Readiness of health facilities in providing basic antenatal care laboratory test services and client satisfaction in Ethiopia

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Abstract

Background: To enable early identification of pregnancy-related health complications and other potential problems that affect the outcomes of pregnancy, pregnant women need to receive the basic laboratory test services during antenatal care. The provision of antenatal care laboratory test services is influenced by the availability and capacity of support systems.

Methods: A health facility based cross-sectional study design was employed.

Results: One hundred and ninety-nine facilities and 960 pregnant women were involved. Sixty-seven-point one percent of facilities had the minimum required infrastructure; the minimum required laboratory documents were present in 67.2% of facilities; the minimum laboratory equipment needed was present in 49.6% of facilities; and 76% of facilities had trained laboratory personnel who could provide basic antenatal care laboratory test services. The average stockout rate on the date of the visit was 29.6%; stockouts during the past thirty days was 32%; and the mean number of days that the available stocks last was for 93 days. The average availability of basic antenatal care laboratory test services in health facilities was 84% with infrastructure (p=0.018) and equipment (p=0.000) being the significant predictors of service availability. The satisfaction rate for overall laboratory test services provided in the health facilities was 83.2%.

Conclusions: Readiness of health facilities to deliver basic antenatal care laboratory test services in terms of infrastructure, documents, equipment, reagents, and human resource was low but the client satisfaction rate was within an acceptable range. The gaps in infrastructure, documents, medical equipment, reagents, and human resource of facilities need to be addressed to ensure better laboratory test services.

Background

Globally, 303,000 maternal deaths, 2.6 million stillbirths, and 2.7 million newborn deaths occur annually from preventable causes related to pregnancy and childbirth. Good-quality antenatal care (ANC) is crucial for the prevention of maternal and newborn deaths and stillbirths. Eighty six percent of pregnant women access at least one ANC service from a skilled provider and 78% deliver with the assistance of skilled birth attendants globally (1).

Ethiopia has made good progress in reducing maternal mortality with the maternal mortality ratio declining from 1,400/100,000 live births in 1990 to 401/100,000 in 2017: mainly due to improved access, quality, and utilization of maternal health services (2).

The most common causes of maternal deaths in the country include obstetric hemorrhage, anemia, hypertensive disorders in pregnancy, and sepsis which can be prevented by instituting interventions, including ANC (3).

To achieve the full life-saving potential of ANC, four visits where essential evidence-based interventions are provided is required. The essential interventions in ANC include identification and management of obstetric complications, tetanus toxoid immunization, and identification and management of infections. All these service components require effective laboratory services. In Ethiopia 74% of pregnant women have at least one ANC visit and the ANC 4+ coverage is 43%. However, only 20% attend their first ANC visit before 16 weeks of gestation (4-8).

Pregnant women should receive the basic ANC laboratory services (hemoglobin, blood group and Rh status, urinalysis, test for human immuno-deficiency virus (HIV) serostatus, Rapid Plasma Reagin (RPR) test for syphilis, and hepatitis B surface antigen) to identify pregnancy-related health complications and other potential problems that affect the outcomes of pregnancy (6).

The provision of quality healthcare including ANC is influenced by the availability and capacity of support systems, including adequately staffed and stocked laboratories. The Service Availability and Readiness Assessment (SARA) has been used in Ethiopia to determine the availability of basic equipment, basic amenities, essential medicines, and diagnostic capacity at health facilities (7, 9-11).

The limited capacity of health facilities in Ethiopia to provide adequate laboratory test services remains a major barrier to the quality of ANC services. ANC-related laboratory test services can be hampered by shortages and quality of human resources, equipment, test kits, reagents, and other supplies (12).

The aim of this study is to assess the readiness of health facilities in providing basic antenatal care laboratory test services and satisfaction of clients with the services in Ethiopia.

Methods

Design: A health facility based cross-sectional study design was employed.

Setting and period: The study was carried out within a sample of 113 primary hospitals (PHLs) and 1,837 health centers (HCs) in the Amhara, Oromia, and South Nations and Nationalities and Peoples' (SNNP) regions of the country where the USAID Transform: Primary Health Care Activity has been operating since January 2017. The study was conducted between 1st of July – 30th of September 2020.

Study participants: Participants of the study were randomly selected sample PHLs, HCs, and pregnant women who received basic ANC laboratory test services in those facilities.

Sample size and sampling method: For this assessment two separate sample sizes were drawn.

Sample size 1 - Health facilities (PHLs and HCs): The number of health facilities were determined based on the Aga Khan Foundation's (13) recommendations as the rule of thumb during sampling for the purpose of readiness assessment which states that if the number of unit is very large (500 – 1,000), take a ten percent sample, if it is of medium size (100 - 500), take 15 – 20 percent sample, if it is small (50 -

100) take a 20 – 30 percent sample and if it is very small (less than 50), take a 30 – 50 percent sample. Therefore, 22 PHLs (20%) and 183 HCs (10%) were selected.

Sample size 2 - Pregnant women's exit interviews: A single population proportion survey formula was used. The formula is,

$$n = \frac{Z\alpha_{/2}^2 P (1-P)}{d^2}$$

where, n = sample size, P = proportion of satisfied women with ANC laboratory test services in Addis Ababa. P=56.3% (10), d = allowable margin of error of 4%, CI = confidence interval at 95%, design effect=2.

$$\text{Hence, } n = \frac{(1.96)^2 * 0.563 * 0.437}{(0.04)^2}$$

$$n = 590$$

Considering the design effect of 2, the final sample size was taken to be 1,180.

Hence, the assessment was carried out in randomly selected 205 intervention health facilities (22 PHLs and 183 HCs) of the USAID Transform: Primary Health Care Activity. In addition, 1,180 pregnant women were included for the exit interviews. The sample size was allocated proportionally for each of the three regions and primary healthcare entities. Each of the assessment subjects were identified through simple random sampling methods.

Inclusion criteria: Functional PHLs and HCs during the data collection period were included. Additionally, pregnant women who received basic ANC laboratory test services in the selected facilities during the assessment period and consented to the exit interviews were included.

Exclusion criteria: Facilities out of the USAID Transform: Primary Health Care Activity intervention areas, facilities providing ANC services for less than six months, pregnant women that were seriously ill and mentally incapable of providing consent, pregnant women aged less than 18 years, and pregnant women who did not consent to take part in the study were excluded.

Data collection: Twenty-five data collectors and three supervisors, fluent in the local languages were involved. All the data collectors and supervisors were health workers with at least master's level degrees in health-related fields. Data was collected using structured interview questionnaires; an equipment, reagent, materials, and supply audit tool; and a secondary data extraction format. Interviews of pregnant women were conducted after they received basic ANC laboratory test services in the selected facilities. The questionnaire used in the interviews was developed in the English language and was then translated into local languages, and back into English to check for consistency of the ideas and contents.

To ensure the quality of data, properly designed data collection processes were followed. Both data collectors and supervisors attended a two-day intensive training during which pretesting of the data collection tools was carried out. Each supervisor reviewed the completeness and consistency of collected data daily. Supervisors held discussions with data collectors at the end of each day and in the mornings to minimize errors and to take timely corrective actions.

Data analysis: The collected data from each of the facilities was cleaned and entered to Epi Info version 10 and later exported to SPSS version 25 for statistical analysis. A binomial logistic regression analysis was used. An odds ratio of 95% confidence interval (CI) was calculated to identify predictors of the availability of basic ANC laboratory test services and satisfaction levels of pregnant women on basic ANC laboratory test services.

Ethical considerations: Ethical clearance was granted from the JSI Research & Training Institute, Inc. Institutional Review Board (IRB), IRB REFERENCE: IRB #19-30E and the IRBs of Amhara, Oromia, and SNNP regional state health bureaus. All the necessary and appropriate information about the study was explained to each of the participants of the study. Written consent was sought from each of the pregnant women for the exit interviews. Verbal consent was obtained from the heads of each of the facilities and the professionals that provided the required information about laboratory services.

Operational definitions

- Turnaround time: the time from receipt of specimen in laboratories until results are reported.
- Laboratory test service availability: availability of the basic ANC laboratory test services in health facilities during data collection.
- Services functionality: status of the basic ANC laboratory test services that went uninterrupted for more than a day with in the last one year.
- Trained laboratory personnel: laboratory personnel who were formally trained to provide laboratory services in health facilities, whatever the qualifications of the person may be.
- Non-laboratory personnel: a person who isn't formally trained to provide laboratory services but because of shortage of manpower in the facilities, has been delegated to provide laboratory services with minimal training or using experience s/he gained from others.
- Client satisfaction: reflections of service utilizers on how they feel about the basic ANC laboratory test services they received at facilities.

Results

Findings of this study are presented categorized into: 'readiness of health facilities to provide the basic ANC laboratory test services' and 'satisfaction of clients with the services provided'.

Readiness of facilities: Readiness of facilities in delivering basic ANC laboratory test services was assessed in relation to infrastructure; availability of standard operating procedures (SOPs), guidelines,

protocols, and documentation; availability of laboratory equipment; availability of laboratory reagents; personnel; and overall availability of basic ANC laboratory test services. A total of 199 of the sampled 205 health facilities (97.1%) were assessed for readiness to provide basic ANC laboratory test services.

1. Infrastructure: Status of infrastructures assessed included the physical structures and presence of consistent supplies of amenities like water and electric power. Sixty-seven-point one percent of the assessed health facilities were found to have the minimum infrastructure required to provide the basic ANC laboratory test services. The presence of appropriate laboratory infrastructure ranged from 26.8% for the presence of 'access to safe drinking water supply for staff' to 91.9% for the presence of 'a well-maintained roof in laboratories'. Running water was available in 42.1% of the laboratories assessed while 64.0% had consistent electric power supply (table 1).

Table 1: Status of laboratory infrastructure in health facilities at USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia.

	N	n (%)
Infrastructure	**191**	**128 (67.1%)**
Laboratory area is maintained in good condition.	197	173 (87.8%)
Laboratory is secured with a lock and key but is accessible during normal working hours.	198	178 (90.4%)
Laboratory has shelves and lockable cupboards; access is limited to authorized personnel.	197	139 (70.6%)
Laboratory has enough space to adequately store existing supplies.	198	82 (41.4%)
Laboratory has running water.	195	82 (42.1%)
Laboratory has a consistent power supply and/or a generator with a guaranteed supply of petrol or solar power.	189	121 (64.0%)
Laboratory has an adequate number of power points (sockets).	198	147 (74.2%)
Laboratory has separate sinks for washing laboratory ware and staining, and for washing hands after being exposed to infected materials.	198	130 (65.7%)
Laboratory has drainage for laboratory sinks that are closed and that lead to either a septic tank or deep pits.	197	134 (68.0%)
Laboratory has a functioning incinerator or another nationally acceptable waste management system (e.g., a protected pit) to correctly dispose of all hazardous waste (e.g., needles, toxic materials) and fuel for the incinerator (if applicable).	198	165 (83.3%)
Laboratory floors are in good condition without the need for repair.	198	169 (85.4%)
At all times, roof is maintained in good condition to avoid sunlight and water penetration.	197	181 (91.9%)
Internal walls are in good condition without the need for repair.	196	179 (91.3%)
External walls are in good condition without the need for repair.	197	176 (89.3%)
Laboratory is well lit.	194	172 (88.7%)
Laboratory is well ventilated and cross-ventilated.	198	173 (87.4%)
Windows and doors are in good condition without the need for replacement or repair.	197	174 (88.3%)
Laboratory has firm built-in benches with leveled tops in good condition.	196	132 (67.3%)
Laboratory has firm shelves to store supplies and reagents.	197	125 (63.5%)
There is adequate glassware and/or plasticware.	197	100 (50.8%)
Distilled/deionized water is available.	196	90 (45.9%)
Windows have security bars.	196	126 (64.3%)
There is an adequate number of laboratory stools.	195	76 (39.0%)
The laboratory has an indoor patient waiting area with seats.	196	96 (49.0%)

Laboratory staff have access to clean toilet facilities.	198	112 (56.6%)
Laboratory staff have access to safe drinking water.	194	52 (26.8%)
Laboratory has a working fire extinguisher.	193	80 (41.5%)
The laboratory working environment is kept organized and clean, with safe procedures for handling of specimens and waste material to ensure patient and staff protection from unnecessary risks at all times.	198	146 (73.7%)
The laboratory has adequate lighting, ventilation, water, waste and refuse disposal.	195	134 (68.7%)

2. Availability of SOPs, guidelines, protocols, and documentation: The assessed documents-related areas were the presence of SOP manuals, guidelines, management protocols and laboratory test request, report and referral forms, and registers. The minimum required laboratory SOPs, guidelines, protocols, and documentation were present in 67.2% of the assessed facilities. The presence of these documents ranged from 26.1% for the presence of 'referral forms' to 96.5% for the for 'registers' (table 2).

Table 2: Presence of laboratory SOPs, guidelines, protocols, and documentation in health facilities at USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia. (N=99)

	Number	Percent
Availability of laboratory SOPs, guidelines, protocols, and documentation	**134**	**67.2%**
Standard operating procedure manuals	177	88.9%
Guidelines for all tests and equipment	137	68.8%
Laboratory request and report forms	172	86.4%
Laboratory specimen and results registers	192	96.5%
Equipment and supplies inventory registers	107	53.8%
Quarterly/monthly reporting forms	135	67.8%
Referral forms	52	26.1%
Periodic reporting (monthly, quarterly)	170	85.4%
Preliminary analysis	58	29.1%
Utilization of results	107	53.8%
Collection of useful and appropriate information	117	58.8%
Archiving and retrieval	69	34.7%
Patient identification	189	95.0%
Date and time of specimen collection	160	80.4%
Test performed	184	92.5%
Date of report	170	85.4%
The reference or normal range	76	38.2%
Laboratory interpretation (where appropriate)	79	39.7%

3. Availability of laboratory equipment: The minimum laboratory equipment needed to provide basic ANC laboratory test services was present in 49.6% of the assessed facilities. The availability of these laboratory equipment ranged from 13.6% for 'lab coats' to 99.5% for 'waste receptacles' (table 3).

Table 3: Availability of laboratory equipment in health facilities at USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia. (N=199)

	Number	Percent
Availability of laboratory equipment	**99**	**49.6%**
General centrifuge for urine	176	88.4%
Micro-hematocrit centrifuge	112	56.3%
Hemo Cue for hemoglobin determination	59	29.6%
Complete blood count machine	66	33.2%
Laboratory refrigerators	152	76.4%
Bright field compound microscopes	154	77.4%
Light source	132	66.3%
Desktop computers and printers	56	28.1%
Thermometers	57	28.6%
Hand soaps	57	28.6%
Unused sharps boxes	170	85.4%
Gloves	187	94.0%
Waste receptacles	198	99.5%
Goggles	188	94.5%
Masks	62	31.2%
Plastic aprons	158	79.4%
Lab coats	27	13.6%

4. Availability of laboratory reagents, test kits, and other supplies: The availability of laboratory reagents, test kits, and other supplies was assessed for stockout on the date of the visit, for stockout during the last thirty days, and mean number of days the stock lasts. The average stockout rate on the day of the visits was 29.6% and ranged from 10.1% for ‘immersion oil’ to 61.8% for ‘xylene’. The average presence of stockout during the last thirty days was 32% and ranged from 6.5% for ‘Uristix (dipstick)’ to 73.4% for “xylene”. The mean number of days the available stocks last was 93 days and ranged from 70 days for ‘HIV test kits’ to 129 days for ‘immersion oil’.

Table 4: Stockout of laboratory reagents, test kits, and other supplies in health facilities at USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia. (N=199)

	Stockout on the day of visit		Stockout on the last thirty days		Mean number of days stock is available
	Number	Percent	Number	Percent	
Stockout of laboratory reagents, test kits, and other supplies	**59**	**29.6%**	**64**	**32.0%**	**93**
Uristix (dipstick)	21	10.6%	13	6.5%	78
Capillary tube (heparinized)	39	19.6%	35	17.6%	106
Giemsa staining solution	37	18.6%	31	15.6%	97
Crystal violet	109	54.8%	124	62.3%	89
Gram iodine	112	56.3%	130	65.3%	100
Acetone alcohol	95	47.7%	112	56.3%	103
Safranin	108	54.3%	125	62.8%	97
Hepatitis test kits	27	13.6%	23	11.6%	84
RPR antigen kits	21	10.6%	17	8.5%	86
Blood group/type antisera	24	12.1%	18	9.0%	88
Pregnancy test kits	22	11.1%	19	9.5%	85
HIV test kits	40	20.1%	47	23.6%	70
Hematology auto analyzer reagent kits	113	56.8%	126	63.3%	84
Methanol	61	30.7%	66	33.2%	92
Xylene	123	61.8%	146	73.4%	96
Immersion oil	20	10.1%	14	7.0%	129

5. Personnel: 76% of the assessed facilities have trained laboratory personnel who can provide basic ANC laboratory test services while 6% of the facilities have non-laboratory personnel who are providing laboratory test services (table 5).

Table 5: Presence of personnel for laboratory test services in health facilities at USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia.

	N	n (%)
Trained laboratory personnel who can provide the basic ANC laboratory services.	197	150 (76.1%)
Non-laboratory personnel who are providing basic ANC laboratory services.	199	12 (6.0%)

6. Availability of basic ANC laboratory test services: The average availability of basic ANC laboratory test services in facilities was 84% ranging from 60.8% for 'Hgb/CBC/HCT' to 98.5% for 'RPR syphilis tests' and 'urinalysis'. Fifty three percent of the assessed facilities reported that the facility did stop providing one or more of the basic ANC laboratory test services during the last six months (table 6).

Table 6: Availability of laboratory test services in health facilities at USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia. (N=199)

	Number	Percent
Availability of basic ANC laboratory test services	**167**	**84.0%**
Hgb/CBC/HCT	121	60.8%
Hepatitis B surface antigen (HBsAg)	183	92.0%
Syphilis test (RPR)	196	98.5%
Blood group & RH	192	96.5%
HIV tests	184	92.5%
Urine-analysis	196	98.5%
The health facility stopped providing service of one or more of the basic ANC laboratory test services in the last six months.	105	52.8%

A binomial logistic regression was performed to ascertain the effects of availing SOPs, personnel, equipment, reagents, and infrastructure on the likelihood that facilities have laboratory test services. Linearity of the continuous variables with respect to the logit of the dependent variable was assessed via the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all fifteen terms in the model, resulting in statistical significance being accepted when $p < .00333$ (Tabachnick & Fidell, 2014). Based on this assessment, all continuous independent variables were found to be linearly related to the logit of the dependent variable. There was no standardized residual with a value of greater than 3.0 standard deviations. The logistic regression model was statistically significant, $\chi2(7) = 69.638$, $p < .0005$. The model explained 40.8% (Nagelkerke R2) of the variance in service availability and correctly classified 73.3% of cases. Sensitivity was 73.0%, specificity was 73.6%, positive predictive value was 75.3%, and negative predictive value was 71.3%. Of the potential predictor variables checked, only two were statistically significant: ‘equipment availability’ and ‘infrastructure’ (table 7). Increases in any of the significant variables was associated with an increased likelihood of laboratory test service availability.

Table 7: Predictors of availability of basic ANC laboratory test services in health facilities at USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
National SOPs, guidelines, protocols, and documentation	.015	.012	1.506	1	.220	1.015	.991	1.039
Personnel	-.013	.012	1.212	1	.271	.987	.964	1.010
Equipment availability	.074	.020	14.216	1	**.000**	1.076	1.036	1.119
Reagent availability (30 days)	-.228	.297	.593	1	.441	.796	.445	1.423
Infrastructure	.025	.011	5.635	1	**.018**	1.025	1.004	1.047
Constant	-6.217	1.327	21.951	1	.000	.002		

Client satisfaction: Exit interviews on satisfaction levels of clients with basic ANC laboratory test services rendered at facilities was carried out with 960 pregnant women (81.4%).

Seventy-eight-point six percent of the clients reported that they were satisfied with the turnaround time at the laboratory, 86% were satisfied with the laboratory staff, and 83.2% were satisfied with the overall

basic ANC laboratory test services provided at the facilities (table 8).

Chi-square test of homogeneity was conducted between facility type and levels of satisfaction. All expected cell counts were greater than five. There is no statistically significant difference (p > .05) between HCs and PHLs regarding the level of satisfaction with laboratory turnaround time, laboratory staff, and laboratory test services (table 8).

Table 8: Satisfaction of clients with basic ANC laboratory test services rendered in health facilities of USAID Transform: Primary Health Care intervention woredas, July-September 2020, Ethiopia.

	Satisfaction level	Health centers N (%)	Hospitals N (%)	Total N (%)	Pearson Chi-square (P)
Satisfaction with the turnaround time of the laboratory	Dissatisfied	54 (8.3)	34 (11.4)	88 (9.3)	0.308
	Neutral	81 (12.5)	34 (11.4)	115 (12.1)	
	Satisfied	514 (79.2)	231 (77.3)	745 (78.6)	
Satisfaction with the laboratory services	Dissatisfied	43 (6.5)	11 (3.6)	54 (5.6)	0.141
	Neutral	69 (10.5)	38 (12.6)	107 (11.1)	
	Satisfied	546 (83)	253 (83.8)	799 (83.2)	
Satisfaction with laboratory staff	Dissatisfied	25 (3.8)	7 (2.3)	32 (3.3)	0.289
	Neutral	65 (9.9)	37 (12.3)	102 (10.6)	
	Satisfied	568 (86.3)	258 (85.4)	826 (86)	

Discussion

In this study, the readiness of health facilities to provide the basic ANC laboratory test services in terms of infrastructure was at 67.1% which is higher than the 39% of mean availability of tracer items for basic amenities in the 2018 SARA report (9). This difference may be because the SARA report was based on the overall health facility status while this study is on specific laboratory units of health facilities. In addition to that, considerable investments have been made into the healthcare system of the country in the period after the SARA report.

Availability of SOPs, guidelines, protocols, and documentation is at 67.2% which is higher than the 15.4% of a study done in Addis Ababa (10). This difference may be due to the difference in sample size, as the Addis Ababa study was conducted on only thirteen health facilities while the current study was conducted on close to two hundred health facilities and a lot has been invested to develop and distribute national documents since the previous study.

The minimum required laboratory equipment is available in 49.6% of the facilities which is lower than the 60% for the mean availability of tracer item equipment of the 2018 SARA report (9). This difference may be because in the SARA report, the tracer items selected were the most easily procured and easy to maintain medical equipment while in this study specific laboratory equipment were assessed which are often expensive to procure and become non-functional easily if not properly utilized.

Stockout of laboratory reagents, test kits, and other supplies on the day of the visits was found in 29.6% of the facilities which is lower than the 53.8% for equipment down time due to reagents stockout in a study done in Addis Ababa (14). This difference may be due to the difference in sample size which was small (thirteen) in the Addis Ababa study and the country's significant investment in health since the Addis Ababa study.

Trained laboratory personnel who can provide the basic ANC laboratory test services were in 76.1% of the facilities which is comparable with the 77.5% of health centers in Addis Ababa but lower than the 92.4% of hospitals in Addis Ababa (14). The difference with hospitals in Addis Ababa may be due to the regional difference in the required number of laboratory personnel and the tendency for professionals to be concentrated in the capital city of the country as compared to the rural setup, where this current study was conducted.

Basic ANC laboratory test services were available in 84.0% of facilities which is comparable with the 80% in North West Ethiopia (15) and 83.4% at Debremarkos referral hospital in Ethiopia (16), but higher than the 38.5% of a study in Addis Ababa (14) and the 40% report of mean availability of tracer items in the SARA 2018 report (9). The difference with the Addis Ababa study may be due to the difference in sample size where the Addis Ababa study only used thirteen facilities. Additionally, the significant investments in health after the previous study may explain the difference with both the Addis Ababa study and the SARA 2018 report.

Client satisfaction with overall ANC laboratory test services provided was found to be 83.2% which is comparable with the 87.9% of a study in Wolaita, Ethiopia (17) but higher than the pooled estimate of 66% in a systematic review (18), and the 56.9% in a study at public health facilities of Addis Ababa (10). This difference with the systematic review and the Addis Ababa study may be due to the fact that the systematic review is a pooled estimate of different study settings with varying study populations, while the study in Addis Ababa was on women who are more educated and have better incomes than the women in the current study -conducted on rural women with lower educational and socio-economic statuses.

Client satisfaction with turnaround time in facilities was found to be 78.6% which is less than the >90% reported in Egypt (19). This difference may be due to the difference in study settings and study population between the two countries.

Conclusion

The overall readiness of health facilities to deliver basic ANC laboratory test services in terms of infrastructure (67.1%), documents (67.2%), equipment (49.6%), reagents, and personnel (76%) was found to be low. The client satisfaction rate was found to be within the acceptable range (83.2%). There is a need to fill gaps in infrastructure, documents, medical equipment, reagents, and personnel of health facilities to deliver a better-quality service. Based on this study more emphasis should be given to infrastructure and laboratory equipment to improve the laboratory test service availability in health facilities.

Abbreviations

ANC: Antenatal Care, CBC: Complete Blood Count, CI: Confidence Interval, HBsAg: Hepatitis B Surface Antigen, HC: Health Center, HCT: Hematocrit, Hgb: Hemoglobin, HIV: Human Immuno-deficiency Virus, IRB: Institutional Review Board, JSI: John Snow Inc., PHL: Primary Hospital, RPR: Rapid Plasma Reagin, SARA: Service Availability and Readiness Assessment, SNNP: South Nations Nationalities and Peoples, SOP: Standard Operating Procedure, SPSS: Statistical Package for Social Sciences, USAID: United States Agency for International Development.

Declarations

Ethics approval and consent to participate: ethical clearance was granted from JSI Research & Training Institute, Inc. Institutional Review Board (IRB), IRB REFERENCE: IRB #19-30E and the IRBs of Amhara, Oromia, and SNNP regional states health bureaus. All the necessary and appropriate information about the study was explained to each of the participant of the study. Written consent was sought from each of the pregnant women who took part in the exit interviews. Verbal consent was obtained from the heads of each of the facilities and the professionals who provided required information about the laboratory.

Consent for publication: consent for publication is not applicable in this research.

Availability of data and materials: the datasets of the current study are available from the corresponding author upon reasonable request.

Competing interests: all authors of this study declare that they do not have any competing interests.

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Authors' contributions: HSA was involved in the inception, concept note development, data collection, analysis, interpretation, and write up of the manuscript. IAB was involved in the data collection tool development, data analysis, and interpretation. ZTT was involved in the inception, concept note development, data collection, and read and commented on the final manuscript. BFD was involved in the inception, concept note development, and read and commented on the final manuscript. AAG, BTM, TTM,

and ZKG were involved during the data collection stage. All authors have read and approved the manuscript.

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