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Transforming reproductive healthcare in rural China: The impact of mobile health, telemedicine, and e-health innovations on family planning and maternal health services

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Abstract

This study systematically examines the impact of digital health solutions on reproductive healthcare in rural China employing a mixed-method approach, including qualitative interviews with healthcare providers and rural patients, analysis of government pilot projects, and review of digital healthcare policies. The methodology combines field interviews, policy research, and project data evaluation to provide a comprehensive picture of how mobile health, telemedicine, and electronic health are being implemented and experienced in the reproductive healthcare system of rural China. The findings indicate that mobile apps for reproductive health education, appointment scheduling, and remote consultations have improved timely access to family planning information and maternal care. The results of this study underline the importance of critical innovations that are beginning to be implemented in rural healthcare in China and the difficulties that must be resolved if scalable long-term success is to be obtained. The study concludes with policy recommendations to strengthen digital health integration in rural regions, enhance training programmes for healthcare providers, and foster public-private partnerships to expand digital services. *(Afr J Reprod Health 2025; 29 [8s]: 13-21).*

Keywords: Digital Health Solutions, Rural Regions, Digital Services

Résumé

Cette étude examine systématiquement l'impact des solutions de santé numérique sur les soins de santé reproductive en Chine rurale en utilisant une approche méthodologique mixte, comprenant des entretiens qualitatifs avec des prestataires de soins de santé et des patients ruraux, l'analyse de projets pilotes gouvernementaux et l'examen des politiques de santé numérique. La méthodologie combine des entretiens de terrain, des recherches sur les politiques et une évaluation des données de projets pour offrir une vision globale de la mise en œuvre et de l'expérience de la santé mobile, de la télémédecine et de la santé électronique dans le système de soins reproductifs des zones rurales chinoises. Les résultats indiquent que les applications mobiles dédiées à l'éducation à la santé reproductive, à la prise de rendez-vous et aux consultations à distance ont amélioré l'accès en temps voulu aux informations sur la planification familiale et les soins maternels. Cette étude souligne l'importance des innovations clés qui commencent à être mises en œuvre dans les soins de santé ruraux en Chine ainsi que les défis à relever pour garantir un succès durable à grande échelle. L'étude se conclut par des recommandations politiques visant à renforcer l'intégration de la santé numérique dans les régions rurales, à améliorer les programmes de formation des prestataires de soins, et à encourager les partenariats public-privé pour développer les services numériques. *(Afr J Reprod Health 2024; 29 [8s]: 13-21).*

Mots-clés: Solutions de santé numérique, régions rurales, services numériques

Introduction

The significant disparity between rural and urban health resources is among the most important health problems in China. Rural areas have medical experts, infrastructure, and culture; but there are less than half as many hospital beds and physicians per 1,000,000 fields[1,2]. The results of reproductive health indicators in cities mirror similar discrepancies. The maternal death rate in rural regions in 2022 was 16.6 per 100,000 live births, somewhat higher than the urban rate of 14.3 % [3]. China has drastically reduced total maternal mortality in recent years, but restricted access to

excellent treatment still causes avoidable risks for women living in isolated communities. Examining 556 mother fatalities from obstetric hemorrhage (2011-2018) revealed that 71.8% of them can be attributed to poor emergency response by rural health providers April in or inadequate awareness of the risks of hemorrhage, therefore essential training and resource gaps[3]. Such differences in availability and quality of care help explain the more significant infant mortality in the rural region: 3.6%, almost double the urban rate. Rural visitors,[4] often, they must travel great distances for sophisticated obstetric treatments, paying expenses and delays those urban residents experience more frequently. A significant public the health issue still is this urban-rural disparity in access to and results from reproductive health care.

The expansion of "Internet Plus" approaches and mobile technologies provides a fresh means of providing treatment over great distances. Telemedicine allows remote consultations and professional help for underprivileged regions, therefore offering a workable answer to the misdistribution of providers. Using smartphones and applications, mobile health may empower rural women with knowledge about health, decision support, and doctor connectivity[4]. Given China's technological environment, these strategies are progressively feasible: Internet penetration among rural people already exceeds 64% of the total population, which means hundreds of millions of rural individuals online through mobile devices. 4G networks and cell phones have become ubiquitous even in rural areas, providing a platform for health interventions that were not possible ten years ago. Recognizing this opportunity, the Chinese government has prioritized digital health integration over telemedicine and bridging the urban-rural health divide through government initiatives (such as the 2020 telemedicine expansion plan to increase the ease of re-ase5G service to village clinics and township health centers). Because Of the fast increase in online services, China's telemedicine network linked over 24,000 medical institutions and enabled 21.7 million remote patient visits in one year in 2019[2,3].

To increase the continuity of service and data monitoring, e-health systems such as electronic health records and health information systems are being implemented concurrently in rural regions. These digital breakthroughs have great potential to improve reproductive health results for rural Chinese women and their families[5]. Tele-ultrasound and teleconsultation tools allow county hospital obstetricians to help township doctors handle high-risk pregnancies. Cloud-based health information systems support the more effective monitoring of maternal health indices in scattered communities. Although digital health has expanded rapidly in China, there is limited evidence of its practical impact in rural reproductive health. This study addresses this gap by investigating how mobile health, telemedicine, and e-health systems are transforming maternal and family planning services in underserved regions. The objectives are to assess usage patterns, evaluate clinical and system-level effects, and identify barriers to sustainable implementation[6,7].

Literature review

Digital health and reproductive healthcare: Global and China context

From SMS reminders to telemedicine, digital health has improved mother and infant care, especially in resource- constrained environments. Mobile health has been found in low- and middle-income nations to encourage good practices, reduce maternal and perinatal death, and increase prenatal visits. Widespread use of smartphones and supportive legislation in China have resulted in an explosion of mother health applications with an eye toward education, pregnancy tracking, and appointment reminders. However, most lack sophisticated features such as hospital integration or artificial intelligence support, which emphasises the need for improved clinical alignment and system integration[3]. Table 1 highlights significant main barriers that hinder rural China's adoption of digital health solutions.

More than 75% of pregnant women in northern China use mobile health apps (MCHs) for

Table 1: Barriers to digital health adoption in rural areas

Barrier	Description	Impact	Potential Solution
Digital Literacy Gap	Low familiarity with apps among older women	Limited use of mobile health tools	Training programs
Poor Internet Connectivity	Unreliable network in remote areas	Inconsistent telemedicine use	Expansion of rural broadband

health education, self-monitoring, and prenatal reminders. These apps are less popular among older, less educated, low-income women, underscoring the need for inclusive design and digital literacy. A 2022 study did not find significant differences in unfavourable pregnancy outcomes between app users and non-app users, suggesting that apps may not improve delivery[8]. Digital interventions can be successful if targeted. A Qinghai Province WeChat programme greatly improved postpartum exclusive breastfeeding. These examples show that cheap platforms like WeChat can improve mother-child health[8].

China has also put mHealth solutions into use for front-of-service providers. The village doctors in rural Hebei used cellphones for verbal autopsy to improve mother death surveillance. Another initiative used text reminders to improve township doctors' adherence to treatment guidelines. Through data systems and decision support, these projects demonstrate how digital health in reproductive care helps patients and professionals [9].

Telemedicine in rural China's reproductive health

Aiming to address rural-urban healthcare care gaps by spreading knowledge to underdeveloped areas, telemedicine has linked hospitals in China since the 1990s. More than 3,000 hospitals were linked in 2018; the industry is valued at $2.68 billion. Through the internet and 4G / 5G, it improves reproductive health by teleconsultations, telediagnosis and teleeducation. Continued prenatal and postpartum care availability throughout COVID-19. However, adoption is low: Only 0.67% of 2,100 rural Guangdong households used telemedicine[12].

Low awareness, mistrust, bad infrastructure, and digital illiteracy[11] are among the obstacles. Although they have the tools, hospitals deal with "last mile" problems. Success calls for trust, user-centred design, and insurance integration. Rural patients used to prefer metropolitan hospitals due to insurance policies, but changes today support telehealth payments[13]. The 2023 policy promotes rural e-health, although system fragmentation and misalignment of policies persist[9]. Size and interoperability require unified national systems. Promising pilot programmes include Xinjiang using remote monitoring for safer delivery and a Yunnan app enhanced midwife-obstetrician interactions. Evidence points to improved outcomes in rural areas and increased provider confidence[14, 15].

E-Health infrastructure and policy landscape

Using digital platforms such as the Maternal and Child Health (MCH) information system, which tracks pregnancies and promotes almost universal maternal care, e-health in China improves the delivery of healthcare. With 99.9% of pregnant women delivering in health institutions[5], 93.6% of them used MCH programmes by 2022. Strong legislative support and digital tracking help explain its success. Programmes such as the Healthy China 2030 and 2018 telemedicine rules extended digital tools to county hospitals[1]. Standardising electronic health records remains a challenge due to fragmentation of data and platform incompatibility[16]. With increased use in metropolitan areas, Internet hospitals allow scheduling, e-prescriptions, and consultations for millions of people. Access is getting better in rural areas, particularly with respect to local providers who help to increase confidence and use. Although younger and educated women prefer mobile apps, quality and inclusiveness issues still exist[17, 18]. Telemedicine has opportunities, but requires community involvement and integration into regular treatment since it faces challenges of trust

Table 2: Disparities in reproductive healthcare access between Rural and Urban China

Indicator	Urban China	Rural China	Source
Maternal Mortality Rate (per 100,000 live births)	14.3	16.6	National Bureau of Statistics of China (2023)
Percentage of Births Attended by Skilled Providers	99.1%	92.3%	WHO China Report (2022)
Obstetricians per 1,000 Population	2.3	0.8	Ministry of Health (2023)

Table 3: Overview of digital health interventions in rural china

Digital Health Intervention	Functionality	Target Population	Implementation Status
Mobile Health Apps	Prenatal education, appointment reminders, symptom tracking	Pregnant women, mothers	Widely available
Telemedicine	Remote consultations, specialist guidance	Healthcare providers, high-risk patients	Expanding
EHR Systems	Digital patient records, data tracking	Hospitals, clinics	Being scaled up

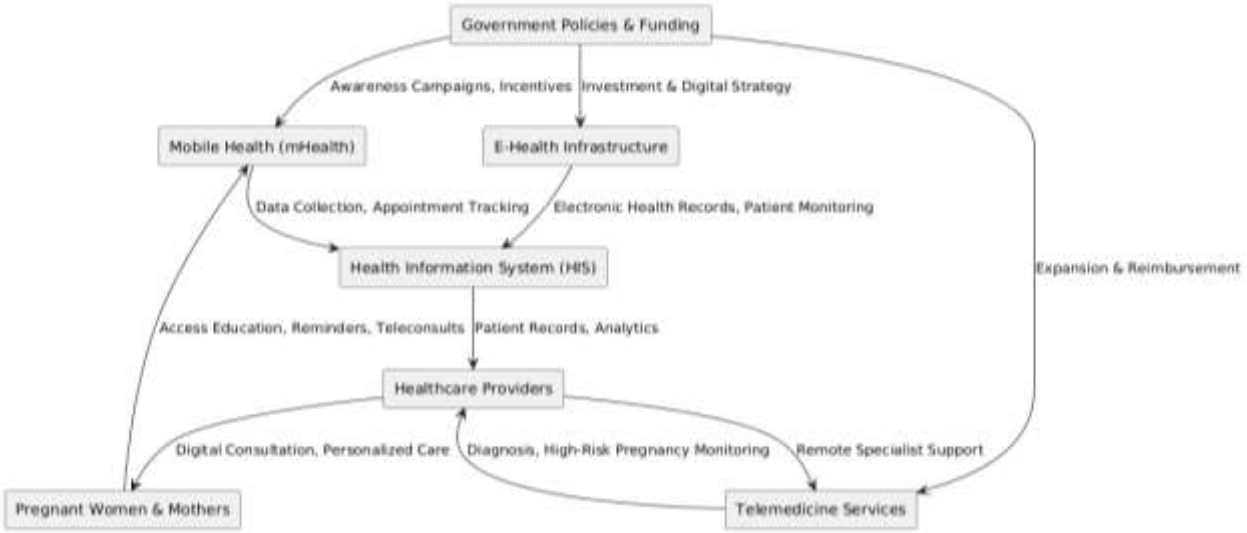

Figure 1: Conceptual framework of digital health integration in reproductive healthcare

and awareness. China's regulatory backing and digital infrastructure investment help mainstream e-health services[19] as shown in Table 2.

Digital health interventions

The rapid expansion of digital health in China has brought creative ideas to address the differences in rural mother healthcare. Key interventions include mobile health apps, telemedicine, and electronic health records (EHR), so improving access to family planning, prenatal and postnatal care. Applications for mHealth help with foetal monitoring, appointment scheduling, and mother education. Telemedicine allows virtual consultations, tele-ultrasound, and remote high-risk pregnancy treatment[7]. However, adoption is limited by infrastructure, training gaps, and lack of reimbursement policies[20]. EHR systems facilitate real-time monitoring and data management. Despite policy support under Healthy China 2030, challenges remain in data privacy, system. interoperability, and cybersecurity as shown in Table 3 and Figure 1.

This framework is a model for understanding how digital health interventions impact reproductive healthcare access, use, and outcomes in resource-constrained settings. It also helps identify potential barriers, such as gaps in digital literacy, infrastructure limitations, and regulatory challenges, that must be addressed for long-term sustainability and scalability.

Methods

Study design

In this mixed-method study the implementation and effects of digital health interventions on reproductive healthcare in rural China were investigated. Consistent with accepted practices in digital health implementation studies, the approach combined qualitative data collection (semi-structured interviews and focus groups) with document and programme data analysis to ensure triangulation and contextual depth.

Qualitative data collection

Semi-structured interviews

Key stakeholders - including 20 rural women, 12 healthcare professionals (midwives, township physicians, and obstetricians), and 4 local health administrators - were interviewed in a total of 36 semi-structured sessions. Two rural counties were purposefully selected for participants to provide a variety of points of view that ranged from age, education, and health care responsibility. The interviews investigated experiences with telemedicine systems, mobile health apps, and opinions about adoption of digital health. Following qualitative processes, interviews were conducted in Mandarin or local dialects with translation support, where appropriate[17, 18].

Focus group discussions

Village women of reproductive age participated in three focus groups (FGDs) to investigate common attitudes, perceived benefits, and obstacles related to digital reproductive healthcare technologies. Using a modified thematic guide from accepted mother health research techniques, each FGD consisted of 6-8 participants and was supported by a qualified moderator [24].

Document and policy analysis

Reviewed were national and local digital health policy documents covering mother's health information systems and telemedicine implementation instructions. Two current digital health projects in the study locations also provided project-level data—one on a mother mobile education app and another on a telemedicine system connecting township and county-level facilities. According to previous programmatic evaluations, the data included utilisation statistics, referral records, and routine maternal health indicators before and after intervention deployment [12,26].

Data analysis

Thematic analysis of the transcribed and translated qualitative data. Deductive and inductive coding techniques were combined in a codebook. Two researchers separately coded the transcripts; differences were resolved through conversation. Emerging themes were digital trust, access constraints, and behaviour related to seeking care. Content analysis and basic trend comparisons examined policy papers and programme data to triangulate conclusions with qualitative data[29].

Ethical considerations

Given the involvement of human participants, including rural women of reproductive age, healthcare professionals, and local administrators, this study required adherence to ethical research standards. All participants were informed about the purpose, scope, and voluntary nature of the study. Informed consent was obtained in writing, with assurances that participation was entirely voluntary and that participants could withdraw at any stage without any repercussions. To protect participants' confidentiality and privacy, all personal identifiers were removed during data transcription, and data was stored securely with access limited to the research team. Particular attention was given to ethical sensitivity when engaging with potentially

vulnerable groups, including pregnant and postpartum women in rural settings. Interviews and focus group discussions were conducted in a culturally appropriate manner, with efforts made to ensure comfort, understanding, and respect for local norms and values

Results

The findings are organised into three key areas: (1) mobile health applications, (2) telemedicine platforms, and (3) outcomes of policy and programme implementation.

Mobile health apps: Use and effects on women's healthcare

Younger women, especially those under 30 years of age, made great use of mobile health apps. Of the 25 postpartum mothers surveyed, 19 said they used pregnancy-related apps, including Good Baby and Mother's Handbook. The important points mentioned were peer support groups, appointment reminders, and pregnancy monitoring. Many users reported advantages, including better awareness of prenatal care milestones and reminders for clinical exams. Some women reported scheduling hospital visits using app alerts. Third-trimester screening rates increased from 88% to 92% after app distribution, according to local health officials. However, older or less educated women were less likely to use these apps, usually claiming a taste for conventional advice or lack of knowledge of cellphones.

Often used as a substitute platform, WeChat allowed women to access local clinic health notices and video guidance. Village midwives also held group meetings to answer frequently asked questions about pregnancy.

Telemedicine platforms: Providing rural clinics with extended specialist support

Rising Use of Teleconsultation by Rural Healthcare Providers: Our study revealed that healthcare. Particularly for difficult obstetric situations, healthcare professionals in both counties noted growing use of teleconsultation services. Regular remote case evaluations with provincial experts were carried out by county-level hospitals. Township physicians sought advice on recommendations and sent ultrasound photos using iPads or PCs. 120 mother-foetus teleconsultations were recorded in six months, mostly related to the management of high-risk pregnancy and diagnostic support. Providers said they had better clinical judgment and more faith in local management of the problems. Sometimes, telemedicine allowed real-time evaluation and collaboration with higher-level hospitals, therefore helping to cut unnecessary referrals.

The provider's reports of challenges included sporadic equipment failure, insufficient IT assistance, and inconsistent internet connection. Due to their simplicity, some preferred phone-based consultations. The younger doctors adopted more than their more experienced colleagues.

Results of policies and programmes toward integrated digital health care

Aligning with national policy objectives: The policy evaluation results show that the study counties under more general national and provincial plans, the countries under study started digital health projects. The County B mobile app project received central support in the form of licenses and training and matched a provincial mother health campaign. Under a national policy effort, County an expanded its telemedicine system with equipment and training sponsored. Following implementation, health records revealed gains. Over three years, postpartum visit rates within 42 days in County B rose from 85% to 95%. County A claimed earlier identification of high-risk pregnancies and a 15% decrease in unnecessary referrals outside of the county. Health officials credited improved tracking, real-time expert access, and automatic alarms for these gains.

However, sustainability issues surfaced. Officials mentioned the requirement of constant training as well as the dependence on trial-phase money for equipment and subscriptions. An operational hurdle is data duplication between digital and paper-based reporting. Figure 2 presents the summary key findings on digital health in rural China.

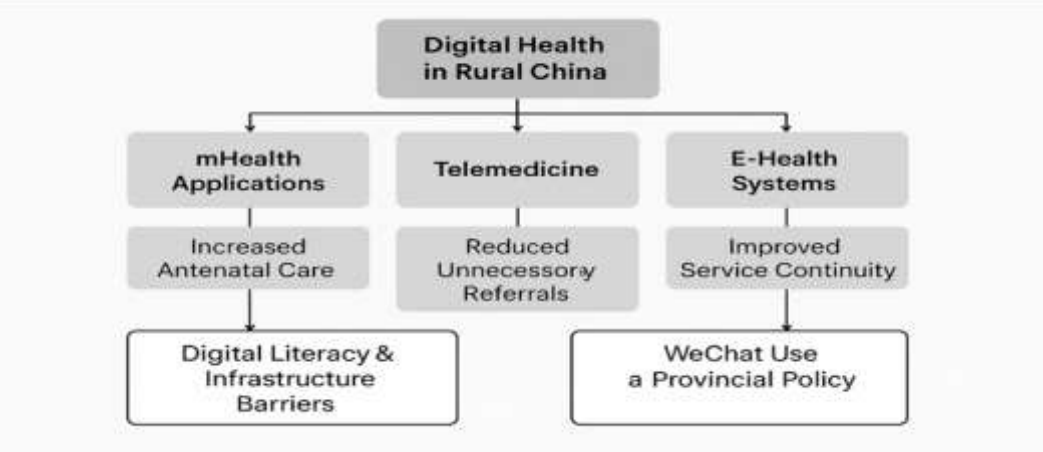

Figure 2: Key findings on digital health in rural China

Discussion

This article adds to the expanding corpus of data on how digital health interventions, particularly mobile health apps, telemedicine, and e-health systems, could improve reproductive healthcare in rural China. The results highlight ongoing inadequacies in infrastructure, inclusion, and policy integration, as well as the great progress achieved in improving access to mother care.

Younger women were found to be extensively using mobile health apps for appointment scheduling, self-monitoring, and prenatal instruction. These results are consistent with previous studies showing substantial use of mobile apps among Chinese pregnant women for maternal health reasons[10]. However, digital exclusion was clear, as was the case with other studies in low-resource environments: older, less educated, lower-income women demonstrated minimal interaction with mobile platforms[10]. This emphasises the need to create inclusive technologies that consider, among underprivileged users, literacy, language, and usability restrictions. Although app use appeared to boost care seeker behaviours, such timely checkups, the effect on delivery outcomes was less clear, confirming past conclusions that knowledge alone may not be sufficient without enabling structures[18].

Especially in bridging communication between health authorities and communities, WeChat-based interventions offered a potential alternative. Using WeChat to distribute visual health materials and enable peer assistance fits results from previous randomised studies showing changes in nursing practices made possible by such platforms[1]. However, the overreliance on unofficial or unapproved content could also lead to false information, so expert supervision and quality control become even more important.

Especially in the management of high-risk pregnancies, telemedicine has shown success in providing clinical support to township-level clinicians. Remote consultations and diagnostic support enabled timely decision-making and reduced unnecessary referrals. These findings confirm past assessments of China's telemedicine system, which has shown greater provider confidence and greater adherence to clinical guidelines[10]. Technical and operational constraints still exist nonetheless. Rural clinics still deal with unreliable internet access, inadequate IT assistance, and older staff members' resistance to using new systems [20, 11]. Sometimes doctors returned to phone consultations due to system inefficiencies; this suggests that telemedicine is still underused unless closely included in daily operations.

In particular the Maternal and Child Health System (MCH) and the Healthy China 2030 programme, the integration of digital health tools within national policy frameworks has driven improvements in data tracking and service

coverage[1-5]. Counties that closely matched these programmes showed improved maternal health indicators and more digital consumption, therefore, confirming arguments that top-down policy support is a major enabler of digital health adoption[9, 12]. Still, some difficulties still exist. Many initiatives rely on outside project-based financing, and repeats in data reporting, where both paper and digital records are kept, continue to tax already scarce healthcare resources[6]. This inefficiency points to a more general problem of system fragmentation, therefore impeding uniform deployment of digital tools and interoperability[21].

The acceptance of digital health is much shaped by the sociocultural setting. Maternal health decisions are influenced by family hierarchies and gender roles; in many situations, older relatives or spouses decide whether digital tools are embraced. As seen in previous studies, patient engagement with technology[17], still depends mostly on confidence in local healthcare practitioners. Thus, approaches to advance digital health must incorporate community education, active participation of front-line workers, and sensitivity to cultural expectations that give relational care first priority over remote engagement.

Policy-wise, these results underline the need to expand rural digital infrastructure and include telemedicine in regular service delivery. Although the national government has made great strides in telehealth promotion and broadband expansion[26] access and quality still vary greatly. Under public insurance, financial coverage for telemedicine treatments is still uneven, which can deter patient and provider acceptance. Moreover, the increasing number of mother-health apps differs greatly in quality. To ensure that they meet safety and efficacy criteria, regulatory authorities, including the National Health Commission, must standardise and certify digital tools[21]. In essence, even though digital health technologies have created new avenues for improving mother health in rural China, their success relies on coordinated policy support, local integration, digital literacy, and continuous investment in infrastructure. Other health systems that try to implement responsible, inclusive, and scalable digital health models can benefit a lot from the Chinese experience. The achievement of fair technologically enabled maternal healthcare in rural areas depends on ongoing treatment of the structural and social barriers found in this study.

Conclusion

This article shows how digital health interventions, especially mobile health apps, telemedicine, and e-health infrastructure, are helping rural Chinese residents to have better access to reproductive healthcare and service continuity. Although telemedicine has improved clinical assistance for rural physicians, mobile platforms have raised health awareness and involvement among younger women. E-health technologies have improved data tracking and integration within programmes for mother care. However, to maintain and scale these developments, ongoing issues with digital exclusion, infrastructure constraints, system interoperability, and policy alignment must be resolved. The digital divide is still a major obstacle, since underprivileged and older groups are usually left out of the advantages of digital health. Long-term success will require inclusive design, ongoing public funding, professional development, and integration of digital services into regular healthcare delivery. China's experience provides significant insights for other nations that hope to use digital innovation to overcome rural health disparities. Not only will technical development help achieve fair and sustainable mother health results, but also trust-building, cultural adaptation, and coherent policy frameworks that match digital technologies with front-line healthcare reality.

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