Original Article

Investigation of Global Trends of Articles Published on Delirium and Nursing in Intensive Care Units: A Descriptive and Bibliometric Analysis Study

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Abstract
Background: Delirium is a cognitive disorder with multifactorial etiology that imposes a significant burden on healthcare services.
Aim: To identify and visualize studies on delirium and nursing in intensive care units (ICUs) and to elucidate the global trends within this field.
Methodology: In this descriptive bibliometric study, the VOSviewer software was utilized to conduct performance analysis, scientific mapping, and comprehensive bibliometric assessments. A total of 648 publications were systematically analyzed to evaluate research trends, collaboration networks, and thematic developments within the field of delirium and nursing in intensive care units (ICUs).
Results: The analysis revealed that Ely E.W. was the most prolific author, contributing 15 publications. The United States led in the number of publications with a total of 215 articles. Universidade de São Paulo emerged as the top institution, producing 26 publications. Additionally, the American Journal of Critical Care published the highest number of articles in this field, totaling 56.
Conclusion: The bibliometric analysis revealed a gradual increase in the number of studies on delirium and nursing in intensive care units from 1997 to 2023, with a significant rise beginning in 2018 and peaking in 2021.

Keywords: bibliometric; delirium; intensive care; intensive care unit; intensive care nursing

Introduction

Delirium is a clinical syndrome marked by transient alterations in the level of consciousness, disruptions in attention, and impaired perception. It typically manifests in elderly individuals, evolves over a brief timeframe, and exhibits fluctuations throughout the day. The clinical presentation of delirium can vary significantly and often includes psychomotor disturbances, such as hyperactivity or hypoactivity, along with disruptions in sleep duration and quality (Mart et al., 2021). The incidence and prevalence of delirium among intensive care unit (ICU) patients average approximately 29% and 40%, respectively, with rates reaching up to 80% in those requiring mechanical ventilation (Ely et al., 2004; Girard et al., 2008; Li et al., 2020; Slooter et al., 2017). The pathophysiology of delirium remains poorly understood, with no singular etiology identified. It is likely multifactorial, as any condition or factor that significantly disrupts brain function has the potential to precipitate delirium.

Factors contributing to delirium include various medications, such as sedatives, antihypertensives, sleeping aids, and analgesics; acute illnesses; infections; exacerbation of chronic conditions; hypoxia resulting from respiratory issues like asthma; ischemia affecting the brain or heart; severe pain; dehydration; sleep deprivation; metabolic disturbances, such as hypoglycemia or electrolyte imbalances; alcohol withdrawal in individuals with chronic heavy alcohol use; and surgical interventions involving general

anesthesia (Maldonado, 2018). Furthermore, Kooken et al. (2021) identified a strong association between prolonged coma, mechanical ventilation, intensive care unit (ICU) stays, hospitalization, and the use of physical restraints with the development of delirium. Similarly, another study reported that severe illness, the application of physical restraints, an increased need for nursing interventions, and various nursing-related factors were significantly associated with a heightened risk of delirium (Piao et al., 2016).

Delirium is a serious and often preventable condition that is associated with substantial economic burdens, as well as increased morbidity and mortality rates (Hayhurst et al., 2016).

Nurses play a crucial role in enhancing the quality of care for patients with delirium by conducting early assessments, identifying potential underlying causes, and implementing appropriate management strategies (Sook Roh, 2021). Therefore, nurses must comprehend the factors that elevate the risk of delirium and take a proactive role in its prevention. In the long term, by focusing on patients requiring extensive nursing interventions, nurses can serve as key contributors to the prevention of delirium (Piao et al., 2016). Preventing delirium requires a focus on its prevention, early detection, and the treatment of underlying causes. This process necessitates the use of valid and reliable delirium assessment tools. Effective management also depends on ensuring robust coordination among interprofessional team members and fostering interdisciplinary collaboration to optimize patient outcomes (Gómez Tovar et al., 2022; Mart et al., 2021; Reznik and Slooter, 2022). A qualitative study by Emme (2020) involving nurses revealed that the lack of a clear definition of delirium and preventive activities were significant challenges. The study also identified several interrelated barriers, including deficiencies in knowledge, perceived meaningfulness, prioritization, resources, and working conditions. Furthermore, Emme (2020) emphasized that the identification, prevention, and management of delirium using non-pharmacologic methods necessitate a dedicated and collaborative effort from all stakeholders, including physicians, healthcare leaders, and policymakers. Accordingly, it is crucial to emphasize the prevention of delirium, which is commonly observed in ICUs, by conducting nurse-led non-pharmacologic interventions and developing standardized protocols or care packages to address this issue effectively.

The literature includes several bibliometric studies on delirium, such as research on hotspots and publication trends in postoperative delirium (Lin et al., 2022), findings from the Delirium Subtype Survey, the relationship between COVID-19 and delirium (Bansal et al., 2021), an analysis of the 100 most-cited articles on delirium (Fei et al., 2022), and a scientometric study examining publications on delirium from 2001 to 2020 (Grover and Gupta, 2021). However, these studies did not include bibliometric analyses focusing specifically on high-quality and highly cited articles related to intensive care units (ICUs), delirium, and nursing. Bibliometric analysis serves as a vital tool for evaluating research performance and identifying influential publications within specific fields (Wang et al., 2020).

Highly cited articles offer valuable insights into the current state of research within a specific field (Yi et al., 2021). Given the significance of delirium in nursing within the ICU setting, this bibliometric analysis was conducted to assist researchers in evaluating the quality of research, identifying global trends in the field, utilizing existing publications more effectively, and providing a valuable reference for future studies.

Methods

Objectives: The aim of this study was twofold: (1) to identify and visualize research conducted on delirium and nursing in ICUs between 1997 and 2023, and (2) to uncover global trends within this field.

Design: This descriptive bibliometric analysis examined studies on delirium and nursing in ICUs published in the 'Web of Science (WoS) Core Collection' database, with the aim of analyzing them bibliometrically and identifying global trends in the field.

This manuscript presents the findings of an observational bibliometric study and adheres to the applicable Enhancing the Quality and Transparency of Health Research (EQUATOR) guidelines, including PRISMA and STROBE.

Bibliometric analysis is a scientific method that facilitates the quantitative and qualitative evaluation of extensive bibliometric data, offering insights into key research components

such as authors, countries, journals, and emerging trends (Donthu et al., 2021).

Unlike traditional review methods, such as systematic reviews that focus on specific and narrowly defined aspects of a research question, bibliometric analysis offers an objective and comprehensive overview of the literature in a given research area, highlighting general trends and uncovering potential directions for future studies.

Bibliometric analysis is well-suited for handling large datasets, making it particularly effective for research areas with broad scopes (Donthu et al., 2021; You et al., 2021). An essential aspect of bibliometric analysis is the selection of databases from which the dataset will be derived. Currently, numerous databases are available for bibliometric analysis, with PubMed, Embase, Scopus, SpringerLink, Google Scholar, and ScienceDirect being among the most frequently utilized. Each of these databases possesses unique characteristics (Moral-Munoz et al., 2020).

Among these databases, the Web of Science (WoS) is the most preferred by researchers and is widely utilized to obtain datasets in numerous research studies (Karagöz and Şeref, 2019).

Data collection: The data for this study were collected on July 26, 2023, from publications available in the Web of Science (WoS) database between 1995 and 2023. Using the keywords 'ICU' OR 'intensive care' OR 'intensive care unit' OR 'intensive care units' AND 'delirium' AND 'nursing,' a total of 291,887 publications were identified in the WoS database. A total of 648 articles retrieved from the Web of Science (WoS) database formed the dataset for this study.

Figure 1 illustrates the search flow for this bibliometric analysis. The following main steps were undertaken during the literature visualization process using VOSviewer:

Step 1-Identifying the Research Topic: The initial step involves defining the research focus. This study specifically examines publications related to delirium and nursing within the context of intensive care units (ICUs).

Step 2-Collecting Literature Data: In this step, a comprehensive literature search is conducted in the relevant database using the predefined search strategy to retrieve publications aligned with the research topic. The collected literature needs to be refined and cleaned. In this study, the Web of Science (WoS) database is utilized, as its data can be directly imported and analyzed using VOSviewer.

Step 3-*Setting up an Analysis Project:* Define the analysis items in VOSviewer and configure the relevant parameters, such as time segmentation, network type, and correlation thresholds. Once the setup is complete, run VOSviewer to perform the analysis.

Step 4-*Visualization:* Review the analysis results (refer to Zhu et al., 2017, for detailed analysis content), adjust the clustering algorithm and parameters as needed, and generate visual displays for each analysis type, such as network maps, time charts, and time zone diagrams.

Step 5-*Visual Analysis*: Combine the analysis results with professional knowledge to conduct a comprehensive evaluation based on the proposed analysis types. Finally, compile and prepare the analysis report.

Ethical considerations Ethics committee approval was not required as this study was conducted retrospectively.

Data analysis: This bibliometric analysis examined the annual numerical distribution of publications and citations, leading countries, predominant publication languages, most active journals, institutions, and publications, co-authorship networks, institutional and international collaborations, notable researchers, and frequently used keyword.

In this study, VOSviewer (version 1.6.15) was utilized to visualize the bibliometric analysis. To enhance the comprehension of the results, data were graphically represented using the VOSviewer software (van Eck and Waltman, 2010).

Analysis and graphical interpretation are essential tools for helping researchers gain deeper insights into issues related to research funding and identifying key trends in the field. VOSviewer enables the analysis of bibliographic data from various databases, including WoS, Scopus, and PubMed (Leydesdorff and Rafols, 2022).

VOSviewer generates clear graphical maps that visualize results using various techniques, such as co-citation analysis, bibliographic coupling, co-authorship networks, and keyword co-occurrence analysis (Guo et al., 2021).

Validity, reliability, and rigour: To ensure the validity and reliability of bibliometric studies, the selection process must be transparent and reproducible. In this study, researchers randomly sampled publications from the dataset

to verify their relevance and appropriateness for the analysis.

Results

Trend of publications

Examining the annual number of articles published on delirium and nursing in ICUs provides insight into the level of interest in this field over time. Table 1 presents the number of articles published in this research area from 1997 to 2023, revealing a total of 648 relevant publications with a generally stable growth trend. From 1997 to 2009, the number of articles published remained relatively low, suggesting that this field was in its early developmental stage during that period.

The top 10 authors, countries, institutions and journals contributing the most to the topic

The top contributors to the field of delirium and nursing in intensive care units include the leading authors, countries, institutions, funding agencies, and journals. The most prolific author was Ely E.W. with 15 publications. The United States of America (USA) ranked as the top contributing country with 215 publications, while Universidade de São Paulo emerged as the leading institution with 26 publications. The primary funding agency was the United States Department of Health and Human Services, supporting 84 studies. The most active journal in this field was the American Journal of Critical Care, which published 56 relevant articles. The most cited article, titled "Delirium in Older Emergency Department Patients: Recognition, Risk Factors, and Psychomotor Subtypes," was published in Academic Emergency Medicine in 2009 (Table 2).

Highly cited articles

The top 10 most cited publications are presented in Table 3. Among these, the articles titled "Delirium in Older Emergency Department Patients: Recognition, Risk Factors, and Psychomotor Subtypes" and "Four Sensitive Screening Tools to Detect Cognitive Dysfunction in Geriatric Emergency Department Patients: Brief Alzheimer's Screen, Short Blessed Test, Ottawa 3DY, and the Caregiver-completed AD8" were ranked at the bottom of the list.

Emerging trends and thematic progression

In the common keyword analysis, the network was found to comprise 335 keywords surpassing the threshold value, organized into 22 clusters, with 1,969 links and a total link strength of 2,576. The keyword network map analysis in the field of delirium and nursing in ICUs revealed the following key findings (Image 1):"Critical care": 16 clusters, 62 occurrences, 111 links, and a total link strength of 204."Intensive care unit": 17 clusters, 40 occurrences, 74 links, and a total link strength of 109."Intensive care units": 2 clusters, 56 occurrences, 85 links, and a total link strength of 178."Nursing": 22 clusters, 87 occurrences, 1,969 links, and the highest total link strength of 2,576."Delirium": 10 clusters, 67 occurrences, 87 links, and a total link strength of 67."Mechanical ventilation": 1 cluster, 37 occurrences, 70 links, and a total link strength of 108.These results highlight the centrality of keywords like "nursing" and "critical care" in the field's research landscape.

Analysis of co-author-author, institution, country and network map

Co-Authorship Analysis (Figure 2A) Ely, E. Wesley: 15 co-authorships, 920 citations, and a link strength of 68.Happ, Mary Beth: 14 co-authorships, 397 citations, and a link strength of 34.Han, Jin H.: 9 co-authorships, 703 citations, and a link strength of 41.Institutional.

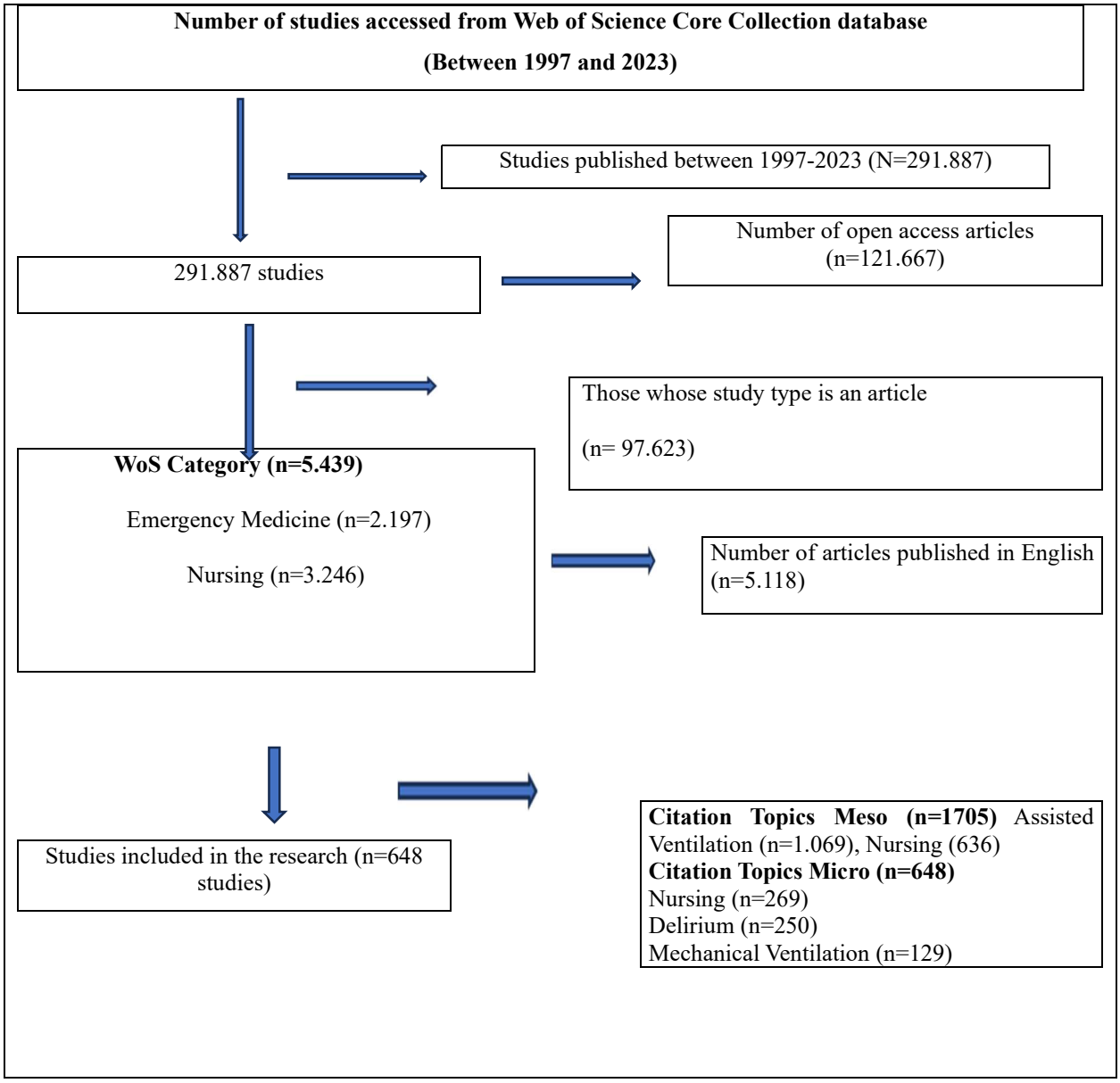


Figure 1. Publication selection flow diagram

Table 1. Publications by years (1997- 2023)

Publication Years	Record Count	% of 648
2023	22	3.395
2022	76	11.728
2021	94	14.506
2020	74	11.420
2019	52	8.025
2018	36	5.556
2017	57	8.796

2016	30	4.630
2015	40	6.173
2014	39	6.019
2013	29	4.475
2012	31	4.784
2011	19	2.932
2010	13	2.006
2009	15	2.315
2008	5	0.772
2007	9	1.389
2006	1	0.154
2005	2	0.309
2004	1	0.154
2003	1	0.154
1998	1	0.154
1997	1	0.154

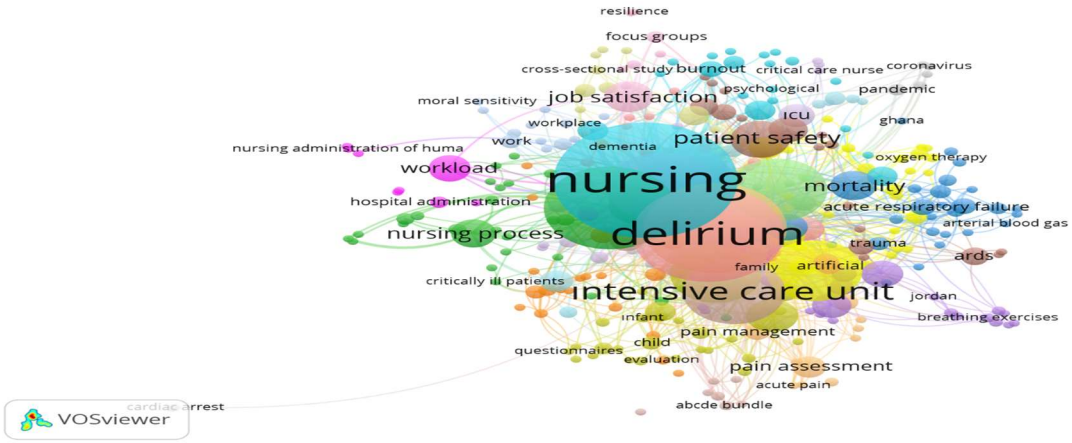
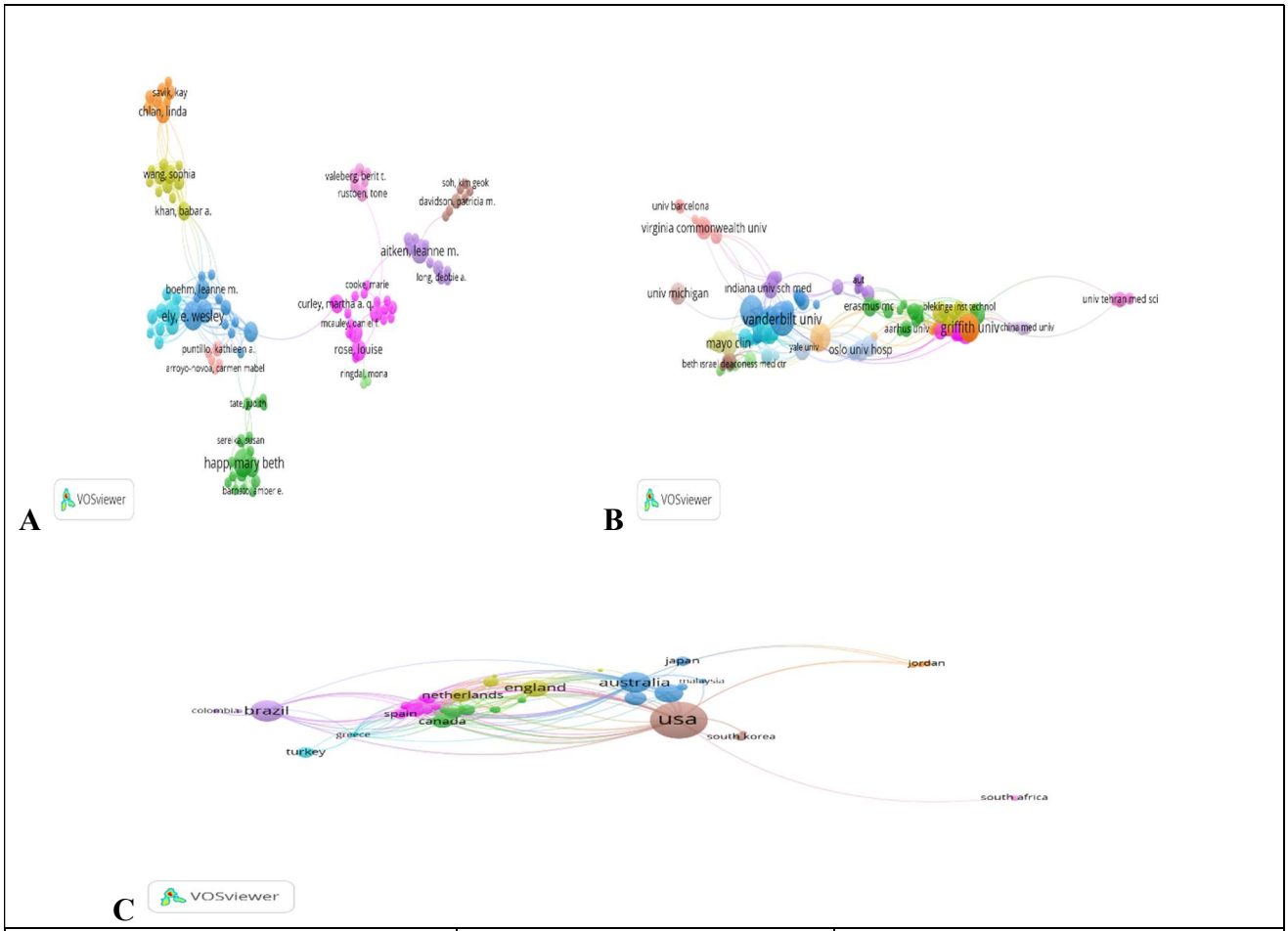


Image 1. Keyword analysis network map



A. *The co-author-author collaboration network consists of 107 authors, 11 clusters and 335 links.* *The total link strength is 602.*	***B****. In the co-author-institution collaboration, the network consists of 210 institutions, 17 clusters and 624 links.* *The total link strength is 919.*	***C****. In co-author-country collaboration, the network consists of 41 countries, 9 clusters and 214 links. The total link strength is 363.*

Figure 2. Co-author-author, institution, country analysis network map

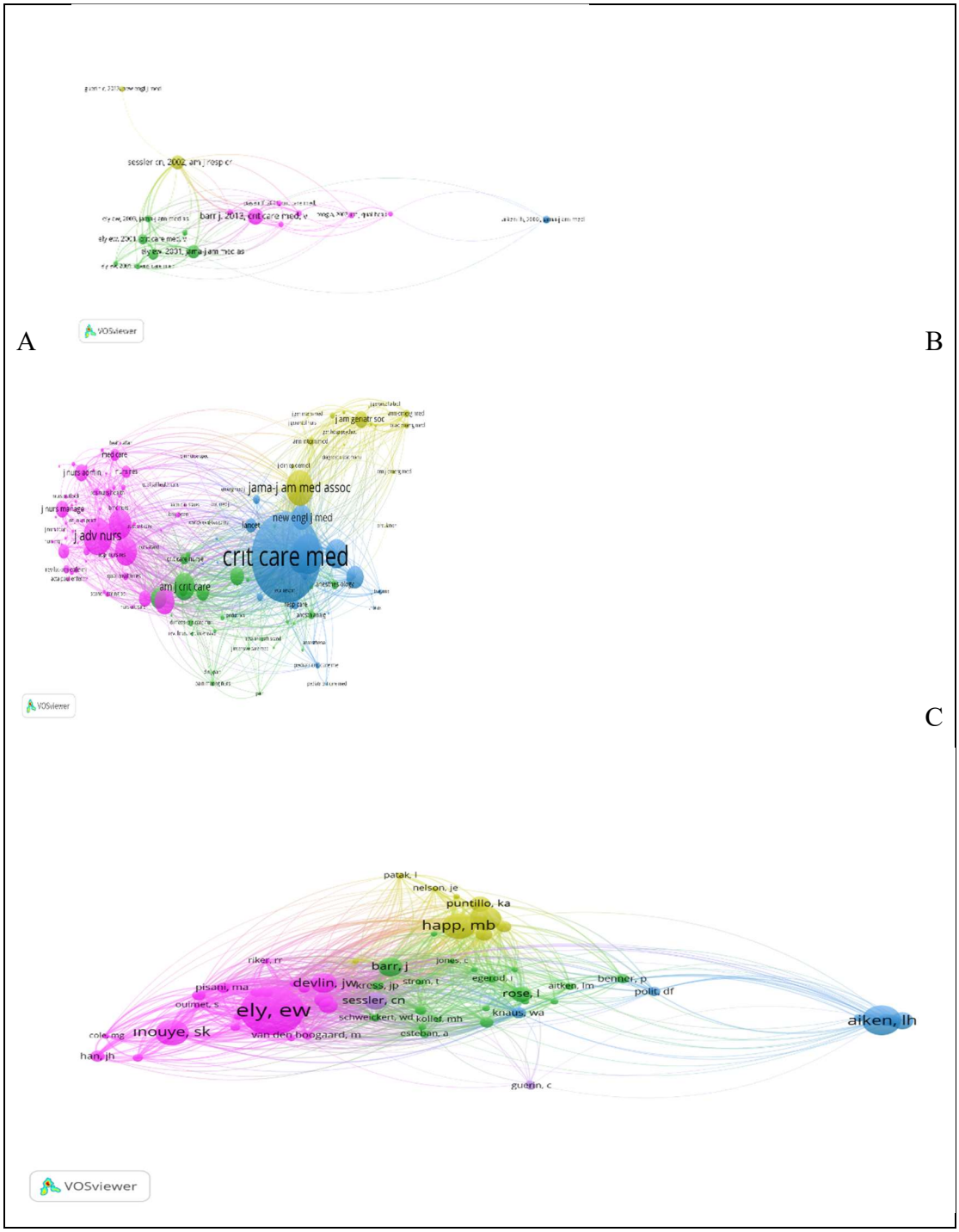


Figure 3. Cited article, journal, author analysis network map

Collaboration (Figure 2B) A total of 1,137 institutions participated in collaborations, with 266 institutions meeting the threshold for analysis.Vanderbilt University: 24 publications, 1,052 citations, and a total link strength of 46. University of Toronto: 10 publications, 462 citations, and a total link strength of 26.Tennessee Valley Healthcare System: 7 publications, 534 citations, and a total link strength of 11.Country-Level Analysis (Figure 2C) : 65 articles, 918 citations, and a total linkage strength of 66.England: 45 articles, 620 citations, and a total linkage strength of 49. Brazil: 73 articles, 599 citations, and a total

linkage strength of 23.These results highlight the significant contributions of key authors, institutions, and countries in the field, as well as the strength of collaborative networks.

The network map according to citations

The dataset analysis revealed the following cluster and network characteristics: Figure 3A: A total of seven clusters were identified, comprising 81 links and a total link strength of 554. Figure 3B: The dataset formed four clusters, with 7,401 links and a total link strength of 1,607,221. Figure 3C: Five clusters were observed, including 1,210 links and a total link strength of 11,982. These results demonstrate varying levels of connectivity and link strength across the analyzed datasets, highlighting the structural differences in the networks.

Discussion

This study conducted a bibliometric analysis spanning the years 1997 to 2023 to explore the general landscape of publications on delirium and nursing in ICUs, as well as to identify global trends in this field.

Visual mapping and bibliometric analyses were utilized to evaluate the publication performance of key concepts, countries, institutions, and researchers in the field of delirium and nursing in ICUs. As a result, it was observed that the number of articles published on delirium and nursing in ICUs began to rise significantly in 2011, reaching its peak with 94 articles published in 2021.

Delirium, often referred to as "acute brain failure," is characterized by an acute change in mental status and is known for its high incidence rates in ICU settings (Mattison, 2020). The rapid increase in publications in 2021 may be attributed to the heightened ICU demands for patients with critical conditions resulting from the COVID-19 pandemic.

In a related study conducted by Zhou et al. (2023), it was observed that numerous articles on delirium subtypes were published during the five-year period from 2011 to 2015 and after 2019. While this finding aligns with the results of our study, differences in the keywords used for analysis present a limitation that should be considered.

In the field of delirium and nursing in ICUs, Ely E.W. stands out as the most prolific author, and the USA emerges as the leading contributor both institutionally and as a primary funder. Consequently, researchers interested in understanding the structure of this research field and staying updated on developments in delirium studies are recommended to follow the work of Ely E.W. and related research initiatives in the USA. Furthermore, it is suggested that comprehensive research projects can be developed through international collaboration with the USA to advance strategies and health policies aimed at preventing delirium in ICUs across countries.

Among the top 10 most cited publications in the study, the highest citation count was attributed to "Delirium in Older Emergency Department Patients: Recognition, Risk Factors, and Psychomotor Subtypes," followed by "The Presence of Resilience Is Associated with a Healthier Psychological Profile in ICU Nurses: Results of a National Survey" and "Impact of Hospital Nursing Care on 30-Day Mortality for Acute Medical Patients." In the literature, advancing age (>65 years) has been identified as a significant risk factor for delirium (Zhu et al., 2020). Given the aging global population, it is recommended that efforts to prevent and manage delirium be intensified through targeted research and intervention strategies.

The analysis results indicate that the keywords "critical care," "intensive care unit," "intensive care units," "nursing," "delirium," and "mechanical ventilation" exhibit high occurrence density and relatively recent emergence. These keywords can therefore be considered as the latest emerging research focal points in the field. Keyword analysis reveals the relationships among primary keywords, providing insights into the structure of research fields. It also helps readers identify and prioritize the hot topics in popular literature and understand current research trends (Fei et al., 2022).

Citation burst analysis highlights the hotspots within a research area. This analysis typically demonstrates that while the rate of article publications remains stable, the number of citations increases over time, reflecting sustained and growing interest in the field (Donthu et al., 2021; You et al., 2021).

Table 2. Top 10 authors, country, institution, funding institution, journal

Author	Count of articles	Country	Count of articles	Institution	Count of articles	Funding organization	Count of articles	Journal	Count of articles
Ely EW	15	USA	215	Universidade De Sao Paulo	26	United States Department of Health Human Services	84	American Journal of Critical Care	56
Happ MB	14	Brazil	73	Pennsylvania Commonwealth System of Higher Education Pcshe	25	National Institutes of Health NIH USA	80	Journal of Nursing Management	38
Aitken LM	11	Australia	65	Vanderbilt University	24	NIH National Institute of Nursing Research NINR	33	Intensive and Critical Care Nursing	30
Han JH	9	Peoples R China	53	University of Pittsburgh	20	NIH National Heart Lung Blood Institute NHLBI	20	Nursing in Critical Care	26
Munro CL	9	England	45	Us Department of Veterans Affairs	18	NIH National Institute on Aging NIA	15	Critical Care Nurse	25
Vasilevskis EE	9	Iran	32	Veterans Health Administration VHA	18	NIH National Center for Advancing Translational Sciences NCART	9	Revista Latino Americana de Enfermagem	22
Blackwood B	8	Netherlands	30	Geriatric Research Education Clinical Center	17	NIH Eunice Kennedy Shriver National Institute of Child Health Human Development NICHD	8	Australian Critical Care	21
Chlan L	8	Canada	28	University of California System	17	NIH National Center For Research Resources NCRR	8	BMC Nursing	21

Grap MJ	8	Norway	20	University System of Ohio	17	Agency For Healthcare Research Quality	6	Revista Da Escola De Enfermagem Da USP	20
Rose L	8	Sweden	20	Griffith University	16	Coordenacao De Aperfeicoamento De Pessoal De Nivel Superior Capes	6	Heart Lung	19

Table 3. Top 10 most cited publications (1997-2023)

No	Publication	Author	Year	Journal	Mean Citation	Total Citation
1	Delirium in Older Emergency Department Patients: Recognition, Risk Factors, and Psychomotor Subtypes	Han, JH; Zimmerman, EE; Cutler, N; Schnelle, J; Morandi, A; Dittus, RS; Storrow, AB; Ely, EW	2009	Academic Emergency Medicine	17.53	263
2	The presence of resilience is associated with a healthier psychological profile in intensive care unit (ICU) nurses: Results of a national survey	Mealer, M ; Jones, J; Newman, J; McFann, KK; Rothbaum, B ; Moss, M	2011	International Journal of Nursing Studies	21.25	255
3	Impact of hospital nursing care on 30-day mortality for acute medical patients	Tourangeau, AE; Doran, DM; Hall, LM; Pallas, LO; Pringle, D; Tu, JV; Cranley, LA	2007	Journal of Advanced Nursing	12.06	205
4	Global Use of the Practice Environment Scale of the Nursing Work Index	Warshawsky, NE ; Havens, DS	2011	Nursing Research	12.31	160
5	Delirium in the Emergency Department: An Independent Predictor of Death Within 6 Months	Han, JH; Shintani, A; Eden, S; Morandi, A; Solberg, LM; Schnelle, J; Dittus, RS; Storrow, AB; Ely, EW	2010	Annals of Emergency Medicine	10.79	151
6	Incidence and short-term consequences of delirium in critically ill patients: A prospective observational cohort study	van den Boogaard, M; Schoonhoven, L; van der Hoeven, JG; van Achterberg, T; Pickkers, P	2012	International Journal of Nursing Studies	12.33	148

7	Competence and Certification of Registered Nurses and Safety of Patients in Intensive Care Units	Kendall-Gallagher, D ; Blegen, MA	2009	American Journal of Critical Care	8.47	127
8	The cardioprotective effect of dexmedetomidine on global ischaemia in isolated rat heartsick	Okada, H; Kurita, T ; Mochizuki, T; Morita, K ; Sato, S	2007	Resuscitation	7.47	127
9	Critical Care Nurses' Role in Implementing the "ABCDE Bundle" Into Practice	Balas, MC; Vasilevskis, EE; Burke, WJ; Boehm, L ; Pun, BT; Olsen, KM; Peitz, GJ ; Ely, EW	2012	Critical Care Nurse	9.92	119
10	Four Sensitive Screening Tools to Detect Cognitive Dysfunction in Geriatric Emergency Department Patients: Brief Alzheimer's Screen, Short Blessed Test, Ottawa 3DY, and the Caregiver-completed AD8	Carpenter, CR; Bassett, ER; Fischer, GM ; Shirshekan, J; Galvin, JE; Morris, JC	2011	Academic Emergency Medicine	8.92	116

The most cited article in this study, "Delirium in Older Emergency Department Patients: Recognition, Risk Factors, and Psychomotor Subtypes," authored by Han, J.H. et al., was published in 2009 and has received 263 citations. The most cited journal in this study was the American Journal of Critical Care, followed by the International Journal of Nursing Studies.

The incidence rate of delirium among patients undergoing mechanical ventilation is reported to be approximately 70-80%, with even higher rates observed in COVID-19 patients requiring intensive respiratory support (Kotfis et al., 2020; Ticinesi et al., 2020). Therefore, it is crucial for intensive care nurses to integrate delirium care knowledge into clinical practice to promptly recognize and effectively manage ICU delirium. However, delirium remains a frequently undetected condition in the ICU, as nurses often struggle to recognize it and lack sufficient familiarity with the use of delirium assessment tools (Ho et al., 2022). The results of this study have highlighted gaps in the literature on delirium in ICUs and nursing, offering valuable insights for guiding future research. Beyond descriptive and exploratory bibliometric analyses, incorporating content analysis—where researchers actively engage in the analytical process—could further advance the field. However, the findings and recommendations of this study are limited to the general overview and global trends in this area.

Limitations and Strengths: It is recommended that the findings of this study be interpreted while considering its specific strengths and limitations. This study's major strength lies in being the inaugural bibliometric analysis that investigates research focuses, thematic trends, delirium in intensive care units (ICU), and the progression of nursing research. However, the study has certain limitations. Specifically, the data are restricted to the period between 1997 and 2023, which corresponds to the timeframe during which the literature review was conducted. Conducting a similar study during a different time period may yield different results. Additionally, another limitation of this study is that the literature review is confined to data obtained exclusively from the Web of Science (WoS) database. Additionally, although no language restrictions were imposed during the literature search, all searches were conducted in English. Consequently, using keywords in other languages might yield more comprehensive results.

Conclusion: This study has the potential to elucidate variables that explain the research focus, global thematic trends, and the advancement of research on delirium and nursing in intensive care units (ICUs). This study has the potential to identify variables that elucidate the research focus, global thematic trends, and the development of studies on delirium and nursing in intensive care units (ICUs). Accordingly, the insights derived from this study provide a strategic framework for guiding future research initiatives within this domain.

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