REVIEW

Research Trends of Specialty Nurse Training from 2003 to 2023: A Bibliometric Analysis via CiteSpace

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Objective: To analyze research trends, frontiers, and hot topics in specialty nurse training over the past 20 years, and provide a reference for researchers to understand the current research landscape in this field.

Methods: Studies from the core collection of Web of Science were used. Furthermore, CiteSpace 6.3 R3 was utilized to analyze information on country, institution, authors, keywords and burst words.

Results: A total of 296 articles were included in the analysis. The United States had the highest number of articles, and there was limited cooperation between authors and institutions. The research hotspots in this field included "clinical education models for specialist nurses", "APN role training", and "interprofessional education".

Conclusion: The future research trend is to explore the effective integration of training models suitable for different regions and cultural backgrounds and cross-professional education models. It is suggested that researchers pay attention to the innovation and development of specialized nursing clinical practice under different cultural backgrounds, and strengthen international exchanges and cooperation.

Keywords: specialty nurse, train, bibliometric analysis, CiteSpace, data visualization

Introduction

The concept of specialty nursing originated in the United States in the 19th century. It refers to nurses who possess extensive theoretical knowledge, refined skills, and clinical practice experience within a specific field, providing direct nursing care to patients.[1,2] Serving as the cornerstone of specialty nursing, specialist nurses make indispensable contributions to enhancing medical service quality, elevating patient satisfaction levels, improving patients' quality of life, and reducing medical and nursing costs.[3–5] Consequently, training and development for specialty nurses have become pivotal topics in both medical education and clinical practice.

Over the past 20 years, significant progress has been made in the domain of specialty nurse training, both domestically and internationally. Not only has educational technology and the methodology of training been continuously innovated, such as simulation-based training,[6] integrated telehealth,[7,8] etc., but the scope of training content has also expanded. For instance, some scholars focus on empathy education for specialist nurses,[9] training of advanced nurse practitioners,[10] standardization of clinical practice,[11] etc. Thus, it is essential to evaluate and refine the current training system to meet the future healthcare needs. However, current research on specialty nurse training primarily focuses on qualitative descriptions[12,13] and intervention research,[14–16] lacking a comprehensive understanding of the overall research trends and knowledge evolution in the literature.

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While traditional literature reviews focus deeply on a small research group, bibliometric analysis offers a quantitative approach to analyze and interpret extensive literature data, thereby objectively reflecting the research status and trends in a particular field.[17] Furthermore, if such review efforts are not conducted periodically, a field's body of knowledge becomes overwhelming to navigate.[18]

Consequently, this study aims to explore the research trends, hot topics, and knowledge structure in the field of specialty nurse training over the past two decades using bibliometric analysis. It can reveal the evolution of research in nurse specialist training, identify key topics, and potential gaps in research, and offer recommendations for enhancing and refining nurse specialist training.

Against this backdrop, our research questions are as follows:

- Which countries, institutions, and authors are most influential in terms of the number of publications?
- What themes emerge from the analysis based on key keywords?
- What trends do these studies show?
- What are the potential research gaps?

Methods

Data Sources and Search Strategies

Literature was searched online using the Web of Science Core Collection (WoSCC). This database selects literature based on a professional review process, ensuring that included papers meet recognized objective standards and reflect the professional standards and quality of the papers. All data were obtained on 1 May 2024 to avoid bias caused by database updates, yielding a total of 1398 results. Two researchers eliminated irrelevant literature by manually reviewing the titles, abstracts, and full texts. Disagreements were resolved through discussion, and 296 articles were ultimately included. The literature screening process is depicted in Figure 1.

The time span was from 1 January 2003 to 31 December 2023. The following search terms were used: (TS = (("Advanced practice nurse" OR "Advanced nurse practitioner" OR "Advanced nurse" OR "Clinical Nurse Specialty" OR "Certified Nurse Specialty" OR "Nurse Practitioner" OR "Specialty Nurse" OR "Specialty nurse" OR "Nurse Specialty") AND ("train*" OR "educate*" OR "instruct*" OR "teach*" OR "cultivate")) AND Language = English).

Inclusion/Exclusion Criteria

The retrieved literature was exported to NoteExpress (V4.0.0.9855), and duplicate literature was deleted.

Studies were included if they (1) pertained to specialty nurse training, (2) were articles or reviews, and (3) were in English. Studies unrelated to nurse specialty education were excluded.
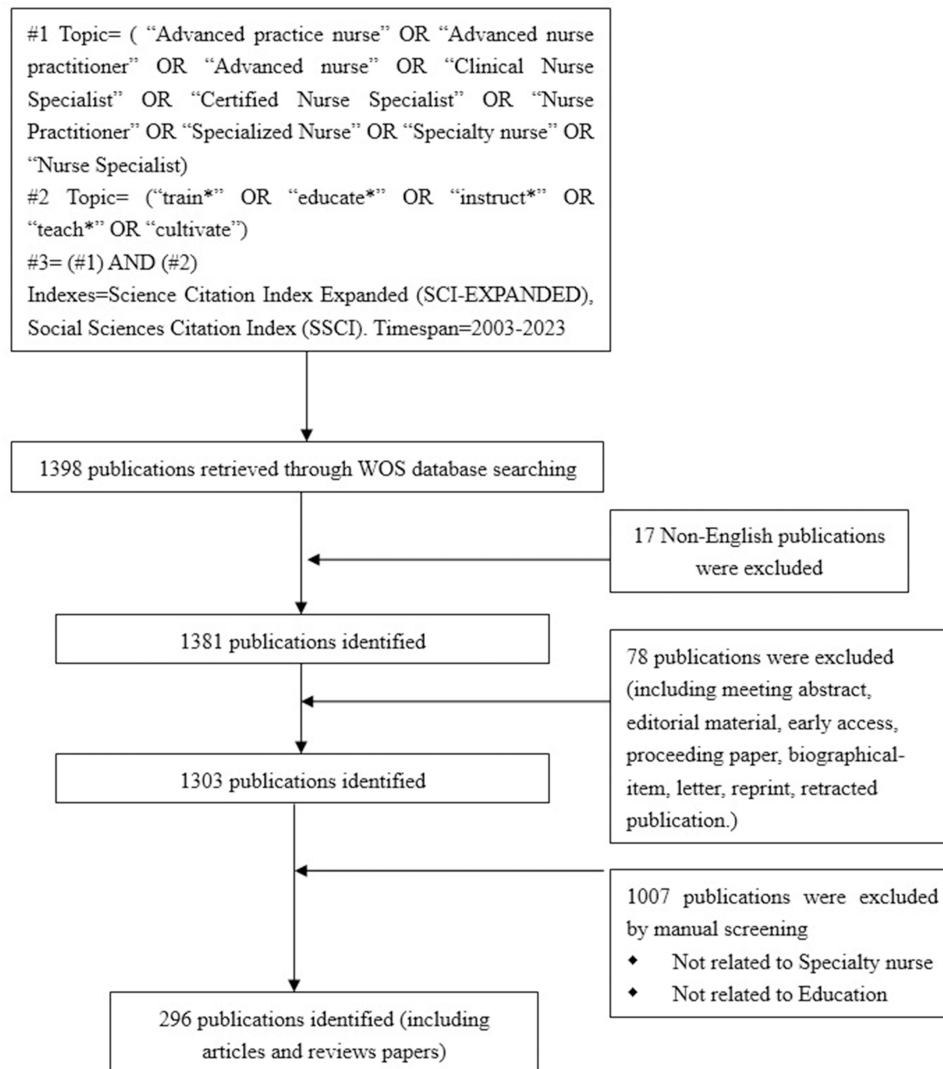
Analysis Tool

CiteSpace6.3. R 1(64 bit) was used to analyze the countries, authors, keywords and citations of the collected catalogue data, so as to infer the research status and future research frontiers in this field.[19] The parameters of CiteSpace were set as follows: time slicing (2003–2023), years per slice (1), the g-index (10), pruning (none), threshold selection standard (Top 50), time span of the cited literature (less than 5 years). The visual knowledge map is composed of nodes and links. Different nodes represent distinct elements, including country, institution, author, and keywords. Larger nodes indicate higher publication frequencies, wider links suggest more robust co-occurrence or co-citation relationships. The purple circle denotes high centrality, signifying a pivotal or transformative point within a domain.[20]

Result

Bibliometric Analysis of Publication Years

The publication growth trends over the past two decades, as illustrated in Figure 2, can be segmented into two stages: a slow period from 2003 to 2020, with an average annual publication count of approximately 10; followed by a rapid

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#1 Topic= ( "Advanced practice nurse" OR "Advanced nurse
practitioner" OR "Advanced nurse" OR "Clinical Nurse
Specialist" OR "Certified Nurse Specialist" OR "Nurse
Practitioner" OR "Specialized Nurse" OR "Specialty nurse" OR
"Nurse Specialist)
#2 Topic= ("train*" OR "educate*" OR "instruct*" OR
"teach*" OR "cultivate")
#3= (#1) AND (#2)
Indexes=Science Citation Index Expanded (SCI-EXPANDED),
Social Sciences Citation Index (SSCI). Timespan=2003-2023
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1398 publications retrieved through WOS database searching

17 Non-English publications were excluded

1381 publications identified

78 publications were excluded (including meeting abstract, editorial material, early access, proceeding paper, biographical-item, letter, reprint, retracted publication.)

1303 publications identified

1007 publications were excluded by manual screening
- Not related to Specialty nurse
- Not related to Education

296 publications identified (including articles and reviews papers)

Figure 1 Flow chart of literature screening included in this study.

growth phase from 2020 to 2023, during which the maximum yearly publications reached 40. In summary, the total number increased over the past 20 years, albeit with some fluctuations.

Bibliometric Analysis of Countries and Institutions

A total of 35 countries and 198 institutions published articles related to specialty nurse training. The United States published the largest number of studies, followed by the England, Canada, Australia and China. This suggests that these countries are leading the research in this field (Table 1). The United States and England exhibited high national centrality (0.84 and 0.62, respectively) and were found to mediate national cooperation networks (Figure 3).

Most institutions exert a low level of influence and engage in limited cooperation, with the top five all located in the United States. They are Duke University, University of Michigan, University of Illinois, Old Dominion University, and University of Pittsburgh. Thus, American academic institutions have an important place in the field of specialty nurse training (Figure 4).
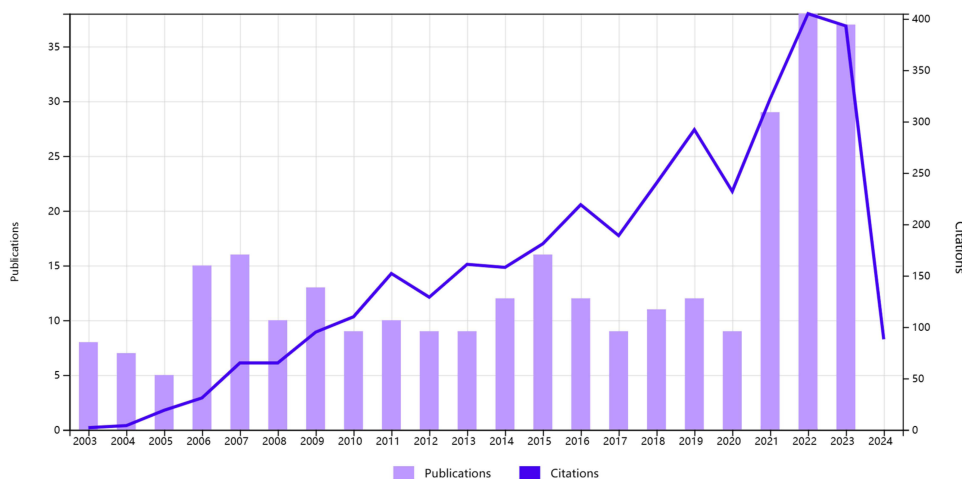
Figure 2 Annual trend chart of publications and citations. The period was from 1 January 2003 to 31 December 2023.

Bibliometric Analysis of Co-Authors

Through the knowledge graph analysis of the cooperative network of co-authors, it is found that many authors are mostly isolated and not closely related to each other, but there is also a core research team composed of Wright, LL and others, who continue to cooperate in several years, as shown in Figure 5.

Bibliometric Analysis of Co-Occurring Keywords, Cluster and Citation Bursts

High-Frequency Keywords

The keyword co-occurrence map indicates that specialty nurse training spans a broad spectrum of aspects and fields (Figure 6). This analysis can be divided into three stages: (1) Early focus areas: As depicted in the map, key words during the initial years (2003–2007) primarily revolved around "Randomized controlled trial", "Clinical nurse specialty", and "nursing." The high citation frequency of these keywords indicates that during this stage, emphasis was placed on basic research and practical application in specialty nurse training. (2) Medium-term development trend: Over time, from 2006 to 2016, keywords in the map gradually expanded to encompass a broader spectrum including fields like "attitude", "primary care", "knowledge", and "advanced health assessment." This shift signifies an increased focus on professional attitude, knowledge training for specialty nurses, and healthcare promotion. (3) Recent hot spots: In recent years (2016 to present), the graph reflects more diverse keywords related to educational methods and tools such as "standardized patients", "flipped learning", "distance education", and "simulation." Additionally, it highlights role development areas like "graduate nursing education" and "nurse practitioner role transition".

Highlighting Keywords

Figure 7 identifies the top 17 keywords with the strongest citation bursts between 2003 and 2023. The keyword "simulation" exhibits the highest citation burst (4.12), while "Advanced Practice Nursing" has been trending since

Table 1 Top 5 Countries and Institutions

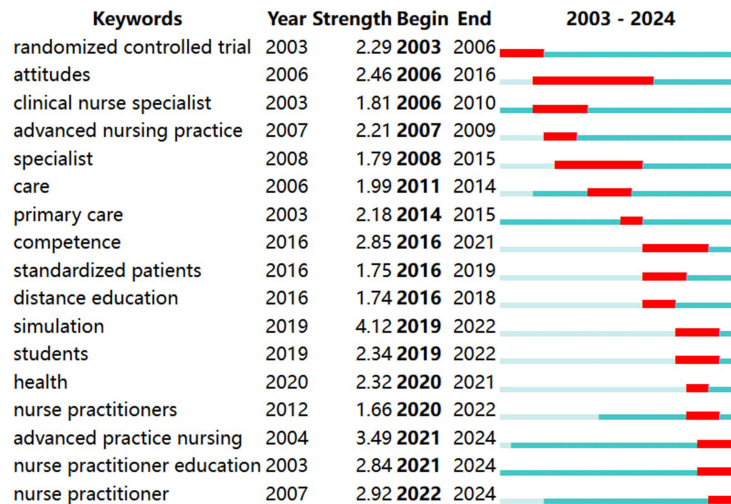| Rank	Country	Publications	Centrality	Rank	Institution	Publications
1	USA	214	0.84	1	Duke Univ	14
2	ENGLAND	27	0.62	2	Univ MICHIGAN	13
3	CANADA	15	0.23	3	Univ Illinois	12
4	AUSTRALIA	13	0.12	4	Old Dominion Univ	6
5	PEOPLES R CHINA	10	0.21	5	Univ Pittsburgh	6

Figure 3 CiteSpace visualization of the countries participating in the research of specialty nurse training. The size of node reflects the co-occurrence frequencies, and the links indicate the co-occurrence relationships. The color of node and line represent different years, and node with purple round means high betweenness centrality (>0.1).
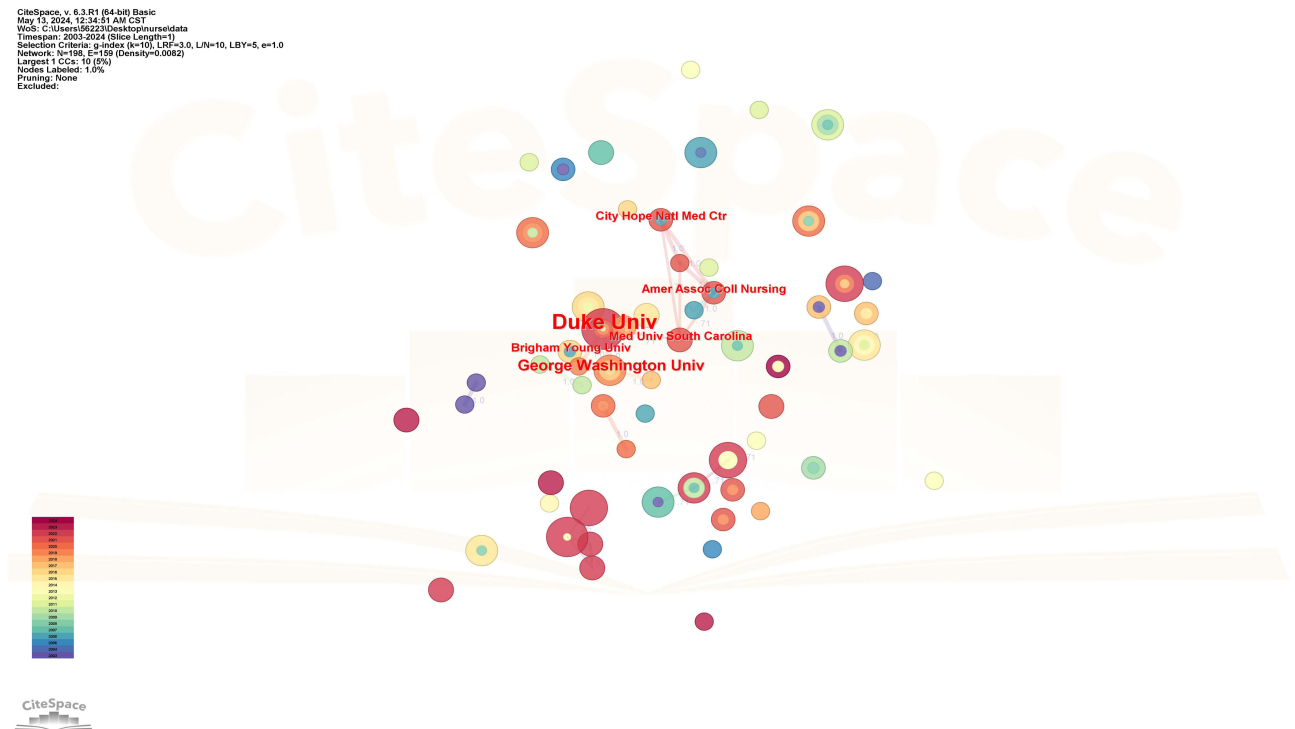
Figure 4 CiteSpace visualization of institutions participating in the research of specialty nurse training. The circular nodes represent institutions; the links between nodes represent interactions between institutions.

Figure 5 CiteSpace visualization of co-authors involved in the research of specialty nurse training. Circle nodes represent the author of papers; links between nodes represent partnerships.

Figure 6 CiteSpace visualization of keywords involved in the research of specialty nurse training – Network of the main keywords in publications.

Top 17 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2003 - 2024
randomized controlled trial	2003	2.29	2003	2006	
attitudes	2006	2.46	2006	2016	
clinical nurse specialist	2003	1.81	2006	2010	
advanced nursing practice	2007	2.21	2007	2009	
specialist	2008	1.79	2008	2015	
care	2006	1.99	2011	2014	
primary care	2003	2.18	2014	2015	
competence	2016	2.85	2016	2021	
standardized patients	2016	1.75	2016	2019	
distance education	2016	1.74	2016	2018	
simulation	2019	4.12	2019	2022	
students	2019	2.34	2019	2022	
health	2020	2.32	2020	2021	
nurse practitioners	2012	1.66	2020	2022	
advanced practice nursing	2004	3.49	2021	2024	
nurse practitioner education	2003	2.84	2021	2024	
nurse practitioner	2007	2.92	2022	2024	

Figure 7 Top 17 keywords with the strongest citation bursts. The red line represents that the keywords are active in this period.

2021, indicating that this research topic has attracted continuous attention in recent years and might be the trend of research on specialty nurse training.

Keyword Clustering

To elucidate the research frontiers in specialty nurse training, cluster analysis based on keyword co-occurrence was performed. The cluster analysis map shows a module clustering value of Q=0.5862 and S=0.8565, indicating good clustering effect (Q>0.3) and a high degree of homogeneity, suggesting that the clustering result is significant (S>0.7).[21] Multiple clusters were overlap, indicating that despite differences in relevant studies of specialty nurse training, there is concentrated and closely related thematic content. These clusters are further classified into thematic categories: #0, #3, #4, and #6 constitute the first category for exploring clinical nursing education and evidence-based practice. Clinical education provides specialist nurses with the theoretical knowledge and practical skills requisite for supporting their work in clinical settings. The training of specialized nurses not only emphasizes clinical practice but also accentuates the cultivation of scientific research ability and the promotion of the evidence-based nursing concept. #1, #2, #8, and #9 form the second category for exploring cross-professional education in the training of specialist nurses. This cluster emphasizes the significance of cross-professional education, with clinical decision-making and diagnostic skills being a key aspect in training. #5 constitutes the third category, which deliberates on the training mode and path of Advanced Practice Nurses (APN). This cluster focuses on the optimization of the education path and the improvement of the professional certification system. #7 and #10 form the fourth category, indicating that action research and qualitative research methods are extensively adopted in specialist nurse training research to facilitate the application of research findings in clinical practice. These categories are presented in Figure 8 and detailed in Table 2.

Discussion
General Information

The number of papers published in the past 20 years indicates a significant increase in research on specialty nurse training. Geographically, the leading contributing to this research are the USA, England, Canada, Australia, and China. Notably, China's presence among these leading nations reflects a positive advancement for specialty nursing in developing countries. For instance, since 2010, National Health Commission of the People's Republic of China has initiated the national clinical key specialty nursing construction project. This has prompted nursing societies and health
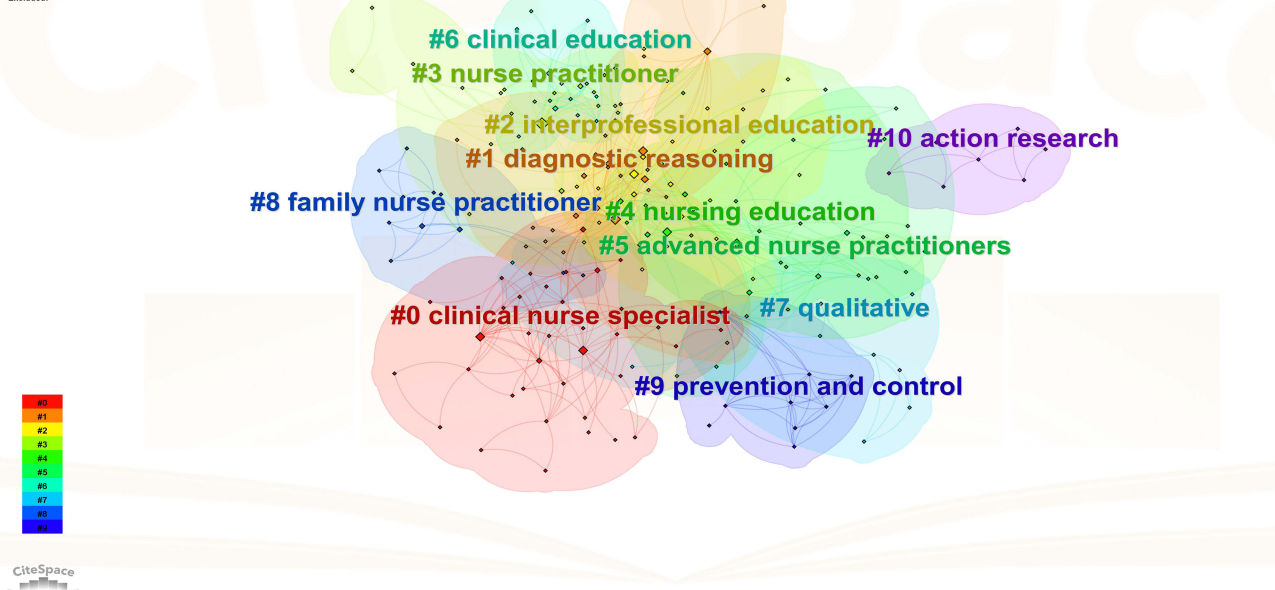
Figure 8 CiteSpace visualization of keywords involved in the research of specialty nurse training – Cluster analysis of keywords.

administrative departments in China to align with global trends by implementing multidisciplinary nurse training programs and fostering the growth of specialty nurse teams.[22,23] However, the literature indicates that developing countries still face significant challenges in the future development of specialty nurses compared to developed countries.

Table 2 Keyword Cluster Analysis

Label (LLR)	Silhouette	Included Keywords (Top 5)	Mean (Year)
#0 clinical nurse specialty	0.868	clinical nurse specialty; attitudes; certified nurse-midwives; reproductive health; evidence-based practice	2009
#1 Diagnostic reasoning	0.768	diagnostic reasoning; online learning; nurse practitioner education; competency-based education; competencies	2015
#2 interprofessional education	0.765	interprofessional education; advanced practice; primary care; midwifery; community	2009
#3 nurse practitioner	0.861	nurse practitioner; critical care; distance education; acute care nurse practitioner; continuing education	2015
#4 nursing education	0.832	nursing education; advanced practice nurses; nurse practitioners; evaluation; acute care	2014
#5 advanced nurse practitioners	0.921	advanced nurse practitioners; advanced nursing practice; advanced nursing; responsibility; cardiovascular	2012
#6 clinical education	0.891	clinical education; preceptorship; nurse practitioner role transition; oncology nursing; cancer	2019
#7 qualitative	0.9	qualitative; advanced practice nurse (apn); multidisciplinary teams; breast cancer; breast care team	2009
#8 family nurse practitioner	0.924	family nurse practitioner; doctorate of nursing practice; teaching/learning strategies; mixed-; based learning	2019
#9 prevention and control	0.986	prevention and control; septicaemia; patient education; neoplasm; central venous	2006
#10 action research	0.99	action research; advanced practice nursing education; flipped learning; active learning exercises; nurse practitioner	2019

There were deficiencies in the breadth, depth and effectiveness of training.[24] The co-author network analysis reveals limited scholarly connections, underscoring the need for enhanced academic exchanges and cooperation among researchers internationally. Sharing research findings and experiences can foster collaborative research and development, capitalizing on interdisciplinary and complementary strengths. This approach will stimulate more comprehensive and innovative research, enhancing global standards of specialty nurse training.

Research Topics and Frontiers

Bibliometric analysis findings reveal a significant rise in academic publications over the past two decades, particularly concerning clinical education models, APN role training, and interprofessional education.

Innovation of Training Approaches and Methods

The high citation rates of keywords such as "distance education", "standardized patients", and "simulation" indicate that specialty nurse training is constantly innovating in its approaches and methods, with a greater emphasis on practice and simulation. Since the COVID-19 pandemic, there have been significant changes in the education of health professionals reflected in part in the large-scale application of information technology to education.[25] For example, Bobek et al explored teaching strategies for online nurse practitioner physical assessment and distance health education, so that students' learning outcomes were comparable to those of face-to-face teaching.[26] However, some countries or regions lack access and ability to use digital technology, or lack of awareness of online courses, which makes the implementation of online education less effective.[27] Therefore, how to improve the quality of online courses and students' participation is a future research hotspot. As far as we know, in addition to specialty theories in a specific field, specialty nurses should also have a certain level of professional practice. Several researches indicated that the simulation-based learning resulted in increased student satisfaction with simulation and increased self-confidence to apply the information in the clinical setting.[28,29] And the use of standardized patients (SPs) as a supplement to traditional clinical experience is of interest in the specialty nursing curriculum.[30] It can be seen that researchers are constantly seeking more flexible and efficient methods of education and training. Future research will focus on multi-dimensional, high-quality training model research, and develop a homogeneous training and assessment system of local models.

Cultivation of Advance Practice Nurse

The current research focus is on the training of Advanced Practice Nurse (APN), as indicated by the clustering results of co-cited literature and burst keywords. The International Council of Nurses (ICN) defines an APN as

> one who has acquired, through additional education, the expert knowledge base, complex decision- making skills and clinical competencies for expanded nursing practice, the characteristics of which are shaped by the context in which they are credentialed to practice, and it is recommended that they have a master's degree or above.[31]

APNs are capable of providing primary healthcare services comparable to those offered by physicians, and in some aspects, even outperforming them, thereby playing a crucial role in the intricate healthcare environment.[32,33] Research has demonstrated that APNs not only enhance patient prognosis and reduce complications but also lead to shorter hospitalization times and improved patient satisfaction levels.[34,35] Many developed countries have established comprehensive and authoritative APN training models and qualification certification systems. Taking the United States as an example, 41 nursing organizations have devised a unified regulatory consensus model known as LACE (Licensure, Accreditation, Certification, Education) elements,[36] achieving standardized management of APN qualifications. In terms of curriculum design for APN practitioners in the United States, provisions have been made for professional courses alongside basic core courses and advanced nursing practice core courses.[37] However, due to limited clinical practice opportunities,[38] novice nurses struggle to fully develop their requisite knowledge system and lack clinical judgment during their transition period into becoming APN practitioners – a pressing issue that represents a key area for future research direction.[39] Conversely, in developing countries such as China, where APN training started relatively late without a standardized training mode or clear definition of training and certification standards, resulting in disparate levels of training quality making it difficult to compare outcomes. Additionally, no clear assessment or certification system exists for Chinese APN trainers.[40] To address these challenges, the refinement of curricula should be considered

along with establishing specialty field-specific core curricula, and implementing an evaluation system for specialty nurse certification/re-certification – representing a future hotspot for research.

Multi-Dimensional Training and Development of Specialty Nurses

The sustained popularity of keywords such as "interprofessional education" and "prevention and control" indicates the evolving professionalization and diversification of specialty nurse training. In the process of training specialized nurses, scholars build a diversified and comprehensive knowledge system by integrating cross-specialty courses, which broadens the professional vision of specialized nurses.[41,42] With the in-depth development of this training model, a variety of new team models with specialist nurses as the core have been formed, such as single-discipline,[43] medical integration,[44] and multidisciplinary nursing[45] teams. The future research trend is to explore how to integrate the knowledge and skills of different specialties more effectively to form a more systematic and coherent training system for specialized nurses. It will also focus on how to develop specialist nurses' decision-making skills in complex clinical situations, including how to quickly acquire, analyze, and apply relevant information, and how to develop and implement effective care plans.

Limitations

There are several limitations in this study. Firstly, the inclusion of only English-language literature may have precluded capturing diverse perspectives and approaches from different cultural and regional contexts, potentially leading to an incomplete understanding of the current state of specialty nurse training. Future research should expand the scope of literature searches, utilize translation services, or collaborate with researchers proficient in other languages. This will ensure a more comprehensive and inclusive review of available evidence and enhance the generalizability of research findings. Secondly, reliance solely on CiteSpace for visual analysis, while common in bibliometrics, may not fully uncover the complex relationships within the literature. Future studies should incorporate additional bibliometric analysis tools, such as VOSViewer and Bibliometrix, to improve the comprehensiveness and reliability of the analysis.

Conclusion

This study found that the field of specialty nurse training has yet to establish an effective cooperative network, with a limited number of central authors and authorities. Currently, there are gaps in interdisciplinary integration and training models across different regions and cultural contexts. Concurrently, it is recommended that researchers focus on innovation and development in specialized nursing clinical practices across various cultural contexts, and enhance international collaboration and communication.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, methodology, execution, formal data curation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

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