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Enhancing Community Health Worker Capacity through Digital Health Outreach: A Model for Primary Care in Rural Pakistan

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Abstract

Objective: This study aims to improve the capacity of community health workers (CHWs) in rural Pakistan to deliver digital health services, particularly through mobile health platforms that facilitate outreach and education. **Theoretical framework:** The study is based on the theory of teacher professional development, which posits that continuous training improves teaching effectiveness, leading to better student outcomes. **Literature review:** Previous studies have shown the positive impact of digital health tools on health service delivery in low-resource settings. Research indicates that digital platforms can bridge the gap in healthcare access and empower CHWs to provide better care. **Methods:** This intervention was carried out in rural Pakistan with a group of 50 CHWs. The CHWs were trained on using a mobile health platform designed to track patient data, facilitate health education, and improve service outreach. The effectiveness was measured through pre- and post-assessments of digital literacy, usage logs, and community feedback. **Results:** Results showed a significant improvement in CHW digital literacy and their ability to reach more households. On average, CHWs increased their home visits by 30% after using the digital platform. **Implications:** The findings suggest that integrating digital tools into rural health services can enhance outreach and efficiency, providing a scalable model for other rural settings in Pakistan and beyond. **Novelty:** This study presents a practical model for improving rural health service delivery by integrating digital health platforms and local community health workers.

Keywords: community health workers, digital health, rural Pakistan, mobile health platform, primary care outreach.

INTRODUCTION

Rural areas in Pakistan face significant challenges in accessing adequate healthcare due to limited infrastructure, geographic isolation, and a shortage of trained medical personnel. In Pakistan, nearly 65% of the population resides in rural areas, where healthcare facilities are sparse, and many rural communities rely heavily on basic health units (BHUs) and community health workers (CHWs) to access primary healthcare services. Despite the government's efforts to address these challenges through the development of a nationwide health network, disparities in healthcare access remain pronounced, particularly in remote and underdeveloped regions of the country [1]-[3].

One of the key challenges faced by the rural healthcare system in Pakistan is the lack of trained personnel and healthcare workers, particularly in rural areas where the burden of disease is often higher. CHWs play a critical role in this context, acting as intermediaries between the healthcare system and the community. They provide basic health services, conduct health education, and support disease prevention efforts. However, many CHWs in rural areas are undertrained, lack access to up-to-date medical knowledge, and face difficulties in delivering effective outreach services due to limited resources and outdated tools. The training of CHWs and the integration of digital tools could significantly improve the quality of healthcare services and community outreach, helping bridge the gap between the urban-centric healthcare system and the rural population [4]–[7].

Recent advancements in mobile health (mHealth) offer significant promise in improving healthcare delivery in low-resource settings like rural Pakistan. Digital health platforms are emerging as powerful tools to support healthcare workers by enabling real-time data collection, patient monitoring, and communication with remote healthcare providers. In particular, mobile health applications allow CHWs to better track patient health data, manage referrals, and provide health education in a more efficient and standardized manner. By leveraging the capabilities of mobile technology, CHWs can increase their outreach, improve patient follow-up, and provide better-quality care, even in the most remote and underserved areas of Pakistan [8], [9].

Pakistan has seen increasing investment in mobile health technologies in recent years, with pilot projects targeting chronic disease management, maternal health, and vaccination tracking. These initiatives have shown that integrating digital tools into the healthcare system can improve service delivery and health outcomes. However, despite these advances, the uptake of mobile health tools has been slow, primarily due to challenges such as poor mobile network connectivity in rural areas, low digital literacy among healthcare workers, and limited technical infrastructure. While national health initiatives have laid a strong foundation, there remains a need for localized interventions that focus on empowering rural healthcare workers with the skills and tools necessary to use digital health platforms effectively [10]–[12].

This article focuses on a community service initiative aimed at training and empowering CHWs in rural Pakistan to use a mobile health platform designed to track patient data, deliver educational content, and improve health outreach. The goal of this initiative is to enhance the effectiveness of CHWs, enabling them to deliver better healthcare services and improve patient outcomes through digital tools. The project also aims to assess the feasibility, impact, and sustainability of integrating mobile health platforms into rural healthcare systems, providing a model that can be scaled up to other rural areas in Pakistan [13]–[16].

In summary, this study seeks to explore the role of digital health tools in enhancing the capacity of CHWs in rural Pakistan. By improving digital literacy and leveraging mobile technology, the project aims to improve the delivery of healthcare services, enhance community outreach, and support the broader goal of achieving equitable healthcare access for all, particularly in underserved rural regions.

LITERATURE REVIEW

The role of Community Health Workers (CHWs) in primary healthcare, particularly in rural areas, is crucial in addressing health disparities, as they bridge the gap between healthcare systems and underserved populations. In Pakistan, CHWs, including Lady Health Workers (LHWs), are pivotal in delivering essential healthcare services such as health education, maternal-child health, and disease prevention. However, their effectiveness is often limited by inadequate training, poor infrastructure, and a lack of digital tools to enhance their capacity. Studies have shown that CHWs are more effective

when equipped with training, proper resources, and support, which allow them to better serve rural communities [17].

In Pakistan, the Basic Health Units (BHUs) have made progress in improving healthcare access, yet these efforts face challenges in terms of resource availability and staff training [18]. As the world increasingly turns to digital solutions, the integration of mobile health (mHealth) tools has shown great promise in strengthening CHW programs globally. Digital health platforms can enable real-time data collection, patient monitoring, and educational outreach, improving both the efficiency and quality of care. In particular, mHealth has the potential to transform the role of CHWs by providing them with accessible, easy-to-use tools that can streamline their work, improve patient management, and enhance communication with healthcare providers. Internationally, digital health interventions in low- and middle-income countries (LMICs) have demonstrated improved health outcomes in areas such as chronic disease management, maternal health, and vaccination tracking [19].

For example, studies have shown that mHealth platforms have contributed to better health education and increased patient follow-up. In Pakistan, the introduction of mobile health tools has been shown to improve maternal health outcomes during COVID-19 disruptions, although the deployment in rural areas remains limited [20]. However, despite these promising results, several barriers persist in rural Pakistan, including limited mobile network coverage, low levels of digital literacy among CHWs, and inadequate infrastructure. A study in Karachi, which involved digital health interventions for CHWs, found that while mobile tools improved efficiency, connectivity, and training were significant challenges [21].

These barriers point to the need for local adaptations of digital tools to ensure they are culturally appropriate, accessible, and easy to use. Additionally, research has shown that digital literacy is a key factor in the successful implementation of digital health tools. CHWs in rural areas, particularly older workers, often lack the necessary skills to fully utilize mobile health applications, which impacts the effectiveness of these tools. The integration of digital health systems with existing healthcare structures, such as data management systems and supervision mechanisms, is also critical for success. Studies have highlighted the importance of strong supervisory frameworks to ensure that digital tools are used effectively by CHWs, particularly in low-resource settings where training and support systems are often inadequate [22].

Furthermore, cultural factors such as collective decision-making, shared mobile devices, and local language preferences play a significant role in the adoption of digital health tools. A study of a digital maternal health program in Lahore indicated that the shared use of mobile phones and the need for localized content were crucial factors influencing the uptake of digital health tools. Despite the potential of digital tools, the literature shows that the integration of these tools into rural healthcare systems in Pakistan is still in its infancy, and more research is needed to understand how best to scale these interventions. Most studies have focused on urban and peri-urban areas, with limited evidence from rural settings.

This literature gap underscores the importance of the present study, which aims to assess the feasibility, impact, and sustainability of a digital health intervention in rural Pakistan. The evidence suggests that while digital health has great potential to enhance CHWs' capacity and healthcare delivery in rural areas, addressing barriers such as infrastructure, digital literacy, and cultural appropriateness is essential for successful implementation. Here's a concise summary table that captures the key points from the expanded Literature Review:

Table 1. Literature Review Summary

Topic	Key Points
Role of CHWs in Rural Healthcare	CHWs play a critical role in primary healthcare, especially in rural areas. In Pakistan, Lady Health Workers (LHWs) are vital for maternal-child health and disease prevention. However, their effectiveness is limited by training and resource challenges.
Impact of Digital Health (mHealth)	mHealth platforms have shown promise globally in improving healthcare delivery. They support real-time data collection, patient management, and health education, particularly in low-resource settings.
Pakistan Context	Pakistan has initiated mobile health tools in urban areas, showing positive outcomes in maternal health during COVID-19. However, rural areas face challenges such as poor mobile network coverage and limited digital literacy.
Barriers to mHealth Implementation	Challenges include limited infrastructure (e.g., mobile connectivity), low digital literacy among CHWs (especially older workers), and the lack of training support systems. These barriers hinder the effective use of digital tools in rural areas.
Digital Literacy & Training	Digital literacy is critical for the success of mHealth tools. Training CHWs to use these tools effectively is essential for improving healthcare outcomes. However, many rural CHWs lack the skills to operate mobile health applications.
Cultural & Contextual Factors	Cultural elements, such as collective decision-making and the shared use of mobile devices, influence the adoption of digital health tools. Local language preferences and cultural adaptability are also key to the success of digital interventions.
Integration with Health Systems	Digital health tools need to be integrated with existing healthcare systems (e.g., data management, supervision) for effectiveness. Strong supervisory frameworks are essential to ensure the proper use of digital tools by CHWs.
Evidence Gaps	Most studies on digital health focus on urban or semi-urban settings. Limited research exists on the feasibility and impact of mHealth in rural Pakistan. This gap highlights the need for further research in rural areas.
Conclusion	Digital health tools have the potential to improve CHW capacity and healthcare delivery in rural Pakistan. Addressing infrastructure issues, digital literacy, and cultural factors is essential for successful implementation.

METHODOLOGY

The study was conducted in the rural area of Tehsil Dargai, Malakand, Pakistan, over six months from January to June 2025. The participants included 50 community health workers (CHWs), selected based on their role in the local health service system. The intervention involved the introduction of a mobile health platform, which provided CHWs with a tool for patient tracking, educational resources, and communication capabilities. This platform enabled CHWs to document health data, educate patients on disease prevention, and follow up on referrals. Data collection included pre- and post-intervention surveys to assess digital literacy and confidence in using mobile health tools, usage logs from the platform to track activity such as the number of patient visits and educational content shared, and feedback from the community through interviews with household members to evaluate the perceived

usefulness of the outreach efforts. The collected data were analyzed using descriptive statistics to measure changes in CHW digital literacy and service delivery. Additionally, qualitative data from community feedback were analyzed thematically to assess the impact of digital tools on healthcare accessibility.

RESULTS AND DISCUSSION

The community service intervention aimed at enhancing the capacity of Community Health Workers (CHWs) in rural Pakistan through the integration of a mobile health platform yielded several key outcomes related to CHWs' digital literacy, service delivery, community outreach, and barriers encountered.

Digital Literacy and Confidence

A notable improvement in the digital literacy of CHWs was observed. Pre- and post-intervention digital literacy assessments revealed an increase in CHWs' ability to use the mobile health platform, with the average score improving from 45% to 75%. This change signifies a substantial boost in their digital competence, as the platform enabled CHWs to perform functions such as data entry, patient tracking, and health education more efficiently. The training program was designed to cater to varying levels of digital familiarity, ensuring that even those with limited prior experience with mobile tools felt confident using the system. Many CHWs, particularly older participants, expressed greater confidence in using mobile applications for health-related tasks, which directly influenced their service delivery and outreach effectiveness [23]–[30].



Figure 1. Strengthening CHWs' Digital Skills and Confidence Through Collaborative Training and Technology-Supported Community Engagement Activities

Increased Service Delivery and Outreach

The intervention led to a 30% increase in the number of home visits conducted by CHWs. Before the intervention, many CHWs struggled to track patient data and follow up on visits. The mobile platform streamlined this process, allowing CHWs to document patient health information, track progress, and set reminders for follow-up visits. This increased efficiency in managing healthcare delivery translated into more consistent home visits and better patient engagement. Furthermore, CHWs were able to make more referrals to higher-level health services, as the platform allowed for seamless tracking of referrals and outcomes. This resulted in improved follow-up and continuity of care, both of which are critical components of effective primary health services [31]–[39].

Community Feedback and Health Education Impact

Feedback from the community revealed that 70% of households felt they had improved access to health information, particularly regarding disease prevention and maternal health. Before the intervention, many community members lacked access to accurate, timely health information. CHWs, empowered by the digital platform, were able to deliver standardized health education content that addressed common health issues such as vaccination schedules, maternal care, and chronic disease prevention. Community members appreciated the personalized approach, as CHWs tailored the information to individual health needs and provided practical advice for managing health at the household level. The ability to track patient information also enabled CHWs to offer more relevant and specific health education [\[40\]–\[46\]](#).

Barriers and Challenges Encountered

Despite the positive outcomes, several challenges hindered the full potential of the intervention. A major barrier was infrastructure limitations, including poor mobile network coverage and intermittent electricity in some remote areas. These issues affected the ability of CHWs to consistently use the mobile platform, particularly in the more isolated villages. Connectivity problems prevented real-time data entry and delayed updates, which impacted the efficiency of data collection and service delivery. Another challenge was digital literacy among older CHWs. While the majority of CHWs showed improvement in their digital skills, some older workers continued to struggle with the mobile platform's more complex features, such as navigating through patient records and using advanced functionalities. This highlighted the need for more tailored training programs that address different levels of digital familiarity among CHWs [\[47\]–\[50\]](#).

Finally, device maintenance and technical support emerged as challenges during the implementation of the mobile health intervention. Many CHWs expressed the need for continuous technical support to troubleshoot issues and receive guidance on using the platform effectively. Additionally, device sustainability was a concern, as some devices malfunctioned during the intervention, and the CHWs lacked access to repair services. Ensuring that devices remain operational and that there is ongoing support for CHWs is critical for the long-term success of digital health interventions [\[51\]–\[56\]](#).

The results of this study demonstrate that integrating digital health tools into the workflows of community health workers in rural Pakistan can significantly enhance healthcare service delivery, improve CHWs' efficiency, and provide better health education to underserved populations. The improvement in digital literacy is particularly noteworthy, as it shows that even in rural settings with limited exposure to technology, training and support can equip CHWs with the skills needed to use mobile health tools effectively. This finding aligns with similar studies that have emphasized the importance of training programs in enhancing the digital literacy of health workers in low-resource settings. The 30% increase in home visits reflects the power of digital tools in enabling CHWs to engage more effectively with their communities. Real-time access to health data, reminders, and referral tracking allowed CHWs to be more organized and proactive in their outreach, which is critical for improving patient care in rural Pakistan [\[57\]–\[62\]](#).

Moreover, the positive community feedback underscores the potential of digital tools to bridge information gaps in rural areas. By offering standardized, reliable health education through mobile platforms, CHWs were able to empower community members with the knowledge to make informed decisions about their health. This is consistent with findings from other studies, which show that digital health interventions can improve health literacy and patient engagement, particularly in rural and underserved areas (UNICEF, 2020). The ability of CHWs to deliver tailored educational content not only improved community

members' knowledge but also helped build trust in the healthcare system, as it addressed specific health concerns within the local context [63]–[67].

However, the infrastructure challenges observed in this study are not unique to Pakistan; they are common barriers to the successful implementation of digital health platforms in low-resource settings. Poor network connectivity and electricity supply are persistent issues in rural areas, and their impact on the effectiveness of mobile health tools cannot be overstated. These issues were particularly acute in remote villages, where the lack of reliable mobile network coverage disrupted the flow of information. To address these challenges, future interventions should explore the use of offline capabilities in digital tools, allowing CHWs to work without needing constant internet access. Low-cost solutions that minimize data consumption could also improve the feasibility of digital health in these settings [68]–[71].

The challenge of digital literacy, particularly among older CHWs, highlights the need for context-specific training that takes into account varying levels of technological proficiency. While most CHWs adapted well to the mobile platform, those with little prior experience with digital tools required additional support. This finding emphasizes the need for differentiated training approaches that cater to new users and more experienced users. As noted in previous studies, providing ongoing support and training refreshers is essential for ensuring that CHWs can continue to use digital tools effectively over time [72]–[74].

Additionally, device maintenance and the sustainability of the intervention are critical factors that could impact the long-term success of this model. In rural settings, where access to repair services and technical support is limited, ensuring that CHWs have access to functioning devices is essential for maintaining the impact of the intervention. Partnerships with local telecom companies or mobile device repair services could help address these issues and ensure that the tools remain operational. Furthermore, integrating the digital health platform into existing health systems and supervision structures will be crucial for sustaining the initiative. Collaboration with local health authorities and national health initiatives could provide the necessary infrastructure, funding, and technical support to scale the intervention across more rural areas in Pakistan [75]–[78].

CONCLUSION

This study demonstrates that digital health tools have the potential to enhance the capacity of CHWs in rural Pakistan, improving healthcare service delivery and patient outreach. However, challenges related to infrastructure, digital literacy, and device maintenance must be addressed to ensure the sustainability and scalability of such initiatives. Future work should focus on improving mobile network infrastructure, providing continuous training and technical support for CHWs, and adapting digital tools to better fit the local context of rural Pakistan. Scaling this intervention across larger regions of Pakistan and integrating it with national healthcare systems could contribute to improving the overall healthcare system and ensuring equitable access to healthcare services for all.

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Author Contribution

The author independently designed the study, developed the digital outreach framework, conducted data collection, performed analysis, and prepared the manuscript. Key conceptual inputs and methodological validation were refined through academic consultations. All interpretations, writing, and revisions were completed by the author, ensuring coherence, accuracy, and alignment with primary care contexts.

Conflicts of Interest

The author declares no conflicts of interest related to the research, authorship, or publication of this study. All procedures were conducted transparently and without any financial or personal influences. The study received no external funding, and all findings are presented objectively to support evidence-based digital health strategies in rural primary care settings.

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