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GLOBAL RESEARCH TRENDS IN POST INTENSIVE CARE SYNDROME: A BIBLIOMETRIC ANALYSIS (2010-2025)

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Abstract
Post-Intensive Care Syndrome (PICS) is the physical, cognitive and psychological dysfunction in survivors after they leave the intensive care unit (ICU). The long-term complications are now recognized and have resulted in greater interest in research throughout the world. This study covers the latest trends, key players, collaboration networks, and future trends of PICS research from 2010 to 2025 on a global basis. A bibliometric analysis was carried out in Scopus, and 190 articles were pre-selected based on the criteria predefined. VOSviewer software was used to analyze publication trends, co-occurrence, co-authorship and country collaborations. The results showed that the volume of research has significantly increased, especially since 2020, indicating more focus on survivorship of an ICU and the COVID-19 pandemic. Key research areas were clinical outcomes, cognitive impairment, psychological health, rehabilitation, and quality of life. The USA proved to be the top contributor in publications, citations and network of collaborators. In general, PICS is a growing multi-disciplinary field, and future research and international co-operation are needed to enhance the long-term outcomes of survivors of the ICU.

KEYWORDS: Post-Intensive Care Syndrome; ICU Survivors; Critical Illness; Bibliometric Analysis; Rehabilitation; Quality of Life.

1. INTRODUCTION

Survival of patients admitted to an intensive care unit (ICU) has greatly improved in the recent years due to advances in critical care medicine [1]. With advancements in mechanical ventilation, sepsis management, organ support, and a multidisciplinary approach to critical care, more patients are surviving conditions that were once considered to be high risk for mortality [2]. This has led to a critical care emphasis shifting from short-term survival to long-term survival and quality of life for patients who have survived the ICU [3]. Even though patients now have improved rates of survival, many still suffer from lasting physical, cognitive, and psychological deficits after they leave the hospital, which poses major health system and societal challenges [4]. However, with the rising number of survivors of the ICU, long-term monitoring, rehabilitation and survivorship programs have become more crucial to maximize patient outcomes and minimize the burden of care from the health care system [5].

Post-Intensive Care Syndrome (PICS) is a term used to describe new or additional physical, cognitive, and mental dysfunction that occurs in patients during critical illness that persists after their hospital stay [1]. The idea was conceived to enhance awareness of long-term burden of surviving in the ICU and to encourage strategies that can help guide recovery from critical illness [6]. The physical symptoms of PICS are often muscle weakness, chronic pain, fatigue and diminished functional capacity [7]. Cognitive impairments can include memory problems, attention deficits, and executive functioning deficits, while psychological complications are often anxiety, depression, and post-traumatic stress disorder [8-9]. These complications can significantly diminish survivors' quality of life, social interaction and functional independence [10].

The major risk factors associated with development of PICS are prolonged mechanical ventilation, delirium, deep sedation, sepsis, acute respiratory distress syndrome, immobility, and prolonged ICU stays [11]. Patients, as well as family members and caregivers can also suffer psychologically, from stress, anxiety and caregiver burden, which has been called Post-Intensive Care Syndrome-Family (PICS-F) [12]. The impact of critical illness is therefore larger than the individual and can impact the family, financial security, and social functioning [13]. The recognition of PICS-F has helped to shift to family-centred care philosophies and support networks both during and after ICU care [14].

The interest in PICS has grown significantly over the past decade [5]. The epidemiology, risk factors, rehabilitation strategies, cognitive recovery, psychological interventions and long-term outcomes of ICU survivors have been studied extensively [2]. The COVID-19 pandemic also stimulated research activity due to many patients who had survived from severe COVID-19 who had similar symptoms as seen in the traditional populations of PICS [15-16]. As a result, PICS is an emerging field of multidisciplinary research with critical

care medicine, rehabilitation sciences, psychology, nursing and public health all contributing to the studies of PICS [3]. Additionally, the expansion of scientific literature in this area has been driven by the increased collaboration and awareness among healthcare professionals in this field [17].

With the rapid growth of publications in the field of science, there is an abundance of literature, and it becomes difficult to find key articles, authors, active institutions and new research areas. [18]. Bibliometric analysis is an approach that is systematic and quantitative in assessing scientific productivity, impact of citations, collaboration network and thematic evolution of scientific field [19]. Bibliometric studies can be used to uncover the intellectual structure and evolution of science knowledge by using citation analysis, co-authorship mapping, co-citation analysis and keyword co-occurrence analysis, among others (van Eck and Waltman) [20].

While there have been some reviews of the clinical aspects of PICS, complete bibliometric studies to investigate global research trends, collaboration patterns and thematic evolution are limited [17]. Thus, it is necessary to conduct a bibliometric evaluation to gain a better understanding of the progress of PICS research and its state of the art. This analysis may be used to inform future research and policy efforts through determining influential publications, key contributors, areas of research activity, and trends.

The aim of this study is to survey and summarize research on a phenomenon called Post-Intensive Care Syndrome (PICS) from a bibliometric perspective in the period of 2010 to 2025, with the following research questions (RQs):

a) Which studies on the overarching issue of Post-Intensive Care Syndrome have received the highest citation counts?

b) List the significant terms from published literature related to Post-Intensive Care Syndrome, ICU survivorship, rehabilitation, cognitive impairment, psychological outcomes and quality of life.

c) What countries have strong collaborative networks of Post-Intensive Care Syndrome research?

The purpose of this study is to focus on a comprehensive analysis of the scientific landscape of studies on Post-Intensive Care Syndrome (PICS) worldwide with the help of bibliometric analysis and visualization techniques. The methods used in the study include mapping and bibliometric analysis using the VOSviewer software (van Eck and Waltman, 2010) to identify influential journals, authors, institutions, countries, and publications. In addition, the study identifies recent research issues and global networks of collaboration to gain insights into the development and future of PICS research globally.

2. REVIEW STRUCTURE AND METHODOLOGY

This study identifies and analyses the most significant scholarly contributions in the domain of Post-Intensive Care Syndrome (PICS). The Scopus database was selected as the primary source for data retrieval due to its extensive collection of peer-reviewed papers and its reliability in providing comprehensive citation information. Bibliometric approaches allow for a systematic analysis of publication trends, impact of publications, collaboration networks and trends in new research areas associated with PICS. A total of 398 papers were retrieved from the search strategy published from 2010 to 2025. Through a series of inclusion and exclusion criteria, 190 articles were deemed suitable for bibliometric analysis. Figure 1 shows the process of systematic literature review.

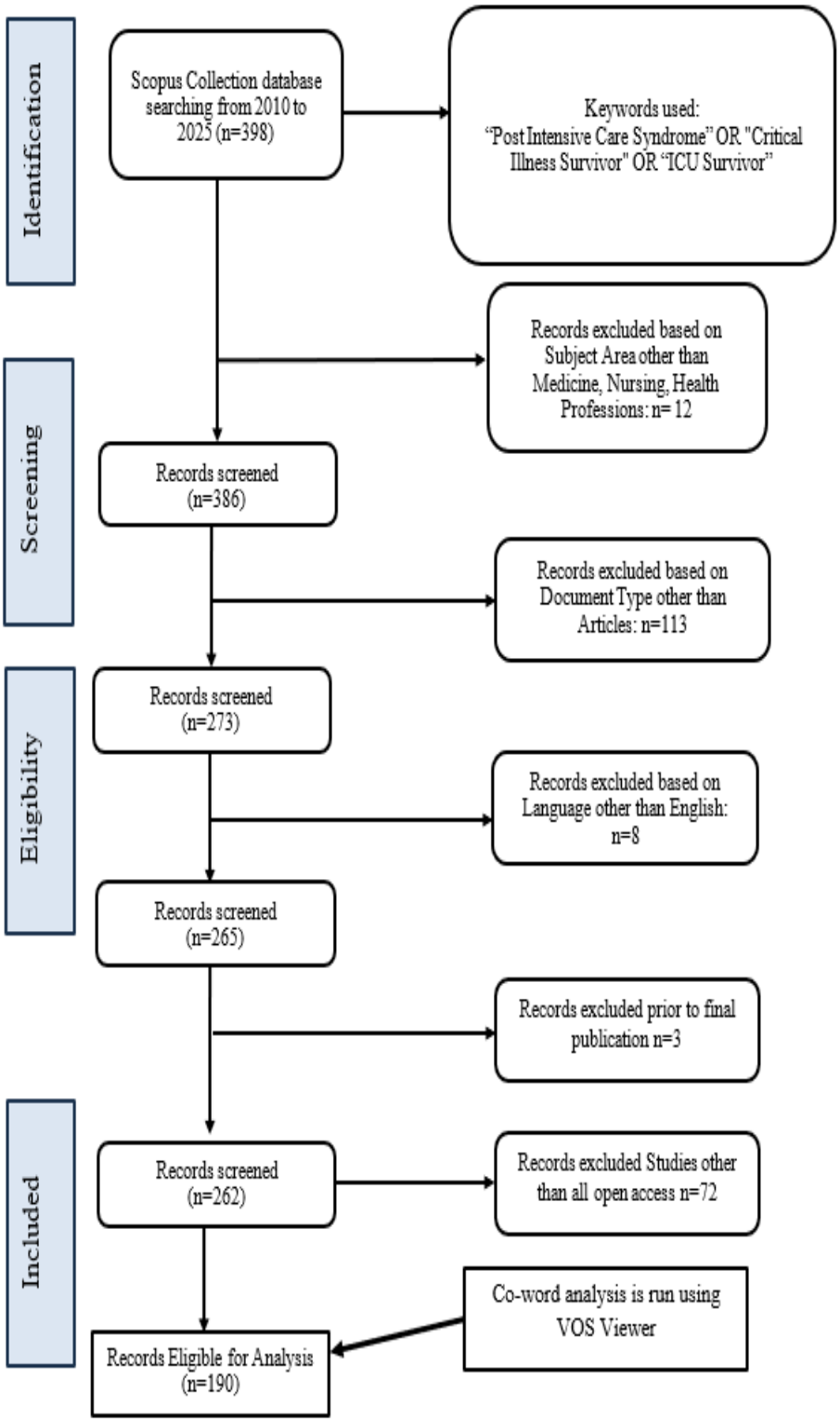

Figure 1: Systematic Literature Review Process

Source: Self-prepared by Author

Figure 1 depicts the studies' total data identification, screening, eligibility assessment, and inclusion process. From 2010 to 2025, the Scopus Collection database served as the starting point for the methodical literature search procedure. The search was conducted using the keywords "Post Intensive Care Syndrome," "Critical Illness Survivor," and "ICU Survivor." The initial search identified 398 records.

Several screening procedures were used to clean the data set. Firstly, the records of subjects other than Medicine, Nursing, and Health Professions were removed (12 records). Then, 113 documents other than research articles were discarded. An extra 8 publications in languages other than English were taken off. In addition, 3 records that had not been published as a finalized record were removed. To make the literature reviewed accessible and

consistent, 72 non-open access studies have also been excluded from the set. After applying these criteria systematically, 190 publications were finally selected for bibliometric analysis.
The selection of the literature was a structured screening process that ensured to include relevant, reliable and representative literature of the current research field on Post-Intensive Care Syndrome. The final data set offer an excellent basis for analysis of publication trends, key contributors, research collaborations and thematic evolution in this area.
Bibliographic data were extracted as part of the Scopus data extraction process, such as the author names, publication titles, journal sources, institutional affiliations, countries, publication years, author keywords, abstracts and number of citations. The scientific performance of PICS research and the intellectual structure were assessed using bibliometric analysis. Several analytical methods were used to examine publication productivity, citation impact and collaboration networks.
Visualizations of co-authorship networks, keyword co-occurrence maps and country collaboration networks were produced using the VOSviewer software. Major clusters of research and thematic links between publications have been identified using distance-based mapping methods. The keywords, titles and abstracts were examined to identify dominant research themes and trends in the PICS literature.

Table 1: Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Keywords	Records related to Post-Intensive Care Syndrome, Critical Illness Survivors, ICU Survivors, rehabilitation, cognitive impairment, psychological outcomes, and quality of life	Records unrelated to PICS research
Timeframe	2010–2025	Before 2010
Study Area	Medicine, Nursing, and Health Professions	Other subject areas
Document Type	Research Articles	Conference papers, editorials, reviews, letters, book chapters
Language	English	Other languages
Access Type	Open Access	Non-open-access publications
Publication Status	Final published articles	Articles excluded prior to publication

The inclusion and exclusion criteria listed in Table 1 were used to select pertinent studies. Studies addressing the Post-Intensive Care Syndrome (PICS) and associated subjects, such as ICU survivability, rehabilitation, cognitive function, psychiatric difficulties, and quality of life, were the focus of the inclusion criteria. To ensure that the analysis would reflect current developments in the area, only English-language research published between 2010 and 2025 were included.
The study focused only on the publications in the Medical, Nursing and Health Professions disciplines and excluded the records of other non-medical disciplines. Only original research articles were included because of a desire for methodological uniformity and scientific rigor, excluding conference papers, editorials, letters, and book chapters.
In addition, literature in English only was selected, to help standardize and interpret the literature. The reviewed studies were selected to be open access, to make the results accessible and transparent. Duplicate and unpublished records were not duplicated, as this would compromise the integrity of the data set. This systematic approach led to a targeted and high-quality data set of the studies, which laid a foundation for further bibliometric analyses of the global research trends in the topic of Post-Intensive Care Syndrome.

3. ANALYSIS AND RESULTS

➢ Time Frame

Table 2: Number of Documents Published in the Given Time Frame

Year	No. of Documents
2010	0
2011	0
2012	1

2013	3
2014	0
2015	4
2016	8
2017	4
2018	7
2019	14
2020	14
2021	25
2022	33
2023	18
2024	26
2025	33
Total	**190**

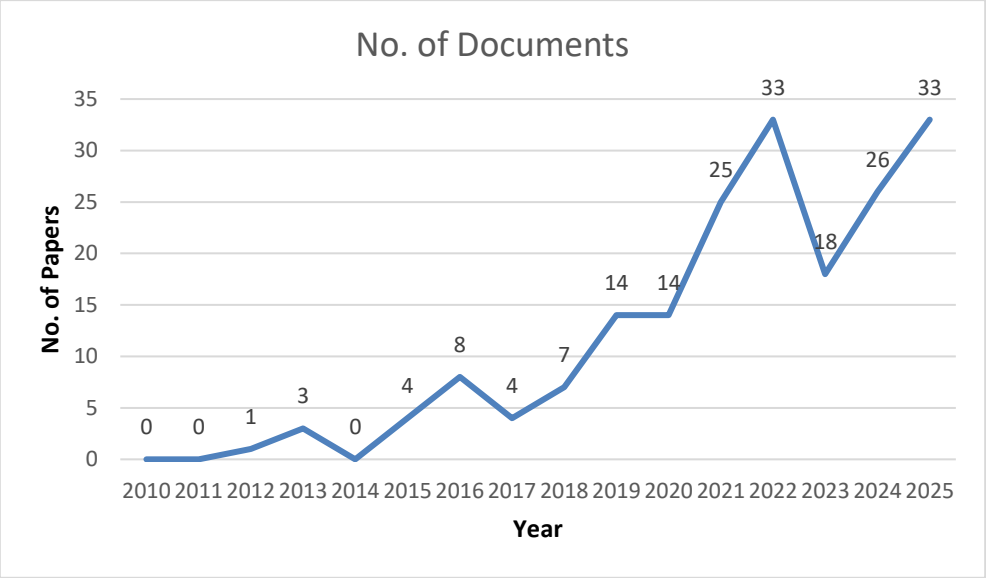

Figure 2: The number of total publications from 2010-2025

Table 2 demonstrates a consistent and substantial rise in research articles concerning Post-Intensive Care Syndrome (PICS) from 2010 to 2025. There is minimal academic interest in the initial years of the study period (2010, 2011, and 2014), as no publications were documented. The initial publication occurred in 2012, followed by a modest increase in 2013 (3 documents) and 2015 (4 documents). The quantity of publications has increased from 8 in 2016 to 14 in both 2019 and 2020. A significant rise in scientific productivity was observed post-2020,

with 25 publications in 2021 and 33 in 2022, attributed to the heightened knowledge of the long-term consequences of critical disease and the focus it garnered during the COVID-19 pandemic. A transient decline occurred in 2023 (18 papers), followed by an increase in 2024 (26 documents), culminating in a peak in 2025 (33 documents). The findings indicate a substantial rise in research activity within the domain of PICS, highlighting its growing significance in the critical care and survival research community.

- **Co-occurrence of Keywords**

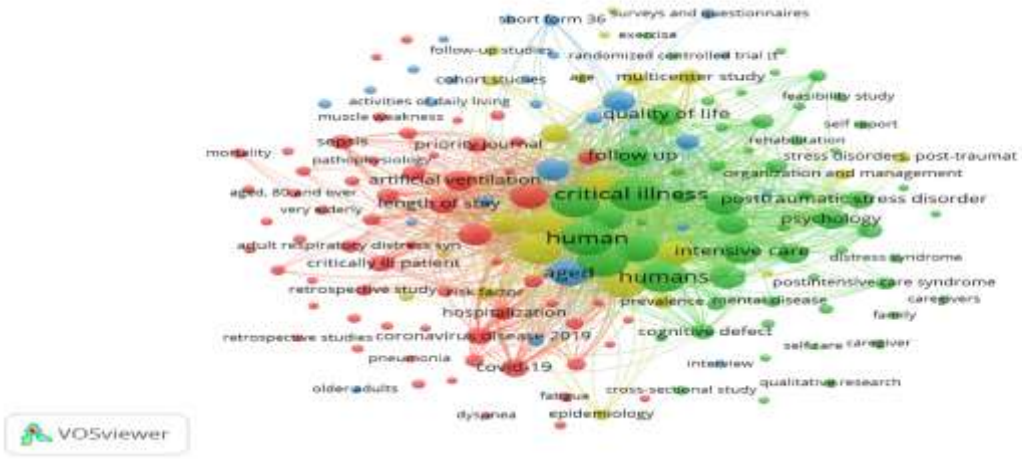

Figure 3: Co-occurrence Network of Keywords Related to Post-Intensive Care Syndrome

The keyword co-occurrence network of Post-Intensive Care Syndrome (PICS) studies that was created with VOSviewer is shown in Figure 3. There are 119 keywords (grouped in 4 clusters), 6,107 links and a total of 54,913 links, which suggests that there are tight relationships between the studied research topics. This list of the most frequently occurring keywords illustrates how human (170), critical illness (163), intensive care unit (153), humans (135), male (126), female (126), adult (114) and survivor (106) words feature prominently, reflecting the focus on the experience of people who survive critical illness, and on long-term outcomes.

The network shows four prominent research themes. The first one is based on critical illness and clinical outcomes, such as the following keywords: length of stay, artificial ventilation, sepsis, hospitalization. The second cluster is psychological outcomes with depression, anxiety, post-traumatic stress disorder and mental health included. The third cluster is reconstructive and quality of life, comprising of follow up studies, physiotherapy, muscle weakness, activities of daily living and quality of life. The fourth cluster is cognitive impairment and epidemiology, of which cognitive defect, cognition, prevalence and risk factors are the members.

In addition, COVID-19, SARS-CoV-2 and coronavirus disease 2019 are used as keywords, which shows the increasing importance of the pandemic in the research activities of PICS. Overall, the network reflects the current trend in PICS research, which has moved beyond the focus on survival to a multi-disciplinary approach to rehabilitation, psychological recovery, cognitive health and quality of life in patients surviving from the ICU.

- **Relationship Between Countries**

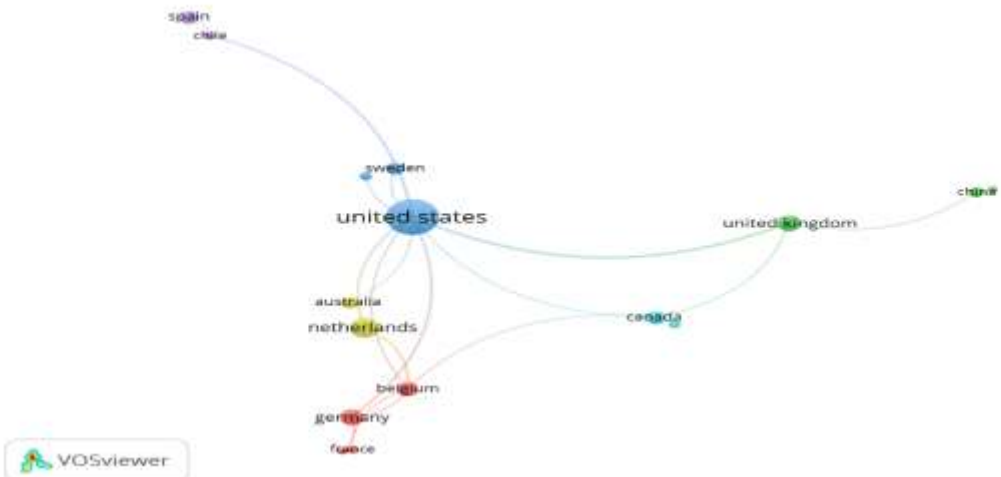

Figure 4: Country Collaboration Network in Post-Intensive Care Syndrome (PICS) Research

Figure 4 shows the international collaboration network of countries involved in Post-Intensive Care Syndrome (PICS) research, as visualised using VOSviewer. The network visualizes the cooperation between countries, derived from publications they co-author. The United States appears to be the most important contributor with 60 publications, 1,930 citations and the highest total link strength (16) in the world of PICS research. The Netherlands (19 publications, 567 citations) and the United Kingdom (12 publications, 1,611 citations) also show strong research involvement and collaboration.

There is engagement in international partnerships in critical care and survivorship research, as seen in strong collaborative links between the United States, the United Kingdom, Canada, Belgium, Germany, and the Netherlands. However, other countries, like Australia, China, Spain, and Sweden, also are involved with the network, but to a relatively lesser degree. In sum, the network emphasizes the pre-eminence of North American and European countries in research on the PICS and the need for international cooperation to promote knowledge in the field of long-term outcomes of the ICU survivors.

- **Co-Authorship Between Authors**

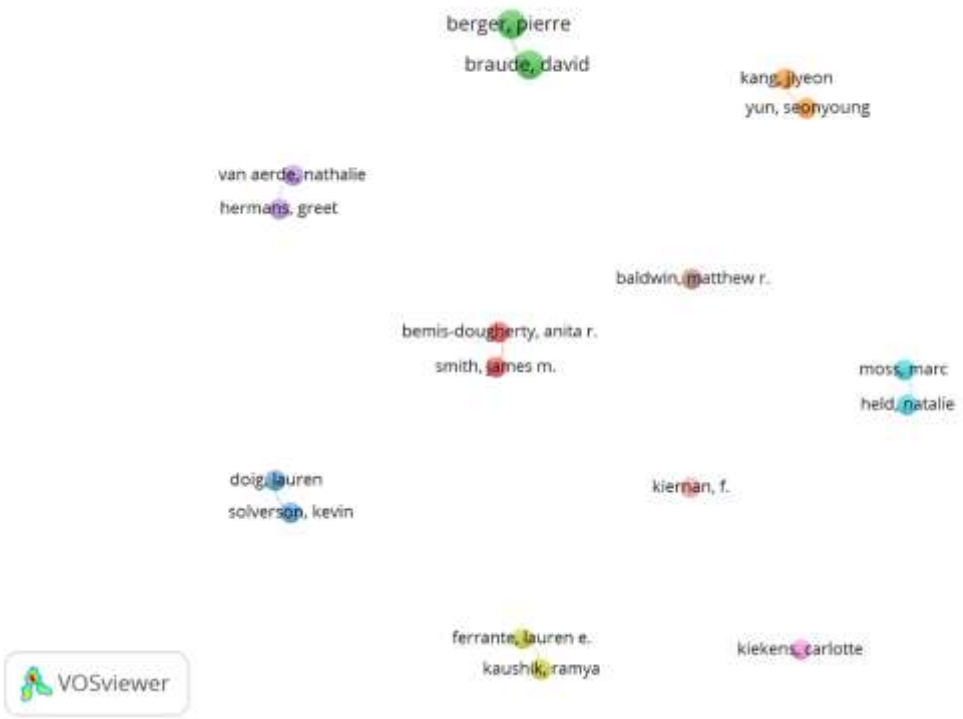

Figure 5: Co-authorship between authors for resource

The co-authorship network among researchers involved in the research of Post-Intensive Care Syndrome (PICS) is depicted in Figure 5, created with the help of VOSviewer. A total of 16 authors is grouped into 6 clusters, there are 21 links, and the overall link strength is 29, indicating links between the leading researchers in this field.

One of the most prominent collaborations is between Berger Pierre and Braude David who have 2 publications from each, and 22 citations together. Other distinguished partnerships include the Bemis-Dougherty Anita R. and Smith James M. Moss Marc and Held Natalie (26 citations each), and Doig Lauren and Solverson Kevin. These are author pairs for current collaborative research in critical illness survivorship, rehabilitation and patient outcomes.

The network also highlights the existence of several smaller and more autonomous research groups, indicating that PICS research is not concentrated in one collaborative research network but is spread out over several institutions and countries. The co-authorship network has moderate levels of collaboration between researchers and shows increased interdisciplinary research on PICS rehabilitation, psychological outcomes and quality of life in survivors of the ICU.

➢ **Organizational Collaboration Network**

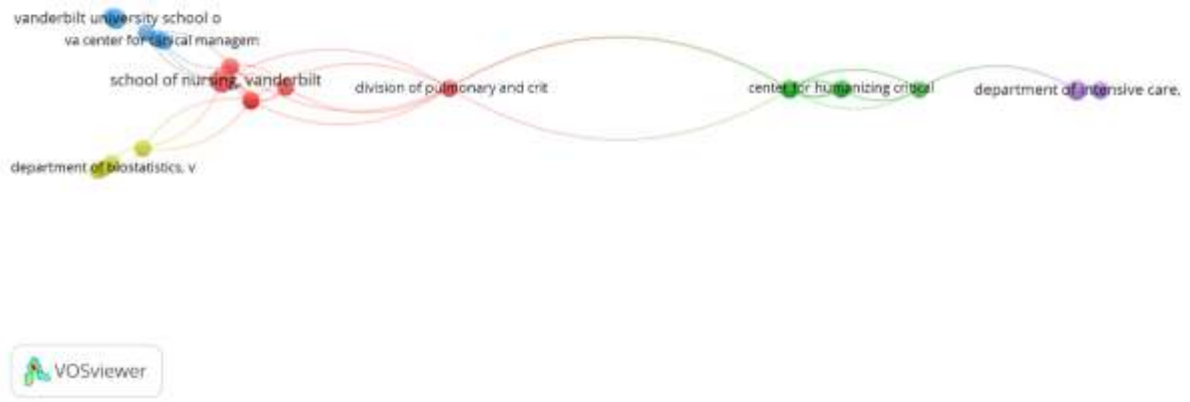

Figure 6: Organizational Collaboration Network in Post-Intensive Care Syndrome (PICS) Research

The network of collaboration among the organizations in Post-Intensive Care Syndrome (PICS) research is shown in Figure 6, created with the help of the software program VOSviewer. The network shows how institutions are connected through publications that have multiple authors. The analysis pinpoints some of the key organizations that have been involved in promoting PICS research and raises awareness of their joint power.

Vanderbilt University School of Nursing was the most productive institution, publishing 4 papers, 91 citations, and having the highest total link strength (11), which showed that they had a high level of engagement in collaborative work. The Division of Pulmonary and Critical Care, the Department of Physical Medicine and Rehabilitation and the Outcomes After Critical Illness and Surgery Group were also among the top cited groups with 274 citations each and proving to be highly research impactful. The Center for Humanizing Critical Care also has a high number of citations (191) and a high total link strength (6), indicating that the centre is actively involved in collaborative research efforts.

Overall, the network shows the importance of between-department collaboration, for example, intensive care and psychiatry, public health and physiology, and clinical management and intensive care, highlighting the multi-disciplinary aspects of PICS research. In all, the organizational network for collaboration around the ICU emphasizes the key contributions of academic medical centers and specialized critical care research groups in advancing knowledge around the survivorship of the ICU, rehabilitation, psychological recovery, and long-term outcomes for patients.

4. DISCUSSION

The purpose of this bibliometric analysis study is to provide a summary of PICS (Post-Intensive Care Syndrome) research trends from 2010 to 2025. The findings demonstrate that there has been a notable rise in research publications throughout the course of the study, which is indicative of growing scientific interest in the long-term effects of critical illness. Although there weren't many publications, there was a noticeable increase from 2020. This could be explained by increased knowledge of ICU survivorship issues and the COVID-19 pandemic's consequences, which highlighted the persistent physical, mental, and emotional challenges that critically ill patients face after leaving the hospital. The survival rates of patients with severe illnesses continue to rise in healthcare systems, and an emphasis made on understanding and resolving the long-term burden that patients experience following a severe illness.

The keyword co-occurrence analysis revealed four major study themes: critical illness and clinical results, psychological outcomes, rehabilitation and quality of life, and cognitive impairment. Common terminology like "depression," "anxiety," "PTSD," "physiotherapy," "quality of life," and "cognitive defects" indicate that the emphasis is increasingly on healing rather than merely survival, with researchers starting to concentrate on patients' long-term well-being. The multifaceted nature of PICS and the significance of treating patients with a whole-person approach emphasise the themes. The impact that COVID-19 has had on expanding PICS-related research and knowledge of post-critical illness consequences is further demonstrated by the inclusion of COVID-19-related terms.

The United States, the Netherlands, and the United Kingdom were identified as the country most influential contributors to PICS research, by the country collaboration network. North American and European countries have good cooperation, indicating that international cooperation has been important for the progress in this field. These partnerships help share knowledge, expertise, and clinical experiences, resulting in better research outcomes. The representation of developing countries was, however, rather low which suggests a need for there to be a wider global representation in future investigations. More research partnerships in a wider range of healthcare contexts would yield a better understanding of PICS and its worldwide effect.

The multi-disciplinary nature of PICS research was again confirmed through the co-authorship and organisational collaboration analyses. These academic medical centers and nursing schools, rehabilitation units and critical care research groups have made significant contributions to the literature. The partnerships reflect the multi-disciplinary nature of PICS that brings together critical care medicine, psychology, rehabilitation sciences, nursing and public health. Multiple disciplines are also involved, recognising that effective recovery from critical illness is not limited to the hospital setting and a coordinated approach is needed to recovery in the longer term.

The results mainly indicate that the field of PICS has become a fast-growing field of research, gaining worldwide interest. The future research should be directed towards the development of effective rehabilitation intervention, goal-oriented assessment techniques, and support programs for families, as well as follow-up plans of longer duration after the ICU to enhance the quality of life and outcomes of ICU survivors. Ongoing international partnerships continue to be vital in developing evidence-based practices and to overcoming the challenges of survivorship of critical illness.

5. CONCLUSION

The present bibliometric study evaluated the current state of Post-Intensive Care Syndrome (PICS) research worldwide, covering the years 2010–2025, and retrieved from the Scopus database. The findings show that the number of scientific publications has significantly increased during the study period, highlighting the growing awareness of the chronic physical, cognitive and psychological effects which survivors of critical illness experience. The growing number of publications since 2020 further reflect the impact of the COVID-19 pandemic of accelerating research on survival after ICU and recovery following critical illness.

Themes from the analysis identified included clinical outcomes, cognitive dysfunction, psychological issues, rehabilitation and quality of life. Keyword co-occurrence mapping revealed the cross-disciplinary aspect of PICS research and country; author and organizational collaboration networks revealed the significant role of international partnerships and specialized critical care research groups. The USA showed up as the country with the greatest number of publications, citations, and collaborative power, highlighting its pivotal role in the development of the discipline.

In general, this study shows that PICS has become an area of critical care research of increasing interest in the world. The number of survivors of ICUs is growing and there is a need for more evidence-based rehabilitation programmes, more standardized assessment tools, and long-term follow-up programmes. It is hoped that future research promote more international collaboration, including with developing countries, to further understand PICS in a variety of healthcare contexts. The results of this study offer important information to researchers, clinicians and policy makers and can inform future studies seeking to enhance recovery, functioning and quality of life for survivors of the ICU.

6. Implications of Research

This study offers an important insight into the current research field of Post-Intensive Care Syndrome (PICS). The results underscore the need for the study of long-term physical, cognitive and psychological outcomes of patients who survive the ICU. The identified trends and collaboration networks can be used by researchers to inform future study and to fill gaps in existing research.

The results underline the importance of a multidisciplinary rehabilitation programme and long-term follow-up treatment to enhance the quality of life of the survivors of the ICU. The research also underscores the need for cooperation among nations to promote learning and inform successful care plans. In addition, these findings can be leveraged by policy makers in the development of survivorship programs, rehabilitation services, and healthcare policies that help to lower the burden of PICS. Overall, the study helps in understanding the global research on PICS and initiates the evidence-based practices and future research projects.

7. Limitations of Research

This study is limited in several ways. First, papers from other databases like Web of Science, PubMed, or Dimensions might not have been included because the analysis was limited to those found in the Scopus database. Second, the analysis may be skewed, and some papers may be excluded because only English-language, open-access articles were included. Third, only research publications were included in the analysis; conference papers, editorials, reviews, and book chapters—all of which could offer valuable information about the topic—were not considered. Furthermore, bibliometric metrics such as citations do not always reflect the high scientific merit or

therapeutic significance of studies. Finally, the emergence of new publications and the impact of fresh research might cause citation patterns to change over time.

8. Future Research Directions

Future studies should expand bibliometric analysis by using more databases for a more comprehensive and complete investigation of PICS. Researchers should persist in investigating post-COVID-19 survivability, digital health therapies, family-centered care, and long-term quality of life outcomes in intensive care unit survivors. Increased engagement from developing countries is essential to improve the worldwide scope of PICS research and address the difficulties faced by these regions. Furthermore, future studies should aim to establish standardized assessment tools, assess the effectiveness of rehabilitation strategies, and enhance interdisciplinary collaboration among health care professionals. Experiences like these help move the field forward in evidence-based practices and help to enhance the potential for long-term recovery for patients impacted by Post-Intensive Care Syndrome.

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