Evaluating the Sustainability of Digital Health Intervention: Enablers, Challenges and Lessons Learned from the Sehatmandi Application in Afghanistan, Qualitative Study

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Submitted to: Journal of Medical Internet Research
on: March 26, 2025

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Abstract

Background: In low- and middle-income countries (LMICs), maternal, newborn, and child health (MNCH) face significant challenges due to infrastructure limitations, access disparities, and service delivery inefficiencies. To address these issues, the Sehatmandi mHealth application was deployed in 189 health facilities across Afghanistan's Bamyan and Badakhshan provinces, aiming to enhance health services through real-time data monitoring and improved accountability.

Objective: This study explores the enablers, challenges, and lessons learned for the long-term sustainability of this digital health intervention in conflict-affected settings, Afghanistan.

Methods: A cross-sectional qualitative study was conducted, employing in-depth interviews with 24 stakeholders, including facility managers, administrators, and decision-makers. Participants were selected via stratified purposive sampling until theoretical saturation. Data, collected using a semi-structured guide and transcribed into English, was analyzed through thematic content analysis using NVivo. Ethical approvals were obtained, and informed consent was secured.

Results: Enablers such as enhanced performance monitoring, accountability, and timely reporting were found to improve data quality and application effectiveness. Crucially, offline data entry features addressed accessibility limitations in remote areas by enabling data capture without internet connectivity, with subsequent synchronization. However, the intervention faced significant challenges that hindered its sustainable use. Poor internet connectivity and electricity shortages directly impacted data transmission and application functionality, highlighting the necessity of reliable internet access and a stable power supply. Additionally, device malfunctions, high staff turnover, and inadequate training disrupted workflow and data accuracy. To ensure long-term sustainability, robust follow-up and monitoring, continuous capacity building, and sustained funding are essential. Furthermore, device malfunctions, high staff turnover, and inadequate training disrupted workflow and compromised data accuracy. To ensure sustainability, robust follow-up and monitoring mechanisms, continuous capacity-building initiatives, and sustained funding are essential. Despite these hurdles, participants recognized the application's potential to improve evidence-based decision-making and health outcomes in conflict-affected settings.

Conclusions: The Sehatmandi application demonstrated significant potential to strengthen health services through real-time data monitoring, accountability, and accessibility in resource-constrained and conflict-affected settings. However, sustainable digital health interventions require reliable internet access in remote regions and long-term funding. This study offers valuable insights for scaling and sustaining mHealth solutions in LMICs.

(JMIR Preprints 26/03/2025:74923)
DOI: https://doi.org/10.2196/preprints.74923

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Method

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The Sehatmandi application demonstrated significant potential to strengthen health services through real-time data monitoring, accountability, and accessibility in resource-constrained and conflict-affected settings. However, sustainable digital health interventions require reliable internet access in remote regions and long-term funding. This study offers valuable insights for scaling and sustaining mHealth solutions in LMICs.

Keywords:

mHealth, Sehatmandi, digital health, sustainability, LMIC, Afghanistan

Introduction:

Maternal, newborn, and child health (MNCH) remains a global priority, particularly in low- and middle-income countries (LMICs), where preventable maternal and child mortality rates are high(1). Despite progress in recent decades, LMICs face persistent barriers, including insufficient healthcare infrastructure, inequitable access to services, and inefficiencies in service delivery (2). Mobile health (mHealth) interventions have emerged as transformative tools to address these challenges by

improving healthcare accessibility, enhancing system efficiency, and supporting data-driven decision-making (3). These technologies have demonstrated their potential to empower healthcare workers, improve service delivery systems and support evidence-based decision-making through real-time data monitoring (4). However, the sustainability of mHealth solutions in resource-constrained settings is often hindered by inadequate digital infrastructure, limited digital literacy, insufficient integration with health systems, and funding constraints (5).

Afghanistan exemplifies these challenges, with some of the highest MNCH mortality rates globally: maternal mortality at 638 per 100,000 live births, under-five mortality at 57.7 per 1,000 live births, and infant mortality at 45 per 1,000 live births (6). The health system is critically short of qualified healthcare workers, which limits access to essential services for Afghan women, especially in conflict-affected areas (7). To address this, the Ministry of Health (MoH) Afghanistan contracted non-government organisations (NGOs) to advance the healthcare system through the introduction of Basic Package Health Service (BPHS) and Essential Package Health Service (EPHS) (8, 9). The introduction of these programs led to the establishment of multiple health facilities, and a significant improvement in the utilization of health services, such as the number of deliveries occurring in health facilities and the provision of antenatal care from a skilled provider (10). The Ministry of Health (MoH) adopted a Pay-for-Performance (P4P) model approach through which they provided financial compensation to the service providers, depending on their performance in achieving targets for specific indicators, allowing them to monitor healthcare provision by the facilities, which showed positive effects on the quality of healthcare (11).

In 2019, the Aga Khan Health Services, Afghanistan (AKHS, A) was entrusted with managing 189 government health facilities across Bamyan and Badakhshan provinces to strengthen health services. Aga Khan University (**AKU)**, in collaboration with **AKHS, A** developed a tablet-based digital health application called Sehatmandi. The Sehatmandi tool was implemented to digitize the collection and monitor health facility key performance indicators collected through Basic Package Health Service (BPHS) and Essential Package Health Service (EPHS) in Afghanistan. It aimed at improving workforce productivity and health outcomes. The real-time/close-to-real-time data collection of Sehatmandi enables performance evaluation, logistical tracking and organisational accountability (12). Despite these promising features, the limited financial resources, ongoing conflict, political instability, and infrastructural disruptions impact the sustainability of the interventions.

Sehatmandi can potentially ensure that widespread healthcare services are monitored by the Ministry of Health (MoH) and sustained as per the P4P agreement plan, leading to improved healthcare service provision, sound decision-making and strengthening of Afghanistan’s health system with further expansion across various regions of Afghanistan (13). Therefore, evaluating the sustainability of digital health interventions like Sehatmandi is critical for understanding their effectiveness and scalability in fragile and conflict-affected settings.

The study explores the enablers, challenges faced, and lessons learned from the implementation of digital health intervention in Afghanistan. By providing evidence of the intervention’s efficacy, the research will help formulate strategies and policies for the viability of interventions in similar settings, contributing to the broader goal of improving health outcomes in LMICs.

Methodology:

Study Design

The study employed the cross-sectional qualitative research design, involving in-depth interviews

with key health system stakeholders to explore barriers to the sustainability of the Sehatmandi application. The qualitative design allowed a rich, nuanced understanding of participant experiences and perspectives.

Study Setting

The Sehatmandi application was implemented across 189 health facilities, encompassing 115 health facilities in 28 districts of Badakhshan Province and 74 health facilities in 8 districts of Bamyan Province, Afghanistan. For the qualitative study, we selected health facilities across both provinces, ensuring geographic diversity and representation of various facility types. This selection ensured the inclusion of facilities representing varied operational contexts and challenges.

Study Populations

The study population included health facility managers, administrators, and high-level decision-makers.

Inclusion Criteria:
Adults (18+ years) who were users of the Sehatmandi across catchment facilities in Afghanistan

Exclusion Criteria:

1. Users under the age of 18 years.
2. Users not living in catchment areas.

Sample Size and Sampling Strategy

A total of 24 participants (14 from Badakhshan and 10 from Bamyan) were recruited using stratified purposive sampling until theoretical saturation was achieved.

Data Collection

The semi-structured interviews were conducted using an interview guide designed to elicit detailed information about participants' experiences with Sehatmandi. The guide included open-ended questions pretested with a small group of participants to ensure clarity, relevance, and cultural appropriateness. Written informed consent was obtained before the research. The interviews were conducted in the participant's preferred language (Dari or English) by trained researchers. The qualitative data collected via voice recordings was transcribed in Dari and translated into English by local researchers. Transcriptions were translated into English by bilingual researchers and verified for accuracy by a third party fluent in both languages. The interviews were conducted until saturation was reached, resulting in a total of 24 interviews.

Data Analysis

The qualitative data was analyzed using thematic content analysis using QSR NVivo 11 by a trained researcher at Aga Khan University. Within each thematic area, deductive coding was conducted based on emerging concepts from the narrative.

Ethical Consideration

Ethical approval was obtained from the Aga Khan University Ethical Review Committee and the Institutional Review Board, Ministry of Public Health, Afghanistan. Informed consent was obtained from all participants before the interviews, emphasising their voluntary participation and the right to withdraw at any time.

Results

This section presents the findings from the implementation of the Sehatmandi digital health intervention, focusing on both the positive outcomes and the challenges encountered. The analysis is structured to first highlight the enablers, demonstrating the intervention's impact on performance monitoring, accountability, and data-driven decision-making. Subsequently, the section delves into the challenges and lessons learned, particularly concerning infrastructure limitations, operational hurdles, and human resource constraints, offering insights into the complexities of implementing digital health solutions in resource-limited and conflict-affected settings.

Enablers

The Sehatmandi digital health intervention significantly enhanced performance monitoring, accountability, and data-driven decision-making in healthcare facilities, particularly in underserved regions. It offers real-time data monitoring in areas with internet access and near real-time monitoring through offline entry where the internet is limited. Additionally, by streamlining reporting processes and improving data accuracy, the system empowered health facility managers to track service delivery, assess performance trends, and respond proactively to emerging challenges.

"Data was entered offline in Sehatmandi and synchronized when the network is available." ***(Manager, BHC Layaaba, BDK)***

"Reports were sent accurately, correctly, and quickly to the central office." ***(Manager, Health Facility, BDK)***

"Our weekly, daily, and monthly performance was accurately recorded, and we were aware of all our activities. When we collected and recorded data in Sehatmandi, our performance was evident." ***(Manager, Atin Jalo HF, BDK)***

The intervention also fostered a culture of accountability within health facilities, which led to its general acceptance. By discussing data in HMIS committee meetings, health leaders could identify gaps, analyze performance trends, and implement targeted strategies to improve service delivery.

"The app was acceptable to us because we could keep clinic staff active. We analyzed the monthly report in the HMIS committee meeting. If any indicator did not meet the target, we would identify the reasons for not reaching the target and instruct the relevant personnel to make more efforts to meet the target in the following month." ***(Director, CHC Shaidan, BMN)***

"The Sehatmandi app was well-accepted as a monitoring and reporting tool, providing a simple and effective way to track and oversee health workers' activities." ***(HMIS officer, Provincial office, BMN)***

Challenges and Lessons Learned

The system faced substantial obstacles, including infrastructure limitations, financial constraints, and human resource challenges, which impeded its overall efficiency and ability to scale. Despite these difficulties, valuable lessons were learned, providing critical guidance for future digital health initiatives in comparable resource-limited and conflict-affected environments.

Infrastructure and Operational

The Sehatmandi digital health intervention faced significant infrastructure and operational hurdles. Inconsistent electricity and poor internet connectivity severely disrupted data synchronization and hindered real-time data monitoring. Poor-quality tablets, subject to damage and delayed replacement, further impeded data collection. Crucial operational requirements, like timely credit card distribution and functional SIM card management, were frequently unmet.

"Weak internet at the health center hinders report submission" ***(Manager, Kalo BHC, BMN)***

"Quality of the tablets was not good" ***(Manager, Nardara HF, BDK)***

*"The devices would break and were not quickly repaired and made available. Sometimes, it took up to two months to receive a credit card, and occasionally, the SIM card would be blocked and not quickly reactivated."****(Manager, Umal HF, BDK)***

To enable real-time data monitoring**,** reliable internet and stable electricity are essential. As a health facility manager emphasized, *"All health centres should have access to the Internet."* Additionally, durable devices, backup power solutions, and offline data entry options can mitigate disruptions in remote areas. In response, offline data entry was introduced in Sehatmandi, enabling healthcare administrators to continue data entry without internet connectivity and synchronize the data when connectivity was restored. Moreover, a user highlighted that dedicated local support structure, such as an on-site focal person, can provide real-time troubleshooting, enhance user confidence, and improve adoption rates.

Workforce and Training

High staff turnover and limited digital literacy among health workers initially reduced the usability of the Sehatmandi system. Many healthcare workers were unfamiliar with digital tools, leading to hesitancy in adoption.

"User unfamiliarity with the application led to incorrect data entry"
(Technical Manager, BDK)

"Our main problem is the turnover of employees. When a new employee is hired, it takes a lot of time for them to be trained and become proficient, causing delays in work."
(Project Director, Provincial Office, BDK)

Continuous training and capacity building should be done to enhance user proficiency and adoption. These training sessions should focus on practical skills, troubleshooting, and building user confidence through structured programs and regular refreshers, ultimately increasing staff proficiency and reducing resistance to the technology, leading to sustainable and improved data collection practices.

"Continuous training should be provided to staff to build their capacity to use application."
(Manager, Atin Jawla HF, BDK)

Political Instability and Financial Constraints

Taliban's takeover of Afghanistan in 2021 created significant financial challenges. Several international funding agencies, citing security concerns and uncertainties in governance, suspended funding, abruptly halting project operations. This financial instability limited resource access,

demotivated staff, and threatened the program's sustainability.

"Financial and budgetary issues are the main obstacles" ***(Manager, BHC Naheya 3, BDK)***

To ensure sustainability, efforts shall be made to integrate digital health mediums into national health budgets and explore alternative funding models, including donor support and public-private partnerships. Securing diversified financial resources reduced the dependency on single funding sources and enabled more consistent improvements to the system.

Monitoring and Evaluation

Data reliability suffered from inadequate oversight and delayed evaluations. Supervisory teams provided insufficient follow-up, and quality assurance officers were slow to review submitted reports. As a manager from SHC Umal stated, *"Proper evaluation... was sometimes lacking. Reports we entered were not reviewed for up to two or three months."*

Robust monitoring and feedback systems are crucial for maintaining data accuracy and enhancing overall program performance. Regular monthly follow-up meetings can enable supervisors to provide timely guidance and address emerging problems, fostering accountability and driving continuous improvement. Consistent operational and technical support is also critical for successful application implementation and expansion. As emphasized by a Project Director, *"Continuous follow-up is necessary."* Managers also stressed the importance of timely feedback and regular monitoring, with one reporting, *"Submitted reports should be checked, timely feedback should be provided, and the program should be monitored and followed up."* Furthermore, a shift to more frequent reporting, as suggested by an HMIS Manager, with *"daily or weekly basis rather than a monthly basis,"* could enhance health worker engagement and activity.

Comprehensive Data Integration System

The Sehatmandi app's potential was hampered by a critical limitation: the absence of integrated health reports. This fragmented data landscape prevented a comprehensive understanding of healthcare service delivery, hindering informed decision-making. HMIS manager emphasized that a wider range of health reports must be incorporated, enabling a holistic view of patient care. This expansion would empower healthcare administrators and policymakers with robust data, facilitating improved service coordination and accurate monitoring of all healthcare facets.

"The system requires revision to align with the Ministry of Public Health's new HMIS package. Specifically, integrating reports like HMIR, MAAR, Nutrition, EPI, MCH CBHC, and Pharmacy would transform Sehatmandi into a comprehensive data tracking system" ***(HMIS Manager, BMN)***

Discussion

Principal Findings

The Sehatmandi digital health intervention improved performance monitoring, accountability, timely reporting and evidence-based decision-making in resource-limited and conflict-affected settings. However, infrastructure limitations, financial constraints, and workforce challenges hindered its scalability. The factors required for sustainability include offline data entry, capacity building of healthcare workers, and continuous follow-up and monitoring. To maximize impact, full integration with national health systems and interoperability with other reporting mechanisms are crucial for

long-term success.

The Sehatmandi app's effectiveness was challenged by unreliable infrastructure. Unreliable internet and frequent power outages significantly hindered real-time data monitoring, a critical aspect of effective health service delivery. To counter this, robust infrastructure investments in offline functionality and backup power are essential, mirroring successful strategies in similar low-resource digital health programs(14, 15).

Additionally, consistent follow-up and monitoring from high-level decision-makers are crucial for successful technology adoption. Addressing the common challenge of high employee turnover, structured training and regular refresher courses were deemed necessary for long-term program sustainability and effectiveness. As evidenced by the previous literature, these combined strategies, targeting infrastructure and human resource challenges, are crucial for maximizing the impact of digital health interventions in resource-constrained settings(16, 17).

Financial constraints further exacerbate these challenges. Insufficient funds impede critical infrastructure upgrades, and delays in payment systems further threaten the program's sustainability. The announcement of the cessation of Sehatmandi funding in mid-August 2021 resulted in a sharp decline in health service utilization, emphasizing the critical need for sustained funding to enhance health service delivery (17). These findings are consistent with the broader systemic issues in healthcare financing within LMICs, where limited budgets and reliance on donor funding create significant bottlenecks (18).
Integrating digital health programs into national health budgets and exploring alternative financing models, such as public-private partnerships, could enhance long-term viability(19). Strengthening partnerships with key stakeholders, including government agencies, donor organizations, and private sector actors can significantly improve the program’s effectiveness(19). Collaborative efforts can enhance coordination, facilitate smoother implementation, and increase resource availability, ensuring long-term sustainability(19).

Strengths and Limitations

The study, conducted in the challenging context of conflict-affected and resource-constrained Afghanistan, offers valuable insights into the successful implementation of mHealth interventions. By selecting health facilities across two provinces (Badakhshan and Bamyan), the study ensured a geographically and operationally diverse representation of participants, enhancing the generalizability of findings to similar settings. A thematic content analysis enabled the identification of nuanced themes. Furthermore, rigorous transcription and translation processes ensured that linguistic barriers did not compromise the accuracy or quality of the data. The study outcomes provide actionable recommendations for stakeholders, offering a valuable framework for scaling and sustaining mHealth interventions in low- and middle-income countries (LMICs). However, the limitation of the study includes a cross-sectional study, the findings provide a snapshot of challenges and facilitators at one point in time, limiting the ability to assess changes or trends over time. The study relied on self-reported data from interview participants, which might be subject to recall bias or social desirability bias.

Conclusion

The Sehatmandi digital health intervention significantly improved performance monitoring, accountability, and evidence-based decision-making in Afghanistan’s health facilities. However, sustainability challenges such as poor digital infrastructure, financial constraints, staff turnover, and lack of interoperability with broader health information systems limited its scalability and long-term

viability. Key lessons from this study emphasize the need for reliable infrastructure, continuous workforce training, diversified funding sources, and robust monitoring mechanisms to enhance the sustainability of digital health interventions. The introduction of offline data entry, structured training programs, and adaptive implementation strategies helped mitigate some challenges, demonstrating the potential of digital health solutions in fragile settings. Future efforts should focus on integrating digital health solutions into national health systems, securing long-term funding, and strengthening technical and operational support. By addressing these gaps, digital health interventions like Sehatmandi can play a transformative role in improving health outcomes and ensuring the resilience of healthcare delivery in LMICs.

Acknowledgements

The authors would like to thank the Ministry of Public Health, Afghanistan, for providing support during the evaluation and acknowledge the participants' efforts.

Author Contribution

SS conceptualized, designed, and supervised the study. FJ contributed to data analysis, results, and manuscript writing. SSM contributed to the development of the study design and methodology. AM and AK conceptualized and contributed to the methodology. GD and MS contributed to the conceptualization and data acquisition. All authors contributed to the manuscript writing and provided final approval.

Funding

Sehatmandi was administered by the World Bank through the Afghanistan Reconstruction Trust Fund (ARTF) and implemented by the Ministry of Public Health in Afghanistan.

Conflict of interest

The authors have no conflict of interest

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