Global research trends and hotspots in pharmaceutical care: a bibliometric analysis and visualisation using CiteSpace and VOSviewer

Yani Zhang, Jie Yao, Wanni Li, Hua Wang

ABSTRACT
Objective Pharmaceutical care is closely related to the outcome and prognosis of disease treatment. This study analyses the research status, hotspots, frontiers and development trends of pharmaceutical care from the perspective of bibliometrics.

Methods Related literature on pharmaceutical care published in the Web of Science Core Collection database was collected and knowledge maps were drawn by science information visualisation software Citespace 6.1.R3 and VOSviewer 1.6.17.0.

Results A total of 3289 institutions from 105 countries/regions published 2906 papers in 669 academic journals, which were cited 50027 times. The top three countries/regions by the number of publications are the USA, UK and Brazil. The top three institutions are Utrecht University and the University of Groningen in the Netherlands, and University College London in the UK. The top three journals are American Journal of Pharmaceutical Education, International Journal of Clinical Pharmacy and American Journal of Health-System Pharmacy. The top three authors are Hersberger KE, Bouvy ML and Hughes CM. The most co-cited is Hepler CD, and the most co-cited influential is Strand LM. COVID-19 pandemic, chronic obstructive pulmonary disease and pharmacy practice are the most cutting edge topics in the field of research in pharmaceutical care. Pharmaceutical service and clinical pharmacy are research hotspots in pharmaceutical care.

Conclusion In the past 10 years, papers in the field of pharmaceutical care have shown a significant growth trend and scholars have become increasingly interested in research on related content in the field of pharmaceutical care. Our research results are of great significance for improving the connotation construction of pharmaceutical care and improving patient satisfaction and prognosis, and can also be used as an important reference for relevant scholars to select scientific research topics for subsequent research. The objective basis for relevant government departments is to modify and formulate health policies or measures.

INTRODUCTION
Hepler and Strand pointed out that pharmaceutical care refers to pharmaceutical knowledge and information services provided by pharmaceutical professionals to the public through professional pharmaceutical tools, including drug selection and use, in order to detect and resolve the drug use problems that have occurred or prevent potential problems. In economically developed countries such as the UK and the USA, pharmacists are accepted members of the clinical multidisciplinary team as the medicines experts and can even become prescribers. However, pharmacists in economically underdeveloped countries such as China and Japan prepare medicines completely under doctors’ prescriptions, and clinicians seldom pay attention to pharmacists’ suggestions for prescription modifications. The distribution of pharmacists’ clinical departments and the absence of the role of clinicians lead to relatively few pharmacists participating in drug education activities. In daily diagnosis and treatment, it is difficult for most inpatients and outpatients to get pharmaceutical service from professional pharmacists, which results in patients repeating or seriously abusing drugs, and even mutual antagonism of drug efficacy and many adverse events.

In recent years, in order to reduce the incidence of adverse drug reactions and to improve the diagnosis and satisfaction of patients, the patient-centred
pharmaceutical care model has gradually replaced the drug-centred product service model—for example, a seamless collaboration between general practitioners and community pharmacists during oral antineoplastic drug therapy.7 Also, the multidisciplinary remote pharmaceutical care software trialled for patients with congenital coagulopathy significantly improved the compliance of patients with drug treatment and also won unanimous praise from people from all walks of life.8 In addition, the evaluation tool for drug-related consultation developed by Middleton et al9 provides a basic guarantee for realisation of the concept of high-quality people-oriented pharmaceutical care. The application of wearable medical devices based on mobile devices is becoming more and more common, and provides a new paradigm for medical personnel to accurately observe and evaluate the condition. It significantly improves the comfort and accuracy of patient treatment, and also improves patient treatment adherence and satisfaction.10–12 Thus, pharmacists are important members of the medical team, and the pharmaceutical care content is closely related to disease outcome and prognosis. It is believed that pharmacists should first evaluate the condition objectively and fairly, and propose scientific and accurate pharmaceutical service plans. Second, during the treatment of patients, it is also recommended that a variety of evaluation tools should be used to observe and evaluate the treatment situation in a timely and accurate manner, aiming at early detection and treatment of drug-related adverse reactions and improvement of treatment outcomes, improved patient satisfaction and treatment compliance to carry out pharmaceutical care in an orderly manner.

Increasing healthcare challenges, such as prolonging life expectancy and increasing drug use for complex diseases, have placed higher demands on health workforce development policies, and it is urgent to explore transformative policies for globally applicable pharmaceutical care. To the best of our knowledge, no intuitive analysis of literature in the field of pharmaceutical service has been conducted to date. In order to further understand the development status of global pharmaceutical service research, grasp the research hotspots and cutting-edge content of this discipline, this analysis is needed to provide objective basis for relevant departments to formulate and improve health policies and policies, and provide quantitative reference for relevant scholars’ research. The follow-up research is based on the original research and review related to Chinese pharmacy service in the Web of Science core collection (WoS), and uses CiteSpace 6.1.R3 and VOSviewer 1.6.17.0 to draw the relevant publications of the scientific knowledge map of pharmacy service to determine its research status, hotspots and development trends.

METHODS

Data sources and search strategies

The data used in this study were collected from the Citation Index of the Web of Science Core Collection database using an advanced search strategy on 20 September 2022. The search words used were: “pharmaceutical care” OR “medication education” OR “medication service” OR “drug service” OR “Pharmaceutical service”. Refining strategy: (1) literature type: Article; (2) time span: Founded until 21 September 2022; (3) Language: English; (4) Remaining is the default of the system. All the 2998 papers retrieved were preliminarily included. Subsequently, two researchers read the title, abstract, keywords and author information of the paper independently to eliminate papers that were not related to pharmaceutical care or missing author information. If there were disagreements, other group members were invited to discuss them. Finally, the papers that met the inclusion criteria were marked and exported as “Full Records and References” in plain text format. As the data were retrieved from the public open access database, ethical permission was not required.

Data analysis and visualisation

The two visualisation tools CiteSpace 6.1. R3 and VOSviewer 1.6.17.0 were used to draw knowledge maps. CiteSpace 6.1. R3 (64-bit) was used to generate knowledge maps of countries and references and node burst detection, and VOSviewer 1.6.17.0 was used to draw knowledge maps of institutions, authors, journals and keywords. Excel 2019 was used to analyse the time distribution and citation trend of publications. By analysing the growth of annual publications, the rising trend of citations and the keyword sets that appeared at the same time, we captured keywords with strong citation outbreaks over time and identified research frontiers and emerging trends in this field.13 14

Result determination method

In the relevant scientific knowledge graph obtained, the co-authorship frequency, co-citation frequency and co-present frequency are proportional to the nodes, and the node centrality with purple outer circles is greater than or equal to 0.1, which has a key ‘bridge’ role in scientific research cooperation. The connection between each node is also proportional to the link strength between addition, the colours of nodes in the same cluster are consistent, and the evolution process from cool to warm colours represents the development path of research content from far to near in time. Modularity (Q) and silhouette (S) were used to assess the quality of clustering clusters. When Q is greater than 0.3, it indicates that clustering is significant. When S is greater than 0.5, it indicates that the clustering is reasonable. Clustering is convincing when S is greater than 0.7. Burst detection is used to detect current and future research hotspots. When a time period in a burst detection is red, it means that the element is experiencing a reference burst during that time period, which may indicate an underlying trend in the field. The parameter settings of CiteSpace are shown in the upper left corner of the picture.13 15 16

RESULTS

Annual publications and growth forecast

The selected 2906 pharmaceutical service-related publications were cited 50,027 times, with an H-index of 83. These publications are published in 669 journals, and the details of the top three periodicals in the number of publications are American Journal of Pharmaceutical Education, International Journal of Clinical Pharmacy and American Journal of Health-System Pharmacy. The top three journals with highest co-citations are Annals of Pharmacotherapy, American Journal of Health-System Pharmacy and American Journal of Hospital Pharmacy. Their publishing time and citation frequency changes are shown in figure 1A. Although there were some small fluctuations during the period, they generally showed an upward trend (figure 1B and figure 1C). Therefore, we believe that the development foundation of the pharmaceutical care research field is sound, it is still the main topic of concern at present, and there are good future expectations.

Distribution of countries/regions

Figure 2 shows that pharmaceutical care-related publications come from 105 countries/regions, and the top three countries/regions in terms of productivity are the USA, UK and Brazil.
The three most centrality countries/regions were UK’s Northern Ireland, Denmark and Australia. In addition, Qatar, Belgium, Ireland and other countries/regions with fewer publications and a later start of research had higher co-citation frequencies of their publications, suggesting that these countries have a significant influence in the field of pharmaceutical services.

Distribution of institutions
Figure 3 shows that a total of 3289 institutions have published articles in the pharmaceutical care field. The top three institutions for productivity are the University of Groningen, Utrecht University and University College London (UCL). The top three institutions in terms of impact are Utrecht University, University of Michigan and Erasmus MC. Burst detection showed that publications from Saint University Malaysia, Private University of Applied Sciences, Jordan University of Science and Technology, Poznan University of Medicine and UCL were frequently cited in recent years.

Analysis of authors and co-authors
Figure 4A shows the co-occurrence map of authors, and these publications have a total of 11285 named authors. The top three authors by the number of publications are Hersberger KE, Bouvy ML and Hughes CM. The top three authors of centrality publications are Strand LM, Gisev N and Mehralian G. Figure 4B shows the co-citation relationship map of authors. The top three authors in terms of co-citation frequency are Hepler CD, WHO and Strand LM, and they have high academic influence in the field of drug service research.

Analysis of references
The highly cited literature reflects the basic situation of the research field. In this group of pharmaceutical care-related publications, among the top 10 publications by total citations, four studies from China are included, all of which were COVID-19-related. There are a total of 61670 references cited in these publications, and 163 references were considered important documents and knowledge bases in the field of pharmaceutical services (total cited frequency ≥20 times). The composition relationship of co-cited references of papers related to pharmaceutical care is shown in figure 5A. Among them, the most frequently cited references are the papers by Hepler et al.17–19 Their research mainly involves the definition of pharmaceutical care and its responsibilities, pointing out the important role of community pharmacists in the management of chronic diseases such as diabetes. The most influential co-cited references are those by Vivian et al.20–23 Their study involved the economic benefits of pharmacy services and important evidence of improved disease outcomes, pointing out that pharmaceutical care is important for the management of chronic diseases such as hypertension. They formed 14 clusters (figure 5B), and their evolution process from warm
colour (#0) to cool colour (#16) represents the evolution path of the research frontier content in this discipline from near to far in time (the smaller the cluster number, the newer the research content it represents). Figure 5C shows the papers that attracted the greatest attention of scientists in different time periods (the larger the burst value, the higher the degree of attention). In summary, we believe that the most cutting-edge research content in the field of pharmaceutical care is “COVID-19 pandemic (#0)”, “chronic obstructive pulmonary disease (#1)” and “pharmacy practice (#2)”

Analysis of keywords
As a summary of research topics, keyword analysis can reflect the frontiers of the research field and point out future directions. Among the 49,870 keywords, we extracted 665 core keywords whose co-occurrence frequency was ≥27 times, to draw a co-occurrence keyword knowledge map due to space limitations and brevity considerations. According to the above criteria, VOSviewer identified 399 keywords, generating two clusters (figure 6A). The top 10 co-occurrence keywords are pharmaceutical care, community pharmacy, management, intervention, service, adherence and community pharmacist. In addition, it can be concluded that most of the keywords were published in 2014 and are greener or yellower in appearance (figure 6B). The co-occurrence frequency of keywords in the yellow area in the density map was significantly higher than that in the green area (figure 6C).

Figure 6D shows that the earliest research contents started in 1991 were “pharmacists-hospital”, “pharmaceutical service”, “health”, “ambulatory care” and “quality of life”, which have attracted attention in the pharmaceutical care field for more than 20 years. It also suggests that pharmaceutical service and clinical pharmacy are the most cutting-edge research topics in this field. For example, during the COVID-19 pandemic, many countries allowed the use of generic or treatment alternative medicines and implemented virtual medical consultations.
and electronic prescriptions. Hospital pharmacists have taken advantage of cross-departmental and multidisciplinary collaboration to educate and manage the disease status of patients, use remote medication procedures to monitor and guide patients' medication, and conduct cognitive screening for elderly patients with metabolic diseases to eliminate hidden dangers of medication. Different levels of graded pharmaceutical care measures are implemented at different stages of the disease, which can identify and intervene in drug-related problems in a timely manner in the treatment of COPD and other diseases. In addition, it enables correct understanding of the connotation of pharmacy services, forming good values, encouraging innovative strategies such as personalised pharmaceutical care to improve patient satisfaction and improve prognosis.

**DISCUSSION**

**Research hotspots of pharmaceutical care**

Previous research hotspots can be summarised into three areas.

Pharmacy services are subject to the degree of hospital and community clinic environment construction

Pharmacy services need to be delivered in hospital or in community clinics, and there may be context-related pharmacy issues. Although hospital pharmacists' sense of mission as a 'gatekeeper' helps them urge consultant pharmacists to improve the appropriateness of drug prescriptions and save money, the private nature of pharmacies makes community pharmacists focus on 'products'. The implementation of tele-ICU pharmacy services in hospital systems can
minimise healthcare costs and provide simultaneous medication delivery. The availability of PCs in hospital pharmacies can help compensate for lack of guidance and training of professionals, as well as providing rapid and comprehensive access to patient medical record information.

Pharmacy services are related to the quality and cost of hospital and community services

In addition to the software and hardware facilities of the medical environment affecting the development of medical services, the construction of the connotation of pharmaceutical services is also related to the quality and cost of medical services. For example, multidisciplinary care and pharmaceutical care are key elements in improving outcomes for cancer patients and avoiding healthcare costs. The pharmaceutical service “Refer the Patient” makes it possible to detect a disease at an early stage and reduce hospital costs and length of stay.

New developments in pharmaceutical care interventions

Interventions synergistically affect the quality and cost of pharmacy care with context, cognition and skills. Torres-Robles et al. found that, after 6 months of drug compliance management for patients with hypertension, asthma and COPD, the drug compliance was good and the clinical outcome was judged to be effective. Telephone follow-up by clinical pharmacists can improve treatment outcomes in patients with peptic ulcers. A pharmacist-based diabetes intervention model can effectively improve patients’ diabetes knowledge, self-care habits, medication compliance and blood sugar control.

Research frontier and development trends of pharmaceutical care

Research topic #0 is the COVID-19 pandemic, which is a hot topic at present and will continue to be in the future. A recent study concludes that the COVID-19 pandemic may affect the ability of medical staff to provide safe and effective care. Pharmacies have used telemedicine to transform patient care and played an important role under the enforced blockade and social distancing norms. Telemedicine can also provide better care services for patients in remote areas to effectively prevent and treat different infectious diseases.

Research topic #1 is COPD, which is second only to the #0 cluster theme. Latest research by the Turkish Pharmacists Association shows that community pharmacists trained in pharmacy services, asthma, COPD, diabetes and hypertension can improve the health status of patients through the provision of pharmaceutical care, which provides direction for continuing education of pharmacists. Other studies have found that patients with moderate to severe COPD who do not adhere to treatment have a higher mortality rate, pointing out that such patients should strengthen monitoring and optimise drug treatment adherence strategies. In summary, community pharmacist-led intervention is effective in improving medication compliance and clinical efficacy in patients with hypertension, asthma and COPD.
Research topic #2 is pharmacy practice. Managers guide pharmacists to adapt to the new pharmaceutical care practice mode and serve patients better.32

Research topic #3 is general hospital. Engagement of hospital and community pharmacists will help achieve seamless pharmaceutical care between primary and secondary care settings.47 Pharmaceutical care interventions provided by pharmacists can solve 90% of pharmacy-related problems.48 The participation of clinical pharmacists in the hospital drug policy of rural hospitals can optimise drug investment and save a lot of medical costs for the medical system.49

It can also be seen from figures 5 and 6 that the popularity of the research topic clustering 4–16 is gradually decreasing, as is also the development process of the research topic from near to far over time—for example, a patient satisfaction questionnaire for outpatient pharmacy based on the assessment of feasibility and sustainability of pharmaceutical care provided (#4 ambulatory care pharmacy service),50 formulating pharmaceutical care measures to solve problems related to drug treatment of inpatients in internal medicine (#5 drug-related morbidity),51 pharmaceutical care intervention is crucial to establish a good medical relationship, and affects the treatment and care outcomes of the elderly.52 However, there may be future research hotspots which also require further exploration by pharmacists with rich professional knowledge and clinical experience.

Strengths and limitations
This study conducted a bibliometric analysis of the hotspots and development of international pharmaceutical care research and presents the current research status of pharmaceutical care to readers objectively, truthfully and directly, avoiding the limitations of previous literature reviews and has high reference value. The shortcoming of this study is that the Chinese literature has not been analysed, which will also be the focus of our future research.

CONCLUSION
In the past 10 years, papers in the field of pharmaceutical care have shown a significant growth trend and scholars have become increasingly more interested in research in related content in the field of pharmaceutical care. The COVID-19 pandemic, COPD and pharmacy practice are cutting edge research topics, while service and clinical pharmacy are current research hotspots. Pharmaceutical care is a gradual and continuous improvement process. Pharmacists are an important part of the medical team and need to participate in the whole process of pharmaceutical care at home, in the community and in hospital. While doctors and nurses have relatively more contact with patients, pharmacists should further optimise their knowledge structure and service and assist doctors in early prevention, early diagnosis and early treatment. Our research results are of great significance for improving the connotation construction of pharmaceutical care and improving patient satisfaction and...
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prognosis, and can also be used as an important reference for relevant scholars to select scientific research topics in subsequent research. The objective is for relevant government departments to modify and formulate health policies or measures.

Contributors Yani Zhang, Jie Yao and Hua Wang contributed to the conception and design of the study and revised the manuscript. Hua Wang and Wanniu Li collected and analyzed the data. Yani Zhang and Jie Yao wrote the paper.

Funding This work was supported by the key research and development program Project of Shaanxi Province (Research Project Number: 2019SF-150); 15

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository.

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ORCID ID Yani Zhang http://orcid.org/0000-0002-1004-3421

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