

GLOBAL TREND FOR HUMAN RESOURCE DEVELOPMENT MAPPING FOR PHARMACISTS

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ABSTRACT

Pharmacist workforce planning remains a global challenge, with fragmented evidence and no comprehensive framework across diverse contexts. This paper aims to analyze structures and patterns of knowledge on pharmacist workforce planning and management at the discipline level.

This study employed a systematic bibliometric analysis of 364 Scopus-indexed articles published between 1968 and 2024. The analysis was done using citation analysis, co-occurrence network analysis, and bibliographic coupling to identify key themes, patterns of connections, and directions of knowledge development.

The results indicate that studies on pharmacist workforce planning can be clustered to reflect key dimensions of the workforce system, including strategic workforce management, specialty distribution, supply-demand analysis, and work system and technology design. Existing literature remains constrained by static frameworks and insufficient integration of roles, competencies, technology, and system dynamics.

This study structures global knowledge and identifies future research directions to support forward looking pharmacist workforce planning in complex systems.

KEYWORDS:

Workforce planning, Pharmacist, Bibliometric analysis, Global trend, Human resource

INTRODUCTION

Technological changes, demographic structures, and healthcare systems have made workforce planning a strategic issue in many countries. However, roles, responsibilities, and scopes of pharmacist practices vary significantly depending on each country's context, including legal frameworks, healthcare systems, labor market structures, and technological development levels [1]. These contextual differences mean that pharmacist workforce planning cannot directly rely on a single, unified framework and present a structural challenge to healthcare systems globally.

Although studies on pharmacist workforce planning have been produced in many countries and contexts, the development of knowledge in this field is fragmented. Many studies focus on specific country or contextual problems, such as hospital staff shortages, the expansion of community pharmacist roles, or the impact of technology on service delivery, by studying them in isolation [2,3]. This results in no systematic understanding of how these national differences are managed, interconnected, or reflected in the overall academic knowledge.

This paper does not aim to propose a universal pharmacist workforce model or to offer a global policy conclusion. Rather, it aims to investigate pharmacist workforce planning as a framework of knowledge within a global academic field by analyzing how studies from different countries, healthcare systems, and professional contexts are produced, grouped, and interconnected within the overall knowledge framework. Therefore, national differences are not viewed as limitations to the study, but rather as a crucial element that shapes the style and direction of studies in this field.

Within the context of complex healthcare systems [4], workforce planning based on linear assumptions and a fragmented approach to problem-solving cannot adequately reflect dynamics, delays, and reversals of impacts [5]. Overlooking the structural level of knowledge is therefore a significant limitation that prevents a lot of pharmacist workforce planning from systematically linking workforce issues, policies, and healthcare service structures together.

Although previous studies have employed a wide range of approaches to examine the pharmacist workforce, including statistical analyses, field surveys, and quantitative forecasting models [6-9], these methods have often been applied in an issue-specific manner and have lacked an explanation of the structural limitations of the knowledge base as a whole. As a result, it remains difficult to understand how findings from individual studies are connected to or complement one another at the disciplinary level. This methodological gap highlights the need for an approach capable of systematically exploring patterns, interconnections, and constraints across the entire body of literature, a role that bibliometric analysis is well positioned to address [10-11] (Yoon et al., 2024; Reyes et al., 2024).

To understand these structural gaps, this study used bibliometric analysis as its primary tool to study the field-level knowledge structure of pharmaceutical workforce. This method allows for the revelation of key themes, research trends, and interconnected studies. Even if these studies originate from different countries and contexts, without reducing contextual differences to a single framework, they reflect how these differences are managed and integrated within the academic literature [12].

This study aimed to:

- (1) Analyze structures and themes of international knowledge on pharmacist workforce planning;
- (2) Identify studies and concepts that influence the formation of the field of pharmacist workforce planning; and
- (3) Explain how differences in the roles of pharmacists, healthcare systems, and policies across countries are reflected in the academic knowledge structure.

The results of this study are intended to enhance a systematic understanding of the development of knowledge on pharmacist workforce planning and to provide a conceptual basis for contextual policy interpretation and application at the national level.

RESEARCH METHODOLOGY

RESEARCH DESIGN AND FRAMEWORK

This study was designed as a systematic bibliometric study with the goal of understanding the knowledge structure of international studies on pharmacist workforce planning. The objective of this bibliometric design is to systematically examine the intellectual structure, thematic evolution, and interconnections of studies within the global field of pharmacist workforce planning.

The research methodology framework utilized the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach to ensure transparency, verifiability, and reproducibility in the search, selection, and management of articles as well as integrated various bibliometric analysis techniques to systematically reflect both the conceptual knowledge base and contemporary research themes in this field.

SEARCH STRATEGY

Data retrieval was conducted using the Scopus database, which was selected because it provides broad international coverage of peer-reviewed journals and is widely used in bibliometric research due to its comprehensive citation indexing. The search used the Title, Abstract, and Keywords fields, specifying search terms with Boolean operators as follows: ("Workforce" OR "Human Resource" OR "Manpower") AND ("Planning" OR "Forecasting" OR "Management") AND ("Pharmacist").

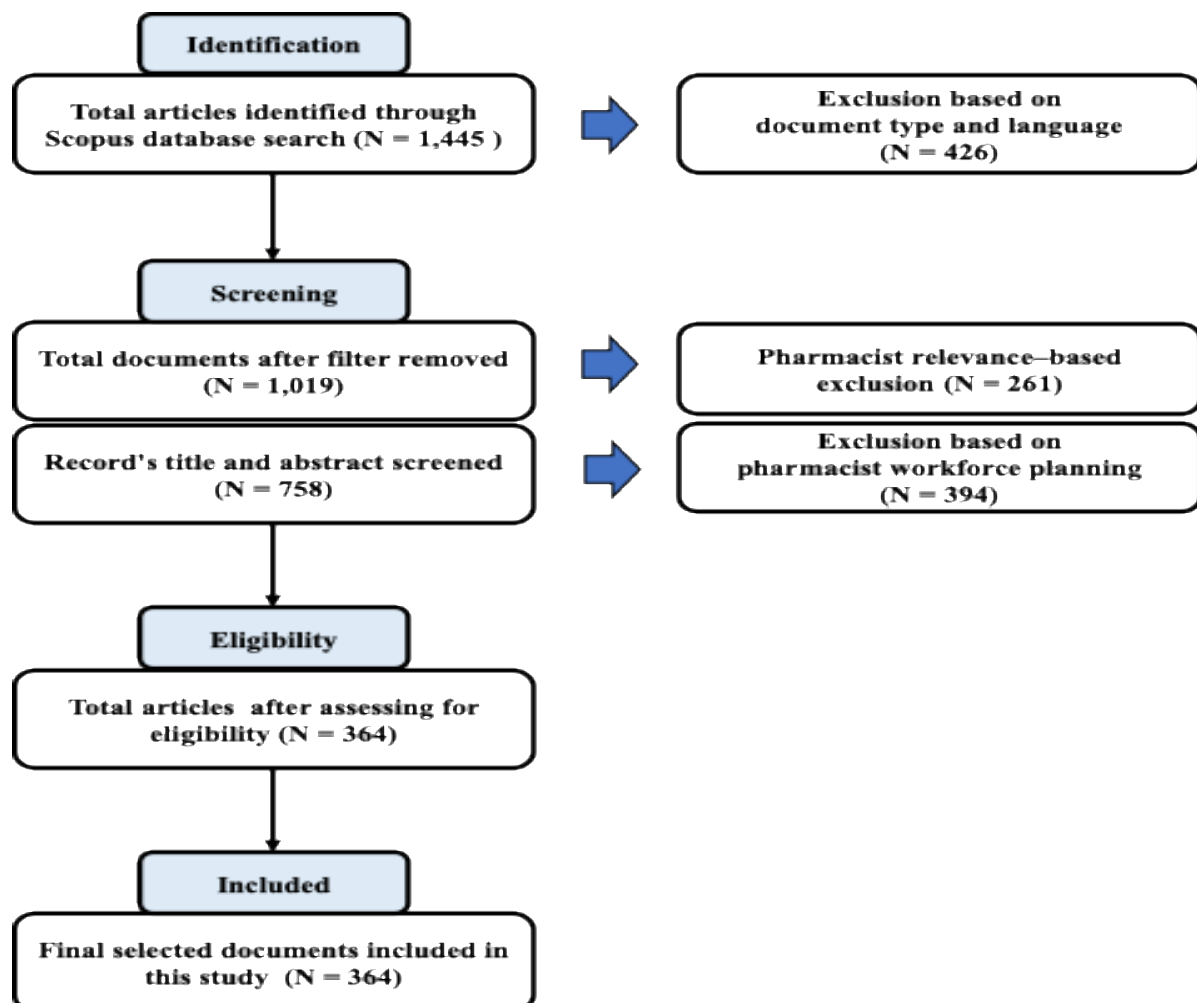
The search scope was limited to English articles to maintain consistency in document type and references, covering the period from 1968–2024. All bibliographic data and reference lists were exported in CSV format for use in the filtering and analysis process according to the PRISMA guidelines.

SELECTION CRITERIA AND REDUCTION OF ARTICLE VARIANCE

To address concerns about content heterogeneity, this study established rigorous article selection criteria, using the workforce-centrality concept as its core. Articles were only included in the analysis if pharmacist workforce planning was the primary focus of the studies, not merely a contextual or secondary mention.

Included articles included studies aimed at analyzing or discussing issues, such as workforce forecasting, workforce planning, supply-demand imbalance, workforce distribution, changing professional roles, and impact of policies or technologies on pharmacist workforce. Conversely, articles that only superficially addressed pharmacists or focused on clinical outcomes without a systematic connection to workforce planning were eliminated. In addition, the screening process followed the PRISMA sequence to ensure the final dataset was conceptually consistent and suitable for knowledge structure analysis, as illustrated in Figure 1.

FIGURE 1 ARTICLE SEARCH, SCREENING, AND SELECTION USING PRISMA DIAGRAM



DATA CLEANING AND PROCESSING

Articles that met the selection criteria underwent initial data processing using Microsoft Excel to remove duplicates, verify the completeness of key fields, and standardize bibliographic data, especially reference lists, which are crucial for bibliographic analysis.

Then, the data was imported into RStudio for initial bibliographic processing. Using packages designed for bibliometric analysis, RStudio was used to (1) examine the reference data structure, (2) verify the completeness and consistency of bibliographic data, and (3) prepare the dataset in a format suitable for relational network construction. Using RStudio in this step reduces the risk of technical errors and acts as a bridge between the raw data and the structural network analysis. Once the data had been examined and prepared in RStudio, the dataset was imported into VOS viewer for use in constructing bibliometric relational networks. This division of roles allows RStudio to handle preparation, while VOS viewer handles network construction, visualization, and clustering in a clear and systematic manner.

BIBLIOMETRIC ANALYSES AND THRESHOLDS

The bibliographic analysis in this study utilized three main techniques that work synergistically to describe the knowledge structure in multiple dimensions. The threshold selection followed common practices in bibliometric studies to ensure that only documents with sufficient citation linkages were included in the network analysis while minimizing noise from weakly connected publications.

Firstly, co-citation analysis was used to identify the knowledge base of the field by considering which documents are frequently cited together in all articles. Co-citations reflect studies that have a conceptual influence and form the foundation for the development of the field of pharmacist workforce planning.

Secondly, keyword co-occurrence analysis was used to analyze research themes and concepts based on the common appearance of keywords within the same articles. This technique helps identify key topics, interconnected concepts, and contemporary research directions in the field.

Finally, bibliographic coupling was used as the main technique for grouping articles based on the similarity of shared citations. The unit of analysis was "documents," and Total Link Strength (TLS) was used as an indicator of the relationship strength. Grouping was performed in VOS viewer using a modularity-based clustering algorithm, which increases the density of links within groups and decreases links between groups.

To enhance methodological clarity, this study set a minimum threshold for including articles in network analysis based on the level of citations and structural linkages. Threshold adjustment was used to reduce noise from articles with low conceptual roles and to test the stability of the network structure. The final threshold was selected from a level that allows the network to be separated into 4 clusters that are conceptually clear and facilitate interpretation in the context of pharmacist workforce planning.

RESULTS

DOCUMENT PROFILES, GROWTH TREND, AND GEOGRAPHIC DISTRIBUTION

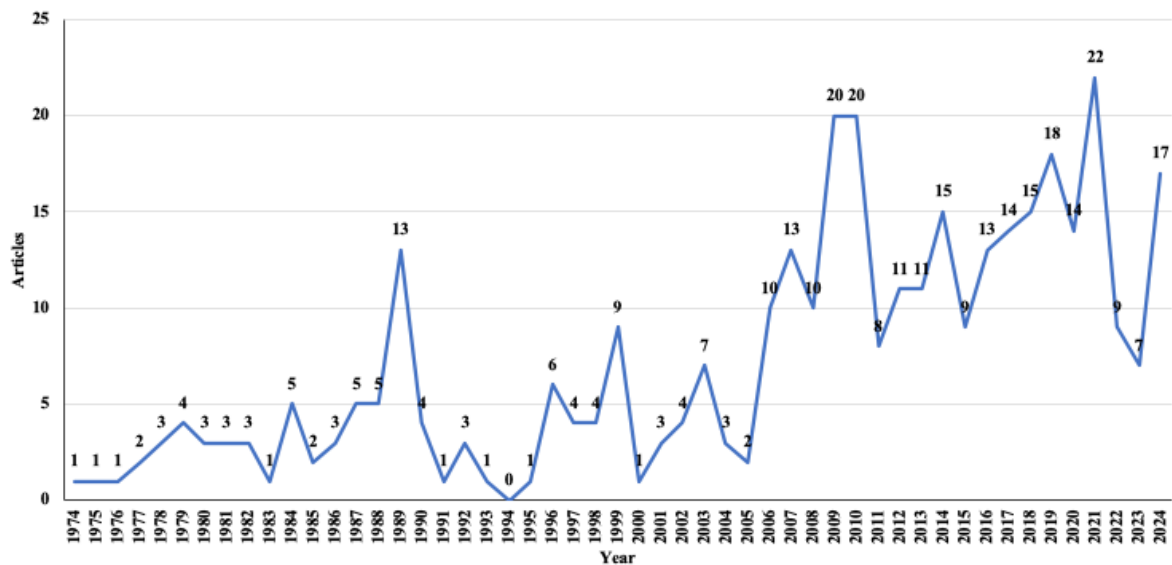
The analysis of document profiles, growth trends, and geographic distribution of studies in this section aims to create a structural understanding of the development of knowledge in pharmacist workforce planning at the international level. This analysis serves as a structural context for interpreting the results of the knowledge network analysis in the next section. It is not intended to evaluate the content quality of individual articles, but rather to explain the pattern of knowledge production at the discipline level.

The data used in the analysis consisted of 364 articles that were selected using the PRISMA approach and the workforce centrality criterion as described in the research methodology section. The analysis of document profiles in this study refers

to the consideration of the bibliographic characteristics of the articles, including the year of publications, the number of citations, the type of documents, and the country of main authors. Using data processing via RStudio and data validation with Microsoft Excel, document profiles were employed to reflect the underlying structure of the academic field, not to provide a substantive analysis of the article's content.

The selected articles from the Scopus database, spanning 1968 to 2024, demonstrate a rising trend in pharmacist workforce planning research. Analysis of 364 documents revealed an average annual growth rate of 5.83% and an average of 15.91 citations per document, reflecting increasing academic and policy relevance. Initially, from 1968–2000, publication numbers were low, averaging fewer than 10 articles annually. Post-2000, publications surged, driven by the growing complexity of healthcare systems and demand for pharmacists in accessibility, drug safety, and workforce management. Particularly during 2020–2024, intensified focus on pharmacists' roles in drug production and vaccine distribution underscored the profession's strategic importance in global health policy, as shown Figure 2.

FIGURE 2 GROWTH TRENDS OF ARTICLES ON PHARMACIST WORKFORCE PLANNING FROM 1968 TO 2024



The top three countries publishing research on pharmacist workforce planning are the United States, the United Kingdom, and Australia.

ANALYSIS OF THE MOST CITED ARTICLES

This analysis of articles with citation influence aims to identify the intellectual influence structure within the academic field of pharmacist workforce planning, with the goal of understanding which articles play a significant role in shaping the directions, concepts, and analytical frameworks of this field in the long term. This analysis is not intended to rank the best articles or select articles for content synthesis, but rather to use the number of citations as a structural indicator of intellectual influence.

This avoids the bias associated with using only total citations, which favors older articles. The results presented in this section are not limited to older articles but aim to reflect both foundational conceptual work and work that continues to influence the development of studies in pharmacist workforce planning.

Top 10 journals publishing pharmacist workforce planning research from 1968 to 2024 are listed in Table 1. Leading journals include the American Journal of Health-System Pharmacy, Human Resources for Health, Research in Social and Administrative Pharmacy, Journal of the American Pharmacists Association, and the International Journal of Pharmacy Practice. The American Journal of Health-System Pharmacy recorded the highest citation count (736 citations from 36 publications), highlighting its influence in hospital pharmacy workforce administration. Human Resources for Health follows

with 683 citations from 25 publications, emphasizing strategic workforce development and healthcare system adaptation. Research in Social and Administrative Pharmacy accumulated 614 citations from 44 publications, focusing on human resource administration, pharmaceutical policy, and community health impacts.

Thus, this analysis suggests that to maximize research visibility and impact, future studies should target these top-tier journals. Research on workforce planning models, pharmacist integration into multidisciplinary healthcare teams, and the role of AI-driven automation is particularly promising. Moreover, fostering interdisciplinary approaches could expand the research scope and enhance citation performance in pharmacist workforce planning literature.

This study does not claim that highly cited articles are qualitatively the most important or encompass all the latest studies, particularly the high-quality works of the U.S. national pharmacist workforce planning researchers. The said studies are reflected in the bibliographic coupling and co-occurrence network analysis in the following section, which is a more appropriate method for detecting emerging trends and contemporary studies that have not yet had time to accumulate citations.

Therefore, the analysis of articles with high citation influence in this section should be interpreted as a reflection of the historical influence structure and core concepts of the field, not as a selection of studies for direct content discussion. In addition, it serves as a basis for understanding the structural connections of knowledge, which will be systematically analyzed through keyword networks and bibliographic coupling later.

TABLE 1 TOP 10 JOURNALS PUBLISHED RESEARCH ARTICLES ON PHARMACIST WORKFORCE PLANNING DURING 1968 TO 2024

Rank	Source	Domain	Total citations	Number of publications	Scopus Quartile (2025)
1	American Journal of Health-System Pharmacy	Health Professions, Pharmacy	736	36	1
2	Human Resources for Health	Public Health, Environmental and Occupational Health	683	25	1
3	Research in Social and Administrative Pharmacy	Health Professions, Pharmacy	614	44	1
4	Journal of the American Pharmacists Association	Health Professions, Pharmacy	290	11	1
5	American Journal of Pharmaceutical Education	Health Professions, Pharmacy	158	12	1
6	American Journal of Hospital Pharmacy	Health Professions, Pharmacy	136	29	1
7	Australian Journal of Rural Health	Public Health, Environmental and Occupational Health	109	7	1
8	BMC Health Services Research	Medicine and Health Policy	92	11	1
9	International Journal of Pharmacy Practice	Health Professions, Pharmacy	84	15	1
10	Hospital Pharmacy	Health Professions, Pharmacy	32	23	1

CO-OCCURRENCE NETWORK ANALYSIS

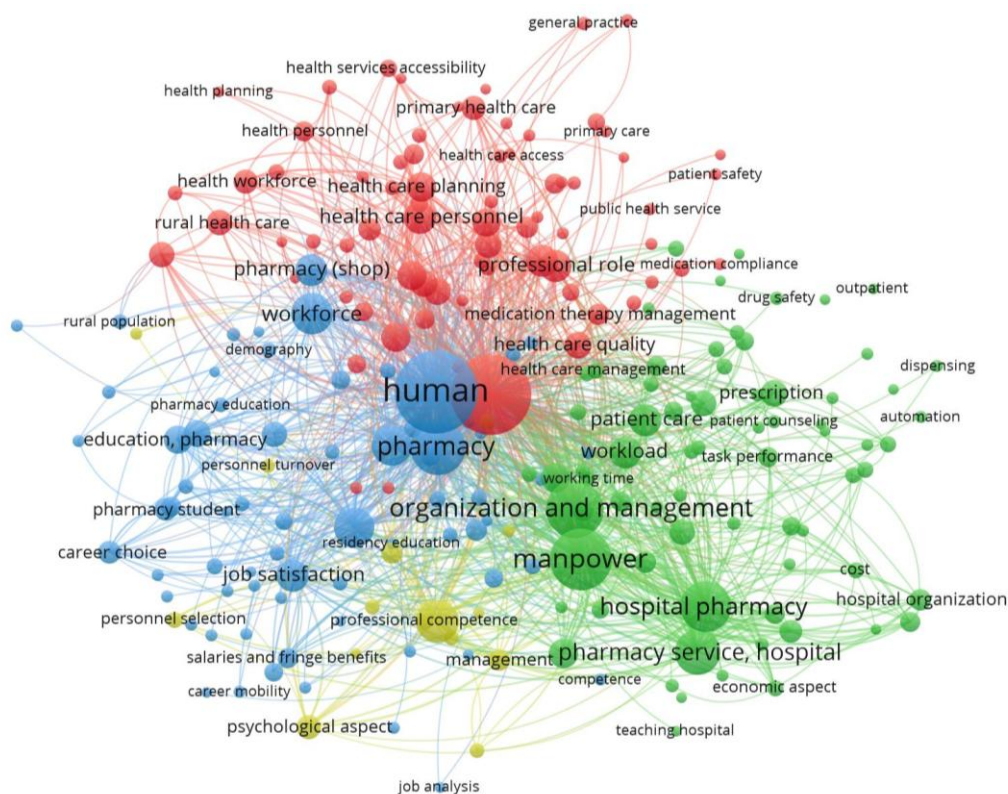
The analysis of keyword co-occurrence networks aims to understand the conceptual structure of knowledge in pharmacist workforce planning as well as to identify which concepts are emphasized in this field, how those concepts are interconnected, and what main themes can be grouped into. This analysis serves as a link between the structural overview of the documents and the network analysis of the articles.

The analysis was performed using author and indexed keywords from 364 selected articles, employing the VOS viewer program to create a co-occurrence network of keywords. A minimum threshold was set at 5 times to select only words with conceptual roles and reduce noise from words appearing only once or twice, which often reflect the specific context of individual articles rather than structural themes.

From the said process, 227 keywords that met the criteria were found and used to create the network, considering the frequency of co-occurrence between words. The size of the nodes in the network represents the frequency of keywords, while the thickness of the edges reflects the strength of the conceptual relationship between words. Keyword clustering was performed using the VOS viewer algorithm, which automatically groups words based on co-occurrence patterns, rather than pre-determining the groups by the researcher.

The co-occurrence network analysis, conducted using VOS Viewer with a threshold of 5 occurrences, examined 227 keywords related to pharmacist workforce planning. Keywords were grouped into four thematic clusters, with node size and line thickness indicating frequency and strength of co-citation links. As can be seen in the map presented in Figure 3. Prominent keywords included "human" (281), "pharmacist" (260), "manpower" (151), "pharmacy" (124), and "workforce" (71), reflecting the focus on workforce management. High-frequency terms such as "hospital pharmacy" (107), "healthcare personnel" (41), and "healthcare planning" (35) highlight the systematic attention required for workforce distribution, addressing the first research question on current workforce planning dynamics. The keywords are grouped into four clusters reflecting key themes in pharmacist workforce management.

FIGURE 3 CO-OCCURRING KEYWORD MAP FOR PHARMACIST WORKFORCE PLANNING (THRESHOLD 5 OCCURRENCES, 227 KEYWORDS)



The knowledge structure of studies on pharmacist workforce planning was divided into four main clusters, which are systemically interconnected but have distinctly different conceptual focuses. Cluster 1 (Red): Healthcare Workforce Planning was the largest cluster, with 72 keywords, focusing on workforce planning at the overall healthcare system level. Keywords, such as "Pharmacist" and "healthcare planning," reflected the study of the roles of pharmacists as a strategic resource in healthcare systems. Studies in this group often analyze workforce demands, personnel distribution, and alignment between supply and demand in the context of structural changes, such as an aging society, the burden of non-communicable diseases, and the expanding clinical roles of pharmacists.

Cluster 2 (Green): Pharmacist Service Operations, with the same number of 72 keywords, focused on the operational level of pharmaceutical service delivery. Keywords, such as "Workload" and "Scheduling" indicated studies on workload, workforce scheduling, and service efficiency. This cluster reflected efforts to link workforce planning with actual management in service units. Cluster 3 (Blue): Pharmacist Workforce Development had 68 keywords and focused on long-term workforce development, such as "Education" and "Job satisfaction," covering education, competencies, job satisfaction, and personnel retention. Finally, Cluster 4 (Yellow): Strategic Workforce Management, although having the fewest keywords of only 15, clearly reflected policy and strategic management dimensions through keywords like "Personnel management" and "Leadership," emphasizing systemic decision-making and organizational direction setting, and clearly linking pharmacist workforce planning to macro-level health strategies.

In summary, the analysis of keyword co-occurrence networks indicates that the body of knowledge in pharmacist workforce planning comprises multiple systematically interconnected themes, ranging from systematic workforce management, career development, clinical role expansion, to strategic planning. These conceptual groupings serve as the basis for the subsequent analysis of article networks via bibliographic coupling, revealing deeper research directions and structural connections within the body of knowledge.

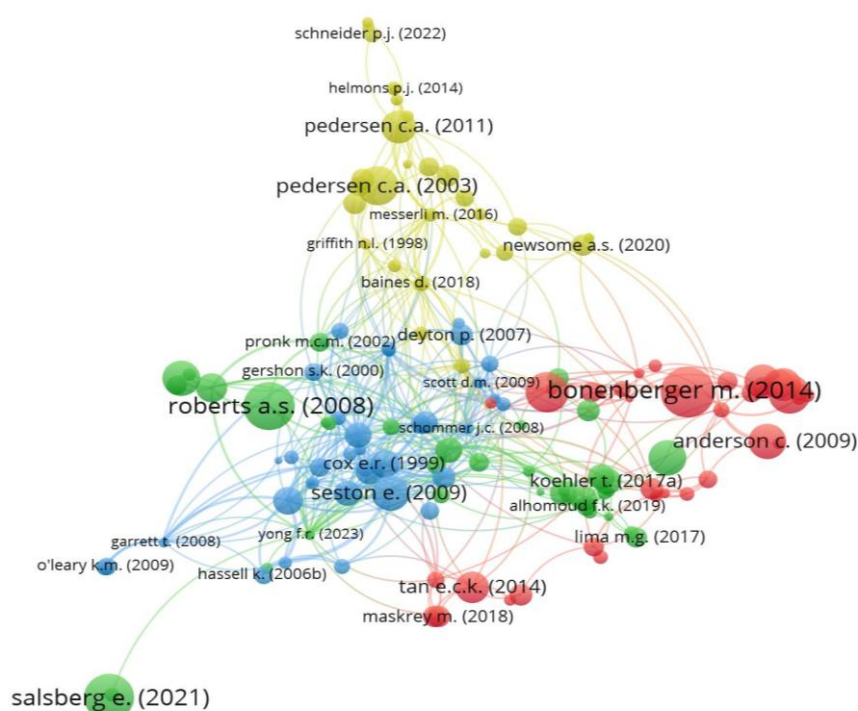
BIBLIOGRAPHIC COUPLING ANALYSIS

Bibliographic coupling analysis was employed to examine relationships between research articles on pharmacist workforce planning. Unlike keyword co-occurrence analysis, which reveals the conceptual structure of the research, bibliographic coupling analysis assessed article relationships based on shared references.

From a total of 364 selected articles, bibliographic coupling analysis was conducted using VOSviewer, applying a minimum threshold of five citations. This criterion resulted in 146 articles being included in the network analysis. Articles were linked based on shared references and clustered using VOSviewer without pre-defining the number of clusters.

The analysis identified four clusters of articles reflecting research trends in pharmacist workforce planning. Figure 4 illustrates the bibliographic coupling network and the relationships between these clusters. These findings, combined with the keyword co-occurrence results, provide empirical evidence for interpretation in the Discussion section.

FIGURE 4 BIBLIOGRAPHIC COUPLING IN PHARMACIST WORKFORCE PLANNING (THRESHOLD 5 CITATIONS, 146 DOCUMENTS)



DISCUSSION

PROFESSIONAL ROLE CONSIDERATIONS (CLUSTER 1; RED)

The first cluster of research reflects the expanding roles of pharmacists, shifting from supportive tasks to medication management, interdisciplinary collaboration, and direct patient care [13, 14]. This transition demonstrates that workforce demand depends on not only the number of pharmacists, but also the specific roles they are expected to fulfill. However, constraints regarding staffing levels, remuneration, and organizational structures may not align with this expanded scope of roles [15, 16]. Consequently, the overall evidence highlights the interconnections among workforce size, professional roles, job design, and team structure [17].

SKILLS AND SPECIALTIES (CLUSTER 2; GREEN)

The second cluster of research highlights imbalances in the pharmacist distribution based on personnel skills and specialties. The rising demand for specialized pharmacists may not align with existing workforce structures and job positions [18], suggesting that the total number of pharmacists alone does not accurately reflect workforce demand [19, 20]. Research concerning skills and specialties also reveals a mismatch between workforce development and health system requirements [21, 22]. These findings underscore the relationships among specialty-based demand, workload, and efficiency gaps in ongoing workforce assessment [23, 24].

WORKFORCE SUPPLY AND DEMAND ANALYSIS (CLUSTER 3; BLUE)

The third cluster of research demonstrates relationships among supply, demand, workload, and workforce sustainability. Workforce shortages may stem not only from the absolute number of personnel but also from shifting demands and the workforce supply adaptability [25]. Furthermore, workload, intentions to leave the job, and pull of the private sector influence workforce availability [26], highlighting the limitations of assessing the workforce solely based on headcount or static staffing ratios [27]. Additionally, evidence regarding workload, stress, turnover, and professional satisfaction illustrates the link between workforce behavior and long-term sustainability [28, 29].

WORKFORCE PLANNING TECHNOLOGIES (CLUSTER 4; YELLOW)

The fourth cluster of research suggests relationships among technologies, work system designs, and pharmacist's roles. Digital technologies, automation systems, and data analytics can transform workflows and job division between operational and clinical tasks [30]. However, the impact on the workforce is also linked to changes in work structures and professional roles [31]. Evidence regarding workload, work environments, and competency gaps further demonstrates that technologies are interconnected with skill mixes, role designs, and workforce development [32]. Thus, technologies represent another dimension linked to the framework of workforce planning.

RESEARCH CLUSTER SYNTHESIS

According to the four clusters of research, pharmacist workforce planning is not only a matter of personnel numbers, but it also is interconnected with professional roles, skills and specialties, supply and demand, workload, workforce sustainability, technologies, and work system design. The key issue emerging from this synthesis is not a lack of workforce planning elements in the literature, but rather that these elements have been examined from disparate perspectives and lack sufficient integration within workforce planning research, affecting the identification of future research gaps.

RESEARCH GAPS

From the synthesis of four clusters of research, three significant gaps were identified. The first gap concerns the time. While past research has examined workforce size, supply and demand, and workload, the linkage between these elements and long-term changes in workforce demand remains limited. Consequently, there is a lack of clear understanding regarding how the relationship between supply and demand might evolve over time.

The second issue relates to workforce skills, specialties, efficiency, and workload emerged as key factors in previous studies, they have not been fully integrated into supply and demand assessments. This gap implies that focusing solely on workforce numbers may fail to reflect the varying demands dictated by specific roles, expertise levels, and work contexts. The final issue concerns technologies. Existing literature demonstrates interconnections among technologies, professional roles, and work patterns, yet relationships between technological change and long-term workforce demand remain unclear, particularly regarding shifts in roles, skill mixes, and job structures.

Taken together, these three gaps reflect a common underlying issue: the integration of time, workforce specialties, and technologies into supply and demand assessments remains incomplete. Consequently, these gaps point toward directions for future research.

THEORETICAL AND MANAGERIAL IMPLICATIONS

This study indicates that assessing the pharmacist workforce involves more than simply determining the correct number of personnel. It is also linked to professional roles, skills and specialties, workloads, technologies, and work patterns. While these elements appear in the literature, they have not been fully integrated into workforce planning studies. Consequently, this study highlights dimensions requiring further research to develop a more comprehensive understanding of workforce demand.

For recruiters and decisionmakers, this study is useful for broadening the interpretation of workforce issues, moving beyond mere position counts to the specific nature of workforce demand. It demonstrates that workforce challenges may stem from staffing levels, the alignment of skills and specialties, workloads, or shifts in roles and work systems driven by technologies. These dimensions can serve as key factors when assessing the workforce situation and identifying information gaps prior to developing specific interventions.

However, as this study focuses on analyzing and synthesizing the structure of existing literature rather than evaluating the effectiveness of specific recruitment methods, workforce management measures, or specific policies, it cannot determine

which approaches are the most effective. Therefore, formulating specific practical and policy recommendations requires additional empirical evidence, particularly studies that address gaps regarding timeframes, workforce specialties, and technologies.

CONCLUSIONS

This study focuses on analyzing research regarding pharmacist workforce planning; therefore, the findings indicate that workforce assessment requires an understanding of the relationships among workforce numbers, capabilities, and changes in work systems to better reflect workforce requirements. A key contribution is the synthesis of knowledge into an interconnected structure, providing a clearer and more comprehensive perspective on workforce planning. This pattern can support decisionmakers in assessing multiple dimensions of workforce requirements and can also serve as a starting structure for workforce planning in other healthcare professions, with appropriate adaptation to the specific characteristics of each profession.

Table 2 was developed from an analysis of structural gaps in knowledge within each cluster, considering issues that are not fully explained in the current literature or are repeatedly identified as limitations in highly correlated articles. Therefore, the global trend for future research direction is the result of a systematic synthesis of the literature across the entire field. However, these research directions require further empirical investigation before specific practical or policy implications can be established. Future studies may also engage relevant decisionmakers to assess the practical relevance and applicability of the resulting evidence to pharmacist workforce planning.

In addition, future research should investigate whether interrelationships among staffing levels, professional roles, specialties, workloads, technologies, and work patterns, as identified in research on pharmacists, also appear in workforce studies concerning other health professions. Such comparative studies may help assess the extent to which this analytical approach is transferable to the contexts of other professions and identify which aspects require adaptation to the specific characteristics of each profession.

TABLE 2 GLOBAL TREND FOR FUTURE RESEARCH DIRECTION

Clusters	Future lines of research
Cluster 1: Pharmacist workforce integration	• Study the impact of increased clinical pharmacist coverage on service quality and patient safety in hospitals. • Study the pharmacist integration in multidisciplinary teams on continuity of care and quality of medication use. • Analyze workforce limitations hindering the expansion of clinical pharmacy services. • Evaluate integrative roles of pharmacists in healthcare system and policy values.
Cluster 2: Workforce capability deployment	• Develop a capability-based workforce planning model to replace headcount planning. • Study the link between competency gaps, patient safety, and workload. • Analyze the allocation of pharmacists based on skill levels in middle-income countries. • Study the use of a competency framework to predict long-term workforce demands.

Clusters	Future lines of research
Cluster 3: Workforce sustainability	• Develop a demand–supply model using workload pressure to assess workforce sustainability. • Analyze the workload of accredited pharmacists on their ability to provide long-term services. • Assess workforce adequacy relative to the population-level polypharmacy burden. • Analyze effects of staffing constraints on continuity of hospital pharmacy services.
Cluster 4: Workforce system design	• Evaluate effects of automated dispensing systems on skill mixes and FTE requirements of pharmacists. • Study workflow design in conjunction with technology to increase productivity without increasing workforce. • Analyze effects of advanced dispensing technologies on system efficiency and workforce allocation. • Evaluate effects of formulary-driven system redesign on workload and workforce costs.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

DISCLOSURE OF INTEREST

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

No new data were generated or analyzed in this study. All information used in this research was obtained from publicly available sources.

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