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Harnessing digital health and machine learning for early detection of hypertensive disorders in pregnancy: Insights from low-resource settings, Tanzania

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Citation

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Background

Tanzania's high maternal mortality ratio presents economic and social challenges, particularly in marginalized communities. Key contributors include inadequate antenatal care (ANC), healthcare provider shortages, and limited diagnostic resources. Digital health and machine learning (ML) offer new opportunities for early risk identification. This study explores the potential of leveraging digital ANC records to predict hypertensive disorders during pregnancy in low- resource settings.

Material and Methods

We analyzed 300,000 ANC records from Unified Community System (UCS) (2023–2024), a Government of Tanzania digital data collection initiative. The dataset included key maternal health indicators such as BP, BMI, and urine protein levels. Hypertensive disorder was defined as systolic BP ≥ 140 mmHg and diastolic BP ≥ 90 mmHg. Five ML classifiers—K-Nearest Neighbors, Logistic Regression, Random Forest, Support Vector Machine, and XGBoost—were tested. The final model was trained on 187,438 records and validated using 120,000 independent records.

Results

A total of 1,894 cases met the outcome criteria. The training dataset consisted of 3,788 records (50/50 risk distribution). XGBoost was selected as the final model, achieving 90.05% accuracy, 14% precision, and a 24% F1-score for gestational hypertension prediction. The AUC was 0.95 (95% CI: 0.9532–0.9548), indicating strong discriminatory power. The model was deployed online for real- world application.

Conclusion & Recommendations

AI-driven risk prediction models can enhance early detection of hypertensive disorders, reduce maternal mortality, and ease healthcare burdens. However, improving routine data quality is essential for scalability and reliability. Policymakers should prioritize AI adoption alongside robust data and implementation strategies.

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Missed opportunities for antenatal screening coverage at first contact in routine public health facilities: Findings from Geita Region, Tanzania

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Citation

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Background

Early detection of maternal health conditions through comprehensive screening is critical for improving pregnancy outcomes. WHO and the

national ANC guidelines recommend a set of screening tests during the first ANC visit, including HIV, syphilis, malaria, haemoglobin, and urine protein/sugar tests. This study evaluated the extent to which key screening services are delivered during the first ANC contact in public health facilities as a baseline survey before project implementation.

Program Intervention/Methodology

We conducted a cross-sectional study to analyse records of 657 women attending ANC across six health facilities in Geita region from January to December 2022. We used data from ANC/Labour & Delivery registers, supplemented by DHIS2 records. We evaluated key screenings practises for ANC: malaria testing, HIV testing, syphilis testing, urine sugar, and urine protein (proteinuria). Descriptive statistics summarized screening coverage.

This study was done as part of a baseline survey prior to implementing the Mlinde Mama Project.

Results Finding

Malaria testing (99.1%) and HIV testing (95.4%) coverage were high, reflecting strong integration into early ANC. However, no records were found for syphilis screening, urine sugar, or urine protein testing, indicating critical gaps in service delivery or documentation. These missed screenings limit opportunities for early identification of pre-eclampsia, urinary tract infections, and congenital infections.

Program Implication & Lesson Learned

While malaria and HIV screening are routinely implemented, substantial gaps exist in delivering the full recommended ANC screening at first contact. Further studies to understand the reasons why women did not receive the screening tests are recommended. Possible reasons could be supply chains disruptions, provider attitudes or data quality gaps.

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Perspectives of women, providers and health managers on Group Antenatal Care (G-ANC) model implementation in Geita, Tanzania: A qualitative study

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Citation

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Background

Group Antenatal Care (G-ANC) is an innovative model of care where pregnant women at similar stages of pregnancy meet together for their care visits, rather than individually. This approach promotes peer support, shared learning, and a sense of community among pregnant women, while also enhancing the quality of care. This study aimed to assess the perspectives of providers, women and health managers to determine the feasibility acceptability of G-ANC.

Material and Methods

This qualitative study explored the perspectives of women, healthcare providers, and health managers on the acceptability and feasibility of G-ANC in Geita. Data were collected through six Focus Group Discussions (FGDs) with women who recently attended G-ANC sessions, and 15 Key Informant Interviews (KIIs) with ANC providers and facility managers. Recorded audios were transcribed verbatim. Transcripts were thematically analyzed using NVIVO software, guided by Bowen et al.'s (2009) feasibility framework, focusing on perceptions, practicality, adaptability, integration, and acceptability of interventions.

Results

Findings revealed high levels of satisfaction and acceptability of G-ANC among all stakeholder groups. Women reported increased knowledge on maternal health, emotional support, and enhanced communication with providers. Healthcare providers noted improved efficiency, better patient engagement, and peer support among clients. Health managers observed

increased ANC attendance and more interactive care. However, challenges such as limited space, need for facilitator training, and resource constraints were identified. Institutionalizing G-ANC as a standard antenatal care model could be the best option to address the low coverage of ANC visits, sub optimal quality care, and institutional deliveries.

Conclusion & Recommendations

The G-ANC model is highly acceptable and feasible in Geita context. It demonstrated significant benefits for maternal health education, peer support, and healthcare delivery efficiency. These findings support the scale-up of G-ANC in Tanzania, provided investments are made in infrastructure, training of providers, and service integration.

Reference

1. Bowen et al.'s 2009