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Review Article

Research trends in telemedicine for chronic diseases: A bibliometric study

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Abstract: **Objective:** The aim of this bibliometric study review is to analyze the current research status, hotspots, and trends in telemedicine in the management of chronic diseases using VOSviewer and CiteSpace. **Methods:** Relevant publications were retrieved from the Web of Science Core Collection and Scopus databases up to the year 2023. The search strategy was based on keywords such as "telemedicine", "chronic disease" and "management" as well as their synonyms and related terms. Boolean operators were applied to combine these terms appropriately. The literature was manually screened. CiteSpace and VOSviewer were used for visual analysis. The knowledge map was created from multiple dimensions, including publication trends, author collaboration, country distribution, keyword co-occurrence, clustering and burst analysis. **Results:** A total of 1,747 articles were included. The annual number of publications showed an upward trend, peaking in 2021 with 210 articles. The United States, China, and Italy were the leading countries in publication volume, with the United States contributing the most (37.71%). The most prolific authors were Zanaboni P., and Koehler F., who published nine papers each. Collaboration among authors appeared to be relatively independent. The clustering of keywords revealed three main themes: diseases, management pathways, and clinical applications. The co-occurrence analysis showed that the main focuses were "chronic disease identification", "disease management pathways", and "clinical application of telemedicine". Technology-related keywords such as "mobile applications", "telemedicine", and "digital health" occurred frequently. The burst analysis indicated that "coronavirus disease 2019" and "digital health" have emerged as current research hotspots. **Conclusion:** Research on telemedicine in chronic disease management is growing rapidly. The focus has shifted from traditional healthcare services to intelligent technologies and personalized care. Technologies such as mobile health, digital interventions, and remote monitoring are expected to play key roles in self-management, long-term monitoring, and improving accessibility to healthcare. Future research should emphasize interdisciplinary integration and patient adherence to promote practical applications across the full chronic disease lifecycle.

Keywords: Telemedicine; Chronic disease; Disease management; Digital health; Remote monitoring

Received: Jun.28, 2025; Revised: Aug.6, 2025; Accepted: Aug.13, 2025, Published: Aug.20, 2025

DOI: https://doi.org/10.55976/jdh.42025141560-69

1. Introduction

In the context of China's rapidly aging population, the burden of chronic non-communicable diseases (NCDs) continues to rise, posing a significant challenge to public health and healthcare systems. These diseases mainly include cardiovascular diseases, diabetes, cancer, and chronic obstructive pulmonary disease (COPD) [1]. Chronic diseases are characterized by a slow onset, a long duration, and a complex etiology. They are often not caused by infectious agents and tend to persist over a long period of time [2]. According to the Fifth National Health Service Survey Report, chronic diseases have gradually replaced acute infectious diseases and their prevalence is increasing rapidly. In urban areas, the rate of chronic diseases increased by 8.5% [3]. Data from the Seventh National Population Census shows that there are about 191 million people aged 65 and older in China, accounting for 13.5% of the total population [4]. Among them, about 76.3% suffer from at least one chronic disease [5]. Research indicates that chronic diseases account for 86.6% of all deaths and 70% of the total disease burden in China [6,7]. This poses a major health and economic challenge. Chronic diseases are characterized by several features: long duration, low control rates, high rates of disability and death, and large population impact. These diseases require long-term management and place pressure on healthcare systems, social services, and families [8]. There is an urgent need to establish an integrated chronic disease management system based on early detection, early intervention, and continuous care. The rapid development of internet-based technologies has opened up new paths for healthcare services. In 2018, the policy "Opinions on Promoting the Development of 'Internet Plus Healthcare'", and in 2019, "Pilot Plan for 'Internet Plus Nursing Services'" were released. These policies signal the deep integration of internet technology into healthcare delivery [9]. Telemedicine as a core element of the "Internet Plus Healthcare" model is now widely used for the prevention, monitoring, diagnosis, and rehabilitation of chronic diseases. It overcomes barriers of time and space, improves access to medical services, and enhances patients' awareness of self-management. It is becoming a key tool to ensure continuity and stability in chronic disease treatment. However, telemedicine is still an evolving concept. As technology advances, its definition and scope are also expanding. Traditional literature reviews often focus on specific diseases or topics and are based on subjective summaries. This study uses CiteSpace and VOSviewer to conduct a visual bibliometric analysis. Publications related to telemedicine in chronic disease management were retrieved from the Web of Science Core Collection and Scopus databases.

This study aims to generate a visual knowledge map and present the research landscape in this field. It provides a multi-dimensional and multi-layered analysis of current trends, research hotspots, and frontier directions. The findings may offer useful references for future research and practice in China.

2. Materials and methods

Based on the recommendations by Öztürk et al. [10], we selected only the Web of Science Core Collection and Scopus databases for data retrieval to minimize duplication and to avoid the technical inconsistencies of integrating article data from multiple databases with different formats and metadata structures. Scopus offers extensive journal coverage, while Web of Science includes more selectively curated journals, providing complementary strengths for bibliometric analysis [11]. Taking the Web of Science Core Collection as an example, the search strategy was as follows: ((((((((((((TS = "telemedicine") OR TS = "telehealth") OR TS = "remote consultation") OR TS = "remote diagnosis") OR TS = "remote clinic") OR TS = "remote surgery") OR TS = "remote rehabilitation") OR TS = "remote nursing") OR TS = "remote health care") OR TS = "Internet medical services") OR TS = "Internet hospital") OR TS = "Digital health") OR TS = "Mobile health") OR TS = "mhealth") AND (TS = "Chronic Disease") OR TS = "Noncommunicable Diseases") AND TS = "Disease Management". The time range was from database inception to December 2023. Conference abstracts, non-English articles, and studies not related to the themes of 'telemedicine', 'chronic disease', or 'disease management' were excluded. A total of 1,747 articles were finally included in the analysis. To ensure the quality of the selection process, two researchers independently screened the literature based on predefined inclusion and exclusion criteria. Any discrepancies or disagreements were resolved through discussion with a third researcher. The specific screening process is shown in Figure 1.

This study using bibliometric visualization software CiteSpace 6.2. R6 and VOSviewer (version 1.6.19). CiteSpace and VOSviewer are Java-based bibliometric and data visualization tools, which are widely used in information science. They generate visual network maps that reveal the dynamics and structure of scientific research. Visualization nodes include publication volume, countries, authors, and keywords. The similarity of keywords was analyzed to create a macro-level visual map of telemedicine applications in chronic disease management. This map helped to identify research hotspots and development trends.

2. Results

2.1 Publication trends

Research on the application of telemedicine in chronic disease management has shown a steady increase in

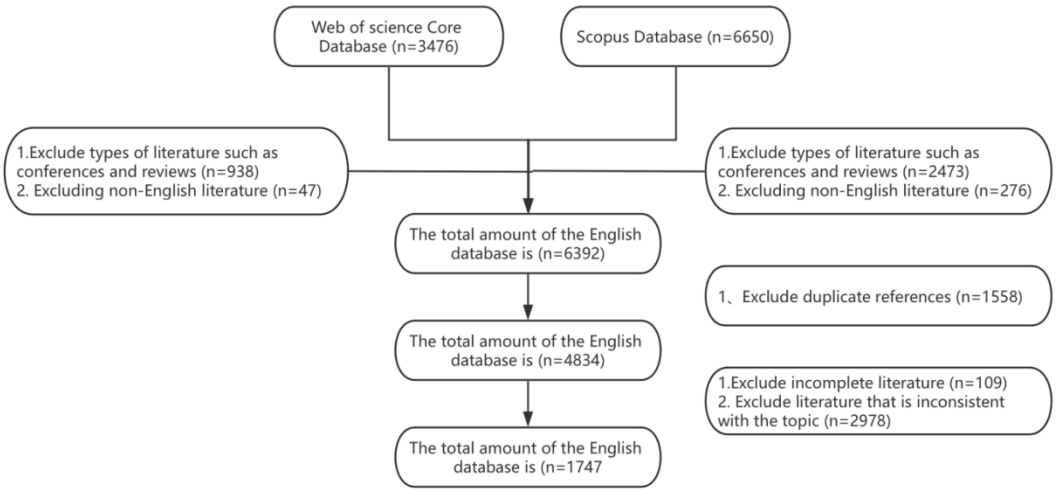

Figure 1. Flowchart of literature screening

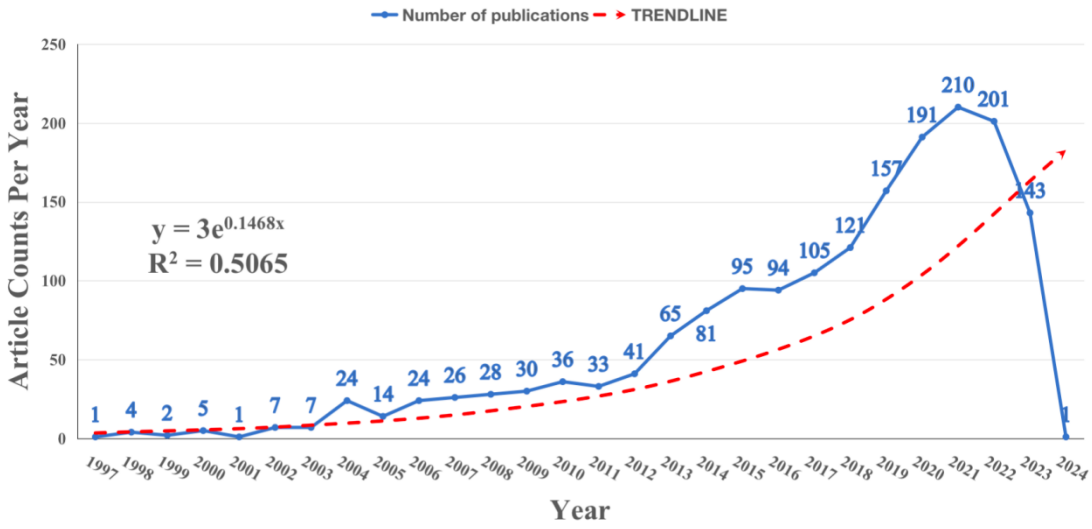

Figure 2. Annual publication trend in the field of telemedicine and chronic disease management (Database inception to 2023)

publication volume over time (Figure 2). After 2004, the number of annual publications began to grow. From 2004 to 2012, the average number of annual publications was 24.2. Between 2013 and 2021, this number increased to an average of 124.3 articles per year. In 2022, 201 articles were published. Although this is slightly less than the 210 articles in 2021, the overall trend remains upward. Since the retrieval deadline was set to December 2023, the total number of publications for that year could not be determined.

2.2 Author distribution

Using VOSviewer, author co-occurrence analysis was conducted with the minimum number of publications set to one. A total of 8,851 authors were identified from the 1,747 articles (Figure 3). The results show that the most prolific authors were Zanaboni P. and Koehler F., each publishing nine articles. Other prolific authors included Wootton R., Winkler S., Koehler K., Rogers A., and Vargiu E., each publishing more than five articles, with published articles of 8, 7, 6, 6, and 5 respectively (Table 1). In terms of author influence, Price's Law was used to identify core contributors. According to the formula $N = 0.749 \times \sqrt{M}$ (where M is the maximum number of publications), authors with at least one publication were considered core authors in this field [12].

2.3 Country distribution

The analysis at country-level helps to identify leading nations and potential research collaborators. It also supports the development of national research strategies and policy planning. In this study, a total of 84 countries

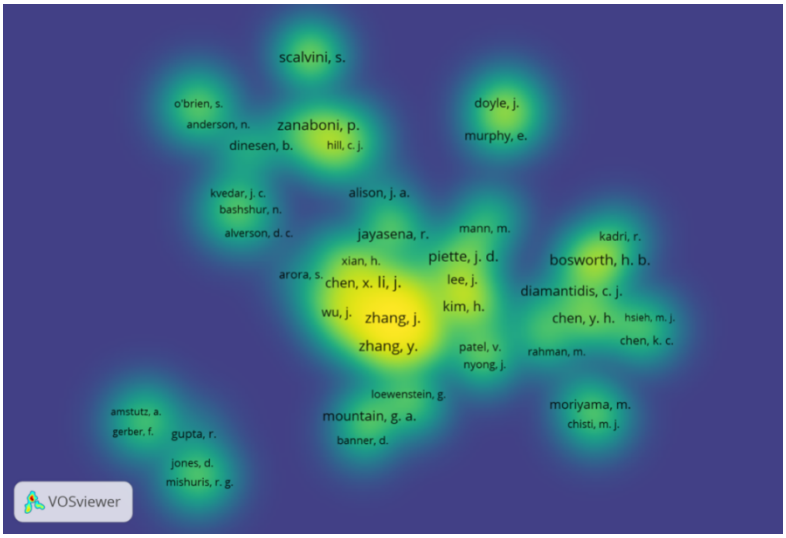

Figure 3. Author co-occurrence network in the field of telemedicine and chronic disease management

Table 1. Top 15 authors in the field of telecare for chronic disease management

Rank	Author	Publication (n=1747)	Strength
1	zanaboni, p.	9	64
2	wootton,r.	8	57
3	koehler, f.	9	56
4	rogers, a.	7	55
5	vargiu, e.	6	53
6	bravo, m. o.	5	53
7	de batlle, j.	5	53
8	fuentes, a.	5	53
9	massip,m.	5	53
10	miralles, f.	5	53
11	nadal, n.	5	53
12	torres, g.	5	53
13	holland, a. e.	4	52
14	winkler, s.	8	52
15	koehler, k.	8	51

Table 2. Top 15 Countries in the field of telecare for chronic disease management

Rank	County	Frequency (n=1747)	Country Income
1	The United States	554 (37.71%)	High income
2	China	192 (10.99%)	Upper-middle income
3	Italy	115 (6.58%)	High income
4	The United Kingdom	105 (6.01%)	High income
5	Australia	104 (5.95%)	High income
6	Canada	92 (5.27%)	High income
7	Spain	61 (3.49%)	High income
8	Germany	53 (3.03%)	High income
9	Greece	42 (2.40%)	High income
10	South Korea	40 (2.29%)	High income
10	Netherlands	40 (2.291%)	High income
12	Scotland	34 (1.95%)	High income
13	Denmark	28 (1.60%)	High income
14	France	25 (1.43%)	High income
15	India	22 (1.26%)	Lower-middle income

contributed to research on the application of telecare in chronic disease management. As shown in Table 2, the United States had the most number of publications (n = 554, 37.71%), followed by China (n = 192, 10.99%) and Italy (n = 115, 6.58%).

2.4 Keyword co-occurrence analysis

A keyword co-occurrence analysis was conducted to explore research topics related to the application of telecare for chronic disease management. The results are shown in Table 3 and Figure 4. A total of 278 keyword nodes and 1,216 co-occurrence links were identified. The most frequent keywords were health care (n = 523), chronic disease (n = 425), mobile applications (n = 405), remote monitoring (n = 373), and disease management (n = 360). Keywords with high centrality included digital health (centrality = 0.12), health care (centrality = 0.09), and cardiovascular disease (centrality = 0.09), indicating their pivotal role in the network.

2.5 Keyword clustering

In this study, the Log-Likelihood Ratio (LLR) algorithm was used to perform keyword clustering in the field of telemedicine for chronic disease management. The analysis was set to display the top seven clusters. The results are shown in Table 4. The top seven keyword clusters identified in this field were: #0 chronic disease, #1 disease management, #2 mobile application, #3 health care, #4 virtual reality, #5 telemedicine, and #6 digital health.

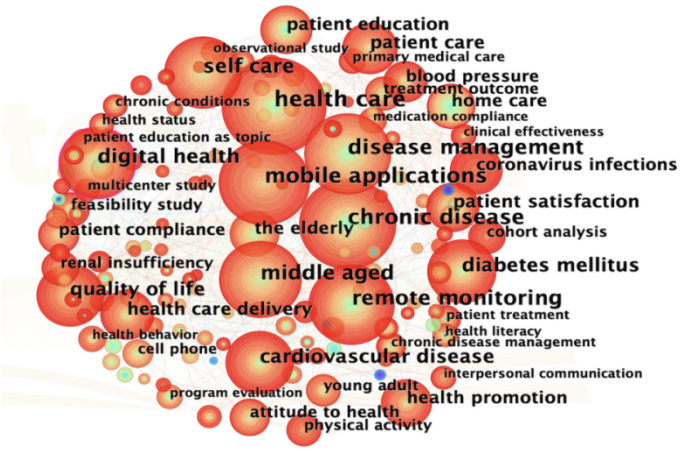

Figure 4. Keyword co-occurrence network in telemedicine research for chronic disease management (Database inception to 2023)

Table 3. Top 15 Keywords in the field of telecare for chronic disease management

Rank	Keywords	Frequency (n%)	Centrality
1	Health Care	523 (29.94%)	0.09
2	Chronic Disease	425 (24.33%)	0.06
3	Mobile Applications	405 (23.18%)	0.01
4	Remote Monitoring	373 (21.35%)	0.07
5	Disease Management	360 (20.61%)	0.05
6	Digital Health	289 (16.54%)	0.12
7	Self Care	282 (16.14%)	0.08
8	Diabetes Mellitus	235 (13.45%)	0.07
9	Cardiovascular Disease	231 (13.22%)	0.09
10	Chronic Obstructive Lung Disease	218 (12.48%)	0.05
11	Quality Of Life	201 (11.51%)	0.05
12	The Elderly	116 (6.64%)	0.04
13	Patient Compliance	97 (5.55%)	0.03
14	Blood Pressure	92 (5.27%)	0.04
15	Renal Insufficiency	72 (4.12%)	0.05

Table 4. Keyword clustering in the field of telecare for chronic disease management

Classification	Cluster Number	Cluster Name	Main Keywords
Disease	#0	Chronic Disease	Information Management, Health Care Delivery,Diagnosis, Diseases
The Implementation Path of Disease Management	#1	Disease Management	Chronic Kidney Failure, Blood Pressure Regulation, Cardiovascular Disease, Blood Glucose
	#3	Health Care	Patient Education, Self Care, Health-Related Quality, Patient Care
Clinical Application	#2	Mobile Application	Pressure Monitoring, Computer Architecture, Consumer Telemedicine, Ambulatory Care Facilities
	#4	Virtual Reality	Clinical Practice, Practice Patterns, Systems Integration
	#5	Telemedicine	Telecardiology, Consultation, Diagnostic Test, Disease Course
	#6	Digital Health	Patient Monitoring, Database Systems, Speech Recognition

Table 5. Top 15 Keywords with the strongest citation bursts in telecare research for chronic disease management

Keywords	Year	Strength	Begin	End	1993 - 2023
Patient Monitoring	1993	15.23	1993	2010	
Patient Education	1993	10.29	1993	2009	
Assisted Living	1993	7.39	1993	2003	
Health Care System	1998	18.27	1998	2013	
Management	2000	13.44	2004	2012	
Health Care Quality	2002	10.85	2005	2013	
Patient Satisfaction	2000	8.85	2007	2013	
The Elderly	2004	8.17	2007	2017	
Patient Education	2008	8.85	2008	2014	
Medical Computing	2004	9.54	2010	2015	
Cell Phones	2014	7.25	2014	2016	
Health Promotion	2017	8.13	2017	2019	
Patient Participation	2018	8.61	2018	2019	
Coronavirus Disease 2019	2020	33.12	2020	2023	
Digital Health	2020	10.88	2021	2023	

2.6 Keyword burst analysis

The burstness function was used to detect emerging keywords in telemedicine research for chronic disease management from database inception to 2023. The top 15 keywords with the strongest citation bursts are summarized in Table 5. Red bars indicate the time periods during which each keyword experienced a burst in frequency. The keywords bursted recently include health promotion, patient participation, coronavirus disease 2019, and digital health. Among them, coronavirus disease 2019 had the highest burst intensity. This suggests that starting in 2020, it became a central topic in telemedicine research related to chronic disease management.

3. Discussion

3.1 Overview of telemedicine applications in chronic disease management

A visual analysis of the literature on telemedicine in chronic disease management shows a steady increase in

publication volume over time. This reflects the growing academic interest in this field. The development can be divided into three stages. The first stage was the early development period (1997–2003), during which publication growth was slow. The second stage, from 2004 to 2012, saw moderate and steady growth. During this period, telemedicine began to be used to provide personalized and timely healthcare services for patients with chronic diseases [13]. The third stage, from 2014 to the present, marks a period of rapid growth. In 2021, the number of publications peaked at 210. Although the data for 2023 is incomplete due to the retrieval cutoff in December, 43 publications had already been indexed, suggesting that research interest continues to rise.

The distribution of authors shows a high concentration of publications on certain international researchers. This indicates concentrated academic attention from a global perspective. Among the most prolific authors, Zanaboni P. and Koehler F. each published nine papers, showing sustained contributions to the field. In the density visualization map, larger and darker yellow areas indicate greater academic influence. A total of 8,851 authors were grouped into 18 main clusters. Most of the collaborations appeared relatively independent. The cluster centered around author Zhang J. had the darkest yellow area, suggesting that this research group had a significant influence and a high collaboration intensity in the field.

In terms of country distribution, research on telemedicine in chronic disease management is globally dispersed, forming a pattern of regional complementarity. The United States ranked first with 554 publications, accounting for 37.71% of the total. This dominant position is closely linked to its leading role in telemedicine legislation, technological innovation, and the systematic development of chronic disease management. This dominant position can be attributed not only to its leadership in telemedicine legislation and technological innovation, but also to its large population and long-standing investment in digital health infrastructure. The concept of telemedicine was first introduced in the US in the 1960s and further developed in the 1990s. China ranked second with 192 publications (10.99%), showing rapid growth in recent years. This trend is driven by several key factors, including its large population, the strategic implementation of national policies such as the Healthy China 2030 plan, the expansion of digital health platforms, and the ongoing primary healthcare reform initiatives [14]. Although there remains a large gap in publication volume compared to the US, China has shown strong momentum in regional collaboration, the development of smart healthcare systems, and the establishment of mobile health platform. Notably, countries such as South Korea, the Netherlands, Denmark, and France—despite lower publication counts—have made significant contributions in terms of research quality and innovation. For example, the Netherlands has explored patient-centered telecare models [15], while South Korea and Australia have achieved notable progress in mobile health (mHealth)–assisted care [16]. It is also worth noting that many European Union countries, including Italy, the Netherlands, Denmark, and France, participate in joint health strategies and research framework programmes (e.g., Horizon Europe), which may foster collaborative publications and influence distribution trends.

However, it is important to highlight that low- and lower-middle-income countries, where the burden of chronic diseases is rising sharply, often face significant challenges in accessing telemedicine services due to limited healthcare infrastructure, the digital divides, and resource constraints. These disparities may contribute to a relative lack of research output from these regions, underscoring the urgent need for increased focus on developing accessible and equitable telemedicine solutions that address the particular barriers faced by vulnerable populations.

3.2 Research hotspots in telemedicine for chronic disease management

Based on the analysis of the keyword co-occurrence and clusters, seven major clusters were identified. Current research hotspots in the field of telemedicine for chronic disease management—both in China and globally—are centred on three key areas:

(1) Chronic diseases: This cluster focuses on chronic conditions and includes keywords such as information management, health care delivery, diagnosis, and diseases. These terms reflect a dual focus in the literature. On the one hand, researchers are exploring the relationship between chronic diseases and information management systems. On the other hand, there is a strong interest in optimizing remote diagnosis and care delivery. (2) Ways for disease management: This cluster emphasizes disease-specific management approaches using telemedicine. It highlights precision management centered on specific chronic diseases. Studies in this area emphasize the importance of patient engagement, self-care ability, and improved quality of life. These topics reflect the patient-centered philosophy of modern nursing practice. (3) Clinical application of telemedicine technologies: This cluster focuses on the practical integration of telemedicine technologies into chronic disease care. Major themes include mobile applications, virtual reality, telemedicine, and digital health. Mobile applications are valued for their convenience and accessibility. They support self-management functions such as blood pressure monitoring and remote follow-up. Virtual reality enhances immersive experiences during clinical care. Telemedicine is widely used in consultations and diagnostics and improves continuity and efficiency in the follow-up of chronic diseases. It also supports the comprehensive recording of patient data. Digital health integrates database systems and voice recognition technologies to enable real-time monitoring and intelligent feedback. This supports

timely, personalized interventions through telemedicine platforms.

3.3 Research trends in telemedicine for chronic disease management

Keyword burst analysis can reveal research hotspots over time and help identify emerging frontiers and development trends. The top 15 burst keywords are presented in Table 5. The results show that research in this field is broad in scope. Based on the timeline and the strength of keyword bursts, the development of telemedicine in chronic disease management can be divided into three main phases. In the initial exploration phase, the focus was on traditional nursing services. Keywords such as patient monitoring, patient education, and assisted living were frequently mentioned. These reflect the early efforts to apply telemedicine technologies to support basic patient care and chronic disease management. In the phase of rapid development, driven by the rise of smartphones, wearable devices, and mobile applications, new burst keywords emerged. These included cell phones, medical computing, and health care quality. The focus of research shifted from the basic service delivery to technological innovation and platform development. Notably, the keyword cell phones had a strong burst starting in 2014 (strength = 7.25). At that time, studies on digital health interventions for asthma began to emerge globally [17]. This marked the growing role of smartphone-based mHealth applications in supporting self-management for chronic diseases. Research during this phase emphasized improving patient adherence and developing digital nursing information systems. In the past five years, the field has entered a phase of intelligent integration. As artificial intelligence and big data technologies matured, new research hotspots have emerged. Notable keywords include digital health and coronavirus disease 2019. The outbreak of COVID-19 led to an urgent demand for remote healthcare solutions. For patients with chronic conditions living in isolation at home, remote monitoring and continuous care became a critical public health challenge [18]. Digital health has emerged as a major topic since 2021, indicating a shift from device-dependent systems to algorithm-driven approaches. These include digital diagnostics, real-time monitoring, and intelligent decision-support systems [19,20]. However, the full potential of digital health interventions has yet to be fully realized.

4. Conclusion

In this study, the literature on telecare applications in chronic disease management was systematically reviewed in the Web of Science database using VOSviewer and CiteSpace software. It objectively and visually presents the current research status and the hotspots in this field. Compared to conventional reviews, this approach provides a more intuitive and comprehensive overview, that provides valuable information for future research. The knowledge mapping analysis shows that research on telecare in chronic disease management has developed significantly. The overall number of studies continues to grow. International collaboration has become closer, and research topics have diversified. The focus has shifted from early remote diagnosis and patient education to mobile health, digital health technologies, and innovative remote services under the context of the COVID-19 pandemic. Currently, telemedicine research has moved from basic exploration into a phase of rapid growth featuring clinical applications and intelligent technology integration. Future studies should emphasize interdisciplinary collaboration, improving the accessibility and usability of technologies and developing personalized management strategies for patients with chronic diseases. Importantly, future research should also prioritize health equity by addressing disparities in access to telemedicine, particularly in low- and middle-income countries and among vulnerable populations. Strategies to bridge digital divides and resource gaps are essential to ensure that advancements in telemedicine benefit all populations globally. Nonetheless, this study has certain limitations. This study only included the Web of Science Core Collection and Scopus databases, excluding other databases such as PubMed, which may have resulted in the omission of some relevant literature. Additionally, the data collection cutoff point (December 2023) may not fully reflect the latest developments in this rapidly evolving field. Therefore, the analysis results may be incomplete or biased to some extent. Future research should consider expanding the search scope and integrating additional databases to provide a more comprehensive evidence base, that could better support the widespread implementation of telemedicine and contribute to achieving national health goals such as the Healthy China strategy.

Acknowledgments

We would like to express our sincere gratitude to all individuals and institutions that contributed to this study.

Conflict of interest

The authors declare that there is no conflict of interest in this work.

Ethical consideration

No ethical approval and patient consent were required

for the analyses in this work.

Ethics approval and consent to participate

Not applicable.

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