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Health Technology Innovations in Community Services: A Bibliometric Analysis of Health Applications, Agribusiness, Telemedicine, and Digital Health Tools

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Abstract

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Background: Rapid advances in digital health technologies have transformed healthcare delivery by improving accessibility, efficiency, and quality of care. While research has largely focused on clinical information systems, disease management, and healthcare infrastructure, limited attention has been given to community empowerment, digital health literacy, behavioral acceptance, and community-based implementation. Mapping the intellectual landscape of health technology innovation is therefore essential to identify research trends and gaps.

Aim: This study maps the global scientific landscape of health technology innovation in community services, identifies dominant and emerging research themes, and provides evidence to support community-based digital health models, particularly in rural and agribusiness settings.

Methods: A bibliometric approach was employed using metadata from internationally indexed publications. Data were analyzed with the Bibliometrix package in RStudio through descriptive bibliometric analysis, co-occurrence network analysis, science mapping, thematic evolution, and conceptual structure mapping to examine publication trends, collaboration patterns, research clusters, and emerging topics.

Results: Health technology research is predominantly centered on telemedicine, digital health systems, electronic health records, disease management, healthcare information technology, and clinical decision-support systems. Telemedicine has emerged as a multidisciplinary research hub linking digital innovation, healthcare management, patient outcomes, service quality, and policy development. However, notable gaps remain in community participation, digital health literacy, behavioral acceptance, community health worker involvement, and the application of behavioral theories, including the Technology Acceptance Model, in community-level implementation.

Conclusion: Integrating technological innovation with community empowerment can strengthen digital health adoption, improve equitable healthcare access, and support sustainable digital health ecosystems, particularly in rural and agribusiness communities.

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INTRODUCTION

The rapid advancement of digital technology has fundamentally transformed healthcare systems worldwide, reshaping the way health services are delivered, managed, and accessed. Health technology innovations, including mobile health applications, telemedicine, electronic health records, wearable health devices, artificial intelligence, and digital decision support systems, have become essential components of modern healthcare (Morris et al., 2022). These technologies enhance clinical decision making, improve healthcare efficiency, facilitate real time monitoring, and expand access to quality health services, particularly for populations experiencing geographical and

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socioeconomic barriers. Consequently, digital health has emerged as a key driver of healthcare transformation, supporting more patient centered, efficient, and sustainable healthcare systems (Cascini et al., 2023; Silva et al., 2025).

The acceleration of digital health adoption has been particularly evident following the COVID 19 pandemic, which highlighted the importance of technology enabled healthcare delivery. During and after the pandemic, healthcare providers increasingly relied on telemedicine platforms, remote patient monitoring, and digital communication technologies to ensure continuity of care while minimizing physical contact. As a result, health technology has evolved beyond a supporting tool into an integrated digital ecosystem that connects healthcare providers, patients, health information systems, and policy makers (Greiner, 2017). This transformation has also stimulated multidisciplinary research on healthcare innovation, emphasizing the integration of digital technologies with clinical practice, health management, and public health services.

In Indonesia, health technology represents a strategic opportunity to strengthen community based healthcare while addressing persistent challenges within the national healthcare system. Community health services continue to face limitations related to healthcare workforce availability, unequal distribution of healthcare facilities, limited access in rural and remote regions, and disparities in digital and health literacy. These challenges reduce the effectiveness of promotive, preventive, and primary healthcare services, particularly among vulnerable populations. The implementation of digital health technologies provides a promising solution by improving healthcare accessibility, supporting early disease detection, facilitating continuous health monitoring, and enhancing communication between healthcare professionals and communities (Pramanik et al., 2019). telemedicine contributes to reducing healthcare inequalities by extending essential healthcare services to underserved communities. Together with other digital health technologies, telemedicine has become a critical component of healthcare system modernization, supporting equitable, accessible, and sustainable healthcare delivery while strengthening community health outcomes (Yang & Silverman, 2014a).

A study by (Saputra & Wijaya, 2021a) shows that telemedicine in Indonesia has been developing since the 1980s and experienced significant acceleration during the COVID-19 pandemic, although it still faces challenges in terms of infrastructure, human resources, and regulations. Furthermore, other research confirms that telemedicine can improve access to healthcare, especially in remote areas, and support efficiency in primary healthcare (Nurminingsih & Purba, 2023a). Globally, studies show that the use of health applications can improve patient health outcomes, expand access to services, and reduce healthcare costs (Jat & Grønli, 2024). However, the implementation of this technology also faces various challenges, such as data security, privacy, and the digital divide. Digital transformation in the healthcare sector also includes the use of technologies such as artificial intelligence, big data, and integrated health information systems. Research by (Hanifa & Wicaksono, 2025) shows that the integration of these technologies can increase the efficiency of healthcare services and support data-driven decision-making, particularly in the context of public healthcare. Furthermore, health information systems such as electronic medical records also play a crucial role in supporting health data management and improving service quality (Pongtambing et al., 2023a). In practice, the implementation of health technology in community services involves not only the technology itself but also the role of health workers as primary users. A systematic study by (Tesa et al., 2026a) showed that health workers, particularly nurses, play a crucial role in implementing digital technology in community services, including as educators, clinical decision-makers, and telehealth service managers (Yang & Silverman, 2014b). However, the study also identified various barriers, such as limited infrastructure, low digital literacy, and a lack of policy support (Sieverdes et al., 2013). Despite its significant potential, the implementation of health technology in community services still faces various complex challenges. One major challenge is the digital divide, which prevents everyone from having equal access to digital technology (Bali, 2019). Furthermore, data security and privacy issues are also important concerns in the use of health technology, particularly in the context of electronic medical data exchange. Research by (Syarifuddin, 2023) emphasizes the importance of strengthening regulations and legal frameworks to support the implementation of telemedicine in Indonesia. Furthermore, user behavior is also a key determinant of the successful adoption of health technology. Research by (Firmansyah et al., 2023a) shows that telemedicine adoption is influenced by various factors,

such as economic value, social support, and perceptions of the technology's benefits. This suggests that the implementation of health technology depends not only on technical aspects but also on the social and psychological factors of users (Riady et al., 2025).

A study by (Oktaviana, 2024) showed that telemedicine can support the integration of primary healthcare services by improving coordination, efficiency, and continuity of services. Furthermore, other research has shown that telemedicine can improve the quality of healthcare services in rural areas and assist in the management of non-critical cases (Salsabila, 2024). Globally, health technology innovation continues to evolve in line with advances in digital technology. Telemedicine, health apps, and wearable devices are becoming part of an increasingly integrated digital health ecosystem. International research shows that health technology has significant potential to increase access to healthcare services, reduce costs, and improve people's quality of life (Jat & Grønli, 2024). However, the successful implementation of this technology depends heavily on the readiness of infrastructure, regulations, and the community's digital literacy (Yellowlees & Shore, 2018). Although numerous studies have been conducted on health technology innovation, the existing literature remains scattered and has not been systematically integrated. This results in a lack of comprehensive understanding of research trends, focus of studies, The combination of these two methods can provide a clearer picture of the research landscape on health technology innovation in community services and identify research gaps that can serve as a basis for further research (Kemp et al., 2021). Furthermore, the results are expected to serve as a reference for researchers, practitioners, and policymakers in developing more targeted health technology implementation strategies (Salman et al., 2021).

Health technology innovation refers to the application of digital technology to improve the quality, efficiency, and accessibility of healthcare services. This innovation encompasses various forms such as mobile health applications, telemedicine, health information systems, and data-driven digital devices. According to (Hafidza & Wicaksono, 2025) digital transformation in the Indonesian healthcare sector has evolved through the integration of technologies such as artificial intelligence, big data, and telemedicine, which support data-driven decision-making. Conceptually, health technology innovation focuses not only on technological aspects but also encompasses changes in service systems, business models, and interactions between patients and healthcare providers. (Pongtambing et al., 2023a) emphasize that health information systems and digital technology serve as the foundation for building integrated and sustainable healthcare services. This demonstrates that health technology innovation is part of a comprehensive health system transformation, not simply the adoption of technological tools. Globally, health technology innovation is also driven by the need to increase health system efficiency and address resource constraints. (Jat & Grønli, 2024) state that digital health technology, particularly mobile health, can increase access to healthcare services, improve clinical outcomes, and reduce service costs. Thus, health technology innovation has great potential in supporting the achievement of a more inclusive and sustainable health system (Bashshur et al., 2016).

Community-based healthcare is a healthcare approach that focuses on the community as the primary subject. This approach emphasizes promotive and preventive efforts by involving active community participation in maintaining their health. In the Indonesian context, this service plays a strategic role in reaching communities in remote areas and improving overall public health. According to (Oktaviana, 2024), the integration of community-based primary healthcare services with digital technology can increase service efficiency and strengthen coordination between healthcare professionals. This demonstrates that healthcare technology can be an enabler in strengthening the community healthcare system. Furthermore, (Salsabila, 2024) stated that the implementation of telemedicine in rural communities can increase access to healthcare services and reduce the service gap between urban and rural areas (Dodoo et al., 2021).

However, the implementation of community health services still faces various challenges, such as limited resources, low health literacy, and a lack of supporting infrastructure. Therefore, the integration of health technology is a relevant solution to improve the effectiveness of community-based health services.

Telemedicine is a form of health technology innovation that enables remote medical services using communication technology. Telemedicine has grown rapidly in recent years, particularly since the COVID-19 pandemic, which has driven the need for contactless healthcare

services. (Saputra & Wijaya, 2021a) explain that telemedicine in Indonesia has experienced significant development, although it still faces challenges in terms of regulation, infrastructure, and human resource readiness. Furthermore, (Nurminingsih & Purba, 2023b) state that telemedicine can improve access to healthcare services, particularly in remote areas with limited healthcare facilities.

(Abugabah et al., 2020) From an implementation perspective, the success of telemedicine is heavily influenced by technological factors, policies, and user acceptance. Emphasized that regulatory and data security aspects are crucial factors in supporting the sustainability of telemedicine in Indonesia. Furthermore, user behavior also plays a significant role in telemedicine adoption (Setiawaty, 2024). Demonstrated that health technology adoption is influenced by perceived benefits, ease of use, and social support.

Mobile health Mobile health (mHealth) is a subset of health technology that utilizes mobile devices to support healthcare services (Li et al., 2020; Odendaal et al., 2020). Health applications allow users to monitor their health, access medical information, and communicate with healthcare professionals in real time. According to (Jat & Grønli, 2024), mHealth has significant potential to improve the quality of healthcare services through remote monitoring, chronic disease management, and health education. In the context of community services, health applications can increase community participation in managing their own health (Jones-Esan et al., 2024). However, mHealth implementation also faces various challenges, such as data security, privacy, and disparities in technology access. Therefore, a comprehensive approach is needed in developing and implementing health applications to provide optimal benefits to the community.

Digital transformation in healthcare is the process of integrating digital technology into all aspects of healthcare. This transformation encompasses not only the use of technology but also changes in work processes, organizational culture, and interactions between stakeholders (Ghosh et al., 2022; Jouni, 2024). Stated that digital transformation in healthcare in Indonesia is driven by the use of technologies such as artificial intelligence, big data, and telemedicine. Furthermore, (Tesa et al., 2026b) emphasized the crucial role of healthcare workers in implementing digital technology, particularly in the context of community healthcare (Dodoo et al., 2021). Digital transformation is also closely linked to improving the quality of healthcare services (Pongtambing et al., 2023b). stated that an integrated health information system can increase service efficiency and support more accurate decision-making. Thus, digital transformation is a key factor in improving the overall performance of the healthcare system.

The development of health technology innovation in community-based services shows an increasing trend, particularly in the use of health apps, telemedicine, and other digital systems. However, based on bibliometric analysis using Bibliometrix RStudio, the scientific structure in this field still shows a fairly clear fragmentation between technological aspects, user behavior, and community context. This indicates that despite rapid technological development, its integration into community-based health services is still suboptimal. Most previous research in Indonesia tends to focus on the development or partial utilization of technology. For example, a study by (Pratama & Hidayat, 2022) showed that the use of health apps in the community is still limited to communication and health information retrieval functions, without strong integration with the broader health service system. This finding aligns with the results of keyword network visualization which show the dominance of terms such as messaging and consultation, indicating that health technology is still in the early stages of digital transformation.

On the other hand, user behavior-based research often adopts frameworks such as the Technology Acceptance Model to explain factors influencing technology adoption. A study (Sari & Nugroho, 2021) found that perceived ease of use and usefulness significantly influence people's intention to use health apps. However, this research is still quantitative and limited to examining relationships between variables, without actual implementation at the community level. Furthermore, community-based research in Indonesia generally emphasizes community empowerment and the role of health workers, such as integrated health post (Posyandu) cadres and community health workers. According to (Wulandari et al., 2020), the success of community-based health programs depends heavily on the active role of cadres in bridging information between health workers and the community. However, this study has not integrated digital technology as part of the service system, thus underutilizing the potential of health technology.

Based on these gaps, the novelty of this research lies in its integration of three key domains that have previously developed separately: digital health technology, user behavior, and community-based service systems. This research not only adopts technology as a tool but also integrates it into a social system that involves community actors as key elements. This approach shifts the paradigm from technology-centric to community-centric, where the success of technology implementation (Handayani et al., 2017) is highly dependent on the social and cultural context of the community. Furthermore, this research also presents methodological novelty through the use of bibliometric analysis as the basis for designing interventions. This approach differs from conventional methods that rely solely on local needs surveys. By utilizing a map of the global scientific structure, the research is able to identify research trends and gaps more comprehensively. This is in line with the opinion of (Firmansyah et al., 2023b) who stated that bibliometric analysis can be used as a strategic tool in designing evidence-based research that is relevant to scientific developments.

Furthermore, this study operationalizes the Technology Acceptance Model framework in a real-world context. While previous research has used the TAM solely to explain user behavior, this study utilizes the TAM factors as the basis for designing intervention programs, such as training on health application use that emphasizes ease of use and practical benefits. This approach provides a novel contribution in connecting theory with practice. Another novelty lies in the transformation of the role of community health workers. In this study, community health workers function not only as service providers but also as technology intermediaries, assisting the community in accessing and using health technology. This aligns with the findings of (Rahmawati & Putra, 2022) who stated that increasing the digital capacity of community health workers can accelerate technology adoption in the community.

METHOD

Desain the research is bibliometric research, analysis of publication data processed using the Bibliometrix package in VOSviewer to identify research structures, trends, and gaps in health technology development. This study employed a bibliometric research design to systematically examine the global scientific landscape of health technology innovations in community services, focusing on health applications, telemedicine, and digital health tools. Bibliographic data were retrieved from the Scopus database using a structured search strategy based on predefined keywords combined with Boolean operators. Only English language journal articles and review papers published within the selected time frame were included, while conference papers, editorials, book chapters, and duplicate records were excluded to ensure data quality and consistency. The retrieved records were exported in BibTeX format and processed using the Bibliometrix package in RStudio. Data preprocessing involved duplicate removal, metadata verification, author name standardization, and keyword harmonization to improve analytical accuracy. The bibliometric analysis comprised performance analysis and science mapping. Performance analysis evaluated annual scientific production, citation performance, leading authors, journals, institutions, and countries. Science mapping included keyword co occurrence, co citation, bibliographic coupling, collaboration network, thematic mapping, thematic evolution, and conceptual structure analysis using Multiple Correspondence Analysis. The results were visualized through Biblioshiny to identify research trends, intellectual structures, collaboration patterns, emerging themes, and knowledge gaps, providing evidence based insights for future health technology innovation and community healthcare research.

The Boolean operators OR were applied to combine synonymous concepts, while AND was used to connect the health technology domain with community healthcare concepts, ensuring comprehensive yet relevant retrieval of publications. Only journal articles and review papers published in English were included, whereas conference papers, editorials, notes, letters, book chapters, and duplicate records were excluded to maintain the quality and consistency of the bibliometric dataset.

The publication period covered 2015–2026, representing more than a decade of scientific development following the rapid expansion of digital health technologies, telemedicine implementation, and healthcare digitalization worldwide. The earliest publication included in the

dataset was published in 2015, while the most recent publication was indexed in 2026, reflecting the latest developments available in Scopus at the time of data retrieval. The initial Scopus search produced a substantially larger number of records than required for bibliometric mapping. To obtain a dataset that remained computationally efficient while preserving representative coverage of the research domain, the publications were sorted by Scopus relevance and screened according to the predefined inclusion criteria. After metadata cleaning, duplicate removal, and eligibility screening, the first 1,500 most relevant articles were selected as the final dataset. This number is considered sufficient for large-scale bibliometric analysis because it captures the dominant intellectual structure, collaboration patterns, citation networks, and thematic evolution while avoiding excessive computational complexity during science mapping in Bibliometrix. Previous bibliometric studies have similarly demonstrated that datasets containing approximately 1,000–2,000 high-quality records are adequate to produce stable and reliable bibliometric networks without substantially altering the overall knowledge structure. The final dataset was exported in RIS format from Scopus and imported into Bibliometrix (version 4.x) using the Biblioshiny interface in RStudio. Data preprocessing included duplicate removal, metadata verification, author name standardization, affiliation normalization, and keyword harmonization to improve analytical accuracy. The bibliometric analysis consisted of performance analysis and science mapping. Performance analysis evaluated annual scientific production, citation performance, leading authors, influential journals, productive institutions, and country contributions. Science mapping included keyword co-occurrence analysis, co-citation analysis, bibliographic coupling, collaboration network analysis, thematic mapping, thematic evolution, and conceptual structure analysis using Multiple Correspondence Analysis (MCA). The visualization outputs generated through Biblioshiny were used to identify research trends, intellectual structures, collaboration patterns, emerging themes, and knowledge gaps, providing evidence-based insights for future health technology innovation and community healthcare research.

RESULTS AND DISCUSSION

Results

Despite the rapid expansion of digital health research over the past decade, the existing body of literature remains predominantly concentrated on clinical and hospital centered healthcare settings. Most studies have focused on the implementation and evaluation of telemedicine, mobile health (mHealth), electronic health records, remote patient monitoring, and artificial intelligence to improve diagnosis, clinical decision-making, disease management, and healthcare delivery within formal healthcare institutions. Consequently, digital health has largely been conceptualized as a technological solution to enhance clinical efficiency, patient management, and healthcare accessibility in hospitals and specialized medical facilities. This concentration has created an important research gap concerning the broader application of digital health within community-based healthcare services. Community health system including primary healthcare centers, community health workers, home-based care, preventive health programs, and public health outreach represent the frontline of healthcare delivery, particularly in low- and middle-income countries. However, comparatively little attention has been devoted to understanding how digital health technologies can support these community-oriented services, facilitate preventive healthcare, strengthen health promotion activities, and improve community engagement beyond institutional clinical environments. Furthermore, although digital health technologies have demonstrated significant potential to improve healthcare accessibility and continuity of care, previous studies have primarily evaluated their effectiveness from clinical perspectives, such as patient outcomes, treatment adherence, diagnostic accuracy, and physician-patient interactions. Limited scholarly attention has been directed toward investigating how digital health ecosystems can enhance healthcare delivery at the community level through collaborative networks involving healthcare professionals, local governments, community organizations, and citizens. As a result, the existing literature provides only a partial understanding of the broader societal implications of digital health transformation.

The current research landscape also exhibits limited integration between technological innovation and community health development. While emerging technologies including mobile applications, wearable devices, cloud computing, Internet of Things (IoT), and artificial intelligence

have become increasingly prominent in digital health research, their potential contributions to strengthening community resilience, expanding preventive healthcare services, promoting health literacy, and supporting decentralized healthcare systems remain underexplored. This imbalance indicates that technological advancement has progressed more rapidly than research addressing its implementation within community-based healthcare ecosystems. Accordingly, there remains a substantial need for a comprehensive examination of how digital health research has evolved beyond hospital centered applications toward community-oriented healthcare services. Mapping the intellectual structure, thematic evolution, and emerging research trends in this area is therefore essential for identifying underexplored topics, revealing future research opportunities, and providing strategic directions for developing more inclusive, accessible and sustainable digital health systems that effectively support community healthcare services. This study addresses this gap by conducting a bibliometric analysis of the digital health literature to identify the evolution of research themes, influential knowledge structures, and emerging directions related to community service-oriented digital healthcare.

Herefore this bibliometric analysis not only illustrates the intellectual evolution of telemedicine research but also highlights broader patterns of digital transformation applicable across multiple sectors. The findings indicate that future innovation will increasingly depend on multidisciplinary collaboration, technological integration, user empowerment, and data-oriented systems capable of addressing complex societal challenges. Consequently, the digital transformation observed in telemedicine can be understood as both a healthcare phenomenon and a broader developmental model for building sustainable, inclusive, and technology-driven systems within sectors such as agribusiness, public services, and community development in the digital era.

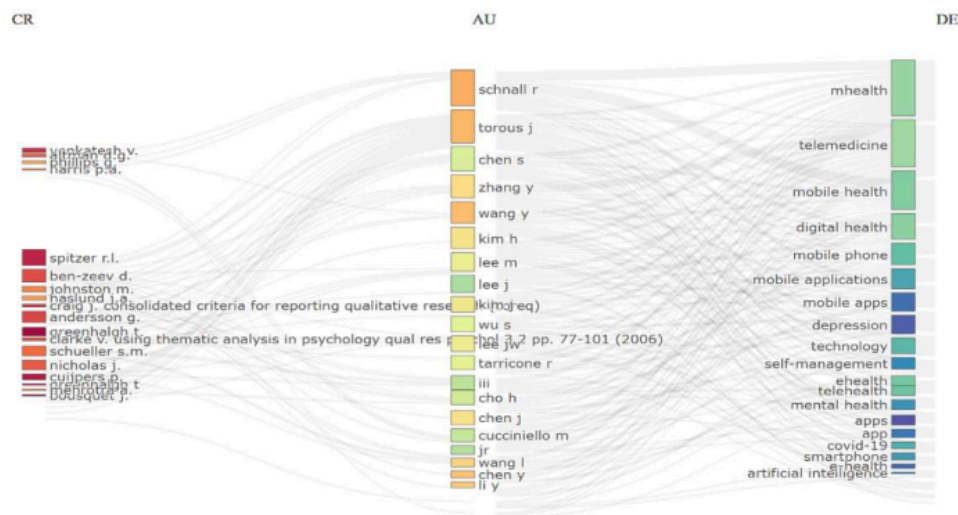


Figure 1. Three-Fields Plot Analysis of Telemedicine Research

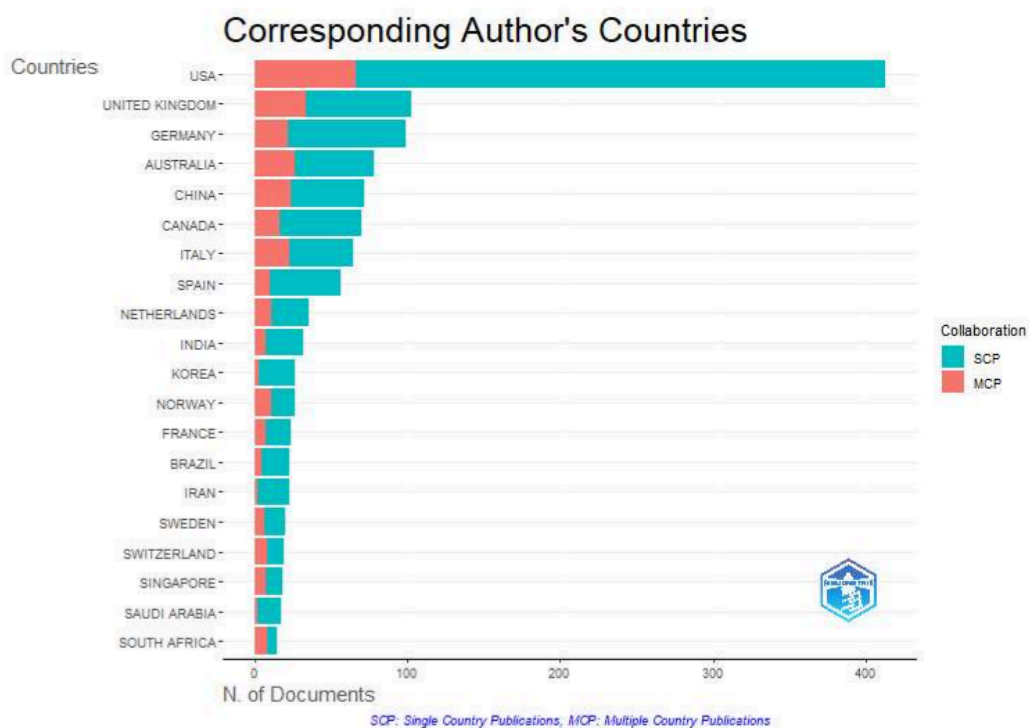


Figure 2. Corresponding Author's Countries in Digital Health Publications

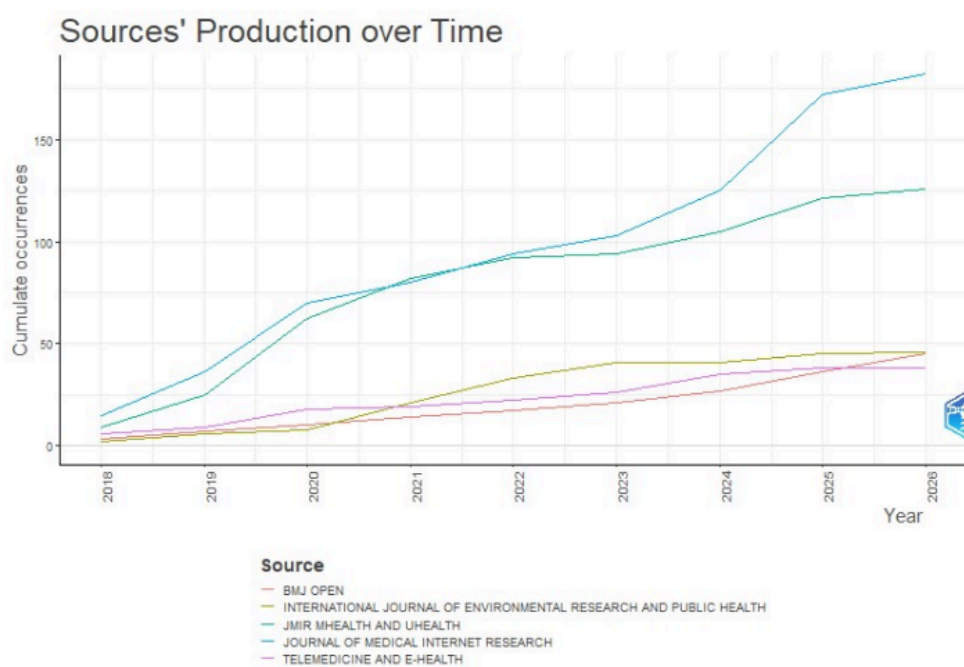


Figure 3. Sources Production Over Time

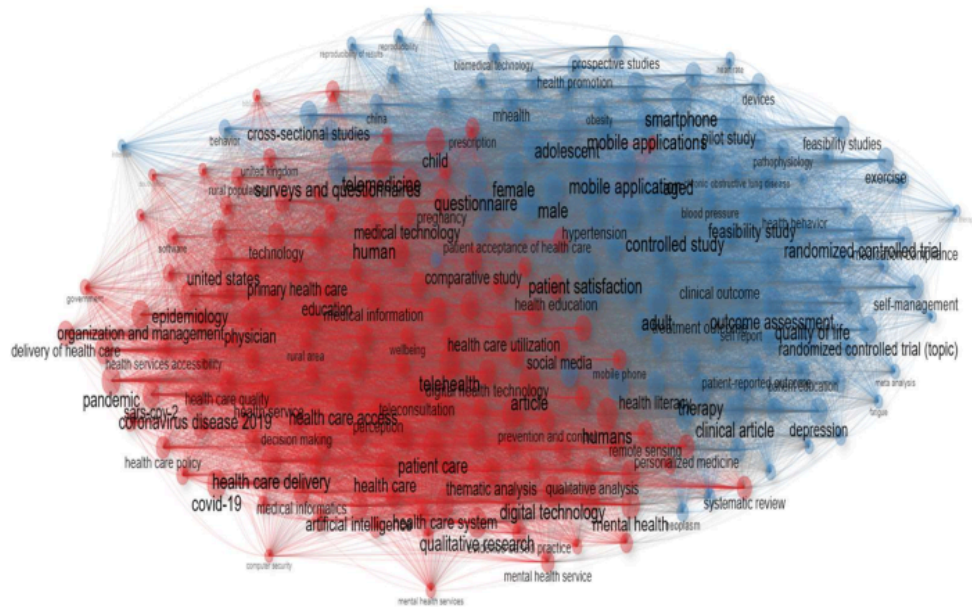


Figure 4. Keyword Co-occurrence Network Mapping

The bibliometric visualization presented through the Three-Fields Plot illustrates the relationship among cited references (CR), authors (AU), and descriptors/keywords (DE), thereby revealing the intellectual structure of telemedicine and digital health research. The interconnectedness among these three dimensions demonstrates how influential authors have shaped the development of telemedicine by introducing concepts related to digital healthcare delivery, remote patient monitoring, mobile health technologies, and patient-centered care. The relational patterns indicate that telemedicine has evolved into a multidisciplinary research field integrating information technology, healthcare services, and digital communication to improve healthcare accessibility, efficiency, and quality. The dominance of keywords such as *telemedicine*, *digital health*, *mobile health*, and *mobile applications* indicates that digital technologies have become the primary drivers of healthcare transformation. These technologies enable healthcare providers to deliver medical consultations, diagnosis, treatment, monitoring, and follow-up services remotely through internet-based platforms and mobile devices. The strong connections between these descriptors and highly cited references suggest that recent research has increasingly focused on expanding healthcare accessibility, reducing geographical barriers, and improving healthcare delivery through digital innovation. Furthermore, the widespread adoption of mobile health applications demonstrates the growing importance of patient-centered digital services that support continuous communication between healthcare professionals and patients. The appearance of descriptors such as *mobile phone*, *app*, and *self-management* further emphasizes the critical role of mobile technologies in empowering patients to actively participate in managing their own health conditions. These keywords reflect a paradigm shift from conventional hospital-centered healthcare toward personalized and decentralized healthcare systems, where patients are supported by digital applications for disease monitoring, medication adherence, symptom reporting, and health education. Mobile devices have become essential tools that facilitate continuous healthcare interactions, allowing patients to receive timely medical guidance regardless of geographical location while simultaneously enhancing treatment adherence and long-term health outcomes.

In addition, the strong link between influential authors and descriptors related to telemedicine reflects the growing integration of emerging digital technologies into healthcare systems. Research has increasingly explored the application of artificial intelligence, wearable health devices, electronic health records, cloud computing, and Internet of Things (IoT) technologies to strengthen telemedicine services. These technological advancements enhance diagnostic accuracy, enable real-time patient monitoring, facilitate data-driven clinical decision-

making, and improve coordination among healthcare providers. The convergence of these innovations demonstrates that telemedicine is evolving beyond virtual consultations into a comprehensive digital healthcare ecosystem. The cited references occupying central positions within the Three-Fields Plot further indicate that foundational studies continue to influence contemporary research directions. These seminal publications have established the theoretical and practical foundations of telemedicine by examining technology acceptance, implementation challenges, healthcare accessibility, patient satisfaction, clinical effectiveness, and health system integration. Their strong relationships with recent authors and descriptors demonstrate a cumulative process of scientific knowledge development, where current studies extend previous findings while adapting telemedicine applications to emerging healthcare needs and technological advancements.

Overall, the Three-Fields Plot reveals that telemedicine research has developed around interconnected themes involving digital healthcare technologies, patient empowerment, mobile health applications, and integrated healthcare delivery systems. The close relationships among cited references, leading authors, and dominant descriptors demonstrate a mature and rapidly expanding research landscape that continues to evolve alongside technological innovation. These findings suggest that future telemedicine research will likely emphasize intelligent healthcare systems, personalized digital medicine, remote monitoring technologies, and sustainable digital health infrastructures capable of improving healthcare accessibility, efficiency, and quality on a global scale (Widodo & Santoso, 2021). market prices, cultivation techniques, fertilizer use, and pest control strategies. Consequently, agribusiness digitalization not only enhances production efficiency but also strengthens farmers' decision-making capacity through data- and information-driven approaches. In addition, the appearance of the keyword *artificial intelligence* demonstrates that research has evolved toward the utilization of intelligent technologies within service systems. In agribusiness, the application of artificial intelligence holds significant potential for supporting *precision agriculture*, crop yield prediction, soil quality analysis, and more efficient agricultural supply chain management. The integration of artificial intelligence into agribusiness systems can improve agricultural productivity while simultaneously reducing the risks associated with climate change, pest infestations, and market instability. Therefore, the research development patterns reflected in the visualization represent a broader trajectory of digital transformation that is also highly relevant to sustainable agribusiness development.

Within the *authors* dimension, several researchers appear to possess high connectivity across multiple research themes. From a bibliometric agribusiness perspective, this condition indicates the importance of multidisciplinary collaboration in developing digital innovation. Agribusiness transformation cannot rely solely on agricultural approaches but instead requires the integration of information technology, business management, digital communication, and community empowerment. Authors with high connectivity within the visualization may therefore be interpreted as academic actors who play a strategic role in building interdisciplinary knowledge networks that support technology-based innovation (Virnanda & Simangunsong, 2026).

The relationship between authors and keywords also demonstrates that current digital research is highly oriented toward practical solutions for societal needs. In agribusiness, this pattern may be interpreted as the necessity to develop technologies that are accessible to farmers, food-based SMEs, and rural agricultural communities (Anggo et al., 2025). This is particularly important because one of the major challenges in modern agribusiness is the disparity in technological and informational access between urban and rural areas. Accordingly, agribusiness digitalization should not merely focus on technological innovation but must also emphasize sustainability, inclusivity, and the empowerment of farming communities.

On the *cited references* side, the appearance of references such as Braun and Clarke (2006) concerning *thematic analysis* indicates that many studies employ qualitative approaches to understand user behavior toward technology adoption. In relation to agribusiness, such approaches are highly relevant for examining farmers' acceptance of digital innovations, levels of agricultural technological literacy, and barriers to the adoption of digital agribusiness systems. Qualitative research in digital agribusiness is particularly important because the successful implementation of technology is determined not only by the sophistication of the system itself but also by the social, cultural, and economic readiness of its users.

Overall, the *Three-Fields Plot* visualization demonstrates that the development of digital technology-based research possesses strong connections with the transformation of modern agribusiness. The dominance of themes such as *digital health*, *mobile applications*, and *artificial intelligence* reflects the evolution of knowledge toward adaptive and integrated technology-based service systems. In the context of agribusiness, these patterns may be interpreted as significant opportunities for developing *digital agribusiness* through the utilization of mobile applications, artificial intelligence, and community-based information systems to improve production efficiency, market access, farmer empowerment, and the sustainability of the agricultural sector in the digital era.

Discussion

The bibliometric analysis reveals that global research on health technology innovations in community services has evolved into several interconnected thematic domains, with telemedicine, mHealth, mobile health, digital health, and mobile applications emerging as the most prominent research topics. The three field plot (Figure 1) demonstrates strong relationships among influential references, productive authors, and frequently occurring author keywords, indicating that scientific attention has increasingly focused on digital technologies that improve healthcare accessibility and delivery. The high frequency of keywords such as *telemedicine*, *mHealth*, *digital health*, and *mobile applications* suggests that mobile based technologies have become the primary platforms for extending healthcare services beyond conventional clinical settings. This finding reflects the global transition toward digitally supported healthcare systems that emphasize accessibility, continuity of care, and patient engagement. The keyword co occurrence network (Figure 2) further illustrates the intellectual structure of this research field by identifying two major thematic clusters. The first cluster is centered on telemedicine, health care delivery, primary health care, health care access, telehealth, and health care systems, demonstrating that existing studies primarily investigate digital technologies as mechanisms for improving healthcare accessibility, service organization, and clinical communication. The close relationships among these keywords indicate that telemedicine is increasingly recognized as an integral component of healthcare system strengthening rather than merely a technological innovation. This cluster also includes terms related to the COVID 19 pandemic, reflecting the significant role of public health emergencies in accelerating the adoption of digital healthcare services. The second thematic cluster is dominated by keywords including mobile application, mHealth, smartphone, quality of life, health promotion, patient satisfaction, clinical outcome, self management, and controlled study. This cluster demonstrates that recent research has shifted toward evaluating the effectiveness of digital health technologies in improving patient outcomes, promoting healthy behaviors, and supporting disease self management. The presence of keywords such as *quality of life*, *patient satisfaction*, and *clinical outcome* indicates that contemporary research is no longer limited to technology development but increasingly emphasizes the impact of digital health interventions on healthcare quality and patient centered outcomes.

An important finding emerging from both bibliometric visualizations is the central role of health education, health literacy, and digital technology as connecting elements between the two thematic clusters. Their bridging positions suggest that the successful implementation of health technologies depends not only on technological availability but also on the ability of communities to understand, accept, and effectively utilize digital health services. Therefore, community capacity building should be regarded as an essential component of digital health implementation.

Implications for Community Service The bibliometric findings provide clear evidence that community service programs should prioritize strengthening community capacity rather than merely introducing digital health technologies. Since telemedicine, mobile health, and digital health consistently appear as dominant research themes, community service initiatives should focus on improving digital health literacy, facilitating technology adoption, and enhancing community participation in digital healthcare. These findings support the development of community based interventions that emphasize practical digital competencies and sustainable technology utilization.

Based on the identified research trends, a community service implementation model can be developed consisting of four sequential stages. The first stage involves community needs assessment, aiming to identify the existing level of digital health literacy, technology readiness, and

barriers to technology adoption. The second stage consists of capacity building, including training on the use of telemedicine platforms, mobile health applications, and digital health tools for both community members and community health workers.⁶² The third stage focuses on technology assisted health services, where participants apply digital health technologies for remote consultation, disease monitoring, health promotion, and self management activities under professional supervision. Finally, the fourth stage comprises program evaluation, measuring digital health literacy, technology adoption, user satisfaction, utilization frequency, and perceived accessibility to healthcare services.

This implementation model is directly derived from the bibliometric evidence rather than conceptual assumptions. The dominance of keywords related to telemedicine, mobile health, self management, health promotion, patient satisfaction, and healthcare accessibility demonstrates that these components represent the current scientific priorities in digital health research. Consequently, community service activities should integrate these evidence based themes into practical interventions that strengthen community engagement and improve the adoption of digital health technologies. Such an approach not only aligns community service programs with contemporary scientific developments but also enhances the sustainability and effectiveness of digital healthcare implementation at the community level.

The results of this bibliometric analysis indicate that telemedicine research has developed into a multidisciplinary field integrating healthcare services, digital technology, patient-centered care, and data-driven innovation. The strong relationship among keywords demonstrates that telemedicine is no longer limited to remote consultation tools, but has evolved into a comprehensive digital healthcare ecosystem that supports healthcare accessibility, efficiency, and sustainability. The red cluster¹⁷ highlights the importance of healthcare systems, telehealth policy, and digital transformation, especially after the COVID-19 pandemic.⁸ This finding shows that telemedicine has become a strategic solution for overcoming healthcare access limitations, particularly in rural and underserved areas. In addition, the blue cluster emphasizes the growing role of mobile health technologies, clinical evaluation, and patient satisfaction, indicating that telemedicine research increasingly focuses on evidence-based healthcare practices and measurable clinical outcomes. Another important finding is the shift toward patient-centered healthcare models.⁶ Keywords such as self-management and quality of life illustrate that digital technologies enable patients to become more actively involved in managing their health conditions. Furthermore, the emergence of artificial intelligence within telemedicine research reflects the movement toward intelligent and predictive healthcare systems capable of improving diagnosis, monitoring, and personalized treatment.

Beyond the healthcare sector, the findings also reveal that telemedicine concepts can be adapted into other fields such as digital agribusiness. Technologies such as mobile platforms, artificial intelligence, and digital monitoring systems have the potential to improve agricultural productivity, information accessibility, and decision-making processes for farming communities. Therefore, this study demonstrates that telemedicine not only represents healthcare innovation, but also serves as a broader model for sustainable digital transformation across multiple sectors.

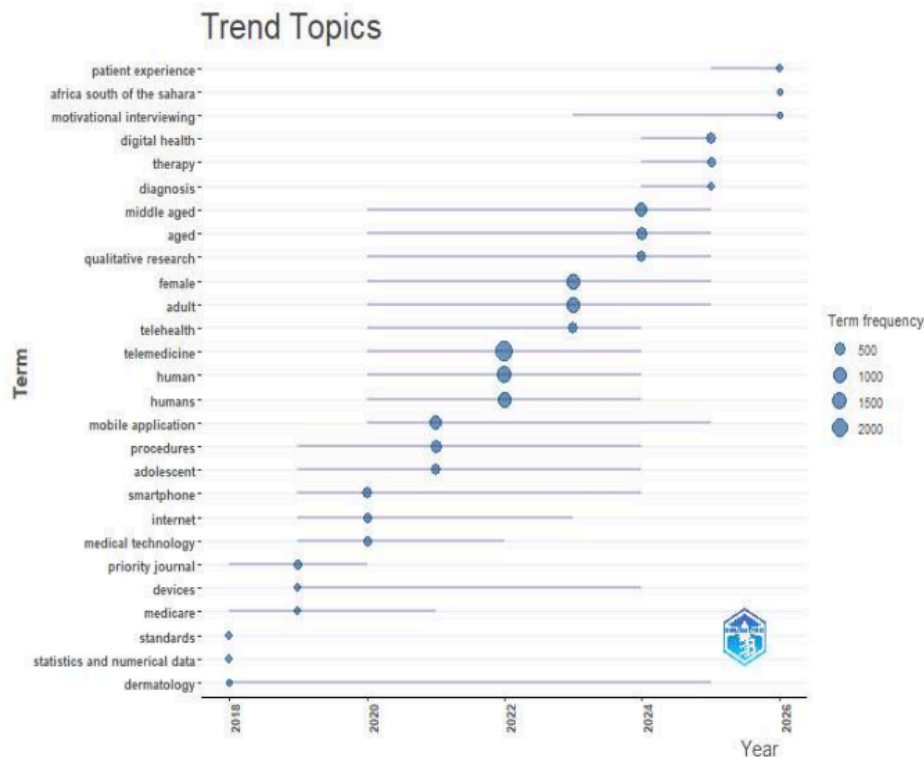


Figure 5. Trend Topics

Implications

This study provides several important implications theoretically, practically, and socially. Theoretically, the findings confirm that telemedicine has evolved into an interdisciplinary research field integrating healthcare, digital technology, artificial intelligence, and patient-centered systems. This development expands the understanding of digital transformation within modern healthcare management and strengthens the relevance of technology-driven healthcare theories. Practically, the study implies that healthcare institutions and policymakers should strengthen digital healthcare infrastructure, improve telemedicine accessibility, and support the integration of mobile health applications and artificial intelligence into healthcare services. The findings also highlight the importance of patient-centered digital systems that improve healthcare efficiency, service quality, and healthcare accessibility, especially for rural and underserved communities (Bogati, 2025).

From a broader perspective, the study implies that the digital ecosystem model found in telemedicine can be adapted into other sectors such as agribusiness. Technologies including mobile platforms, data-driven systems, and artificial intelligence may support agricultural productivity, monitoring systems, and decision-making processes for farmers. Therefore, telemedicine serves not only as a healthcare innovation model but also as a framework for sustainable digital transformation across multiple sectors.

2 Research contribution

This research contributes to the literature by providing a comprehensive bibliometric analysis of telemedicine research and identifying the major themes, research trends, and intellectual structures within the field. The study demonstrates how telemedicine has evolved from a simple remote healthcare communication tool into an integrated digital healthcare ecosystem involving healthcare systems, mobile technologies, artificial intelligence, and patient-centered services.

In addition, this study contributes theoretically by highlighting the multidisciplinary nature of telemedicine research, particularly the interconnection between healthcare, technology, digital

innovation, and service management. The findings also enrich the understanding of digital transformation theory within healthcare systems and demonstrate the growing importance of evidence-based digital healthcare practices.

Practically, this research provides insights for healthcare institutions, policymakers, and technology developers regarding the importance of strengthening digital healthcare infrastructure and integrating advanced technologies such as artificial intelligence and mobile health systems into healthcare services. Furthermore, the study contributes by introducing the possibility of adapting telemedicine concepts into other sectors, particularly digital agribusiness, as a model for sustainable and technology driven development.

8 Limitations

This study has several limitations³ that should be considered in interpreting the findings. First, the bibliometric analysis was limited to publications indexed within a specific database, which may exclude³ relevant studies published in other databases or non-indexed sources. As a result, the analysis may not fully represent the entire body of global telemedicine research. Second, the study focused primarily on keyword co-occurrence and network visualization, meaning that the analysis emphasized research patterns and thematic relationships rather than examining the detailed content or methodological quality of individual studies. Therefore, the findings reflect general research trends rather than specific empirical conclusions. Third, bibliometric analysis is highly dependent on the accuracy and consistency of keywords used by authors. Differences in terminology, keyword selection, and indexing practices may influence the network structure and clustering results. Finally, this study mainly analyzed the development of telemedicine research from a quantitative bibliometric perspective and did not include qualitative exploration of policy implementation, technological challenges, or user experiences. Future studies are recommended to combine bibliometric methods with systematic literature reviews or empirical approaches to provide deeper and more comprehensive insights into telemedicine development and its crosssector applications.

Suggestions

Future research is recommended to use multiple databases and combine bibliometric analysis with systematic literature reviews¹¹ empirical studies to obtain more comprehensive results. Further studies should also explore the role of artificial intelligence, big data, and digital platforms in improving telemedicine services and healthcare quality. In addition, future research may examine the application of telemedicine concepts in other sectors such as digital agribusiness and community services to support sustainable digital transformation.

CONCLUSION

This bibliometric study demonstrates that digital health research has evolved around four dominant themes: telemedicine, mobile health, digital health applications, and patient centered healthcare. The mapping reveals a growing integration of artificial intelligence, mobile technologies, and digital platforms into healthcare systems, reflecting a shift toward more accessible, personalized, and technology enabled healthcare services. These findings indicate that digital health is increasingly positioned as a comprehensive ecosystem supporting remote healthcare delivery, patient engagement, and continuous health management. Despite this rapid development, the bibliometric mapping identifies a significant research gap. Existing studies remain predominantly focused on clinical and hospital settings, while relatively limited attention has been given to the implementation of digital health technologies in community healthcare services. Consequently, further research is needed to explore how digital health can strengthen health promotion, disease prevention, and primary healthcare delivery within community settings.

The findings also provide practical directions for community service activities. Future community engagement programs should prioritize improving digital health literacy, enhancing the capacity of healthcare workers and community members to utilize

telemedicine and mobile health applications, and promoting the sustainable adoption of digital health technologies. Such initiatives can contribute to expanding healthcare access, increasing community participation, and supporting more inclusive and resilient community healthcare systems.

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AUTHOR CONTRIBUTION STATEMENT

² The Author did all the research and writing from the beginning until the ending.

AI DISCLOSURE STATEMENT

I hereby declare that the manuscript submitted is an original ³⁰ scholarly work conducted and written by the author. The ideas, analysis, interpretations, arguments, and conclusions presented in this article are the result of the author's own academic research and intellectual effort. Furthermore, this manuscript was not generated, written, or produced by any artificial intelligence (AI) system. Any writing, analysis, and scientific contributions contained herein were developed independently by the author in accordance with accepted academic and research ethics standards.

⁴³

CONFLICTS OF INTEREST

We have no conflict of interest regarding this article, hopefully this article can run well.

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