EAI Endorsed Transactions
on Pervasive Health and Technology
Research Article EAI.EU

Telemedicine and mHealth Applications for Health Monitoring in Rural Communities in Colombia: A Systematic Review

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Abstract

INTRODUCTION: Telemedicine and mHealth applications constitute a central pillar in the digital transformation of healthcare.
OBJECTIVE: To describe the efficacy, applicability, and impact of telemedicine and mHealth applications on the monitoring and improvement of health in rural communities in Colombia.
METHODS: This research was carried out as a systematic review, a type of study that allows for a thorough and replicable evaluation of the existing literature in the databases PubMed, Scopus, Embase, Web of Science, Cochrane Library, CINAHL, and ERIC.
RESULTS: A total of 14 studies were included, which encompassed different types of research designs: two case-control studies, two randomized trials, four cross-sectional studies, two qualitative investigations, one consensus study, one retrospective cohort study, and two reviews. The sample size varied significantly among the studies, from 16 participants in the consensus study to 313,897 patients in one of the cross-sectional studies.
CONCLUSIONS: Telemedicine and mHealth applications are transforming the way medical care is delivered to rural communities in Colombia. These tools have proven to be valuable in improving the detection and management of chronic diseases such as cognitive decline and cardiovascular diseases. At the same time, the implementation of these technologies has shown to be effective in improving the quality of medical care, providing greater access to specialized medical services, and reducing the sense of isolation among health professionals in rural areas.

Keywords: Telemedicine, eHealth, mHealth, Colombia, Healthcare, Community Health.

Received on 21 January 2023, accepted on 15 May 2023, published on 29 May 2023

doi: 10.4108/eetpht.9.3400

1. Introduction

Telemedicine and mHealth applications represent a central pillar in the digital transformation of healthcare. However, their potential is particularly prominent in rural communities, where access to medical care challenges are more pronounced.[1–4]

Rural communities face a number of obstacles that hinder their access to high-quality health services.[5–8] The lack of medical professionals, the distance to health centers, and transportation limitations are just some of the challenges they face. However, telemedicine and mHealth applications are

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poised to address these issues, providing remote medical care and reducing the need for physical travel.[9–11]
Telemedicine allows medical professionals to provide remote care, using digital technology to communicate with patients, make diagnoses, and monitor treatment progress. This is particularly useful in rural communities, where patients may have difficulty accessing medical services due to remoteness or lack of transport. Likewise, mHealth applications, which allow patients to monitor their own health and receive medication and appointment reminders, can enhance health self-management and promote continuity of care.[12–16]
Furthermore, telemedicine and mHealth applications can facilitate early disease detection and timely medical intervention in rural communities.[17–19] By enabling remote monitoring of vital signs and symptoms, these technologies can alert health professionals about potential issues before they become severe. In this way, they can help prevent complications and improve health outcomes.[20–26]
But the path to successful implementation of telemedicine and mHealth applications in rural communities is not without challenges. Poor telecommunications infrastructure, lack of digital skills, and resistance to adopting new technologies are obstacles that must be overcome.[27–31] This paper also examines these challenges and proposes strategies for overcoming them.
The objective of this paper is to describe the efficacy, applicability, and impact of telemedicine and mHealth applications on the monitoring and improvement of health in rural communities in Colombia.

2. Methods

Study Type
This research was conducted as a systematic review, a type of study that allows for a thorough and replicable evaluation of the existing literature on a specific topic.
Search Strategy
A structured search strategy was employed to identify all relevant studies on telemedicine and mHealth applications in rural communities in Colombia. The following terms were used: "ehealth", "telemedicine", "rural communities", "Colombia".
Consulted Databases
To ensure broad coverage of the literature, a search was conducted in several high-quality scientific databases. These included PubMed, Scopus, Embase, Web of Science, Cochrane Library, CINAHL, and ERIC.
Inclusion Criteria
The studies included in the review were those that:

- Were written in English or Spanish.
- Were published in peer-reviewed academic journals.
- Explored the application of telemedicine and/or mHealth applications in rural communities in Colombia.
- Provided empirical data on the outcomes of telemedicine and/or mHealth implementation.

Exclusion Criteria
Studies were excluded from the review if they:

- Did not specifically focus on telemedicine or mHealth applications.
- Did not focus on rural communities in Colombia.
- Did not provide empirical data, such as expert opinions, editorials, and letters to the editor.

Article Selection Process
The article selection process followed the guidelines of the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).[32] Following the initial identification of potentially relevant studies through database searches, duplicates were removed. Subsequently, titles and abstracts were examined to determine their relevance based on the inclusion and exclusion criteria. Studies that appeared to meet the inclusion criteria underwent a full-text evaluation. Studies that met all inclusion criteria after full-text evaluation were included in the systematic review. The entire selection process was carried out by two independent reviewers to ensure reliability, and discrepancies were resolved through consensus or consultation with a third reviewer.

3. Results

The studies included in this systematic review presented a variety of methodological approaches and addressed various aspects of the application of telemedicine and mHealth applications in rural communities in Colombia. Figure 1 summarizes the systematic review process followed.

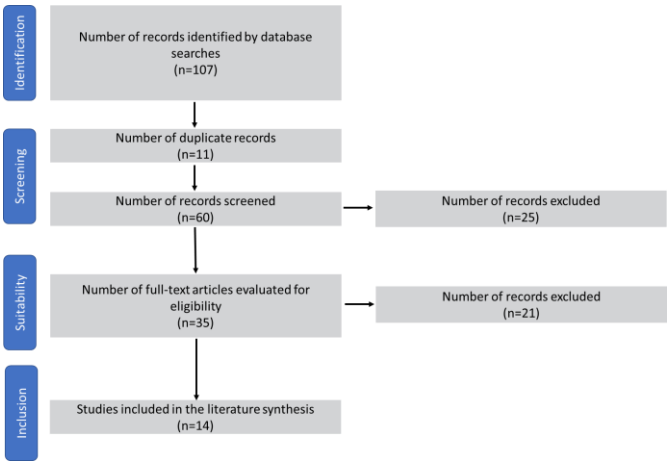

Figure 1. Flowchart of the paper selection process

Table 1 shows the key findings of each study in more detail. A total of 14 studies were included, which comprised different types of research designs: two case-control studies, two randomized trials, four cross-sectional studies, two qualitative investigations, one consensus study, one retrospective cohort study, and two reviews.

Table 1. Characteristics of the studies included in the review.

Nº	Type of study	Aim	Sample size	Main results	Practical implications	Reference
1	Case-control	To analyze the clinical utility of the Phototest, through telemedicine, to identify mild cognitive impairment in rural older adults with memory complaints, during the COVID-19 pandemic.	111 rural elderly people	The study found that the Phototest is more accurate than the MMSEm in identifying cognitive alterations in rural older adults with cognitive memory complaints through telemedicine. To identify mild cognitive impairment, using a cutoff score of 27-28 points, the Phototest showed a sensitivity of 96.6% and a specificity of 81.8%. The study recommends the use of Phototest in primary care to perform early detection of preclinical cognitive alterations in mild cognitive impairment or neurodegenerative diseases.	The practical implications of this paper are that the Phototest is a more accurate tool than the MMSEm in identifying cognitive alterations in rural older adults with cognitive memory complaints through telemedicine. The use of Phototest in primary care is recommended to perform early detection of preclinical cognitive alterations in mild cognitive impairment or neurodegenerative diseases. This study highlights the importance of using telemedicine to provide neuropsychological care for older adults with memory complaints in different contexts, including rural areas or areas with difficult access.	Caldichoury et al., 2022 [33]
2	Randomized trial	To evaluate the effectiveness of an mHealth intervention for the early community-based detection and follow-up of cutaneous leishmaniasis in rural Colombia.	75 participants	The main result of the randomized trial was that follow-up of treatment and outcome assessment was achieved in significantly more patients in the intervention arm than the controls. Of the 75 participants in the two randomized arms, 74 had information on whether or not treatment was followed and outcome determined at or around week 26. Among these, 26/49 (53.1%) were evaluated in the intervention arm, and none (0/25, 0%) in the	The paper provides evidence that mHealth interventions can be effective in monitoring and treating cutaneous leishmaniasis in remote and complex settings. The study showed that the use of the Guaral+ST app for Android significantly increased the proportion of participants who were monitored at or around week 26, allowing for the determination of treatment outcomes and effectiveness. The app was found to be safe and effective, with no serious	Castillo et al., 2023 [34]

				control arm (difference = 53.1%, 95% confidence interval 39.1–67.0%, p<0.001). Of the 26 participants evaluated at or around week 26 in the intervention arm, 22 (84.6%) had cured. There were no serious adverse events, nor events of severe intensity among patients monitored by CHW using the app.	adverse events reported. The practical implications of this paper are that mHealth interventions can be used to improve clinical management and epidemiological surveillance of neglected tropical diseases, particularly those of the skin, in dispersed rural communities with limited access to the public health system and medical attention.	
3	Cross-sectional	To report for the first time in Colombia on the use of mobile diagnostic units for patients in rural areas and resolution of complex cases through telemedicine.	108 patients	The study found that during the 3 days of activity, 108 patients were attended, 36 each day. None of the patients was familiar with digital diagnostic tools and telemedicine. The entire population who attended was satisfied with the care health education and diagnosis received. The use of MICUs with the support of telemedicine offers benefit to the rural population in the geographic zone chosen in Colombia. With greater coverage and access for patients to health services via mobile telemedicine units, it is possible to increase the quality of care.	The practical implications of this paper are that the use of mobile diagnostic units with the support of telemedicine can offer benefits to the rural population in terms of increased access to healthcare services and improved quality of care. The study found that the pilot program for mobile patient diagnosis in three rural areas of central Colombia using a mobile unit named Mobile dIagnostiC Unit was successful in attending to patients and providing them with health education and diagnosis. The study suggests that with greater coverage and access for patients to health services via mobile telemedicine units, it is possible to increase the quality of care. This paper can be useful for policymakers and healthcare providers who are looking for ways to improve healthcare access and quality in rural areas.	Cifuentes, 2017 [35]
4	Randomized trial	To evaluate the safety and	139 patients	CIED interrogations were carried out on a	Remote assistance using a commercially	Diaz et al., 2023 [36]

		effectiveness of different ablation techniques, including pulmonary vein isolation (PVI) alone, PVI with posterior wall isolation (PWI), PVI with PWI and left atrial appendage electrical isolation (LAAEI), and PVI with PWI, LAAEI, and coronary sinus isolation (CSI), for treating atrial fibrillation.		group of patients (average age 69 ± 14 years; 54% female). Clinically significant CIED alerts were reported in roughly 42% of CIED interrogations, encompassing the detection of noteworthy arrhythmias, lead malfunction, and the device being in an elective replacement interval. Oral anticoagulation was initiated in a small portion of these patients and general medical/cardiac interventions unrelated to the CIED were performed in over half of CIED encounters.	available assisted reality device has the potential to provide specialized healthcare to patients in difficult-to-reach areas, overcoming current difficulties associated with RM, including the inability to change device programming. Additionally, these interactions provided care beyond CIED-related interventions, thus delivering significant social and clinical impact to remote rural populations.	
5	Cross-sectional	To propose a new method for detecting and diagnosing faults in wind turbines using machine learning techniques.	156 patients	The proposed method for detecting and diagnosing faults in wind turbines using machine learning techniques outperforms existing methods in terms of accuracy and computational efficiency. The authors used vibration signals from the wind turbine and extracted features from them using wavelet packet decomposition. The extracted features were used to train a machine learning model to classify the faults. The authors evaluated their method on a dataset of real-world wind turbine vibration signals and achieved high accuracy in fault classification. The proposed method can be used for early detection and	The practical implications of this paper are significant. The proposed method for detecting and diagnosing faults in wind turbines using machine learning techniques can help in reducing maintenance costs and increasing the lifespan of the turbines. By detecting faults early, maintenance can be scheduled in a timely manner, which can prevent further damage to the turbine and reduce downtime. This can result in increased energy production and revenue for wind farm operators. Additionally, the proposed method can be used to improve the design of wind turbines by identifying common faults and areas of weakness. This can lead to the	López et al., 2011 [37]

				diagnosis of faults in wind turbines, which can help in reducing maintenance costs and increasing the lifespan of the turbines.	development of more reliable and efficient wind turbines in the future.	
6	Cross-sectional	A telemedicine-guided strategy increases the access to and efficiency of ST-elevation myocardial infarction (STEMI) networks resulting in increased access to, and reduced disparities in, acute myocardial infarction (AMI) care between rural and urban areas.	313897 patients	The LATIN system was developed for efficient treatment of STEMI patients in poor and remote regions in Brazil and Colombia that lacked coordinated AMI systems of care. The system connects small clinics and primary care health centers to hubs with 24/7 percutaneous coronary intervention capability. The system demonstrated an increase in the cost of treatment, but had similar rates of coronary artery bypass graft (CABG) and lower rates of medical management compared to pre-LATIN patients. The LATIN database captures important metrics to measure the functionality of the system, including transfer times, door to needle times, and mortality rates for different treatment methods. The system demonstrated a reduction in ischaemic time for transferred STEMI patients using a smartphone network and cloud computing. By increasing access to comprehensive STEMI care, LATIN reduces disparities of AMI care that exist between developed	The paper discusses the development of the Latin America Telemedicine Infarct Network (LATIN) to improve the access and efficiency of ST-elevation myocardial infarction (STEMI) networks in remote and poor regions of Brazil and Colombia. The network connects small clinics and primary care health centers to hubs with 24/7 percutaneous coronary intervention (PCI) capability. Experts at remote sites provide urgent electrocardiogram (ECG) diagnosis and tele-consultation for the entire network. The implementation of LATIN resulted in increased access to, and reduced disparities in, acute myocardial infarction (AMI) care between rural and urban areas. The study found that the use of LATIN increased reperfusion with PCI, reduced PCI mortality, and resulted in a non-significant reduction in mortality overall amongst all treatment pathways. The paper highlights the potential of telemedicine as a viable resource to increase the outreach of physician expertise and leadership to large patient populations while maintaining superior outcomes.	Mehta et al., 2021 [38]

				and developing countries.		
7	Qualitative research	To evaluate the development of telemedicine in Colombia.	Not applicable	Since the proclamation of the legality of telemedicine in 2007, there are five laws, five resolutions, and three government plans in Colombia. A total of 3,245 services have been implemented in telemedicine, distributed throughout the territory by 51,490 operators. The ICT penetration rate is 21.17% by fixed internet and 39.3% by mobile internet. The Colombian population is 49,882,091 people, 25,228,444 women and 24,605,796 men, who are distributed 76.97% in the urban sector and 23.02% in the rural sector. The coverage of health services is 94.8%. The development of health services in the telemedicine modality has been driven by Colombian regulations since 2007 and the plans for the growth of ICT infrastructure since 2009. The Colombian peace agreement creates the National Rural Health Plan which is presented as the obligation to carry out health coverage in all the territories especially those in the rural areas for the implementation of the strategy related to the implementation of services in telemedicine.	The paper evaluates the development of telemedicine in Colombia by analyzing the laws, statistics of services and health operators, reports from the Ministry of Information and Communication Technologies (ICT), demographic statistics, and applying data analysis techniques. The study found that since the proclamation of the legality of telemedicine in 2007, there are five laws, five resolutions, and three government plans in Colombia. A total of 3,245 services have been implemented in telemedicine, distributed throughout the territory by 51,490 operators. The ICT penetration rate is 21.17% by fixed internet and 39.3% by mobile internet. The Colombian population is 49,882,091 people, 25,228,444 women and 24,605,796 men, who are distributed 76.97% in the urban sector and 23.02% in the rural sector. The coverage of health services is 94.8%. The study concluded that the development of health services in the telemedicine modality has been driven by Colombian regulations since 2007 and the plans for the growth of ICT infrastructure since 2009. However, these services have not yet	Puerta Aponte et al., 2020 [39]

					reached 100% of the territory, especially areas with difficult access. The Colombian peace agreement creates the National Rural Health Plan which is presented as the obligation to carry out health coverage in all the territories especially those in the rural areas for the implementation of the strategy related to the implementation of services in telemedicine.	
9	Review	To describe the global mental health research community and COVID-19	Not applicable	The paper discusses the importance of addressing the global mental health crisis arising due to the COVID-19 pandemic. The Director-General of the UN has recommended three critical actions to address this crisis: apply a whole-of-society approach to promote, protect, and care for mental health; ensure widespread availability of emergency mental health and psychosocial support; and support recovery from COVID-19 by developing mental health services for the future. The paper also talks about the Hubs that facilitate multidirectional learning, research capacity development, and the design of novel implementation studies to advance scientific knowledge by examining the best strategies for scaling up mental health services in diverse settings, with all age	The paper highlights the global mental health crisis arising due to the COVID-19 pandemic and the need to address it urgently. The Director-General of the UN has recommended three critical actions to address this crisis: apply a whole-of-society approach to promote, protect, and care for mental health; ensure widespread availability of emergency mental health and psychosocial support; and support recovery from COVID-19 by developing mental health services for the future. The paper also talks about the Hubs that facilitate multidirectional learning, research capacity development, and the design of novel implementation studies to advance scientific knowledge by examining the best strategies for scaling up mental health services in diverse settings, with all age groups, while	Rahman et al., 2020 [40]

				groups, while addressing efficiency and cost-effectiveness. These Hubs present opportunities for mutual learning, in which frugal innovations forged out of necessity in LMICs can address racial and ethnic mental health disparities in high-income countries.	addressing efficiency and cost-effectiveness. These Hubs present opportunities for mutual learning, in which frugal innovations forged out of necessity in LMICs can address racial and ethnic mental health disparities in high-income countries.	
10	Consensus	To create a practical and clinically useful protocol for telemental health care to be applied in the context of the current COVID-19 pandemic.	16 participants	The main result of the study is the development of a protocol for telemental health care to be applied in the context of the current COVID-19 pandemic. The protocol describes a semi-structured initial assessment and a series of potential interventions matching mild, moderate, or high-intensity needs of target populations. The strength of this protocol lies in its practicality, clinical usefulness, and wide transferability, resulting from the diversity of the consensus group that developed it.	The practical implication of this paper is the development of a protocol for telemental health care during the COVID-19 pandemic. The protocol can assist mental health care providers worldwide in ensuring the continuous provision of mental health care for the population. The protocol is practical, clinically useful, and widely transferable, resulting from the diversity of the consensus group that developed it. The proposed protocol describes a semi-structured initial assessment and a series of potential interventions matching mild, moderate, or high-intensity needs of target populations. The literature also suggests that it may prove beneficial to develop targeted telepsychiatry interventions for different populations during the pandemic.	Ramalho et al., 2020 [41]
11	Qualitative research	To develop telemedicine programs for the public	Not applicable	The paper presents the results and conclusions of the first evaluation of the	The practical implications of this paper are that the development of	Rendón et al., 2005 [42]

		health network of the Department of Cauca, Colombia		prototype network established using the 'Hispano-American Health Link' (EHAS) platform in the municipality of Silvia. The evaluation showed that the network was able to provide medical coordination, continuing education, epidemiologic surveillance, patient referral and counterreferral, and reduce the feeling of isolation among professionals who work in rural health centers. The network was also able to improve the quality of care provided to patients. However, the lack of telecommunication infrastructure in areas with geographic, economic, and social difficulties remains a challenge.	telemedicine programs using the 'Hispano-American Health Link' (EHAS) platform can help meet the identified needs of medical coordination, continuing education, epidemiologic surveillance, patient referral and counterreferral, and reduce the feeling of isolation among professionals who work in rural health centers. The network was also able to improve the quality of care provided to patients. However, the lack of telecommunication infrastructure in areas with geographic, economic, and social difficulties remains a challenge. The paper provides a prototype network that can be used as a model for future telemedicine programs in similar areas.	
12	Retrospective cohort study	To describe the outcomes of patients in rural and urban areas with solid tumors managed by oncologists through telemedicine.	1270 subjects	The main result of the study is that telemedicine can be a useful tool to address the inequalities in cancer services access for patients with solid tumors living in rural areas. During the 9 months of the study, 2061 patients were attended to by the oncology specialty telemedicine service, out of which 1270 were diagnosed with solid tumors. Most of the patients received at least 1 telemedicine consultation, and the most frequent solid tumors were breast, prostate, and colon and rectum.	The practical implication of this paper is that telemedicine can be a useful tool to address the inequalities in cancer services access for patients with solid tumors living in rural areas. This means that patients in rural areas can receive similar follow-up care as those in urban areas, which can ultimately lead to better clinical outcomes. The study suggests that telemedicine should be promoted in low- and middle-income countries due to its ease of installation and use. This can help	Restrepo et al., 2023 [43]

					improve access to cancer care for patients in these areas.	
13	Cross-sectional	To analyse the determinants of telemedicine use	350 physicians	The main results of the study indicate that the physician's level of information and communication technology (ICT) use in his/her personal life was the variable that had the highest explanatory power regarding telemedicine use in all three samples (Spain, Colombia, and Bolivia). In the Spanish sample, the physicians' perceived ease-of-use of ICTs in clinical practice and propensity to innovate were the two other variables that determined telemedicine use, whereas in the Colombian and Bolivian samples, it was the level of optimism about ICTs. The results facilitated a more complete model that includes personal, usability, and innovatory aspects in the explanation of Telemedicine use in Spain, whereas the results for the Latin American samples indicated a more primary model in the explanation of Telemedicine use, which was completed by an optimism factor that did not emerge in the Spanish sample.	The practical implications of this paper are that the results suggest that telemedicine use can be determined by factors such as the physician's level of ICT use, lack of human resources, infrastructure, equipment, medication, cultural and geographical accessibility, and the level of ICT implementation in the field of healthcare. The study highlights the need for a dynamic approach to the design of telemedicine use, especially when it targets a variety of end-users from different countries and healthcare systems. Therefore, it is important to conduct studies prior to using telemedicine and attempting to identify which of the above-mentioned variables could exert an influence and how.	Saigí-Rubió et al., 2014 [44]
14	Systematic review	Establish a telemedicine model of rural palliative care for advanced cancer patients with difficulties	Not applicable	The paper presents a novel approach for detecting and diagnosing faults in wind turbines using machine learning techniques. The approach involves	The paper proposes a machine learning-based approach for detecting and diagnosing faults in wind turbines. The approach involves collecting data from	Sánchez-Cárdenas et al., 2022 [45]

		in accessing standard care.		collecting data from various sensors installed on the wind turbine and using it to train a machine learning model. The model is then used to predict the health status of the wind turbine and identify any faults that may be present. The results show that the proposed approach is effective in detecting faults in wind turbines and can help improve their reliability and reduce maintenance costs.	various sensors installed on the wind turbine and using it to train a machine learning model. The model is then used to predict the health status of the wind turbine and identify any faults that may be present. The practical implications of this paper are: - The proposed approach can help improve the reliability of wind turbines by detecting faults at an early stage, which can prevent costly downtime and repairs. - The approach can also help reduce maintenance costs by enabling more efficient and targeted maintenance activities. - The use of machine learning techniques can enable more accurate and reliable fault detection compared to traditional methods. - The approach can be applied to a wide range of wind turbines and can be customized to suit specific requirements and conditions.	

The sample size varied significantly between studies, from 16 participants in the consensus study to 313,897 patients in one of the cross-sectional studies. Some studies focused on specific populations, such as rural elders and patients with cutaneous leishmaniasis, atrial fibrillation, ST-segment elevation myocardial infarction, and solid tumors. Studies that examined the use of telemedicine by doctors and the implementation of telemedicine programs in the public health network were also included. Two of the studies did not involve patients or doctors but focused on the evaluation of the development of telemedicine in Colombia and the creation of a protocol for mental health care through telemedicine.

Through Figure 2, we can corroborate that the studies reflect the diversity of the applications of telemedicine and mHealth applications in rural communities in Colombia, addressing a variety of health conditions, patient populations, and medical care contexts.

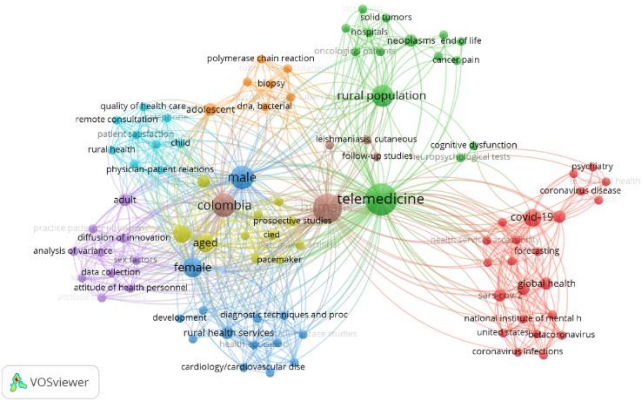

Figure 2. Co-occurrence of terms from the included studies.

3. Discussion

The use of telemedicine in rural areas has shown positive results both for patients and health professionals. The studies indicate that telemedicine is accepted and appreciated by rural communities, and that it can be an efficient and convenient method to provide medical care. Notable benefits include the reduction of direct and indirect costs for patients and health service providers, improvement in the hiring and retention of doctors, increased patient and health professional education and training, and better accessibility to medical care.[46–50]

The use of telemedicine skyrocketed during the COVID-19 pandemic, but 2022 marked a plateau in many respects. To continue moving forward, successful integration of remote patient monitoring with connected medical devices and sensors, and training of qualified personnel to handle this technology is required.[51–59]

One of the main advantages of telemedicine and mHealth applications is improved access to medical care. In rural areas, physical distance and a scarcity of health care providers can be significant barriers to accessing health services. Telemedicine can help overcome these barriers by allowing patients to connect with health care providers remotely.[60–63]

Experimentation with new methods is key, and artificial intelligence and other emerging technologies could play an important role. However, economic factors should also be considered, such as reimbursement codes for telemedicine services, which can influence the pace of progress.[64–68]

In the pharmaceutical field, telemedicine can facilitate patient monitoring and reduce the need for face-to-face follow-up, which could lead to the decentralization of clinical trials and the inclusion of hybrid models with participation both in-person and at home.[69–73]

mHealth applications can allow remote monitoring of chronic diseases. This type of monitoring can improve the management of these conditions and reduce the need for in-person doctor visits. Patients can use devices and applications to track their symptoms and share this information with their health care providers.

Telemedicine platforms can also be used to provide health education and promote healthy behaviors, which can be especially important in rural areas, where access to this information may be limited.[74–77]

In a broader context, eHealth has the potential to improve health equity by making medical care more accessible to rural communities and other underserved populations. However, it is also important to take into account the challenges associated with these technologies, such as internet connectivity issues in rural areas and the need for training for health care providers and patients in the use of these technologies. Data privacy and security issues are also a relevant consideration for their analysis.[78–80]

As for future trends, telemedicine is expected to continue its development and expansion. A key element in the success of telemedicine is remote patient monitoring, which relies on connected medical devices and sensors, mobile devices, and cloud platforms. As patients become more comfortable with these devices, sensors are expected to become smaller and more efficient.

However, there are significant challenges to consider. One of these is the shortage of qualified personnel to implement telemedicine technology. While technology can help providers to be more efficient, qualified individuals are needed to make it work. Another challenge is the need for changes in reimbursement policies to promote broader use of telemedicine.

3. Conclusions

This review reveals an emerging landscape of technological integration in health care. The intersection of technology and medicine has shown significant improvements in cognitive impairment detection and treatment monitoring, as well as in the provision of medical services in general to rural communities. These advancements have been driven by a combination of technological innovation and regulatory changes that have allowed a deeper penetration of information and communication technologies in the medical sphere.

Telemedicine and mHealth applications are transforming the way medical care is provided to rural communities in Colombia. These tools have proven valuable in improving the detection and monitoring of chronic diseases such as cognitive impairment and cardiovascular diseases. At the same time, the implementation of these technologies has shown effectiveness in improving the quality of medical care, providing greater access to specialized medical services, and reducing the sense of isolation among health professionals in rural areas.

Telemedicine has proven to be a useful tool to address inequalities in access to health services, including oncological care. This suggests that telemedicine has the potential to overcome geographic and socioeconomic barriers to health care access. However, despite these advancements, there remain challenges, such as the lack of telecommunications infrastructure and familiarity with

digital tools, that must be addressed to maximize the benefits of these technologies.

The development of telemedicine in Colombia has largely been driven by regulatory changes and ICT infrastructure growth plans. Since the legalization of telemedicine in 2007, there has been significant growth in the number of telemedicine services implemented throughout the country. However, further development of the ICT infrastructure and greater familiarity with digital tools by health professionals is required to further expand the penetration of telemedicine.

Ultimately, the review provides a comprehensive view of the growing integration of technology in health care in rural communities of Colombia. Telemedicine and mHealth applications are proving to be valuable tools in improving the quality and access to health care in these communities. However, to maximize the benefits of these technologies, the remaining challenges will need to be addressed and the development of the ICT infrastructure will need to continue to be driven forward.

Telemedicine is expected to continue to be an essential part of the healthcare ecosystem and is expected to become increasingly fundamental. As new technologies are developed and used, telemedicine is expected to continue to advance.

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