central to direct patient care and spending considerable time with patients, their contribution to patient safety research remains minimal, both nationally and internationally. Collectively, the findings underscore a maturing and dynamic field, one that is responsive to both global health disruptions and evolving systemic challenges. As patient safety continues to intersect with workforce well-being, organizational design, and policy frameworks, future research must prioritize collaboration, inclusivity, and translational relevance. Strengthening cross-border research networks and embracing interdisciplinary approaches will be key to advancing the “from errors to excellence” trajectory in global patient safety research.

Conflicts of Interest: None

Sources of Funding: None

Abbreviations and Terminologies

- **h_index:** Number of articles (h) with $\geq h$ citations – indicates productivity + impact.
- **g_index:** Gives more weight to highly cited papers – rewards citation concentration.
- **m_index:** h-index divided by years since first publication (rate of citation impact).

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