

Article

Citation Network Analysis of Nurse Staffing Research from the Past Two Decades: 2000–2022

Noriko Morioka ^{1,*} , Masanao Ochi ², Suguru Okubo ³ , Mutsuko Moriwaki ⁴, Kenshi Hayashida ⁵ ,
Ichiro Sakata ²  and Masayo Kashiwagi ¹

¹ Graduate School of Health Care Sciences, Tokyo Medical and Dental University, Bunkyo-ku, Tokyo 113-8510, Japan; kashiwagi.fnl@tmd.ac.jp

² Graduate School of Engineering, University of Tokyo, Bunkyo-Ku, Tokyo 113-8656, Japan; ochi@ipr-ctr.t.u-tokyo.ac.jp (M.O.); isakata@ipr-ctr.t.u-tokyo.ac.jp (I.S.)

³ Institute of Ars Vivendi, Ritsumeikan University, Kyoto 603-8577, Japan; suguruokubo@gmail.com

⁴ Quality Management Center Medical Hospital, Tokyo Medical and Dental University, Bunkyo-ku, Tokyo 113-8510, Japan; mmoriwaki.qmc@tmd.ac.jp

⁵ Department of Medical Informatics and Management, University Hospital, University of Occupational and Environmental Health, Fukuoka 807-8555, Japan; kenshi@clnc.uoeh-u.ac.jp

* Correspondence: morioka.gh@tmd.ac.jp

Abstract: Studies have indicated that higher numbers of nurses regarding staffing ensure patient safety and a better practice environment. Using citation analysis, this study visualizes the landscape of nurse staffing research over the last two decades to show the overall publication trends, major contributors, and main research topics. We extracted bibliometric information from PubMed from January 2000 to September 2022. After clustering the network, we analyzed each cluster's characteristics by keyword. A total of 2167 papers were considered for analysis, and 14 clusters were created. The analysis showed that the number of papers published per year has been increasing. Researchers from the US, the UK, Canada, Australia, and Belgium have led this field. As the main clusters in nurse staffing research during the past two decades, the following five research settings were identified: nurse outcome and patient outcome research in acute care hospitals, nurse staffing mandate evaluation research, nursing home research, and school nurse research. The first three clusters accounted for more than 80% of the total number of published papers, and this ratio has not changed in the past 20 years. To further develop nurse staffing research globally, evidence from other geographic areas, such as African and Asian countries, and from long-term care or community settings is necessary.

Keywords: nurse staffing; patient safety; citation analysis; bibliometric analysis; nursing administration research



Citation: Morioka, N.; Ochi, M.; Okubo, S.; Moriwaki, M.; Hayashida, K.; Sakata, I.; Kashiwagi, M. Citation Network Analysis of Nurse Staffing Research from the Past Two Decades: 2000–2022. *Healthcare* **2023**, *11*, 3050. <https://doi.org/10.3390/healthcare11233050>

Academic Editor: Andrea Tittarelli

Received: 3 October 2023

Revised: 20 November 2023

Accepted: 20 November 2023

Published: 27 November 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Background

Worldwide, approximately 20 million nursing staff, accounting for more than 70% of healthcare professionals, provide patient care on the front lines 24 h a day, 365 days a year [1]. The efficient and effective allocation of nursing staff is a major component of establishing a quality healthcare system. Since early 2000, in the context of developing indicators for quality assurance, the nurse-to-patient ratio and skill mix have been considered as some of the nursing sensitivity indicators [2]. Several studies on appropriate nurse staffing have been conducted since the landmark studies of the early 2000s [3,4]. Analyses of these findings from systematic and umbrella reviews have shown robust evidence for an association between higher nursing staffing and a shorter length of stay, increased patient satisfaction, improved quality of nursing care, fewer readmissions, and reduced in-hospital mortality [5–11].

Concurrently, to ensure safe nurse staffing, several countries and states have introduced legislation or financial incentives related to nurse staffing ratios in hospitals and

other facilities. California was the first US state to enact a minimum nurse-to-patient staffing ratio law in 2004 [12,13]. The state currently requires a minimum ratio of one nurse to five patients in medical–surgical units and one nurse to two patients in critical care units. Massachusetts, USA, requires a 1:1 nurse-to-patient ratio in ICUs. The New York State enacted the “Safe Staffing for Quality Care Act” for acute care facilities and nursing homes in 2021. A roughly 2:1 patient-to-nurse ratio in intensive care units or nursing homes requires facilities to meet a minimum daily average of three and a half hours of nursing care per resident [14]. In Australia, Victoria [15] and Queensland [16] have established regulations and laws regarding the minimum required nurse-to-patient ratio in hospitals, with one nurse to four patients for the day shift and one nurse to seven patients for the night shift. Japan [17] and South Korea [18] have also introduced nurse staffing levels into their financial schemes as patient-to-nurse ratios differentiate the reimbursement of nursing fees. In Japan, there are four categories of nurse staffing in hospitals as follows: the 7:1 patient-to-nurse ratio, 10:1, 13:1, and 15:1. In South Korea, nursing fees are determined by the hospital type and combination of patient-to-registered nurse ratios and patient-to-nursing assistant or ward staff ratios [17]. The UK does not have legal nurse staffing mandates [19]; however, the National Institute for Health and Care Excellence has introduced guidelines for safe nurse staffing levels [20].

To improve nurse staffing policies, it is important to conduct policy evaluations of these regulations in various countries and/or states. In countries without legislation, it is necessary to undertake research on safe nursing placement that captures the characteristics of the country’s healthcare system. However, a geographic bias has been indicated in previous research, which has mostly presented evidence from high-income countries [21,22]. In addition, nurses are active in both hospitals and other areas [1], and there is a lack of evidence and regulations on safe nurse staffing in long-term care settings [23,24] and community settings [25,26]. Appropriate nursing assignments are important not only in acute care settings in acute care hospitals but also in long-term care settings and community settings.

Recently, with the advancement of language processing technology, “bibliometric (or citation network) analysis”, which analyzes bibliographic information, has become increasingly useful in showing the landscape and identifying the major topics of a health service research [27,28]. In nursing research, the themes of “magnet hospital” [29], “nursing student education” [30], or “nurse resilience” [31] have been used to visualize research trends and issues. Regarding nurse staffing research, studies have synthesized the evidence using systematic and umbrella reviews that focus on specific settings and outcomes, for example, intensive care units [9] and mortality in acute care hospitals [6,8,32], and study designs, such as longitudinal studies [10]. As the research on nurse staffing has grown enormously, it has become difficult for traditional manual literature review methods to provide a bird’s-eye view of the entire research area and its trends and hot spots. Bibliometric (or citation network) analysis methods can contribute to uncovering research gaps within nurse staffing research that have not yet been identified and research that remains untapped. Identifying this research gap can ultimately contribute to developing healthcare systems that benefit patients and nurses worldwide.

Consequently, this study aimed to visualize the landscape of nurse staffing research over the past two decades. It used citation analysis to show the overall trends in the number of publications and major contributors and reveal the main research topics and the trends in these topics based on similarities in citation relationships.

2. Methods Section

2.1. Design and Data Collection

A citation network analysis was conducted. We extracted bibliometric information from PubMed. The search strategy was “nurse staffing” [Title/Abstract] OR “nurse workload” [Title/Abstract] OR “nurse workforce” [Title/Abstract] OR “nurse to patient” [Title/Abstract] OR “patient to nurse” [Title/Abstract] OR “nurse to bed” [Title/Abstract]. We set the publication limit from 1 January 2000 to 30 September 2022 (Appendix A Table A1).

In the search process, unlike traditional literature review methods, all the literature that met the above search strategy was included in the citation analysis. No limitation was imposed on the study setting. Nursing positions or titles were included, ranging from general nursing staff to advanced practice nurses. We also included a broad range of the literature with titles or abstracts in English, even if the main text was in a different language.

2.2. Analysis

2.2.1. Citation Network Analysis

We used the “academic-landscape system” at the University of Tokyo, Japan (<https://academic-landscape.com/page/about?next=/> accessed on 1 October 2022) (Copyright © 2010–2013 Innovation Policy Research Center, The University of Tokyo.) for the analysis. This system was developed to visualize citation network analyses through the following procedures: (1) retrieving data, (2) determining the maximum connected component and network clustering, and (3) visualization [33]. We performed citation analysis by combining direct citation relationships (when a paper directly cites other papers and analyzing these citation relationships helps us understand the direct connections between papers), co-citation relationships (when multiple papers cite the same other paper and these papers are in a co-citation relationship), bibliographic coupling (when using the same references in their citations, the similarity between papers can be assessed through bibliographic coupling), weighting functions (when representing relationships between papers, assigning weights to each relationship is often used, which allows the importance of different relationships to be considered), keyword similarity (cosine similarity) (by treating keywords in papers as vector representations and calculating the cosine similarity between keyword vectors, the similarity in the content between papers can be evaluated), and modularity maximization (a method that uses the network theory to identify modules or communities within a network) [34,35]. In the clustering process, papers that have no direct citation relationship with other papers are automatically excluded from the analysis.

The size of the clusters indicates the number of papers included, and the spatial distance between clusters indicates the similarity of the content. Clusters that are far apart in spatial distance indicate independent research topics with little citation relationship. More details of the analysis are described in Kajikawa et al. [33,36]. The schematic analysis procedure is illustrated in Appendix A, Figure A1.

After clustering the network, we analyzed each cluster’s characteristics by the keywords with higher scores of term frequency-inversed cluster frequency (TF-ICF), titles, and abstracts in papers that were frequently cited by other papers in the cluster in which they were published. TF-ICF is a vector representation of natural language and is an effective method for extracting important words that characterize a cluster. The following equations calculated TF-ICF:

$$\text{TF-ICF} = \text{TF} \times \text{ICF}$$

where

TF = the term (keyword) counts in the cluster/total word counts in the cluster,

ICF = $\log[1 - (\text{the total number of clusters/number of cluster including the term})]$

The TF-ICF scores were higher for words that occurred more frequently only in the cluster. A higher TF-ICF score indicates more importance regarding the word that characterizes the cluster.

2.2.2. Analysis of Publication Trends, Authors, and Journals

We also carried out a trend analysis of the number of publications, authors, and journals for the articles included in our analysis. For the trend analysis of the number of publications, we visualised each cluster’s annual trends and showed each cluster’s rise and fall over the past 20 years. The affiliations and countries of the top 20 authors, in terms of the number of publications, were listed to reveal the geographical distribution of the nurse staffing studies. The top 20 journals in terms of the number of publications were listed to

identify which areas of medicine, nursing, and public health more likely covered the nurse staffing issue.

3. Results

3.1. Global Publication Trends from 2000 to 2022

Of the 2308 articles returned by the search strategy, 14 clusters were formed from 2167 papers based on citation relationships. In total, 141 articles were automatically dropped during the clustering process because they had no citation relationship with other articles. The overall number of papers published per year has been on the rise, starting with 26 per year in 2000 and gradually increasing to more than 100 per year in 2011 and more than 160 per year after 2020 (Figure 1a).

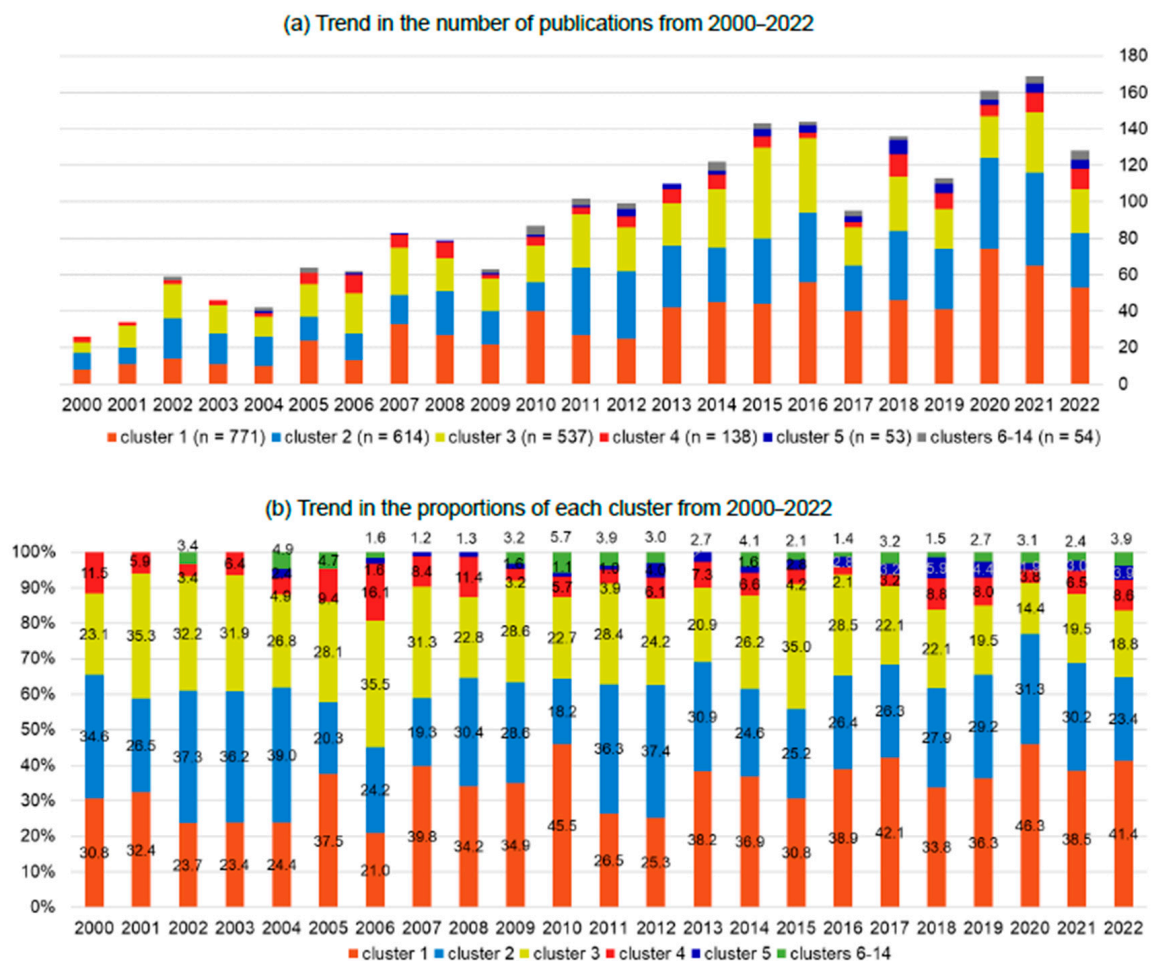























Figure 1. Trends in the number of articles published from 2000 to 2022 ($n = 2167$). Cluster #1 was titled “nurse outcome research in acute care hospitals”, Cluster #2 was titled “patient outcome research in acute care hospitals”, Cluster #3 was titled “nurse staffing mandate evaluation research”, Cluster #4 was titled “nursing home research”, Cluster #5 was titled “school nurse research”, and Clusters #6–14 are clusters that are small in number and were not included in the top five main clusters. (a) Trends in the number of publications from 2000 to 2022; (b) Trends in the proportions of each cluster from 2000 to 2022.

3.2. Analysis of Authors and Journals

Table 1 shows the top 20 most productive authors and their most recent affiliations and countries. Nurse staffing articles were mainly written by authors in the USA, UK, Canada, Australia, and Belgium. The top three researchers who published over 40 papers were Dr. Linda Aiken from the University of Pennsylvania, USA; Dr. Douglas M. Sloane

from the University of Pennsylvania, USA; and Dr. Peter Griffiths from the University of Southampton, UK.

Table 1. Affiliations and countries of the top 20 authors.

Author	Number of Articles	Affiliation	Country	
Linda H. Aiken	95	University of Pennsylvania	USA	
Douglas M. Sloane	51	University of Pennsylvania	USA	
Peter Griffiths	44	University of Southampton	UK	
Matthew D. McHugh	36	University of Pennsylvania	USA	
Joanne Spetz	27	University of California, San Francisco	USA	
Sean P. Clarke	27	McGill University, Quebec	Canada	
Charlene Harrington	25	University of California, San Francisco	USA	
Walter Sermeus	23	KU Leuven-University of Leuven	Belgium	
Eileen T. Lake	22	University of Pennsylvania	USA	
Christine Duffield	21	University of Technology Sydney/Edith Cowan University	Australia	
Jeannie P. Cimiotti	20	Emory University, Georgia	USA	
Kathleen Rice Simpson	19	Mercy Hospital, Missouri	USA	
Barbara A. Mark	19	University of North Carolina at Chapel Hill	USA	
Jane Ball	18	University of Southampton	UK	
Peter I. Buerhaus	18	Montana State University	USA	
Jack Needleman	18	University of California, Los Angeles, San Francisco	USA	
Koen Van den Heede	17	KU Leuven-University of Leuven	Belgium	
David W. Harless	16	Virginia Commonwealth University	USA	
Vincent S. Staggs	15	University of Missouri-Kansas City, Missouri	USA	
Luk Bruyneel	13	KU Leuven-University of Leuven	Belgium	
Anne Marie Rafferty	13	King's College London	UK	

The most recent literature in the PubMed search results was used to identify each author's affiliation. UK; United Kingdom, USA; United States of America.

Table 2 shows the top 20 journals in terms of their number of publications related to nurse staffing. In descending order, the most publications were in the Journal of Nursing Administration, Journal of Nursing Management, and International Journal of Nursing Studies, which published over 80 related articles each. Some journals in the medical field, but not specifically the nursing field, were also ranked in the top 20, including Medical Care, Health Services Research, Health Affairs, BMJ Open, and the Journal of the American Geriatrics Society.

Table 2. Titles and Journal Impact FactorTM of top 20 journals.

Journal Title	Number of Articles	Journal Impact Factor in 2021
Journal of Nursing Administration	88	1.806
Journal of Nursing Management	85	4.682
International Journal of Nursing Studies	81	6.612
Journal of Advanced Nursing	52	3.057
Nursing Economics	49	1.193
Medical Care	47	3.178
Health Services Research	45	3.734
Journal of Clinical Nursing	43	4.423
Nursing Standard	43	no data
Journal of Nursing Scholarship	33	3.928
Policy, Politics & Nursing Practice	33	no data
Journal of Nursing Care Quality	29	1.728
Health Affairs	29	9.048
BMJ Open	23	3.007
International Nursing Review	23	3.384
American Journal of Nursing	22	2.577
MCN: The American Journal of Maternal-Child Nursing	21	1.753
Nursing Research	19	2.364
Nursing Outlook	19	3.315
Nursing Times	19	no data
Journal of the American Geriatrics Society	19	7.538
Modern Healthcare	19	no data

Journal Impact FactorTM was taken from the Web of Science (Clarivate).

3.3. The Clustered Network Map of Co-Cited References

Out of the 14 clusters, the top five clusters comprised 97.5%. The 6th to 14th clusters, thus, only consisted of a total of 54 papers (2.5%). Therefore, in this paper, we discuss only the top five clusters, which included a level of papers that could be interpreted (Figure 2). Cluster #1 was titled “nurse outcome research in acute care hospitals”, Cluster #2 was titled “patient outcome research in acute care hospitals”, Cluster #3 was titled “nurse staffing mandate evaluation research”, Cluster #4 was titled “nursing home research”, and Cluster #5 was titled “school nurse research”. Over the past 20 years, the proportions of each cluster have not changed (Figure 1b).

Cluster #1, “nurse outcome research in acute care hospitals”, was the largest, with 771 articles. “ICU” (0.00171), “workload” (0.00075), “environment” (0.00061), “quality” (0.00050), and “outcome” (0.00045) were identified as representative key terms with high TF-ICFs (Table 3 and Appendix A Table A2). In this cluster, the papers mainly focused on the association between nurse staffing and nurses’ reporting on the quality of care and nurse outcomes (burnout, intent to stay in their role, satisfaction) in critical care or acute care hospitals (Table 3). The annual number of publications showed an increase overall, although there have been various increases and decreases. This cluster represents an annual share of 30–40% (Figure 1). The annual numbers were around 10 articles from 2000 to 2006, 20–40 articles from 2007 to 2012, and 40–70 articles from 2013 to 2022.

Cluster #2 was titled “patient outcome research in acute care hospitals” and comprised 614 articles. “Mortality” (0.00127), “patient outcome” (0.00104), “hospital” (0.00103), “fall” (0.00078), “surgical” (0.00066), and “readmission” (0.00062) were identified as key terms with high TF-ICFs (Table 3 and Appendix A Table A2). In this cluster, the papers mainly focused on the association between patient outcomes (mortality, length of hospital stay, fall, readmission) in acute care hospitals. Similar to Cluster #1, the annual number of publications in this cluster showed an increase overall and comprised an annual share of

20–37% (Figure 1). The annual numbers were 10–20 articles from 2000 to 2010; since 2011, the annual numbers almost doubled to around 40 articles.

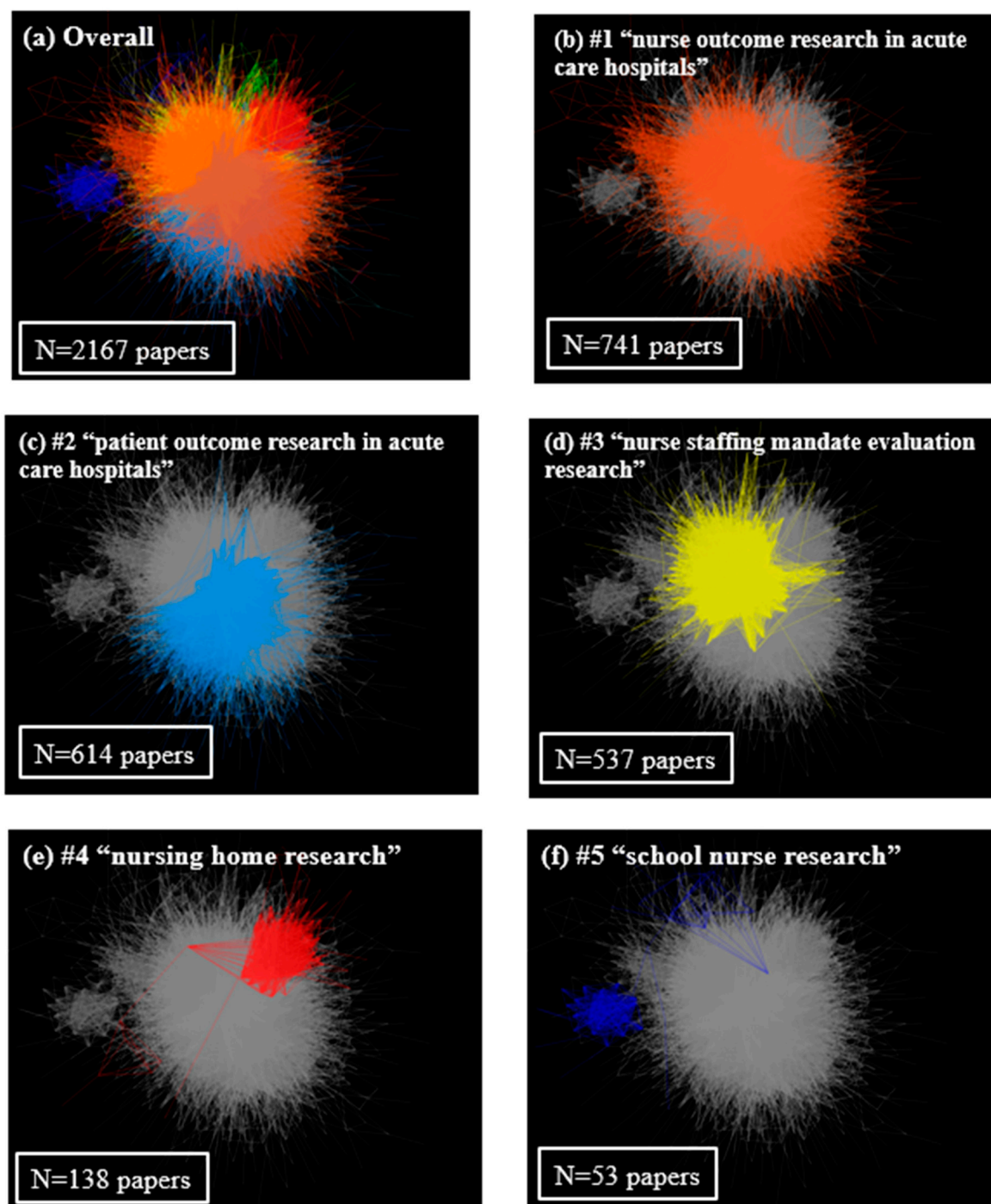


Figure 2. Visualization of the citation network of the top 5 clusters. Cluster #1 was titled “nurse outcome research in acute care hospitals”, Cluster #2 was titled “patient outcome research in acute care hospitals”, Cluster #3 was titled “nurse staffing mandate evaluation research”, Cluster #4 was titled “nursing home research”, and Cluster #5 was titled “school nurse research”. The size of the clusters indicates the number of papers included, and the spatial distance between clusters indicates the similarity of the content. Clusters that are far apart in spatial distance indicate independent research topics with a limited citation relationship.

Table 3. Representative keywords and papers in the top five clusters.

Cluster Name	Keywords (TF-ICF)	Examples of Included Papers
#1 “nurse outcome research in acute care hospital”	ICU (0.00171), workforce (0.00085), nursing care (0.00084), workload (0.00075), work environment (0.00056), missed (0.00056)	[3,37]
#2 “patient outcome research in acute care hospitals”	mortality (0.00127), patient outcome (0.00104), hospital (0.00103), patient (0.00080), fall (0.00078), outcome (0.00077)	[4,38,39]
#3 “nurse staffing mandate evaluation research”	staffing level (0.00225), patient outcome (0.00084), hospital (0.00065), registered nurse (0.00064), California (0.00063), policy (0.00063)	[40–42]
#4 “nursing home research”	nursing home (0.00728), resident (0.00433), medicare (0.00105), deficiency (0.00096), Medicaid (0.00093), nursing facility (0.00089)	[43–45]
#5 “school nurse research”	school nurse (0.01518), school (0.00933), student (0.00395), mental (0.00238), school nurse workload (0.00231), asthma (0.00130)	[46–48]

TF-ICF: term frequency-inverse cluster frequency.

Cluster #3, “nurse staffing mandate evaluation research”, comprised 537 articles. “Staffing level” (0.00225), “patient outcome” (0.00084), “registered nurse” (0.00064), “California” (0.00063), “policy” (0.00063), and “cost” (0.00058) were identified as key terms with high TF-ICFs (Table 3 and Appendix A Table A2). The papers in this cluster focused on the effect of nurse staffing mandates on patient and nurse outcomes, particularly on California’s mandate (Table 3). The annual number of publications in this cluster was around 20 articles from 2000 to 2022, representing a 14–35% annual share (Figure 1). There was an uptrend ($n = 50$ in 2015) in the four years from 2014 to 2018.

Cluster #4, “nursing home research”, comprised 138 articles. “Nursing home” (0.00728), “resident” (0.00433), “facility” (0.00154), “quality” (0.00127), “medicare” (0.00093), “rating” (0.00076), and “star” (0.00072) were identified as key terms with high TF-ICFs (Table 3 and Appendix A Table A2). In this cluster, the papers mainly focused on the association between nurse staffing and resident outcomes in line with policy changes in the Medicare system in the US, such as the Nursing Home Compare program and star ratings (Table 3). The annual number of publications ranged from 2 to 12, comprising approximately a 10% annual share. There were three uptrends from 2005 to 2008 (10 articles in 2006), 2012 to 2015 (8 articles in 2014 and 2015), and 2018 and 2022 (an average of 10 articles) (Figure 1).

Cluster #5, the “school nurse research” cluster, comprised 53 articles. “School nurse” (0.01518), “school” (0.00933), “student” (0.00395), “mental” (0.00238), “school nurse workload” (0.00231), “asthma” (0.00130), and “epinephrine” (0.00111) were identified as key terms with high IFICFs (Table 3 and Appendix A Table A2). In this cluster, the papers mainly focused on school nurse workload and the association between school nurse staffing and student outcomes in the US (Table 3). The annual number of publications was zero or one from 2000 to 2011; thereafter, fewer than five articles were published annually, except for 2008, when eight were published (Figure 1).

In terms of spatial location, Cluster #1 and Cluster #2, as well as Cluster #1 and Cluster #3, were found to be in close spatial distance and highly similar. Conversely, Clusters

#4 and #5 were far from the other clusters and, thus, represented independent research topics (Figure 2).

4. Discussion

To the best of our knowledge, this study is the first to capture the landscape of articles on nurse staffing from 2000 to 2022 using a citation network analysis. In terms of the overall publication trends, we found that nurse staffing research has expanded, led by US and UK researchers. We also found that nurse staffing research can be divided into five main clusters according to the co-citation relationship: #1 “nurse outcome research in acute care hospitals”, #2 “patient outcomes research in acute care hospitals”, #3 “nurse staffing mandate evaluation research”, #4 “nursing home research”, and #5 “school nurse research”.

4.1. Overall Publication Trends and Leading Authors and Journals from 2000 to 2022

The overall trend of annual publications has been rising, indicating that the nurse staffing research field has been growing. However, it is suggested that more robust evidence on new adequate nurse staffing methods is needed, for instance, flexible nurse staffing methods beyond the use of ratios [49], shift work, working time [50,51], and nurse allocation methodology [52,53]. Thus, the theme of nurse staffing should continue to be a focus in the future.

Researchers from the US, the UK, Canada, Australia, and Belgium have led this field. This finding is consistent with the findings of a previous study focusing on the overall trend of high-impact nursing research papers, which are defined as papers ranked in the top 10% of citation frequency [30]. Among the top 20 contributors, the most prolific can be divided into the following three groups: the first includes Linda H. Aiken and Douglas M. Sloane at the University of Pennsylvania, US; the second includes Peter Griffiths and Jane Ball at the University of Southampton, UK; and the third includes Joan Spetz and Charlene Harrington at the University of California system, US. As for the first group, the University of Pennsylvania was also ranked number one in high-impact nursing research [54]; researchers at the University of Pennsylvania are also the major contributors to, and leaders in, the magnet hospital research [29] and the huge international nurse staffing research group “RN4CAST” was launched in 2007 [55,56]. As for the second group, Griffiths et al. (2016b) from the University of Southampton contributed to the adequate nurse staffing project at the National Institute for Health and Care Excellence in England, leading to the creation of nurse staffing policies in England [20,57]. The third group, Spetz et al. (2004, 2009) from the University of California, led an evaluation of the California nurse staffing mandate and nurse workforce research.

As for journals in which nurse staffing research is published, nursing administration journals are ranked highly. The International Journal of Nursing Studies, which has a broad scope across the nursing field, and other high-impact journals within the broader medical and health service research field also ranked highly, including Medical Care, Health Services Research, Health Affairs, BMJ Open, and the Journal of the American Geriatrics Society. Higher attention to nurse staffing in nursing administration, health policy, and health service research is indicated. However, the publication trends and leading authors and journals over the past two decades demonstrate that there is still limited knowledge and evidence on adequate nurse staffing from other countries, such as low-middle income countries and/or Asian regions with different nurse staffing regulation systems within their healthcare systems.

4.2. Cluster by Citation Network Analysis

Five main clusters in nurse staffing research over the past two decades were identified in this study: #1 “nurse outcome research in acute care hospitals”, #2 “patient outcome research in acute care hospitals”, #3 “nurse staffing mandate evaluation research”, #4 “nursing home research”, and #5 “school nurse research”. The first three clusters accounted for more than 80% of the total, and this share has not changed in the past 20 years.

The largest clusters were #1, “nurse outcome research in acute care hospitals”, and #2, “patient outcome research in acute care hospitals”. Although there was no small number of articles that examined both patient and nurse outcomes, those in Cluster #1, “nurse outcome research in acute care hospital”, were relatively more focused on the working environment and nurses’ turnover or retention in relation to the shortage in the nursing workforce.

Clusters #1, “nurse outcome research in acute care hospitals”, and #2, “patient outcome research in acute care hospitals”, were found to be spatially close, indicating the similarity in their context, with the only difference being whether they both focused on nurse outcomes or patient outcomes in nurse staffing research in acute care hospitals. Both clusters examine acute care hospital settings and reflect the trend of quality assurance in healthcare systems, mainly in the US, since the Institute of Medicine’s “To Err is Human” report. To assess the extent to which nursing personnel in acute care hospitals contribute to healthcare quality, patient safety, and a professional and safe work environment, the National Quality Forum developed 15 performance measures for nursing-sensitive care in 2004 [2]. Nursing sensitivity indicators included patient-centered outcomes, nursing-centered outcomes, and system-centered outcomes in nurse staffing and the Practice Environment Scale—Nursing Work Index (PES-NWI) [58]. Our findings indicate an uptrend in Cluster #1, “nurse outcome research in acute care hospitals”, after 2005, which the development of this nursing sensitivity outcome framework may explain. In addition, the uptrend in Cluster #2, “patient outcome research in acute care hospitals”, since 2011, may have been affected by the progress in the international research project RN4CAST [55,56]. Against the backdrop of worldwide nurse workforce shortages, RN4CAST was launched in 2007, coordinated by Walter Sermeus at Katholieke Leuven, Belgium, and Linda Aiken at the University of Pennsylvania, to innovate forecasting methods by addressing the volume and quality of nursing staff as well as the quality of patient care. The project targeted 12 European countries, including the USA, Botswana, China, South Africa, and Chile. The findings from this project have been disseminated since 2011; this trend is shown in Figure 2c. Although the RN4CAST has a remarkable output, there are limitations in its cross-sectional design and manner of presenting the mean data, which do not consider the important differences in outcomes, staff characteristics, and care models [59].

Cluster #3 was titled “nurse staffing mandate evaluation research”. The most famous minimum nurse staffing ratio mandate is that of California, US. Since the minimum nurse staffing mandate was introduced in 2004 and became active in 2005, it has been empirically examined as a natural experiment [13,42]. Research articles that examined the expansion of mandates to other states then followed [40]. The spatial distance between Clusters #1, “nurse outcome research in acute care hospitals”, and #3, “nurse staffing mandate evaluation research”, was also close. This may reflect the context in which the nurse staffing mandate in California, US, developed as a California Nursing Association initiative to improve the working environment for nurses and patient safety. Further, there are also some research articles from Australia in which minimum nurse staffing ratio mandates have been introduced [16]. This trend is consistent with a previous systematic review that examined the evaluation of the nurse staffing methodology [60]. Currently, Germany [61], Japan [17], and Korea [18] have reformed nurse staffing mandates and regulations in the payment system, although evaluations of related policy changes are still minimal compared to those in the US and Australia. Although healthcare systems differ from country to country, it is important to share knowledge about the various safe nurse staffing regulations, including laws, payment systems, and guidelines for nursing staffing, and their effects worldwide to build a better nursing delivery system.

In Cluster #4, “nursing home research”, most articles were related to policy changes in Medicare Medicaid certification made by the Centers for Medicare Medicaid Service (CMS) in the US [62]. The Nursing Home Compare website was launched in 1998 for quality assurance in nursing homes and has since undergone several revisions. The Nursing Home Compare program presents the following five categories of information: inspection results, including deficiencies from Medicare; certification surveys and complaint investigations;

facility characteristics; nursing home staffing levels; and quality measures, which provide information on the clinical and physical characteristics of a nursing home's residents. This information is retrieved from the Online Survey Certification and Reporting (OSCAR) data and the Long-Term Care Minimum Data Set (MDS) Repository. In 2008, CMS launched the Five-Star Quality Rating System to help consumers, their families, and caregivers compare nursing homes more easily and identify areas about which they wanted to ask questions [63]. In addition, since 2002, nursing home pay-for-performance programs, based on the quality of the chronic care delivered and using financial incentives tied to Medicaid or Medicare payment, have been implemented in some states and CMSs [44]. Over the past two decades, approximately 10 papers have been published in this cluster annually. Understanding nurse staffing and its association with resident and nurse outcomes in long-term care settings is necessary. In addition, the importance of research in long-term care settings is even greater for both Asian countries with already super-aged societies and Asian and African countries that could become aged societies in the relatively near future.

Cluster #5, "school nurse research", was a relatively newly developed area of research. The annual number of papers was over five for the first time in 2018, and the total amount of research in this cluster is somewhat limited compared to research in acute care hospital settings. School nurses take on the role of case managers, bringing providers, families, and schools together to support students' health; as a result, better attendance and academic success are gained [64,65]. Some states in the US recommend one school nurse for every 750 students in the healthy student population, a ratio of 1:225 for student populations requiring daily professional nursing services, a ratio of 1:125 for student populations with complex healthcare needs, and a ratio of 1:1 for individual students requiring daily, continuous professional nursing services [66]. However, the National Association of School Nurses stated that the workload of school nurses has been expanding in line with an increase in children with mental health issues and those requiring special medical treatment [66]. More evidence is necessary to ensure adequate and safe nurse staffing in school settings.

4.3. Limitations

This study has some limitations. The first relates to the search database. The WOS database is widely used in bibliometric analysis; however, we used PubMed because we could only access the current trends via WOS from 2000 to 2011 due to funding limitations. However, using PubMed has some benefits. For example, PubMed has the advantages of being the best database in the medical field, having an optimal update frequency, and including early online articles [67]. Future studies should extend the search to WOS and other databases. Second, we could not include articles in which the title, abstract, and text were in a language other than English. Thus, we might have overestimated the geographic bias of the evidence on nurse staffing. Nevertheless, this citation analysis provides a more comprehensive picture of nurse staffing research in that, even if the text was in another language, it was included as long as some parts of the article, such as the title and abstract, were in English. Thus, this study included studies from the literature that have been excluded from traditional literature reviews. Third, since the method used in this study analyzes direct citation networks, the results may be biased due to the issue that papers already cited in other works in the literature are more likely to be cited in new papers. In recent years, it has been noted that evaluating researchers using the citation matrix is invalid as it depends on citation and publication counts [63]. Alternative indexes considering co-author contributions and publication age beyond the sole publication count have been developed [68]. Fourth, although we revealed a landscape of over 2000 nurse staffing articles from the viewpoint of the citation network, we could not evaluate the research quality of each article in the same manner as a systematic review. However, it is crucial to capture the latest research trends in real time from the rapidly growing academic literature. We believe that sharing the results of our analysis with the nursing community,

including researchers, could provide objective evidence to help determine this community's future direction.

5. Conclusions

Using citation analysis, nurse staffing research over the past two decades formed five major clusters, depending on the study setting and outcomes focused on. This landscape of over 2000 nurse staffing articles revealed that evidence regarding long-term care settings and/or those from other geographic areas is still small compared to those in acute care settings from the US or UK. To ensure the safety of patients and nurses in all practice settings and locations, diverse geographic and setting knowledge is essential.

Author Contributions: Conceptualization, N.M., S.O., M.M., K.H. and M.K.; methodology, N.M., S.O. and M.O.; software, N.M., S.O. and M.O.; formal analysis, N.M., S.O. and M.O.; writing—original draft preparation, N.M.; writing—review and editing, N.M., S.O., M.O., M.M., K.H., I.S. and M.K.; visualization, N.M. and S.O.; supervision, M.M., K.H., I.S. and M.K.; funding acquisition, N.M., K.H. and I.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Ministry of Health, Labour and Welfare Program, grant number (21IA1002), and a Grant-in-Aid for Scientific Research from the Ministry of Education, Culture, Sports, Science and Technology, Japan (No. 20H03972 and No.21K2118), and the New Energy and Industrial Technology Development Organization (NEDO) in Japan (No. JPNP20006). The funders had no role in the study design, data collection and analysis, decision to publish, or the preparation of the manuscript.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Publicly available datasets were analysed in this study. All data are provided in the article. Further data can be provided on request.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

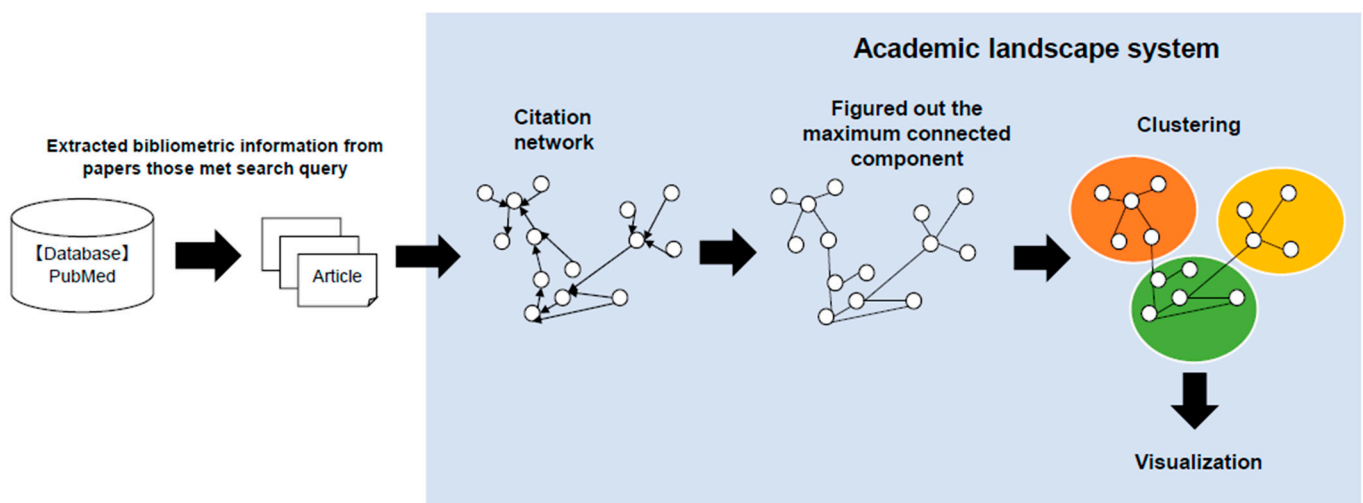


Figure A1. Overview of the citation analysis procedure.

Table A1. Search strategy.

	Number of Articles That Met the Search Query
"nurse staffing"	26,194
"nurse workload"	8113
"nurse workforce"	18,801
"nurses to patients"	163,885
"nurse to patients"	163,885
"nurse to patient"	163,885
"nurses-to-patients"	163,885
"nurse-to-patients"	163,885
"nurse-to-patient"	414
"patients to nurses"	163,885
"patient to nurses"	163,885
"patient to nurse"	163,885
"patients-to-nurses"	163,885
"patient-to-nurses"	163,885
"patient-to-nurse"	171
"nurses to beds"	2357
"nurse to beds"	2357
"nurse to bed"	7235
"nurses-to-beds"	7235
"nurse-to-beds"	7235
"nurse-to-bed"	39
number of nurses	29,725
"nurse staffing" [Title/ Abstract]	1752
"nurse workload" [Title/ Abstract]	147
"nurse workforce" [Title/ Abstract]	280
"nurses to patients" [Title/ Abstract]	0
"nurse to patients" [Title/ Abstract]	0
"nurse to patient" [Title/ Abstract]	415
"nurses-to-patients" [Title/ Abstract]	0
"nurse-to-patients" [Title/ Abstract]	0
"nurse-to-patient" [Title/ Abstract]	415
"patients to nurses" [Title/ Abstract]	0
"patient to nurses" [Title/ Abstract]	0
"patient to nurse" [Title/ Abstract]	171
"patients-to-nurses" [Title/ Abstract]	0
"patient-to-nurses" [Title/ Abstract]	0
"patient-to-nurse" [Title/ Abstract]	171
"nurses to beds" [Title/ Abstract]	0
"nurse to beds" [Title/ Abstract]	0

Table A1. *Cont.*

	Number of Articles That Met the Search Query
“nurse to bed” [Title/Abstract]	39
“nurses-to-beds” [Title/Abstract]	0
“nurse-to-beds” [Title/Abstract]	0
“nurse-to-bed” [Title/Abstract]	39
“nurse staffing” [Title/Abstract] OR “nurse workload” [Title/Abstract] OR “nurse workforce” [Title/Abstract] OR “nurse to patient” [Title/Abstract] OR “patient to nurse” [Title/Abstract] OR “nurse to bed” [Title/Abstract]	2563

Table A2. Details of the TF-ICF score of each keyword in the five main clusters.

Cluster #1						Cluster #2						Cluster #3					
TERM	TFICF	TC	CC	TF	ICF	TERM	TFICF	TC	CC	TF	ICF	TERM	TFICF	TC	CC	TF	ICF
icu	0.00171	652	4	0.00314	0.54407	mortality	0.00127	591	6	0.00344	0.36798	staffing level	0.00225	563	6	0.00611	0.36798
nursing	0.00130	2575	11	0.01239	0.10474	patient outcome	0.00104	398	5	0.00232	0.44716	level	0.00219	830	8	0.00901	0.24304
intensive care	0.00086	597	7	0.00287	0.30103	hospital	0.00103	2654	12	0.01545	0.06695	nurse staffing level	0.00171	352	5	0.00382	0.44716
workforce	0.00085	584	7	0.00281	0.30103	level	0.00089	627	8	0.00365	0.24304	nurse staffing	0.00116	1594	12	0.01730	0.06695
nursing care	0.00084	582	7	0.00280	0.30103	patient	0.00080	4249	13	0.02473	0.03218	staffing	0.00092	2626	13	0.02850	0.03218
workload	0.00075	517	7	0.00249	0.30103	icu	0.00079	250	4	0.00145	0.54407	patient outcome	0.00084	174	5	0.00189	0.44716
intensive care unit	0.00073	413	6	0.00199	0.36798	fall	0.00078	246	4	0.00143	0.54407	outcome	0.00078	493	10	0.00535	0.14613
care unit	0.00069	479	7	0.00231	0.30103	outcome	0.00077	902	10	0.00525	0.14613	relationship	0.00077	237	7	0.00257	0.30103
unit	0.00066	942	10	0.00453	0.14613	nursing	0.00069	1135	11	0.00661	0.10474	nursing	0.00076	665	11	0.00722	0.10474
level	0.00066	562	8	0.00270	0.24304	rate	0.00067	475	8	0.00276	0.24304	registered	0.00065	199	7	0.00216	0.30103
work	0.00063	679	9	0.00327	0.19189	surgical	0.00066	252	5	0.00147	0.44716	hospital	0.00065	889	12	0.00965	0.06695
job	0.00062	429	7	0.00206	0.30103	readmission	0.00062	237	5	0.00138	0.44716	registered nurse	0.00064	195	7	0.00212	0.30103
environment	0.00061	522	8	0.00251	0.24304	unit	0.00060	700	10	0.00407	0.14613	california	0.00063	107	4	0.00116	0.54407
critical care	0.00058	221	4	0.00106	0.54407	cost	0.00056	317	7	0.00184	0.30103	policy	0.00063	157	6	0.00170	0.36798
intensive	0.00057	622	9	0.00299	0.19189	data	0.00055	646	10	0.00376	0.14613	data	0.00060	377	10	0.00409	0.14613
work environment	0.00056	261	5	0.00126	0.44716	ratio	0.00054	887	11	0.00516	0.10474	mortality	0.00059	148	6	0.00161	0.36798
missed	0.00056	259	5	0.00125	0.44716	effect	0.00052	298	7	0.00173	0.30103	cost	0.00058	178	7	0.00193	0.30103
turnover	0.00055	211	4	0.00102	0.54407	ulcer	0.00052	164	4	0.00095	0.54407	staffing and patient	0.00053	73	3	0.00079	0.66901
care	0.00051	3275	13	0.01576	0.03218	associated	0.00051	600	10	0.00349	0.14613	effect	0.00051	156	7	0.00169	0.30103
quality	0.00050	718	10	0.00346	0.14613	surgery	0.00051	195	5	0.00113	0.44716	quality	0.00050	317	10	0.00344	0.14613
critical	0.00049	279	6	0.00134	0.36798	complication	0.00050	158	4	0.00092	0.54407	nurse staffing and patient	0.00049	68	3	0.00074	0.66901
infant	0.00046	175	4	0.00084	0.54407	workload	0.00050	283	7	0.00165	0.30103	unit	0.00048	302	10	0.00328	0.14613
outcome	0.00045	638	10	0.00307	0.14613	risk	0.00047	334	8	0.00194	0.24304	research	0.00045	218	9	0.00237	0.19189
job satisfaction	0.00044	169	4	0.00081	0.54407	pressure ulcer	0.00047	149	4	0.00087	0.54407	skill mix	0.00045	93	5	0.00101	0.44716
data	0.00043	609	10	0.00293	0.14613	odds	0.00046	214	6	0.00125	0.36798	association	0.00043	207	9	0.00225	0.19189
satisfaction	0.00042	291	7	0.00140	0.30103	hospital mortality	0.00045	116	3	0.00068	0.66901	evidence	0.00043	205	9	0.00223	0.19189
registered	0.00042	289	7	0.00139	0.30103	lower	0.00045	257	7	0.00150	0.30103	safety	0.00042	158	8	0.00171	0.24304
mortality	0.00041	234	6	0.00113	0.36798	staffing level	0.00044	205	6	0.00119	0.36798	mix	0.00041	126	7	0.00137	0.30103
decision	0.00035	163	5	0.00078	0.44716	patient ratio	0.00039	352	9	0.00205	0.19189	model	0.00035	169	9	0.00183	0.19189

Table A2. Cont.

Cluster #4						Cluster #5					
TERM	TFICF	TC	CC	TF	ICF	TERM	TFICF	TC	CC	TF	ICF
nursing home	0.00728	647	5	0.01627	0.44716	school nurse	0.01518	164	1	0.01324	1.14613
resident	0.00433	385	5	0.00968	0.44716	school	0.00933	314	6	0.02535	0.36798
home	0.00418	684	8	0.01720	0.24304	student	0.00395	90	4	0.00727	0.54407
nursing	0.00223	845	11	0.02125	0.10474	school nursing	0.00305	33	1	0.00266	1.14613
facility	0.00154	252	8	0.00634	0.24304	mental	0.00238	66	5	0.00533	0.44716
quality	0.00127	345	10	0.00868	0.14613	school nurse	0.00231	25	1	0.00202	1.14613
home resident	0.00116	69	3	0.00174	0.66901	workload	0.00206	57	5	0.00460	0.44716
nursing home	0.00116	69	3	0.00174	0.66901	mental health	0.00176	19	1	0.00153	1.14613
resident	0.00105	77	4	0.00194	0.54407	pmh	0.00169	200	11	0.01615	0.10474
medicare	0.00105	171	8	0.00430	0.24304	health	0.00158	65	7	0.00525	0.30103
level	0.00096	85	5	0.00214	0.44716	workforce	0.00157	17	1	0.00137	1.14613
deficiency	0.00094	56	3	0.00141	0.66901	school health	0.00146	60	7	0.00484	0.30103
chain	0.00093	83	5	0.00209	0.44716	workload	0.00130	24	3	0.00194	0.66901
medicaid	0.00089	53	3	0.00133	0.66901	asthma	0.00111	12	1	0.00097	1.14613
nursing facility	0.00087	41	2	0.00103	0.84510	epinephrine	0.00102	11	1	0.00089	1.14613
life care	0.00083	110	7	0.00277	0.30103	psychiatric	0.00102	11	1	0.00089	1.14613
registered	0.00081	107	7	0.00269	0.30103	mental	0.00102	11	1	0.00089	1.14613
registered nurse	0.00076	68	5	0.00171	0.44716	mental health	0.00102	11	1	0.00089	1.14613
rating	0.00072	43	3	0.00108	0.66901	school setting	0.00096	14	2	0.00113	0.84510
star	0.00072	34	2	0.00086	0.84510	adolescent	0.00093	10	1	0.00081	1.14613
hprd	0.00069	75	6	0.00189	0.36798	school district	0.00093	10	1	0.00081	1.14613
staffing level	0.00066	31	2	0.00078	0.84510	school nurse	0.00093	10	1	0.00081	1.14613
home quality	0.00066	31	2	0.00078	0.84510	staffing	0.00093	10	1	0.00081	1.14613
nursing home	0.00062	45	4	0.00113	0.54407	public school	0.00093	10	1	0.00081	1.14613
quality	0.00060	125	9	0.00314	0.19189	school nurse	0.00093	10	1	0.00081	1.14613
profit	0.00058	77	7	0.00194	0.30103	workforce	0.00093	10	1	0.00081	1.14613
state	0.00056	74	7	0.00186	0.30103	anaphylaxis	0.00093	10	1	0.00081	1.14613
case	0.00055	73	7	0.00184	0.30103	allergy	0.00093	10	1	0.00081	1.14613
effect	0.00055	73	7	0.00184	0.30103	hop	0.00093	10	1	0.00081	1.14613
relationship	0.00045	60	7	0.00151	0.30103	psychiatric	0.00083	23	5	0.00186	0.44716
life	0.00045	60	7	0.00151	0.30103	policy	0.00077	26	6	0.00210	0.36798
						academic	0.00074	8	1	0.00065	1.14613
						outcome	0.00068	80	11	0.00646	0.10474
						nursing					

CC: number of clusters including the term, COVID: coronavirus disease, HPRD: hours per resident day, ICF: $\log [1 - (\text{total number of clusters}/\text{CC})]$, ICU: intensive care unit, PMH: Psychiatric Mental Health, TC: term (keyword) counts in the cluster, TF-ICF = $\text{TF} \times \text{ICF}$, WISN: workload indicators of staffing needs.

References

- World Health Organization. *State of the World's Nursing 2020: Investing in Education, Jobs and Leadership*; World Health Organization: Geneva, Switzerland, 2020.
- National Quality Forum. *National Voluntary Consensus Standards for Nursing-Sensitive Care: An Initial Performance Measure Set*; National Quality Forum: Washington, DC, USA, 2004.
- Aiken, L.H.; Clarke, S.P.; Sloane, D.M. Hospital Staffing, Organization, and Quality of Care: Cross-National Findings. *Nurs. Outlook* **2002**, *50*, 187–194. [\[CrossRef\]](#)
- Needleman, J.; Buerhaus, P.; Mattke, S.; Stewart, M.; Zelevinsky, K. Nurse-Staffing Levels and the Quality of Care in Hospitals. *N. Engl. J. Med.* **2002**, *346*, 1715–1722. [\[CrossRef\]](#)
- Pearson, A.; Pallas, L.O.; Thomson, D.; Doucette, E.; Tucker, D.; Wiechula, R.; Long, L.; Porritt, K.; Jordan, Z. Systematic Review of Evidence on the Impact of Nursing Workload and Staffing on Establishing Healthy Work Environments. *Int. J. Evid. Based Healthc.* **2006**, *4*, 337–384.
- Kane, R.L.; Shamliyan, T.A.; Mueller, C.; Duval, S.; Wilt, T.J. The Association of Registered Nurse Staffing Levels and Patient Outcomes: Systematic Review and Meta-Analysis. *Med. Care* **2007**, *45*, 1195–1204. [\[CrossRef\]](#)
- Twigg, D.; McCullough, K. Nurse Retention: A Review of Strategies to Create and Enhance Positive Practice Environments in Clinical Settings. *Int. J. Nurs. Stud.* **2014**, *51*, 85–92. [\[CrossRef\]](#)
- Griffiths, P.; Ball, J.; Drennan, J.; Dall'Orta, C.; Jones, J.; Maruotti, A.; Pope, C.; Recio Saucedo, A.; Simon, M. Nurse Staffing and Patient Outcomes: Strengths and Limitations of the Evidence to Inform Policy and Practice. A Review and Discussion Paper Based on Evidence Reviewed for the National Institute for Health and Care Excellence Safe Staffing Guideline Development. *Int. J. Nurs. Stud.* **2016**, *63*, 213–225.
- Bae, S. Intensive Care Nurse Staffing and Nurse Outcomes: A Systematic Review. *Nurs. Crit. Care* **2021**, *26*, 457–466. [\[CrossRef\]](#)
- Dall'Orta, C.; Saville, C.; Rubbo, B.; Turner, L.; Jones, J.; Griffiths, P. Nurse Staffing Levels and Patient Outcomes: A Systematic Review of Longitudinal Studies. *Int. J. Nurs. Stud.* **2022**, *134*, 104311. [\[CrossRef\]](#)
- Blume, K.S.; Dietermann, K.; Kirchner-Heklau, U.; Winter, V.; Fleischer, S.; Kreidl, L.M.; Meyer, G.; Schreyögg, J. Staffing Levels and Nursing-Sensitive Patient Outcomes: Umbrella Review and Qualitative Study. *Health Serv. Res.* **2021**, *56*, 885–907. [\[CrossRef\]](#)
- Spetz, J. California's Minimum Nurse-to-Patient Ratios: The First Few Months. *J. Nurs. Adm.* **2004**, *34*, 571–578. [\[CrossRef\]](#)
- Mark, B.A.; Harless, D.W.; Spetz, J.; Reiter, K.L.; Pink, G.H. California's Minimum Nurse Staffing Legislation: Results from a Natural Experiment. *Health Serv. Res.* **2013**, *48*, 435–454. [\[CrossRef\]](#)
- The New York State Senate. *Assembly Bill A2954 Enacts the "Safe Staffing for Quality Care Act"*; The New York State Senate: Albany, NY, USA, 2019.
- Gerdtz, M.F.; Nelson, S. 5-20: A Model of Minimum Nurse-to-Patient Ratios in Victoria, Australia. *J. Nurs. Manag.* **2007**, *15*, 64–71. [\[CrossRef\]](#)
- McHugh, M.D.; Aiken, L.H.; Sloane, D.M.; Windsor, C.; Douglas, C.; Yates, P. Effects of Nurse-to-Patient Ratio Legislation on Nurse Staffing and Patient Mortality, Readmissions, and Length of Stay: A Prospective Study in a Panel of Hospitals. *Lancet* **2021**, *397*, 1905–1913. [\[CrossRef\]](#)
- Morioka, N.; Tomio, J.; Seto, T.; Kobayashi, Y. The Association between Higher Nurse Staffing Standards in the Fee Schedules and the Geographic Distribution of Hospital Nurses: A Cross-Sectional Study using Nationwide Administrative Data. *BMC Nurs.* **2017**, *16*, 25. [\[CrossRef\]](#)
- Shin, S.; Park, J.D.; Shin, J.H. Improvement Plan of Nurse Staffing Standards in Korea. *Asian Nurs. Res.* **2020**, *14*, 57–65. [\[CrossRef\]](#)
- Ball, J.E.; Griffiths, P. Consensus Development Project (CDP): An Overview of Staffing for Safe and Effective Nursing Care. *Nurs. Open* **2022**, *9*, 872–879. [\[CrossRef\]](#)
- National Institute for Health and Care Excellence. *Safe Staffing for Nursing in Adult Inpatient Wards in Acute Hospitals (SG1)*; National Institute for Health and Care Excellence: London, UK, 2014.
- Assaye, A.M.; Wiechula, R.; Schultz, T.J.; Feo, R. Impact of Nurse Staffing on Patient and Nurse Workforce Outcomes in Acute Care Settings in Low- and Middle-Income Countries: A Systematic Review. *JBI Evid. Synth.* **2021**, *19*, 751–793. [\[CrossRef\]](#)
- Imam, A.; Obiesie, S.; Aluvaala, J.; Maina, J.M.; Gathara, D.; English, M. Identifying Gaps in Global Evidence for Nurse Staffing and Patient Care Outcomes Research in Low/Middle-Income Countries: An Umbrella Review. *BMJ Open* **2022**, *12*, e064050. [\[CrossRef\]](#)
- Spilsbury, K.; Hewitt, C.; Stirk, L.; Bowman, C. The Relationship between Nurse Staffing and Quality of Care in Nursing Homes: A Systematic Review. *Int. J. Nurs. Stud.* **2011**, *48*, 732–750. [\[CrossRef\]](#)
- Clemens, S.; Wodchis, W.; McGilton, K.; McGrail, K.; McMahon, M. The Relationship between Quality and Staffing in Long-Term Care: A Systematic Review of the Literature 2008–2020. *Int. J. Nurs. Stud.* **2021**, *122*, 104036. [\[CrossRef\]](#)
- Royal College of Nursing. *Mandatory of Nurse Staffing Levels*; Royal College of Nursing: London, UK, 2012.
- Murrells, T.; Ball, J.; Maben, J.; Ashworth, M.; Griffiths, P. Nursing Consultations and Control of Diabetes in General Practice: A Retrospective Observational Study. *Br. J. Gen. Pract.* **2015**, *65*, 642. [\[CrossRef\]](#)
- Zengul, F.D.; Oner, N.; Ozaydin, B.; Hall, A.G.; Berner, E.S.; Cimino, J.J.; Lemak, C.H. Mapping 2 Decades of Research in Health Services Research, Health Policy, and Health Economics Journals. *Med. Care* **2022**, *60*, 264–272. [\[CrossRef\]](#)
- Dong, J.; Wei, W.; Wang, C.; Fu, Y.; Li, Y.; Li, J.; Peng, X. Research Trends and Hotspots in Caregiver Studies: A Bibliometric and Scientometric Analysis of Nursing Journals. *J. Adv. Nurs.* **2020**, *76*, 2955–2970. [\[CrossRef\]](#)

29. Yang, W.; Liu, Y.; Zeng, T.; Wang, Y.; Hao, X.; Yang, W.; Wang, H. Research Focus and Thematic Trends in Magnet Hospital Research: A Bibliometric Analysis of the Global Publications. *J. Adv. Nurs.* **2021**, *77*, 2012–2025. [\[CrossRef\]](#)
30. Chang, C.; Gau, M.; Tang, K.; Hwang, G. Directions of the 100 most Cited Nursing Student Education Research: A Bibliometric and Co-Citation Network Analysis. *Nurse Educ. Today* **2021**, *96*, 104645. [\[CrossRef\]](#)
31. Chiang, H.; Lee, H.; Hung, Y.; Chien, T. Classification and Citation Analysis of the 100 Top-Cited Articles on Nurse Resilience using Chord Diagrams: A Bibliometric Analysis. *Medicine* **2023**, *102*, e33191. [\[CrossRef\]](#)
32. Shekelle, P.G. Nurse-Patient Ratios as a Patient Safety Strategy: A Systematic Review. *Ann. Intern. Med.* **2013**, *158*, 404–409. [\[CrossRef\]](#)
33. Kajikawa, Y.; Ohno, J.; Takeda, Y.; Matsushima, K.; Komiyama, H. Creating an Academic Landscape of Sustainability Science: An Analysis of the Citation Network. *Sustain. Sci.* **2007**, *2*, 221–231. [\[CrossRef\]](#)
34. Newman, M.E.J. Coauthorship Networks and Patterns of Scientific Collaboration. *Proc. Natl. Acad. Sci. USA* **2004**, *101* (Suppl. 1), 5200–5205. [\[CrossRef\]](#)
35. Fortunato, S. Community Detection in Graphs. *Phys. Rep.* **2010**, *486*, 75–174. [\[CrossRef\]](#)
36. Kajikawa, Y.; Hashimoto, M.; Sakata, I.; Takeda, Y.; Matsushima, K. Academic Landscape of Innovation Research and National Innovation System Policy Reformation in Japan and the United States. *Int. J. Innov. Technol. Manag.* **2009**, *9*, 1250044.
37. Ball, J.E.; Murrells, T.; Rafferty, A.M.; Morrow, E.; Griffiths, P. ‘Care left undone’ during nursing shifts: Associations with workload and perceived quality of care. *BMJ Qual. Saf.* **2014**, *23*, 116–125. [\[CrossRef\]](#)
38. Aiken, L.H.; Sermeus, W.; Van den Heede, K.; Sloane, D.M.; Busse, R.; McKee, M.; Bruyneel, L.; Rafferty, A.M.; Griffiths, P.; Moreno-Casbas, M.T.; et al. Patient safety, satisfaction, and quality of hospital care: Cross-sectional surveys of nurses and patients in 12 countries in Europe and the United States. *BMJ Clin. Res.* **2012**, *344*, e1717. [\[CrossRef\]](#)
39. Rafferty, A.M.; Clarke, S.P.; Coles, J.; Ball, J.E.; James, P.; McKee, M.; Aiken, L.H. Outcomes of variation in hospital nurse staffing in English hospitals: Cross-sectional analysis of survey data and discharge records. *Int. J. Nurs. Stud.* **2007**, *44*, 175–182. [\[CrossRef\]](#)
40. Aiken, L.H.; Sloane, D.M.; Cimiotti, J.P.; Clarke, S.P.; Flynn, L.; Seago, J.A.; Spetz, J.; Smith, H.L. Implications of the California Nurse Staffing Mandate for Other States. *Health Serv. Res.* **2010**, *45*, 904–921. [\[CrossRef\]](#)
41. Sochalski, J.; Konetzka, R.T.; Zhu, J.; Volpp, K. Will mandated minimum nurse staffing ratios lead to better patient outcomes? *Med. Care* **2008**, *46*, 606–613. [\[CrossRef\]](#)
42. Spetz, J.; Harless, D.W.; Herrera, C.N.; Mark, B.A. Using Minimum Nurse Staffing Regulations to Measure the Relationship between Nursing and Hospital Quality of Care. *Med. Care Res. Rev.* **2013**, *70*, 380–399. [\[CrossRef\]](#)
43. Hyer, K.; Thomas, K.S.; Branch, L.G.; Harman, J.S.; Johnson, C.E.; Weech-Maldonado, R. The influence of nurse staffing levels on quality of care in nursing homes. *Gerontologist* **2011**, *51*, 610–616. [\[CrossRef\]](#)
44. Werner, R.M.; Konetzka, R.T.; Polsky, D. The Effect of Pay-for-Performance in Nursing Homes: Evidence from State Medicaid Programs. *Health Serv. Res.* **2013**, *48*, 1393–1414. [\[CrossRef\]](#)
45. Li, Y.; Cai, X.; Wang, M. Social media ratings of nursing homes associated with the experience of care and “Nursing Home Compare” quality measures. *BMC Health Serv. Res.* **2019**, *19*, 260. [\[CrossRef\]](#)
46. Tetuan, T.M.; Akagi, C.G. The effects of budget, delegation, and other variables on the future of school nursing. *J. Sch. Nurs.* **2004**, *20*, 352–358. [\[CrossRef\]](#) [\[PubMed\]](#)
47. Daughtry, D.; Engelke, M.K. Demonstrating the relationship between school nurse workload and student outcomes. *J. Sch. Nurs.* **2018**, *34*, 174–181. [\[CrossRef\]](#) [\[PubMed\]](#)
48. Best, N.C.; Nichols, A.O.; Waller, A.E.; Zomorodi, M.; Pierre-Louis, B.; Oppewal, S.; Travers, D. Impact of school nurse ratios and health services on selected student health and education outcomes: North Carolina, 2011–2016. *J. Sch. Health* **2021**, *91*, 473–481. [\[CrossRef\]](#) [\[PubMed\]](#)
49. Griffiths, P.; Saville, C.; Ball, J.E.; Jones, J.; Monks, T.; Safer Nursing Care Tool Study Team. Beyond Ratios—Flexible and Resilient Nurse Staffing Options to Deliver Cost-Effective Hospital Care and Address Staff Shortages: A Simulation and Economic Modelling Study. *Int. J. Nurs. Stud.* **2021**, *117*, 103901. [\[CrossRef\]](#)
50. Ball, J.; Day, T.; Murrells, T.; Dall’Ora, C.; Rafferty, A.M.; Griffiths, P.; Maben, J. Cross-Sectional Examination of the Association between Shift Length and Hospital Nurses Job Satisfaction and Nurse Reported Quality Measures. *BMC Nurs.* **2017**, *16*, 26. [\[CrossRef\]](#)
51. Dall’Ora, C.; Ejebu, O.; Griffiths, P. Because They’re Worth it? A Discussion Paper on the Value of 12-H Shifts for Hospital Nursing. *Hum. Resour. Health* **2022**, *20*, 36. [\[CrossRef\]](#)
52. Griffiths, P.; Saville, C.; Ball, J.; Jones, J.; Pattison, N.; Monks, T.; Safer Nursing Care Study Group. Nursing Workload, Nurse Staffing Methodologies and Tools: A Systematic Scoping Review and Discussion. *Int. J. Nurs. Stud.* **2020**, *103*, 103487. [\[CrossRef\]](#)
53. Griffiths, P.; Saville, C.; Ball, J.; Culliford, D.; Pattison, N.; Monks, T. Performance of the Safer Nursing Care Tool to Measure Nurse Staffing Requirements in Acute Hospitals: A Multicentre Observational Study. *BMJ Open* **2020**, *10*, e035828. [\[CrossRef\]](#)
54. Zhu, R.; Wang, Y.; Wu, R.; Meng, X.; Han, S.; Duan, Z. Trends in High-Impact Papers in Nursing Research Published from 2008 to 2018: A Web of Science-Based Bibliometric Analysis. *J. Nurs. Manag.* **2020**, *28*, 1041–1052. [\[CrossRef\]](#)
55. Sermeus, W.; Aiken, L.H.; Van den Heede, K.; Rafferty, A.M.; Griffiths, P.; Moreno-Casbas, M.T.; Busse, R.; Lindqvist, R.; Scott, A.P.; Bruyneel, L.; et al. Nurse Forecasting in Europe (RN4CAST): Rationale, Design and Methodology. *BMC Nurs.* **2011**, *10*, 6. [\[CrossRef\]](#)

56. European Commission. *Final Report Summary—RN4CAST (Nurse Forecasting: Human Resources Planning in Nursing)*; European Commission: Brussels, Belgium, 2017.
57. Lawless, J.; Couch, R.; Griffiths, P.; Burton, C.; Ball, J. Towards Safe Nurse Staffing in England's National Health Service: Progress and Pitfalls of Policy Evolution. *Health Policy* **2019**, *123*, 590–594. [\[CrossRef\]](#)
58. Lake, E.T. Development of the Practice Environment Scale of the Nursing Work Index. *Res. Nurs. Health* **2002**, *25*, 176–188. [\[CrossRef\]](#)
59. Di Giulio, P.; Clari, M.; Conti, A.; Campagna, S. The Problems in the Interpretation of the Studies on the Relationship between Staffing and Patients' Outcomes: The Case of the RN4CAST Studies. *Assist. Infirm. Ric.* **2019**, *38*, 138–145.
60. Twigg, D.E.; Whitehead, L.; Doleman, G.; El-Zaemey, S. The Impact of Nurse Staffing Methodologies on Nurse and Patient Outcomes: A Systematic Review. *J. Adv. Nurs.* **2021**, *77*, 4599–4611. [\[CrossRef\]](#)
61. European Commission. *Germany: Improving Staffing and Workforce Availability in Healthcare and Long-Term Care*; European Commission: Brussels, Belgium, 2018.
62. Centers for Medicare & Medicaid Services. *Nursing Homes Medicare and Medicaid Programs; Reform of Requirements for Long-Term Care Facilities*; Centers for Medicare & Medicaid Services: Baltimore, MD, USA, 2022.
63. Centers for Medicare & Medicaid Services. *Five-Star Quality Rating System*; Centers for Medicare & Medicaid Services: Baltimore, MD, USA, 2023.
64. Moricca, M.L.; Grasska, M.A.; BMarthaler, M.; Morphew, T.; Weismuller, P.C.; Galant, S.P. School Asthma Screening and Case Management: Attendance and Learning Outcomes. *J. Sch. Nurs.* **2013**, *29*, 104–112. [\[CrossRef\]](#)
65. Engelke, M.K.; Swanson, M.; Guttu, M. Process and Outcomes of School Nurse Case Management for Students with Asthma. *J. Sch. Nurs.* **2014**, *30*, 196–205. [\[CrossRef\]](#)
66. Dolatowski, R.; Endsley, P.; Hiltz, C.; Johansen, A.; Maughan, E.; Minchella, L.; Trefry, S. School Nurse Workload—ZStaffing for Safe Care: Position Statement. *NASN Sch. Nurse* **2015**, *30*, 290–293.
67. Falagas, M.E.; Pitsouni, E.I.; Malietzis, G.A.; Pappas, G. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and Weaknesses. *FASEB J.* **2008**, *22*, 338–342. [\[CrossRef\]](#)
68. Belikov, A.V.; Belikov, V.V. A Citation-Based, Author- and Age-Normalized, Logarithmic Index for Evaluation of Individual Researchers Independently of Publication Counts. *F1000Res* **2015**, *4*, 884. [\[CrossRef\]](#)

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.