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REVIEW ARTICLE

Telemedicine Acceptance in Rural Settings: A Systematic Review of Definitions, Methods, and Measurement Practices

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Abstract
Technological advances, particularly in e-health and telemedicine, have significantly influenced the evolution of healthcare services, especially after COVID-19. Telemedicine, defined as "the delivery of health services where distance is a critical factor", is gaining popularity by extending the available services from urban centers to rural areas, and technology acceptance frameworks have been widely used to assess the telemedicine acceptance level. However, the heterogeneity of assessments leads to fragmentation, which limits methodological rigor and generalizable results. The current systematic review aims to answer three questions: (1) How is "acceptance" defined and measured in telemedicine? (2) What methods are most used to assess the acceptability of telemedicine delivered in rural areas? (3) To what extent do rural health care practitioners and patients accept telemedicine?. The review incorporated a final sample of 104 studies published between 2018 and 2024 that show a balance between quantitative, qualitative, and mixed methods approaches. Unfortunately, the same cannot be said for the number of studies referencing a theoretical framework when evaluating acceptance (29%) and using standardized research tools (37%). The combination of these results with the fact that most authors (68%) claimed to have measured high levels of acceptance calls for a critical look into the literature and the generalizability of published results.

Trial Registration
Not applicable.

Keywords Telemedicine · Rural areas · Technology acceptance · Research methods · Systematic review

Introduction

Over the past 80 years, technological advancement has profoundly transformed multiple sectors, including healthcare (Yeasmin, 2024), reshaping service delivery across the sector (Stoumpos et al., 2023). Electronic healthcare (e-health), which refers to the use of Information and Communication Technologies (ICTs) to create dynamic digital environments aimed at improving healthcare services at local, regional, and global levels (Eysenbach, 2001), serves as an umbrella term encompassing services such as telemedicine. The World Health Organization (WHO) defines telemedical services as the "*delivery of health services where distance is a critical factor, or would be using appropriate technologies, by all healthcare professionals using information and communication technologies in the exchange of valid information for diagnosis of patients, treatment, and prevention of disease and injuries*" (WHO, 2022, p. 2). Examples of telemedicine services include remote teleconsultation visits between

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patients and doctors (Pullyblank et al., 2023), or telerehabilitation for both physical (Seron et al., 2021) and psychological (Burton & O'Connell, 2018) health issues.

One of the most valuable applications of telemedicine services is the coverage and improvement in the accessibility of health services for patients who live in remote or rural areas (Hutchinson et al., 2022). Individuals who reside in geographically isolated territories benefit from telemedicine services in terms of reduction in transportation costs (Tromans et al., 2024), unnecessary clinic visits (Day et al., 2023), and decreased healthcare service delays (Mohammadzadeh et al., 2023), proper delivery of care and support to chronically ill patients (Siminerio et al., 2023), improved management of complex cases (Bidmead et al., 2020), and reduction in hospitalization (Ohligs et al., 2020). Healthcare professionals with access to these services report increased perceived safety during clinical practice (Hege & Kary, 2010), improved work efficiency (Rasekaba et al., 2021), and greater patient trust in the care provided (Potter et al., 2016).

Despite its benefits, acceptance of telemedicine is challenged by individual psychological factors, such as technophobia (Khasawneh, 2018), as well as societal factors, such as distrust of technology (Reimann et al., 2017; Shoabjareh et al., 2024). Concurrently, historical and socioeconomic barriers may have limited access to healthcare and information services for remote populations, thus fostering skepticism toward new technologies (Boulware et al., 2003; Yee et al., 2022). As a result, although telemedicine aims to reduce disparities in healthcare access between rural and urban populations (Katta et al., 2024), insufficient culturally tailored education and dissemination strategies widen the gap (Ezeudoka & Fan, 2024).

Scientific psychological research addressed similar technology acceptance problems in the 80s and 90s. The development of models like the Technology Acceptance Model (TAM; Davis, 1989) and the Unified Theory for Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003), along with many others (Fishbein & Ajzen, 1975; Thompson et al., 1991; Davis et al., 1992), has tried to identify the key factors who influence acceptance of new technologies like performance expectancy, degree to which an individual believes that using the system will help him or her to attain gains in job performance, or social influence, degree to which an individual perceives that important others believe they should use new system (Venkatesh et al., 2003). However, the heterogeneity of assessments might have led to a fragmentation in methodological rigor and generalizability of results. The main objective of the present work is to account for this fragmentation and provide a critical overview of the current state of research on professionals' and consumers' acceptance of telemedicine services in rural areas. With the current systematic review, we want to answer three core questions:

Q1: How is "acceptance" defined in the context of telemedicine?
Q2: What are the most used methods to assess the acceptance of telemedicine services in rural and remote areas?
Q3: To what extent do rural dwellers and practitioners accept the introduction of telemedicine services?

Methods

Design

This review has been written following the standardized strategy provided by the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) checklist (Page et al., 2021). The current work was registered online on the *Open Science Framework* website before the full paper screening (https://osf.io/4xyr5/).

In designing our review, we took inspiration from the work of Harst and colleagues (2019). The main objective of their work was to understand which theories are most used to predict end-user acceptance of telemedicine services until June 2018, and, at the same time, evaluate and classify the strongest predictors. From the results of their work, focused only on quantitative studies, the TAM and UTAUT models have been identified as the most used in literature and most effective in predicting telemedicine acceptance (Harst et al., 2019). Our work differs in many ways. Given the advantages of introducing telemedicine services in remote areas, we decided to focus only on studies that evaluate the acceptance of telemedical technologies in those zones. Furthermore, we wanted to critically examine the methods, theoretical frameworks, and definitions of technology acceptance used by researchers. In doing so, we decided not to restrict our research exclusively to quantitative studies but also included qualitative ones. In the end, considering our interest in accounting for a "COVID-19 effect" and creating a continuum from Harst and colleagues' work (2019), we narrowed the timeframe of paper publications between January 2018 and October 2024, the starting date of the database research. All these elements make this study a new and meaningful addition to the growing literature.

In the end, since a partial overlap in the objectives of the two studies, we adapted their keywords to our border needs.

Inclusion & Exclusion Criteria

The Population, Intervention, Comparison, Outcome, and Study Design (PICOS) criteria were used to identify the keywords for the database research (Higgins et al., 2024, Cochrane book). The population we referred to includes practitioners and patients living in mountainous, rural, or remote areas. We did not restrict the type of telemedicine intervention evaluated, such as teleconsultation, tele-monitoring, tele-intervention, tele-rehabilitation, and tele-expertise. To be sure we could reach all the relevant published literature, we included aspects of telehealth and e-health while structuring our keyword strings. Since our study aims do not encompass the evaluation of the effectiveness of telemedical services compared to other medical treatments, we decided not to include the comparison criteria. In conclusion, the outcome was considered only related to service acceptance or acceptance of new technology in the telemedical field. Regarding the study design, we decided to exclude only reviews, book chapters, comments, or letters to the editor.

Literature Research

Combining the block of keywords string identified through the PICOS guidelines, we conducted literature research in the following three online repositories: PsycINFO, PubMed, and Scopus. Considering the different search guidelines and indexing of MeSH terms of all the databases, we decided to adapt the keyword strings to each repository. In this way, we maximized our research, and the results connected. In Supplemental Material 1, we report the strings of keywords, adapted for each database.

Screening Procedure

After applying all the keyword strings in the respective database, combining the results in a single Excel file, and controlling for duplicates, the screening procedure comprised two abstract screening sessions and a full paper review. The screeners agreement were respectively 92%, 76,50%, and 88,5%. One thousand eighty-two records were identified, 144 duplicates were removed, and 200 abstracts were assessed in the second round (46 excluded). Full-text screening of 154 reports led to 43 exclusions and three unavailable papers, leaving 104 studies for inclusion. Figure 1 illustrates the PRISMA flow chart, which shows the study selection process.

Extraction Strategy

Study characteristics, including papers' metadata, participant characteristics, level of rurality, type of telemedicine investigated, methods used to evaluate acceptance, and acceptance levels, have been extracted into an Excel table from all 104 eligible papers. The data extraction has been divided evenly among the three screeners. All data extracted have been analyzed using R statistical software (v4.1.3, R Core Team, 2021).

Assessment for Methodological Quality

The methodological quality of each study was evaluated independently by two screeners using the AXIS tool for cross-sectional studies (Downes et al., 2016). The focus was primarily methodological, particularly on the validity of measurement tools and the procedures. Following the assessment protocol for the evaluation: N = item not fulfilled; Y/N = item partially fulfilled; Y = item fulfilled. We transformed our scoring system into $N = 0$; $Y/N = .5$; $Y = 1$ to obtain average scores for the different criteria among the eligible papers. For those studies where some items were not applicable, we put NA (Not Applicable).

Results

Articles Characteristics

Year of Publication

Our results, reveal a growing trend in the number of publications from 2018 (10 publications) to 2022 (23 publications), and a decrease in 2023 (15 publications). We cannot make any clear inference for 2024, since we stopped collecting paper at the beginning of October. In Supplemental Material 2, we report the graph with the publication trend.

Type of Publishing Journals

92 studies (88%) have been published in medical or health-related scientific journals (e.g., Bhatt et al., 2018; Cheung et al., 2021; Nyoni et al., 2024). In particular, 30 (33%) in telemedicine and e-health, 28 (30%) in general health, 14 (15%) in public health or health policies, 9 (10%) in nursing or patient education, 6 (6,5%) in health in remote or rural areas, and 5 (5,5%) in geriatrics. Only 12 studies (12%) have been published in scientific journals related to psychology and mental health issues (e.g., Journal of Rural Mental Health, JMIR MENTAL HEALTH, Journal of Health Psychology). A table containing the researchers' department affiliations can be found in Supplemental Material 3.

Participants' Geographical Origin

63 studies (61%) were conducted in the United States of America (USA) or Australia. See Fig. 2 for a complete geographical representation of the countries from which the rural samples in the reviewed studies were drawn.

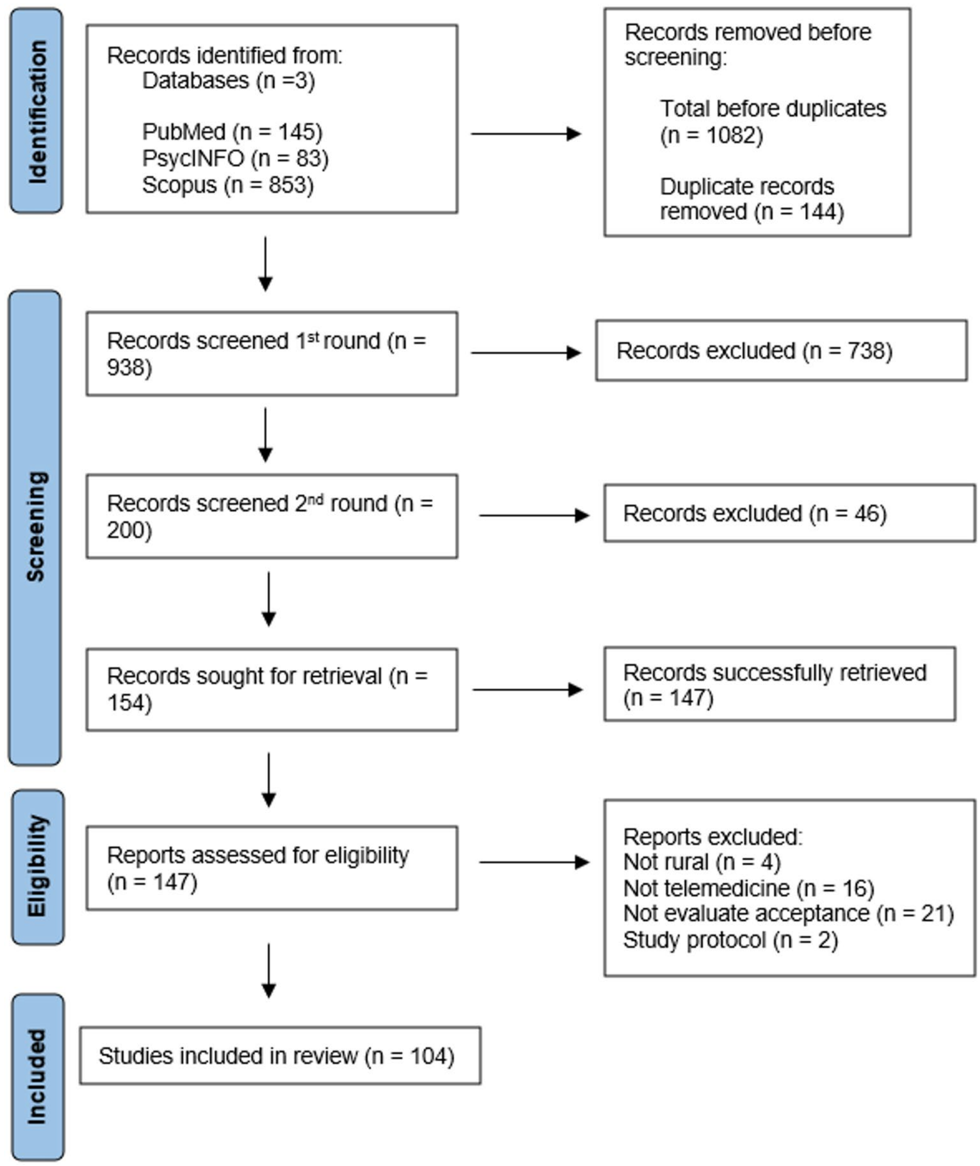


Fig. 1 Flow chart of studies included and excluded from the systematic review

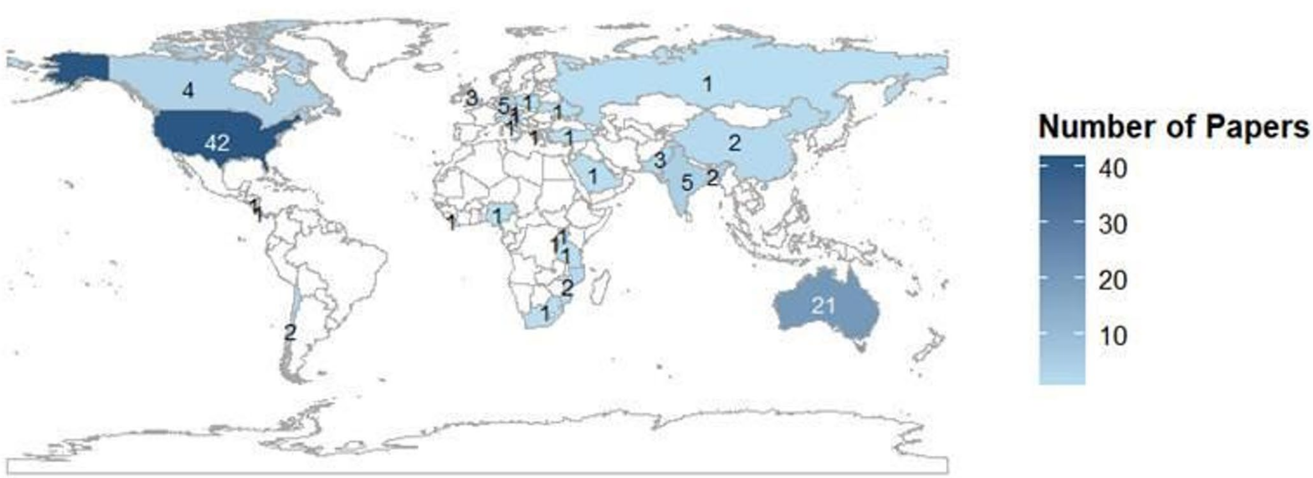


Fig. 2 Number of studies included per country

Only one study (Tsami et al., 2019) was designed and run in multiple countries: Turkey, Greece, Costa Rica, Saudi Arabia, Ukraine, and Russia. For this reason, the total sum of the studies shown on the map exceeds 104. A map showing the approximate city-level location of the participant samples is provided in Appendix A.

Participants Characteristics

While evaluating telemedicine acceptance in rural areas, the studies focused on different users. Fifty-seven studies (56%) focused on the acceptance levels of patients, 20 (20%) on professional healthcare, and 25 (24%) evaluated both patients and providers. In one case, participants were identified as policymakers (Weißenfeld et al., 2021); in another, their role was not specified for privacy reasons (Schoenberg et al., 2021). Considering that any individual may potentially be a telemedicine services user, we included all participants of Weißenfeld and Schoenberg studies under the patient group, regardless of whether this was explicitly stated, to ensure consistency when calculating the total number of participants across studies. Across all studies, a total of 14,365 participants participated in the research, 11,536 were patients, and 2829 were healthcare professionals. About the patient group, 84% of participants have been tested to evaluate their acceptance of telemedicine services. The mean sample size was 116, ranging across studies from 5 to 1840 participants. On the other hand, 92% of healthcare providers have been tested for acceptance of telemedical services. The mean sample size was 62, ranging from 2 to 764 participants across studies.

The mean age of patient participants was 51,9 (SD = 14,7), while for professionals it was 39,4 (SD = 4,17). This calculation included only studies (52% that tested patients, 6,5% assessing healthcare professionals) that reported the sample's age in mean value and standard deviation. Several studies reported age as median (e.g., Latendresse et al., 2023; Peltan et al., 2020), range (e.g., Strickler et al., 2018; LeBaron et al., 2022; Brunelli et al., 2021; Miyashita et al., 2022), or percentage over a criterion (e.g., 91% over 26 years old; Casilang et al., 2020). Around 8% of studies with patients, and 64,5% of studies concerning healthcare providers did not report age-related data.

The percentage of female patient participants was 62,4% (SD = 28,3), while for the professionals, it was 68% (SD = 28,9). Around 12% of studies with patients, and 63% concerning healthcare providers, did not report age-related data.

Rurality Levels

We identified four main types of rurality descriptors: Distance from urban center expressed in km (10% of the papers), e.g. "*distance between Hospital B and Hospital A was approximately 72 km*" (Zhang et al., 2023); Distance from urban center expressed in travelling time (2% of the papers), e.g. "*the rural site is located 45–60 minutes driving from Jinja*" (Ellington et al., 2021); Official report on rurality (17% of the papers), e.g. "*We use the U.S. Department of Health and Human Services definition of rural; any place with fewer than 50,000 inhabitants and not adjacent to an urban area*" (Latendresse et al., 2023), and population number (11% of the papers), e.g. "*Participants were eligible if they […] lived in a rural community (defined as areas with < 35,000 inhabitants)*" (Price & Brunet, 2021).

The average reported distance from an urban center is 335.8 km, the average time to reach an urban center was 56 min, and the average population number was 95,545 inhabitants. In Supplemental Material 3, a list of the official reports divided by country is presented.

Some studies (32%) included other types of descriptions, a few examples are: "*The study population were people […] in an economically poor rural part of the south-west UK*" (Tromans et al., 2024), or "*the study was conducted at three county hospitals in rural China: Zhangwu, Liaoning Province (Northeastern China); Qingtongxia, Ningxia Hui People Autonomous Region (Northwestern China); and Dianjiang, Chongqing municipality (Southwestern China)*" (Zhou et al., 2019). Around 29% of papers only stated that participants came from rural or remote areas, but did not provide any measure.

In 36 studies (35%), participants came from urban and rural areas. Only 19% of these papers (Peltan et al., 2020; Weißenfeld et al., 2021; Miyashita et al., 2022; Kalańska-Łukasik et al., 2022; Price-Haywood et al., 2023; Mihevc et al., 2024; Dhillon et al., 2022) used this disparity to make a comparison between acceptance levels in rural and urban dwellers.

Telemedicine Characteristics

We identified six categories of telemedical services across the studies: Teleconsultation (61 times), Tele-intervention (28 times), Telemonitoring (17 times), Tele-expertise (3 times), Telerehabilitation (2 times), and Telemedicine as a general concept (2 times). Telemedicine applications referred for the majority to physical medical problems (67%; e.g., arterial hypertension (AH) and type 2 diabetes (T2D), neck and head cancer or maternal hypertension), followed by psychological mental issues (18%; e.g., Disruptive Behavior Disorders (DBD), Autism Spectre Disorder (ASD) or mild and moderate profound intellectual disability), and in some cases to both (11%). In a few cases, the acceptance of telemedicine services was evaluated, not referring to a specific type of disease, but to the service itself (4%).

In 24 studies (23%) new telemedical technologies applications have been explored (Day et al., 2023; Ellington et al., 2021; LeBaron et al., 2022; Staszewsky et al., 2018; Mace et al., 2022; Zhang et al., 2023; Bhatt et al., 2018; Mitchell et al., 2021; Boene et al., 2021; Kinshella et al., 2021; Hossain et al., 2019; Lopez et al., 2020; Boente et al., 2024; Dandge et al., 2019; Zhou et al., 2019; Siminerio et al., 2023; Bonsignore et al., 2018; Demirci et al., 2019; Udenigwe et al., 2022; Schweitzer et al., 2020; Bucknell et al., 2024; Schoenberg et al., 2021; O'Grady et al., 2023; Roh et al., 2023). A table that contains a list of the studies, as well as the names of the new devices studied can be found in Appendix B.

In Supplemental Material 5, it is possible to find a summary table containing all the most important information extracted from each eligible study.

Definitions of Acceptance in Telemedicine

In response to our first research question on how 'acceptance' is defined in the context of telemedicine, we identified 36 theoretical frameworks applied in 30 studies (see Supplemental Material 6). The most used ones are the TAM and UTAUT models, respectively with 18 and 6 occurrences. In six cases (Hossain et al., 2019; Livet et al., 2021; Van Den Broek et al., 2021; Mueller et al., 2020; Price-Haywood et al., 2023; Nabelsi & Lévesque-Chouinard, 2024), a combination of different theoretical frameworks (i.e., TAM and UTAUT 4 occurrences; TAM and IOQ 1 occurrence; UTATUT and TTF 1 occurrence) has been used to create new models and surveys. The authors have explicitly defined acceptance in only 19 papers, in which 80% of the time it corresponded with theoretical models. When specified, acceptance has been mostly identified with attributes related to individual participants perceptions of the telemedicine services, e.g., satisfaction in the usage, receptivity for future use, perceptions of usefulness, ease of use of the new service, social influence from peers and the working place, and perceived behavioral control over the technology (Day et al., 2023; LeBaron et al., 2022; Brunelli et al., 2021; Udenigwe et al., 2022; Hebert et al., 2025; Hayes et al., 2023; Burnham et al., 2022; O'Grady et al., 2023; Price-Haywood et al., 2023; Garcìa et al., 2023; Demirci et al., 2019; Cummings et al., 2023; Mihevc et al., 2024). Further, acceptance definitions also included components related to behavioral and practical characteristics, e.g., intention to use a technology, actual usage behavior, likelihood of use, and frequency of current adoption of the services (Day et al., 2023; Brunelli et al., 2021; Pullyblank et al., 2023; Hossain et al., 2019; Boene et al., 2021; Dandge et al., 2019; Weaver et al., 2020; Demirci et al., 2019; Price-Haywood et al., 2023). In the end, few studies described telemedicine acceptance using characteristics of participants' attitudes towards the service, e.g., positive or negative feelings toward the technology (Brunelli et al., 2021; Udenigwe et al., 2022; Price-Haywood et al., 2023; Cummings et al., 2023; Holtz et al., 2022).

Methods for Assessing Telemedicine Acceptance in Rural and Remote Areas

In response to our second research question on the methods used to assess telemedicine acceptance in rural and remote areas, we identified three main approaches: qualitative, quantitative, and mixed-method designs. The representation of these three investigation methods was balanced, with 33% quantitative, 34% mixed-method, and 33% qualitative. For the qualitative studies, we identified three different techniques: interview/semi-structured interviews (63%), open-ended questions/free comment space (29%), and focus groups (8%). For the quantitative research tools we identified: Likert scale (73%), single-item question (19%), multiple choice questions (6%), and dichotomous choice questions (2%). Some studies complemented their assessment with behavioral measures, such as participation rate in interventions (70%), usage of services (15%), and completion of tasks (15%). Only in a few cases (Dandge et al., 2019; Kalańska-Łukasik et al., 2022; Nkurunziza et al., 2022; Garcia-Esperon et al., 2022; Ng et al., 2024; Satyanarayana et al., 2024; Latendresse et al., 2023), acceptance was measured exclusively through behavioral methods.

Only 37% of the authors declared in their articles to have used research tools adapted from standardized and validated instruments (e.g., "*To address the acceptability and perceived utility of incorporating live critical care consultation during IHCA resuscitation using telemedicine technology, we included questions based on the technology acceptance model*", Peltan et al., 2020; or "*Immediately after treatment implementation, the therapist asked the parents to complete a modified version of the Treatment Acceptability Rating Form*", Tsami et al., 2019).

In Supplemental Material 7, the number of different research techniques associated with the overall research methods is shown.

To further explore how acceptance was measured in mixed-methods studies, we examined the co-occurrence of quantitative/behavioral and qualitative tools (Fig. 3). The heatmap reveals that Likert scales were most frequently paired with qualitative interviews (12 instances) and open-ended questions (11 instances), indicating a common strategy of integrating structured attitudinal measurement

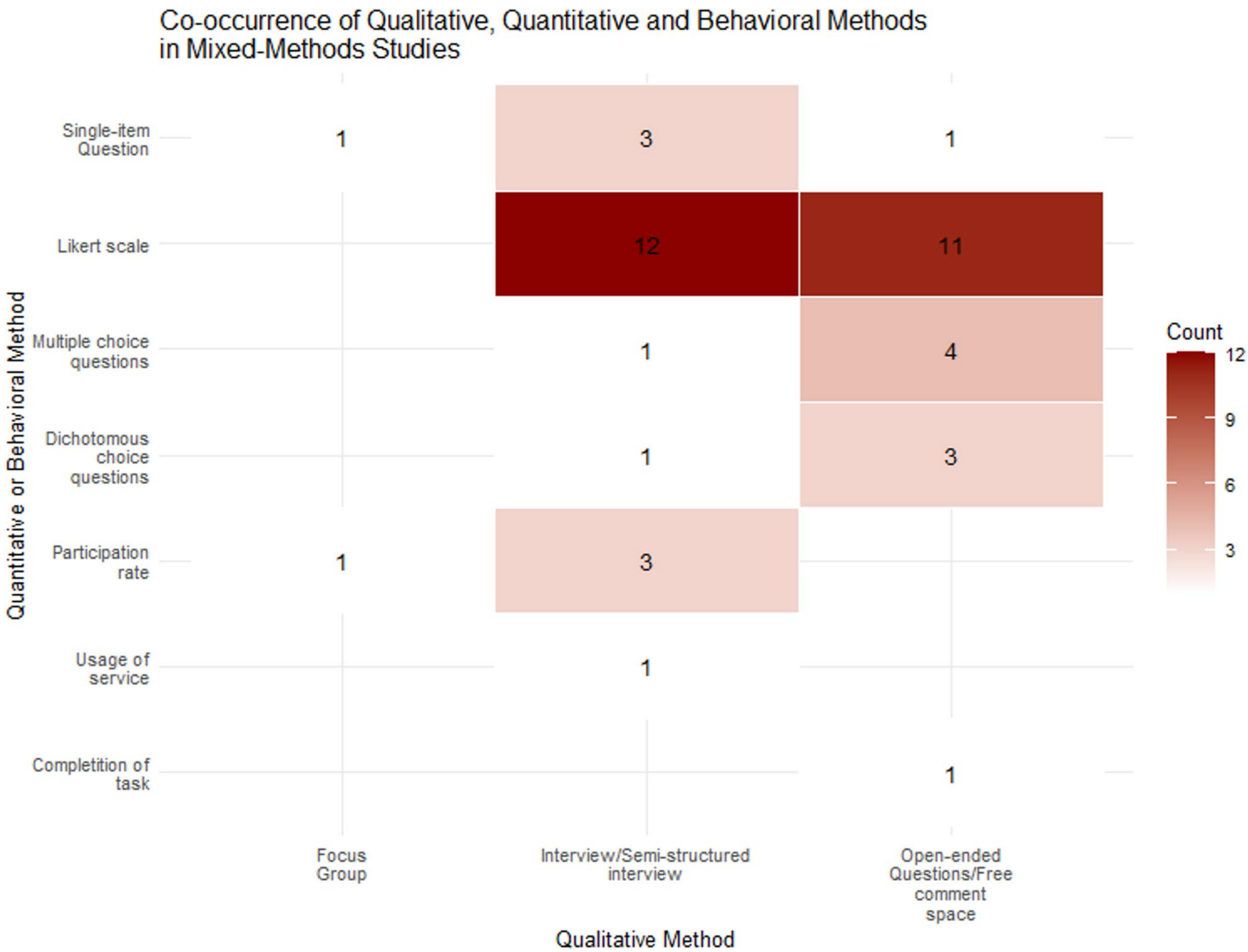


Fig. 3 Co-occurrence of quantitative/behavioral and qualitative methods in mixed-methods studies

with more open-ended, exploratory techniques. Single-item questions and participation rate data were occasionally combined with interviews or open-ended responses (3 occurrences each), while multiple-choice and dichotomous questions appeared less frequently. Notably, behavioral indicators such as use of service, completion of tasks, and participation rate were rarely used, and when they were, they were typically coupled with interviews. Focus groups appeared only once across all pairings, suggesting limited use within mixed-methods designs. These results suggest a predominant reliance on Likert-based quantitative metrics supplemented by qualitative interviews, with relatively scarce incorporation of purely behavioral assessments.

Acceptance of Telemedicine Among Rural Dwellers and Practitioners

In response to our third research question on the extent to which rural dwellers and practitioners accept the introduction of telemedicine services, we based our analysis on the findings reported by the original study authors. For example, Elk et al. (2020) noted that '*in all the applicable questions*, *there was a high degree of satisfaction (either satisfied or very satisfied) with the PC consult*.' In contrast, García et al. (2023) reported that '*more than half (57.1%) of study participants expressed no interest in undergoing consultations with their dental providers through video conferencing*'. In total, 71 papers (68%) defined their acceptance levels as high, 17 (16%) as medium, and 3 (3%) as low. In 13 studies (11%) (Cluxton-Keller et al., 2018; Read et al., 2019; Rasekaba et al., 2021; Silvestrini et al., 2021; Trinidad et al., 2023; Edwards & Parry, 2022; Bidmead et al., 2020; Schoenberg et al., 2021; Zaslavsky et al., 2022; Nyoni et al., 2024; Kamal et al., 2020; Zobair et al., 2021; Bonsignore et al., 2018), it was not possible to evaluate acceptance levels from the authors results.

As shown in Fig. 4, research methods appear evenly distributed across acceptance levels, with qualitative, quantitative, and mixed-method approaches.

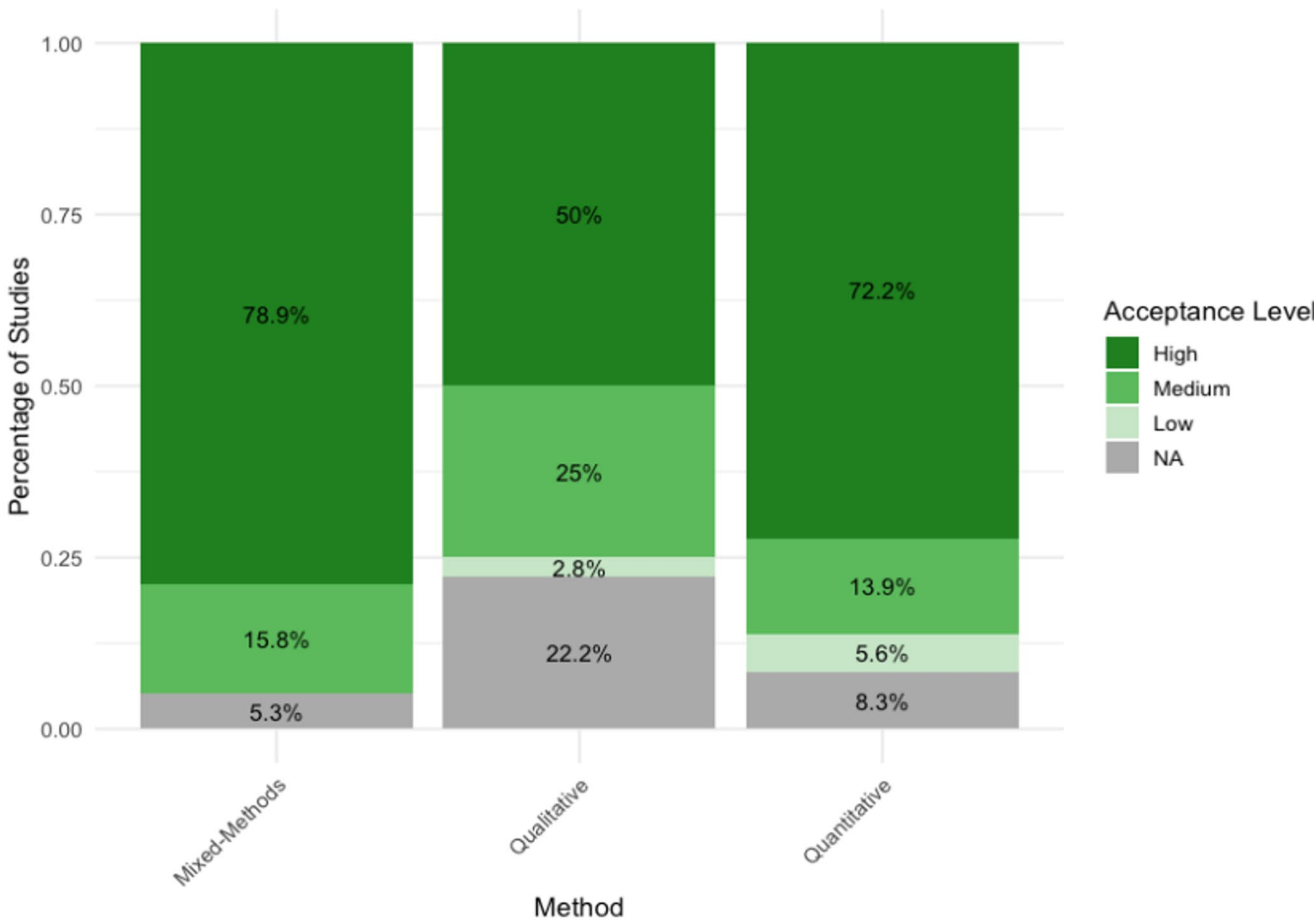


Fig. 4 Telemedicine acceptance levels for the different types of research methods identified

We also examined whether the use of methodological frameworks was associated with reported levels of acceptance. Among studies that applied theoretical frameworks, 64% reported high acceptance, whereas 82% of studies without frameworks reported high acceptance. In Supplemental Material 8, the different results obtained using the different methodological frameworks identified are shown.

Assessment for Methodological Quality

To explore the distribution of AXIS item ratings across studies, we calculated, for each paper, the number of items rated as Yes (Y), No (N), Partially Yes (Y/N), or Not Applicable (NA). For two reverse-coded items (D13 and D19), the interpretation of Yes and No responses was inverted to maintain consistency in scoring direction. All data transformations were performed using the dplyr and tidyr packages in R (v4.3.1).

On average, studies received 13.38 "Yes" ratings (SD = 2.61) out of 20, with 3.20 "No" ratings (SD = 1.64), 2.57 "Partially" (SD = 1.96), and approximately 0.85 missing items (SD = 0.97; see Supplemental Material 9). While this suggests moderate reporting quality overall, the results fall short of the completeness and transparency envisioned by the AXIS developers. The original AXIS study emphasized that poor or absent reporting should not be dismissed as neutral; instead, it may signal limitations in design or increase the risk of bias. From this perspective, the presence of more than six items (on average) not fully rated "Yes" in our sample is nontrivial.

To better understand specific areas of methodological concern, we examined the frequency of Yes", "No", "Partially", and "Missing" ratings across AXIS items (a granular breakdown of all item-level ratings is shown in Appendix C) (McGuinness & Higgins, 2020). The most frequently unmet criteria were D3 (justification of sample size), D7 (categorization of non-responders), and D14 (description of non-responders), which were rated "No" in 66, 65, and 64 studies, respectively. This indicates that non-response bias and sampling transparency are recurrent weaknesses in the reviewed literature. Items related to ethical approval (D20), aims clarity (D1), and target population definition (D4) consistently received "Yes" responses, while methodological transparency regarding sample justification and bias control remained limited.

Global Disparities in Rural Telemedicine Acceptance Evaluations

The results of the data extraction on the geographical locations of the works in this review, shown in Fig. 2 and Appendix A, highlighted the need for an in-depth exploration of disparities across the countries included in our work. Using the Handbook of Statistics 2022, published by the United Nations/UNCTAD (United Nations, 2022), as a reference, we divided our sample into two groups: Global South and Global North. Countries listed in the first group were Bangladesh, Chile, China, Costa Rica, Dominican Republic, India, Liberia, Mozambique, Nicaragua, Nigeria, Pakistan, Rwanda, Saudi Arabia, South Africa, Tanzania, Turkey, Uganda, and Ukraine, for a total of 25 studies (24%); all remaining countries (e.g., USA, Australia, UK, Germany, Italy) were included in the second group, for a total of 79 studies (76%). The only multi-country region, which included Turkey, Greece, Costa Rica, Saudi Arabia, Ukraine, and Russia, was assigned to the Global South since the majority of the participating countries belonged to that category. The marked imbalance and lack of representativeness highlight substantial under-representation of low- and middle-income contexts in the current literature on telemedicine acceptance in rural areas.

We started by investigating one of the research questions that guided our work, which concerns the application of the acceptance theoretical framework to the study of telemedicine in rural areas. From the extracted data, we observed differences in adoption (North: 24.7%; South: 43.5%), with a focus on TAM (North: 13.1%; South: 26.9%) and UTAUT (North: 6%; South: 3.8%). Furthermore, studies conducted in the Global South relied on a single theoretical model rather than integrating multiple models. On regards of telemedical services investigated, teleconsultation was the most frequently studied modality (North: 50.6%; South: 65.4%), followed by tele-intervention (North: 27.6%; South: 15.4%) and telemonitoring (North: 14.9%; South: 15.4%). Three modalities, tele-expertise ($n = 3$), generic telemedicine ($n = 2$), and telerehabilitation ($n = 1$), were reported exclusively by Global North studies and were absent from the Global South sample. Comparisons between the type of disease (i.e., physical or psychological) reported no differences, showing similar distributions between groups. Overall, the comparison suggests that Global South research is more narrowly focused on direct clinical encounters, primarily teleconsultation, whereas Global North research encompasses a broader range of telemedicine applications, including specialized modalities such as tele-expertise and telerehabilitation. Following an analysis of the measurement methods adopted by researchers and the results obtained, it was deemed necessary to identify discrepancies between the two groups. Qualitative (North: 30%; South: 40%), quantitative (North: 29%; South: 44%), and mixed-methods (North: 41%; South: 16%) usage resulted to be diversely balanced across global north and south studies, but inferential testing failed to reach statistical significance ($\chi^2(2) = 5.12$, p = .077; Fisher's exact test, p = .070). In conclusion, the distribution of high (North: 66%; South: 79%), medium (North: 16%; South: 17%), and low (North: 4%; South: 0%) acceptance scores was very similar between the two groups, and Fisher's exact test confirmed that the two distributions did not differ significantly ($p = .53$). Furthermore, we cross-tabulated the type of telemedicine examined and the methodological approach adopted to assess acceptance, and computed the divergence between the Global North and the Global South in the relative frequency of each combination. In Fig. 5, the percentages are shown within groups (so that the two distributions are placed on a comparable scale despite the different sample sizes) for each combination of telemedicine type and method used between the Global North and South. The difference in research methods used (% North − % South) was used as the color gradient: red shades indicate combinations over-represented in Global North research, blue shades indicate combinations over-represented in Global South research, and white shades indicate combinations equally distributed.

The mapping (Fig. 5) shows that around one third of all Global South studies (35%) fall in a single cell, Teleconsultation evaluated through quantitative methods, against only 17% of Global North studies ($\Delta = -18\%$). A second, smaller blue cluster appears for Teleconsultation × Qualitative (19% South vs. 17% North) and Telemonitoring × Qualitative (12% South vs. 5% North), confirming that Southern research clusters around teleconsultation and tend to favor single-method (quantitative or qualitative) evaluations. Conversely, Global North research is more evenly distributed across the matrix and shows a relative over-representation of Tele-intervention × Mixed-Methods (11% North vs. 4% South) and of Telemonitoring × Mixed-Methods (7% North vs. 0% South), as well as a long tail of less common modalities, tele-expertise, telerehabilitation, and generic telemedicine, that are absent in the Global South sample. Taken together, these patterns suggest that the Global South telemedicine acceptance literature is not only quantitative, but also qualitative. Southern research operates within a narrower methodological and technological space, anchored to teleconsultation as the dominant modality and to single-method evaluations as the prevailing design. Northern research, by contrast, displays a broader portfolio of modalities and a more frequent adoption of mixed-methods designs, which are generally

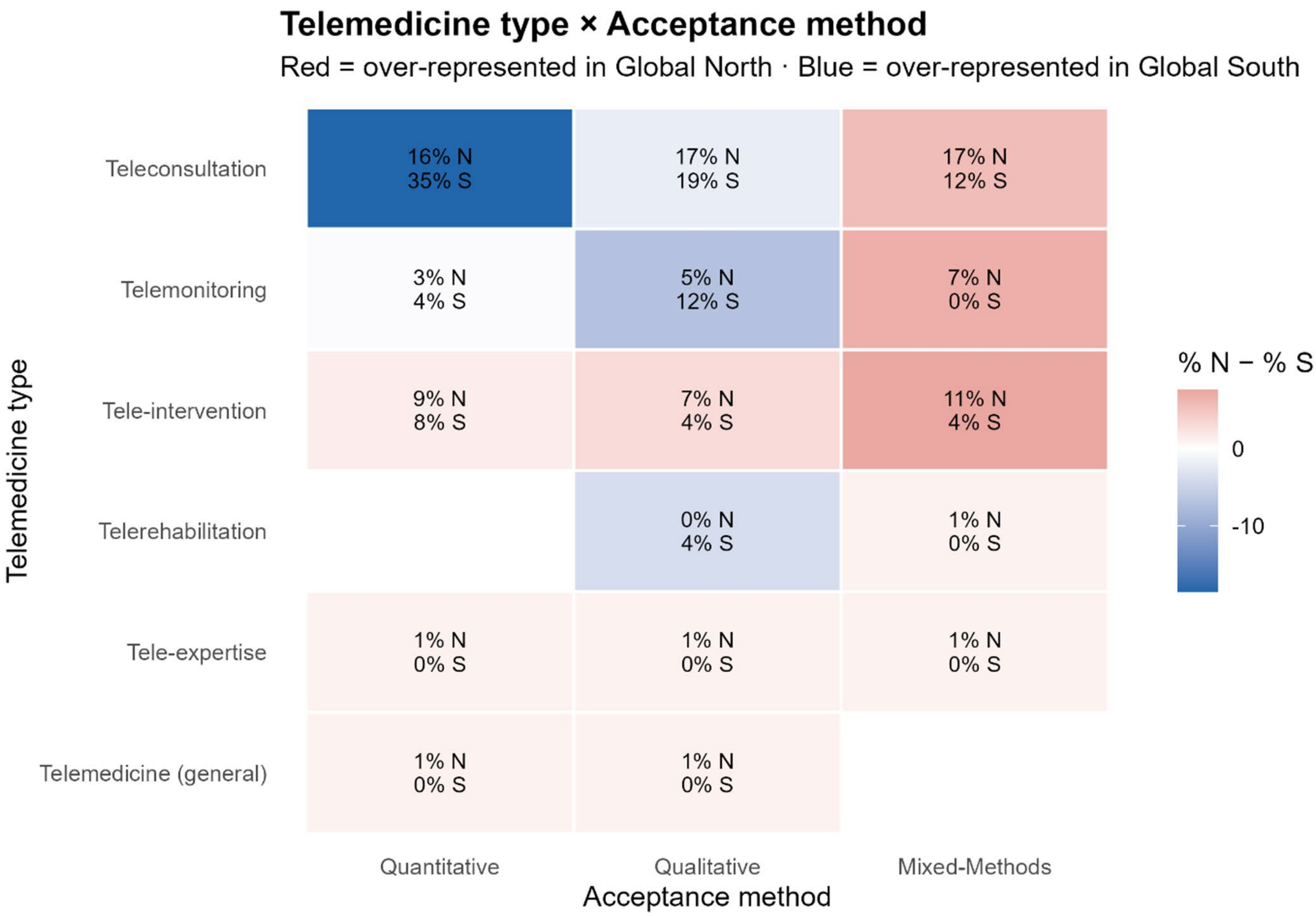


Fig. 5 Table showing the use of discrepancies between the Global North and South across the different telemedicine types investigated

regarded as the most comprehensive approach for evaluating user acceptance. Following our analysis, it is necessary that two interpretative cautions are applied: percentages in the Southern sample are based on $N=23$ studies, so individual cells reflect only a few studies and are sensitive to sampling fluctuation; and the absence of certain combinations in the Southern sample should be read as a current evidence gap rather than as evidence of absence. The results obtained suggest that strengthening telemedicine research in low- and middle-income contexts requires not only expanding the *volume* of studies but also broadening their *methodological and technological diversity*.

Concerning rural measurements, the main difference comprised the reliance on official reports, which was markedly more frequent in Global North studies (21.5%, $n=17$) than in Global South studies (4%, $n=1$), where rural status was more often inferred indirectly through population size or distance metrics.

In conclusion, across the 104 included studies, the mean number of patients per study reflected a growing disparity (North: M = 90.9, SD = 139; South: M = 351, SD = 626). After removing within-group outliers (defined as values beyond 1.5 × IQR from the group-specific quartiles), a Wilcoxon rank-sum test confirmed that Global South studies recruited significantly larger patient samples than Global North studies (W = 237.5, p = .002). A similar, but not significant, trend was observed among healthcare professional participants (North: M = 79.6, SD = 155; South: M = 42.9, SD = 50.5; W = 145, p = .986). When comparing demographics, the proportion of female patients showed a comparable distribution in Global North (M = 63.4%, SD = 28.7) and Global South studies (M = 58.4%, SD = 27.1). Mean patient age showed a tendency toward younger samples in Global South studies (M = 41.9, SD = 9.53) than in Global North studies (M = 53.7, SD = 14.9); this comparison, however, is based on a very small number of Global South studies ($n=5$) and must be interpreted with caution. Given the high levels of missing demographic information for professionals' gender (North: 86.1%; South: 76%) and mean age values (North: 97.5%; South: 96%) in both groups, we deemed it inaccurate to further confront them.

In the end, it is worth noting that the presence of missing data across the two variables was substantial and unevenly distributed: information on patient sample size was missing in 23% of Global North and 28% of Global South studies, while information on professional sample size was missing in 63.0% and 47.8% of studies. A similar trend was observed between the two groups for rurality measures (North: 29%; South: 36%) and the acceptance frameworks used (North: 75%; South: 60%).

In Supplemental Material 10 (SM10), we summarize the main results from the comparison between studies conducted in the Global North and South.

Discussion

This review aimed to analyze the published literature on telemedicine acceptance in rural areas, provide guidelines for future studies, highlight the gaps in the literature, and identify spaces for optimization. Despite growing interest in telemedicine as a means to improve healthcare accessibility in rural and remote areas, the concept of acceptance, and how it is measured, remains inconsistently defined across the literature. Given that the adoption of telemedicine services depends not only on technological availability but also on human factors, the necessity of a work that summarize the current state on: (1) how acceptance is conceptualized within telemedicine research, (2) what methodological approaches are used to evaluate it, and (3) to what extent rural users and healthcare providers accept telemedicine services it is of key importance to provide evidence-based insights that guide future research and practical implementations.

Our results showed a growing trend and interest in the research topic from 2018 to 2022, with a decrease in 2023. A similar result has been obtained by Saigí-Rubió and colleagues (2022). In their overview of systematic reviews published on telemedicine technology use across the WHO European regions, researchers highlighted how of the 33 reviews eligible in their work and published between 2011 and 2022, around 50% has been published between 2021 and 2022, underlying the existence of a COVID-19 effect on the interests of researchers and governors (Saigí-Rubió et al., 2022).

Notably, from our results, it is clear that most of the studies in this area are conducted by medical professionals. This partially explains the limited attention to the theoretical and methodological foundations of acceptance, a construct rooted in psychology. Future studies should consider interdisciplinary approaches to the phenomenon, involving psychological and sociological researchers, public health experts, and engineers to address the complexity of telemedicine acceptance and to translate results into practical implementation guides.

Additionally, across all studies, the heterogeneity of rurality reporting methods further complicates cross-study comparisons. Given that official national indices for rural classification exist, future studies should align with these standards to enable comparability and allow researchers to examine differences in acceptance across varying degrees of rurality.

Analyzing the provenance of participants and the geographic distribution of studies, we can see that countries such as the USA and Australia are most interested in and engaged with this type of research and innovation. They are followed by European and Asian countries, with limited representation of the Global South. While comparing rural telemedicine acceptance research across the Global North and South, several structural asymmetries emerged. The predominance of unreported or implicit definitions of rurality undermines cross-context comparability, while the unequal availability of validated rural-classification systems, largely concentrated in high-income countries, places Global South research at a methodological disadvantage by requiring reliance on heterogeneous proxy measures. Similarly, the limited adoption of theoretical frameworks, affecting most studies in both settings, constrains the cumulative development of knowledge, despite the predominance of TAM and UTAUT models derived from high-income technological contexts. Methodological disparities were also evident, particularly in the use of mixed-methods approaches, which were substantially more common in Global North studies (41%) than in Global South studies (16%). This imbalance likely reflects differences in research infrastructure, resources, and methodological traditions, and should be considered when interpreting the robustness of findings across contexts. Overall, these disparities mirror broader global inequalities in telemedicine development and highlight the need for context-sensitive infrastructures, standardized reporting practices, and stronger collaboration with underrepresented regions (e.g., Sub-Saharan Africa, rural Latin America) to support more equitable and representative telemedicine research and establish rooted, meaningful connections with local territories. Only by fostering inclusion in global representativity and engaging with research groups to assess rural dwellers' needs in developing nations can we create a more inclusive and comprehensive scientific community that can respond to the needs of populations globally.

RQ1: How is 'Acceptance' Defined in the Context of Telemedicine?

Our results show that only 19% of the eligible papers defined acceptance, trying to frame and define their key characteristics and antecedents. From our results, perception-based attributes are mainly used to define telemedicine acceptance, followed by behavioral and attitude characteristics. The high heterogeneity and lack of consensus in the conceptualization of acceptance lead scientists to use and develop different, sometimes ad-hoc, research tools, limiting comparability and cumulation of scientific knowledge. An analogous case is the development of scales to measure depression symptoms in the past 100 years. In total, around 280 scales have been developed, with 50 different symptoms to assess different severity levels of depression. Due to this heterogeneity of definitions and tools, the overlap between the instruments is rare, and around 33% of symptoms included in the different scales do not appear in others. The lack of standardization makes it more challenging to ensure the results' validity (Fried, 2018; Fried et al., 2022). Even without clinical implications, acceptance should be considered as an evaluation of how much a technology, in our case, telemedicine services, will be used, and feedback about the intervention and implementation efforts made by researchers, investors, and policymakers. Without a proper understanding of these crucial elements, attempts to introduce telemedical services may lead to misallocation of public funding, inappropriate introduction of technologies that their target users will not actively adopt, and healthcare service deficiencies resulting from patients' geographic distance from public care facilities. In line with this lack of definition, we see a lack of reliance and use of theoretical frameworks. Only 30 out of 104 studies were implemented in research design and evaluation of accepted valid theories. The low application of these theories leads to a lowering in the reliability of the results obtained. Our results show that, in proportion, the use of theoretical frameworks leads to fewer strong results in telemedicine acceptance, compared to not using them, underlining the existence of an inflation of effect sizes, which is supported by published literature on the topic (Oberauer, K., & Lewandowsky, S., 2019). Our work, together with the comprehensive study by Harst and colleagues (2019), provides valuable insights into the technology acceptance framework and the main antecedents of telemedicine acceptance. Both researchers identified the TAM and UTAUT models as the most widely used in the literature, and, given their historical role, we believe they should be considered the starting point for healthcare system evaluations. One of the strongest aspects of these theoretical frameworks is their flexibility in adapting to different technologies (e.g., different telemedical services) and their capacity to incorporate new context-dependent exogenous variables (Venkatesh et al., 2011). Starting from their base models, we believe that future studies should include relevant acceptance predictors such as the degree of compatibility of new health technologies with existing needs and infrastructures (Moore & Benbasat, 1991), the personal innovativeness and individual participants' willingness to try new technologies (Agarwal & Karahanna, 2000), as well as, when coherent with the local and regional health policies, price value assessments (i.e., the cognitive trade-off a person make between the monetary cost for the use of a technology and the perceived benefits received by the use of the technology itself; Doods et al., 1991). While the latter may be more suitable for patients, the former should be included for evaluations of both providers and end-users. In evaluating and testing physicians' acceptance of telemedicine, scholars should consider work-related stressors that may influence interest in adopting new systems. Health-related work environments are subject to high levels of stressors, such as uneven work-life balance, mobbing, high emotional demand, and technostress (Peter et al., 2020). In particular, techno-overload (i.e., the potential of a technology to compel users to work faster and longer or change work habits) and techno-invasion (i.e., new technologies ability to invade users' personal lives and make the boundaries between work and private contexts more blurred) are known to be most frequent sources of technology related stress in healthcare environments (Tell et al., 2023; Keshavarz et al., 2025) with direct consequences on professionals health (e.g., increase in burnout, sleep disturbances and cardiovascular strains) (Bail et al., 2023; Kumar et al., 2024). Technostress investigations, comprising digital competencies assessments, should be considered particularly relevant in rural contexts evaluations and prior telemedicine planning given the possible presence of socioeconomic and historical characteristics that may have led marginalized and remote communities to not have access to digital instruments, and for which, such innovations, may constitute a barrier to healthcare access, rather than a facilitator (Yee et al., 2022; Boulware et al., 2003). In conclusion, the temporal dimension of service-user interaction must be considered when evaluating telemedical services such as long-term tele-interventions, telerehabilitation, and telemonitoring. The inclusion of variables like habit (i.e., the extent to which an individual believes that carrying out a behavior is automatic) (Limayem et al., 2007) should constitute a valuable source of information regarding the ease with which users integrate the service into their daily life, and its connection to use and compliance with the treatment. Future research should address all these aspects of telemedical research by proposing not only clear and integrative acceptance definitions anchored to valid and robust theoretical frameworks, adapted to rural contexts, but, at the same time, develop and propose new conceptual models for rural settings that include aspects of digital trust, institutional support in healthcare services, and consider cultural barriers limiting telemedicine interest and adoption.

RQ2: "What are the Most Used Methods to Assess the Acceptance of Telemedicine Services in Rural and Remote Areas?"

Our findings balance qualitative, quantitative, and mixed-methods designs in assessing different telemedical acceptance levels. Future review works should include different designs to better represent the phenomenon. From our analysis, quantitative studies primarily rely on Likert scales. By combining the widely debated fragilities of such measurement methods (e.g., lengths of the rating scales, unequal distances between the points in the scale, use of parametric vs. non-parametric statistical analysis) (Joshi et al., 2015) with the lack of use of validated research instruments (37% of cases), the telemedical acceptance levels identified underscore fragilities and limited generalizability. From our results, the mixed-methods design mostly relied on a combination of Likert scales with interview/semi-structured interviews and open-ended questions/free space comments. Integrating different measurements helps overcome Likert scale problems and achieve a primary in-depth analysis and understanding of complex phenomena studied in disciplines like health psychology (Bishop, 2015). At the same time, the vast heterogeneity of methods identified in the present research indicates how researchers still lack a consensus on the techniques necessary to assess telemedicine acceptance. Besides developing reliable and valid research tools with strong psychometric properties that ensure construct validity by aligning the intended constructs with those operationalized in measurement, future research efforts should focus on developing telemedicine technologies and tailored evaluation instruments that provide evidence of measurement invariance across urban and rural populations. The development of evaluation tools that enable comparisons across levels of rurality would allow assessment of variation in the relationships among antecedents influencing acceptance of a specific telemedical service within the target clinical population, across and within regions. These results would represent a valuable resource for guiding the allocation of financial, temporal, and research resources toward the development of targeted, evidence-based strategies to support the implementation and long-term sustainability of telemedicine services. To fully realize their potential, an initial national-level research phase is needed to establish valid, shared research protocols. Building on this foundation, international collaborations will be essential for conducting rigorous cross-cultural validation of measurement instruments and, in turn, enhancing the comparability of findings across countries.

RQ3: "To What Extent do Rural Dwellers and Practitioners Accept the Introduction of Telemedicine Services?"

Our results show that telemedical acceptance levels have been reported as "High" or "Medium" in 84% of the articles between providers and patients. Such results lead to different practical implications. Firstly, they can be considered an indicator of system usability and user interest. As previously discussed, telemedicine services are powerful tools in aiding isolated communities and providing necessary services for their inhabitants. At the same time, positive results are helpful feedback for developing new telemedical technologies and interventions, and for governors and policymakers to understand whether they are going in the right direction. Concurrently, the relevance of such results stands out as a call for good research practices to better investigate and understand complex phenomena like this one. In fact, in our review, the positivity of the result might hide vulnerabilities of the research associated with measurement practices, as discussed before, as well as the participants' numerosity and characteristics. Our results show that patients are the most studied population, in terms of sample size per study, and accuracy in reporting demographic characteristics. The lack of information about providers deprives us of valuable information about one of the two leading actors that plays a crucial role in the dyadic relationship of telemedical services. Equally relevant is the limited number of studies (Peltan et al., 2020; Weißenfeld et al., 2021; Miyashita et al., 2022; Kalańska-Łukasik et al., 2022; Price-Haywood et al., 2023; Mihevc et al., 2024; Dhillon et al., 2022) that evaluate differences in acceptance between urban and rural settings, an essential factor in understanding contextual differences. A deeper understanding of telemedicine adoption in rural settings requires examining not only levels of acceptance, but also the contextual determinants shaping technology use across territories. Future research should therefore prioritize identifying region-specific barriers and enabling factors in rural contexts, with the aim of reducing territorial inequities. Beyond expanding healthcare access, these efforts may also inform the development of locally adapted digital and physical infrastructures capable of sustaining long-term telemedicine implementation.

Limitations

A first limitation of our study is the participants' rural location. During the screening process, we carefully selected only those studies that included at least some participants from remote or rural areas. However, most studies failed to report acceptance levels stratified by different degrees of rurality or to differentiate between rural and urban settings, preventing us from making precise distinctions across participant groups. This issue represents the limits and problems of the current research field. We decided to keep these studies to report the current situation in telemedical technology research properly and highlight the practices used by authors that make inferences about acceptance levels in rural areas. Future studies should account for these differences and report them by making clear differentiations and inferences based on rurality stratification.

A second limitation relates to the limited granularity in categorizing acceptance levels as "Low", "Medium", or "High". While a more detailed classification could have enhanced analysis precision, it would have required a meta-analysis. Many relevant studies would have been excluded due to methodological reasons. We believe that prioritizing including qualitative and mixed-method studies has strengthened the quality of our work and offered a more comprehensive overview of the field's current state. Future reviews should consider the necessity of quantitative summarization of acceptance, not based only on descriptive measures, while acknowledging and considering the methodologies' heterogeneity.

Lastly, the timeframe selected for this review (2018 to 2024) restricts a comprehensive retrospective on telemedicine acceptance in rural and remote areas, covering only the most recent seven years. We decided to proceed in this way to create continuity with the work of Harst and colleagues (2019). However, future reviews should consider extending the time range to provide a more complete understanding of the phenomenon's evolution.

Conclusion

This work provides an overview of current research on telemedicine acceptance in rural areas, highlighting both the growing interest in the topic and the significant methodological and conceptual limitations that still characterize the field. Although telemedicine represents a promising solution to improve healthcare accessibility in underserved communities, acceptance remains inconsistently defined and measured across studies, limiting comparability and the cumulative development of knowledge. The review also identified significant geographical and methodological disparities between Global North and Global South contexts, reflecting broader inequalities in telemedicine development and research resources. Future studies should adopt more interdisciplinary and theory-driven approaches, use standardized rurality classifications, and strengthen collaboration with underrepresented regions and local stakeholders. Advancing research in this area will be essential to support evidence-based implementation strategies and to ensure that telemedicine solutions are equitable, context-sensitive, and responsive to the needs of rural populations.

Appendix A

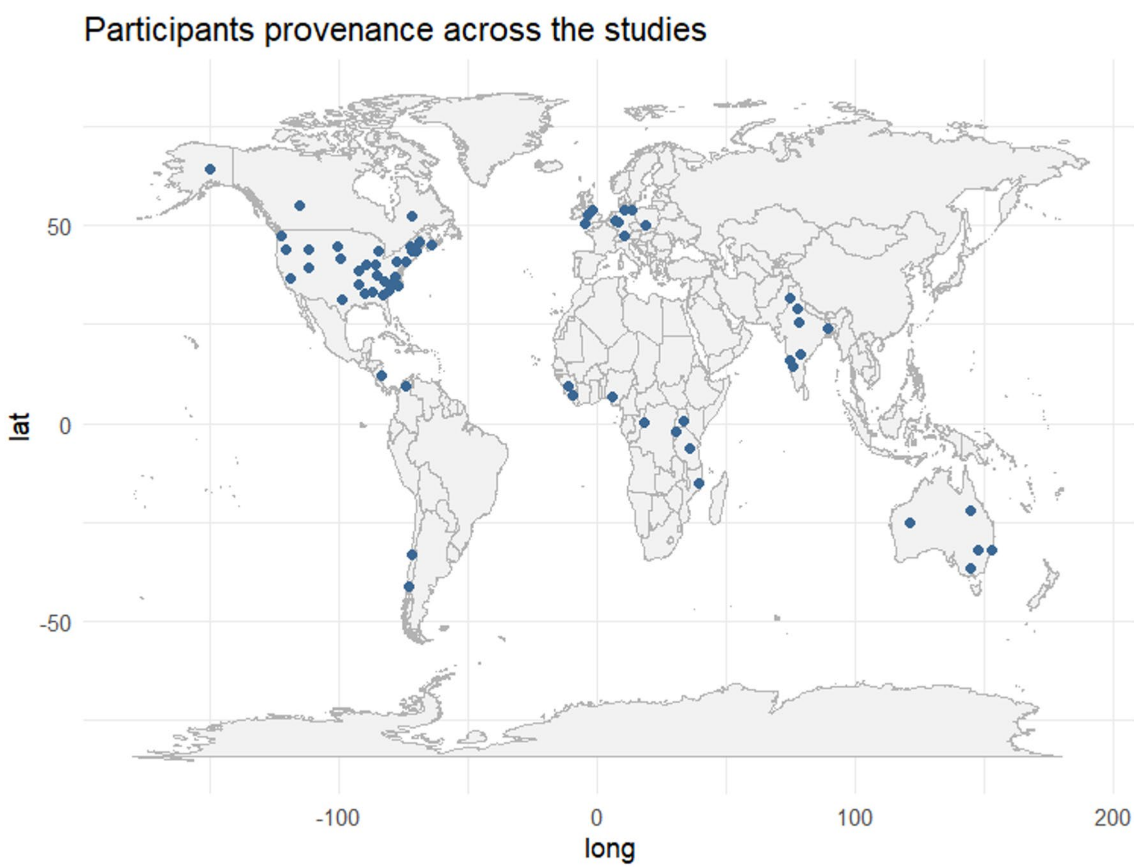


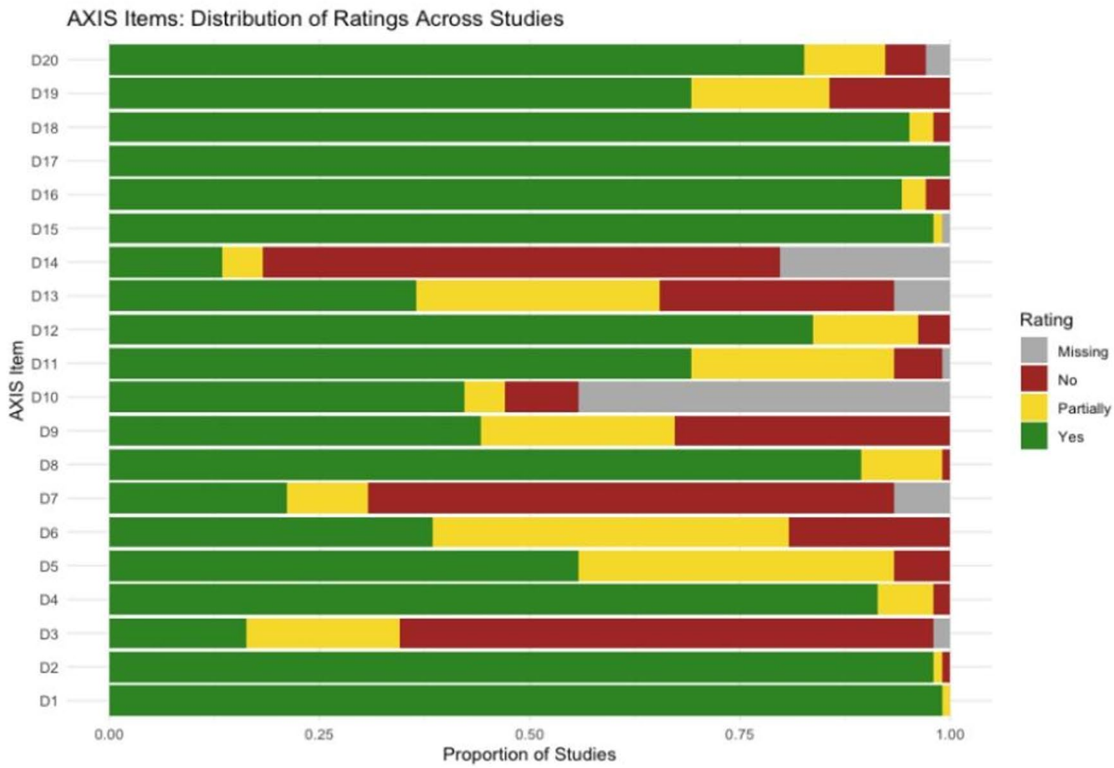
Fig. 6 Approximate city-level location of the participants

Appendix B

technology_type	In-text Citations
2wT	Day et al., 2023
ALRITE	Ellington et al., 2021
BESI-C System	LeBaron et al., 2022
CardioDial	Staszewsky et al., 2018
GetActive-OA	Mace et al., 2022
MGIUS-R3, MGI Tech Co., Ltd.	Zhang et al., 2024
Medic Mobile's prototype	Bhatt et al., 2018
MobileODT platform	McKim et al., 2021
PIERS System	Boene et al., 2021
POMapp	Kinshella et al., 2021
Portable Health Clinic (PHC)	Hossain et al., 2018
SIHLEplus	Lopez et al., 2020
SpiroBank SMART spirometers	Boente et al., 2024
TETRA	Dandge et al., 2019
TIDieR	Zhou et al., 2019
TREAT-ON Model	Siminerio et al., 2023
TapCloud	Bonsignore et al., 2018
Telectation app	Demirci et al., 2019
Text4Life program	Udenigwe et al., 2022
VITAMO	Schweitzer et al., 2020
Virtual Clinical Pharmacy Services (VCPS)	Bucknell et al., 2024
mHealth app	Schoenberg et al., 2021
mSBIRT	O'Grady et al., 2023
wMammogram	Roh et al., 2023

Fig. 7 List of the new telemedical technologies studied

Appendix C



item	n
<fctr>	<int>
D3	66
D7	65
D14	64
D9	34
D13	29
D6	20
D19	15
D10	9
D5	7
D11	6
D20	5
D12	4
D16	3
D18	2
D4	2
D2	1
D8	1

Fig. 8 Item-level ratings for the quality AXIS tool assessment across all the eligible studies. Graphical representation has been possible by using the Checklist and Risk of Bias Visualization Tool (ROBVIS)

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Authors' Contribution Marco Lezcano [Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review and editing]; Maria Gabriella Landuzzi [Methodology, Supervision, Writing – review and editing], Margherita Pasini [Methodology, Supervision, Writing – review and editing], Luca Laezza [Data curation, Formal analysis], Martina Vacondio [Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review and editing, Supervision].

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Data Availability The list of papers screened and included in the review, and all the supplemental material, are available at https://osf.io/4xyr5/.

Declarations

Ethics approval The article consists of a systematic review of the literature and does not involve any studies with human participants or animals performed by the authors. Ethical approval was not required.

Competing Interests On behalf of all authors, the corresponding author states that there is no conflict of interest.

Authors area of interest Marco Lezcano: Telehealth, Telemedicine, Technology Acceptance, Rural and Remote areas, Health Policies, Methodology, Open Science, Environmental Psychology. Maria Gabriella Landuzzi: Social policies, welfare, work and employment, Social inequalities, social exclusion, social integration, educational policies, sociology. Margherita Pasini: Clinical and health psychology, Attention, perception, action, consciousness, Personality and social cognition, emotion, environmental psychology. Luca Laezza: Environmental psychology, Psychometrics. Martina Vacondio: Decision making, Health risk perception and communication, Behavioral economics, Environmental psychology, Pro-environmental behavior, Behavioral change interventions.

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