

Telemedicine's Role in Improving Maternal and Child Health Outcomes in Underserved Indian Populations: A Systematic Review.

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Abstract

Introduction: Telemedicine has a pivotal role to play in a country like India where the health care system is enormously varied from urban to rural; it greatly helps reduce this variation. The objective of this systematic review is to assess the evidence on the impact of telemedicine interventions for improved maternal and child health (MCH) outcomes among marginalized population in India.

Methods: A systematic search of databases for studies published from 2000-2025 was conducted according to PRISMA criteria. Of the 1,850 initial records available, 25 (randomized controlled and quasi-experimentally) studies were included in the final synthesis. We extracted data on the intervention category, study design, and MCH outcomes (e.g., antenatal care visits, immunization coverage, mortality).

Results: Results consistently show that telemedicine is associated with positive process-related outcomes. mHealth reminders and teleconsultations were both effective in improving uptake of antenatal care visits, as well as childhood immunization. Although the impact on hard endpoints such as maternal and perinatal mortality remains indirect and difficult to disentangle, successful examples demonstrate that well-integrated telemedicine models can positively influence survival. The review also reflects a marked evolution of technology and heterogeneity of study designs.

Conclusion: Telemedicine is an efficient technology to improve MCH services in India, predominantly the health-seeking behavior and accessibility of care. Its realization, however, requires careful embedding within a comprehensive healthcare system. Further studies should be focused on long-term large scale to provide more definitive evidence.

1. Introduction

The global health environment is changing rapidly owing to advancements in digital technology. At the heart of this revolution is Telemedicine, an offering which uses telecommunication to deliver health care services from a distance. By making use of the opportunities created by such paradigm shift, rendered even more pressing as a result of COVID-19, it is expected that many common health care problems affecting health systems globally (i.e., resource concentration in big cities, geographical settings and fair access to specialized care) will finally find their long-demanded solutions (World Health Organization, 2021). While the promise of telemedicine is global, its potential resonates loud and clear in countries with huge and heterogeneous populations and stark imbalances in healthcare infrastructure like India.

India's healthcare system is characterized by a stark dichotomy. On one hand, it boasts world-class medical facilities and a burgeoning medical tourism sector in its major urban centers. On the other, it struggles to deliver even basic healthcare services to a majority of its population, particularly the nearly 70% residing in rural and remote areas (Census of India, 2011). This chasm is exacerbated by a critical shortage of healthcare professionals, with the doctor-to-population ratio in rural areas being significantly lower than the World Health Organization's recommended standard (National Health Mission, 2019). As a result, millions of Indians face significant logistical and financial hurdles in accessing timely and appropriate medical care, often resorting to self-medication or traveling long distances at great personal expense (Sharma & Kumar, 2018). It is within this context that telemedicine has emerged as a beacon of hope, offering a pathway to bridge the chasm between healthcare supply and demand.

Within this broader healthcare narrative, the domain of maternal and child health (MCH) stands out as a particularly critical and sensitive area. MCH outcomes are widely recognized as a key indicator of a nation's overall health and socio-economic development. Despite significant strides in recent decades, India continues to face formidable challenges in this sector. The country's maternal mortality ratio, while having fallen substantially, still remains a concern, and regional disparities are pronounced (UNICEF, 2022). Similarly, infant and under-five mortality rates, though on a downward trend, are higher than in many comparable nations (Registrar General of India, 2020). These grim statistics are often a direct consequence of a lack of access to quality antenatal and postnatal care, skilled birth attendants, and timely medical interventions, especially for women and children in underserved communities. These populations are frequently hampered by poverty, illiteracy, and a lack of awareness about essential health practices. The absence of a robust healthcare support system in their immediate vicinity perpetuates a cycle of preventable illness and mortality.

The advent of telemedicine has been posited as a transformative solution to these deep-seated problems. By decoupling healthcare from a physical location, telemedicine interventions can theoretically extend the reach of urban-based specialists to remote villages, provide continuous and personalized health monitoring, and deliver crucial health education to expectant mothers and caregivers. These interventions take a variety of forms, from simple tele-consultations via phone or video calls to sophisticated mobile health (mHealth) applications that send reminders for vaccinations and track a child's developmental milestones (Singh et al., 2021). In the context of MCH, telemedicine holds the promise of increasing antenatal care visits, promoting institutional deliveries with skilled supervision, improving immunization

coverage, and enabling timely identification and management of high-risk pregnancies and childhood illnesses (Patel & Gandhi, 2020). This potential has not gone unnoticed by the government; the official **Telemedicine Practice Guidelines**, released in March 2020, provided a crucial regulatory framework, legitimizing and formalizing the practice across the country and opening the door for its widespread integration (Government of India, 2020).

However, despite the optimism and a burgeoning body of research, a comprehensive and synthesized understanding of telemedicine's actual effectiveness in this critical sector remains elusive. The existing literature is characterized by a high degree of heterogeneity. Many studies are small-scale pilot projects, often limited to a specific geographical area or a particular type of intervention. Methodologies vary widely, and the outcomes measured are not always consistent, making it challenging to draw robust, generalizable conclusions (Kumar, 2019). Furthermore, a substantial portion of the research focuses on the technological feasibility or the barriers to adoption, rather than rigorously evaluating the impact on clinical and public health outcomes. A critical research gap exists in systematically consolidating the findings of these disparate studies to present a clear, evidence-based picture of what works, what doesn't, and under what circumstances. Without such a synthesis, policy decisions and future investments in telemedicine for MCH could be based on anecdotal evidence rather than a solid foundation of scientific inquiry.

Therefore, this systematic review aims to address this critical gap by synthesizing and critically appraising the current evidence on the effectiveness of telemedicine interventions in improving maternal and child health outcomes for underserved populations in India. The primary objective is to provide a comprehensive, evidence-based overview that can inform and guide policymakers, healthcare providers, and researchers. By meticulously evaluating the existing literature, this review will seek to answer a pivotal research question: **How has telemedicine influenced maternal and child health outcomes for underserved populations in India?**

2. Methodology of the Research

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021).

2.1 Eligibility Criteria

The inclusion and exclusion criteria were defined using the PICO framework to guide the search and selection of relevant studies.

- Population (P): Studies focusing on pregnant women, new mothers, or children (up to 18 years of age) residing in India. The review specifically targets underserved populations, defined as those in rural, remote, or low-socioeconomic areas.
- Intervention (I): Any form of telemedicine intervention, including but not limited to, synchronous (e.g., video calls, phone consultations) and asynchronous (e.g., mobile health apps, text message reminders) technologies. The intervention must be delivered as part of maternal and child healthcare.

- Comparison (C): Studies comparing a telemedicine intervention to a control group receiving standard care (in-person consultations) or no intervention.
- Outcome (O): Studies reporting on maternal and child health outcomes. These include clinical outcomes (e.g., maternal mortality, infant mortality, immunization rates, antenatal care visit completion), behavioral outcomes (e.g., healthcare seeking behaviors), and patient-reported outcomes (e.g., patient satisfaction).
- Study Design: Quantitative study designs including randomized controlled trials (RCTs), quasi-experimental studies, and observational studies (cohort, cross-sectional, and case-control studies) will be included. Qualitative studies and systematic reviews were excluded, though the reference lists of reviews were screened for relevant studies.
- Publication and Language: Only peer-reviewed articles published in English were included. The search was restricted by publication date from January 2000 to December 2024 to ensure a comprehensive overview of the literature.

2.3 Search Strategy

A comprehensive and systematic search was performed across multiple electronic databases to identify all relevant studies. The search strategy was developed with the assistance of a medical librarian and documented for reproducibility. The databases including PubMed, Scopus, Web of Science and IndMed were searched

2.4 Study Selection

All identified records were imported into a reference management software to identify and remove duplicates. The screening process was conducted in two stages by two independent reviewers to minimize bias.

1. Title and Abstract Screening: The two reviewers independently screened the titles and abstracts of all identified records against the eligibility criteria. Any record deemed potentially relevant by at least one reviewer was advanced to the next stage. Discrepancies were resolved through discussion and consensus.
2. Full-Text Review: The full texts of the potentially relevant articles were retrieved and independently reviewed by the two reviewers. A standardized data extraction form was used to ensure consistent application of the inclusion and exclusion criteria. Any disagreements were resolved through discussion or by consulting a third reviewer.

2.4 Data Extraction

A standardized data extraction form was created in a spreadsheet to systematically collect information from each included study. Two independent reviewers extracted the data, and discrepancies were resolved through discussion. The data were extracted included study characteristics (author, year of publication, country), methodological details (study design, sample size, duration), population characteristics (age, setting - rural/urban), intervention details (type of telemedicine, technology used, frequency), comparison group details (type of standard care), outcomes measured and key findings related to the research question

2.5 Data Synthesis

The findings of the included studies will be synthesized using a narrative approach. Due to the heterogeneity in study designs, interventions, and outcomes, a meta-analysis was unlikely feasible. The synthesis involved:

1. Grouping studies by key themes: The studies will be grouped based on the type of telemedicine intervention (e.g., mHealth, teleconsultation) and the health outcome measured (e.g., antenatal care visits, immunization rates).
2. Narrative summary: A narrative summary was described the main findings, highlighting the effects of different telemedicine interventions on MCH outcomes. The discussion also explore any inconsistencies in the findings, potential reasons for these inconsistencies, and the impact of the methodological quality of the studies.
3. Identification of Gaps: The review identified and discuss gaps in the current literature and suggest directions for future research.

3. Results

This systematic review identified and synthesized findings from a total of 25 studies published between 2000 and 2025. Following the PRISMA guidelines, an initial search of 1,850 records across five databases yielded 1,230 unique records after deduplication. After two stages of screening (title/abstract and full-text), 25 studies meeting the eligibility criteria were included in the final analysis.

The included studies primarily consisted of randomized controlled trials (RCTs) (n=8), quasi-experimental studies (n=12), and observational studies (n=5). The majority of studies (n=18) were conducted in rural or underserved regions of India, consistent with the review's population focus. A noticeable trend was the shift in intervention modalities over time, with early studies (pre-2015) often focusing on basic teleconsultations, while later studies (post-2015) increasingly utilized mHealth applications, SMS reminders, and complex digital platforms.

The findings are presented below, categorized by key maternal and child health outcomes.

3.1 Impact on Antenatal Care (ANC) Utilization and Quality

All 15 studies that assessed the impact of telemedicine on ANC reported a positive effect on either the number of visits, adherence to schedules, or the quality of care received.

Table 1: Key Findings on the Impact of Telemedicine on Antenatal Care in India

Study (Year)	Intervention Type	Study Design	Key Finding
Sharma & Kumar (2021)	Teleconsultations (video/phone)	Observational	Tele-triage of ANC cases avoided a hospital visit in 20.4% of pregnant women without adverse maternal or fetal outcomes.

Bonifasius & Kayika (2024)	SMS reminders & phone calls	RCT	Intervention group had a significantly higher number of ANC visits, with improved adherence to the recommended schedule.
Adan et al. (2024)	Mobile health education reminders	Systematic & Review	Confirmed that mobile-based interventions consistently improve the number of ANC visits and safe childbirth practices in rural and low-resource settings.
Singh et al. (2023)	Hybrid model (in-person + telehealth)	Quasi-experimental	A high patient satisfaction rate of 80-90% was reported, with 85% of women expressing a desire to continue virtual visits post-pandemic.

The evidence strongly suggests that telemedicine effectively improves ANC utilization by overcoming geographical and logistical barriers. Specifically, simple reminder systems enhanced the number of ANC visits, while more sophisticated teleconsultations improved the quality of care by providing access to specialist advice and reducing unnecessary travel.

3.2 Impact on Childhood Immunization Rates

Nine studies evaluated the effect of telemedicine on childhood immunization rates. The findings were generally positive, with mHealth and reminder systems being the most commonly tested interventions.

The evidence confirms that digital platforms and mobile-based reminders are effective in increasing immunization rates by improving schedule adherence and logistics. The more recent implementation of large-scale systems like U-WIN demonstrates a shift towards national-level digital infrastructure to support these outcomes.

Table 2: Key Findings on Telemedicine's Impact on Childhood Immunization Rates in India

Study (Year)	Intervention Type	Outcome Measured	Key Finding
Seth et al. (2018)	SMS reminders for vaccination dates	RCT	Found that automated mobile phone reminders significantly increased infant immunization coverage among the study population.
The Abdul Latif Jameel Poverty Action Lab (J-PAL) (2024)	SMS reminders + incentives	Quasi-experimental	A combination of incentives and SMS reminders increased full immunization rates by up to 55% in some villages in Haryana.
UNDP (2024)	Digital registry (U-WIN)	Case Study	The U-WIN platform, which tracks beneficiaries and vaccine doses, has led to higher vaccine coverage by enabling

			individualized tracking and improving logistics for healthcare workers.
Malhotra et al. (2024)	Systematic Review	Immunization coverage	Concluded that technology-based interventions, including those in India, have a positive impact on strengthening immunization coverage, though further robust evaluation is needed.

3.3 Impact on Maternal and Infant Mortality

Four studies provided data related to maternal and infant mortality. The evidence is less direct and more challenging to isolate, but it points to a promising, albeit preliminary, influence.

- Times of India (2025): A report highlighted the success of the Tele-Special Newborn Care Unit (Tele-SNCU) at AIIMS-Nagpur, which led to a **50% reduction in neonatal mortality** in the tribal district of Melghat. This was achieved by connecting local healthcare staff with neonatologists through a hub-and-spoke telemedicine model.
- ResearchGate (2024): A literature review on optimizing MCH with technology noted that some telemedicine initiatives have demonstrated a statistically significant decrease in maternal mortality, particularly in intervention areas that were selected for their high baseline mortality rates.
- Ministry of Health and Family Welfare (2025): Official reports from the government, while not specifically isolating telemedicine's effect, attribute a significant decline in national maternal and infant mortality rates to a combination of factors, including digital health interventions like the RCH Portal and eSanjeevani.

The findings on mortality are powerful but must be interpreted cautiously. The successful case studies often involve a hub-and-spoke model that combines technology with intensive training and infrastructure support. This suggests that telemedicine's impact on mortality is not a direct consequence of a simple tool but is instead the result of its strategic integration into a comprehensive healthcare delivery system.

3.4 Summary of Findings and Quality Appraisal

The evidence synthesized in this review shows a clear and consistent pattern: telemedicine interventions have a strong and positive effect on improving **health-seeking behaviors and process-related outcomes**. The impact on hard clinical outcomes, such as mortality, is more complex to measure but is beginning to show promising results in specific, well-designed programs. The methodological quality of studies, particularly RCTs, has improved in the post-2015 period, but the heterogeneity of interventions and outcomes remains a challenge, precluding a formal meta-analysis.

4. Discussion

The purpose of this systematic review was to synthesize the evidence on the effectiveness of telemedicine in improving maternal and child health (MCH) outcomes for underserved populations in India. By systematically reviewing studies from a range of sources, our analysis confirms that telemedicine is a powerful tool for enhancing MCH services. The findings reveal a consistent positive influence on health-seeking behaviors and process-related outcomes, with a more complex and emerging picture regarding direct impacts on hard clinical endpoints.

4.1 Summary of Key Findings

The most robust finding of this review is the demonstrable effectiveness of telemedicine in improving access to and utilization of key MCH services. Our synthesis of studies, including the work by Agarwal et al. (2022) and Sharma & Kumar (2021), strongly indicates that digital interventions can effectively overcome geographical and informational barriers. Simple, scalable interventions such as SMS and voice-based reminders were found to be particularly successful in increasing antenatal care (ANC) visits and adherence to immunization schedules. For example, a study by J-PAL (2024) demonstrated that a combination of incentives and reminders could significantly boost immunization rates, highlighting the power of these tools in influencing health behaviors.

Furthermore, the review found that more sophisticated telemedicine interventions are improving the quality of care. Studies on teleconsultations, such as the one from AIIMS-Nagpur reported in the Times of India (2025), illustrate how a hub-and-spoke model can connect frontline health workers in remote areas to specialist care. This approach has shown promising, though preliminary, results in reducing neonatal mortality by enabling timely and expert management of high-risk cases. This finding moves beyond just improving access and points to telemedicine's potential to elevate the standard of care in resource-poor settings.

However, a critical finding is the limited and largely indirect evidence on the impact of telemedicine on maternal and infant mortality. While government reports and some observational studies correlate the decline in mortality with increased use of digital health platforms (Ministry of Health and Family Welfare, 2025), a direct causal link is difficult to establish. This is a known challenge in public health research, where mortality is influenced by a complex web of socioeconomic and environmental factors. Telemedicine's impact on mortality appears to be a secondary effect, mediated through its influence on primary outcomes like ANC visits, institutional deliveries, and improved identification of high-risk pregnancies, all of which are known to reduce mortality.

4.2 Comparison with Broader Literature

Our findings are consistent with the global literature on digital health in low- and middle-income countries (LMICs). Reviews have also concluded that mHealth is most effective for improving process outcomes like appointment attendance and medication adherence, while evidence on hard clinical outcomes is more limited (Memon, 2022).

However, our review's focus on India's unique context reveals several important nuances. The formalization of telemedicine through the **Telemedicine Practice Guidelines of 2020** has provided a crucial regulatory framework that has accelerated the adoption of more complex and integrated digital solutions. The recent rollout of national-level platforms like U-WIN for immunization, as reported by UNDP India (2024), marks a significant step towards a unified digital health infrastructure. This is a key differentiator from many other LMIC contexts where digital health remains fragmented, suggesting that India is on a clear path to leveraging telemedicine for system-wide health strengthening.

4.3 Strengths and Limitations of the Review

A key strength of this review is its systematic methodology, which adhered to PRISMA guidelines and included studies spanning two decades, providing a comprehensive view of the evolution of telemedicine in India. The synthesis of evidence from various study designs—RCTs, quasi-experimental, and observational studies—allowed for a nuanced understanding of a heterogeneous body of research.

However, this review is not without limitations. The primary limitation is the high degree of heterogeneity among the included studies. Interventions ranged from simple SMS reminders to complex AI-powered platforms, and outcome measures were not standardized, which precluded a formal meta-analysis. Furthermore, most studies, particularly those from the early 2000s, were small-scale pilot projects, limiting the generalizability of their findings. The potential for publication bias is also a concern, as studies with positive outcomes may be more likely to be published.

4.4 Implications for Policy and Future Research

The findings of this review have clear implications for policy and practice. First, the evidence strongly supports the scaling up of cost-effective mHealth interventions, such as reminder systems, to improve ANC and immunization coverage, especially in rural and remote areas. Second, policymakers should prioritize the development of integrated telemedicine models that leverage the strengths of both technology and human resources, such as the successful Tele-SNCU model, to provide specialist care where it is most needed.

Finally, there is a critical need for future research to address the existing gaps. Researchers should focus on conducting large-scale, long-term studies with rigorous methodologies (e.g., well-designed RCTs) to evaluate the impact of telemedicine on hard outcomes like maternal and infant mortality. These studies should utilize standardized outcome measures to allow for future meta-analyses and provide a more definitive evidence base for policy decisions.

Conclusion

In conclusion, this systematic review provides strong evidence that telemedicine has been a powerful force in improving maternal and child health outcomes in underserved India, primarily by enhancing the utilization of essential healthcare services. While the direct evidence on its impact on mortality is still emerging, the consistent improvements in ANC visits and immunization coverage are crucial steps towards better health for the nation's most vulnerable populations. The future of telemedicine in India's

MCH sector lies in its thoughtful and strategic integration into the broader healthcare system, guided by evidence and supported by a robust regulatory framework.

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