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Healthcare Provider Perspectives on Artificial Intelligence and Digital Health Integration in Maternal and Infant Care across Andhra Pradesh, India

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Abstract *Digital health applications are increasingly integrated into maternal and infant healthcare in Andhra Pradesh, India; yet, evidence on how healthcare providers experience this digital health integration into routine workflows, and the extent to which Artificial Intelligence (AI) enabled functionalities are used in their everyday practice remains limited. This qualitative study examines healthcare providers' perceptions of digital health and AI integration, perceived benefits, implementation barriers, and implications for workflow and clinical decision making. Data were collected through semi-structured interviews with 36 healthcare providers, including Auxiliary Nurse Midwives (ANM), Community Health Officers (CHOs) /Mid-Level Health Providers (MLHP), and Medical Officers (MOs), across six purposively selected urban, rural, and tribal districts. Interviews were analysed using directed qualitative content analysis employing a deductive-inductive coding approach. Thematic domains identified in the doctoral research proposal were taken as the initial deductive structure while additional codes were developed inductively from the empirical data. Healthcare providers reported routine use of digital applications for registration, tracking, reporting, risk identification, referral, teleconsultation, and follow-up. Perceived benefits included improved continuity of care, programme monitoring, and timely follow-up. Poor network connectivity, repeated OTP and biometric authentication for registration or ID generation, and limited offline functionality, made regular use challenging, especially in remote areas and tribal areas. The effective integration depends on factors, such as infrastructure, usability, provider capacity, and the particular context of local implementation.*

Keywords *Artificial Intelligence, Andhra Pradesh, Digital Health Applications and Portals, Healthcare Providers, Maternal and Infant Health, Qualitative Content Analysis.*

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Background of the Study

Maternal and infant healthcare in India has improved substantially, but important gaps in service utilization, continuity of care, and equitable access remain. In Andhra Pradesh, the research proposal identified persistent challenges in antenatal care completion, iron-folic acid adherence, access to emergency obstetric care in rural areas, and fragmented health information systems, indicating the need for approaches that can strengthen timely registration, follow-up, risk identification, referral, communication, and continuity of care.

Digital health applications are one of the existing approaches being used to address these service-delivery challenges. A 2024 systematic review of 131 studies from low- and middle-income countries found that mHealth interventions, particularly reminders and provider-facing planning and scheduling functions, could improve antenatal care attendance and the timeliness of childhood immunization, although effects differed across outcomes and implementation contexts [1]. Clinical decision-support systems have also been evaluated in maternity care; a 2024 systematic review and meta-analysis found that such systems can support maternity-care processes, while also highlighting substantial diversity in their design and evaluation [2].

In India, several digital health applications have demonstrated potential benefits in maternal healthcare. The mMitra mobile voice-messaging intervention improved selected maternal health practices among socio economically weaker women, including tetanus toxoid vaccination, care-seeking for bleeding, saving for delivery expenses, and hospital delivery [3]. The SMART health Pregnancy application incorporated mobile clinical decision support to assist community health workers in screening, referral, and counselling of women with high-risk pregnancies. This intervention was evaluated in rural primary healthcare settings, including Guntur district in Andhra Pradesh, and demonstrated feasibility and acceptability for frontline implementation [4].

The evidence does not support one universally superior digital health application for maternal and infant healthcare. Rather, the most appropriate approach appears to be integration of digital health applications into existing healthcare workflows, with implementation adapted to local health-system conditions. Digital health has improved antenatal care adherence to protocols and access to MCH services, especially in low-resource settings [5]. The World Health Organization (WHO) emphasizes that digital health applications should complement rather than replace functioning health systems and that implementation should consider benefits, harms, feasibility, acceptability, resource requirements, and equity [6]. WHO evidence also identifies factors affecting health-worker use of digital interventions, including infrastructure, usability, organizational context, and implementation readiness [6-8].

AI enabled functions may extend the role of digital health applications through clinical decision support, risk assessment, information processing, and other data-assisted functions. In India, an AI enabled Clinical Decision Support System has been integrated into eSanjeevani to capture standardized patient-information and provide AI-based differential diagnosis recommendations to clinicians [9]. These developments demonstrate an important progression from routine digital health record keeping and teleconsultation towards selected AI supported healthcare functions, which involves automated interpretation, diagnostic suggestions or decision support.

India has also made substantial progress in strengthening the policy and infrastructure environment for digital health and AI. The Ayushman Bharat Digital Mission supports interoperable digital-health infrastructure, while eSanjeevani has expanded teleconsultation within public health services

[10]. More recently, the Ministry of Health and Family Welfare (MoHFW) launched the Strategy for Artificial Intelligence in Healthcare for India (SAHI) and the Benchmarking Open Data Platform for Health AI (BODH) in February 2026 to support safe, transparent, accountable, and evidence-based use of AI in healthcare [11].

Despite these achievements, routine integration of AI and digital health applications remains influenced by practical and health-system factors. Infrastructure, internet connectivity, device availability, workflow organization, workforce capacity, training, interoperability, and technical support can affect their use in day-to-day healthcare delivery [6, 8]. The WHO also cautions that digital health applications cannot compensate for weaknesses in the underlying health system and that implementation must be evaluated in relation to feasibility, acceptability, resource use, and equity [6].

The increasing use of AI also raises ethical considerations related to human autonomy, safety, transparency, accountability, inclusiveness, and equity. WHO identifies these as core principles for responsible AI use in health [12]. In India, the Indian Council of Medical Research (ICMR) has developed ethical guidance addressing informed consent, governance, stakeholder responsibilities, ethical review, and responsible development and deployment of AI based healthcare applications [13]. These considerations are particularly relevant where AI supported information contributes to healthcare decisions while healthcare providers retain responsibility for interpreting and acting on that information.

Evidence on routine AI use in resource-constrained healthcare settings remains limited, particularly regarding frontline providers' experiences and perceptions [14-16]. In Andhra Pradesh, little is known about providers' direct experience with AI-enabled functions in maternal and infant care, how these differ from routine digital health functions, and how their use varies across cadres and settings. The present qualitative study examines the experiences of ANMs, CHOs/MLHPs, and MOs across selected urban, rural, and tribal districts of Andhra Pradesh. The study aims to understand the status of AI and digital health application integration, explore the enablers and barriers influencing routine use, and assess healthcare providers' perceived effects on service accessibility, workflow efficiency, and clinical decision-making.

Study Objectives

1. To understand and examine the status of AI and digital health application integration within maternal and infant healthcare systems in Andhra Pradesh, India.
2. To explore the key enablers and barriers that influence the integration of digital health applications into maternal and infant care workflows.
3. To assess perceived impacts of AI and digital health applications on service accessibility, efficiency, and clinical decision-making.

Research Questions

1. How are AI and digital health applications integrated into maternal and infant healthcare workflows, as experienced by ANMs, CHOs/MLHPs, and Medical Officers in selected districts of Andhra Pradesh?
2. What enablers and barriers influence the integration of digital health applications, and how do healthcare providers perceive their effects on service accessibility, workflow efficiency, and clinical decision-making?

Methods and Materials

Study Design and Site

This qualitative study formed part of a broader doctoral research project examining the integration of AI and digital health applications in maternal and infant healthcare in Andhra

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Pradesh. An exploratory qualitative design was used to understand how frontline healthcare providers experienced the routine use of digital health applications, the barriers and enabling factors influencing their use, and their perceived effects on service accessibility, workflow efficiency, and clinical decision-making.

The study was conducted across six purposively selected districts representing urban, rural, and tribal service delivery contexts in Andhra Pradesh. Urban and rural district selection was guided by district-level rural and urban population distributions, [17, 18] while tribal settings were identified from officially recognized Integrated Tribal Development Agency/Integrated Tribal Development Project areas [19].

The selected districts were Visakhapatnam and Guntur for urban, Chittoor and Dr B. R. Ambedkar Konaseema for the rural, and Alluri Sitharama Raju/Paderu ITDA and Srikakulam/Seethampeta ITDA for the tribal were shown in the Figure 1. The qualitative sampling framework used a multistage purposive approach to ensure representation of different service-delivery contexts. Because district selection represented the sampling stratum rather than necessarily the exact location of every participating facility, the sampling stratum and the actual facility setting were retained separately during analysis.

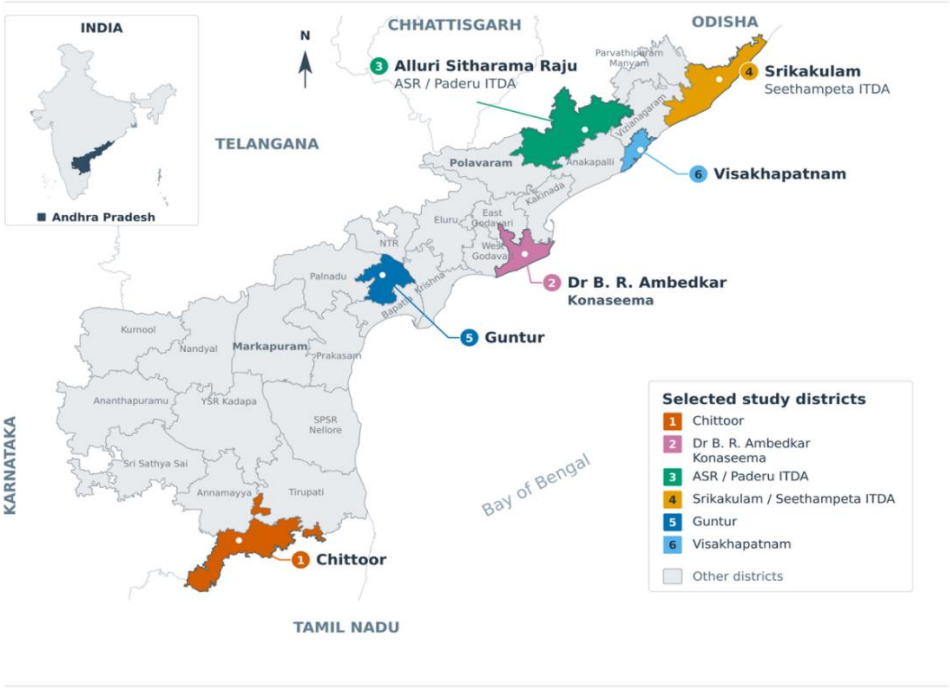


Figure 1. Study Districts/Areas in Andhra Pradesh, India

Participants and Sampling

A purposive stratified sampling strategy was employed to ensure representation across healthcare-provider cadres and geographic settings. Six districts were purposively selected to capture variation in urban, rural, and tribal healthcare contexts. Within each district, six healthcare providers were recruited, comprising two ANMs, two CHOs/MLHPs, and two MOs. Thus, the final sample consisted of 36 healthcare providers, with 12 participants from each cadre.

Eligibility Criteria

Participants were eligible if they (i) were ANMs, CHOs/MLHPs, or MOs working in the selected study districts; (ii) had direct experience using or engaging with digital health applications relevant to maternal, infant, reproductive, child, or primary healthcare services, including associated reporting and

monitoring functions; (iii) had preferably completed at least six months in their current role or had equivalent experience with the relevant digital health application; and (iv) were willing and able to provide informed consent. Direct experience with AI-enabled functions was not required for participation, as the study also explored providers' awareness, exposure and perceptions of AI alongside their routine use of digital health applications. Healthcare providers who had no direct involvement with the relevant digital health applications or associated maternal and child healthcare functions were excluded.

Data Collection

Data were collected through individual semi-structured interviews with health care providers. The interview guide was developed as part of the doctoral research programme; eight predefined themes were developed from the study objectives, research questions, and from the existing literature for the mixed methodology doctoral research proposal. The interview guide comprised of these eight predefined themes for data collection, which were rephrased after pilot to meet the qualitative study requirements.

1. Perceived contributions of digital health interventions to maternal and infant health outcomes.
2. AI-enabled risk assessment and clinical decision support.
3. Enhancement of healthcare providers' knowledge and skills.
4. Implementation, integration, and scalability of digital health technologies in India.
5. Ethical, confidentiality, and privacy concerns associated with AI integration.
6. Algorithmic bias and potential health disparities.
7. Risks associated with over-reliance on AI-enabled tools.
8. Equity and access in digital health.

These 8 predefined themes formed the initial deductive framework, while additional codes were added inductively when relevant concepts emerged from the interview data. The interviews explored participants' experiences of using digital health and AI-enabled applications, perceived benefits, challenges encountered during routine use, and factors influencing implementation and potential scale-up. The semi-structured format allowed the interviewer to use probes and follow-up questions to clarify participants' experiences and explore issues that emerged during the interviews.

Interviews were conducted remotely using Microsoft Teams. Participants were offered the choice of Telugu, English, or a combination of both languages, according to their preference and the language used in their professional communication. Each interview began with the collection of relevant demographic and professional information, followed by discussion of the study themes. With participants' informed consent, interviews were audio-recorded. The recordings were transcribed verbatim. Interviews conducted wholly or partly in Telugu were translated into English for analysis, with attention to preserving the contextual meaning, participants' intended interpretations, and commonly used clinical and digital-health terminology. Transcripts were reviewed against the recordings to ensure accuracy before analysis.

Transcript Preparation and Verification

Transcripts were reviewed against the available source material before coding. Where bilingual transcripts were used, Telugu text was retained alongside the English translation to allow verification of meaning. Potential transcription errors, unclear words, inconsistent numbers, or ambiguous technical terminology were reviewed and verified against the corresponding recording and transcript text.

Qualitative Data Analysis

The interview data were analysed using qualitative content analysis with a hybrid deductive–inductive coding approach, informed by [20]. Qualitative data analysis workflow process was shown in the Figure 2. Using Excel and Word to Structure Qualitative Data. The eight predefined areas of inquiry formed the initial deductive framework, while additional codes were developed inductively from emerging concepts.

Following transcription, interviews were organised in Word and transferred to Excel for systematic coding, sorting, and comparison. Coding was conducted at the level of meaning units, with multiple codes applied where appropriate. The coding structure was reviewed and refined iteratively, including revisiting earlier transcripts to maintain consistency. The primary coding was conducted by the first author. The coding framework and selected coded excerpts were reviewed by the co-authors, and any differences in interpretation were discussed and resolved by consensus. Coded data were consolidated and organised into broader categories and subcategories, while respondent identifiers were retained for traceability. The final analysis examined patterns and variations across healthcare-provider cadres, districts, sampling strata, and facility settings, with findings mapped to the predefined areas and emergent categories.

The final findings were mapped back to the eight thematic areas predefined in the doctoral research proposal. However, based on the results, the thematic areas have been rephrased while keeping the context intact corresponding to the eight themes. For reporting, closely related findings under T6 (AI bias and health disparities) and T8 (equity and access in digital health) were presented together in a single Result to avoid artificial separation of overlapping evidence; all eight predefined thematic areas remained represented in the analysis.



Figure 2. Qualitative Data Analysis Workflow

Analytic rigour

To strengthen analytic credibility and transparency, a versioned codebook and change log were maintained throughout the coding process. Coding decisions were compared across interviews to ensure that code definitions were applied consistently. Representative and analytically important passages were reviewed against the corresponding transcript text, and publication quotations were checked before inclusion in the Results section.

Statements describing improved outcomes were treated as provider-reported perceptions rather than descriptive measured values. Negative and contrasting statements were retained to avoid presenting only dominant views. Sampling stratum and actual facility setting were maintained as separate analytic variables to prevent misclassification of participants. No inferential statistical analysis was performed for the qualitative component. Descriptive counts may be used to summarize participant characteristics or the distribution of coded material where relevant; however, code frequencies were interpreted only as descriptive indicators and not as prevalence estimates or measures of statistical association.

Ethical Considerations

Initial permission was sought from the Andhra Pradesh State Health Department to conduct the interviews followed by individual consent. Participation was voluntary, and informed consent was obtained before each interview. Participants were informed about the purpose of the study, the use of audio recording, confidentiality of their responses, and their right to decline or discontinue participation. Personal identifiers were excluded from the analytic dataset and published quotations. Interview IDs were used during coding and reporting. Audio recordings and transcripts were stored securely, and information was used only for the approved research purpose.

Results

Across the 36 interviews, healthcare providers reported extensive use of digital health applications for registration, follow-up, high-risk identification, programme monitoring, teleconsultation, reporting and service documentation. However, explicit use of artificial intelligence (AI) was considerably less common than routine digital health use. The perceived benefits of digital systems centred on continuity of information, identification and monitoring of high-risk cases, reminders, referral support and programme visibility. At the same time, providers reported persistent challenges related to network connectivity, fragmented applications, repeated data entry, authentication requirements and reduced time for direct beneficiary interaction. Across cadres, professional judgement remained central to clinical decision-making, even where digital prompts or AI-enabled functions were available.

Based on the qualitative content analysis seven interrelated categories were generated : (1) digital continuity, follow-up and access to care; (2) risk identification and clinical decision support; (3) provider knowledge, training and technical support; (4) implementation, interoperability and workflow burden; (5) privacy, authentication and trust; (6) bias, equity and last-mile access; and (7) AI use, professional autonomy and over-reliance. All eight predefined themes remained represented in the analysis; however, Theme 6 (AI bias and health disparities) and Theme 8 (equity and access in digital health) showed substantial overlap in the interview data. These two themes were therefore combined for reporting, resulting in seven reported categories.

Digital Continuity, Follow-up and Access to Care

Digital applications supported several aspects of maternal and child healthcare, including beneficiary registration, reminders,

follow-up and retrieval of previous information. The nature of use differed across professional cadres. ANMs and CHOs/MLHPs more frequently described operational functions such as reminders, vaccination tracking and follow-up of high-risk beneficiaries, whereas Medical Officers (MOs) more often emphasized programme visibility, retrieval of clinical information and access to specialist consultation.

Digital reminders were particularly useful for identifying pending antenatal services, immunization doses and high-risk follow-up. Providers described these alerts as supporting continuity in settings where high workloads could otherwise result in missed follow-up. One ANM explained:

> *"With a heavy workload, cases can sometimes be forgotten; the high-risk reminder helps us remember the mother, birth planning and transport planning. In the RCH portal we can see ANC service due dates, child vaccination dues and pending third or fourth check-ups. These alerts help us remain attentive."*

Digital records could also facilitate re-engagement with beneficiaries who moved between locations. However, continuity often weakened after referral because subsequent treatment information was not consistently visible to the referring provider. This limitation was reported by both frontline providers and Medical Officers. In one account, an MLHP described how a woman who had migrated during pregnancy subsequently reappeared in the application, allowing the healthcare team to trace her location, reassess her condition and initiate referral:

> *"One pregnant woman was anaemic when she registered. She later migrated and we could not contact her or identify where she was staying. In the ninth month she appeared again in the application. We traced her location, visited her home, identified very low haemoglobin and pedal oedema, and she was referred for further treatment."*

Teleconsultation was reported primarily by CHOs/MLHPs and Medical Officers. It was perceived as improving access to doctors and specialists, particularly where specialist services were not locally available. However, its usefulness was constrained by connectivity problems and the availability of the specialists.

These benefits were not uniform across participants, as continuity was limited when post-referral information was not visible to the referring provider and when connectivity constrained teleconsultation. Providers noted that information generated after referral was not consistently visible to the referring provider, limiting the potential for fully integrated continuity of care.

Risk Identification and Clinical Decision Support

Identification and monitoring of high-risk pregnancies was one of the most consistently reported digital functions across cadres and geographic settings. ANMs particularly emphasized pregnancy risk flags, haemoglobin monitoring and reminders for due-services, whereas CHOs/MLHPs and MOs more often discussed referral decisions, interpretation of digital information and the limitation of automated support.

Colour-coded displays were described as a practical mechanism for distinguishing routine from high risk cases. One ANM explained:

> *"It is normal. It comes in blue colour. Anything that is high risk will come in red colour."*

Providers linked these digital risk indicators to follow-up, referral, admission planning and treatment. Anaemia was frequently mentioned, particularly in relation to recording and monitoring haemoglobin values. However, respondents distinguished between systems that flagged or displayed risk information and systems that independently generated a clinical diagnosis or decision.

"At present there is no application that identifies a condition based on symptoms. We identify the symptoms ourselves and immediately refer the patient to the Medical Officer."

Much of what participants described as "digital" or "automated" support consisted of structured alerts, colour-coded risk indicators, reminders and prompts rather than verified AI-based clinical reasoning. Accordingly, these functions are more appropriately characterized as digital risk identification and clinical decision support, unless participants explicitly identified an AI-enabled function. This distinction was consistent across cadres, with participants describing digital prompts as supportive to clinical decision-making rather than as independent diagnostic tools.

Provider Knowledge, Training and Technical Support

Provider capacity to use digital systems was shaped by the availability and form of training and technical support. Providers described formal training sessions, Zoom based sessions, peer learning, instructional videos, in application educational material and district-level technical assistance. CHO/MLHP particularly reported using educational content within applications, including materials related to Ante Natal Care (ANC), Post Natal Care (PNC), infant care and other health topics. These resources were sometimes used both provider learning and beneficiary counselling.

"The CHO Application contains videos on ANC care, PNC care, infant care and NCD related topics. We can review them when we have doubts, and we also show the videos to patients."

Training pathways nevertheless varied across cadres. Several ANMs described learning primarily through colleagues or videos shared outside the formal application rather than through structured application-based training. Whereas MOs frequently referred to formal orientation associated with newer systems or pilots. Technical support from district teams provided an additional mechanism for resolving application-related problems. Training experiences therefore varied by cadre, with no single standardized learning pathway reported across participants.

Overall, implementation depends on a combination of formal training, peer learning, application-based resources and external technical assistance rather than on a consistently standardized training model.

Implementation, Interoperability and Workflow Burden

Although digital systems improved programme visibility and documentation, their implementation also generated substantial workflow challenges. The most frequently reported barriers were poor network connectivity, server or application failure, fragmented platforms, repeated data entry and increased workload. Connectivity problems were reported across settings but were particularly prominent in tribal-selected districts where poor or absent network coverage was described as a structural constraint. Fragmentation between applications was especially evident in rural-selected interviews.

Providers reported entering the same beneficiary information into multiple platforms, including Reproductive and Child Health (RCH), ANM Online (ANMOL), Universal Immunization Programme WIN (U-WIN) and other applications. Repeated data entry increased workload and reduced the time available for direct interaction with beneficiaries. This increased workload and reduced beneficiary interaction time. One provider summarized this burden:

"There are too many apps at field level. The same data have to be entered in RCH, ANMOL and U-WIN, and ABHA-related processes may also be repeated. It would be better to reduce duplication."

The consequences differed by professional role. ANMs and CHOs/MLHPs more often

described the effects on field work, counselling and direct beneficiary interaction, while MOs emphasized reporting, monitoring, programme performance. An ANM noted:

> *"The challenge is that there is a lot of online work now. Because of that, we have very little time to go into the field and do offline, field-level work."*

At the same time, Medical Officers frequently valued improved programme visibility, dashboards and monitoring. This finding illustrates an important implementation tension: the same systems that enhanced programme-level visibility and monitoring could simultaneously increase documentation demands at the frontline. The operational burden was therefore more visible among ANMs and CHOs/MLHPs, while Medical Officers more often emphasized programme monitoring and reporting benefits.

Privacy, Authentication and Trust

Providers generally perceived digital health information as secure, when access was restricted through authorized logins. However, their understanding of data storage and or broader data governance was limited. In practice, authentication requirements were a more immediate concern than abstract data security issues. One Time Password (OTP) requirements, Aadhaar linked mobile numbers and biometric authentication were described as recurring barriers, particularly for beneficiaries with limited literacy, limited access to mobile phones or difficulty using authentication systems. One provider explained:

> *"Making OTP mandatory causes significant difficulty. Many patients are elderly or have limited literacy; some do not have a phone or do not know how to provide an OTP."*

Providers also described situations in which beneficiaries were reluctant to share OTPs because mobile phones themselves warned users against disclosing them. Shared family phones and unavailable Aadhaar linked numbers created additional difficulties.

Confidentiality concerns were discussed most explicitly by MOs, particularly in relation to sensitive health information. Providers emphasized that maintaining beneficiary trust was viewed as a professional responsibility irrespective of whether information was stored digitally or in paper records. Across cadres, practical authentication challenges were discussed more often.

Bias, Equity and Last-Mile Access

Direct evidence concerning algorithmic bias was limited. A small number of providers reported that they had not observed different clinical suggestions according to socioeconomic status, gender or rural urban residence. These accounts represent provider perceptions and should not be interpreted as evidence that algorithmic bias is absent.

One CHO described application questions as being influenced by clinically relevant information such as sex or entered risk factors but not by rural or urban residence. This suggests that providers perceived some differentiation as clinically driven rather than discriminatory.

A more consistently reported equity concern was unequal ability to access and use digital services. CHOs and MOs described beneficiaries who didn't have personal mobile phones, shared telephone numbers across family members or experienced difficulties with OTP-based authentication. In tribal settings, these barriers were compounded by poor connectivity and transport difficulties.

> *"Sometimes, all seven or eight members of a family are linked to the same phone number."*

The finding therefore suggest that digital identification of risk doesn't necessarily translated into timely access to care. In remote settings, distance, transport availability, network connectivity and authentication barriers could still delay referral and follow-up. At the same time, digital records occasionally

enabled providers to reconnect with beneficiaries who moved between locations.

Thus, the principal equity concerns emerging from the interviews related less to differential algorithmic recommendations and more to unequal capacity to access, authenticate and act upon digitally mediated healthcare services. Overall, participants described equity concerns more often in relation to access and authentication barriers.

AI Use, Professional Autonomy and Over-Reliance

Explicit AI use was limited and uneven, while most participants primarily described routine digital health functions rather than confirmed AI-enabled features. Participants described AI-related functions involving information seeking, voice-assisted documentation, administrative data extraction and advisory supports. MOs reported greater direct exposure to AI-enabled functions, including diagnostic suggestions and voice-assisted documentation. Some ANMs reported using AI-supported information or explanation functions, whereas several CHOs/MLHPs reported limited familiarity with AI.

Where AI generated diagnostic or advisory outputs were encountered, MOs emphasized the need for professional verification.

> *"The application can generate a diagnosis, but sometimes it is not appropriate. In that situation, I have to correct it and enter the information manually. Clinical judgment is still necessary."*
>
> *"AI still needs to improve further in the medical field. Without the human touch and clinical judgment of a physician, it can be difficult to arrive at an accurate diagnosis, even if all the symptoms are provided."*

These accounts indicate that participants generally viewed AI as supportive rather than substitutive. Professional autonomy was retained at the level of clinical judgement, although providers remained operationally dependent on digital systems for registration, reporting and documentation. This distinction between clinical autonomy and digital-system dependence was evident across the interviews. Across cadres, AI was generally viewed as supportive rather than substitutive, with clinical judgement retained by healthcare providers.

Together, the findings indicate that digital health has become embedded in routine maternal and child healthcare delivery, particularly for registration, follow-up, risk identification, monitoring and reporting. However, implementation benefits were accompanied by interoperability problems, documentation burden and access barriers. Explicit AI use remained comparatively limited and was characterized primarily as an assistive technology requiring human verification. The central finding across the themes was therefore not technological replacement of healthcare providers, but an evolving relationship in which digital systems increasingly mediate healthcare work while clinical responsibility remains with frontline professionals.

Discussion

This study found that digital health applications were increasingly embedded in routine maternal and infant healthcare, particularly for documentation, monitoring, high-risk identification, follow-up, and continuity of care. However, Direct exposure to AI-enabled functions remained limited and uneven across healthcare cadres. Providers generally viewed digital and AI-enabled tools as supportive mechanisms rather than replacements for professional judgement, with clinical decision-making remaining under healthcare-provider oversight.

The findings also highlight important technical, organisational, workforce and equity-related barriers to digital health integration. Although providers valued improved access to information, teleconsultation, reminders and monitoring, implementation was constrained by poor

connectivity, device limitations, fragmented applications, repeated data entry, authentication requirements, technical problems and inadequate training [21]. Similar implementation challenges have been reported in the TECHO+ programme in Gujarat, where frontline health workers described connectivity and software problems, training limitations, adaptation to digital technologies, and additional workload from maintaining parallel digital and paper records [22]. Recent evidence from India similarly identifies difficulty using digital health applications, privacy concerns, language barriers and hesitation to share OTPs as important barriers to ABDM use [23]. These challenges contributed to increased workload and disruption of routine workflows.

Geographical and cadre-specific differences were also evident. Connectivity and physical access barriers were more prominent in tribal-selected settings, while duplicate data entry and workflow burden were particularly evident in rural-selected interviews. ANMs primarily highlighted field-level follow-up and workload; CHOs/MLHPs emphasised teleconsultation and counselling support; while Medical Officers more frequently discussed programme monitoring, privacy, AI functionality and professional oversight. These cadre-specific differences are consistent with evidence that frontline rural health workers' readiness for mobile-phone-based telemedicine varies across knowledge, attitudes and practice domains [24].

Overall, the findings suggest that effective use of digital health applications and AI-enabled functions also depends on infrastructure, interoperability, training, technical support, and healthcare provider oversight [7]. Reliable infrastructure, interoperable and user-friendly platforms, adequate training, technical support and continued professional oversight are essential. Particular attention is needed in rural and tribal settings, where digital exclusion may intersect with geographical, infrastructural and access-related inequalities. A context-sensitive, provider-centred and equity-oriented approach may therefore be critical for ensuring that digital innovation strengthens rather than adds to the burden of maternal and infant healthcare delivery.

Conclusion

This study shows that digital health applications are integrated into several aspects of routine maternal and infant healthcare in Andhra Pradesh, particularly for documentation, follow-up, monitoring, teleconsultation and continuity of care, with limited explicit AI use. Healthcare providers generally viewed digital health applications and AI-enabled functions as supportive tools, with clinical decision-making remaining under provider judgement. Their effective use was influenced by both enabling and constraining factors, including infrastructure, connectivity, interoperability, device availability, training, technical support, workflow integration, authentication requirements, privacy considerations and local service-delivery conditions. Differences across urban, rural and tribal settings further indicate that implementation cannot be approached uniformly. The study extends existing evidence by providing provider-level insights into how AI and digital health applications are experienced within routine maternal and infant healthcare and by highlighting the distinction between widespread digital application use and more limited AI-enabled functionality. These findings suggest that future implementation should consider interoperability, reliable infrastructure, technical support, appropriate training, privacy safeguards, and continued healthcare-provider oversight, particularly in rural, tribal, and other resource-constrained settings.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Author Contributions

Pavani Divi: Conceptualization, literature search, developed semi-structured interview tool, conducted qualitative interviews, data extraction, thematic synthesis, original draft preparation, and review. Aparajita Mishra & Pragath Kumar Ponnam: Review and editing, methodological guidance, critical revision of intellectual content and contextual validation of India-specific content. Abiodun Olaiya Paul: Review and editing, methodological guidance and supervisory oversight. K V N S Anil Kumar: Review, guidance and critical appraisal.

Ethical Approval

Ethical approval for the doctoral research study was obtained from the Institutional Ethics Committee, Dr Patnam Mahender Reddy Institute of Medical Sciences; Approval No. IEC/PMRIMS/0121, dated 22/03/2025. Administrative permission to conduct the study was also obtained from the Maternal and Child Health Department, Office of the Commissioner of Health and Family Welfare, Government of Andhra Pradesh. The study followed the ethical considerations specified by the Texila University for research proposal development, includes informed consent, confidentiality and participant anonymity. Respondents' participation was voluntary, and informed consent was obtained from all participants before the interviews.

Data Availability

The qualitative data supporting the findings of this study are not publicly available because of participant confidentiality. Data with only interview IDs may be made available by the corresponding author upon request.

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References

[1]. Knop MR, Nagashima-Hayashi M, Lin R, Saing CH, Ung M, Oy S, et al. Impact of mHealth interventions on maternal, newborn, and child health from conception to 24 months postpartum in low- and middle-income countries: a systematic review. BMC Med. 2024;22(1):196. Available from: https://doi.org/10.1186/s12916-024-03417-9

[2]. Cockburn N, Osborne C, Withana S, Elsmore A, Nanjappa R, South M, et al. Clinical decision support systems for maternity care: a systematic review and meta-analysis. eClinicalMedicine. 2024; 76:102822. Available from: https://doi.org/10.1016/j.eclinm.2024.102822

[3]. Murthy N, Chandrasekharan S, Prakash MP, Ganju A, Peter J, Kaonga N, et al. Effects of an mHealth voice message service (mMitra) on maternal health knowledge and practices of low-income women in India: findings from a pseudo-randomized controlled trial. BMC Public Health. 2020;20(1):820. Available from: https://doi.org/10.1186/s12889-020-08965-2

[4]. Nagraj S, Kennedy S, Jha V, Norton R, Hinton L, Billot L, et al. A mobile clinical decision support system for high-risk pregnant women in rural India

(SMARThealth Pregnancy): pilot cluster randomized controlled trial. JMIR Form Res. 2023;7:e44362. Available from: https://doi.org/10.2196/44362

[5]. Mohamed H, Ismail A, Sutan R, Rahman RA, Juval K. A scoping review of digital technologies in antenatal care: recent progress and applications of digital technologies. BMC Pregnancy Childbirth. 2025;25(1):153. Available from: https://doi.org/10.1186/s12884-025-07209-8

[6]. World Health Organization. WHO guideline: recommendations on digital interventions for health system strengthening. Geneva: World Health Organization; 2019. Available from: https://www.who.int/publications/i/item/9789241550505

[7]. World Health Organization. Global strategy on digital health 2020-2025. Geneva: World Health Organization; 2021. Available from: https://www.who.int/publications/i/item/9789240020924

[8]. World Health Organization. Classification of digital health interventions v1.0. Geneva: World Health Organization; 2020 [cited 2025 Oct 22]. Available from: https://iris.who.int/server/api/core/bitstreams/5ed36c71-bc74-41e9-8751-ca8bd9a8d823/content

[9]. Ministry of Health and Family Welfare, Government of India. Measures taken by the government to use AI in the public health system. 2025 [cited 2026 Mar 30]. Available from: https://www.pib.gov.in/PressReleasePage.aspx?PRID=2113683

[10]. Mishra US, Yadav S, Joe W. The Ayushman Bharat Digital Mission of India: an assessment. Health System Reform. 2024;10(2):2392290. Available from: https://doi.org/10.1080/23288604.2024.2392290

[11]. Ministry of Health and Family Welfare, Government of India. Union Minister of Health and Family Welfare Shri Jagat Prakash Nadda launches SAHI and BODH initiatives to strengthen responsible Health AI ecosystem at the India AI Impact Summit 2026. 2026 [cited 2026 Mar 22]. Available from: https://www.pib.gov.in/PressReleasePage.aspx?PRID=2229226

[12]. World Health Organization. Ethics and governance of artificial intelligence for health: WHO guidance. Geneva: World Health Organization; 2021. Available from: https://iris.who.int/server/api/core/bitstreams/f780d926-4ae3-42ce-a6d6-e898a5562621/content

[13]. Indian Council of Medical Research. Ethical guidelines for application of artificial intelligence in biomedical research and healthcare. New Delhi: Indian Council of Medical Research; 2023 [cited 2026 Mar 30]. Available from: https://www.icmr.gov.in/icmrobject/custom_data/pdf/Ethical-guidelines/Ethical_Guidelines_AI_Healthcare_2023.pdf

[14]. Wahl B, Cossy-Gantner A, Germann S, Schwalbe NR. Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings? BMJ Glob Health. 2018;3(4):e000798. Available from: https://doi.org/10.1136/bmjgh-2018-000798

[15]. Gore MN, Olawade DB. Harnessing AI for public health: India's roadmap. Front Public Health. 2024; 12:1417568. Available from: https://doi.org/10.3389/fpubh.2024.1417568

[16]. Joo JY, Liu MF, Ho MH. Nurses' perceptions of artificial intelligence adoption in healthcare: a qualitative systematic review. Nurse Educ Pract. 2025; 88:104542. Available from: https://doi.org/10.1016/j.nepr.2025.104542

[17]. Department of Health, Medical and Family Welfare, Government of Andhra Pradesh. CRS annual report 2024. Andhra Pradesh: Government of Andhra Pradesh; 2024 [cited 2026 Jun 8]. Available from: https://hmfw.ap.gov.in/docs/DPHFW/CRS%20Annual%20Report-2024.pdf

[18]. Department of School Education, Government of Andhra Pradesh. Educational statistics 2022-23. Andhra Pradesh: Directorate of School Education; 2022-23 [cited 2026 Jun 7]. Available from: https://cse.ap.gov.in/MISdownload/MIS_REPORT_NOTIFICATION/Educational%20Statistics%202022-23.pdf

[19]. Ministry of Tribal Affairs, Government of India. Integrated Tribal Development Agency (ITDA)/Integrated Tribal Development Project (ITDP) areas. New Delhi: Ministry of Tribal Affairs; 2016 [cited 2026 Jun 8]. Available from: https://tribal.nic.in/ST/1-ITDAArea.pdf

[20]. Ose SO. Using Excel and Word to structure qualitative data. J Appl Soc Sci. 2016;10(2):147-62. Available from: https://doi.org/10.1177/1936724416664948

[21]. Arora S, Huda RK, Verma S, Khetan M, Sangwan RK. Challenges, barriers, and facilitators in telemedicine implementation in India: a scoping review. Cureus. 2024;16(8):e67388. Available from: https://doi.org/10.7759/cureus.67388

[22]. Saha S, Quazi ZS. Does digitally enabling frontline health workers improve coverage and quality of maternal and child health services? Findings from a mixed methods evaluation of TECHO+ in Gujarat. Front Public Health. 2022; 10:856561. Available from: https://doi.org/10.3389/fpubh.2022.856561

[23]. Ranjan A, Singh G, Singh H, Singh M. Adoption, digital health literacy, and patient satisfaction of Ayushman Bharat Digital Mission: an analytical cross-sectional study among outpatient department attendees. BMC Health Serv Res. 2026;26(1):512. Available from: https://doi.org/10.1186/s12913-026-14314-7

[24]. Gandhi PA, Kathirvel S, Chakraborty S. Rural community health workers' readiness for mobile-phone based telemedicine uptake in India. J Rural Med. 2022;17(3):166-70. Available from: https://doi.org/10.2185/jrm.2021-044