

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

While antenatal care (ANC) coverage has improved substantially in many low- and middle-income countries (LMICs), increasing evidence suggests that attendance alone does not guarantee receipt of the full package of recommended maternal health interventions. Group Antenatal Care (G-ANC) has emerged as a promising model for improving maternal health service utilization and quality of care. However, little is known about how implementation performance varies across facilities when G-ANC is integrated into routine government health systems. This study assessed facility-level variation in the delivery of essential ANC interventions among women enrolled in 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. The study included 5,936 pregnant women enrolled in G-ANC across six public health facilities comprising two dispensaries, two health centres, and two district hospitals. Twelve facility-level ANC indicators were assessed, including ANC4+, intermittent preventive treatment for malaria in pregnancy (IPTp3+), iron–folate supplementation, haemoglobin testing, malaria testing, HIV testing, syphilis testing, deworming, facility delivery, blood pressure (BP) monitoring, tetanus vaccination and urine testing. A composite facility performance score was calculated for nine of these twelve indicators, as the mean coverage across the nine indicators.

Results

Coverage of ANC4 + visits (90.2–95.0%), facility delivery (94.1–97.7%), malaria testing (91.5–95.5%), and blood pressure monitoring (100% across all facilities) remained consistently high. In contrast, substantial variation was observed in 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 facility performance scores ranged from 80.1% to 91.9%, with Bwanga Health Centre ranking highest and Butengorumasa Dispensary lowest. Health centres demonstrated the strongest overall implementation performance across most ANC indicators, with variations observed across the six facilities for the nine selected essential ANC indicators.

Conclusions

Among women enrolled in G-ANC across six public facilities, ANC attendance and facility delivery coverage were consistently high. However, substantial variation in the delivery of essential preventive and diagnostic ANC interventions persisted across facilities, highlighting important gaps between service utilization and effective coverage. Routine maternal health monitoring should move beyond attendance indicators alone to include measures of ANC content and implementation quality. Strengthening facility-level implementation capacity, supportive supervision, and continuous quality improvement will be essential to ensure that increased ANC attendance translates into comprehensive, high-quality maternal healthcare.

BACKGROUND

Globally, an estimated 260,000 women die annually from preventable causes related to pregnancy and childbirth, with approximately 70% of these deaths occurring in sub-Saharan Africa[1]. Despite substantial improvements in maternal health service utilization over recent decades, 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) serves as a critical platform for delivering evidence-based interventions that can identify, prevent, and manage pregnancy-related complications, improve birth preparedness, facilitate early detection of high-risk pregnancies, and ultimately improve maternal and newborn survival.

Recognizing the importance of quality antenatal care, the World Health Organization (WHO) recommends a minimum of eight ANC contacts during pregnancy, together with a comprehensive package of clinical assessments, preventive interventions, laboratory investigations, counselling, and health education[3]. However, growing evidence suggests that increasing contact with health services alone is insufficient to improve maternal outcomes if women do not receive the full package of recommended interventions[4, 5]. Consequently, global maternal health discourse has increasingly shifted from measuring service utilization alone toward assessing effective coverage i.e. the extent to which women receive high-quality care that is capable of producing the intended health benefits[6–9]. According to previous data, only 4 out of 10 women receive effective ANC care in Tanzania[10].

In many LMICs, substantial gaps remain between ANC attendance and the actual content of care received. Women may attend multiple ANC visits yet fail to receive essential interventions such as malaria prevention, anaemia screening, HIV and syphilis testing, tetanus immunization, or counselling on birth preparedness and danger signs [4, 11]. These gaps are often driven by health system constraints, including shortages of trained

personnel, stock-outs of commodities, limited laboratory capacity, inadequate supervision, weak referral systems, and inconsistent adherence to clinical guidelines. As a result, high ANC coverage does not necessarily translate into improved maternal and newborn health outcomes.

Tanzania has achieved high coverage of at least one ANC visit during pregnancy, with recent national surveys reporting that approximately 89% of women receive ANC from a skilled provider at least once during pregnancy[12]. Nevertheless, challenges remain in ensuring timely initiation of ANC, continuity of care, and delivery of the complete package of recommended services[13, 14]. Maternal mortality remains a significant public health concern, and previous studies have highlighted persistent gaps in the quality and content of ANC services, particularly in rural and underserved settings[15]. These findings underscore the need for innovative service delivery approaches that not only improve attendance but also strengthen the quality and comprehensiveness of care provided during pregnancy.

Group Antenatal Care (G-ANC) has emerged as an innovative and increasingly adopted 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. Previous studies from both high-income and resource-constrained settings have demonstrated that G-ANC can improve ANC attendance, maternal knowledge, birth preparedness, satisfaction with care, and selected maternal and newborn health outcomes[16–19]. In Tanzania, G-ANC has gained increasing attention as a promising strategy for strengthening person-centred care, improving continuity of care, and enhancing maternal engagement throughout pregnancy[20, 21].

Although previous studies have demonstrated that G-ANC can improve antenatal care attendance, maternal experience, and selected maternal and newborn health outcomes, most evaluations have focused on overall program effectiveness. Considerably less attention has been paid to understanding how implementation performance varies across facilities or how consistently individual essential antenatal care interventions are delivered when G-ANC is integrated into routine public health systems. To our knowledge, no published study has specifically examined facility-level variation in the delivery of individual essential ANC interventions within routine G-ANC programmes. Understanding why some facilities consistently deliver a more complete package of ANC interventions than others is critical for improving effective coverage, informing quality improvement efforts, and guiding scale-up of maternal health interventions. This represents an important knowledge gap because implementation success may be influenced by local contextual factors, including staffing levels, leadership, commodity availability, infrastructure, supervision, and organizational capacity. Consequently, facilities implementing the same intervention may achieve substantially different results. Understanding these differences is essential for informing scale-up strategies, identifying implementation bottlenecks, and ensuring equitable delivery of quality maternal health services.

Between 2023 and 2024, the Prime Health Initiative Tanzania (PHIT), in collaboration with regional and district health authorities, implemented a routine Group Antenatal Care program across six public health facilities in Geita Region as part of the Mlinde Mama Project, funded by the Gates Foundation. The intervention was integrated within existing government maternal health services and supported by the Unified Community System (UCS), a digital platform designed to strengthen client registration, service delivery, continuity of care, and routine performance monitoring.

This present study aimed to evaluate implementation performance and effective coverage across facilities in the delivery of essential antenatal care interventions among women enrolled in the routine G-ANC program. Specifically, we compared coverage of key ANC interventions across facilities and facility types and examined differences in overall implementation performance. By moving beyond aggregate program outcomes to explore facility-level variation, this study contributes to a growing body of evidence on effective coverage, quality of care, and implementation science in maternal health. The findings may help inform quality improvement efforts and guide the scale-up of Group Antenatal Care within routine health systems in Tanzania and other similar low-resource settings.

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[22], 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.

Six public health facilities participating in the Mlinde Mama 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 (Butengorumsa and Nkome), two health centres (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.

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 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.

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 toxoid 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 toxoid 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 Microsoft Excel. 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 centre, 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 centres (Katoro Health Centre and Bwanga Health Centre), and two district hospitals (Chato District Hospital and Nzera District Hospital). Katoro Health Centre enrolled the largest number of participants (1,593; 26.8%), followed by Bwanga Health Centre (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 centres 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

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 and Fig. 2).

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

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

Table 2
Composite Facility Performance Scores Across Six G-ANC Implementation Sites in Geita Region, Tanzania

Facility	N	ANC4+	IPTp3+	Iron-Folate	Hb ≥ 2	Malaria ≥ 2	HIV ≥ 2	Syphilis ≥ 2	Deworming ≥ 2	Facility Delivery	Composite Score (%)	Rank
Bwanga HC	1,265	95.0	86.3	92.7	85.0	95.0	95.0	95.0	85.0	97.7	91.9	1
Nkome Disp	1,082	93.3	80.0	80.0	80.0	95.5	85.0	85.0	80.0	96.8	86.2	2
Katoro HC	1,593	93.8	73.6	75.0	80.0	93.0	90.0	90.0	70.0	95.0	84.5	3
Chato DH	846	94.7	75.1	81.0	70.0	93.9	80.0	80.0	75.1	94.9	82.7	4
Nzera DH	691	90.2	60.1	83.8	87.3	91.5	70.0	70.0	79.7	94.2	80.8	5
Butengorumasa Disp	459	93.9	66.9	83.2	86.5	93.9	59.9	59.9	83.0	94.1	80.1	6

Composite scores for the 9 Essential ANC indicators ranged from 80.1% to 91.9%.

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 consistently high across all facilities, ranging from 90.2% at Nzera District Hospital to 95.0% at Bwanga Health Centre. 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 Centre to 92.7% at Bwanga Health Centre. IPTp3 + coverage ranged from 60.1% at Nzera District Hospital to 86.3% at Bwanga Health Centre.

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

Overall, Bwanga Health Centre 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 antenatal care (ANC) interventions across six public health facilities implementing routine Group Antenatal Care (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 pressure; IPTp3+ = receipt of three or more doses of intermittent preventive treatment for malaria during pregnancy; Hb ≥ 2 = haemoglobin testing on at least two occasions; HIV ≥ 2 and Syphilis ≥ 2 = testing conducted on at least two occasions during pregnancy.

The heatmap demonstrates consistently high coverage of 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 centres demonstrated the strongest overall performance across several key indicators. Coverage of IPTp3+ was highest among health centres (79.3%), compared with dispensaries (76.1%) and district hospitals (68.3%). Health centres 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 remained consistently high across all facility types, exceeding 92% and 94%, respectively. Blood pressure monitoring achieved universal coverage (100%) across all three levels of care. Malaria testing also remained consistently high, 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 centres, while haemoglobin testing was highest among health centres (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 centres (76.6%).

Overall, health centres 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. While the intervention achieved consistently high ANC attendance and facility delivery coverage, 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 [4, 23, 24].

Four major findings emerged from this analysis. First, ANC attendance and facility delivery coverage were consistently high across all facilities. Second, important gaps remained in the delivery of several essential ANC interventions despite high service utilization. Third, health centres demonstrated superior overall implementation performance compared with district hospitals and dispensaries. Finally, facility-level contextual and operational factors appeared to influence implementation success more strongly than facility level alone.

High ANC Attendance and Facility Delivery Coverage Across Facilities

One of the most notable findings was the consistently 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 [12] and compare favourably with results from previous studies evaluating Group Antenatal Care in similar settings[25–30].

Although this study was not designed to evaluate the effectiveness of G-ANC, the high levels of ANC attendance observed are consistent with previous studies suggesting that G-ANC may facilitate continuity of care through improved provider–client relationships, peer support, and structured cohort-based follow-up. The integration of G-ANC within routine government services, together with digital client tracking through the UCS, may have supported continuity of care by facilitating appointment tracking, follow-up, and service documentation throughout pregnancy.

Importantly, the consistency of these findings across all facility levels suggests that the model can be successfully implemented in diverse service delivery settings.

Coverage Does Not Necessarily Equate to Content of Care

Despite strong attendance outcomes, substantial variation was observed in the delivery of several essential ANC interventions, including IPTp3+, HIV testing, syphilis testing, urine testing, and tetanus toxoid vaccination. These findings reinforce concerns raised in recent maternal health literature that a contact with health services does not necessarily guarantee receipt of the full package of recommended interventions. While women attended ANC visits and remained engaged in care, many did not receive all recommended preventive and diagnostic services. This discrepancy highlights the distinction between service utilization and quality of care. Similar findings have been reported from several low- and middle-income countries, where improvements in ANC coverage have not always translated into improvements in service content or quality[4, 10, 11, 23, 24].

The relatively lower coverage of HIV and syphilis testing observed in some facilities may reflect periodic shortages of diagnostic commodities, limited laboratory capacity, inadequate service readiness, or inconsistent implementation of testing protocols. Similar barriers to routine ANC screening have been reported in sub-Saharan African settings, where facility readiness and availability of diagnostic supplies remain important determinants of service quality. Similarly, variation in IPTp3 + coverage may be associated with delayed ANC initiation, missed opportunities during follow-up visits, or intermittent stock-outs of sulfadoxine-pyrimethamine. During implementation of this G-ANC project, reagents for urine tests were reported to be frequently out of stock, thus hindering routine performance of the tests. Overall, these findings mirror other studies conducted in low-resource settings, highlighting logistical and planning challenges that may affect effective coverage of ANC services [31–34].

The wide variation observed in urine testing coverage may further suggest differences in local implementation practices and resource availability. The observed variation in tetanus toxoid vaccination could not be fully interpreted because previous maternal immunization history was not captured in the routine dataset. As eligibility for vaccination depends on prior doses received, differences in coverage may not necessarily reflect differences in implementation performance.

Health centres demonstrated the most consistent overall implementation performance

An unexpected finding was that Health centres achieved the highest overall composite performance and consistently performed well across most preventive and screening interventions, particularly IPTp3+, HIV testing and syphilis testing. However, they did not outperform other facility types across every indicator. For example, district hospitals achieved slightly higher haemoglobin testing coverage, while dispensaries demonstrated the highest deworming coverage. These findings suggest that implementation performance reflects multiple dimensions of service delivery rather than superiority across all clinical processes. Several explanations may account for this observation. Health centres often provide a balance between adequate staffing, manageable patient volumes, and continuity of provider-client interactions. Unlike district hospitals, which frequently manage large patient loads and complex referrals, health centres may be better positioned to maintain adherence to routine ANC protocols and ensure that women receive the full package of recommended interventions. At the same time, health centres generally have greater staffing levels and diagnostic capacity than dispensaries, enabling more comprehensive service delivery. These results are consistent with broader health systems research demonstrating that organizational effectiveness, leadership, staff engagement, and workflow management may be more important determinants of service quality than infrastructure or facility designation alone [35].

Facility-Level Factors Influence Implementation Success

The substantial differences observed between facilities implementing the same intervention suggest that local contextual factors play an important role in determining implementation success. The average composite performance scores differed by more than ten percentage points between the highest- and lowest-performing facilities. These findings suggest that successful implementation of G-ANC depends not only on the intervention itself but also on the capacity of individual facilities to operationalize the model effectively. Factors such as leadership engagement, provider motivation, supervision, staffing levels, commodity availability, laboratory capacity, and data use practices may influence the extent to which women receive comprehensive ANC services [35–37].

From an implementation science perspective, these results highlight the importance of monitoring facility-level performance during scale-up efforts. Aggregate program indicators may conceal important variations in implementation quality and may fail to identify facilities requiring additional support. Routine performance monitoring using composite quality indicators could help identify implementation bottlenecks and inform targeted quality improvement interventions.

Although all facilities received similar training, utilized the same digital platform, and implemented the same G-ANC model, differences in performance suggest that local context plays a critical role in determining implementation outcomes. G-ANC strengthened service utilization (attendance) but was not a solution for some underlying health system weaknesses such as commodity shortages, laboratory constraints, workforce limitations, and supervision gaps. These findings reinforce the importance of considering implementation readiness, organizational

capacity, and health system context when scaling maternal health interventions within routine service delivery settings. Overall, these findings suggest that improving ANC attendance alone is insufficient to achieve effective maternal healthcare. Routine monitoring should therefore move beyond service utilization indicators to assess whether women consistently receive the complete package of recommended ANC interventions across all facilities.

Implications for Policy and Practice

The findings have important implications for maternal health policy and program implementation. First, routine monitoring systems should move beyond attendance-based indicators and incorporate measures of ANC content and effective coverage to better assess quality of care. Programs need to track ANC content indicators alongside ANC attendance indicators. Second, facility-level performance dashboards should be institutionalized within routine maternal health monitoring systems to identify implementation gaps and support data-driven decision-making. Third, targeted quality improvement interventions should focus on strengthening delivery of lower-performing ANC components, particularly IPTp3+, HIV and syphilis testing and urine testing and ensure adequate coverage for tetanus vaccination (according to women's eligibility). Fourth, supportive supervision approaches should prioritize low-performing facilities and focus on addressing operational barriers such as commodity stock-outs, laboratory capacity constraints, staffing shortages, and workflow inefficiencies. Finally, future scale-up of G-ANC should incorporate continuous quality improvement and implementation monitoring mechanisms to ensure that gains in ANC attendance are accompanied by improvements in the content and quality of care delivered.

Strengths and Limitations

This study has several important strengths. First, it 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. Second, 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. Third, inclusion of facilities across three levels of care—dispensaries, health centres, and district hospitals—allowed for meaningful comparison of implementation performance across different health system contexts.

Several limitations should be considered when interpreting the findings. First, 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.

Second, 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.

Third, 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.

Fourth, 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.

Fifth, 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.

Finally, the 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 centres 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

BP

Blood Pressure

DH

District Hospital

G-ANC

Group Antenatal Care

Hb

Hemoglobin

HC

Health Center

HMIS

Hospital 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

SVD

Spontaneous Vaginal Delivery

TT

Tetanus Toxoid

UCS

Unified Community System

WHO

World Health Organization

DECLARATIONS

Ethics approval and consent to participate

The study protocol was approved by the National Health Research Ethics Committee (NatHREC), Tanzania (NIMR/HQ/R.8a/Vol.IX/4194; 23 January 2023). Participation in G-ANC was voluntary; withdrawal did not affect access to standard care. 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.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests

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Author Contribution

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, HM, EE, 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: 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.

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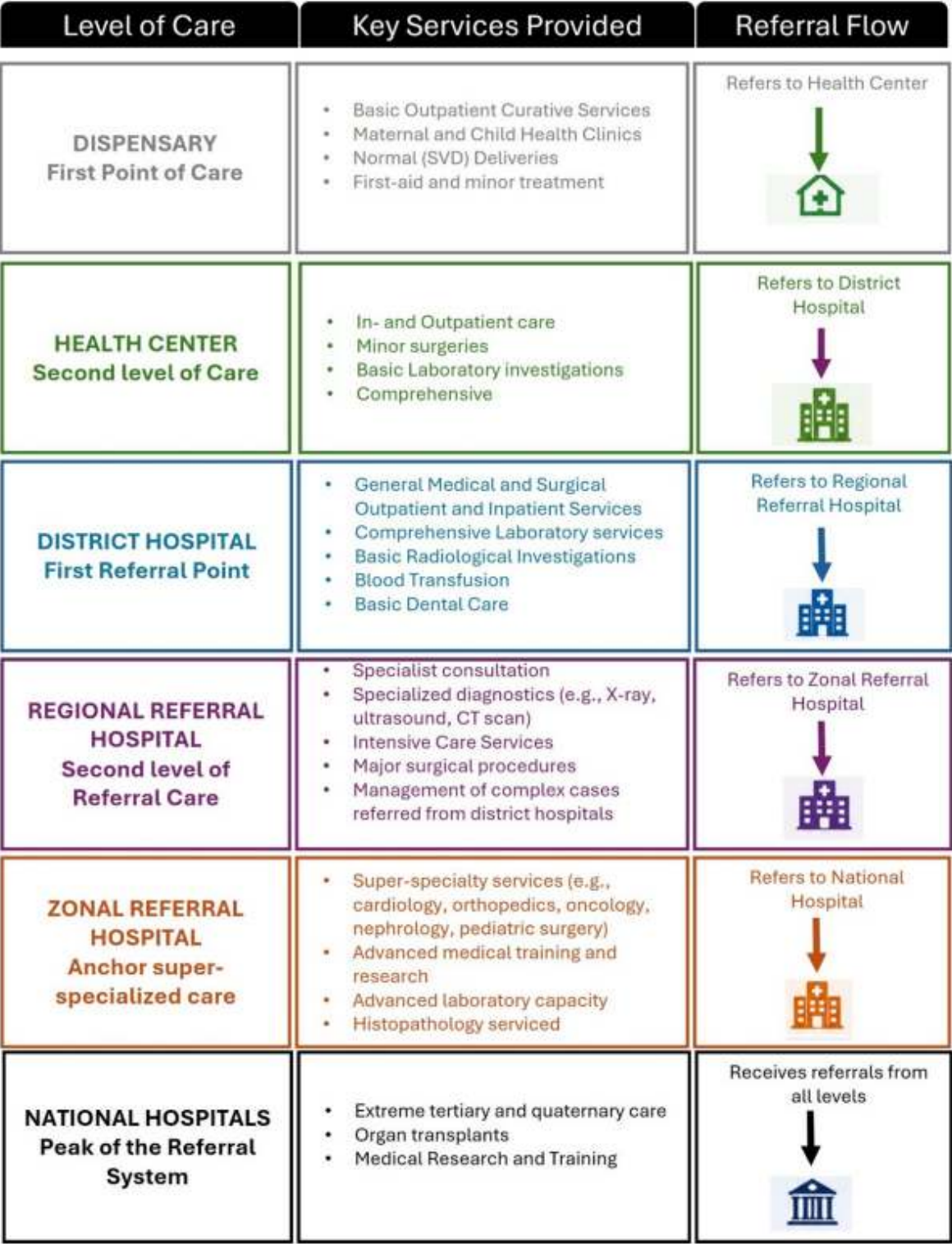
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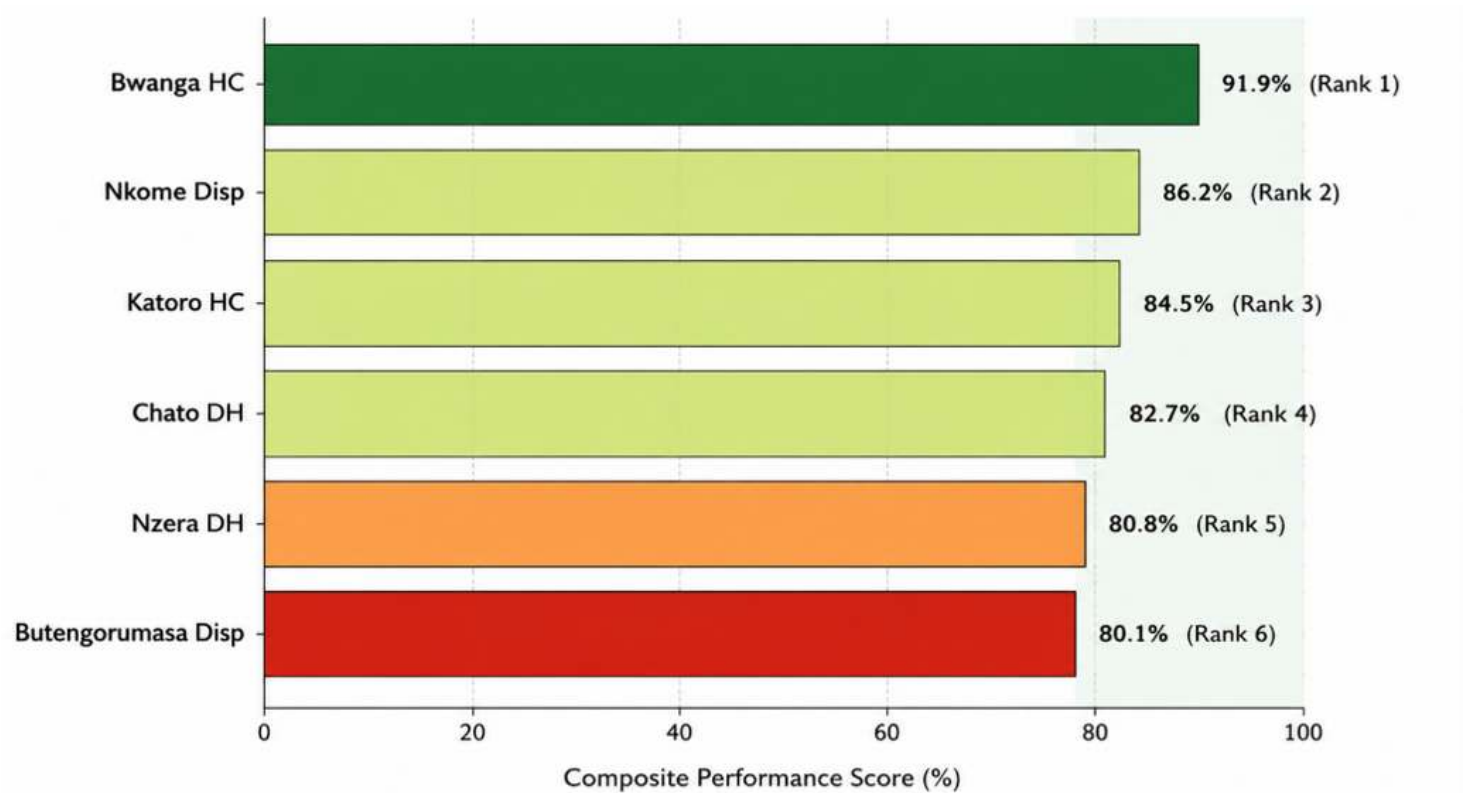
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Figures



Tanzania Health System Levels of Care:



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

Figure 2

Facility Performance Ranking:

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)	TT Vaccination (≥2)	Urine Testing (≥2)	BP Monitoring (Every visit)	Facility Delivery
Bwanga HC (1,265)	95.0	86.3	82.7	85.0	95.0	95.0	95.0	85.0	91.7	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	48.1	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	48.0	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	38.1	100.0	94.2
Butengorumasa Disp (459)	93.8	66.9	83.2	86.5	93.8	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 (≥90%)

High (80 – 89.9%)

Moderate (70 – 79.9%)

Low (50 – 69.9%)

Very Low (<50%)

Notes: BP – Blood Pressure; TT – Tetanus Toxoid; 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.

Figure 3

Heatmap of ANC Indicator Coverage Across G-ANC Implementation Sites

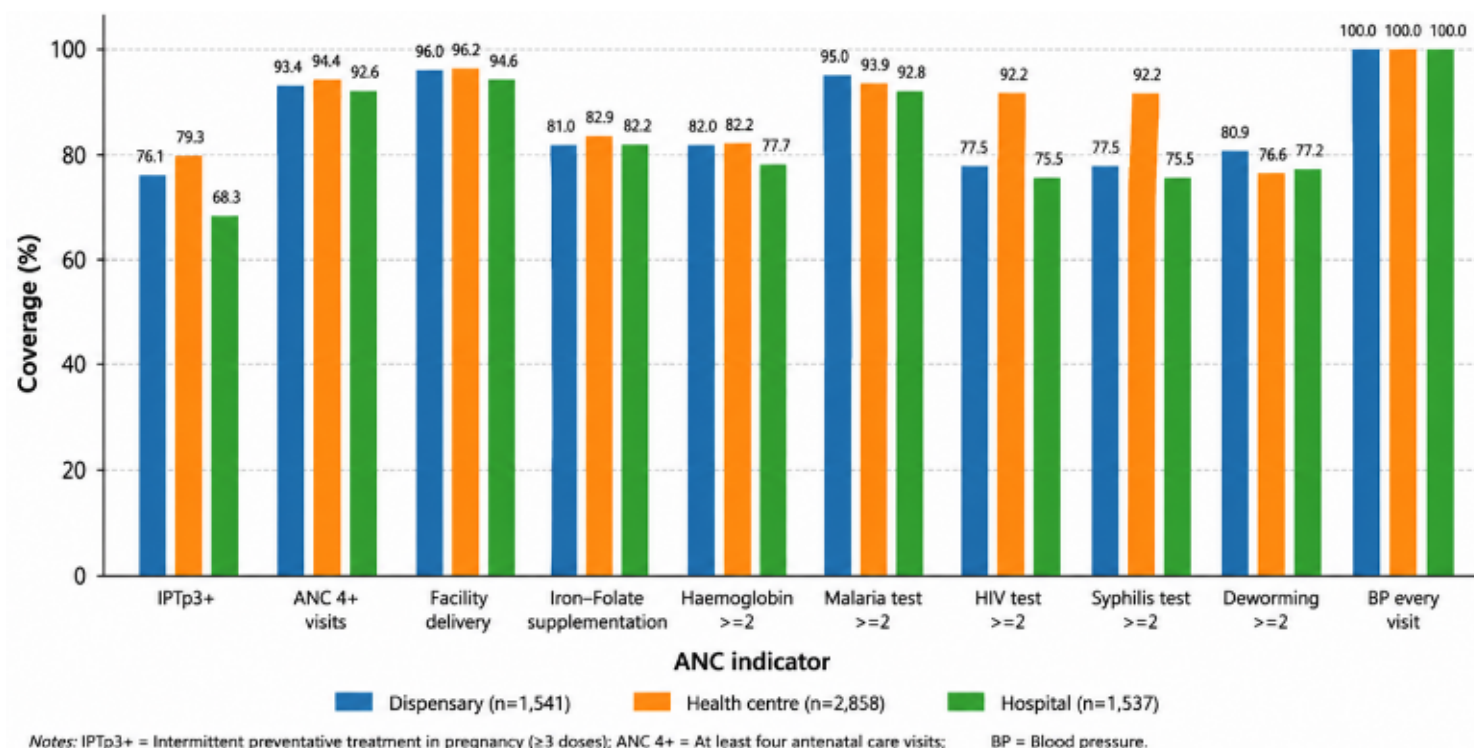


Figure 4

G-ANC Coverage by Facility Level: