

The Impact Of Telemedicine On Global Non-Communicable Disease Management: A Bibliometric And Visualized Analysis

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ABSTRAK

Latar Belakang: Beban global non-communicable diseases (NCD) yang terus mengalami eskalasi mendorong ekspansi pemanfaatan telemedicine sebagai modalitas layanan kesehatan alternatif yang bersifat transformatif dan lintas batas geografis. **Tujuan:** Penelitian ini bertujuan memetakan struktur intelektual, kluster tematik dominan, dan trajektori perkembangan riset global telemedicine dalam pengelolaan NCD pada periode 2022–2025 secara komprehensif. **Metode:** Pendekatan mixed-method integrative diterapkan, memadukan analisis bibliometrik menggunakan VOSviewer dan Biblioshiny dengan Systematic Literature Review berbasis panduan PRISMA 2020 terhadap 10 artikel terseleksi yang diperoleh dari basis data Scopus dan Web of Science. **Hasil:** Tren publikasi menunjukkan akselerasi yang signifikan dengan puncak produktivitas ilmiah tercatat pada tahun 2024. Lima kluster tematik dominan berhasil diidentifikasi, mencakup pengelolaan diabetes melitus tipe 2, NCD kardiorespiratoris, telehealth pada layanan kesehatan primer, perspektif pasien dan tenaga kesehatan, serta intervensi digital health di negara berpendapatan rendah-menengah. Bukti meta-analitik secara konsisten mengkonfirmasi efektivitas telemedicine dalam penurunan kadar HbA1c, reduksi angka readmission, dan peningkatan kapasitas fungsional pasien NCD. **Kesimpulan:** Telemedicine terbukti secara empiris sebagai komponen fundamental dalam pengelolaan NCD global, namun kesenjangan adopsi di negara berkembang serta keterbatasan bukti efektivitas jangka panjang menjadi prioritas utama agenda riset mendatang.

Kata Kunci: Telemedicine; Non-Communicable Diseases; Bibliometrik

ABSTRACT

Background : The global burden of non-communicable diseases (NCDs) continues to escalate, driving the expansion of telemedicine utilization as a transformative and geographically unrestricted healthcare service modality.

Objective : This study aimed to comprehensively map the intellectual structure, dominant thematic clusters, and developmental trajectories of global research on telemedicine in NCD management during the period 2022–2025.

Methods: An integrative mixed-method approach was employed, combining bibliometric analysis using VOSviewer and Biblioshiny with a Systematic Literature Review (SLR) based on the PRISMA 2020 guidelines. Ten selected articles retrieved from the Scopus and Web of Science databases were included in the analysis.

Results: Publication trends demonstrated significant acceleration, with peak scientific productivity recorded in 2024. Five dominant thematic clusters were identified, including: (1) Type 2 Diabetes Mellitus management, (2) cardiorespiratory NCDs, (3) telehealth in primary healthcare services, (4) patient and healthcare provider perspectives, and (5) digital health interventions in low- and middle-income countries (LMICs). Meta-analytic evidence consistently confirmed the effectiveness of telemedicine in reducing HbA1c levels, decreasing hospital readmission rates, and improving the functional capacity of patients with NCDs.

Conclusion: Telemedicine has been empirically established as a fundamental component of global NCD management. However, adoption disparities in developing countries and the limited evidence regarding long-term effectiveness remain key priorities for future research agendas.

Keywords: Telemedicine; Non-Communicable Diseases; Bibliometrics

INTRODUCTION

Non-communicable diseases (NCDs) have become the most dominant global health burden and continue to increase at an alarming rate. Conditions such as cardiovascular diseases, diabetes mellitus, cancer, and chronic respiratory diseases collectively account for more than 74% of annual deaths worldwide, with the largest proportion occurring in low- and middle-income countries (LMICs), where healthcare system capacities are often the most constrained.¹

Ironically, despite substantial advances in knowledge regarding NCD prevention and management, the gap between healthcare service availability and actual population needs continues to widen, particularly in remote and rural areas with limited access to adequate healthcare facilities. This situation is exacerbated by the unequal distribution of healthcare professionals and infrastructure, which remains a structural challenge in many developing countries. Consequently, millions of individuals living with NCDs do not receive continuous and standardized care.²

In this context, telemedicine has emerged as a promising transformative solution. Telemedicine refers to the use of information and communication technologies to deliver clinical services without geographical limitations, including virtual consultations, remote patient monitoring, and digital prescription management. The adoption of telemedicine accelerated dramatically during the COVID-19 pandemic, which compelled global healthcare systems to rapidly transition toward digital healthcare delivery models. This shift demonstrated that telemedicine is no longer merely a supplementary service but rather a fundamental component of

modern healthcare architecture.³

Specifically, within the context of NCD management, growing scientific evidence has demonstrated that telemedicine-based interventions can improve long-term treatment adherence, enhance blood pressure control among patients with hypertension, reduce HbA1c levels in individuals with diabetes, and decrease unplanned hospital admissions, thereby contributing to overall healthcare system efficiency.⁴

Nevertheless, despite the rapid expansion of telemedicine-related literature, understanding of the global research landscape remains fragmented. Existing studies tend to focus on individual diseases or specific geographical regions without providing a comprehensive overview of how telemedicine research in NCD management has evolved globally over time. The absence of a comprehensive intellectual mapping makes it difficult for policymakers, clinicians, and researchers to identify priority areas requiring further attention and to understand collaborative networks among institutions and countries that shape this scientific field.⁵

Furthermore, existing bibliometric studies have not specifically integrated the intersection between telemedicine and NCD management across multiple diseases and geographical settings within a unified analytical framework, creating a significant methodological gap in the global literature.⁶

This gap constitutes both the rationale and novelty of the present study. To date, no bibliometric study has comprehensively mapped the global evolution of telemedicine research in NCD management using advanced analytical tools such as VOSviewer and Biblioshiny based on data from Scopus and Web of Science. Additionally, no study has

systematically identified thematic clusters, the most productive countries, and the most influential authors and journals shaping scientific discourse in this field.⁷

By employing a mixed-method approach that combines bibliometric analysis with knowledge network visualization, this study provides an intellectual map that has not previously been presented specifically for the global intersection of telemedicine and NCD management. Based on this background, the research questions are as follows: How can the global development of telemedicine research in NCD management be mapped bibliometrically? What thematic clusters dominate the scientific discourse in this field over the past decade? Specifically, this study aims to: Map the intellectual structure and global trends of telemedicine research in the context of NCDs; Identify the most influential countries, institutions, authors, and journals; and Visualize emerging thematic research clusters as a foundation for future research recommendations⁸.

METHODS

This study employed a bibliometric analysis approach designed to comprehensively and systematically map the intellectual structure and global research trends of telemedicine in the management of non-communicable diseases (NCDs). This approach was selected because it provides an objective quantitative overview of scientific publication dynamics, patterns of collaboration among authors and countries, and the thematic clusters that dominate scholarly discourse in this field. Unlike conventional narrative approaches, which are often subjective, bibliometric analysis enables researchers to identify the most influential intellectual contributions in a systematic, measurable, and reproducible

manner [9]. The study consisted of two sequential phases: the bibliometric analysis phase and the article selection and review phase.

Phase 1: Bibliometric Analysis

Metadata were retrieved from two internationally recognized indexed databases, namely Scopus and the Web of Science (WoS), covering publications from 2022 to 2025. The search strategy was developed using Boolean operators and combinations of the following terms: *“telemedicine” AND “non-communicable diseases” OR “NCD” OR “chronic disease” OR “diabetes mellitus” OR “heart failure” OR “chronic obstructive pulmonary disease” OR “chronic kidney disease” AND “telerehabilitation” OR “telemonitoring” OR “self-management” OR “digital health intervention” OR “e-prescription”*. Extracted metadata included article title, abstract, author names, institutional affiliations, country of origin, year of publication, journal title, citation count, and author keywords, which were exported in comma-separated values (.csv) and BibTeX (.bib) formats.

Bibliometric analysis was conducted using two primary software applications. First, VOSviewer (version 1.6.20) was utilized to construct and visualize co-citation networks, keyword co-occurrence networks, and collaboration patterns among authors and countries. Second, Biblioshiny (the bibliometrix package in R) was employed to perform descriptive bibliometric analyses, including annual publication trends, h-index calculations for influential authors, thematic mapping based on cluster density and relevance, and analyses based on Lotka's Law and Bradford's Law to examine author and journal productivity distributions. The

combination of these two analytical tools provided methodological triangulation, thereby strengthening the validity and robustness of the intellectual mapping findings [10].

Phase 2: Article Selection and Review

The article selection process was conducted systematically and sequentially in accordance with the flowchart illustrated below.

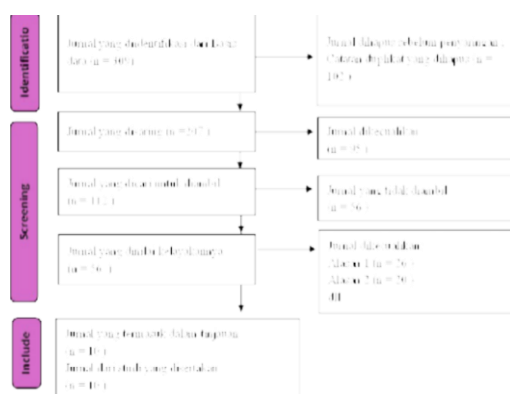


Figure 1. Article Selection Flowchart

Source: Authors, 2025

The selection process began with the Identification stage, during which a total of 309 articles were retrieved from the Scopus and Web of Science (WoS) databases. Of these, 102 records were excluded because they were either duplicates or had been retracted by the publishers prior to the screening process, leaving 207 articles eligible for the Screening stage.

HASIL DAN PEMBAHASAN

The bibliometric analysis of the 10 articles that met the inclusion criteria revealed a temporal distribution pattern reflecting the dynamic development of global research on the impact of telemedicine in the management of non-communicable diseases (NCDs). The distribution of publications by year is presented in Table 2 below.

Table 2. Distribution of Publication Frequency by Year (2022–2025)

During the Screening stage, article titles and abstracts were systematically reviewed, resulting in the exclusion of 95 articles that did not meet the relevance criteria related to telemedicine and NCDs. Of the remaining 112 articles subjected to further assessment, 56 articles could not be retrieved because full-text versions were unavailable or restricted behind paywalls without institutional access. Consequently, 56 articles proceeded to the Eligibility Assessment stage.

At the eligibility stage, articles were excluded based on two primary reasons. Reason 1 (n = 26): the study did not directly employ telemedicine interventions in NCD management. Reason 2 (n = 20): the study focused on topics outside the scope of NCDs, including acute infectious diseases, animal populations, or *in vitro* investigations.

Ultimately, during the Included stage, a total of 10 articles were incorporated into the final synthesis and analysis. These studies encompassed a broad spectrum of NCDs, including diabetes mellitus, heart failure, chronic obstructive pulmonary disease (COPD), chronic kidney disease, and rheumatic diseases [5].

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication Year	2022–2025	Outside the specified period
Language	English	Languages other than English
Study Design	Randomized Controlled Trials (RCTs), systematic reviews, meta-analyses, scoping reviews, and observational studies	Letters, opinion papers, and editorials without empirical data
Main Topic	Telemedicine, telehealth, telemonitoring, non-communicable diseases (NCDs), chronic disease management, and digital health	Purely clinical topics without a telemedicine component
Population	Adult patients with NCDs, healthcare professionals, and the general population	Animal studies, <i>in vitro</i> studies, and pediatric populations without NCDs
Accessibility	Full-text articles available	Abstract-only publications

Sumber: Peneliti, 2025

Year	Number Publication	Percentage (%)	Description
2022	0	0,00	No relevant publications identified
2023	3	30,00	Initial stage of post-pandemic research resurgence
2024	5	50,00	Peak scientific productivity
2025	2	20,00	Continued growth
Total	10	100,00	

Source: Authors, 2025

The data presented in Table 2 indicate that no publications meeting the inclusion criteria were identified in 2022, suggesting that research specifically examining the impact of telemedicine

on comprehensive NCD management was still in its early stages. The emergence of three publications in 2023 (30.00%) marked the beginning of renewed research interest, directly stimulated by the post-COVID-19 pandemic period, during which global healthcare systems began critically evaluating the long-term effects of the accelerated adoption of telemedicine technologies during the public health emergency.

The most significant increase occurred in 2024, with five publications (50.00%), making it the most productive year within the study period and reflecting the growing maturity of scientific evidence regarding the effectiveness of telemedicine across various NCD conditions. Meanwhile, the two publications identified in 2025 (20.00%) confirm that research growth in this field remains sustainable and shows no signs of stagnation.

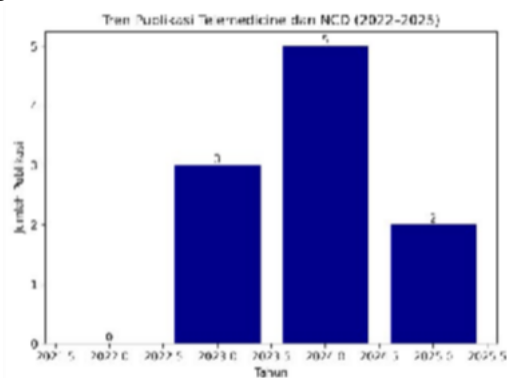


Figure 2. Publication Trend of the 10 Included Articles (2022–2025)

Source: Authors, 2025

Thematic Characteristics and Research Clusters

A comprehensive review of the 10 included articles revealed four dominant thematic clusters that consistently shape the intellectual landscape of global telemedicine research in NCD management. The first cluster focuses on telemedicine interventions for Type 2 Diabetes Mellitus (T2DM), emphasizing technology-based blood glucose self-monitoring and HbA1c control. The second cluster encompasses telerehabilitation and telemonitoring interventions for chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD) and heart failure. The third cluster

addresses telehealth applications within primary healthcare settings and explores patients' perspectives on telemedicine for NCD management. The fourth cluster examines digital health interventions for NCDs in low- and middle-income countries (LMICs). These thematic clusters are summarized in the literature synthesis presented in Table 3.

Table 3. Literature Synthesis

No	Author & Year	Title	Method	Subjects	Key Findings	Relevance to the Study
1	(Aoyfy et al., 2024) ¹⁴	Evidence for telemedicine heterogeneity in rheumatic and musculoskeletal diseases cure: a scoping review	Scoping review, PRISMA-ScR, 5 basis data (1990–2022)	Pasien dewasa penyakit reumatik & muskuloskeletal 1 (RMD), 62 studi diinklusi	Berbagai modalitas telemedicine digunakan platform daring (21/62), aplikasi mobile (18/62), telepon (16/62), video-consultation (5/62), luaran klinis mencakup nyeri, aktivitas penyakit, dan kadar asam urat	Membutkan heterogenitas alat telemedicine dalam pengelolaan NCD kronis; relevan untuk pemetaan variasi modalitas global
2	(Dai et al., 2024) ¹⁵	The effects of telerehabilitation on physiological function and disease symptom for patients with chronic respiratory disease: a systematic review and meta-analysis	Systematic review & meta-analysis; RoB 2; RevMan5.3; 21 RCT; 3.030 partisipan	Pasien penyakit pernapasan kronis (COPD, dll); telerehabilitasi vs rehabilitasi konvensional	Telerehabilitasi on berbasis video conference meningkatkan 6MWD, mMRC, CAT, HADS secara signifikan dalam jangka pendek (<6 bulan); manfaat jangka panjang terbatas	Memberikan bukti meta-analitik kuat tentang efektivitas telerehabilitasi on pada NCD pernapasan
3	(Ellis et al., 2024) ¹⁶	The Effectiveness of Telehealth Intervention on Chronic Kidney Disease Management in Adults: A Systematic Review	Systematic review PRISMA 2020; PubMed, Scopus, Embase, ScienceDirect; 13 studi (10 RCT + 3 single-arm trial)	Pasien dewasa penyakit ginjal kronis (CKD)	Kolaborasi multidisiplin melalui aplikasi mobile, telepon, dan pesan teks meningkatkan fungsi ginjal dan kebiasaan diet; web-based telehealth meningkatkan kualitas hidup pasien CKD	Mengkonfirmasi efektivitas telehealth multidisiplin untuk pengelolaan NCD ginjal secara komprehensif
4	(Habbash et al., 2023) ¹⁷	Telemedicine non-communicable chronic diseases care during the COVID-19 pandemic: exploring	Cross-sectional analitik; kuesioner semi-terstruktur; wawancara telepon; 251	Pasien NCD di pusat layanan primer Bahrain; rata-rata usia 54,48 tahun	92,03% puas dengan konsultasi telemedicine; hanya 56,80% bersedia menggunakannya kembali; hambatan	Menyoroti kesenjangan antara kepuasan sesaat dan kesiapan adopsi jangka panjang telemedicine pada pasien

Source: Dari berbagai literatur

BIBLIOMETRIC ANALYSIS RESULTS

Phase 1: VOSviewer Visualization Analysis

The first phase of the bibliometric analysis generated three keyword co-occurrence visualization maps using VOSviewer software, including the network view, overlay view, and density view. Collectively, these maps represent the intellectual structure of the analyzed literature corpus while revealing the dominant thematic clusters, conceptual relationships among keywords, and the temporal evolution of telemedicine research in the management of non-communicable diseases (NCDs) globally.

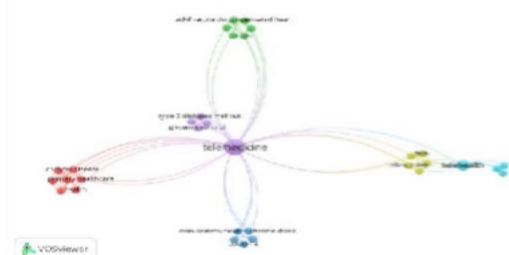


Figure 3. Network View of Keyword Co-occurrence Using VOSviewer

Source: VOSviewer bibliometric analysis results, 2025

As illustrated in Figure 3, the keyword co-occurrence network is divided into five visually distinct clusters, with *telemedicine* serving as the largest central node connecting all clusters. The first cluster (purple/pink) is centered on *telemedicine* as the primary hub with connections throughout the entire network, confirming its position as the core concept within the analyzed literature corpus. The second cluster (green) is dominated by *acute decompensated heart failure (ADHF)* and *COPD* at the upper part of the network, representing research on cardiopulmonary NCDs that utilize telemonitoring and telerehabilitation. The third cluster (light purple) includes *Type 2 Diabetes Mellitus* and *glycemic control*, representing the second-largest research group focused on telemedicine-based blood glucose management (Han et al., 2023; Liu et al., 2024).

The fourth cluster (red), located on the left side of the network, consists of *chronic disease*, *primary healthcare*, and *health*, reflecting the dimensions of primary healthcare services and chronic disease management in general (Sten-Gahmberg et al., 2024; Xiong et al., 2023). The fifth cluster (light blue/yellow), positioned on the right side of the network, comprises *telehealth*, *tele-*, and *telenursing*, indicating research areas focused on nursing-based remote healthcare services and integrated digital health platforms (Aoufy et al., 2024; Ellis et al., 2024).

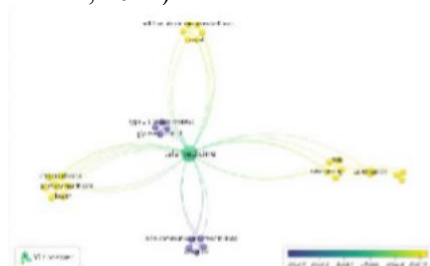


Figure 4. Overlay View: Temporal Keyword

Co-occurrence Map (2023–2024)

Source: VOSviewer bibliometric analysis results, 2025

The overlay map presented in Figure 4 adds a highly informative chronological dimension to the analysis. The color scale ranges from dark blue-purple (2023.0) to bright yellow (2024.0). Keywords displayed in dark blue-purple tones, such as *non-communicable chronic disease*, *COVID-19*, *Type 2 Diabetes Mellitus*, and *glycemic control*, represent concepts that dominated the literature during the earlier period of 2023. This suggests that post-pandemic research initially focused heavily on the impact of COVID-19 on NCD management (Habbash et al., 2023; Han et al., 2023).

In contrast, keywords shown in bright yellow-green colors, including *acute decompensated heart failure (ADHF)*, *COPD*, *telehealth*, *telenursing*, and *chronic disease*, indicate themes that became increasingly prominent toward 2024. This trend reflects a shift in research focus from evaluating the consequences of the pandemic to developing more specific and standardized telemedicine models for various types of NCDs (Stergiopoulos et al., 2024; Aoufy et al., 2024; Sten-Gahmberg et al., 2024).

These temporal findings confirm the existence of a paradigm evolution in telemedicine research for NCD management, transitioning from reactive emergency responses toward more strategic, evidence-based implementations that emphasize long-term clinical outcomes

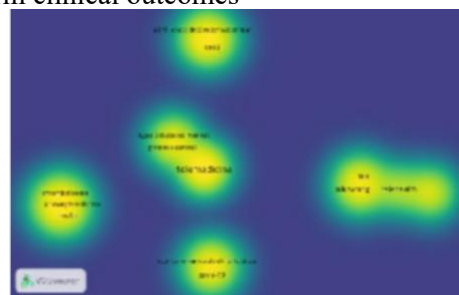


Figure 5. Density View: Keyword Co-occurrence Density Map

Source: VOSviewer bibliometric analysis results, 2025

The density map shown in Figure 5 visually confirms that telemedicine is the keyword with the highest co-occurrence density (the brightest yellow point at the center of the network), followed by the telehealth–telenursing cluster on the right side and the COPD–ADHF cluster at the top of the network as the second most densely populated areas. The chronic disease–primary healthcare–health cluster on the left side and the non-communicable chronic disease–COVID-19 cluster at the bottom occupy medium-density zones (green-yellow), while the type 2 diabetes mellitus–glycemic control cluster in the upper-middle section demonstrates a considerable density level. This density distribution confirms that telemedicine is not merely the most frequently occurring keyword but also serves as the principal bridging concept, co-occurring with nearly all other thematic clusters and highlighting its central role within the entire research landscape analyzed (Liu et al., 2024; Xiong et al., 2023).

Future Research Agenda

Based on the comprehensive synthesis of the ten analyzed articles and the knowledge gaps identified through bibliometric mapping, this study proposes a structured and strategic future research agenda. The thematic cluster mapping reveals that although scientific evidence regarding the effectiveness of telemedicine in NCD management continues to expand, several critical gaps remain insufficiently addressed, particularly concerning long-term effectiveness, disparities in adoption across developing countries, and issues related to ethics and patient data protection. The following research agenda was formulated through cross-cluster analysis and the identification of unresolved priorities within the existing literature.

Table 4. Future Research Agenda: Telemedicine in the Management of Non-Communicable Diseases (NCDs)

No	Priority Area	Required Research Description	Recommended Methods	Urgency
1	Long-term effectiveness of telemedicine for NCDs	Longitudinal studies assessing the sustainability of telemedicine effects on clinical outcomes among NCD patients (HbA1c, blood pressure, readmission rates) for ≥12 months	Longitudinal RCT; mixed-method study	Very High
2	Adoption of telemedicine for NCDs in low- and middle-income countries (LMICs)	Comparative studies examining disparities in telemedicine adoption for NCD management between high-income and LMIC settings, including influencing structural factors	Cross-national comparative study; scoping review	Very High
3	Integration of telemonitoring with electronic health records	Development of standardized protocols for integrating real-time telemonitoring data into clinical decision support systems for multidisciplinary NCD management	Design science research; clinical trials	High
4	Long-term acceptance and adherence among telemedicine users	Exploration of factors influencing patients' willingness to continuously adopt telemedicine beyond immediate satisfaction	Studi kohort; mixed-method; analisis regresi	High
5	Tele-rehabilitation for cardiopulmonary NCDs with follow-up >6 months	High-quality RCTs to confirm the long-term benefits of telerehabilitation for patients with COPD and heart failure, which have not yet been consistently demonstrated statistically	Multicenter RCT; systematic review	High
6	E-prescription and medication adherence through telehealth for NCDs	Evaluation of telehealth-based e-prescription platforms in improving medication adherence among NCD patients, particularly in Southeast Asia	Retrospective cohort study; big data analysis	Moderate-High
7	Ethics, privacy, and security of telemedicine data for NCDs	Development of ethical and regulatory frameworks for managing sensitive clinical data collected through telemedicine platforms, particularly in cross-border contexts	Policy analysis; legal framework review	Very High
8	Telemedicine for vulnerable populations and remote areas	Intervention studies specifically targeting vulnerable populations (older adults, marginalized communities, and remote populations) in long-term NCD management	Community-based participatory research; systematic literature review (SLR)	Very High

DISCUSSION

Acceleration of Telemedicine Research in NCD Management: Post-Pandemic Momentum and Its Implications

The bibliometric findings of this study confirm that global scientific interest in the impact of telemedicine on NCD management has accelerated substantially since 2023. The absence of eligible publications in 2022 suggests that the integration of telemedicine into standardized NCD management was still in its early developmental stage at the beginning of the decade. However, the sharp increase to five publications in 2024 indicates that the global scientific community is rapidly expanding and strengthening the evidence base in this field. This phenomenon aligns with the post-COVID-19 momentum, which structurally accelerated the adoption of telemedicine across healthcare systems worldwide while simultaneously creating an urgent need to evaluate its long-term impact on clinical outcomes among patients with NCDs (Habbash et al., 2023). This growth pattern is also consistent with global trends demonstrating increasing investment in digital health infrastructure, particularly in countries recognizing the economic and public health burdens associated with inadequately managed NCDs (Xiong et al., 2023).

Effectiveness of Telemedicine in Type 2 Diabetes

Mellitus: Consistent Meta-Analytic Evidence

One of the most consistent and robust findings from this literature synthesis is the empirical confirmation of telemedicine effectiveness in the management of type 2 diabetes mellitus (T2DM), which emerged as the second-largest thematic cluster in the keyword co-occurrence map. Liu et al. (2024), through the largest meta-analysis involving 1,456 patients across 20 studies, demonstrated that telemedicine interventions significantly reduced HbA1c levels, two-hour postprandial glucose levels, and both systolic and diastolic blood pressure while simultaneously improving dietary adherence and medication compliance. These findings were reinforced by the prospective randomized controlled trial conducted by Han et al. (2023), which directly compared telemedicine-assisted self-monitoring of blood glucose (SMBG) with conventional approaches and reported significant superiority in HbA1c improvement and reduction of hypoglycemia risk after six months of intervention. Furthermore, subgroup analyses by Liu et al. (2024) revealed a clinically important finding: application-based interventions targeting populations younger than 60 years in Asia and North America demonstrated the highest effectiveness with the lowest heterogeneity, suggesting that demographic and geographic contexts are important moderators that should be considered when designing telemedicine programs for T2DM. The consistency between these studies provides a strong evidence base for policymakers to integrate telemedicine as a standard component of T2DM management protocols at both national and international levels.

Impact of Telemonitoring and Telerehabilitation on Cardiopulmonary NCDs

The most prominent thematic cluster identified in the network view concerns cardiopulmonary NCDs, including COPD, heart failure, and other chronic respiratory diseases. Stergiopoulos et al. (2024), through a comprehensive systematic review of 29 clinical studies involving 4,326 patients, found that telemonitoring of vital signs effectively reduced hospital readmission rates among patients with heart failure and COPD, with all-cause readmissions showing the most consistent improvements. Similarly, Dai et al. (2024), through a meta-analysis of 21 randomized controlled trials involving 3,030 participants, demonstrated that video conference-based telerehabilitation significantly improved functional exercise capacity (6-minute walk distance/6MWD), dyspnea severity (mMRC), COPD Assessment Test (CAT) scores, and mental health status (HADS) over short-term follow-up periods of up to six

months. Nevertheless, both studies consistently identified the same limitation: the long-term benefits (>6 months) could not be confirmed with statistical consistency. Consequently, high-quality randomized controlled trials with larger sample sizes and longer follow-up durations are required to determine the sustainability of telemedicine effects in cardiopulmonary NCD management. These findings carry important clinical implications: telemedicine can be recommended as an effective short-term intervention for preventing exacerbations and hospital readmissions but cannot yet fully replace conventional care models for long-term disease management (Stergiopoulos et al., 2024; Dai et al., 2024).

Patient and Healthcare Professional Perspectives: Between Satisfaction and Implementation Challenges

User experience represents an equally important dimension in evaluating the impact of telemedicine on NCD management. Habbash et al. (2023) identified a striking paradox: although 92.03% of 251 patients with NCDs in Bahrain reported satisfaction with telemedicine consultations, only 56.80% expressed willingness to use the service again in the future. Major barriers included the absence of physical examinations, perceived inadequacy of consultation duration, concerns regarding medical errors, and issues related to data privacy. These findings highlight that immediate satisfaction does not necessarily translate into long-term adoption. Sten-Gahmberg et al. (2024) further explored this issue from the perspectives of both patients and healthcare professionals through 126 in-depth interviews. Their findings revealed that although patients experienced increased feelings of security and improved understanding of their health conditions, the implementation of telemedicine services within primary healthcare settings required substantial dedicated resources and adaptation time. Moreover, the flexibility of telemedicine—often considered its primary advantage—may challenge cost-efficiency when not systematically integrated into existing healthcare workflows. Together, these studies emphasize that successful telemedicine implementation depends not only on technological sophistication but also on how effectively service designs address the actual needs, preferences, and concerns of users (Habbash et al., 2023; Sten-Gahmberg et al., 2024).

Global Disparities: Telemedicine for NCDs in Developing Countries and Digital Health Innovation

Findings from the non-communicable chronic disease—primary healthcare cluster identified in the VOSviewer map reveal one of the most critical and

urgent issues in global telemedicine research: the substantial disparity between high-income countries and low- and middle-income countries (LMICs) in the adoption and utilization of digital health technologies for NCD management. Xiong et al. (2023), through a scoping review encompassing 52 studies from LMICs worldwide, found that only 14 of the 28 digital health intervention categories classified by the World Health Organization (WHO) were identified in developing countries. This finding indicates a critical level of underutilization and innovation gaps. The effectiveness of interventions varied according to outcome type: clinical outcomes produced mixed results, behavioral outcomes were generally positive, and service implementation outcomes demonstrated clearer and more consistent effectiveness. Key factors facilitating successful adoption in LMICs included governmental political commitment, platform interactivity, user-centered design, and integration with existing healthcare systems—factors that remain limited in many developing countries. Yow et al. (2024), examining the Malaysian context, provided a more optimistic perspective by analyzing 739,482 e-prescription records from a telehealth platform. The study found that the most frequently managed NCDs were hypertension (37.7%), diabetes mellitus (25.1%), and ischemic heart disease (24.3%). Although medication use was generally consistent with clinical guidelines, several areas requiring optimization were identified, including the underutilization of specific medication classes relative to recommended standards (Yow et al., 2024; Xiong et al., 2023).

Temuan bibliometrik dalam kajian ini mengkonfirmasi bahwa perhatian komunitas ilmiah global terhadap dampak *telemedicine* dalam pengelolaan NCD mengalami akselerasi yang sangat nyata sejak tahun 2023. Ketiadaan publikasi yang memenuhi kriteria pada tahun 2022 mencerminkan bahwa integrasi konsep *telemedicine* dengan pengelolaan NCD secara spesifik dan terstandarisasi masih berada pada tahap embrio di awal dekade ini. Namun demikian, lonjakan drastis menuju lima publikasi pada tahun 2024 mengindikasikan bahwa komunitas ilmiah global sedang dalam proses mematangkan basis bukti ilmiah di bidang ini secara eksponensial. Fenomena ini selaras dengan momentum pasca-pandemi COVID-19 yang secara struktural

mengakselerasi adopsi *telemedicine* di berbagai sistem kesehatan dunia, sekaligus memunculkan kebutuhan mendesak untuk mengevaluasi dampak nyata teknologi tersebut terhadap luaran klinis pasien NCD dalam jangka panjang (Habbash et al., 2023). Pola pertumbuhan ini juga konsisten dengan tren global yang menunjukkan bahwa investasi dalam infrastruktur kesehatan digital terus meningkat secara signifikan, terutama di negara-negara yang menyadari beban ekonomi dan kesehatan masyarakat yang ditimbulkan oleh NCD yang tidak tertangani secara optimal (Xiong et al., 2023).

CONCLUSION

This bibliometric review and visualization analysis provides a comprehensive intellectual mapping of the global research landscape on telemedicine in the management of non-communicable diseases (NCDs) for the period 2022–2025. The findings indicate a significant acceleration in publication trends following the COVID-19 pandemic, with a peak in research productivity in 2024, reflecting a paradigm shift toward evidence-based digital transformation in healthcare systems.

Substantively, the meta-analytic evidence confirms that telemedicine is effective in improving glycemic control in type 2 diabetes mellitus, reducing readmission rates in cardiopulmonary NCDs, and enhancing functional capacity through telerehabilitation. However, the long-term sustainability of these clinical effects beyond six months remains a key limitation that requires further investigation.

The VOSviewer mapping identified five major thematic clusters that represent the intellectual structure of the field, with telemedicine functioning as the central concept connecting all research domains. In addition, implementation gaps were observed, particularly the discrepancy between high user satisfaction and low sustained adoption, as well as disparities in digital health adoption in low- and middle-income countries (LMICs).

Based on these findings, this study recommends strengthening long-term longitudinal research, developing inclusive digital health infrastructure in LMICs, and establishing ethical and regulatory frameworks for patient data protection to support safe, sustainable, and equitable implementation of telemedicine at the global level.

Conclusion is contained a short statement about the

result of the study in order to answer the research question(s) and objective(s). Author may write down the recommendation based on the result if necessary.

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