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ORIGINAL ARTICLE

Acceptability and Barriers to Mobile Health Application Use Among Community Healthcare Workers in Rural Tamil Nadu: A Qualitative Study

Sai Santhoshini Thiruvarasan,¹ Madhivanan Arulmozhi^{2,*} and Premanandh Kandasamy³

¹Post Graduate, Department of Community Medicine, Sri Manakula Vinayagar Medical College and Hospital, Puducherry

²Associate Professor, Department of Community Medicine, Sri Manakula Vinayagar Medical College and Hospital, Puducherry

³Professor and Head, Department of Community Medicine, Sri Manakula Vinayagar Medical College and Hospital, Puducherry

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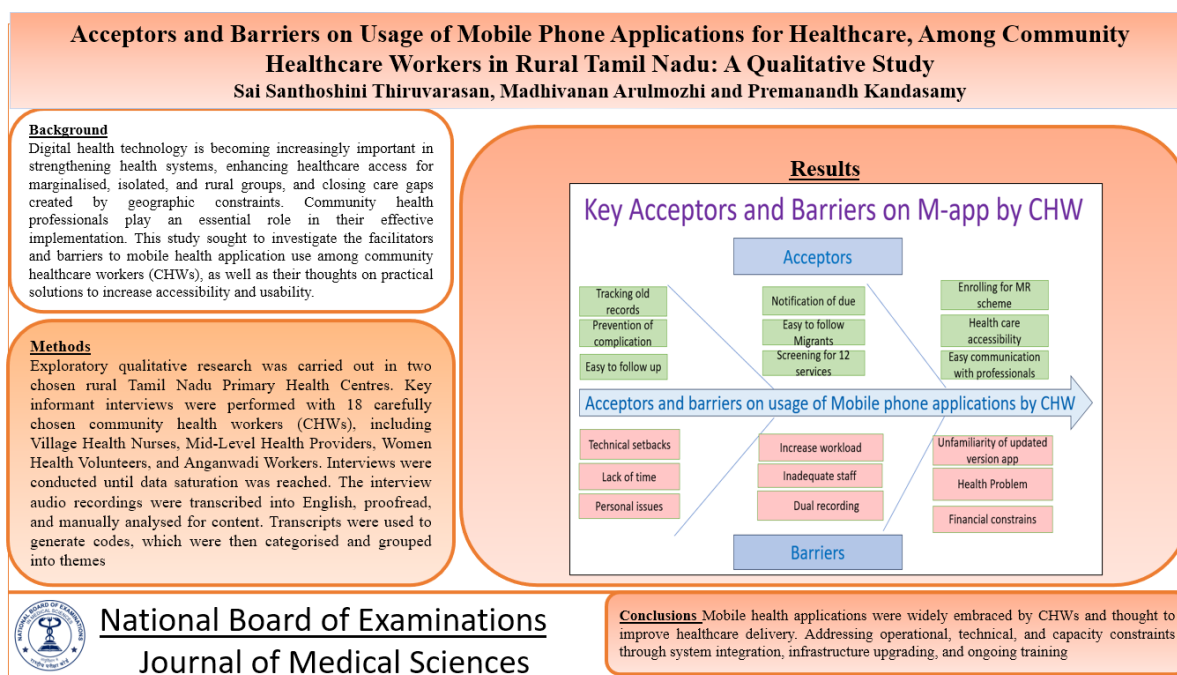
Abstract

Background: Digital health technology is becoming increasingly important in strengthening health systems, enhancing healthcare access for marginalised, isolated, and rural groups, and closing care gaps created by geographic constraints. Community health professionals play an essential role in their effective implementation. This study sought to investigate the facilitators and barriers to mobile health application use among community healthcare workers (CHWs), as well as their thoughts on practical solutions to increase accessibility and usability. **Methodology:** Exploratory qualitative research was carried out in two chosen rural Tamil Nadu Primary Health Centres. Key informant interviews were performed with 18 carefully chosen community health workers (CHWs), including Village Health Nurses, Mid-Level Health Providers, Women Health Volunteers, and Anganwadi Workers. Interviews were conducted until data saturation was reached. The interview audio recordings were transcribed into English, proofread, and manually analysed for content. Transcripts were used to generate codes, which were then categorised and grouped into themes. **Results:** The facilitating factors were user-friendly interface, improved patient tracking, illness monitoring, quick follow-up, referral, and integrated health care services all contributed to the success. The majority of CHWs (n=14) cited technological difficulties, dual recording, and time limits as their main obstacles. Logistical and budgetary difficulties were also identified as impediments to the adoption of mobile health applications. **Conclusion:** Mobile health applications were widely embraced by CHWs and thought to improve healthcare delivery. Addressing operational, technical, and capacity constraints through system integration, infrastructure upgrading, and ongoing training is critical to improving the successful and long-term adoption of mHealth apps in rural primary healthcare settings.

Keywords: Mobile health application, community health worker, Rural, Qualitative, Primary health centre

*Corresponding Author: Madhivanan Arulmozhi
Email: cm.arulmozhim@smvmch.ac.in

Graphical Abstract



Introduction

Digital health has evolved as a transformative way to strengthening health systems by making healthcare more accessible to remote, rural, and marginalised groups [1]. In May 2018, the World Health Assembly formally endorsed the Resolution on Digital Health, recognising these technologies' potential to promote health, prevent disease, and improve access, quality, and cost of care [2]. Mobile devices, especially in low- and middle-income countries, offer unique opportunities for service delivery directly at the point of care. Mobile health (mHealth) technologies have the potential to bridge gaps in care caused by geographic isolation, low demand for services, delayed treatment, poor adherence to clinical protocols, and prohibitive financial costs [3]. Furthermore, World Health Organization (WHO) guidelines on digital health interventions emphasize the necessity of creating supportive

environments, ensuring that health workers can seamlessly adapt to and utilize these digital platforms [4].

India has accelerated its digital health transformation through the Ayushman Bharat Digital Mission to enable interoperable electronic health records and digital health services [5]. Furthermore, several programme-specific mobile applications have been developed to support frontline health workers in implementing maternal and child health services, disease surveillance, immunization, nutrition, communicable disease and NCD screening [6,7]. Evidence suggests that incorporating mobile health interventions improved a wide range of outcomes such as improved clinical parameters, treatment outcomes, patient knowledge, health behaviour, satisfaction, and psychosocial wellbeing [8,9].

Community health workers serve as a critical link between health systems and communities, enhancing healthcare access,

service coverage, and progress towards universal health coverage [10]. Studies have shown that the use of mobile phones for health care services enhances frontline health workers' motivation, empowerment, work efficiency, self-efficacy, and credibility within the community. Further, it reduces paperwork and enhances timely reporting, data quality, and data completeness [11]. Despite the greater usefulness of mHealth interventions, their widespread adoption is hindered by barriers such as a lack of smartphones, limited digital literacy, poor internet access, inadequate training, usability concerns, and reluctance among healthcare providers to integrate digital technologies into routine practice [8,12].

Many studies in India have primarily focused only on patient perspectives on digital health are well-documented, qualitative research on the experiences of Community Health Workers (CHWs) implementing mobile health apps in rural Tamil Nadu remains limited. This qualitative study explores CHWs' field experiences to identify the facilitators, barriers, operational gaps, and cultural acceptability of these technologies across the continuum of care. By gathering CHW-proposed solutions, this research provides critical insights to optimize the usability and delivery of grassroots digital health services.

Methodology

The present study was carried out in the field practice area of the Rural Health Training Centre (RHTC) attached to the medical college of Puducherry district. It is a tertiary care teaching hospital with a bed strength of 1180, exclusive of 150 critical care beds, providing comprehensive outpatient and inpatient services across

multiple specialties. The study area is located in a village of Tamil Nadu, which is situated approximately 28 kilometres from the teaching institute. It covers four Primary Health Centres (PHCs), of which one PHC serves 34 villages with a population of 63,921 and another PHC within the same block covers 2,686 population.

It was an exploratory qualitative study design and was conducted over a period of three months in the year 2024. Since qualitative research does not require a predefined sample size, a total of 18 key informant interviews (KIIs) were conducted until the point of data saturation, when no new information emerged with additional interviews. After the initial 12 to 14 interviews, the researchers observed that the core themes regarding mHealth facilitators (e.g., easy retrieval of records) and barriers (e.g., dual data entry, network issues) were consistently repeating. To empirically confirm saturation, a stopping criterion of three consecutive interviews was applied. Interviews 16, 17, and 18 were conducted, transcribed, and manually coded against the existing codebook. When these final three transcripts yielded no new descriptive codes, sub-categories, or novel conceptual insights, the theoretical framework was deemed conceptually dense, and data saturation was officially declared achieved. Among the four PHCs located around the selected village, two PHCs were selected using the lottery method to obtain the diverse perspectives.

A purposive sampling technique was employed to recruit study participants from the selected PHCs. The participants included Community Health Workers (CHWs) such as village health nurses (n=6), mid-level health providers (n=4), women health volunteers (n=4), and Anganwadi workers (n=4). These cadres

were purposively selected as they represent the frontline health workforce in rural Tamil Nadu and are directly involved in service delivery, with routine interaction in digital health initiatives and mobile phone-based healthcare applications.

The Principal Investigator trained in qualitative research techniques through academic workshops and posted as a Medical Officer at Rural Health Training Centre during postgraduate training period in Community Medicine, conducted the interview in acquaintance with PHC medical officers as we coordinate IEC activities with the selected PHCs.

Recognizing the inherent hierarchical power dynamic between a medical officer and community healthcare

workers, proactive steps were taken to mitigate social desirability bias. Prior to each interview, the investigator explicitly de-emphasized their clinical role, framing the interaction strictly as a collaborative research effort. Participants were reassured that their honest feedback including negative criticisms of the digital platforms would not impact their employment, performance evaluations, or professional relationship with the medical college or PHC. Furthermore, the researcher maintained a reflexive journal throughout the study to document personal preconceptions regarding mHealth utility, ensuring these assumptions did not influence the interview probing or the manual coding process (Table 1).

Table 1. Mobile application used by the community health care workers

S.NO	Health care workers	Mobil Application
1.	Anganwadi workers (4)	Poshan tracker app
2	Village health nurse (6)	PICKEME3.0, HMIS, Thaimai app
3.	Mid-level health provider (4)	AB portal, MTM login, e-sanjeevani, IHIP, Thaimai app
4.	Women health volunteer (4)	MTM portal,

Ethical consideration and permission

The study was initiated after obtaining approval from the institutional ethics committee (Approval No: EC/145/2024 and 14.10.2024). Prior permission was obtained from PHC medical officers. All the information collected from the study participants was kept confidential and their privacy was maintained.

Data collection procedure

After obtaining informed written consent from the study participants, the Principal Investigator, trained in qualitative research methods, conducted the interviews in a language comfortable to the participants at their convenient place and time. The interviews were conducted at the Primary Health Centre (PHC), to minimize potential bias, the interview topic was not disclosed in advance, as prior knowledge of the subject may influence participants'

responses and reduce the authenticity of the data.

A total of 18 key informant interviews (KIIs) were conducted using a pre-designed interview guide. The interview guide was developed based on an extensive literature review to explore the facilitators and barriers to mobile phone application usage among healthcare workers in rural areas. The interview guide consisted of open-ended questions such as: “What are the key motivators for using mobile health applications?”, “What challenges do you encounter while using them for healthcare?”, and “Can you suggest any solutions to improve usage?” Each interview lasted approximately 30–40 minutes.

With the participants’ permission, all the interviews were audio recorded. Following each interview, the Principal Investigator transcribed the recordings verbatim in the local language Tamil on the same day of the interview. The transcripts were then translated into English, maintaining the accuracy of meaning. To ensure reliability, the transcripts were cross-checked against the original recordings, and a random subset was independently reviewed by a faculty supervisor for consistency. Field notes taken during the interviews were incorporated into the transcripts to capture non-verbal cues and contextual details, thereby enhancing the richness of the data.

Following each session, the Principal Investigator conducted a debriefing with the participant, during which they were encouraged to share any additional reflections or insights. These supplementary inputs were duly documented and included in the analysis, ensuring completeness and credibility of the data.

Analysis Plan

The transcripts were meticulously checked for errors, and personal identifiers such as name and address were removed to maintain anonymity. The interview transcripts were read multiple times and analyzed using manual content analysis with an inductive thematic approach. Initially, descriptive codes were generated line-by-line from the raw data to capture key ideas and expressions of participants. Similar codes were then compared, grouped together, and refined to reduce redundancy. These grouped codes were further organized into broader categories that represented patterned responses across participants. Finally, categories were merged into higher-level themes, which reflected the underlying facilitators and barriers influencing the use of mobile phone applications by community health workers.

To enhance reliability, the first two authors independently coded the transcripts, and the codes were cross-verified for inter-rater reliability. The final results were reviewed by the third author to confirm the codes and enhance the credibility of the findings. Any discrepancy arising between the investigators was resolved by mutual consensus. The study findings have been reported using “consolidated criteria for reporting qualitative research” (COREQ) guidelines and Rigour in qualitative research [14].

Coding Framework

An initial coding framework was developed manually by the first two authors. After a detailed, line-by-line reading of the first three information-rich transcripts, meaningful text segments were highlighted and assigned preliminary descriptive labels (codes). A formal

codebook was documented in a spreadsheet, detailing the code name, a brief operational definition, and an exemplar quote to ensure consistent application across all data. For instance, initial descriptive codes such as 'waiting for OTP' and 'inability to edit errors' were established.

Thematic Development

The coding process proceeded iteratively. The researchers utilized a manual thematic charting and color-coding technique to organize the data. As subsequent transcripts were analyzed, new codes were added to the framework. Once all data were coded, the codes were visually mapped and clustered into broader conceptual categories through constant comparison. For example, individual codes relating to operational difficulties and connectivity issues were grouped under the category of 'Technical Setbacks.' Finally, these categories were analytically elevated and synthesized into overarching themes that explained the core phenomena of mHealth facilitators and barriers. To ensure dependability and inter-rater reliability, the manually coded transcripts and the thematic map were cross-verified by the third author, with any conceptual discrepancies resolved through mutual consensus discussions.”

Measures undertaken to the trustworthiness of the findings was established utilizing Lincoln and Guba’s evaluative criteria [15].

Credibility was enhanced through data triangulation by interviewing a diverse cadre of participants, including VHNs, Staff Nurses, MLHPs, and WHVs, capturing a multi-faceted view of mHealth adoption. Additionally, member checking was implicitly conducted during the post-

interview debriefing sessions, where the investigator summarized key takeaways to the participants to verify the accuracy of the interpretations. **Dependability** and **Confirmability** were achieved by maintaining a comprehensive audit trail, which included raw audio files, translated transcripts, field notes, and the manual coding spreadsheets. Furthermore, the inter-coder consensus process between the first three authors minimized individual researcher bias. Finally, **Transferability** was facilitated by providing a thick description of the study setting, participant demographics, and the specific operational contexts of the Thiruvannainallur and Sirumadurai PHCs, allowing readers to determine the applicability of the findings to similar rural landscapes.

Results

The mean age of the participants was 39.0 ± 8.29 years. Of the total 18 community health care workers, the majority 11 (61.1%) were below 40 years of age, while 7 (38.9%) were belongs to age group 40 years and above. About 16 (88.9%) were Hindu, while the remaining two (11.1%) belongs to Christians religion. All the respondents were literate. Table 2 highlights the supportive elements of mobile health platforms as perceived by CHWs, showing features that enhanced their fieldwork and service delivery. Table 3 presents the challenges faced in using these applications, including technical, operational, and contextual barriers. Table 4 outlines the practical solutions suggested by CHWs to overcome these challenges, such as improving efficiency, reducing workload, and enhancing usability of the applications.

Table 2. Supportive elements for CHW in mobile health usage (N=18)

Themes	Categories	Codes
Facilitating factors	Technology-enabled service delivery	• Easy retrieval of patient records through registration or phone number (16) • Able to monitor ANC mothers and chronic conditions (16) • Timely diagnosis and referral to prevent complications (16) • Beneficiary follow-up with due reminders (16) • Tracking follow-up records of migrant patients (15) • App-based colour indicator to flag notified and high-risk cases (8) • Verifies eligibility for enrolment in government health schemes (8) • Immediate notification to the medical officer, as the app is interlinked with both stakeholders (8)
	Operational features	• Easy data entry • Apps are designed in the local language, Tamil • Editable data errors • Lightweight, easy to carry for home visits • User-friendly single interface for screening multiple conditions (NCD, Leprosy, TB, Cancer) • Government training to use mobile health applications
	Patient-centred health outcomes	• Increased health care access to geographically remote beneficiaries (18) • Home-based medicine distribution with concurrent data entry (18) • Instant communication of health information through direct calls & messages (14) • Easy communication with health care personnel for resolving health concerns (14) • Nutrition kit distribution during home visits of TB, leprosy, and cancer patients (8)

Table 2 Key themes identified in the interviews are summarized which

Represents the facilitating factors for CHW in mobile health platforms.

Table 3. Challenges faced by HCW in mobile health usage (*N=18*)

Themes	Categories	Codes
Challenges	Resource constraints	• Dual data entry in both digital platforms and registers (13) • Increased workload to Mid-level health provider (MLHP) and women health volunteer (WHV) in field settings (10) • Inadequate manpower among MLHP / WHV (7) • Limited time for other community-centered activities and personal work. (9) • Inadequate remuneration for women health volunteers (8)
	Digital literacy	• Unfamiliarity and lack of knowledge with latest version of apps (6) • Reliance on virtual training (6) • Deficient technical skills (5)
	Technical setbacks	• Poor network connectivity in field areas (13) • Difficulty in obtaining OTP from the beneficiary for login authentication • Takes a long time to complete data entry • Reduced patient cooperation due to increased data entry time. (10)
	Digital health effects	• Eye strain from prolonged screen exposure (15) • Musculoskeletal discomfort, including neck and back pain (10)
	Financial issues	• Inability to afford smartphones (10) • Self-spending for phone Recharge (13) • Limited storage capacity on personal mobile (13)
	Personal related	• Family misunderstandings arising from frequent phone usage (8) • Lack of privacy and scam calls in personal phone numbers (5)

Table 3 in the interview Participants frequently mentioned about the challenges faced by the health care workers on using mobile application for health care.

Table 4 represents about the Solutions given by the CHW for using mobile application for health purpose is identified in the interviews (Figure 1).

Table 4. Solutions given by the CHW (N=18)

Themes	Categories	Codes
Solutions	Digital support	• Ensure stable WIFI (5G) connectivity at every centre (18) • Offer monetary support for mobile data recharges to health care workers (18) • Supply mobile phone or Laptop to health care workers as per the needs (13) <i>“We are paid less, so most of the time we recharge with our own money for centre work. If recharge benefits are provided, it would be very helpful for us.”</i> (Women health volunteer)
	Capacity building	• Conduct periodic onsite training for the updated app version. (15) • Assign one data entry operator with technical skills at each centre (10) • Recruit additional health care workers (10) • Establish clear protocols for division of work among health care workers (10) <i>“I don’t know about updated version in the app, we need manual training for that periodically, it will be useful for us”</i> (Mid-level health provider)
	Technology enhancement	• Enable app login without the necessity of OTP (16) • Feasibility to use the app at offline mode (6) • AI based chatbot services to handle user queries (2) <i>“ It will be useful for us if government provides us the wifi connection or 5G network in each PHC network, so that we able to do our work easily ”</i> (Village health nurse)

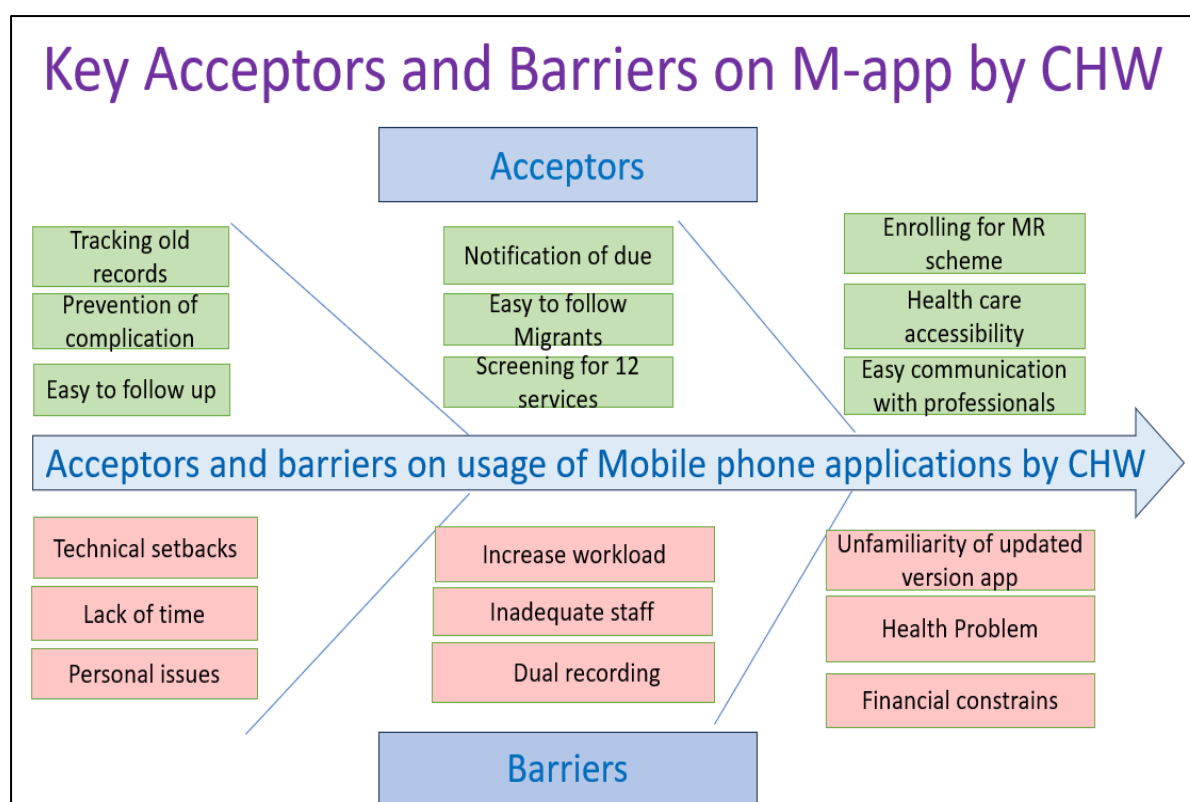


Figure 1. Key Acceptors and Barriers on M-app by CHW

Facilitating Factors

Verbatim
"One of my patients lost his previous documents. I have recovered the documents by entering his registered number in the application. Another patient, he doesn't have a registration number for him, and we traced the records with his phone number." (Village health nurse 2) "I have identified an ANC mother with gestational diabetes just because I uploaded her blood sugar levels at each visit and monitored her regularly. Later, she was referred to GH for further management." (Village health nurse 3) "We check the eligibility person for the Muthulakshmi Reddy scheme, and we help in due remembrance also." (Village health nurse 4,5) "In a particular locality, if there are more fever cases, we screen all the suspected patients, and we will enter into the app to inform the medical officer and Health Inspector of the current area." (Mid-level health provider 3) "Earlier, we were writing in big registers in the field; it took more time. In this app, just a few taps and it is done, very easy for us." (Village health nurse 5)

<i>As I struggle to read in English, this app provides in Tamil language, which makes me to understand easily</i> (Mid-level health provider 2) <i>“Sometimes by mistake, I enter the wrong age or name. In this app I can correct it immediately, but in the register if we make a mistake, we have to use whitener or strike it out, which looks messy.”</i> (Women health volunteer 3) <i>“Earlier we used to carry many notes and forms Training to use mobile health application visits. Now we are just taking mobile and it feels light and easy.”</i>(Women health volunteer 2) <i>“Through the app I can contact patients directly and also send messages for arranging programs</i> (Women health volunteer 4)
<i>“By using the e-Sanjeevani app through video consultation, bedridden persons and in inaccessible areas are getting consulted and treated.”</i>(Village health nurse 6) <i>“For every month, during the house visit, I will provide regular tablets to the beneficiary.”</i> (Mid-level health provider 4)

Challenges

Verbatim
<i>“For data entry it takes nearly one hour for each family because of network problem I can't able to enter the data and it compulsory for us to take ten families per day “</i> (Village health nurse 2) <i>"I used to do data entry while maintaining the register, which made it difficult to manage both tasks at the same time."</i> (Village health nurse 4)
<i>“I don't know about the mobile app and am not familiar how to operate android mobile phones”</i> (Anganwadi worker 2) <i>"Our training is done through online sessions. But it is not very effective due to connectivity issues. Offline training would be more useful for learning about the app.”</i>(Village health nurse 3)
<i>“We have to put 10 house entries per day. Due to network issues, it takes a considerable amount of time to complete one entry for a single patient. So, the other patient starts to scold & complain to us for consuming so much time for one patient.”</i>(Women health volunteer 3) <i>“I used to enter my daily registration data at mid night because at night, network issues are limited.”</i>(Mid-level health provider 4)

"I have pain in my eyes and blurred vision because of using the mobile app for data entry for a long period. " (Anganwadi worker 2, Mid-level health provider 3)

"I don't have proper devices to handle these apps, and I don't have proper capital to recharge my mobile phone." (Anganwadi worker 1)

"My mother-in-law and my husband used to scold and misunderstand me for using mobile phones late at night. Due to network issues in the morning, I used to enter data at night because at night, there will be limited network problem." (Village health nurse 5)

Discussion

The present qualitative study explored the factors influencing acceptance and barriers to the use of mobile health (mHealth) applications among community healthcare workers in rural Tamil Nadu. The findings indicate that although mHealth tools were generally viewed as useful for enhancing service delivery and continuity of care, multiple operational, technical, and system-level challenges limited their optimal use in routine practice.

In our study, we found that mobile health applications were perceived as user-friendly and interoperable, which enhanced patient tracking, risk identification, and improved health accessibility and health communication, especially in maternal and child health services and in chronic disease conditions. Similar findings were reported in Western states by Gwalani et al. and Maita et al in rural settings, supporting the role of mobile health technologies in strengthening health care delivery [16,17]. Thus, mobile health technologies can contribute to improved patient health outcomes in addition to supporting health management information systems [8]. Expanding mobile health interventions at the patient level can influence patient engagement, promote continuity of care,

and lead to sustainable improvement in health outcomes.

Further, the role of training and digital competence emerged as a key facilitator in the adoption of mHealth applications. Participants who had received formal training or had prior experience with digital technologies expressed greater confidence in navigating mobile platforms and addressing minor technical issues. This observation is consistent with evidence from studies conducted in other low- and middle-income countries, where structured training and ongoing technical support were shown to enhance the uptake and sustained use of mHealth interventions [18].

The present study identified increased workload due to parallel paper-based and digital documentation, increased time constraints, and reduced operational efficiency as the prominent challenges in mobile health application use. Comparable findings have been documented in previous studies conducted by Gwalani et al. and Gopalan et al., where duplicate data entry, administrative burden, workforce shortages, and multiple programmatic responsibilities hinder the uptake of mobile digital technologies [16,19]. Findings from these studies suggest that linking mobile applications with existing reporting systems and gradually reducing paper-

based records can help decrease workload and improve efficiency among healthcare workers.

Despite participants being literate, inadequate digital literacy remained a barrier to effective mobile health application use, consistent with findings of Gwalani et al. [16]. A few participants also preferred manual recording because of greater familiarity. Hence, key informants emphasised the need for regular on-site hands-on training of the latest versions and technical support from data entry operators and free chatbot services to improve digital competency and application use.

Technical challenges identified in the present study were poor network connectivity and limited device storage, which hindered the effective mHealth implementation. Similar findings were reported by Prinja et al. in rural and remote areas [21]. Such infrastructural limitations have been widely recognized as critical factors restricting the scalability and long-term sustainability of mHealth interventions in resource-constrained settings across India, despite their potential to improve service delivery [22]. Key informants suggested that offline data entry, strengthening digital infrastructure, minimizing duplicate documentation, and ensuring regular capacity-building of community healthcare workers are essential to improve acceptance and effective use of mHealth applications. In addition, policies that simplify reporting procedures, improve coordination across health programmes, provide adequate training, and strengthen supportive supervision can help ensure sustainability of mHealth initiatives among community healthcare workers in rural areas [23].

Strengths and Limitations

This qualitative study offers a deep understanding of the perceptions, attitudes, and experiences of community healthcare workers regarding mobile health applications. By focusing on rural Tamil Nadu, it captures the socio-cultural, infrastructural, and systemic factors influencing technology adoption, providing valuable insights for policymakers to design locally relevant interventions.

This study findings may have limited generalizability, as they are specific to the rural setting and may not apply to urban areas or other healthcare worker populations, and also, we interviewed different cadre of community health worker across two PHCs which adds diversity and depth to the findings.

Conclusion

Mobile health applications were widely embraced by CHWs and thought to improve healthcare delivery. The integration of mobile health applications into the healthcare system holds the possibility of improving patient management and boosting primary care services. However, solving implementation problems and ensuring that digital innovations are linked with the needs and skills of front-line health workers is critical for their effective use. A user-centered, context-specific approach to designing and implementing mobile health programs is critical for improving health outcomes in rural communities and supporting health information systems.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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