


Low effective coverage of HIV testing and counselling services during antenatal care in Ethiopia: evidence from the demographic and health survey and service provision assessment

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ABSTRACT

Introduction Prevention of mother-to-child transmission contributes to avert nearly 4000 new HIV infections in 2022. HIV testing and counselling (HTC) during antenatal care (ANC) is an effective strategy to reduce the vertical transmission of HIV. While the utilisation of HTC services in Ethiopia has been explored, there is limited evidence exploring the effective coverage of HTC during ANC. We aimed to assess the quality-adjusted (effective) coverage of HTC during ANC in Ethiopia.

Methods We linked the 2016 Ethiopian Demographic Health Survey and the 2021–2022 Ethiopian Service Provision Assessment (ESPA) surveys to determine the crude coverage and assess the quality of HTC provision. The ESPA service quality framework, which has structural and process-related components, was used. We used a weighted additive approach of 61 indicators (38 structural and 23 process) to estimate the quality of care score. Administrative boundary linkage was used to link the two datasets. The effective coverage was calculated as the product of crude coverage and the quality of care score. **Results** During ANC contacts/visits, 17.2% (95% CI 16.0 to 18.4) of women received HTC. The effective coverage of HTC during ANC was 10.8 (95% CI 9.8 to 11.8), with substantial disparities among administrative regions, ranging from 1.6% (95% CI 1.3, 2.0) in the Somali region to 55.5% (95% CI 53.5 to 57.5) in Addis Ababa. The overall service quality was 45.2% (95% CI 42.8 to 47.1). Health facilities in Harari (31.4% (95% CI 19.0 to 43.8)), Somali (34.1% (95% CI 26.8 to 41.6)) and Dire Dawa (34.9% (95% CI 24.71 to 45.0)) demonstrated low-quality service provision. Health posts (5.8%, SD=8.4), health facilities located in rural areas (30.6%, SD=27.3) and public health facilities (44.2%, SD=29.4) had low-quality HTC provision.

Conclusion Nearly 9 in 10 women did not receive quality HTC during ANC provision. The crude coverage, quality of services provision and effective coverage significantly vary across administrative regions. Afar and Somali regions lagged behind the Addis Ababa and Amhara administrative regions. To effectively mitigate mother-to-child transmission of HIV, policymakers need to prioritise

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ HIV testing during antenatal care (ANC) in Ethiopia has been explored. However, the level of HIV testing and counselling (HTC) and its quality-adjusted coverage (effective coverage) were not known.

WHAT THIS STUDY ADDS

⇒ This study provides a comprehensive analysis of the contact coverage, quality and effective coverage of HTC during ANC in Ethiopia. It highlights significant regional disparities, with low-quality service provision, particularly in health posts, rural areas and public health facilities.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Policymakers should prioritise enhancing the quality of HTC services during ANC alongside efforts to expand their coverage. Strengthening the delivery of HTC services, particularly in regions with low effective coverage to effectively reduce mother-to-child transmission of HIV.

enhancing the quality of care in HTC during ANC and expanding service delivery.

INTRODUCTION

In 2022, an estimated 1.2 million pregnant women worldwide were living with HIV, among those approximately 82% of them receiving antiretroviral medication to prevent mother-to-child transmission (MTCT).¹ Since 2000, interventions targeting the vertical transmission of HIV during pregnancy, child-birth and breast feeding prevented an estimated 3.4 million infections among children aged 0–14 years.²

HIV testing and counselling (HTC) is critical to ensuring universal access to HIV prevention and care services. HTC is likely to increase the life expectancy of individuals with HIV, and it is a cost-effective intervention.³ In high-income countries, MTCT of HIV/AIDS is nearly zero with the help of safe and clean delivery services, safe breastfeeding practices (eg, exclusive breast feeding for the first 6 months), access to antiretroviral therapy (ART) and effective testing and counselling for HIV.⁴ Between 2009 and 2013, the MTCT rate dropped from 28% to 18% in Sub-Saharan Africa (SSA).⁵ Even though the MTCT rate has a positive trend, it is considerably higher than elsewhere. However, despite current progress, SSA still has a high burden of MTCT.⁶

The joint United Nations Programme on HIV/AIDS sets the global 90-90-90 target to ensure that 90% of people living with HIV know their status, 90% of people living with HIV start ART, and 90% of people with ART have suppressed viral load by 2020. The strategy was designed to eliminate HIV/AIDS epidemics by 2030.⁷ The WHO promotes a comprehensive approach to improve the effective prevention of MTCT of HIV.⁸ The approach includes routine HTC for pregnant women during antenatal care (ANC), clinical management and highly active ART for the mother or antiretroviral (ARV) prophylaxis during labour, and counselling on safe infant feeding practice after delivery.^{8,9} Prevention of Mother to Child Transmissions (PMTCT) of HIV/AIDS is an integral part of routine ANC care to ensure a high rate of case detection and timely treatment coverage.^{10,11} The WHO recommends provider-initiated HTC as a routine component of the ANC package for all women in all ANC settings. Those who test positive will be linked immediately with interventions such as HIV treatment for the PMTCT.¹² Improving the quality of PMTCT services could substantially contribute to reducing the burden of HIV in children.¹³

Around 76% of early infant mortality and 75% of HIV progression could be reduced by early HIV diagnosis and early ART.¹⁴ Regarding closing that gap, poor adherence to therapy, poor mother-to-child linkage to prevention in MTCT services, low early infant diagnosis coverage and low paediatric ART coverage are among the main challenges in SSA.^{5,15} In Ethiopia, only one in five (19%) women received HIV counselling and testing during ANC visits in 2016, ranging from the highest coverage in Addis Ababa (95.8%) to the lowest in the Somali region (14.2%).¹⁶

The WHO states that MTCT is a serious public health problem that is attributable to 90% of childhood HIV infections.^{17,18} Globally, there were an estimated 160 000 children with newly acquired HIV in 2021. Although children accounted for 4% of people living with HIV, they accounted for 15% of all AIDS-related deaths¹⁹ as they have low immunity, which makes them vulnerable to opportunistic infections.¹⁴ Over 90% of HIV infections among children occur during pregnancy, labour/delivery or breast feeding.⁸ More than 80% of new HIV infections

are from SSA countries. Nearly 95% of children with HIV infection in Ethiopia are attributed to MTCT.^{20,21}

Despite notable improvements in HIV care, the challenges that affect the effectiveness of preventing MTCT of HIV are diverse and multi-factorial.^{22,23} Previous studies identified socio-demographic characteristics such as marital status, education level, place of residence, wealth status, risky sexual activity, having a stigmatising attitude, knowledge of HIV/AIDS and knowledge of MTCT during pregnancy as being factors that affect HIV testing among pregnant women.^{24–26} In addition, health system-related factors influence the uptake of effective HIV counselling and testing during pregnancy.^{27,28}

Tanahashi showed five health service coverage measures. These are (1) availability coverage, (2) accessibility coverage, (3) acceptability coverage, (4) contact coverage and (5) effective coverage.²⁹ Of these coverage measures, the ‘contact coverage’, also known as actual coverage, measures the fraction of participants who used a service. However, this does not guarantee the success of an intervention since it does not account for the quality of care provided to patients.^{29–31} ‘Effective coverage’, which measures both utilisation and quality of care estimating potential health gains from using the services, has been identified as a preferred measure of coverage.³²

Ethiopia has a low effective coverage of ANC services (22%), with regional variations from 15% in the Somali region to 39% in the Tigray region.³² Moreover, the contact coverage of HIV testing during ANC follow-up has been explored in a previous study.²⁴ The effective coverage of HTC services remains unexamined. This study fills that gap by assessing the effective coverage of HTC during ANC follow-up in Ethiopia using a geographic data linkage of the Ethiopian Demographic Health Survey (EDHS) and Ethiopian Service Provision Assessment (ESPA) datasets.

METHODS

Study area

Ethiopia has a three-tiered health system (primary, secondary and tertiary care). A primary healthcare unit consists of four health centres, each with five health posts and a primary hospital. A health centre provides preventive and curative services. The secondary level of care consists of general hospitals. Finally, the tertiary level of care consists of specialised hospitals and university hospitals.^{33,34}

Design and data sources

This study comprises geographic data linkage of the 2021–2022 ESPA and the 2016 EDHS. The ESPA survey is a health facility survey that collects information on the health system’s service availability and quality of care. We used the 2021–2022 ESPA to estimate the quality of HCT provision during ANC follow-up. The ESPA data consist of two sampling approaches—(1) a census of hospitals in the country and (2) a nationally representative sample of

public and private health facilities (health centres, private clinics and health posts). The DHS collects, analyses and distributes accurate and nationally representative information on population, health, HIV and nutrition for over 90 countries. Both EDHS and ESPA datasets are publicly available on the DHS Program website (<https://dhsprogram.com/>). We have followed the Strengthening the Reporting of Observational Studies in Epidemiology statement checklist.³⁵

Sampling procedure

EDHS 2016: the survey used the 2007 Ethiopian population and housing census conducted by the Ethiopian Central Statistical Agency. The census has 84915 enumeration areas—each enumeration area, on average, covers 181 households. The sampling frame has information about the enumeration area location, type of residence and estimated number of households. At the time of data collection, Ethiopia was divided into nine regions and two administrative cities. The survey estimated representative data for the country, rural/urban regions and city administrations. Details of the sampling procedure can be found in the 2016 Ethiopian DHS report.³⁶

ESPA 2021–2022 is a stratified random sample of 1407 health facilities. The health facilities were stratified using region and facility type. The clinics were stratified using clinic designation (higher, medium, lower or specialty clinics). All hospitals (n=413) were included because of the relatively small number. However, the health centres were sampled in all regions except for the Dire Dawa and Harari, where all the health centres were included. The detailed sampling procedure is described in the ESPA 2021–2022 report.³⁷

Study variables and measurement

Contact coverage

HIV counselling is considered when women receive all of the following counselling services: (a) babies getting HIV from their mothers, (b) preventing the virus and (c) getting tested for HIV.³⁸

HIV testing is regarded as when women report the recipient of an HIV test and its results and post-test counselling.³⁸

HTC: women who gave birth in the past 2 years reported the provision of HTC, including post-test consultation during ANC.³⁸

Quality of care variables

For the health facilities that provide HIV testing services (either on-site or at an external testing site), the quality of HTC services was assessed using the service provision assessment (SPA) quality of care framework, which measures structural and process aspects of the services provision (online supplemental figure 1). The structural component consists of the availability of necessary infrastructure and health workforce, such as human and physical resources, while the process component includes the provision of care, which includes HIV

testing, counselling, ART provision, family planning, delivery and postexposure prophylaxis. The components are critical to estimating HTC service quality.^{37 39} The SPA quality framework was underpinned by the Donabedian healthcare quality framework, which has the structure, process and outcome components.⁴⁰

The quality parameters were chosen based on the 2021 national guideline for preventing MTCT of HIV, syphilis and the hepatitis B virus⁴¹ and the 2022 National ANC guideline.⁴² A total of 61 (38 structure-related and 23 process) indicators were used to measure the quality of HTC during ANC follow-ups (online supplemental table 1).

Data management and analysis

We used individual records from the EDHS. For the ESPA, we used the health facility and ANC records. The sociodemographic characteristics of respondents were presented using tables. The mean and percentage of sociodemographic characteristics of respondents were reported. The health facility characteristics were described across administrative regions. The HTC percentages were weighted and presented using figures disaggregated by region. The HTC coverage was calculated as the number of women who received counselling on HIV during ANC, received an HIV test during ANC and received the results of the test divided by the number of women who had a live birth in the 2 years preceding the survey.

The quality of HTC was estimated using additive weighting methods.⁴³ Weights were assigned to each component (structural and process) based on the number of parameters used. Therefore, the structural component constituted 62.3% (38/61×100) of the total, and the process components constituted 37.7% (23/61×100). The score of each component was calculated using the following formula:

$$\text{Structural component} = \frac{\text{Total number of "yes" responses in the structural component}}{\text{Total number of parameter in the structure component}} \times 62.3\%$$

$$\text{Process component} = \frac{\text{Total number of "yes" responses in the process component}}{\text{Total number of parameter in the process component}} \times 37.7\%$$

The components were summed up for each health facility. The country and regional-level HTC quality was reported by calculating the average of the health facilities in the area.

We used the administrative boundary to link the EDHS and ESPA datasets.^{44 45} The linkage was conducted at the regional level, and the DHS and ESPA data were linked using the administrative regions and city administrations.

The effective coverage of HTC was calculated by multiplying the coverage of HTC with the quality of the nearest

health facility. The equation was adopted from the WHO effective coverage framework.^{31 46} The maximum amount of effective coverage would be when the quality is equal to 100%, which is equal to the contact coverage.

$$\text{Effective coverage} = \frac{\text{Quality of health intervention}}{\times \text{crude coverage of service}}$$

Handling of missing data

Missing data were managed according to the DHS statistics guide.³⁸ Respondents with missing values on HIV testing, receiving the result, or receiving post-test counseling were considered not to have received these services.

Patient and public involvement

No patient involved.

RESULTS

Participant characteristics

In this study, a total of 3903 women of reproductive age were included. Over half of the participants (56.59%) were between the ages of 25 and 35, while 95% were married. More than 70% of women are multiparous, and around 7 in 10 women have less than four ANC visits (table 1).

Health facility characteristics

Among 1158 health facilities, a total of 725 health facilities provided ANC services. The majority (95.7%) of the health facilities were managed by the government. Health posts accounted for the majority (34%) of the health facilities. Most of the health facilities are from rural parts of the country (online supplemental table 2).

HTC during ANC

The majority of women got HIV testing services; however, not all of them received the results. There were high variations of HTC across different regions in Ethiopia. Women residing in Addis Ababa had the highest utilisation of HTC service during ANC (76.38%), and the Somali region had the lowest utilisation of HTC during ANC (4.7%) (figure 1).

Quality of care

The structural component of HTC during ANC service quality was found to be 35.4%, with a great gap in regions ranging from Afar and Dire Dawa, each 26% to Addis Ababa (61%). The national process component of HTC during ANC service quality was 61%, ranging from 40% in the Harari region to 92% in Addis Ababa city administration (table 2).

The overall quality score of HTC service provision was 45.2% (95% CI 42.8 to 47.1). There was an HTC quality provision disparity across facility type, location and the managing authority. Hospitals had the highest quality (66.2%, SD=14.2), followed by clinics (54.5%, SD=21.1) and health centres (52.5%, SD=21.6). Health posts had the lowest quality of HTC provision (5.85%, SD=8.4).

Table 1 Respondent characteristics in 2016 (n=3903)

Variables	Number	Percentage
Age		
15–24	1105	28.3
25–35	2,209	56.6
36–49	589	15.1
Marital status		
Unmarried	182	4.7
Married	3720	95.3
Residence		
Urban	458	11.7
Rural	3445	88.3
Religion		
Orthodox	1167	29.9
Muslim	1708	43.8
Protestant	874	22.4
Others	155	4.0
Region		
Afar	43	1.1
Amhara	789	20.2
Oromia	1915	48.0
Somali	178	3.3
Benishangul-Gumuz	45	1.2
SNNPR	876	22.5
Gambela	10	0.3
Harari	10	0.3
Addis Ababa	110	2.8
Dire Dawa	18	0.5
Education		
No education	2392	61.3
Primary education	1182	30.3
Secondary education	216	5.5
Higher	111	2.9
Occupation		
No	2302	59.0
Yes	1601	41.0
Wealth		
Poorest	823	21.1
Poorer	864	22.2
Middle	824	21.1
Richer	726	18.6
Richest	666	17.1
Maternal and obstetric characteristics		
ANC		
Less than four visits	2670	68.4
Four or more visits	1233	31.6
Parity		
1–4	2818	72.2
≥5	1085	27.8

ANC, antenatal care; SNNPR, Southern Nations, Nationalities and Peoples.

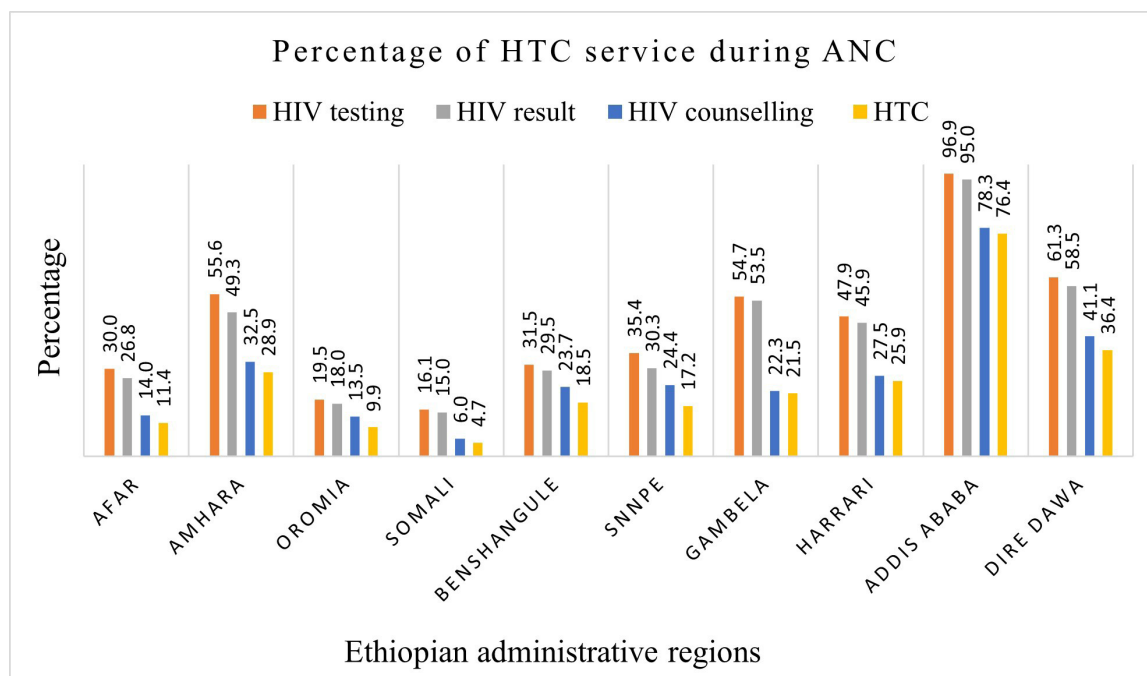


Figure 1 Percentage of women who received HIV testing and counselling (HTC) services during antenatal care (ANC) visits in Ethiopia by region, 2016.

Rural health facilities had low-quality service delivery. The government health facilities had the lowest quality of HTC delivery when compared with the private and NGO health facilities (table 3).

Effective coverage

The national effective coverage of HTC during ANC was 10.8% (95% CI 9.8 to 11.7), with significant variations across the country. The effective coverage ranged from 1.6% (95% CI 1.3 to 2.0) in the Somali region to 55.5% (95% CI 53.5 to 57.5) in Addis Ababa. The difference in crude and effective coverage was highest in Dire Dawa, with a 23.7 percentage point difference (table 4). There were also effective coverage variations across different health facilities (online supplemental table 3).

DISCUSSION

This study measured the effective coverage of HTC during ANC follow-up using the EDHS and ESPA datasets. The effective coverage of HTC during ANC was found to be 10.8%, showing a 10.7 percentage points difference from the crude coverage (17.2%). This indicates that only 1 in 10 women received quality HTC services during ANC. Effective coverage varied significantly across regions, with Somali having the lowest effective coverage at 1.6%, followed by Afar at 4.1%. In contrast, Addis Ababa, the capital city, had the highest effective coverage at 55.5%.

This study revealed that the structural component of HTC during ANC service quality was 35.4%, with significant regional disparities ranging from 26% in

Afar to 61.2% in Addis Ababa. Afar, Harari and Dire Dawa administrative regions exhibited the lowest performance in the structural quality component, with nearly three quarters of human and physical resources missing in these regions. A study conducted in Ghana suggested the need to improve structural barriers to improve PMTCT service.⁴⁷ This shows the importance of ensuring facilities' readiness in human resources and material availability to provide quality HTC services for pregnant women attending ANC.^{48 49} Thus, Afar, Harari and Dire Dawa regions should focus on improving human resource capacity and material availability.

In addition to structural issues, Harari, Somali and Dire Dawa also scored lowest in the quality of care process measurements. This was supported by the lowest healthcare access in the Somali region.⁵⁰ The process component of HTC ranges from 43% in the Somali region to 92% in Addis Ababa. Hospitals (86%) have the highest score in process components of quality of care, and the lowest is at the health posts (9.7%). These findings highlight the need to improve service delivery, increase client centre and smooth provider–client relationships in the health posts. A study in Kumasi metropolis showed the relationship between health provider attitude and HTC during ANC, showing that providers play a great role in creating a safe environment for the client by protecting their privacy and giving appropriate care.⁵¹

The overall quality of HTC during ANC was 45.2%, which varies across different administrative regions, health facilities type (hospital/health centre/clinic)

Table 2 Structural and process components of health facilities quality by region, ESPA 2020–2022

Regions	Number of HF	Hospital	Health centre	Health post	Clinic	Subtotal
Structure						
Afar	27	66.5	27.7	2.6	N/A	26.0
Amhara	114	58.6	49.5	6.7	N/A	45.9
Oromia	150	51.2	31.2	2.4	N/A	35.6
Somali	61	62.5	32.3	5.0	31.6	28.4
Benishangul-Gumuz	28	42.6	54.7	3.4	2.6	37.9
SNNPR	199	50.3	25.8	3.2	56.6	29.4
Gambela	30	61.1	47.1	1.9	N/A	38.9
Harari	31	63.2	61.2	3.6	N/A	26.1
Addis Ababa	43	60.7	61.8	N/A	N/A	61.2
Dire Dawa	42	53.2	49.3	2.0	65.8	26.5
National	725	54.2	39.3	3.5	42.6	35.4
Process						
Afar	27	93.9	64.9	5.44	N/A	51.6
Amhara	114	83.7	76.9	0.80	N/A	65.8
Oromia	150	87.3	75.6	7.43	N/A	67.6
Somali	61	73.9	56.2	11.1	62.3	43.5
Benishangul-Gumuz	28	83.8	85.7	8.7	59.1	65.2
SNNPR	199	85.3	67.0	127	76.7	58.9
Gambela	30	87.9	80.2	25.9	N/A	68.7
Harari	31	79.5	88.1	11.6	N/A	40.1
Addis Ababa	43	92.7	90.7	N/A	N/A	91.7
Dire Dawa	42	96.5	86.2	8.17	95.13	48.6
National	725	85.9	74.3	9.7	74.0	61.4
Quality*						
Afar	27	76.8	41.7	3.7	N/A	35.7
Amhara	114	68.1	59.8	4.5	N/A	53.4
Oromia	150	64.8	47.9	4.3	N/A	47.7
Somali	61	66.8	41.3	7.3	43.2	34.1
Benishangul-Gumuz	28	58.2	66.4	5.4	23.9	48.2
SNNPR	199	63.5	41.3	6.7	64.2	40.5
Gambela	30	71.2	59.6	10.9	N/A	50.1
Harari	31	69.3	71.4	6.6	N/A	31.4
Addis Ababa	43	72.7	72.7	N/A	N/A	72.7
Dire Dawa	42	69.5	63.2	4.3	76.9	34.9
National	725	66.2	52.5	5.9	54.5	45.2

*The overall quality is weighted from 62.23% structure and 37.77% process components; N/A: not applicable (no health facility in the strata). The SNNPR is separated into Sidama, Southwest, South and Central Ethiopia regional states. ESPA, Ethiopian Service Provision Assessment; HF, Health Facility; SNNPR, Southern Nations, Nationalities and Peoples.

and managing authority (public/private/NGO). The quality score ranged from 31.4% in the Harari region to 72.7% in Addis Ababa. Health facilities in rural areas had low HTC quality (30.6%) while the urban health facilities had a 64% quality score. This was supported by a study conducted in Ethiopia⁸ and Vietnam.⁵² In

addition, studies conducted in the Amhara region, Ethiopia⁵³ and Nepal⁵⁴ showed a low ANC quality provision. Health posts have the lowest quality score, while hospitals have the highest quality. Hospitals perform better on the structural and process components of quality of care. The availability of resources

Table 3 Quality of HTC during antenatal care visits by facility type, area and management authority Ethiopian ESPA 2020–2021

Variable	Quality (%)	SD (%)
Facility type		
Hospital	66.2	14.2
Health centre	52.5	21.6
Health post	5.9	8.37
Clinic	54.5	21.1
Area		
Urban	64.2	19.3
Rural	30.6	27.3
Managing authority		
Public	44.2	29.4
Private	67.4	11.9
NGO	67.7	17.8
HTC, HIV testing and counselling; NGO, non-governmental organisation.		

for hospitals could be the main reason. A study conducted in Ghana supports the need for investing in structural parts of PMTCT to improve the quality of care.⁴⁷ According to the management authority, government health facilities have the lowest quality of care score (44.19). The reason could be that government health facilities had limited resources to invest in infrastructure and process of care to deliver effective HTC services during ANC. For instance, health posts had limited infrastructure to deliver effective HTC services.

Ethiopia has a low ANC attendance rate and only 3 in 10 women attended four or more ANC services.

Similar studies showed a low utilisation of ANC services.^{24 55} The contact coverage of HIV testing from women attending ANC is 17.2% (without Tigray region). This finding was consistent with a study conducted in Ethiopia.²⁴

Strengths and limitations of the study

This study is the pioneer study to integrate the quality of HTC services delivery during ANC with contact coverage in Ethiopia. We used the administrative boundary and geographic information system to match the contact coverage from the EDHS with health service quality data from the ESPA dataset.

However, it should be noted that there is a 4-year gap between the two surveys, which could overestimate the effective coverage as the quality of care may have improved over the years. Finally, the Tigray region was not included in the ESPA data and, therefore, had to be excluded from this study. This could underestimate the finding as Tigray had a high effective coverage of ANC services.³²

CONCLUSION

One in 10 women receives effective HTC services during ANC follow-up. There is a significant disparity in the quality of HTC services across health facility types and administrative regions. Afar and Somali regions should focus on improving the structural and process components of quality of care, respectively. Harari and Dire Dawa should focus on both the structural and process components. Policymakers should focus on improving the structural barriers that hinder the delivery of HTC services to improve the quality of care. Further research is recommended to assess the

Table 4 Effective coverage of HTC during ANC service in Ethiopia

Region	Crude coverage	Quality		*Overall quality (95% CI)	Effective coverage (95% CI)	Effective coverage – crude coverage
		Structure	Process			
Afar	11.4	26.0	51.6	35.7 (23.5, 47.8)	4.1 (2.7, 5.5)	7.35
Amhara	28.9	45.9	65.8	53.4 (47.8, 58.4)	15.4 (13.8, 16.9)	13.4
Oromia	9.9	35.6	67.6	47.7 (43.0, 51.9)	4.7 (4.3, 5.2)	5.2
Somali	4.7	28.4	43.5	34.1 (26.8, 41.6)	1.6 (1.3, 2.0)	3.1
Benishangul	18.5	37.9	65.2	48.2 (35.1, 61.2)	8.9 (6.5, 11.3)	9.6
SNNP	17.2	29.4	58.9	40.5 (36.3, 44.0)	7.0 (6.3, 7.6)	10.2
Gambela	21.5	38.9	68.7	50.1 (39.1, 59.0)	10.8 (8.4, 12.7)	10.7
Harari	25.9	26.1	40.1	31.4 (19.0, 43.8)	8.1 (4.9, 11.3)	17.7
Addis Ababa	76.4	61.2	91.7	72.7 (70.1, 75.3)	55.5 (53.5, 57.5)	20.9
Dire Dawa	36.4	26.5	48.6	34.9 (24.71, 45.0)	12.7 (9.0, 16.4)	23.7
National	17.2	35.4	61.4	45.2 (42.8, 47.1)	10.8 (9.8, 11.7)	10.7

*The overall quality is weighted from 62.23% structure and 37.77% process components.

ANC, antenatal care; HTC, HIV testing and counselling; SNNP, Southern Nations, Nationalities and Peoples.

spatial distribution of effective HTC services during ANC follow-up to identify hotspot areas in Ethiopia.

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