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Empowering Lady Health Workers with AI Routing to Solve Healthcare Coordination Failures in Rural Khyber Pakhtunkhwa

Evidence Synthesis and Policy Analysis

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ARTICLE INFO	ABSTRACT
Article history: Received: June 2026 Accepted: June 2026 Available online: 2026 Keywords: Lady Health Workers; AI-assisted triage; Rural healthcare; Khyber Pakhtunkhwa; Telemedicine; Healthcare coordination	This study examines maternal healthcare coordination issues in rural Khyber Pakhtunkhwa (KPK), Pakistan. Despite current infrastructure, rural communities face significant obstacles due to the uneven geographic distribution of physicians and fragmented health governance. The study suggests a decentralized digital approach that equips Lady Health Workers (LHWs) with AI-assisted triage and routing, alongside a telemedicine welfare fund. Analysis of existing digital systems and LHW programs suggests that bridging the gap between discovery and care via trusted community intermediaries may significantly lower preventable maternal mortality without the need for additional physical facilities. Findings suggest that the healthcare crisis in KPK appears to be primarily a problem of coordination and discovery rather than a shortage of infrastructure.

1. Introduction

Rural healthcare access in the Khyber Pakhtunkhwa (KPK) province of Pakistan is often framed as an infrastructure issue, specifically a lack of physical buildings and hospital beds. However, deeper analysis suggests it is more accurately defined as a severe crisis of discovery and coordination. Pakistan suffers from a significant geographic maldistribution of medical professionals: approximately 85% of doctors reside in urban areas, leaving rural populations largely disconnected from specialist and emergency care.¹ This inequity directly impacts mortality; rural areas experience a 26% higher maternal mortality rate than urban centers, with roughly 20 maternal deaths per 10,000 live births compared to 16 in cities.¹ This geographical crisis is complicated by severe governance bottlenecks. A 2025 ThinkWell landscape analysis found that the health system in KPK suffers from fundamental fragmentation following the devolution of health responsibilities under the 18th Constitutional

Amendment, alongside a lack of effective district-level coordination between provincial bodies and local administrations.² Out-of-pocket costs represent 53% of total health expenditures, and patients navigating the system often encounter overlapping service areas and inefficient resource allocation. Building new physical infrastructure seems an inefficient use of resources if the province cannot staff the facilities or coordinate patient pathways effectively. This study explores the research question: How can the integration of Lady Health Workers (LHWs) with decentralized AI routing and telemedicine systems bridge existing health financing and coordination gaps to improve maternal healthcare access in rural KPK? *Hypothesis: If Pakistan's LHWs operating in rural KPK are equipped with AI-assisted triage and routing tools alongside subsidized telemedicine access, then preventable delays in reaching appropriate life-saving care will likely decrease, because the primary barriers to rural healthcare are rooted in coordination and discovery failures, and financial inaccessibility, rather than the outright absence of physical medical facilities.*

This deficit extends beyond maternal care; critical gaps in paediatric intensive care capacity compound the burden on rural families who must travel to urban centers for any specialist intervention.⁹

2. Materials and Methods

The study uses a multi-dimensional analysis of the provincial health system in KPK, incorporating data from the United Nations Population Fund (UNFPA) 2024 Annual Programme Progress Report,¹ ThinkWell's 2025 health financing governance landscape,² and the Asian Development Bank's 2024 digital ecosystem diagnostics.³ Additional evidence was drawn from a 2025 cross-sectional analysis in the Journal of Global Health on LHW program outcomes,⁴ a 2024 Cureus review on AI-telemedicine synergy,⁵ a 2023 PMC scoping review on rural healthcare access barriers in Pakistan,⁶ and a 2024 epidemiological study on MDR-TB outcomes in rural Pakistan.⁷ The approach evaluates the feasibility of a three-layered digital intervention: AI symptom triage, facility capability-matching algorithms, and subsidized telemedicine consultations. Technical feasibility is supported by the Evolve Health prototype (github.com/nameershah/evolve), designed to operate within Pakistani healthcare constraints.

3. Evidence Synthesis

3.1 The core issue is a routing and coordination failure, not a shortage of buildings

A comprehensive scoping review of rural healthcare access barriers in Pakistan suggests that the physical absence of clinics is rarely the primary hurdle.⁶ Surveyed rural populations cited logistical and coordination barriers: 72%

cited long distances, 60% cited a lack of available transport, 55% cited high out-of-pocket costs, and 50% cited prohibitively long wait times at facilities. Patients often cannot identify which facility is equipped to help them, cannot afford transport, or arrive only to find the clinic lacks the required specialist or equipment, a phenomenon researchers describe as a discovery-to-care failure.

3.2 Lady Health Workers demonstrate the power of community intermediaries

Pakistan's LHW program, comprising approximately 29,163 registered workers, provides a proven intervention channel. A 2025 cross-sectional analysis in the *Journal of Global Health* demonstrated a significant multiplier effect when LHWs acted as community intermediaries.⁴ BCG vaccination rates reached 93.2% for children in households with full LHW contact, compared to 68.3% with no contact. Regarding maternal health, skilled birth attendance rose from 54.4% (no contact) to 64.4% (full contact), and completion of at least four antenatal care (ANC) visits jumped from 25.3% to 36.2%.⁴ Because LHWs are already trusted and physically present in the community, they may effectively bridge the gap between the household and the broader health system.

Evidence from Pakistan's community health worker programs further confirms that LHWs have successfully facilitated telemedicine adoption among rural women, enabling remote consultations that would otherwise be inaccessible.⁸

3.3 Digital infrastructure exists to support deployment

The technological foundation already exists. Mobile internet coverage now reaches over 80% of Pakistan's population, with the Universal Service Fund (USF) actively subsidizing fiber-optic connectivity to remote towns.³ Digitally equipped mobile clinics and handheld data collection by community health practitioners are already operating as growing trends.³ A 2024 Cureus review confirmed that pairing AI with telemedicine may push triage capacity into underserved areas and effectively close the physician-to-population gap.⁵

3.4 Decentralized telemedicine models reduce mortality in Pakistan

Evidence from MDR-TB management in Pakistan suggests that decentralization works. A study on MDR-TB outcomes recommended satellite clinics and telemedicine for immediate patient consults alongside community-based healthcare providers to address high abandonment rates caused by long distances.⁷ This decentralized, digitally-backed model appears directly applicable to primary and maternal care.

4. Discussion

To address discovery-to-care failures in rural KPK, the provincial Health Department should equip the existing LHW network with a lightweight AI-assisted mobile triage and routing application, backed by a subsidized telemedicine welfare fund. The intervention consists of three integrated digital layers. First, an AI-assisted symptom triage tool helps the LHW assess the patient's condition on-site. Second, a facility capability-matching algorithm routes the patient to a hospital verified to have the specific staff and equipment needed, eliminating the discovery failure of arriving at unequipped facilities. Third, if in-person care is unreachable, the app connects the patient to an urban doctor via telemedicine, with consultations for patients below a defined income threshold covered by a centralized welfare fund. This system should be deployed exclusively through LHWs as the localized agents rather than as a standalone public app. LHWs already possess the community trust required to drive adoption; bypassing them risks the low engagement rates that historically doom direct-to-consumer health apps in rural, low-literacy settings.⁴ The AI routing tool directly bypasses the coordination failures identified in KPK's governance,² while the welfare fund targets the 55% of rural patients who cited out-of-pocket costs as their primary barrier,⁶ mirroring the successful decentralized models in Pakistan's TB programs.⁷ A working prototype, Evolve Health, already demonstrates the technical feasibility of building this coordination layer within Pakistani healthcare constraints.

Successful implementation carries several risks that the deployment model must account for. LHW digital literacy varies significantly across districts, and a tool that requires extensive training will face adoption resistance. The application interface must be designed for low-literacy users with Urdu and Pashto language support and voice-guided navigation. Network unreliability in mountainous KPK districts means the triage component must function in offline or low-bandwidth modes, syncing data when connectivity is restored. Finally, community trust in AI-generated referrals cannot be assumed. The system must be framed to LHWs and patients as a routing aid, not a diagnostic replacement, to avoid the perception of depersonalized care that undermines adoption in community health contexts.

4.1 Future Work

Translating this intervention from proposal to pilot requires three concrete steps. First, a district-level feasibility study in one rural KPK district — prioritizing Kohistan or Tor Ghar given their documented physician-to-population deficits — should assess LHW smartphone penetration, connectivity reliability, and willingness-to-use among the existing workforce. Second, the AI-assisted triage component requires clinical

validation before deployment. A structured trial comparing triage accuracy between LHWs using the tool and a control group using standard referral protocols would generate the outcome data necessary for regulatory and institutional approval. Third, the welfare fund mechanism requires a defined financing structure. A workable model would mirror the existing Sehat Sahulat Programme architecture, with per-consultation reimbursement rates negotiated with registered telemedicine providers and income verification handled through the existing BISP beneficiary database. Pilot success in even one district would generate the evidence base needed to make the case for provincial Health Department scale-up across KPK, and eventually for replication in similarly structured provinces such as Balochistan and Gilgit-Baltistan.

5. Limitations

This study possesses several limitations. First, as an evidence synthesis, it relies on secondary literature and institutional reports rather than primary field data. Second, the proposed AI-assisted routing system has not undergone clinical validation, and the prototype remains in the proof-of-concept phase. Finally, the direct transferability of decentralized models from tuberculosis management to maternal healthcare requires further investigation.

6. Conclusion

Rural healthcare in KPK appears to be primarily a coordination and discovery problem rather than an infrastructure problem. The physical facilities exist, the LHW workforce is deployed, and mobile connectivity is expanding. What remains missing is a reliable, subsidized mechanism to route remote patients to the right care at the right time. By equipping trusted community intermediaries with AI-powered facility matching and telemedicine access, KPK could bypass its severe urban-rural physician imbalance. This approach appears a significantly more efficient and evidence-backed method for reducing maternal and child mortality than attempting to staff new facilities in regions where physicians are reluctant to reside. While this study focuses on rural KPK, the discovery-to-care framework applies to underserved regions globally; pilot success in KPK can inform scaled deployment across South Asia and beyond. The evidence synthesized here supports the central hypothesis: equipping LHWs with AI-assisted routing and subsidized telemedicine access directly addresses the coordination, discovery, and financial barriers that drive preventable rural maternal mortality in KPK.

Abbreviations

AI: Artificial Intelligence

ANC: Antenatal Care

BCG: Bacillus Calmette-Guérin

KPK: Khyber Pakhtunkhwa

LHW: Lady Health Worker

MDR-TB: Multi-Drug-Resistant Tuberculosis

UNFPA: United Nations Population Fund

USF: Universal Service Fund

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Conflicts of Interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics Statement

Ethics approval was not required for this study, as it did not involve human participants, private identifiable data, or animal subjects. All data used were publicly available from published reports and institutional databases.

Data Availability Statement

All data supporting the findings of this study are derived from publicly available sources cited in the references. No proprietary datasets were used.

AI Use Statement

The author reviewed and edited the final manuscript; generative AI tools were discussed as part of the proposed technical intervention (AI routing) but were not used to generate the manuscript text.

Author Contribution

Muhammad Nameer Shah contributed to conceptualization, methodology, data analysis, writing the original draft, review, and editing.

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