

Beyond attendance: facility-level variations in the delivery of essential antenatal care interventions during routine group antenatal care implementation in Tanzania: a secondary analysis

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Abstract

Background High antenatal care (ANC) attendance does not necessarily ensure receipt of the full package of recommended interventions. Although Group Antenatal Care (G-ANC) may improve service utilization and quality, little is known about facility-level variation in implementation when integrated into routine health systems. We assessed variation in the delivery of essential ANC interventions within a routine G-ANC program in Geita Region, Tanzania.

Methods We conducted a secondary analysis of routinely collected implementation data from the Mlinde Mama Project between January 2023 and August 2024. No sampling was undertaken; all 5,936 pregnant women enrolled in G-ANC across six public health facilities (two dispensaries, two health centers, and two district hospitals) during the study period were included. Coverage of 12 ANC indicators was assessed. A composite facility performance score was calculated as the mean coverage of nine selected indicators. Descriptive statistics summarized coverage, and Pearson's chi-square tests assessed differences across facilities.

Results A total of 5,936 pregnant women were enrolled into 149 G-ANC cohorts at the implementation sites during the study period. ANC4+ coverage ranged from 90.2 to 95.0%, facility delivery from 94.1 to 97.7%, and malaria testing from 91.5 to 95.5%, while blood pressure monitoring was 100% across all facilities. Greater variation was observed for preventive and diagnostic interventions: IPTp3+ coverage ranged from 60.1 to 86.3%, iron-folate supplementation from 75.0 to 92.7%, HIV and syphilis testing from 59.9 to 95.0%, and urine testing from 30.1 to 62.7%. Composite performance scores ranged from 80.1 to 91.9%, with Bwanga Health Center ranking highest and Butengorumasa Dispensary lowest. Health Centers demonstrated the strongest overall performance across most indicators, and coverage of the nine indicators included in the composite score varied significantly across facilities ($p < 0.05$).

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Conclusions Women enrolled in routine G-ANC had high ANC attendance, but delivery of several essential interventions varied substantially across facilities. These findings highlight gaps between service utilization and effective coverage and support monitoring ANC content alongside attendance. Facility-level performance monitoring, supportive supervision, and continuous quality improvement may help address implementation gaps and strengthen comprehensive ANC delivery.

Keywords Group antenatal care · Antenatal care quality · Effective coverage · Implementation science · Health facility performance

Background

Globally, an estimated 260,000 women die annually from causes related to pregnancy and childbirth, with approximately 70% of these deaths occurring in sub-Saharan Africa [1]. Despite improvements in maternal health service utilization, maternal mortality remains unacceptably high in many low- and middle-income countries (LMICs), reflecting persistent challenges in access to and quality of maternal healthcare [2]. Antenatal care (ANC) provides a critical platform for identifying and managing pregnancy-related risks and delivering preventive, diagnostic, counselling, and health-promotion interventions.

The World Health Organization (WHO) recommends a minimum of eight ANC contacts during pregnancy, together with each contact providing opportunities to deliver a comprehensive package of evidence-based interventions [3]. These include nutritional interventions, maternal and foetal assessment, preventive measures, management of common physiological symptoms, and health-system interventions to improve the utilization and quality of ANC [4]. However, increased contact with health services does not necessarily ensure receipt of these recommended ANC components [5, 6], highlighting the importance of assessing both ANC utilization and the content of care delivered. Women may attend ANC yet miss essential interventions such as malaria prevention, anaemia screening, HIV and syphilis testing, immunization, or counselling [5, 7]. Comprehensive ANC provides opportunities to identify broader maternal and foetal risks, including psychosocial concerns during pregnancy and risk factors associated with adverse birth outcomes [8, 9]. The service coverage gap has contributed to increasing emphasis on effective coverage, which considers whether individuals in need of services receive care of sufficient quality to achieve the intended health benefits [10–13].

Tanzania illustrates this gap between service contact and effective coverage. Recent national data indicate that approximately 89% of women receive ANC from a skilled provider at least once during pregnancy [14], yet previous estimates suggest that only about four in ten women receive effective ANC coverage [15]. Challenges remain in timely ANC initiation, continuity of care, and receipt of the complete package of recommended services [16, 17], with persistent gaps in ANC quality and content reported particularly in rural and underserved settings [18]. These findings highlight the need for service delivery approaches that address both utilization and quality of care.

Group Antenatal Care (G-ANC) is an alternative model of ANC delivery that combines routine clinical assessment with facilitated group learning, peer support, and participatory counselling among pregnant women of similar gestational age. Studies from high- and low-resource settings have reported improvements in ANC attendance, maternal knowledge, birth preparedness, satisfaction with care, and selected maternal and newborn outcomes [19–22]. In Tanzania, G-ANC has gained attention as a strategy for strengthening person-centred care, continuity of care, and maternal engagement during pregnancy [23, 24].

Between 2023 and 2024, Prime Health Initiative Tanzania (PHIT), in collaboration with regional and district health authorities, implemented G-ANC across six public health facilities in Geita Region through the Mlinde Mama Project, funded by the Gates Foundation. The intervention was integrated into routine government maternal health services and supported by the Unified Community System (UCS), a digital platform for client registration, service documentation, follow-up, and programme monitoring. This study assessed facility-level variation

in the delivery of essential ANC interventions among women enrolled in the programme, comparing coverage across facilities and levels of care and examining differences in overall implementation performance.

Methods

Study design

This study was a secondary analysis of routine implementation data collected through the Mlinde Mama Project, a maternal health initiative that integrated G-ANC into routine public health services in Geita Region, Tanzania. The study employed a descriptive, cross-sectional analytical design to assess facility-level variation in the coverage of essential antenatal care interventions among women enrolled in the G-ANC program between January 2023 and August 2024.

The analysis was conducted within an implementation science framework and following Standards for Reporting Implementation Studies (StaRI) guidelines [25], focusing on differences in service delivery performance across facilities implementing the same intervention under routine health system conditions. Rather than evaluating the overall intervention effectiveness, the study sought to identify variations in implementation performance across facilities and levels of care.

Study setting

The study was conducted in Geita Region, northwestern Tanzania, specifically within Geita District Council and Chato District Council. Geita Region is predominantly rural and faces many of the maternal health challenges common to low-resource settings, including delayed ANC initiation, shortages of healthcare workers, and geographic barriers to accessing care.

The Mlinde Mama Project was implemented across six public health facilities comprising two district hospitals, two health centres, and two dispensaries. These Six public health facilities participating in the project were included in the analysis. These facilities were purposively selected jointly with the regional and district health authorities, prior to implementation of the Mlinde Mama project, based on service volume, geographic representation, and readiness to implement Group Antenatal Care. The facilities comprised two dispensaries (Butengorumasa and Nkome), two health centers (Bwanga and Katoro), and two district hospitals (Chato and Nzera). Together, these facilities provide antenatal, delivery, postnatal, and referral services to predominantly rural populations. To provide more context, Fig. 1 describes the levels of health care facilities in Tanzania, the range of services provided at each level and referral networks.

Description of the Mlinde Mama intervention

The Mlinde Mama Digital Health Project was implemented through a partnership between PHIT, regional and district health authorities, and participating health facilities. The project aimed to improve maternal health outcomes through integration of Group Antenatal Care and digital health technologies into routine maternal health services. The Ministry of Health provided the national policy and technical framework for maternal and reproductive health services, while the Prime Minister's Office–Regional Administration and Local Government (PMO-RALG), through regional and council health management structures, supported implementation within participating government facilities, including coordination and integration with routine service delivery.

Group Antenatal Care was adapted from internationally recognized G-ANC models and incorporated into existing government ANC services. Pregnant women were enrolled into cohorts of women with similar gestational ages and participated in regularly scheduled group sessions throughout pregnancy. Women attended scheduled group ANC visits according to the national ANC schedule throughout pregnancy. Each session combined

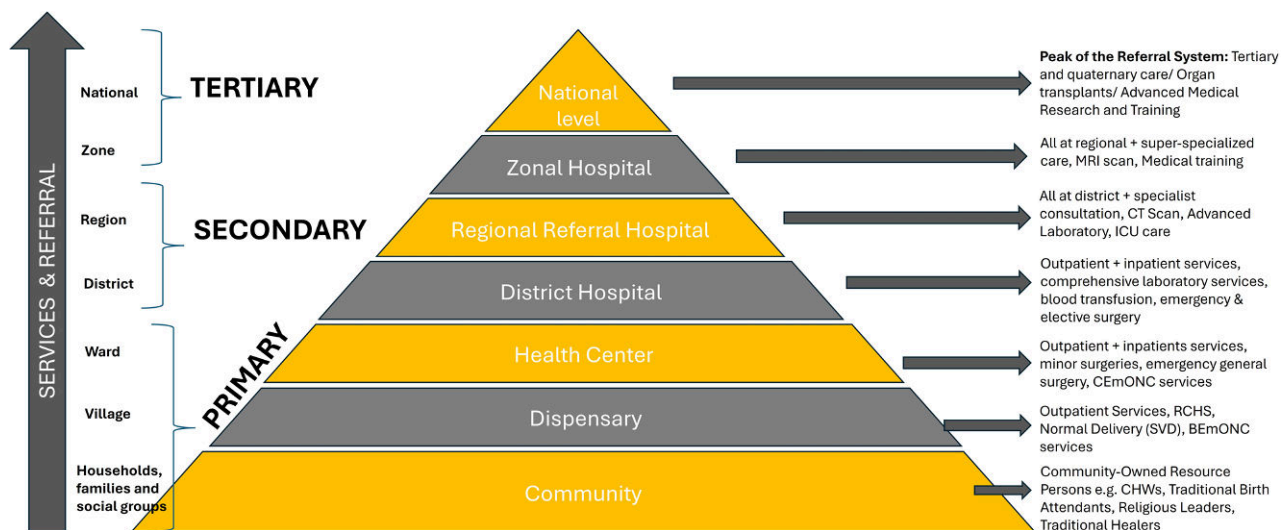


Fig. 1 Tanzania Health System Levels of Care: Hierarchical structure of the Tanzanian health system, illustrating the flow of service delivery and referrals across levels. Source: Adapted from Hyuha et al. [26]

routine clinical assessment with participatory health education, peer learning, counselling, and facilitated discussion on maternal and newborn health topics.

Topics covered during G-ANC sessions included nutrition during pregnancy, birth preparedness and complication readiness, recognition of danger signs, malaria prevention, HIV testing and counselling, newborn care, breastfeeding, family planning, and postpartum care. Individual clinical assessments were conducted in accordance with national ANC guidelines before or during group sessions.

Implementation was supported by the UCS platform to facilitate client registration, cohort management, appointment tracking, service documentation, follow-up, and routine performance monitoring.

Study population

The study included records of all pregnant women enrolled in the Group Antenatal Care program across the six participating facilities between January 2023 and August 2024. No sampling was undertaken, as the analysis used routinely collected implementation data for all eligible participants. All women attending ANC services at participating facilities, who were eligible (GA > 20 weeks, similar gestation age and consenting to G-ANC model) were enrolled. A total of 5,936 women were enrolled into 149 G-ANC cohorts during the implementation period and were included in this analysis. The January 2023–August 2024 period was selected because it represented the period for which routine G-ANC implementation data were available across the participating facilities for this analysis.

Data sources, data collection and data quality

Data were obtained from facility Health Management Information System (HMIS) registers and a cohort tracker, both served as primary data sources for routine program monitoring and documentation. Healthcare providers entered information during routine service delivery, including ANC attendance, laboratory investigations, preventive interventions, clinical assessments, delivery outcomes, and maternal health indicators.

For this secondary analysis, de-identified program data were extracted from the cohort tracker and facility HMIS registers and aggregated at facility level. Data quality assurance procedures included routine validation

checks, assessment of completeness, verification of internal consistency, and removal of duplicate records prior to analysis.

Study variables

The primary outcome indicators were based on facility-level coverage of nine selected facility-level antenatal care interventions. These indicators were selected based on Tanzanian national ANC guidelines and WHO recommendations for routine antenatal care.

The nine indicators included: (1) Completion of four or more antenatal care visits (ANC4+), (2) Receipt of three or more doses of intermittent preventive treatment for malaria during pregnancy (IPTp3+), (3) Iron and folate supplementation, (4) Haemoglobin testing on at least two occasions, (5) Malaria testing on at least two occasions, (6) HIV testing on at least two occasions, (7) Syphilis testing on at least two occasions, (8) Deworming during pregnancy and (9) Facility delivery.

Three additional indicators - blood pressure monitoring, urine testing, and Tetanus-diphtheria (Td) vaccination were assessed as indicators of ANC service content and quality.

Completion of eight or more ANC contacts (ANC8+), recommended by current WHO guidelines, was not assessed because routine maternal health registers and the UCS used during the implementation period continued to collect ANC attendance based on the national ANC4+ reporting framework. Consequently, ANC4+ remained the proxy indicator for ANC attendance for this analysis.

Composite facility performance score

To assess overall implementation performance, a composite facility performance score was calculated for each facility. The score was derived as the arithmetic mean of coverage across nine essential ANC indicators. The arithmetic mean was selected because all indicators were expressed as percentages on a common scale, making the resulting score simple to interpret and compare across facilities. Equal weighting was assigned to each indicator to avoid subjective prioritization of individual ANC components and to provide a transparent and readily interpretable summary measure of implementation performance. Although the clinical importance of individual interventions may differ, there is no empirical evidence to support differential weighting within the ANC routine implementation context. The composite score was used to rank facilities according to overall performance and to facilitate comparison across different levels of care.

The composite score included nine indicators selected a priori because they represented routinely delivered ANC interventions that were consistently recorded across facilities and were expected to discriminate implementation performance.

Three indicators were excluded from the composite score. Blood pressure monitoring was omitted because it achieved universal coverage (100%) across all facilities and therefore did not contribute to differentiating implementation performance. Tetanus-diphtheria (Td) vaccination was excluded because administration is determined by a woman's previous immunization status, meaning that receipt during the current pregnancy is not universally expected. Urine testing was excluded because inconsistencies in routine implementation and documentation across study sites reduced its suitability as a standardized indicator for comparing facility performance. The composite score therefore focused on indicators that were consistently applicable to all women, routinely measured across facilities, and capable of meaningfully distinguishing implementation performance.

Data analysis

Data were analysed using Stata version 18.5. Pearson's Chi-square test was used to compare proportions across facilities and statistical significance was assessed at $\alpha=0.05$. Composite scores are descriptive summaries and were not subjected to Chi-square testing.

Descriptive statistics were used to summarize facility characteristics, participant distribution, and coverage of ANC interventions. Categorical variables were summarized using frequencies and percentages. Coverage for each ANC indicator was calculated as the proportion of eligible women receiving the specified intervention. Comparisons were conducted across individual facilities and by facility type (dispensary, health center, and district hospital). However, results were interpreted as indicative of variation in implementation performance rather than formal hypothesis testing, given the descriptive nature of the study and clustering of observations within facilities. Facility-level performance was visualized using comparative tables, bar charts, and heat maps to identify patterns of variation in implementation performance across facilities and service delivery indicators. Given the programmatic nature of the analysis and the use of aggregated facility-level data, the study focused primarily on identifying implementation patterns and performance variation rather than establishing causal relationships between facility characteristics and outcomes.

Ethical considerations

The parent Mlinde Mama Digital Health Project received ethical approval from the National Institute for Medical Research (NIMR) through the National Health Research Ethics Committee in Tanzania (Certificate No. NIMR/HQ/R.8a/Vol.IX/4194; 23 January 2023). This secondary analysis utilized routinely collected, de-identified program data and involved no direct participant contact. All analyses were conducted using anonymized datasets, and confidentiality was maintained throughout the study in accordance with applicable ethical standards and data protection requirements.

Results

Participant distribution and facility characteristics

A total of 5,936 pregnant women were enrolled into 149 G-ANC cohorts across six public health facilities in Geita Region between January 2023 and August 2024. The participating facilities included two dispensaries (Nkome Dispensary and Butengorumasa Dispensary), two health centers (Katoro Health Center and Bwanga Health Center), and two district hospitals (Chato District Hospital and Nzera District Hospital). Katoro Health Center enrolled the largest number of participants (1,593; 26.8%), followed by Bwanga Health Center (1,265; 21.3%), Nkome Dispensary (1,082; 18.2%), Chato District Hospital (846; 14.3%), Nzera District Hospital (691; 11.6%), and Butengorumasa Dispensary (459; 7.7%) (Table 1).

Overall, health centers accounted for nearly half of all enrolled participants (48.1%), while dispensaries and district hospitals accounted for 26.0% and 25.9%, respectively.

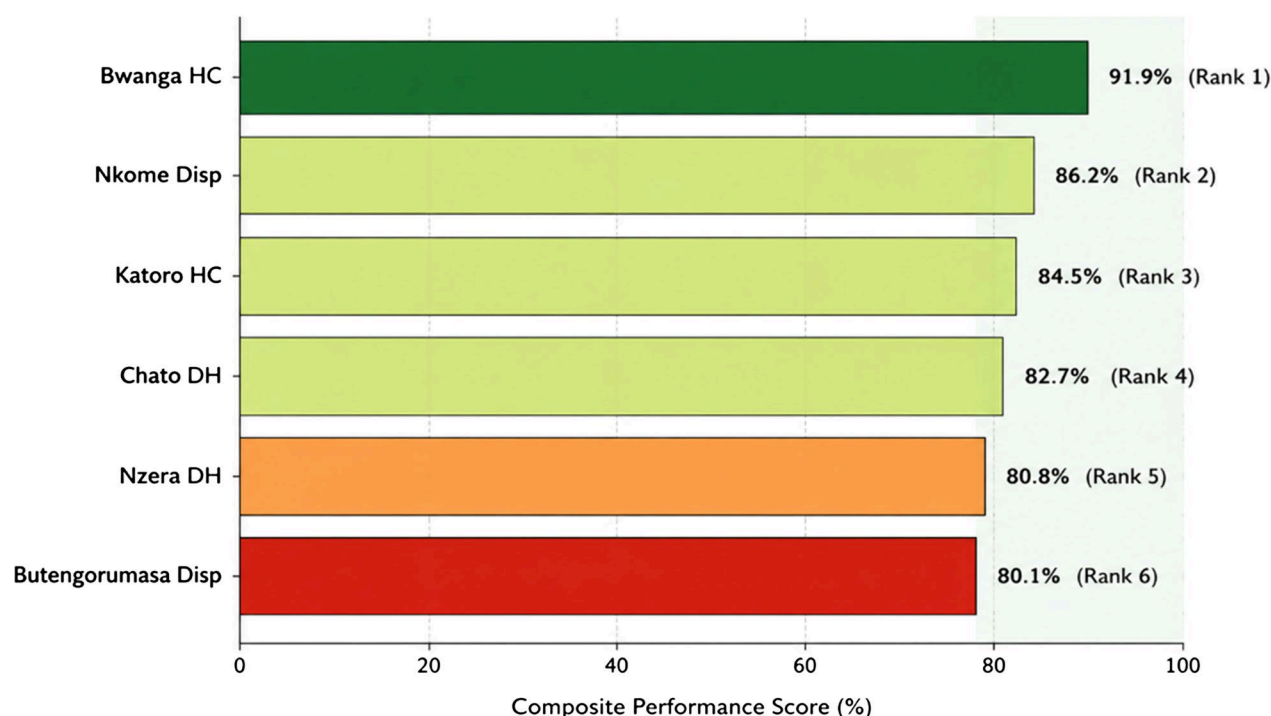
Table 1 Facility characteristics

Facility Name	Level of Care	G-ANC Clients	Proportions (%)
Butengorumasa	Dispensary	459	7.7
Bwanga	Health Center	1,265	21.3
Chato	District Hospital	846	14.3
Katoro	Health Center	1,593	26.8
Nkome	Dispensary	1,082	18.2
Nzera	District Hospital	691	11.6
Total		5,936	100.0

Table 2 Composite facility performance scores across six G-ANC implementation sites in Geita Region, Tanzania

Indicator (%)	Bwanga (N=1265)	Nkome (N=1082)	Katoro (N=1593)	Chato (N=846)	Nzera (N=691)	Butengo- rumasa (N=459)	Overall (N=5936)	χ^2 (df=5)	p-value
ANC4+	95	93.3	93.8	94.7	90.2	93.9	93.7	20.2	0.001
IPTp3+	86.3	80	73.6	75.1	60.1	66.9	75.6	203.3	<0.001
FEFO	92.7	80	75	81	83.8	83.2	82.2	157.9	<0.001
Hb	85	80	80	70	87.3	86.5	81	108.1	<0.001
Malaria testing	95	95.5	93	93.9	91.5	93.9	93.9	17.0	0.005
HIV	95	85	90	80	70	59.9	84.1	468.6	<0.001
Syphilis	95	85	90	80	70	59.9	84.1	468.6	<0.001
Deworming with Albendazole	85	80	70	75.1	79.7	83	77.9	109.8	<0.001
Facility Delivery	97.7	96.8	95	94.9	94.2	94.1	95.7	25.3	<0.001
Composite Score (%)	91.9	86.2	84.5	82.7	80.8	80.1	84.4	NA	NA

Coverage of the maternal health services varied significantly across the health facilities. The largest variations were observed for HIV testing ($\chi^2=468.59$, $p<0.001$), syphilis testing ($\chi^2=468.59$, $p<0.001$), and IPTp3+ uptake ($\chi^2=203.31$, $p<0.001$). Bwanga consistently achieved the highest coverage across most indicators and had the highest composite performance score (91.9%), whereas Nzera and Butengorumsa exhibited comparatively lower performance, particularly for IPTp3+, HIV, and syphilis testing. Although malaria testing and facility delivery coverage were high across the facilities, statistically significant differences remained evident



Composite score calculated from nine indicators: ANC4+, IPTp3+, iron-folate supplementation, Hb ≥ 2 , malaria ≥ 2 , HIV ≥ 2 , syphilis ≥ 2 , deworming, and facility delivery.

Fig. 2 Facility performance ranking

Facility performance ranking

To assess overall implementation performance, a composite facility performance score was calculated as the mean coverage across nine essential antenatal care indicators. Composite scores ranged from 80.1% to 91.9% (Table 2; Fig. 2).

Bwanga Health Center achieved the highest overall performance score (91.9%), followed by Nkome Dispensary (86.2%) and Katoro Health Center (84.5%). Chato District Hospital and Nzera District Hospital achieved composite scores of 82.7% and 80.8%, respectively, while Butengoromasa Dispensary recorded the lowest overall score (80.1%).

The highest-performing facility outperformed the lowest-performing facility by 15.6% points.

Coverage of essential ANC interventions by facility

Substantial variation was observed across facilities in the coverage of essential antenatal care interventions despite implementation of a standardized G-ANC model (Fig. 3).

Completion of four or more ANC visits remained relatively high across all facilities, ranging from 90.2% at Nzera District Hospital to 95.0% at Bwanga Health Center. Facility delivery rates were similarly high, ranging from 94.1% to 97.7%. Blood pressure assessment achieved universal coverage (100%) across all six facilities, reflecting strong adherence to routine maternal monitoring protocols.

Coverage of malaria testing was uniformly high across facilities, ranging from 91.5% at Nzera District Hospital to 95.5% at Nkome Dispensary. Haemoglobin testing ranged from 70.0% at Chato District Hospital to 87.3% at Nzera District Hospital.

Iron–folate supplementation demonstrated generally high coverage but varied across facilities, ranging from 75.0% at Katoro Health Center to 92.7% at Bwanga Health Center. IPTp3+ coverage ranged from 60.1% at Nzera District Hospital to 86.3% at Bwanga Health Center.

The greatest variability was observed for HIV testing, tetanus diphtheria vaccination, and urine testing. HIV testing ranged from 59.9% at Butengoromasa Dispensary to 95.0% at Bwanga Health Center. Tetanus diphtheria vaccination ranged from 84.5% at Nzera District Hospital to 92.7% at Bwanga Health Center, while urine testing remained consistently lower than other indicators, ranging from 30.1% at Butengoromasa Dispensary to 70.0% at Bwanga Health Center. Deworming coverage ranged from 70.0% at Katoro Health Center to 85.0% at Bwanga Health Center.

Overall, Bwanga Health Center consistently achieved the highest coverage across most indicators, whereas lower performance was primarily observed for IPTp3+, HIV testing, and urine testing in selected facilities.

The Heatmap shows facility-level coverage of essential ANC interventions across six public health facilities implementing routine G-ANC in Geita Region, Tanzania (January 2023–August 2024). Cell values represent the percentage of enrolled women who received each ANC intervention. Colours indicate coverage categories: very high ($\geq 90\%$), high (80–89.9%), moderate (70–79.9%), low (50–69.9%), and very low ($< 50\%$). The bottom row presents weighted average coverage across all six facilities, accounting for facility-specific enrolment. BP = blood

Facility (n)	ANC4+ (≥4 visits)	IPTp3+ (≥3 doses)	Iron-Folate Supplementation	Haemoglobin Testing (≥2)	Malaria Testing (≥2)	HIV Testing (≥2)	Syphilis Testing (≥2)	Deworming (≥2)	Td Vaccination (≥2)	Urine Testing (≥2)	BP Monitoring (Every visit)	Facility Delivery
Bwanga HC (1,265)	95.0	86.3	92.7	85.0	95.0	95.0	95.0	85.0	92.7	62.7	100.0	97.7
Nkome Disp (1,082)	93.3	80.0	80.0	80.0	95.5	85.0	85.0	80.0	88.2	45.1	100.0	96.8
Katoro HC (1,593)	93.8	73.6	75.0	80.0	93.0	90.0	90.0	70.0	91.8	60.0	100.0	95.0
Chato DH (846)	94.7	75.1	81.0	70.0	93.9	80.0	80.0	75.1	85.5	40.0	100.0	94.9
Nzera DH (691)	90.2	60.1	83.8	87.3	91.5	70.0	70.0	79.7	84.5	30.1	100.0	94.2
Butengoromasa Disp (459)	93.9	66.9	83.2	86.5	93.9	59.9	59.9	83.0	86.9	35.7	100.0	94.1
Overall Coverage (Weighted %)*	93.4	73.9	81.9	81.0	94.2	78.1	78.1	79.5	88.9	50.1	100.0	95.6

Legend:

Very High ($\geq 90\%$) High (80 – 89.9%) Moderate (70 – 79.9%) Low (50 – 69.9%) Very Low ($< 50\%$)

Fig. 3 Heatmap of ANC Indicator Coverage Across G-ANC Implementation Sites. Notes: BP – Blood Pressure; Td – Tetanus diphtheria vaccination; IPTp3+ – Intermittent Presumptive Treatment for Malaria (3 doses). Percentages represent the proportion of women who received each ANC intervention as recommended. * Overall Coverage is weighted by the number of women in each facility

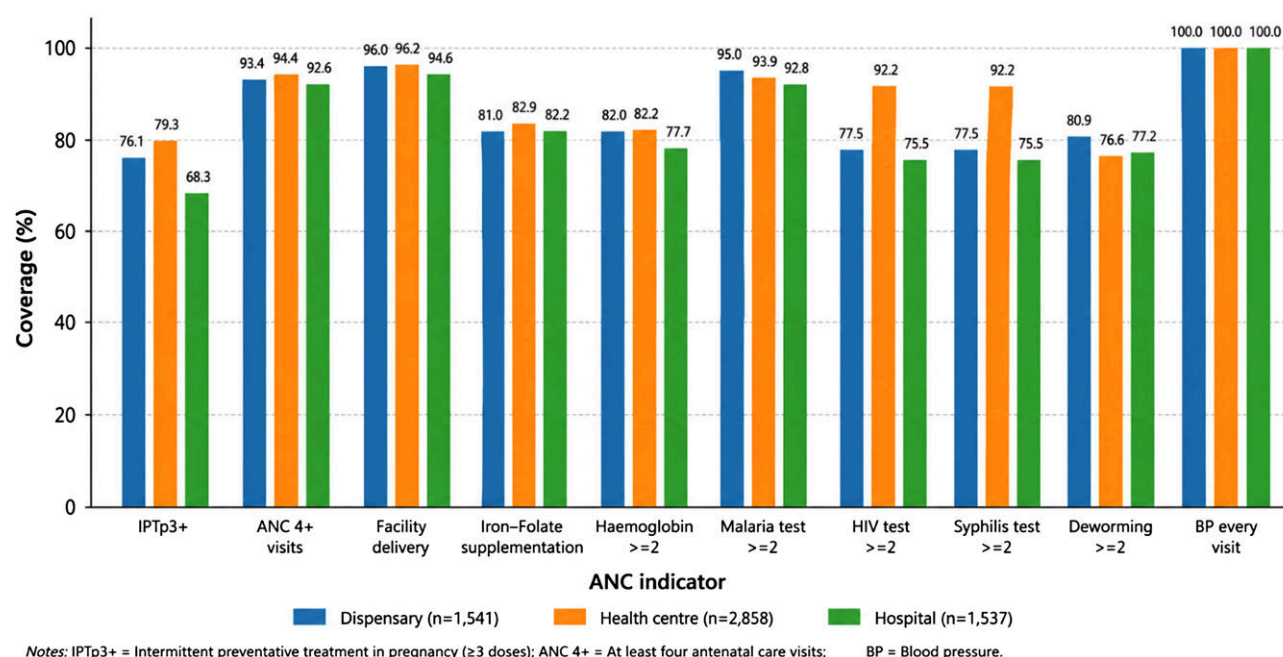


Fig. 4 G-ANC coverage by facility level

pressure; IPTp3+ = receipt of three or more doses of intermittent preventive treatment for malaria during pregnancy; $Hb \geq 2$ = haemoglobin testing on at least two occasions; HIV ≥ 2 and Syphilis ≥ 2 = testing conducted on at least two occasions during pregnancy. The heatmap shows a high ANC attendance, facility delivery, malaria testing, and blood pressure monitoring across facilities, while greater variability was observed for IPTp3+, HIV testing, syphilis testing, urine testing, and selected preventive interventions.

Performance by facility type

Comparison of ANC intervention coverage by facility type is shown by Fig. 4 below. Health Centers demonstrated the strongest overall performance across several key indicators. Coverage of IPTp3+ was highest among health centers (79.3%), compared with dispensaries (76.1%) and district hospitals (68.3%). Health Centers also achieved substantially higher coverage of HIV testing (92.2%) and syphilis testing (92.2%) than dispensaries (77.5% each) and district hospitals (75.5% each).

ANC4+ completion and facility delivery was high across all facility types, exceeding 92% and 94%, respectively. Blood pressure monitoring achieved universal coverage (100%) across all three levels of care. The facilities also maintained a high malaria testing rate, ranging from 92.8% in district hospitals to 95.0% in dispensaries.

Coverage of iron-folate supplementation was comparable across facility types, ranging from 81.0% in dispensaries to 82.9% in health centers, while haemoglobin testing was highest among health centers (82.2%), closely followed by dispensaries (82.0%), with lower coverage observed in district hospitals (77.7%). Deworming coverage was highest in dispensaries (80.9%), compared with district hospitals (77.2%) and health centers (76.6%).

We also analysed HIV & syphilis testing by facility level. Overall, health centers demonstrated the most consistent performance across the majority of ANC indicators, particularly for preventive and screening interventions, whereas district hospitals generally recorded the lowest coverage for IPTp3+, HIV testing, syphilis testing, and haemoglobin testing.

Discussion

This study assessed facility-level variation in the delivery of essential antenatal care interventions among women enrolled in a routine G-ANC program implemented across six public health facilities in Geita Region, Tanzania. ANC attendance and facility delivery coverage exceeded 90% across all facilities, with substantial variation remained in the delivery of preventive and diagnostic ANC services. These findings highlight an important distinction between coverage of care and content of care and suggest that successful implementation of G-ANC within routine health systems depends not only on the intervention model itself but also on facility-level implementation capacity. Similar gaps between service contact and the actual content of care received have been documented across LMICs, underscoring the importance of effective coverage and quality-adjusted measures of maternal health service delivery [5, 27, 28].

High ANC attendance and facility delivery coverage across facilities

One of the most notable findings was the high coverage of ANC4+ visits and facility delivery across all participating facilities. More than 90% of enrolled women completed at least four ANC visits, while facility delivery rates exceeded 94% in every facility. These findings are substantially higher than national averages reported in Tanzania [14] and compare favourably with results from previous studies evaluating Group Antenatal Care in similar settings [29–34].

Although this study was not designed to evaluate G-ANC effectiveness, the high ANC attendance observed aligns with previous studies suggesting that G-ANC may support continuity of care through provider–client relationships, peer support, and structured cohort-based follow-up [references]. Integration with the UCS may also have facilitated appointment tracking, follow-up, and service documentation. The high attendance observed across all facility levels indicates that routine implementation of the model was feasible across diverse service delivery settings.

Coverage does not necessarily equate to content of care

Despite high attendance, substantial variation was observed in several essential ANC interventions, including IPTp3+, HIV and syphilis testing, urine testing, and Td vaccination. This finding illustrates the distinction between service utilization and effective coverage: contact with ANC services does not necessarily ensure receipt of the complete package of recommended interventions. Similar gaps between ANC contact and content of care have been reported across LMICs [5, 7, 15, 27, 28].

Lower coverage of HIV and syphilis testing in some facilities may reflect diagnostic commodity shortages, laboratory capacity, service readiness, or inconsistent implementation of testing protocols, barriers also reported in other sub-Saharan African settings [35–38]. Variation in IPTp3+ may similarly reflect delayed ANC initiation, missed opportunities during follow-up, or intermittent sulfadoxine-pyrimethamine availability. During project implementation, urine-testing reagents were frequently reported to be out of stock, limiting routine testing at some facilities. Together, these findings illustrate how health-system constraints may influence the effective delivery of ANC interventions despite high service utilization.

Variation in Td vaccination requires more cautious interpretation because previous maternal immunization history was not captured. As eligibility for additional Td doses depends on prior vaccination, differences in recorded coverage may reflect variation in eligibility as well as service delivery.

Health centers demonstrated the most consistent overall implementation performance

Health centers achieved the highest overall composite performance and performed particularly well for IPTp3+, HIV testing, and syphilis testing, although they did not outperform other facility types across every indicator.

District hospitals achieved slightly higher haemoglobin testing coverage, while dispensaries had the highest deworming coverage. This pattern suggests that implementation performance is multidimensional and cannot be inferred from facility level alone. One possible explanation is that health centers may combine greater service capacity than dispensaries with less complex referral workloads than district hospitals. However, these factors were not directly measured in this study. Broader health-systems evidence suggests that organizational effectiveness, leadership, staff engagement, and workflow management can influence service quality independently of facility designation [39]. The superior performance of health centers observed in our study is consistent with health systems literature suggesting that provider motivation, management practices, and organizational effectiveness may be more important determinants of quality than facility designation alone [40].

Facility-level factors influence implementation success

The more than ten-percentage-point difference in composite performance between the highest- and lowest-performing facilities, despite implementation of the same G-ANC model and digital platform, highlights the potential importance of facility context. Factors such as leadership, provider motivation, supervision, staffing, commodity availability, laboratory capacity, and data-use practices may influence how effectively facilities operationalize standardized interventions [39, 41, 42].

However, these factors were not systematically measured in this study and should therefore be regarded as plausible explanations requiring further investigation.

These findings also demonstrate the value of facility-level monitoring during scale-up. Aggregate programme indicators may obscure meaningful variation and fail to identify facilities or ANC components requiring additional support. Routine monitoring of service content alongside utilization indicators could therefore help identify implementation bottlenecks and guide targeted quality-improvement efforts.

Implications for policy and practice

These findings have several implications for routine maternal health programmes. Monitoring systems should complement attendance indicators with measures of ANC content and effective coverage, allowing programme managers to identify whether women receive recommended interventions at each facility. Facility-level performance dashboards could support this approach by identifying lower-performing services and informing targeted supportive supervision and quality-improvement activities.

Particular attention may be warranted for interventions showing lower or more variable coverage, including IPTp3+, HIV and syphilis testing, and urine testing. Addressing commodity availability, laboratory capacity, staffing, workflow, and adherence to clinical protocols may help reduce implementation gaps. Scale-up of G-ANC within routine health systems should therefore be accompanied by continuous monitoring and context-responsive quality-improvement mechanisms rather than relying primarily on attendance as an indicator of implementation success.

Strengths and limitations

This study has several important strengths. The study utilized a large routine implementation dataset comprising 5,936 pregnant women enrolled across six public health facilities, making it one of the largest evaluations of routine Group Antenatal Care implementation in Tanzania. Furthermore the study was conducted within routine government health services rather than a controlled research environment, enhancing the external validity and practical relevance of the findings. Inclusion of facilities across three levels of care—dispensaries, health centers, and district hospitals—allowed for meaningful comparison of implementation performance across different health system contexts.

Several limitations should be considered when interpreting the findings. This was a secondary analysis of routinely collected program data, which were originally collected for service delivery and monitoring purposes rather than research. As a result, data quality may have been affected by documentation errors, incomplete records, or variations in reporting practices across facilities. Although data cleaning and validation procedures were undertaken, the possibility of residual reporting bias cannot be excluded.

In addition, the study lacked a comparison group of facilities not implementing G-ANC. Consequently, it was not possible to determine whether observed differences in performance were attributable solely to the G-ANC model or to pre-existing differences between facilities. The findings should therefore be interpreted as measures of implementation performance rather than causal estimates of intervention effectiveness.

The analysis focused primarily on service coverage indicators and did not directly measure implementation fidelity. Factors such as adherence to the G-ANC model, quality of facilitation, provider competency, participant engagement, and group dynamics were not assessed. Variations in these factors may have contributed to differences in facility performance.

Another limitation is the fact that important facility-level contextual factors that may influence implementation success—including staffing levels, provider workload, leadership engagement, commodity availability, laboratory capacity, supervision practices, and frequency of stock-outs—were not systematically measured. Consequently, the study was unable to identify the specific determinants responsible for observed differences in performance across facilities.

We acknowledge that the analysis did not adjust for differences in participant characteristics across facilities, including maternal age, parity, gestational age at enrolment, socio-economic status, or underlying obstetric risk. These factors may have influenced both service utilization and receipt of ANC interventions.

This study was conducted in six facilities within two districts of Geita Region and may not fully represent implementation experiences in other regions of Tanzania or other low-resource settings. Nevertheless, the findings provide valuable insights into the opportunities and challenges of integrating Group Antenatal Care within routine public health systems and may inform future scale-up efforts in similar contexts.

Conclusion

Our findings revealed high levels of ANC attendance and facility delivery across diverse facility settings implementing the G-ANC intervention. However, substantial variation in the delivery of essential preventive and diagnostic ANC interventions persisted across facilities, indicating that increased service utilization does not necessarily translate into receipt of the complete package of recommended antenatal care interventions. These findings highlight the need to move beyond measuring service contacts toward assessing effective coverage and quality of care.

Health Centers demonstrated the strongest overall implementation performance, suggesting that facility-level implementation capacity, organizational effectiveness, provider engagement, and supportive supervision may be more important determinants of implementation success than facility level alone.

From a policy perspective, routine maternal health monitoring systems should incorporate indicators of ANC content alongside attendance measures, while quality improvement initiatives should prioritize strengthening laboratory services, commodity availability, provider adherence to ANC guidelines, and routine facility-level performance monitoring. Ultimately, the success of routine G-ANC should be judged not only by the number of women attending ANC, but by the proportion who receive the complete package of recommended interventions capable of improving maternal and newborn outcomes, thus demonstrating effective coverage of the intervention. As countries scale up innovative service delivery models such as G-ANC, ensuring that every ANC contact delivers the full package of recommended interventions will be essential for achieving equitable improvements in maternal and newborn health outcomes. Future research should explore the implementation fidelity and

facility-level determinants of implementation performance and identify strategies for reducing variation in ANC service delivery across routine health systems.

Abbreviations

ANC	Antenatal Care
BEmONC	Basic Emergency Obstetric and Neonatal Care
BP	Blood Pressure
CEmONC	Comprehensive Emergency Obstetric and Neonatal Care
CHWs	Community Health Workers
DH	District Hospital
G-ANC	Group Antenatal Care
Hb	Hemoglobin
HC	Health Center
HMIS	Health Management Information System
ICU	Intensive Care Unit
IPTp3+	Intermittent Presumptive Treatment of Malaria with 3 doses of Sulfadoxine-Pyrimethamine
LMICs	Low- and Middle-Income Countries
MOH	Ministry of Health
NatHREC	National Health Research Ethics Committee
NIMR	National Institute for Medical Research
PHIT	Prime Health Initiative Tanzania
PMO – RALG	Prime Minister's Office Regional Administration and Local Government
RCHS	Reproductive and Child Health Services
SVD	Spontaneous Vaginal Delivery
Td	Tetanus diphtheria
UCS	Unified Community System
WHO	World Health Organization

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Author contributions AH prepared the initial draft of the initial manuscript. AK, IL and EE reviewed the first draft. AH and EE conducted the secondary data analysis. AH, EE, HM, IL, RB, AK, PS, AM, CM, YK, WK, FP, JT, OS, HA, JH and NK provided final inputs on the discussion and overall write-up. All authors read and critically reviewed the drafts of the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Data availability The de-identified dataset generated and analysed during this study, along with the accompanying data dictionary, has been deposited in the Harvard Dataverse repository and is publicly available at: (Hellar et al., 2025; DOI: <https://doi.org/10.7910/DVN/RLAJMC>) [38]. Data have been fully anonymized in accordance with guidance from MOH, Tanzania, and the National Institute for Medical Research (NIMR). Users are expected to ensure confidentiality and appropriate use of the dataset in line with ethical approvals.

Declarations

Ethics approval and consent to participate Ethical approval for the parent Mlinde Mama Project was obtained from the National Health Research Ethics Committee (NathHREC) of the National Institute for Medical Research (NIMR), Tanzania ((NIMR/HQ/R.8a/Vol.IX/4194; 23 January 2023). All procedures involving human participants were conducted in accordance with relevant national ethical guidelines and regulations and the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment in the parent study. The present study involved secondary analysis of de-identified routinely collected data and involved no additional participant contact.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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