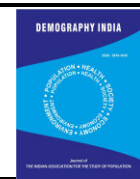


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Linking the Digital Divide: Impact of Digital Health Initiatives on Reproductive Healthcare among Rural Women in Bihar

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Abstract

India's digital health initiatives seek to transform healthcare delivery through technology-driven, inclusive, and citizen-centric systems. This study examines the role and effectiveness of digital health interventions introduced by the Government of India in improving reproductive healthcare services among rural women in Bihar.

Women in remote rural areas face multiple structural challenges, including inadequate health infrastructure, low income, gender inequality, limited mobility, and low awareness of available healthcare services. The Ayushman Bharat Digital Mission (ABDM) aims to build an integrated digital health ecosystem by connecting healthcare providers, beneficiaries, and institutions through platforms such as ABHA (Ayushman Bharat Health Account), eSanjeevani, Kilkari, and AI-based digital tools. Aligned with the Digital India mission, these initiatives aim to bridge the digital divide and promote equitable, data-driven, and patient-centric healthcare delivery.

This study is based on secondary data from government reports, program evaluations, and national surveys such as the National Family Health Survey (NFHS) and the Health Management Information System (HMIS). Key indicators analyzed include digital literacy levels, mobile-based health consultations, institutional deliveries, antenatal care utilization, and maternal and child health awareness among rural women.

The findings suggest that digital health initiatives have improved awareness, service utilization, and continuity of care in several districts. However, significant gaps persist due to poor internet connectivity, limited access to smartphones, low digital literacy, and entrenched socio-cultural barriers. The study highlights the need for stronger community engagement, capacity building, improved digital infrastructure, and integration of technology with frontline health workers to ensure inclusive access.

Strengthening grassroots implementation and combining digital innovation with human support systems are essential to achieving equitable and effective reproductive healthcare outcomes in rural Bihar.

Keywords

Bihar, Digital Divide, Digital Health, Maternal Health, Reproductive Healthcare, Rural Women.

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Introduction

The rapid expansion of digital technologies has significantly reshaped healthcare systems across the globe, offering new possibilities for improving access, efficiency, transparency, and quality of services. In India, this transformation has gained substantial momentum over the past decade and was further accelerated by the COVID-19 pandemic, which exposed critical gaps in healthcare infrastructure, surveillance mechanisms, and service delivery systems (UNDP, 2023). In response, the Government of India advanced several digital health initiatives, including eSanjeevani, CoWIN, and the Ayushman Bharat Digital Mission (ABDM), aimed at strengthening digital health governance, expanding telemedicine services, and creating interoperable electronic health records through unique ABHA Health IDs. These initiatives are designed to streamline service delivery, enhance accountability, reduce administrative inefficiencies, and empower citizens through improved access to reliable health information and digital medical services. (Sharma, 2023)

However, the transformative promise of digital health is closely linked to the broader question of digital inclusion. The concept of the digital divide extends beyond mere access to devices and internet connectivity to include disparities in digital literacy, skills, usage patterns, and the capacity to translate digital engagement into meaningful socio-economic and health outcomes. In the context of healthcare, these inequalities can significantly influence awareness, timely utilization of services, and overall health status (Rana 2024). This intersection becomes particularly critical in the domain of reproductive healthcare, where delays in

antenatal registration, inadequate monitoring of high-risk pregnancies, low institutional delivery rates, and insufficient postnatal follow-up can have severe consequences for maternal and neonatal health.

Bihar presents a compelling case for examining the relationship between digital health expansion and reproductive healthcare equity. As one of India's most populous and socio-economically disadvantaged states, Bihar faces persistent structural challenges, including inadequate healthcare infrastructure, shortages of trained medical personnel, high poverty levels, low female literacy, and entrenched gender norms. Rural regions in particular are characterized by limited internet penetration, unreliable electricity supply, and low smartphone ownership. These infrastructural and socio-economic constraints contribute to a pronounced digital divide that disproportionately affects women. Rural women often have restricted access to mobile phones, limited autonomy over household resources, lower levels of education, and constrained mobility due to patriarchal social structures. Such factors significantly shape their ability to engage with digital platforms, access teleconsultation services, or benefit from online health information (Singh, R., et al., 2025).

Simultaneously, Bihar has increasingly adopted digital and data-driven interventions aimed at strengthening reproductive, maternal, newborn, and child health services. The Reproductive and Child Health Portal facilitates systematic tracking of pregnancies, immunization schedules, and high-risk cases, thereby improving monitoring and follow-up mechanisms

(State Health Society Bihar. (2022). Programmes such as Janani Suraksha Yojana promote institutional deliveries through conditional cash incentives, while SUMAN (Surakshit Matritva Aashwasan) and LaQshya focus on improving the quality of maternal and neonatal care through strengthened digital monitoring and quality assurance systems (State Health Society Bihar, 2021, JSY/SUMAN).

Teleconsultation services via eSanjeevani and digital beneficiary identification under ABDM further aim to bridge geographical barriers and enhance continuity of care (MoHFW, 2019). In principle, these initiatives have the potential to increase antenatal care registration, ensure completion of recommended check-ups, promote safe institutional deliveries, and improve postnatal care coverage.

Yet, the effectiveness of these digital interventions depends largely on the extent to which rural women can independently access, understand, and utilize them. When digital platforms are accessed primarily through intermediaries such as Accredited Social Health Activists (ASHAs) or auxiliary nurse midwives rather than directly by beneficiaries, the empowerment dimension of digital health remains constrained. Moreover, socio-cultural factors including patriarchal decision-making structures, caste-based hierarchies, economic deprivation, and limited educational opportunities mediate the benefits derived from digital health initiatives. While digitalization offers opportunities to overcome geographical and logistical barriers, it may simultaneously reproduce or deepen existing social inequalities if structural determinants of exclusion are not

adequately addressed (Kumar, A., et al., 2020).

Against this backdrop, the present study examines how digital health interventions influence reproductive healthcare awareness and service utilization among rural women in Bihar and whether these initiatives effectively bridge or reinforce existing inequalities. By situating digital health within a broader framework of gender relations, socio-economic disadvantage, and structural inequities, the study seeks to assess whether technological innovation in Bihar is contributing to more inclusive maternal healthcare outcomes or whether the digital divide continues to shape patterns of access, utilization, and benefit. Through this analysis, the paper contributes to ongoing debates on digital governance, health equity, and the role of technology in advancing reproductive health in marginalized and resource-constrained settings (Singh, R., et al., 2025).

Review of Literature

Digital health technologies are increasingly being recognized as transformative tools for strengthening healthcare systems, particularly in developing countries where access to healthcare services remains uneven. In India, digital health initiatives have expanded rapidly under the broader framework of the Digital India mission, aiming to enhance healthcare delivery through integrated digital platforms, telemedicine services, and electronic health records. Agarwal, Srivastava, and Chauhan (2022) highlight that digital health interventions in India offer significant opportunities for improving healthcare access, efficiency, and patient management, although challenges related to

infrastructure, digital literacy, and policy implementation remain critical.

The Government of India has introduced several initiatives to build a comprehensive digital health ecosystem. The Ayushman Bharat Digital Mission (ABDM) seeks to create an integrated digital health infrastructure that enables the exchange of health information across platforms through the use of ABHA (Ayushman Bharat Health Account) IDs, thereby promoting interoperability and patient-centered care (Ministry of Health and Family Welfare, 2021). In addition, platforms such as eSanjeevani telemedicine services and digital health registries aim to improve healthcare accessibility, particularly for rural and remote populations.

Several studies emphasize that digital health platforms can play a significant role in improving maternal and child health outcomes. Evidence from Bihar suggests that digital innovations, including mobile-based information services and digital health tracking systems, have contributed to improved monitoring of pregnancies, immunization coverage, and maternal healthcare services (CARE India, 2023; UNFPA India, 2022). The Health Management Information System (HMIS) has further strengthened health monitoring by enabling systematic data collection, reporting, and analysis of maternal and child health indicators across districts (HMIS, Ministry of Health and Family Welfare, 2023). Similarly, the Bihar State Health Society (2024) reports improvements in institutional delivery rates and antenatal care utilization due to enhanced monitoring and service delivery mechanisms.

Despite these advancements, the digital divide remains a major challenge, particularly for women in rural areas. The digital divide refers not only to unequal access to digital infrastructure but also to disparities in digital skills, awareness, and the ability to effectively utilize technology. Studies indicate that gender-based inequalities significantly influence women's access to digital technologies in India. The GSMA Mobile Gender Gap Report (2023) notes that women are substantially less likely than men to own mobile phones or access mobile internet, particularly in rural regions. In Bihar, structural barriers such as low female literacy, limited smartphone ownership, and socio-cultural restrictions on women's mobility further widen the gender digital divide (Centre for Catalyzing Change, 2021; Population Council, 2021).

Research also highlights the influence of patriarchal social structures on digital exclusion. Sharma and Ranjan (2021) argue that patriarchal decision-making systems in rural Bihar often restrict women's access to digital technologies and limit their participation in digital platforms. As a result, many women rely on intermediaries such as community health workers to access digital health services, which may reduce the empowerment potential of these technologies.

Several policy initiatives have been introduced to address digital literacy gaps and promote digital inclusion. Programs such as the Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA) aim to enhance digital literacy among rural populations and improve their capacity to utilize digital services (Ministry of Electronics and Information Technology, 2022). However, studies suggest that

significant barriers remain in terms of awareness, digital skills, and access to devices (Kaur, 2023).

Recent qualitative studies also highlight persistent socio-economic and infrastructural challenges affecting digital health adoption in rural Bihar. Research conducted by IMPRI India (2025) indicates that rural women often face barriers such as unreliable internet connectivity, lack of digital awareness, and dependence on family members for accessing mobile devices. Similarly, reports from development organizations emphasize the need for greater digital empowerment of rural women to ensure inclusive access to health services (Village Square, 2023).

Other analyses also stress the importance of strengthening health infrastructure and digital connectivity in Bihar. Studies suggest that improvements in healthcare infrastructure and digital service delivery are essential for achieving broader socio-economic development and improving health outcomes (Down to Earth, 2025; World Bank, 2022). Efforts to close the gender digital divide through policy interventions, awareness programs, and community-based initiatives are therefore crucial to ensuring equitable access to digital health services (Sage Journals, 2022; The Multidisciplinary Journal, 2021).

Overall, the existing literature suggests that digital health initiatives hold considerable potential for improving reproductive and maternal healthcare services. However, their effectiveness depends on addressing structural barriers related to digital access, gender inequality, digital literacy, and socio-economic disparities. Strengthening digital infrastructure, promoting digital literacy

among rural women, and integrating digital technologies with community-based health systems are therefore essential for achieving inclusive and equitable healthcare outcomes in Bihar.

Data and Methods

This study adopts a descriptive and analytical research design to examine the influence of digital health interventions on reproductive healthcare accessibility, awareness, and service utilization among rural women in Bihar. The descriptive component systematically reviews existing digital health initiatives and reproductive health indicators, while the analytical component investigates the relationship between digital access, socio-economic characteristics, gender norms, and maternal healthcare outcomes. The study evaluates major government-led digital initiatives, including eSanjeevani, the Ayushman Bharat Digital Mission (ABDM), Kilkari, and AI-SNEH, along with reproductive and maternal health programmes integrated with digital platforms such as the Janani Suraksha Yojana and the Reproductive and Child Health (RCH) Portal.

The research is primarily based on secondary data derived from nationally recognized and publicly available sources. The principal datasets used in this study are the National Family Health Survey-5 (NFHS-5) and the Health Management Information System (HMIS). These datasets provide complementary insights by combining household-level information with facility-level administrative data, thereby enabling a comprehensive assessment of healthcare access, utilization patterns, and service delivery performance in Bihar.

NFHS-5 (2019–21) is a nationally representative household survey conducted using a stratified multi-stage sampling design and provides district-level estimates on population, health, and nutrition indicators. It offers detailed information on maternal and child health, antenatal and postnatal care, institutional delivery, reproductive behaviour, family planning, women's education, media exposure, decision-making autonomy, and mobile phone ownership. These indicators are particularly relevant for assessing digital inclusion and its association with reproductive healthcare utilization among rural women in Bihar.

The HMIS is an administrative database maintained by the Ministry of Health and Family Welfare that compiles monthly service delivery reports from public and selected private health facilities across India. It provides continuous, real-time data on antenatal care registrations, institutional deliveries, postnatal services, immunization coverage, family planning services, and other maternal and child health indicators. Unlike NFHS-5, which is periodic and survey-based, HMIS allows for trend analysis and monitoring of programme implementation at district and facility levels.

In addition to these datasets, policy documents, government websites, programme reports, and digital health portals were reviewed to contextualize the analysis of digital health interventions. A summative content analysis approach was employed, integrating quantitative indicators with qualitative interpretation of policy frameworks and programme guidelines. Content analysis was used to systematically examine textual material and derive meaningful inferences regarding the

design, implementation, and scope of digital health initiatives.

The dependent variables in the study include antenatal care registration and completion of four or more visits, institutional delivery, postnatal care services, and utilization of teleconsultation and mobile-based health platforms. Independent variables include digital literacy, smartphone ownership, internet connectivity, educational attainment, socio-economic status, caste, and women's decision-making autonomy. Descriptive statistics are used to examine trends and patterns in reproductive healthcare utilization, while correlation-based analysis explores the association between digital literacy and maternal healthcare outcomes. Comparative analysis is also undertaken to assess disparities between rural Bihar and broader state or national trends.

The methodological framework is guided by the Digital Divide perspective, which conceptualizes inequality across three levels: access (availability of devices and connectivity), usage (digital skills and literacy), and outcomes (health benefits derived from digital services). A gender and health equity lens further informs the analysis, highlighting how patriarchal norms, caste hierarchies, and socio-economic disadvantages shape women's engagement with digital reproductive health services. By integrating quantitative data analysis with policy review and content analysis, the study provides a comprehensive assessment of the extent to which digital health initiatives influence reproductive healthcare outcomes and address structural inequalities in rural Bihar.

Results

Keeping in view the objectives of the study, this section analyses how digital health initiatives have influenced reproductive healthcare access and outcomes among rural women in Bihar. While digital interventions have expanded institutional delivery coverage and maternal service tracking, persistent socio-economic and infrastructural barriers continue to shape uneven outcomes.

Bihar remains predominantly rural, with the National Family Health Survey 5 (NFHS-5) reporting that approximately 84 per cent of households reside in rural areas. This demographic profile has significant implications for digital health delivery, as rural populations often face limited infrastructure, lower literacy levels, and restricted access to digital technologies.

The Total Fertility Rate (TFR) in Bihar stands at 3.0, significantly above the national replacement level of 2.1. Rural TFR (3.1) remains considerably higher than urban TFR

(2.4), indicating persistent unmet reproductive health needs. Although institutional deliveries have increased to 76 percent overall (74 percent in rural areas), the rural-urban gap persists. Similarly, only 39 percent of women receive antenatal care from a doctor, with rural coverage dropping to 35 percent. These disparities suggest that while service utilization has improved, quality and timely access remain concerns.

Women's digital access indicators further highlight structural limitations. Only 50 percent of rural women report owning a mobile phone, compared to 67 percent in urban areas. Low levels of digital ownership directly influence the reach and effectiveness of digital health platforms such as teleconsultation services and mHealth messaging systems. Moreover, infrastructural constraints such as 45 percent of rural households practicing open defecation and only 8 percent having access to piped water reflect broader developmental deficits that intersect with health outcomes.

Table 1 Rural-Urban Differences in Selected Socio-Demographic and Reproductive Health Indicators in Bihar (NFHS-5, 2019–21)

Indicator	Bihar (Total)	Rural	Urban	Rural-Urban Gap
Rural population (%)	84	-	-	-
Women (15–49) literate (%)	55	52	70	18 pp
Total Fertility Rate	3.0	3.1	2.4	0.7
Institutional deliveries (%)	76	74	87	13 pp
Women using contraception (%)	55	55	62	7 pp
Antenatal care from doctor (%)	39	35	60	25 pp
Households practising open defecation (%)	39	45	12	33 pp
Access to piped water (%)	9	8	18	10 pp
Women owning a mobile phone (%)	54	50	67	17 pp
Households with health insurance (%)	15	15	12	3 pp

Source: International Institute for Population Sciences (IIPS) & ICF (2021), National Family Health Survey (NFHS-5), 2019–21, Ministry of Health and Family Welfare, Government of India.

- The largest rural–urban disparities are observed in antenatal care from a doctor (25 percentage points) and sanitation (33 percentage points).
- Digital readiness (mobile ownership) shows a 17 percentage-point gap, directly affecting digital health adoption.
- Institutional deliveries show improvement but still reflect structural inequality.
- Health insurance penetration remains low, limiting financial protection despite digital enrolment efforts.

These findings suggest that digital health interventions operate within a broader socio-developmental ecosystem. Without improvements in literacy, sanitation, and digital access, technological solutions alone may not fully bridge healthcare inequities.

Digital Health Infrastructure and Reach in Bihar

In recent years, Bihar has expanded its digital health infrastructure under the Ayushman Bharat Digital Mission (ABDM), including the rollout of ABHA Health IDs and the digitization of facility records. The state has also strengthened supply chain transparency through the Drugs and Vaccine Distribution Management System (DVDMS). Mobile health (mHealth) initiatives such as Kilkari deliver targeted reproductive health information directly to beneficiaries. Furthermore, the Health Management Information System (HMIS) has improved real-time reporting and monitoring of maternal and child health indicators, particularly for frontline workers such as ASHAs.

Table 2 Key Digital Health Ecosystem Indicators in Bihar, 2023

Indicator	Value	Analytical Interpretation
Health facilities with digital registration	15,000+	Expanding institutional digitization across districts
Digitally registered health professionals	35,000+	Strengthened provider network integration
Rural women with ABHA Health IDs	7,000,000+	Significant digital identity coverage, but usage depth unclear
Ayushman Bharat cards issued (rural)	8,000,000+	Financial risk protection expanded
Women enrolled in Kilkari	3,500,000+	Strong mHealth outreach for maternal awareness
Facilities using DVDMS	3,500+	Improved drug logistics and transparency
ASHAs trained in digital tools	90%+	High frontline digital readiness

Source: Ministry of Health and Family Welfare (2023), Ayushman Bharat Digital Mission Dashboard; Health Management Information System (HMIS); and Bihar State Health Society Digital Health Programme Reports.

Table 2 demonstrates substantial progress in embedding digital systems within Bihar’s public health architecture. The high number

of ABHA IDs and Ayushman Bharat cards suggests strong enrolment efforts. Similarly, large-scale Kilkari enrolment indicates

expanded digital outreach for maternal and reproductive health education.

However, enrolment figures do not automatically translate into active utilization. While infrastructure and digital identity coverage are expanding, effectiveness depends on women's digital literacy, autonomy, and connectivity. High ASHA digital training rates suggest improved frontline readiness, yet household-level access constraints may still limit end-user benefits.

Thus, Bihar's digital health ecosystem reflects a dual reality: significant institutional progress alongside persistent social and infrastructural divides. Digital initiatives have contributed to improved institutional deliveries and monitoring systems, but closing the rural-urban and gender gaps require complementary investments in digital literacy, gender empowerment, and basic infrastructure.

Digital health initiatives in Bihar have increasingly complemented traditional community-based outreach systems in

strengthening reproductive healthcare awareness and service utilization among rural women. While Accredited Social Health Activists (ASHAs) and Auxiliary Nurse Midwives (ANMs) continue to play a foundational role, digital platforms have expanded the scale, speed, and consistency of communication. Mobile-based voice messages and SMS reminders under mHealth programmes such as Kilkari reinforce antenatal care (ANC) schedules, institutional delivery planning, and postnatal care awareness. Similarly, the digitization of beneficiary tracking and payments under Janani Suraksha Yojana (JSY) has enhanced transparency, reduced delays in cash transfers, and strengthened accountability through digital verification mechanisms linked with health IDs and facility-based registrations.

The cumulative impact of these interventions is reflected in institutional delivery trends across districts. Although variations persist, the overall trajectory suggests moderate but sustained progress, interrupted temporarily during the COVID-19 pandemic period.

Table 3 District-wise Trends in Institutional Deliveries under Janani Suraksha Yojana (JSY) in Bihar, 2016-17 to 2023-24

District	2016-17	2019-20	2020-21	2023-24	% Change (2016-17 to 2023-24)
Muzaffarpur	53	56	56	65	+22.6%
East Champaran	62	66	68	72	+16.1%
Purnea	71	80	80	84	+18.3%
Samastipur	89	92	87	82	-7.9%
West Champaran	68	70	57	71	+4.4%
Patna	64	57	49	56	-12.5%
Arwal	9	10	10	9	0%
Sheikhpura	12	13	14	13	+8.3%
Bihar (Total)	1545	1647	1577	1652	+6.9%

Source: Bihar State Health Society, Government of Bihar 2024.

The data indicates that Bihar witnessed an overall rise in institutional deliveries under JSY from 1.54 million in 2016–17 to 1.65 million in 2023–24, representing a 6.9% increase over the period. However, the trend is not uniform across districts.

Districts such as Muzaffarpur, East Champaran, and Purnea demonstrate consistent growth, reflecting stronger health system responsiveness and possibly more effective integration of digital tracking, beneficiary identification, and awareness mechanisms. Muzaffarpur’s 22.6% increase suggests improved beneficiary outreach and sustained service utilization. Similarly, East Champaran and Purnea exhibit steady upward trajectories, indicating stable institutional coverage.

In contrast, districts such as Samastipur and Patna show stagnation or decline over the long term. Samastipur, despite maintaining high absolute numbers, records a net decline of nearly 8%, suggesting either demographic transitions, reporting changes, or emerging systemic bottlenecks. Smaller districts like Arwal and Sheikhpura display minimal growth, indicating persistent structural constraints such as limited health infrastructure, transport barriers, or weaker digital penetration.

A noticeable dip across multiple districts during 2020–21 corresponds with the COVID-19 pandemic, which disrupted mobility, healthcare delivery, and routine maternal services. However, most districts demonstrate gradual recovery by 2023–24, reflecting resilience and adaptive service delivery—partly enabled by digitized beneficiary tracking and communication systems.

Overall, districts with sustained JSY coverage tend to correspond with higher digital beneficiary registration rates, stronger ASHA engagement, and improved facility-level reporting through the Health Management Information System (HMIS). This pattern underscores the enabling role of digital governance in strengthening maternal healthcare utilization while also highlighting uneven outcomes shaped by socio-economic and infrastructural disparities.

Digital Literacy and Platform Exposure among Women

While institutional service utilization has improved, digital inclusion among women remains uneven, directly influencing the extent to which digital health interventions translate into behavioural change.

Table 4 Women’s Digital Literacy and Digital Exposure in Bihar, 2023 (Estimates)

Indicator	Value (%)
Women (15–49) owning/using a mobile phone	54
Women (15–49) using internet regularly	18
Rural women confident using SMS/apps	12
Women aware of digital health benefits	40
JSY beneficiaries enrolled with phone/SMS linkage	70

Source: NFHS-5 (2019–21), GSMA (2023), HMIS (2023), and UNFPA India (2022).

The figures reveal a significant digital gender gap. Although 54% of women report mobile phone access, only 18% use the internet regularly, and just 12% of rural women express confidence in independently using SMS or mobile applications. This gap between access and functional digital literacy is critical in evaluating the actual reach of digital health initiatives.

Despite limited digital confidence, 70% of JSY beneficiaries are enrolled with phone or SMS linkage, suggesting that frontline health workers often mediate digital enrolment processes. This indicates that digital systems are operational but not fully autonomous from human intermediaries. Women who possess higher digital confidence demonstrate greater awareness of entitlements, more consistent ANC attendance, and improved follow-up compliance, as digital reminders reinforce health-seeking behavior.

However, the low proportion of rural women capable of independently navigating digital platforms suggests that digital interventions function most effectively when integrated with community-based support structures. Women lacking digital literacy remain dependent on ASHAs for information access, which may lead to uneven participation and delayed benefit realization.

The combined analysis of institutional delivery trends and digital literacy indicators demonstrates that digital health initiatives in Bihar have positively influenced reproductive healthcare utilization, particularly in improving institutional deliveries and beneficiary tracking under JSY. Nevertheless, the transformative potential of digital health

remains constrained by socio-economic inequalities, infrastructural deficits, and the persistent gender digital divide.

Thus, while digitization enhances efficiency, transparency, and outreach, its inclusive impact depends substantially on improving women's digital literacy, expanding rural connectivity, and sustaining frontline health worker engagement.

Women's access to digital reproductive health services in rural Bihar is shaped by deeply embedded structural inequalities. Although government-led initiatives such as the Ayushman Bharat Digital Mission (ABDM) and mHealth platforms like Kilkari aim to democratize access to reproductive health information and services, the effectiveness of these interventions depends heavily on women's social position, economic capacity, literacy levels, and infrastructural environment. The barriers are multidimensional and intersectional where gender norms, poverty, and weak infrastructure reinforce each other to limit meaningful participation.

Barriers to women's participation in digital reproductive health programs in rural Bihar are multidimensional, reflecting the intersection of social, economic, educational, and infrastructural disadvantages. Despite increasing efforts toward digital inclusion through programs such as the Ayushman Bharat Digital Mission and mHealth tools like Kilkari, many rural women remain outside the effective reach of these innovations due to constraints embedded in community structures and household dynamics. Through robust analysis and direct reference to empirical data tables, this assessment explores how diverse barriers

intersect to shape rural women’s experiences with digital reproductive health services.

1.Socio-Cultural Barriers

Socio-cultural norms constitute the most pervasive barrier to women’s digital engagement. In rural Bihar, patriarchal household structures often regulate

women’s access to technology, mobility, and health decision-making. Even where devices are available, women’s independent use is frequently monitored or restricted. Reproductive health—being socially sensitive is often considered inappropriate for open discussion, further limiting digital exploration.

Table 5 Socio-Cultural Barriers Affecting Women’s Access to Digital Reproductive Health Services in Bihar

Indicator	Evidence / Status	Implication for Digital Health Access
Gender gap in digital device access	Only ~18% of adolescent girls have independent access to digital devices; access among boys exceeds 80%	Early digital exclusion limits long-term digital literacy among women
Shared phone dependency	Women frequently rely on shared household phones	Reduces privacy for accessing reproductive health information
Restrictive gender norms	Patriarchal control over women’s mobility and phone usage	Limits autonomous engagement with apps and teleconsultation
Female literacy gap	Rural female literacy significantly lower than male literacy	Reduces comprehension of digital content
Language barriers	Most apps/content in Hindi or English; many women primarily speak Bhojpuri, Maithili, or Magahi	Restricts usability and behavioural impact

Source: Population Council (2021); C3 (2021); Sharma & Ranjan (2021); GSMA (2023).

These factors collectively reinforce informational asymmetry. Women may receive calls or SMS reminders, but comprehension and follow-up depend on literacy, autonomy, and privacy. Qualitative evidence suggests that many rural women prefer in-person consultations with ASHAs because these interactions provide trust, contextual explanation, and linguistic familiarity elements often absent in standardized digital content.

Furthermore, digital reproductive health engagement requires confidentiality. Shared device usage undermines privacy, discouraging women from accessing

information on contraception, menstrual health, or pregnancy complications. Thus, socio-cultural norms do not merely limit device access they shape the social legitimacy of women’s digital presence.

2. Economic Barriers

Economic deprivation significantly constrains women’s ability to access and sustain digital connectivity. Bihar remains one of India’s economically weaker states, and financial prioritization within households often favours immediate survival needs over digital investments.

Table 6 Economic Barriers to Women's Access to Digital Reproductive Health Services in Bihar

Indicator	Status	Impact on Digital Health Participation
Per capita income (relative to national average)	Significantly lower than national average	Limits affordability of smartphones and data plans
High poverty incidence	Among the highest in India	Digital access considered non-essential expenditure
Gender gap in phone ownership	Women ~15% less likely to own a phone than men	Reinforces dependency and reduced autonomy
Gender gap in internet use	Women ~33% less likely to use mobile internet	Limits exposure to telemedicine and online awareness campaigns
Device access among poorest households	<10% have internet facilities; <3% have computers	Deep digital exclusion among lowest income groups

Source: World Bank (2022); GSMA (2023); Centre for Catalyzing Change (2021)

Economic constraints operate at both individual and household levels. Even when a mobile phone is present, it may be a basic feature phone rather than a smartphone capable of supporting digital health applications. Data recharge costs, device repair expenses, and irregular income patterns discourage consistent use.

Intersectionality intensifies exclusion. Women from Scheduled Castes, minority communities, and remote rural households often experience overlapping disadvantages—low education, low income,

and limited mobility. In such contexts, digital health services may remain theoretically available but practically inaccessible.

Household-level decision-making patterns also reflect gender bias: investments in digital tools are often justified for men's employment or children's education, not women's health needs. Consequently, digital reproductive health initiatives risk reinforcing rather than reducing inequality if affordability gaps are not addressed.

Table 7 Infrastructural Barriers to Women's Access to Digital Reproductive Health Services in Bihar

Indicator	Current Status	Consequence for Digital Health
Rural internet penetration	~31% (vs. ~67% urban)	Large rural connectivity gap
Electricity reliability	Intermittent supply in many villages	Disrupts device charging and digital continuity
PHC infrastructure adequacy	Only ~41% meet minimum bed standards	Limits integration of telemedicine/digital record systems
Coverage of telemedicine/mHealth	Limited in remote areas	Uneven geographic distribution of benefits
Health workforce shortage	Staff shortages and limited digital training	Reduces operational efficiency of digital tools

Source: World Bank (2022); MoHFW Reports; GSMA (2023); Bihar State Health Society.

3. Infrastructural Barriers

Infrastructure defines the operational boundary of digital inclusion. In rural Bihar, connectivity gaps, unreliable electricity, and weak health facility infrastructure undermine digital health delivery systems.

Poor connectivity directly affects the reliability of teleconsultations, video-based counseling, and real-time reporting systems. Network instability can lead to incomplete data uploads, failed authentication processes, and interrupted communication.

Electricity instability further compounds challenges. Without reliable charging infrastructure, digital tools lose consistency, particularly for frontline health workers dependent on tablets or smartphones.

Additionally, health facility readiness remains uneven. Many Primary Health Centres (PHCs) lack sufficient beds, trained personnel, or digital infrastructure to effectively implement ABDM-linked services. Where digital systems exist, they often operate as hybrid models—partly online, partly manual—reducing efficiency gains.

4. Synthesis: Intersectionality of Barriers

The barriers described above are interlinked rather than isolated. A rural woman in Bihar may face:

- Low literacy limiting comprehension of digital messages
- Economic constraints restricting device ownership
- Patriarchal norms curtailing independent phone use
- Weak network coverage reducing service reliability

These layers interact dynamically to produce compounded exclusion. Digital health systems may be technologically functional, but their inclusivity depends on women's agency the ability to control phone usage, make health decisions, and access services independently.

Empirical patterns consistently indicate that younger, poorer, less educated, and geographically remote women are least likely to benefit from digital reproductive health initiatives. Conversely, women with greater autonomy, higher education, and independent device ownership exhibit higher participation rates in teleconsultations, ANC scheduling, and digital beneficiary registration.

Digital reproductive health initiatives in Bihar demonstrate considerable promise, yet structural inequalities constrain their transformative capacity. Socio-cultural norms restrict autonomy, economic poverty limits affordability, and infrastructural deficits weaken implementation. Without simultaneous interventions targeting digital literacy, gender norms, affordability, and rural connectivity, digital health risks deepening existing disparities rather than bridging them.

Therefore, improving women's digital reproductive health access requires a holistic approach combining technological expansion with gender-sensitive policy design, economic empowerment, localized language content, and sustained community engagement.

The integration of digital tools into maternal healthcare schemes in Bihar, particularly under the Janani Suraksha Yojana (JSY), marks a significant transition toward

technology-enabled governance in public health. Through alignment with the Ayushman Bharat Digital Mission (ABDM), the Health Management Information System (HMIS), and ABHA-based digital health IDs, the state has strengthened beneficiary tracking, ensured greater transparency in

direct benefit transfers, and reduced duplication and fraud. Digital registration now enables real-time monitoring of institutional deliveries, timely verification of claims, and improved oversight at district and block levels.

Table 8 District-wise Utilization of Digital Health Services and Institutional Deliveries in Bihar, 2023–24

District	Digitally Registered JSY Deliveries (%)	Institutional Deliveries ('000s)
Patna	94	56
West Champaran	93	71
East Champaran	92	72
Muzaffarpur	93	65
Purnea	91	84
Darbhanga	91	57
Samastipur	90	82
Nalanda	87	41
Gaya	84	50
Bhagalpur	88	56
Katihar	89	66
Supaul	85	52
Sheikhpura	78	13
Jehanabad	80	14
Arwal	48	9
Bihar (Total)	89	1,652

Source: Bihar State Health Society, 2023–24

The table 8 indicates that Bihar has achieved substantial digital penetration in maternal healthcare services, with 89 percent of institutional deliveries under JSY digitally registered during 2023–24. High-performing districts such as Patna, West Champaran, East Champaran, Muzaffarpur, Purnea, and Samastipur report digital registration rates above 90 percent and also demonstrate high institutional delivery volumes. For instance,

Purnea recorded 84,000 institutional deliveries with 91 percent digital registration, while Samastipur registered 82,000 deliveries at 90 percent digital coverage. This suggests a positive association between digital integration and institutional delivery uptake, supported by improved beneficiary identification, streamlined payment systems, and real-time monitoring.

Urbanized or administratively strong districts show better alignment between digital systems and service outcomes. Enhanced connectivity, trained ASHA workers, and stronger district-level monitoring mechanisms contribute to efficient digital implementation. Digital dashboards allow health administrators to detect trends quickly, reduce payment delays, and monitor high-risk pregnancies more effectively.

However, disparities persist. Arwal, with only 48 percent digital registration and 9,000 institutional deliveries, represents a significant outlier. Similarly, Sheikhpura and Jehanabad fall below the state average in digital coverage and maintain relatively low delivery volumes. These variations indicate that digital tools alone cannot overcome infrastructural limitations such as weak internet connectivity, inconsistent electricity supply, staff shortages, and limited digital literacy among health personnel. In such districts, digitization may remain partial or inconsistently implemented.

Overall, the evidence suggests that the integration of digital tools within JSY and broader maternal health programs has enhanced transparency, efficiency, and monitoring across Bihar. While the state-level achievement of 89 percent digital registration demonstrates strong institutional commitment, district-level variations highlight the continued importance of strengthening infrastructure, capacity-building, and digital inclusion strategies. The experience of Bihar illustrates that digital health integration can significantly promote institutional deliveries and maternal healthcare utilization, but equitable outcomes depend on bridging persistent regional and structural gaps.

Discussion

The findings of this study underscore the dual nature of digital health interventions in rural Bihar as instruments of expanded access and improved monitoring on the one hand, and as mechanisms that may inadvertently reproduce structural inequalities on the other. Initiatives under the Ayushman Bharat Digital Mission (ABDM), along with platforms such as eSanjeevani and Kilkari, demonstrate measurable progress in digitizing reproductive and maternal healthcare delivery. Increased institutional deliveries under Janani Suraksha Yojana (JSY), rising digital registrations, and the expansion of ABHA Health IDs among rural women indicate that digital integration has strengthened beneficiary tracking, streamlined incentive transfers, and improved real-time monitoring through systems such as the Reproductive and Child Health Portal and HMIS. The growth in institutional deliveries across districts such as Purnea and Muzaffarpur suggests that digital reminders, streamlined documentation, and improved coordination between frontline workers and facilities may have contributed to greater service utilization. NFHS-5 trends showing improvements in rural institutional delivery rates further reinforce the positive association between digital tracking and maternal health service uptake.

However, these achievements must be interpreted within the broader context of persistent socio-cultural and infrastructural barriers. The digital divide in Bihar remains pronounced, particularly along gendered lines. Limited smartphone ownership among women, low levels of regular internet use, and restricted autonomy over device

access constrain the independent utilization of digital health platforms. Although a substantial proportion of JSY beneficiaries are registered through digital systems, access often occurs via intermediaries primarily ASHAs rather than through direct engagement by women themselves. This mediated access improves administrative efficiency but does not necessarily translate into digital empowerment. The continued gender gap in mobile and internet usage, as highlighted by national surveys, reflects structural inequalities rooted in patriarchal norms, economic dependency, and lower educational attainment among rural women.

Economic constraints further shape digital engagement. Bihar's low per capita income, combined with high levels of poverty, limits the affordability of smartphones, data packages, and consistent electricity access. Infrastructural deficits including unreliable connectivity, frequent power outages, and suboptimal facility readiness at Primary Health Centres impede seamless digital implementation. While ABDM and related platforms emphasize interoperability and real-time data exchange, the benefits of such systems are unevenly distributed across districts. High-performing districts with stronger administrative capacity and better connectivity demonstrate more consistent digital JSY registration and service tracking, whereas lagging districts reveal gaps in rollout and utilization. This unevenness highlights the importance of contextual readiness in scaling digital reforms.

The study also reveals intersectional disparities that extend beyond gender alone. Women belonging to Scheduled Castes, Scheduled Tribes, and economically marginalized communities face compounded disadvantages arising from

poverty, low literacy, geographic isolation, and social exclusion. In such contexts, digital initiatives risk privileging households with better resources and higher levels of education, thereby reinforcing pre-existing inequalities. Limited confidence in using mobile applications, language mismatches between local dialects and standardized Hindi interfaces, and concerns about privacy and confidentiality further restrict independent digital engagement, particularly in sensitive areas such as contraception and family planning.

At the same time, digital health tools have strengthened the role of frontline health workers by enhancing data accuracy, improving referral coordination, and facilitating timely follow-up of high-risk pregnancies. The large-scale digital training of ASHAs has improved data entry and beneficiary tracking under RMCH programmes. Yet, the reliance on frontline intermediaries underscores the continued necessity of hybrid service models that combine digital innovation with human support systems. Without complementary investments in gender-sensitive digital literacy programmes, localized language interfaces, affordable connectivity, and community-level awareness campaigns, the transformative potential of digital health will remain constrained.

Overall, the study demonstrates that digital health initiatives in Bihar have contributed to measurable improvements in reproductive healthcare monitoring and institutional delivery coverage, but their impact on equitable access remains uneven. Digital reforms have enhanced administrative efficiency and service tracking; however, structural determinants such as gender norms, caste hierarchies,

poverty, and infrastructural deficits continue to shape patterns of access and utilization. Bridging the digital divide in reproductive healthcare therefore requires more than technological integration; it demands inclusive policy design, sustained capacity building, district-level infrastructural strengthening, and community engagement that prioritizes women's autonomy and digital empowerment. Only through such a comprehensive approach can digital health initiatives effectively contribute to reducing maternal health disparities and advancing reproductive health equity in rural Bihar.

Conclusion

This study provides empirical evidence on the evolving role of digital health interventions in reshaping maternal and reproductive healthcare governance in Bihar. Drawing upon district-level trends, administrative data patterns, and programmatic integration under the Ayushman Bharat Digital Mission (ABDM) and the Janani Suraksha Yojana (JSY), the findings demonstrate that digitization has contributed to measurable improvements in service delivery, transparency, and institutional efficiency.

A key finding of the study is the strong association between digital registration coverage and institutional delivery uptake. Districts such as Muzaffarpur, East Champaran, and Purnea characterized by higher rates of ABHA-linked digital enrolment and JSY digital registration also report comparatively higher institutional delivery volumes. This pattern suggests that digital integration reinforces service utilization when supported by adequate health infrastructure and administrative capacity. The fact that nearly 89 percent of

institutional deliveries under JSY in 2023–24 were digitally recorded reflects a structural shift toward real-time, technology-enabled maternal health governance.

The study further finds that digital platforms have improved financial transparency and reduced procedural delays. The integration of beneficiary databases with digital payment systems has strengthened the timeliness of JSY cash transfers and minimized duplication in beneficiary verification. At the managerial level, digital dashboards and reporting systems have enhanced data visibility, enabling district officials to monitor antenatal care compliance, identify high-risk pregnancies, track drug availability, and respond to service gaps more efficiently. This transition from retrospective paper-based reporting to near real-time digital monitoring represents a significant administrative reform.

At the community level, mHealth interventions such as Kilkari have expanded access to reproductive health information through voice-based and SMS communication. These platforms have contributed to increased awareness of antenatal check-up schedules, safe delivery practices, immunization timelines, and entitlement schemes. The findings indicate that information dissemination has improved even among low-literacy populations when communication tools are audio-based and linguistically contextualized.

However, the study also documents persistent structural barriers that limit equitable digital inclusion. Gendered disparities in mobile ownership and internet access remain pronounced, with women less likely to possess independent digital

devices. Patriarchal norms regulating phone usage and mobility reduce privacy and constrain autonomous engagement with digital reproductive health platforms. Low digital literacy among rural and marginalized women further restricts effective utilization of beneficiary portals and mobile applications. Economic constraints, including limited household resources for smartphone purchase and data expenditure, deepen exclusion and reinforce dependency on shared devices.

Infrastructural disparities significantly shape digital outcomes. Districts with relatively stronger connectivity and electricity supply demonstrate more consistent digital reporting and service uptake, whereas districts such as Arwal and Sheikhpura lag behind state averages due to infrastructural and capacity constraints. These findings underscore that digital expansion is uneven and mediated by broader socio-economic and institutional contexts.

Overall, the study concludes that digital health initiatives in Bihar have produced partial but substantive gains in maternal healthcare governance. They have strengthened administrative accountability, enhanced beneficiary tracking, and improved service monitoring. Yet, their transformative potential remains contingent upon addressing structural determinants particularly gender norms, digital literacy gaps, economic vulnerability, and infrastructural deficits. Digitalization, in isolation, cannot ensure equitable reproductive health outcomes; it must be embedded within a broader framework of social empowerment, inclusive design, and systemic strengthening.

Thus, while Bihar's experience demonstrates the administrative promise of digital maternal health governance, achieving sustainable and inclusive reproductive health advancement requires integrating technological innovation with targeted gender-responsive and capacity building interventions.

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