European Journal of Therapeutics
pISSN: 2564-7784
eISSN: 2564-7040

Eur J Ther. 2026.
https://doi.org/10.58600/eurjther3181

Original Research

# Global Trends, Collaboration Patterns, and Thematic Evolution of Telemedicine Research: A Bibliometric Analysis

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**Received:** 2026–05–22 **Accepted:** 2026–08–25 **Published Online:** 2026–09–14

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## ABSTRACT

**Objective:** This study aimed to systematically examine the global scientific landscape of telemedicine research by evaluating publication trends, influential journals and authors, international collaboration networks, and thematic developments over time.

**Methods:** In this bibliometric study, 14,590 peer-reviewed articles indexed in the Web of Science Core Collection between 2015 and 2025 were analyzed. Data processing and quantitative analyses were performed using the bibliometrix R package, while network visualizations were generated using VOSviewer. Annual scientific output and core journals were identified using Bradford's Law. Author productivity and citation impact, country-level collaboration networks, keyword co-occurrence patterns, thematic mapping, and sensitivity analyses comparing the pre-pandemic and post-pandemic periods were also evaluated.

**Results:** Scientific production in the field of telemedicine increased markedly after 2020 and remained at a high level through 2025. Approximately one-third of all publications were concentrated in eight core journals, led by Telemedicine and e-Health and Journal of Telemedicine and Telecare. The United States was the leading contributor in terms of both research productivity and international collaboration, followed by Australia, England, Canada, and China. Keyword co-occurrence analysis identified major thematic clusters related to mental health, primary healthcare, chronic disease management, public health equity, and artificial intelligence. Thematic mapping positioned mobile health (m-health) as a motor theme, whereas COVID-19-related research was identified as a basic theme. Mental health occupied an intermediate position between motor and basic themes, while artificial intelligence and e-health were located within emerging or evolving thematic domains.

**Conclusion:** Telemedicine research has evolved rapidly toward patient-centered and technologically enhanced healthcare models. These findings provide a comprehensive overview of the intellectual structure of the field and identify emerging priorities for future telemedicine research.

**Keywords:** bibliometric analysis, science mapping, telemedicine, telehealth, vosviewer

## INTRODUCTION

The delivery of healthcare has been substantially reshaped by telemedicine, which enables diagnosis, treatment, and monitoring at a distance through digital technologies. What began primarily as a strategy to extend care to remote and underserved populations has expanded into a broad clinical and operational domain. This expansion has been driven by progress in communication technologies, mobile health platforms, and health informatics systems [1,2].

A decisive shift occurred during the COVID-19 pandemic, when healthcare systems worldwide turned rapidly to remote care models to preserve service continuity while reducing infection risk. This transition accelerated both telemedicine use and the volume of related scholarly work to an unprecedented degree [3,4]. As the field expanded, its research agenda diversified considerably, encompassing clinical effectiveness, patient experience, chronic disease management, tele-ophthalmology, digitally enabled hospital care, health system integration, equity, and emerging technologies such as artificial intelligence (AI) [5–7].

In fast-growing areas such as telemedicine, bibliometric analysis offers a rigorous approach for characterizing intellectual structure, tracing thematic change, and examining collaboration patterns. Despite the large and growing body of telemedicine literature, the evidence base remains dispersed across clinical specialties, technological applications, and healthcare contexts. Most prior studies have emphasized specific use cases, selected care settings, or short-term developments associated with the pandemic. A broad longitudinal assessment integrating the pre-pandemic, pandemic, and post-pandemic phases of telemedicine research is still lacking.

To address this gap, the present study provides a large-scale bibliometric analysis of telemedicine publications from 2015 to 2025. By combining performance indicators, collaboration mapping, keyword co-occurrence analysis, and thematic structure assessment, the study was designed to (i) identify global publication trends, (ii) determine core journals and influential authors, (iii) evaluate patterns of international collaboration, and (iv) examine the thematic evolution of telemedicine research.

**Main Points**

- Telemedicine research increased markedly after 2020 and remained high through 2025.
- Mental health, mobile health, artificial intelligence, and health equity emerged as key research themes.
- The United States led global publication output and international collaboration in telemedicine research.

## MATERIALS AND METHODS

This study was designed to comprehensively evaluate global publication trends, international collaboration networks, and thematic evolution in telemedicine research. To this end, a bibliometric analysis was conducted based on a literature search performed in the Web of Science Core Collection database in February 2026.

### Search Strategy and Study Selection

A literature search was conducted in the Web of Science (WoS) Core Collection database in February 2026 [8]. To retrieve publications related to telemedicine, a comprehensive topic-based search strategy was applied using the following query:

TS = (“telemedicine” OR “telehealth” OR “virtual care” OR “remote consultation” OR “telemonitoring”)

Within Web of Science, the TS field tag includes titles, abstracts, author keywords, and Keywords Plus.

The search was limited according to the following criteria:

Publication years: 2015–2025

Document type: Article

Language: English

Indexes: Science Citation Index Expanded (SCI-Expanded) and Social Sciences Citation Index (SSCI)

All records were exported in plain text format together with complete bibliographic information and cited references. Because all data originated from a single indexed source, duplicate removal was not necessary. Study selection was summarized using a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-based flow diagram adapted for bibliometric analysis (Figure 1) [9].

Only original research articles were included in the bibliometric analysis to ensure a homogeneous dataset representing primary scientific evidence and to minimize the influence of review

articles on citation patterns and thematic analyses.

**Bibliometric Analysis**

All bibliometric analyses were performed using the bibliometrix R package (version 5.3.0) [10]. Annual scientific production was evaluated to characterize temporal growth. Bradford's law was used to identify the core journals in the field. Analyses of author productivity and citation impact were undertaken to determine the most influential contributors. Descriptive statistics were also used to summarize national research output and the distribution of funding agencies.

**Network Visualization and Collaboration Analysis**

International collaboration was examined through country co-authorship based on author affiliation addresses. Network visualization and overlay analysis were conducted using VOSviewer (version 1.6.20) [11]. In these maps, countries were represented as nodes and co-authored publications as links. Link strength indicated the magnitude of collaboration between countries.

**Keywords Co-occurrence and Thematic Analysis**

To capture thematic patterns defined by researchers themselves, keyword co-occurrence analysis was based on author keywords. After application of a minimum occurrence threshold, co-occurrence networks and overlay visualizations were generated in VOSviewer. The thematic map was generated from Callon's centrality and density measures, with centrality (x-axis) indicating the importance of a theme within the field through its connections to other themes, and density (y-axis) indicating the internal development and cohesion of that theme. On this basis, themes are distributed across four quadrants: motor themes (high centrality, high density), niche themes (low centrality, high density), basic themes (high centrality, low density), and emerging or declining themes (low centrality, low density) [12]. The thematic map was generated using the bibliometrix R package, which supports comprehensive science mapping and bibliometric network visualization [9].

Citation-based indicators for publications from 2025 were interpreted cautiously because these records had limited time to accumulate citations.

A total of 29,195 records were identified in the initial database search. After restricting the dataset by document type (Article) and language (English), 14,590 eligible records were retained for the final bibliometric analysis (Figure 1).

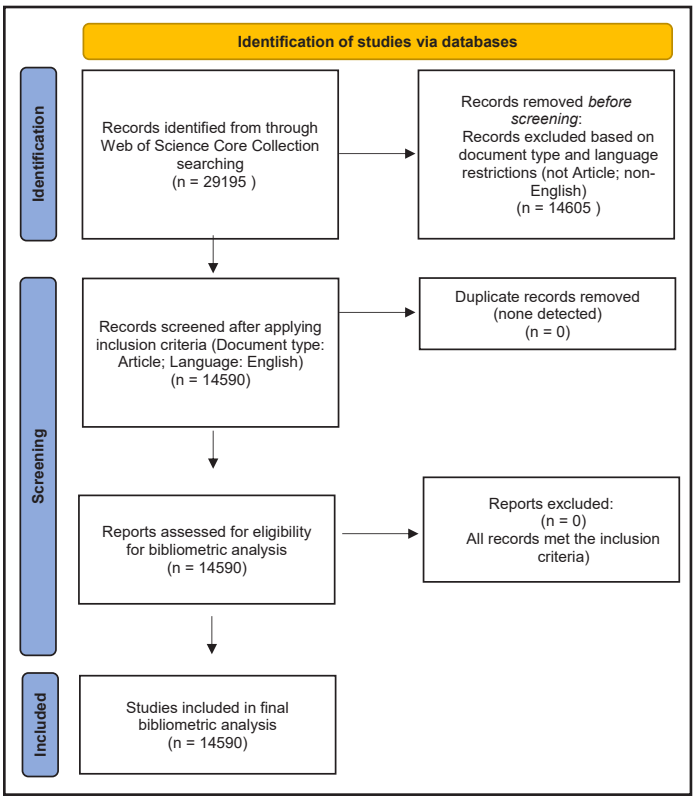


**Figure 1.** PRISMA-based flow diagram of the study selection process.

**Sensitivity Analysis**

To evaluate structural changes in telemedicine research, the dataset was divided into two periods: the pre-pandemic period (2015–2019) and the pandemic/post-pandemic period (2020–2025). Publication trends, thematic evolution, and international collaboration patterns were assessed comparatively between these two periods.

**RESULTS**

**Annual Scientific Production**

From 2015 to 2019, telemedicine publications increased steadily. After 2020, output expanded sharply (Figure 2). Publication counts were highest during 2022–2024 and remained high in 2025, indicating that telemedicine continued to attract substantial scientific attention beyond the acute phase of the pandemic.

**Core Journals and Bradford's Law**

Application of Bradford's law showed that telemedicine research was concentrated within a limited group of journals. Eight journals alone accounted for approximately one-third of all publications. The most productive sources were Telemedicine and e-Health and Journal of Telemedicine and Telecare, followed by Journal

of Medical Internet Research, BMJ Open, BMC Health Services Research, JMIR Formative Research, JMIR Research Protocols, and Digital Health. This pattern indicates a well-defined core journal set within the field (Table 1).

**Author Productivity and Citation Impact**

Figure 3 presents author performance, with dot size representing the number of articles (N. Articles) and color intensity representing total citations per year (TC per Year). The analysis identified a group of researchers with both high productivity and strong citation impact. Most of these influential authors were affiliated with institutions in the United States, Australia, and the United Kingdom, underscoring the major contribution of these countries to telemedicine scholarship.

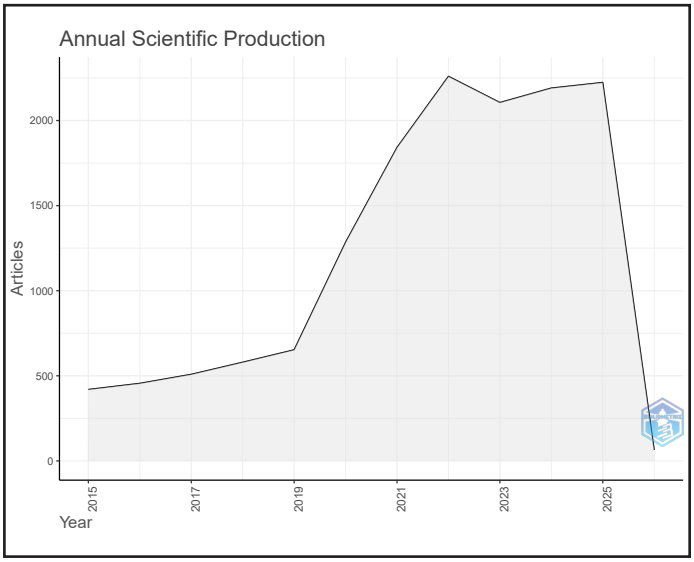


**Figure 2.** Annual scientific production of telemedicine research (2015–2025).

**Table 1.** Core journals in telemedicine research according to Bradford's law.

| Journal | Articles |
|---|---|
| Telemedicine and e-Health | 1,567 |
| Journal of Telemedicine and Telecare | 757 |
| Journal of Medical Internet Research | 736 |
| BMJ Open | 496 |
| BMC Health Services Research | 365 |
| JMIR Formative Research | 336 |
| JMIR Research Protocols | 302 |
| Digital Health | 292 |

**Country-Level Research Output and Collaboration**

At the country level, the United States produced the highest number of telemedicine publications (n = 6,208), followed by Australia, England, Canada, and China. Research activity was concentrated primarily in high-income countries, although the overall dataset also reflected broader international participation.

Collaboration mapping revealed a highly interconnected global network (Figure 4). The United States occupied the most central position, with Australia, England, and Canada also functioning as major collaborative hubs. Overlay visualization indicated that international co-authorship intensified over time, especially during and after the COVID-19 pandemic.

**Keyword Co-occurrence and Thematic Structure**

The keyword co-occurrence network revealed several major thematic clusters, including mental health and telepsychiatry, changes in primary care, chronic disease management, public health equity, and AI-supported digital care. According to the overlay visualization, earlier phases of telemedicine research emphasized implementation and feasibility, whereas more recent work increasingly addressed mental health, digital equity, and artificial intelligence (Figure 5).

**Thematic Mapping**

Within this framework, mobile health was identified as a motor theme, indicating a central and well-developed position in telemedicine research. COVID-19-related research was categorized as a basic theme, reflecting high centrality but lower conceptual consolidation. Mental health occupied a position between motor and basic themes, consistent with its increasing relevance and interdisciplinary integration. Artificial intelligence and e-health, by contrast, appeared in the emerging or evolving thematic domain, suggesting active development and future growth potential (Figure 6).

**Sensitivity Analysis: Pre-Pandemic vs Pandemic/Post-Pandemic Period**

Comparative analysis revealed:

- A substantial increase in annual publication output after 2020
- A thematic shift from technology feasibility and infrastructure-focused research toward mental health, health equity, and artificial intelligence
- Increased international collaboration density during and after the pandemic

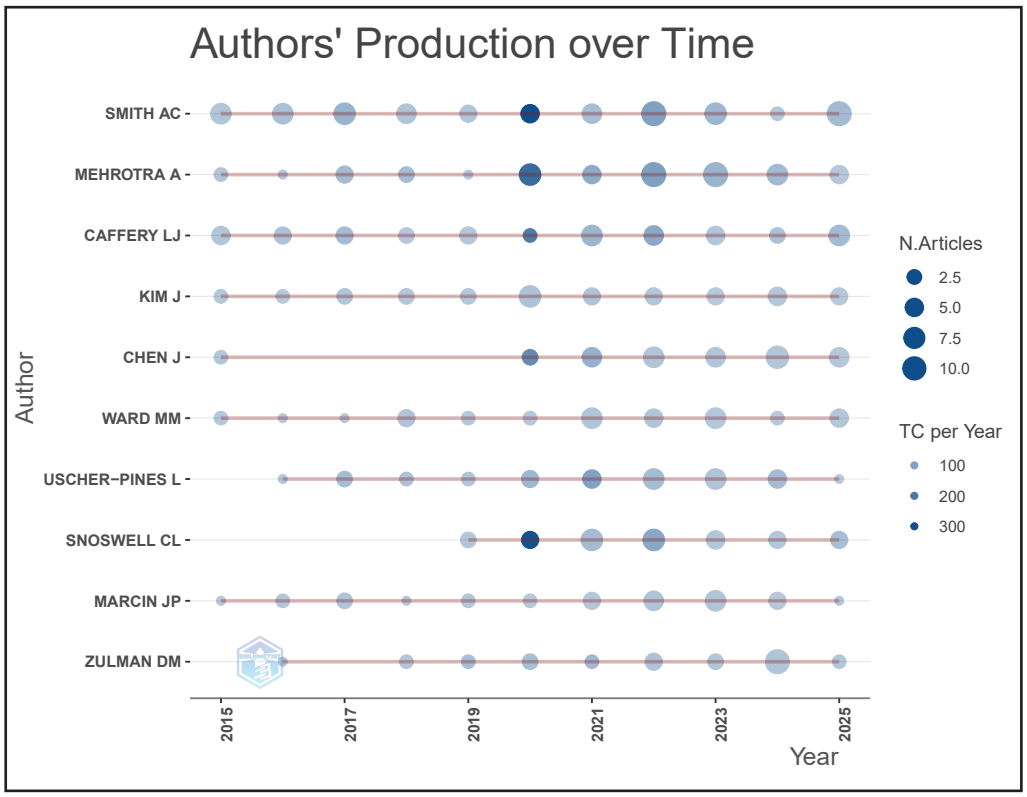


**Figure 3.** Temporal production and citation impact of the most productive authors (2015–2025).

- These findings confirm that COVID-19 functioned as a structural accelerator in telemedicine research development.

**Funding Agency Distribution in Telemedicine Research**

Following manual standardization of funding agency names, the leading funding organizations were the National Institute for Health and Care Research (NIHR) (n = 277), National Center for Advancing Translational Sciences (n = 276), National Institutes of Health (NIH) (n = 247), National Institute of Mental Health (n = 233), Agency for Healthcare Research and Quality (n = 200), National Institute on Aging (n = 198), National Heart, Lung, and Blood Institute (n = 197), European Union/European Commission (n = 187), National Institute on Drug Abuse (n = 176), and National Cancer Institute (n = 165).

These data indicate that telemedicine research has been funded largely by public health institutions and national agencies, underscoring its strategic relevance for healthcare systems and policy development.

## DISCUSSION

This study provides a comprehensive bibliometric analysis of the evolution of telemedicine research between 2015 and 2025. Our findings showed that scientific publication output increased markedly after 2020 and has remained at a high level since then. These findings suggest that telemedicine has evolved beyond a research area driven solely by the COVID-19 pandemic and has become a sustainable field within healthcare research. Furthermore, our results demonstrated increased international collaboration and a clear thematic shift toward mental health, health equity, and artificial intelligence.

These findings support the substantial impact of the COVID-19 pandemic on healthcare delivery and the evolution of healthcare services toward telemedicine. The pandemic accelerated the global adoption of remote care services and expanded their scope. Furthermore, the sustained publication output observed after 2020 reinforces the view that telemedicine has become an integral component of modern healthcare systems.

The thematic profile of the field also changed in meaningful ways. Mental health became increasingly central, consistent with the broad implementation of telepsychiatry and the rising need for accessible mental health services. At the same time, the growing prominence of equity-related topics points to greater recognition of digital inclusion, unequal access, and the need to ensure that telemedicine serves diverse patient groups. Together, these developments reflect a shift toward models of care that are both more patient-centered and more socially responsive.

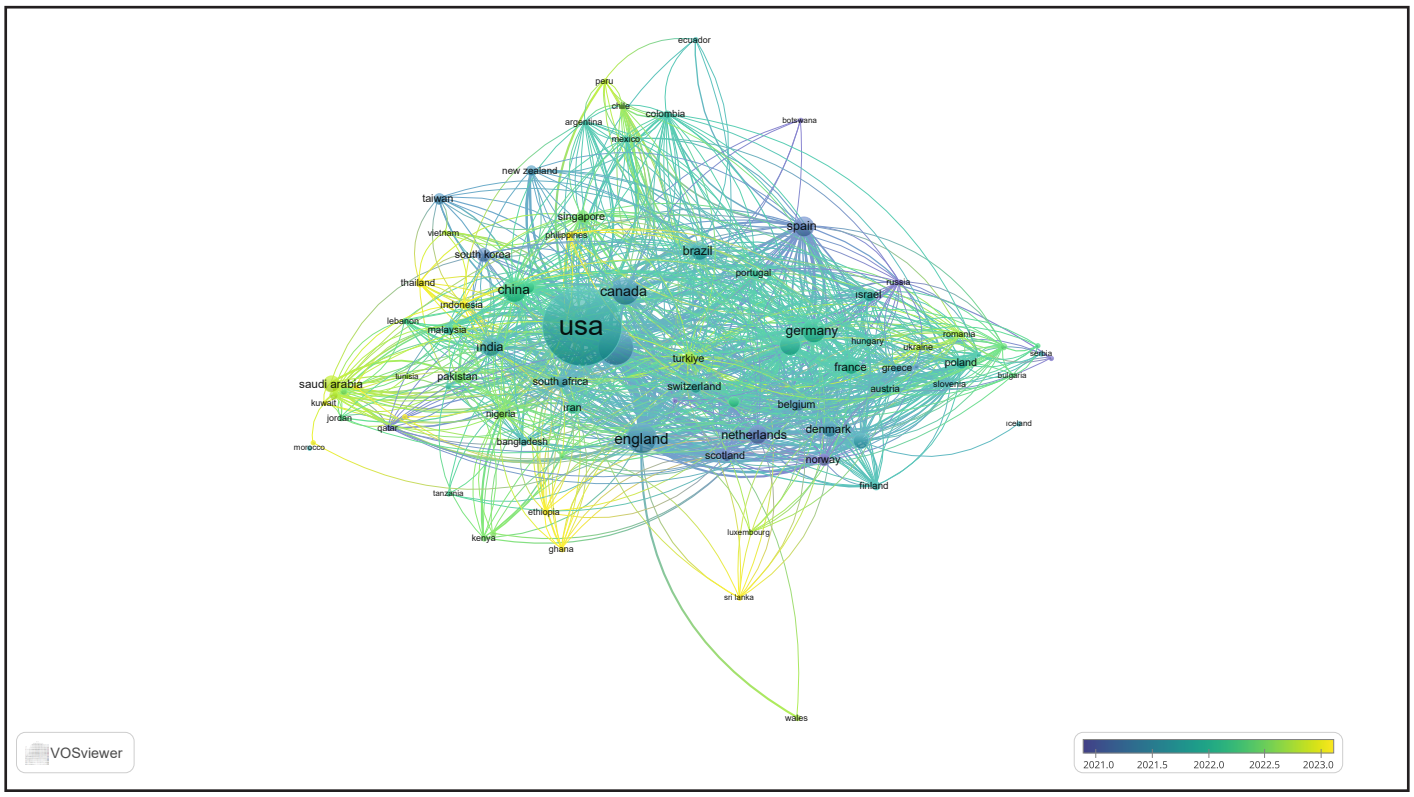


**Figure 4.** International collaboration network in telemedicine research.

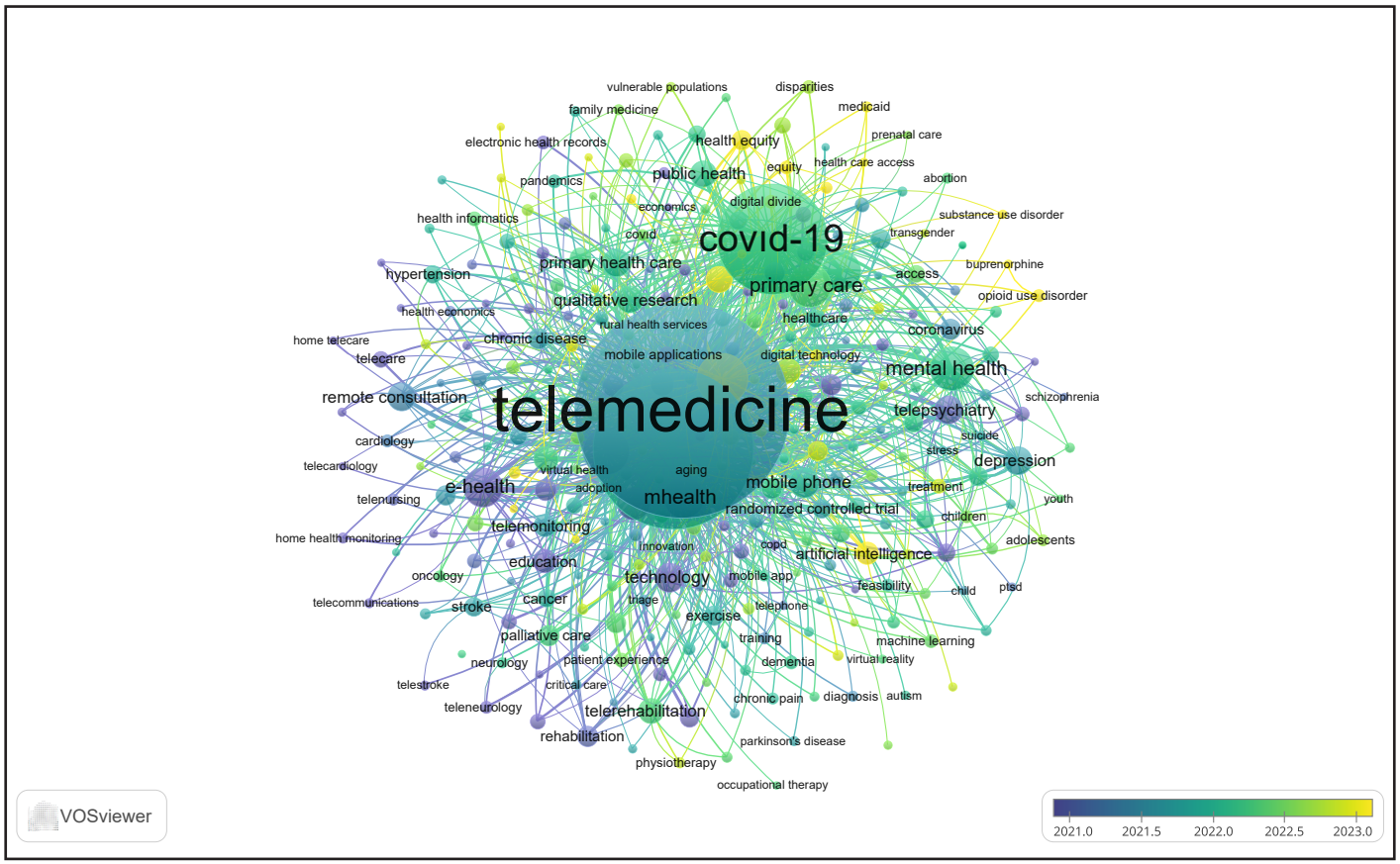


**Figure 5.** Keyword co-occurrence network with overlay visualization.

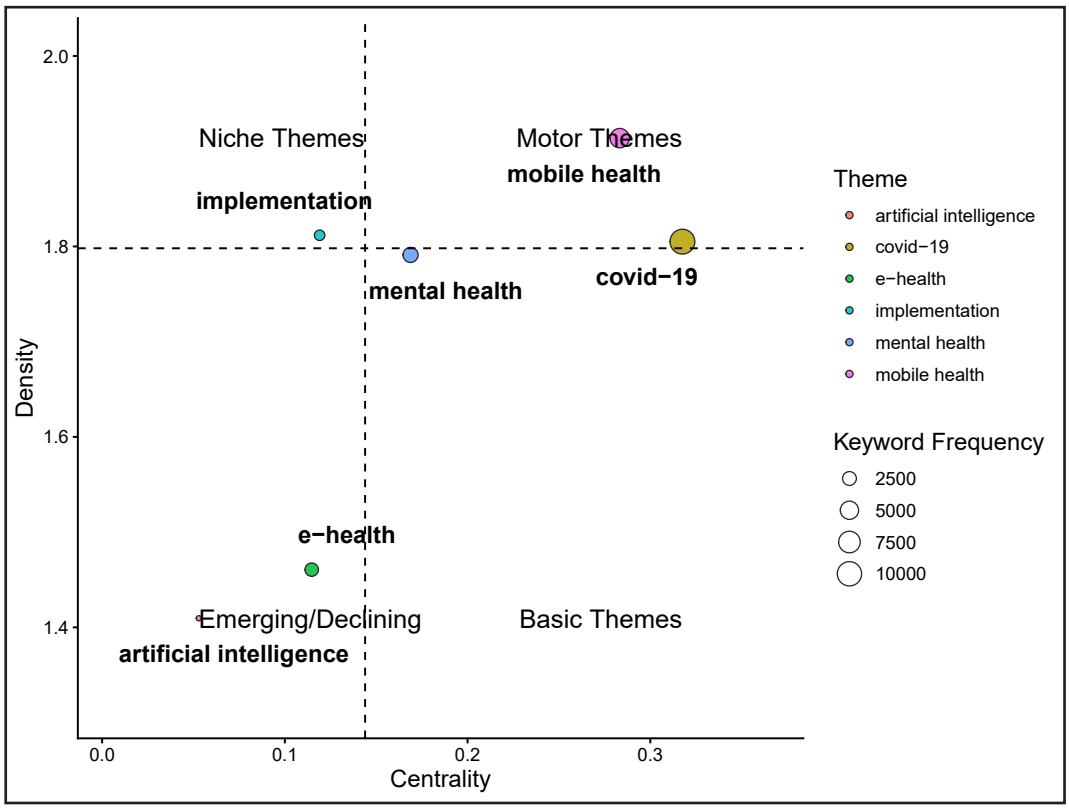


**Figure 6.** Thematic map of telemedicine research.

International collaboration patterns highlight the continued dominance of high-income countries while also showing the gradual expansion of telemedicine research into additional regions. The movement of thematic clusters over time further indicates that the field has advanced beyond early concerns about feasibility and implementation toward more integrated, clinically mature, and technologically sophisticated forms of digital care.

The sensitivity analysis further confirmed that the COVID-19 pandemic acted as a major turning point, reshaping publication trends, research themes, and international collaboration patterns in telemedicine research.

Although the dataset included publications indexed through 2025, some records may not yet have been fully indexed in the Web of Science Core Collection at the time of data extraction because of indexing delays. Accordingly, citation-based indicators for 2025 were interpreted with caution, as these records had less time to accrue citations than publications from earlier years. This consideration is important when evaluating citation-related findings.

The post-2020 transformation of telemedicine research was therefore not merely a matter of increased output. It also involved substantive structural change. The emergence of artificial intelligence within the evolving thematic domain suggests that telemedicine is increasingly intersecting with predictive analytics, decision support systems, and personalized digital healthcare. Continued bibliometric monitoring will be important for understanding how these technologies influence clinical workflows, care quality, and healthcare access in the years ahead.

Future research should focus on establishing legal and ethical boundaries for the integration of artificial intelligence into telemedicine, with particular emphasis on data privacy, algorithm transparency, and clinical accountability. In addition, further studies are needed to evaluate the impact of AI-driven decision support and triage systems in remote care settings on clinical outcomes and equitable access to healthcare services.

**Limitations**

Several limitations should be considered when interpreting these findings. First, the analysis was restricted to the Web of Science Core Collection and may therefore have omitted relevant studies indexed elsewhere. Second, only English-language articles were included, which may have reduced the representation of research produced in non-English-speaking regions. Another limitation is that the search strategy was intentionally restricted to terms

directly related to telemedicine (telemedicine, telehealth, virtual care, remote consultation, and telemonitoring). Broader concepts such as e-health, m-health, and digital health were not included because they encompass a wider range of digital health technologies beyond telemedicine. Consequently, some relevant studies using these broader terms may not have been captured. Finally, bibliometric indicators are shaped by database indexing practices and citation time windows. Finally, although keyword co-occurrence analysis and thematic mapping are useful for identifying research trends, they cannot fully capture the conceptual depth of individual studies.

## CONCLUSION

Between 2015 and 2025, telemedicine research expanded rapidly and became increasingly diverse in thematic scope. Mental health, artificial intelligence, and equity-focused research emerged as prominent areas of growth, while international collaboration intensified markedly after the COVID-19 pandemic. Overall, telemedicine has developed into a mature, multidimensional research field with increasing importance for the future of healthcare delivery.

**Acknowledgments**: The authors would like to thank Assoc. Prof. Dr. Mehmet Karadağ for his valuable scientific contributions and academic support during the preparation of this study.

**Funding**: No specific funding was received for this study.

**Conflict of Interest**: The authors declare no conflict of interest.

**Data Availability Statement**: The bibliographic data analyzed during the current study were retrieved from the Web of Science Core Collection database. Processed data and analysis scripts are available from the corresponding author upon reasonable request.

**Ethical Approval**: Ethics committee approval was not required because this study was based exclusively on publicly available bibliographic data and did not involve human participants or patient data.

**Author Contributions:** Concept: T.G.K; Design: T.G.K.; Supervision: I.D.; Data Collection and/or Processing: T.G.K.; Analysis and/or Interpretation: T.G.K.; Literature Review: T.G.K.; Writing: T.G.K.; Critical Review: I.D.

**Author's Statement Regarding the Use of Artificial Intelligence-Supported Tools**

AI-assisted language editing was performed using ChatGPT (OpenAI) under full human supervision. The authors reviewed and revised all AI-assisted text and take full responsibility for the final content of the manuscript.

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***How to Cite;***

Kazaz TG, Dogan I (2026) Global Trends, Collaboration Patterns, and Thematic Evolution of Telemedicine Research: A Bibliometric Analysis. Eur J Ther. https://doi.org/10.58600/eurjther3181