

Research Article

Viral Load Suppression After Adherence Counselling and Its Predictors Among HIV Patients on Art At Selected Public Health Centers in Addis Ababa

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Abstract

Background: For unsuppressed viral load count, World Health Organization (WHO) currently encourages enhanced adherence counseling (EAC) for human immunodeficiency virus (HIV) seropositive people on antiretroviral therapy (ART) before switching the treatment to the second-line regimen. This study aimed to assess viral load suppression after EAC and its predictors among clients on ART. **Methods:** Institutional-based retrospective cohort study design was used to assess viral load suppression after EAC and its predictors among 175 high viral load and 175 virally suppressed HIV seropositive clients in selected public health centers at Lideta sub-city from November 2019 to December 2022. The magnitude of viral load suppression was determined by proportion. For comparing the probability of viral load suppression Kaplan–Meier curve was used. Cox-regression was used to identify predictors of viral resuppression after EAC. **Result:** The overall viral load suppression after EAC was 76.2% while viral load suppression among exposed and unexposed group were 72.6% and 80% respectively. The median time to complete the EAC of exposed group was 3 months. In this study, participants who were on ART for more than 12 months had more probability of viral load suppression (13-35 months AHR=6.586, 95% CI: 3.307-13.117, 36-59 months AHR=6.826, 95% CI: 4.316-10.796, ≥60 months AHR=6.596, 95% CI: 4.485-9.700) when compared with ART experience ≤ 12 months. Participants who had not disclosed their serostatus, had history of ART drug discontinuation, were free of opportunistic infection and daily laborer had more viral load suppression, too. **Conclusion:** This study showed that viral suppression after enhanced adherence counseling was greater than the WHO's finding (70%) but still below United Nations' 90-90-90 target. The study findings showed gaps in dalliance of completing recommended time of EAC with repeat viral load testing and needs another assessment with issue of groups' comparison.

Keywords

Viral Load Suppression, Adherence Counseling, Lideta Sub City

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Received: 5 September 2024; **Accepted:** 16 January 2025; **Published:** 31 March 2025



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1. Background

The Human Immunodeficiency Virus (HIV) posed a serious threat to human survival. According to a UNAIDS report, since the beginning of the epidemic, about 36.3 million individuals have died as a result of HIV [1]. In 2020, 37.7 million people were living with HIV/AIDS worldwide. East and southern Africa contribute about 54.6% of the global burden of HIV. According to the UNAIDS fact sheet 2020 estimates, 620,000 people are infected with HIV in Ethiopia. According to UNAIDS, 95% of PLHIV on ART should be virally suppressed as is ambitiously set through United Nations' 95-95-95 target [2].

Following the first six months of starting ART, HIV-positive patients should undergo an initial viral load test, which should be repeated routinely every 12 months after that. Besides, targeted viral load testing was offered for suspected clinical or immunological failure [3]. A viral load test could show unsuppressed result (viral load count greater than 1000 copies/ml), which would indicate that HIV is not being controlled by the present ART regimen. Evidence from the past has shown that viral suppression at the first test is significantly lower than anticipated and that viral replication is still a significant barrier for people with HIV. When compared to patients who had a full virologic response, patients with an unsuppressed viral load were found to have a higher risk of clinical progression to acquired immunodeficiency syndrome (AIDS) and mortality [4].

The most frequent cause of treatment failure is poor adherence [5]. Before determining that first-line treatment has failed in patients with high viral load counts, the WHO recommends enhanced adherence counseling sessions for 3-6 months. In order to improve viral load suppression and decrease subsequent treatment failure, EAC involves a structured assessment of the patient's current level of adherence, exploration of the specific barriers the patient must overcome, assistance in identifying solutions, and development of an individual adherence interventional plan [6]. The WHO recommends all individuals with an unsuppressed viral load (>1000 copies/ml) to undergo repeated viral load testing. However, if the patient completes three EAC monthly sessions, spaced one month apart, the client is perfectly adherent for 3-6 months, and there is no opportunistic infection during the 3-6 months, the patient is considered to be within the optimum range for adherence [7]. The WHO estimation that after 3-6 sessions of increased adherence coaching, up to 70% of patients with an initial high viral load count (more than 1000 copies/ml) achieved virologic suppression [7]. Globally 38 million people were infected with human immune deficiency virus (HIV) in 2020, despite a 23% decline in new HIV infections since 2010 [8]. Even though the recommended time to complete the three EAC sessions was 90 days, the previous study conducted in Uganda showed that only 37% of patients complete the sessions in the recommended time

interval. And by the same study done in Harare Zimbabwe 69% underwent a repeat VL test at ≥ 3 months with 31.2% achieving VL suppression [9]. In the previous study done in north wollo zone of Amhara region in Ethiopia, EAC sessions were not completed within the recommended time and of those with high viral loads, only 46.8% of participants completed their EAC session within the recommended time which is 12 weeks [10]. This topic was not studied and any gap was not identified in Addis Ababa. Therefore, that triggered me to conduct this study for identifying predictors, estimation of viral load suppression as general and group (virally suppressed and unsuppressed), time of EAC session completion and time to second viral load test in Addis Ababa.

The Ethiopian Federal Ministry of Health began routine viral load testing for all HIV-positive individuals in March 2016, with the objective of ensuring that every eligible patient receives at least one test per year [7]. In Ethiopia, a total of 128,615 (54% of total HIV seropositive people on ART) viral load tests were performed from March 2016 to January 2019. Viral load suppression at the first viral load test was reported in 73% of pediatric patients and 83.3% of adult patients. This implies in Ethiopia 27% of pediatrics and 17% of adults required enhanced adherence counseling and repeat viral load testing after 3-6 months [11]. There is no available separated research paper or article done in Addis Ababa about viral load suppression after EAC. Furthermore, few researches have been done in Ethiopia which assessed viral load suppression after EAC sessions among high viral load HIV seropositive people who were on ART which were in North Wollo Zone, 2019 and west Gojjem Zone 2020. But still now no similar article found which was done in Addis Ababa and the finding of this research may help Addis Ababa Health Bureau and other stakeholders to assess the progress in the implementation of the national guidelines focus on EAC to increase viral suppression and improve the patient's quality of life. My study also has significant importance in providing information on viral load suppression from virally unsuppressed clients and associated factors for service providers, patient, decision makers and local partners. In addition, it provides input for Lideta sub-city health departments and regional health management staff in strengthening the efforts at ART clinics of the health facility. Last but not least, this study's finding may be used as input for any researcher interested in similar study and particularly help the respective health institutions in formulating management of virally unsuppressed plans and assessing existing treatment program. Therefore, this study assessed magnitude of viral load suppression after EAC, estimated time to completion of the EAC session and identified the predictors of viral load suppression among high viral load HIV sero positive people on ART in Lideta Sub-City, Addis Ababa.

2. Methods

2.1. Study Area

The study was conducted in Lideta Sub City which is one of the eleven sub cities of Addis Ababa. Addis Ababa is the capital city of the Federal Democratic Republic of Ethiopia. In 2022 projected population Addis Ababa has estimated to be 5,461,000 people, it is the country's largest city (52% female Vs 48% male) [12]. Administratively, the city is divided in to 11 sub cities and 121 Woreda. Lideta sub-city is one of Addis Ababa administration's sub-cities and is bordered by Arada sub-city to the north, Addis Ketema sub-city to the west, Kerkos sub-city to the east and Nefas Silk Lafeto sub-city to the south. The total area coverage of the Lideta subcity is 9.18 km². According to 2022 projected population Lideta subcity has estimated 284,208 population [12]. Under the sub-city there are two public hospitals and 8 health centers. According to the monthly report of Addis Ababa city administration Health bureau, April 2023, 115000 adults and children are taking ARV. From those Lideta sub-city is contributed 9459(8%) both adult and pediatric. This study was conducted in selected governmental health centers among high viral load from November 2019 to December 2022 by using ART user's medical records in Lideta sub-city, Addis Ababa, in October 2023.

2.2. Study Design and Period

Health facility-based retrospective cohort study was conducted from November 2019 to December 2022.

2.3. Populations

2.3.1. Source Population

All HIV patients on first line ART who had two separated viral load result and who was on ART at least 6 months from November 2019 to December 2022 governmental health centers of Lideta Sub city, Addis Ababa.

2.3.2. Study Population

All selected HIV patients with first viral load result less than or equal to 1000 copies/ml for unexposed group and greater than 1000 copies/ml for exposed group and had at least one repeated viral load result in Governmental health centers of lideta Sub-city Addis Ababa.

2.4. Inclusion and Exclusion Criteria

2.4.1. Inclusion Criteria

For Exposed group-all HIV infected people with documented viral load results greater than 1000 copies/ml and had second viral load result.

For unexposed-all recent started ART who had baseline viral load result ≤ 1000 copies/ml and had second viral load results.

2.4.2. Exclusion Criteria

For Exposed group-ART patients who had a follow-up of fewer than 6 months, patients who were high viral load and did not start and complete recommended EAC sessions and patients who had no second viral load result were excluded.

For unexposed group- ART patients who had a follow-up of fewer than 6 months, not followed scheduled(every month) of adherence counseling given for new ART starter and had no second viral load.

2.5. Sample Size Determination and Technique

2.5.1. Sample Size Calculation

The required sample size was calculated by Epi-Info version 7 with the following assumption and results:

1. Level of significance (α) = 5%
2. $Z_{\alpha/2}$ (value at 95% Confidence interval) = 1.96
3. 80% power
4. Cohort study
5. From results reported in north wollo; Adjusted Risk Ratio (ARR): of
 - 1) Variable one (period on ART of 36–59 months) = 0.35
 - 2) Variable two (educational status- Primary) = 1.38
 - 3) Variable three (rural residence) = 0.66

Depending on the above information from the calculated sample sizes the largest sample size was 318 and was taken. By adding 10% for missed data the final sample size was 350 and when divided for exposed and unexposed, each group was 175.

2.5.2. Sampling Technique and Procedure

There are 8 health facilities among Lideta sub city which give ART service, out of those 4 health facilities were selected using simple random sampling then proportionally allocated sample size and the data was collected from 4 health facilities. All HIV patients on first line ART who had viral unsuppressed result after 6 months on ART and viral suppressed (newly ART started) from November 2019 to December 2022 were considered as sample population. In total, 501 clients started EAC for being viral suppressed and had been given second viral load result and newly ART started were 630 with suppressed baseline viral load in the 4 health facilities. 175 high viral load who were on EAC and 175 viral load suppressed clients' cards were retrieved by simple random sampling technique. The total sample size of two groups was allocated proportionally among each health centers based on the number of patients with a viral load count. The study participants were selected through simple random sampling technique from a ART registration for non-exposed group and viral load registration book for ex-

posed group. The randomly selected client records/clinical charts were retrieved for different parameters were listed on questionnaire and all data with the prepared checklist were filled properly.

2.6. Study Variable

2.6.1. Dependent Variable

Viral load suppression.

2.6.2. Independent Variable

1. Socio demographic factors: - Age, Sex, educational status, occupation, marital status, Place of resident.
2. Clinical and treatment factors: Baseline clinical and laboratory characteristics (like duration of ART, adherence level before EAC, regimen types, WHO clinical stage, functional status, baseline CD4 counts, and baseline ART regimen, opportunistic infection, use TB and co-trimoxazole prophylaxis therapy(TPT)).
3. Behavioral related factors: Disclosure of status, mental health and substance use.

2.7. Operational Definitions

Viral load suppression: viral load result that is undetectable, equal to or less than 1000 copies/ml which definition was used in this study. Before February 2022 WHO classifies viral load result as unsuppressed which is viral load result above 1000RNA copies/ml and suppressed that is viral load undetectable or viral load result less than or equal to 1000RNA copies/ml. But currently it is classified in three categories as:

- 1) Viral load suppression is a viral load that is undetectable, equal to or less than 50copies/ml
- 2) Low-level viraemia: is one or more viral load results that are detectable (more than 50 copies/ ml) but equal to or less than 1000 copies/ml
- 3) High viral load which is viral load result above 1000RNA copies/ml and their implementation was started on January 2023.

Virological failure:- Viral load above 1000 copies/ml based on two consecutive viral load measurements in 3 months apart with enhanced adherence support following the first viral load test.

Enhanced Adherence Counseling (EAC):- is structured assessment of the patient's current level of adherence, exploration of the specific barriers the patient must overcome, assistance in identifying solutions, for persistent low CD4, new started ART patients to cope with their status (up to 12 months) and to be suppressed viral and development of an individual adherence intervention plan.

Functional status: The functional status is assessing continuously ART patients at every clinical visit as

1. Working = able to perform usual work in or out of the house, harvest, go to school,

2. Ambulatory = ambulatory but not able to work or able to perform activities of daily living, and

3. Bedridden = not able to perform activities of daily living.

ART adherence: is defined as the percentage of ART drug dosage taken or missed calculated from a monthly total dose, and it was classified as good, fair, or poor. Hence,

1. Good adherence is reported if equal to or greater than 95% doses taken or ≤ 3 dose missed per month,
2. Fair if the taken dosage is equal and between 85%–94% or 4–8 doses missed per month and
3. Poor if taken dosage is less than 85% or ≥ 9 dose missing per month.

Opportunistic infection (OI):- infection occurs more frequently and severs in individuals with weakened immune system.

Incomplete registries: - patients with incomplete data on both electronic and hard copy.

2.8. Data Collection Procedures

A retrospective record review technique was used for data collection. The data was collected using a structured questionnaire which was adapted from reviewing of different literatures prepared specifically for this study. Data was collected by reviewing ART registration and follow-up charts, high viral load registration and individual EAC, adherence forms and electronic database using a structured questionnaire which was prepared in English. Comprehensive ART care trained health professionals who had work experience at the ART clinic and was working at places other than the study area who collected the data after one day training under supervision. During data collection We supervised the data collectors and supervisor to insure the data quality.

For ensuring data quality, the questionnaire was prepared in English. Orientation was given by the principal investigator to the data collectors and supervisor who supervised the data collection who had health back ground and training on comprehensive ART care and selected out of the facilities which was the study conducted and was focused on the purpose & scope of the study.

2.9. Data Processing Analysis

The completeness and consistency of data values were checked. The collected data through electronic self account through kobo tool box was downloaded by excel format and then exported to SPSS for analysis. Descriptive statistics including median and frequencies were used to describe characteristics of the study data. Viral load suppression after EAC sessions was presented as proportion. Time to start EAC after first viral load test, time to completion of EAC sessions were presented by the Kaplan–Meier curve. For categorical variables, proportions and for continuous variables, mean or median with SD was used based on the nature of data.

Cox-proportional hazard model was used to identify magnitude and predictors of viral load suppression after EAC. Bivariable Cox-proportional hazard regression was applied to select variables for the multivariable Cox-proportional hazard regression. Those variables with p-value <0.25 in the bivariable analysis was fitted into the multivariable Cox-proportional hazard regression model. Finally, the adjusted hazard ratio (AHR) with its corresponding 95% confidence interval (CI) and p-value <0.05 was used to declare the presence of a significant association between the explanatory and outcome variables.

2.10. Ethical Consideration

Ethical approval and clearance was obtained from Addis Ababa Public Health Research and Emergency Management Directorate. The study was conducted in the facilities after permission obtained to conduct the research from the relevant administering body and the institutions. The confidentiality of information obtained from each study site was guaranteed by omitting facility names and any personal identifiers. Moreover, the collected data were kept safe throughout the whole process of the research work with limited data's accessibility to any third party.

3. Result

3.1. Baseline Characteristics of Study Participants

A total of 350 patients' charts were included in the study and half of them means 175 participants were exposed group; the other half 175 were unexposed group, of those 238 (68%) were males and 112(32%) were females whose charts were reviewed. From 175 exposed group 121 (69.14%) participants were male and 117 (66.9%) were male again from unexposed group. The mean age of study participants' was 37.5 (± 13.86 SD). About 161 participants (46%) were greater than of 40 age category. More than two third of participants 123 (35.1%) were never married and more than half of participants 198 (56.6%) had completed secondary or above educational level. 125 (36%) Participants of unexposed group and 100 (29%) participants of exposed group had CD4 count between 200 and 500 cells/ μ l. Participants who had WHO clinical stage 1 or 2 was 152 (43.4%) unexposed group and 163 (47%) exposed group, but overall WHO stage 1 or 2 were 315 (90%). Out of all participants 213 (nearly 61%) were good ART adherent; half of them 50% had less than or equal to 1000 copies/ml viral load result (all unexposed group) and from the second half 81 (23%) had viral load result >10000 copies/ml when enrolled to EAC sessions (Table 1).

Table 1. Sociodemographic, clinical, laboratory and behavioral characteristics of high viral load HIV seropositive people from November 2019 to December 2022 in selected health centers at Lideta Sub-City, Addis Ababa, Ethiopia (n=350).

Variables	Category	Frequency (%)		Total (%)
		Unexposed Group	Exposed Group	
Age	≤ 10	15 (8.6%)	13 (7.4)	28 (8.0)
	11-20	18 (10.3%)	40 (22.9)	58 (16.6)
	21-30	17 (9.7)	30 (17.2)	47 (13.4)
	31-40	36 (20.6)	20 (11.4)	56 (16.0)
	>40	89 (50.9)	72 (41.1)	161 (46.0)
Sex	Male	117 (66.9)	121 (69.1)	238 (68.0)
	Female	58 (33.1)	54 (30.9)	112 (32.0)
Marital status	Never married	68 (38.9)	55 (31.4)	123 (35.1)
	Married	39 (22.3)	64 (36.6)	103 (29.4)
	Divorced	41 (23.4)	30 (17.2)	71 (20.3)
	Widowed	27 (15.4)	26 (14.9)	53 (15.1)
Religion	Orthodox	84 (48)	93 (53.1)	177 (50.6)
	Muslim	53 (30.3)	50 (28.6)	103 (29.4)
	Protestant	26 (14.9)	24 (13.7)	50 (14.3)
	Catholic	12 (6.9)	8 (4.6)	20 (5.7)

Variables	Category	Frequency (%)		Total (%)
		Unexposed Group	Exposed Group	
Educational status	No formal education	29 (16.6)	32 (18.3)	61 (17.4)
	Primary level	42 (24)	49 (28)	91 (26.0)
	Secondary or above	104 (59.4)	94 (53.7)	198 (56.6)
Occupation	Daily labor	7 (4)	12 (6.9)	19 (5.4)
	Merchant	43 (24.6)	51 (29.1)	94 (26.9)
	Employed	79 (45.1)	55 (31.4)	134 (38.3)
	Students	46 (26.3)	57 (32.6)	103 (29.4)
Residence	Urban	156 (89.1)	132 (75.4)	288 (82.3)
	Rural	19 (10.9)	43 (24.6)	62 (17.7)
Duration on ART	≤12 months	175 (100)	0 (0)	175 (50)
	13-35 months	0 (0)	12 (6.9)	12 (3.43)
	36-59 months	0 (0)	39 (22.3)	39 (11.14)
	≥60 months	0 (0)	124 (70.9)	124 (35.43)
OI status	No OI	139 (79.4)	166 (94.9)	305 (87.1)
	Has OI	36 (20.6)	9 (5.1)	45 (12.9)
ART regimen	DTG-based	134 (76.6)	69 (39.4)	203 (58.0)
	EFV-based	41 (23.4)	106 (60.6)	147 (42.0)
Functional status	Working	150 (85.7)	139 (79.4)	289 (82.6)
	Ambulatory	24 (13.7)	34 (19.4)	58 (16.6)
	Bedridden	1 (1.4)	2 (0.6)	3 (0.9)
CD4 count	<200 cells/μl	9 (5.1)	30 (17.1)	39 (11.1)
	200-500 cells/μl	125 (71.4)	100 (57.1)	225 (64.3)
	>500 cells/μl	41 (23.4)	45 (25.7)	86 (24.6)
WHO stage	Stage I or II	152 (86.9)	163 (93.1)	315 (90.0)
	Stage III or IV	23 (13.1)	12 (6.9)	35 (10.0)
	Good	127 (72.6)	86 (49.1)	213 (60.9)
ART adherence level	Fair	19 (10.9)	29 (16.6)	48 (13.7)
	poor	29 (16.6)	60 (34.3)	89 (25.4)
Food lack problem for taking ART medication	Has food problem	53 (30.3)	44 (25.1)	97 (27.7)
	Has no food problem	122 (69.7)	131 (74.9)	253 (72.3)
Discontinuing ART for other remedy	Discontinued	88 (50.2)	37 (21.1)	125 (35.7)
	Not discontinued	87 (49.7)	138 (78.9)	225 (64.3)
Disclosure status	Disclosed	69 (39.4)	118 (67.4)	187 (53.4)
	Not disclosed	106 (60.6)	57 (32.6)	163 (46.6)
Mental health problem	Have	74 (42.3)	58 (33.1)	132 (37.7)
	Free	101 (57.7)	117 (66.9)	218 (62.3)
Current status of Sexual	Active	34 (19.4)	55 (31.4)	89 (25.4)

Variables	Category	Frequency (%)		Total (%)
		Unexposed Group	Exposed Group	
activity	Not active	141 (80.6)	120 (68.6)	261 (74.6)
	Using	55 (31.4)	46 (26.3)	101 (28.9)
substances use	Not using	120 (68.6)	129 (73.7)	249 (71.1)
	≤1000 copies/ml	175 (100)	0 (0)	175 (50.0)
Base line VL result	1001-5000 copies/ml	0 (0)	30 (17.1)	30 (8.6)
	5001-10000 copies/ml	0 (0)	64 (36.6)	64 (18.3)
	>10000 copies/ml	0 (0)	81 (46.3)	81 (23.1)

3.2. Proportion of Viral Load Suppression After EAC

From a total of 350 participants, 267(76.2%) participants had viral load suppression after enhanced adherence counseling intervention. 140 participants (80%) and 127 (72.6%) had viral load suppression of non-exposed and exposed group respectively. From all viral load suppressed participants, 181(68%) were male and 35% were never married. Majority 145(54.3%) of viral load suppressed participants had secondary and above educational status. 225(84.3%) of viral

suppressed participants were urban residents. More than half of having viral suppression were on ART only less than or equal 12 months duration due to all non-exposed group were below 12 months duration on ART when entering study. Approximately around 47% of viral load suppressed participants were the deltougavir (DTG) based ART regimen and were good adherent to ART medication. From total of viral suppression 218 (82%) participants were working in functional status. More than half of viral suppressed participants 55% had disclosed their sero-status, 72% were sexually active, 35.5% had history of mental health problem and around and 27% had history of substance use (Table 2).

Table 2. Results showing relationship between Socio demographics, clinical, laboratory, behavioral characteristics characteristics and viral load suppression among study participants by their groups from November 2019 to December 2022 in selected health centers at Lideta Sub-City, Addis Ababa, Ethiopia(n=350).

Variables	Category	Viral load					
		Exposed		Unexposed		Overall	
		Suppressed (n=127) (%)	Nonsuppressed (n=48) (%)	Suppressed (n=140) (%)	Nonsuppressed (n=35) (%)	Suppressed (n=267) (%)	Nonsuppressed (n=83) (%)
Age	≤10	11 (6.3)	2 (1.1)	15 (8.6)	0 (0.0)	26 (7.4)	2 (0.57)
	11-20	29 (16.5)	11 (6.3)	16 (9.14)	2 (1.1)	45 (12.9)	13 (3.7)
	21-30	26 (14.8)	4 (2.2)	13 (7.4)	4 (2.2)	39 (11.1)	8 (2.3)
	31-40	13 (7.4)	7 (4)	33 (18.85)	3 (1.7)	46 (13.1)	10 (2.9)
	>40	48 (27.4)	24 (13.7)	63 (36)	26 (14.85)	111 (31.7)	50 (14.3)
Sex	Male	89 (50.8)	32 (18.2)	92 (52.5)	25 (14.2)	118 (33.7)	55 (15.7)
	Female	38 (21.7)	16 (9.14)	48 (27.4)	10 (5.7)	86 (24.6)	26 (7.4)
Marital status	Never married	41 (23.4)	14 (8)	52 (29.7)	16 (9.14)	93 (26.6)	30 (8.9)
	Married	49 (28)	15 (8.5)	28 (16)	11 (6.3)	77 (22)	26 (7.4)
	Divorced	21 (12)	9 (5.1)	35 (20)	6 (3.4)	56 (16)	15 (4.3)

Variables	Category	Viral load					
		Exposed		Unexposed		Overall	
		Suppressed (n=127) (%)	Nonsup- pressed (n=48) (%)	Suppressed (n=140) (%)	Nonsup- pressed (n=35) (%)	Suppressed (n=267) (%)	Nonsup- pressed (n=83) (%)
Religion	Widowed	16 (9.14)	10 (5.7)	25 (14.2)	2 (1.1)	41 (11.7)	12 (3.4)
	Orthodox	75 (42.8)	18 (10.2)	66 (37.7)	18 (10.2)	141 (40.3)	36 (10.3)
	Muslim	31 (17.7)	19 (10.8)	49 (28)	4 (2.2)	80 (22.9)	23 (6.6)
	Protestant	16 (9.14)	8 (4.5)	17 (9.7)	9 (5.1)	23 (6.6)	17 (4.9)
	Catholic	5 (2.85)	3 (1.7)	8 (4.5)	4 (2.2)	13 (3.7)	7 (2)
Educational status	No formal education	26 (14.8)	6 (3.4)	25 (14.2)	4 (2.2)	51 (14.6)	10 (2.9)
	Primary level	34 (19.4)	15 (8.5)	37 (21.1)	5 (2.85)	71 (20.3)	20 (5.7)
	Secondary or above	67 (38.2)	27 (15.4)	78 (44.5)	26 (14.85)	145 (41.4)	43 (12.3)
Occupation	Daily labor	12 (6.85)	0 (0)	7 (4)	0 (0.0)	19 (5.4)	0 (0.0)
	Merchant	37 (21.1)	14 (8)	38 (21.7)	5 (2.85)	75 (21.4)	19 (5.4)
	employed	37 (21.1)	18 (10.2)	61 (34.85)	18 (10.2)	98 (28)	36 (10.3)
	Students	41 (23.4)	16 (9.14)	34 (19.4)	12 (6.85)	75 (21.4)	28 (8)
Residence	Urban	98 (56)	34 (19.4)	127 (72.5)	29 (16.57)	225 (64.3)	63 (18)
	Rural	29 (16.5)	14 (8)	13 (7.4)	6 (3.4)	42 (12)	20 (5.7)
Duration on ART	≤12 months	10 (5.7)	2 (1.1)	140 (80)	35 (20)	150 (42.9)	37 (10.6)
	13-35 months	32 (18.2)	7 (4)	-	-	32 (9.1)	7 (2)
	36-59 months	85 (48.5)	39 (22.2)	-	-	85 (24.3)	39 (11.1)
	≥60 months	10 (5.7)	2 (1.1)	-	-	10 (2.9)	2 (0.6)
OI status	No OI	122 (69.7)	44 (25.1)	110 (62.85)	29 (16.57)	232 (66.3)	73
	Has OI	5 (2.85)	4 (2.2)	30 (17.1)	6 (3.4)	35 (10)	10 (2.9)
ART regimen	DTG-based	54 (30.85)	15 (8.5)	110 (62.85)	24 (13.7)	164 (46.9)	39 (11.1)
	EFV-based	73 (41.7)	33 (18.8)	30 (17.1)	11 (6.2)	103 (29.4)	44 (12.6)
Functional status	Working	101 (57.7)	38 (21.7)	117 (66.85)	33 (18.85)	218 (62.3)	71 (20.3)
	Ambulatory	26 (14.85)	8 (4.5)	22 (12.5)	2 (1.1)	48 (13.7)	10 (2.9)
	Bedridden	0 (0)	2 (1.1)	1 (0.57)	0 (0.0)	1 (0.3)	2 (0.6)
CD4 count	<200 cells/μl	17 (9.7)	13 (7.4)	9 (5.1)	0 (0.0)	26 (7.4)	13 (3.7)
	200-500 cells/μl	77 (44)	23 (13.1)	92 (52.57)	33 (18.8)	169 (48.3)	56 (16)
	>500 cells/μl	33 (18.85)	12 (6.85)	39 (22.2)	2 (1.1)	72 (20.6)	14 (4)
WHO stage	Stage I or II	121 (69.1)	42 (24)	122 (69.7)	30 (17.1)	243 (69.4)	72 (20.6)
	Stage III or IV	6 (3.4)	6 (3.4)	18 (10.2)	5 (2.85)	24 (6.9)	11 (3.1)
ART adherence level	Good	61 (34.85)	25 (14.2)	102 (58.2)	25 (14.2)	163 (46.6)	50 (14.3)
	Fair	21 (12)	8 (4.5)	16 (9.1)	3 (1.7)	37 (10.6)	11 (3.1)
	poor	45 (25.7)	15 (8.5)	22 (12.57)	7 (4)	67 (19.1)	22 (6.3)
Food problem	Has food problem	26 (14.85)	18 (10.2)	40 (22.85)	13 (7.4)	66 (18.9)	31 (8.9)

Variables	Category	Viral load					
		Exposed		Unexposed		Overall	
		Suppressed (n=127) (%)	Nonsup- pressed (n=48) (%)	Suppressed (n=140) (%)	Nonsup- pressed (n=35) (%)	Suppressed (n=267) (%)	Nonsup- pressed (n=83) (%)
	No food problem	101 (57.7)	30 (17.1)	100 (57.1)	22 (12.57)	201 (57.4)	52 (14.9)
Discontinued ART for other remedy	Discontinued	24 (13.7)	13 (7.4)	66 (37.7)	22 (12.57)	90 (25.7)	35 (10)
	Not discontinued	103 (58.85)	35 (20)	74 (42.2)	13 (7.4)	177 (50.6)	48 (13.7)
Disclosure status	Disclosed	86 (49.1)	32 (18.2)	61 (34.85)	8 (4.5)	147 (42)	40 (11.4)
	Not disclosed	41 (23.4)	16 (9.14)	79 (45.1)	27 (15.4)	120 (34.3)	43 (12.3)
Mental health problem	Have	41 (23.4)	17 (9.7)	54 (30.8)	20 (11.)	95 (27.1)	37 (10.6)
	Free	86 (49.1)	31 (17.7)	86 (49.1)	15 (8.5)	172 (49.1)	46 (13.1)
Current status of Sexual activity	Active	45 (25.7)	10 (5.7)	30 (17.1)	4 (2.2)	75 (21.4)	14 (4)
	Not active	82 (46.85)	38 (21.7)	110 (62.85)	31 (17.7)	192 (54.9)	69 (19.7)
substances use	Using	30 (17.1)	16 (9.14)	43 (24.57)	12 (6.85)	73 (20.9)	28 (8)
	Not using	97 (55.4)	32 (18.2)	97 (55.4)	23 (13.1)	194 (54.4)	55 (15.7)
	≤1000	-	-	140 (80)	35 (20)	140 (40)	35 (10)
Base line VL result (copies/ml)	1001-5000	24 (13.7)	6 (34)	-	-	24 (6.9)	6 (1.7)
	5001-10000	45 (25.7)	19 (10.8)	-	-	45 (12.9)	19
	>10000	58 (33.1)	23 (13.1)	-	-	58 (16.6)	23 (6.6)

3.3. Median Time to Start and Time to Complete EAC Sessions After Being HVL of Exposed Group

Median time of exposed group to the start of the EAC sessions after high viral load (>1000 copies/ml) detected date was two weeks. Significant number of participants 135 (77.1%) have started EAC sessions within two weeks after high viral load detection and from those started EAC at <2 weeks

96(54.9%) attained viral suppression. In this study all exposed group 175 started EAC within two months after high viral load detected. Median time to complete the EAC session was at 12 weeks. 94(53.7%) of exposed complete EAC at recommended duration at within 3 months and 75(42%) of them attained viral suppression. Under one-fourth (14.3%) of exposed of high viral load patients completed the EAC sessions at 6 months of initiation of counseling sessions (Table 3).

Table 3. Time from detection of high viral load to start and complete EAC session from November 2019 to December 2022 in selected Health Centers of Lideta Sub-City, Addis Ababa, 2023.

	Subcategory	Frequency	Percentage	Viral load	
				Suppressed n (%)	Unsuppressed n (%)
Time from detection of high viral load to start EAC session	Median	2 weeks	-	2 weeks	2 weeks
	<2 weeks	135	77.1%	96 (54.9)	39 (22.3)
	2-4 weeks	22	12.6%	18 (10.3)	4 (2.3)

	Subcategory	Frequency	Percentage	Viral load	
				Suppressed n (%)	Unsuppressed n (%)
Time to complete EAC sessions	4-8 weeks	18	10.3%	13 (7.4)	5 (2.9)
	Median	3 months	-	3 months	4 months
	3 months	94	53.7%	75 (42.9)	19 (10.9)
	4 months	27	15.4%	19 (10.9)	8 (4.6)
	5 months	12	6.9%	3 (1.7)	9 (5.1)
	6 months	42	24%	30 (17.1)	12 (6.9)

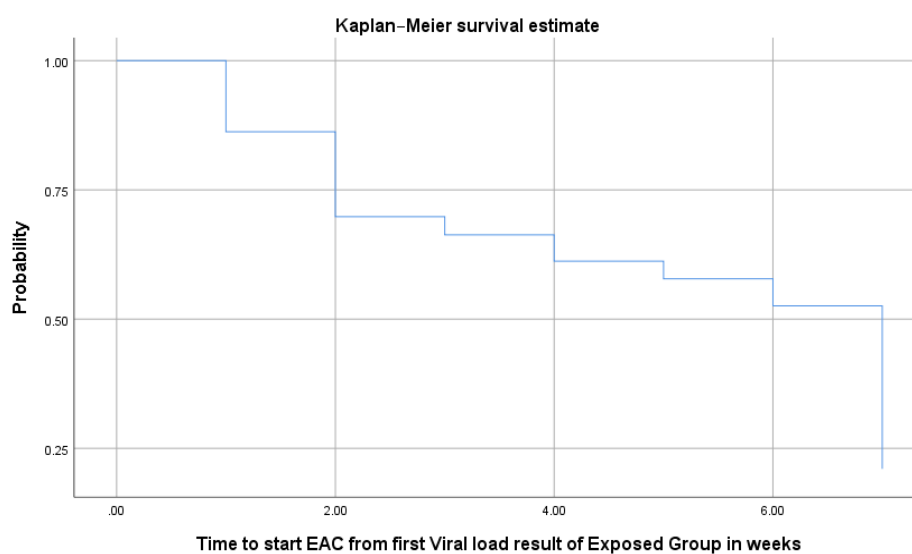


Figure 1. Kaplan-Meier survival curves showing failure experiences of patients which shows time to start EAC among Exposed Group from November 2019 to December 2022 in Health centers Lideta Sub-City, Addis Ababa, Ethiopia.

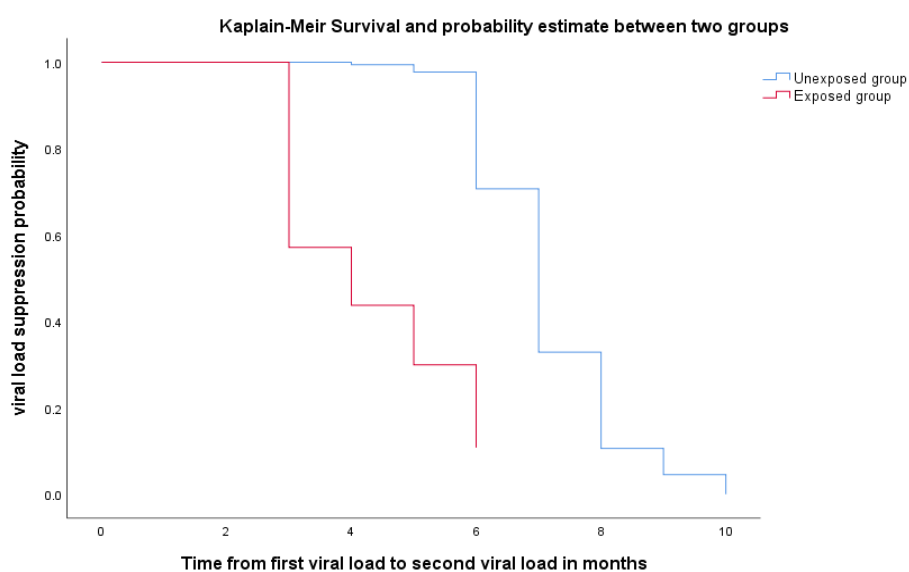


Figure 2. Viral load suppression curves between two study groups participants enrolled to enhanced adherence counseling from November 2019 to December 2022 in Health centers of lideta sub-city, Addis Ababa, Ethiopia.

3.4. Factors Associated with Viral Load Suppression

On bivariable cox-proportional hazard analysis of unexposed group age, ART-regimen, recent Opportunistic status, CD4 count, WHO stage, disclosure status, functional status, history of ART drug discontinuation, substance use and mental health problem were significantly associated with viral load suppression (at p-Value <0.25). For exposed group by bivariable analysis results marital status, occupation, place of residence, religion, CD4 count, disclosure status, WHO stage, recent opportunistic status were significantly associated with viral load suppression (at p-Value <0.25). All variables that had an association with viral load suppression in the bivariable were included separately in multivariable cox-proportional hazard model using backward stepwise regression. There was found that recent opportunistic infection status and disclosure status of unexposed group (Table 4). For exposed group daily laborer and not disclosed their sero status were significantly associated with viral load suppression

at p-value less than or equal to 0.05 and in this study they were declared as predictors of viral load suppression separately (Table 5).

But when both group's data mixed together for analysis; by bivariable cox-proportional hazard analysis age, adherence level, duration on ART medication, ART regimen type, WHO stage, recent opportunistic infection status, disclosure status, history of ART discontinuation, discontinuing ART for taking other remedies, current status of sexual activity, mental health problem, substance use and first or baseline VL results were significantly associated with viral load suppression (at p-Value <0.25). All variables that had an association with viral load suppression in the bivariable were included in multivariable cox-proportional hazard model using backward stepwise regression and there were found that duration on ART, having opportunistic infection or not and history of ART medication discontinuation were significantly associated with viral load suppression at p-value less than 0.05 and they were declared as predictors of viral load suppression in this study (Table 6).

Table 4. Multivariable Cox-proportional Hazard Analysis of unexposed group Shows predictors of Viral Load Suppression ART Patients after EAC from November 2019 to December 2022, Lideta Sub –City, in Addis Ababa, Ethiopia, 2023.

Variables	Category	Viral load(unexposed)		
		Crude Hazard Ratio (95% CI)	Adjusted hazard ratio(95% CI)	p-value
CD4 count	<200 cells/ μ l	1	1	0.096
	200-500 cells/ μ l	0.546(0.273-1.095)	0.519(0.240-1.122)	
	>500 cells/ μ l	1.133(0.547-2.345)	1.321(0.596-2.926)	
WHO stage	Stable	1	1	0.737
	Unstable	0.552(0.317-0.960)	1.131(0.551-2.322)	
OI status	No OI	1	2.346(1.362-4.041)	0.002*
	Had OI	0.563(0.362-0.874)	1	
Disclosure status	Disclosed	1	1.484(1.041-2.115)	0.029*
	Not disclosed	0.642(0.456-0.904)	1	
Functional status	Working	1	1	0.081
	Ambulatory	1.586(1.002-2.509)	1.536(0.949-2.485)	
	Bedridden	1.278(0.178-9.172)	3.973(0.502-31.451)	
Drug discontinuation history	Had	1	1	0.063
	Had not	0.787(0.549-1.127)	0.654(0.418-1.023)	
Substance use history	Had using history	1	1	0.069
	Not had using history	1.435(0.985-2.090)	1.479(0.970-2.254)	

*Their p-values less than 0.05 (statistically-significantly associated), 1 reference category.

Table 5. Multivariable of Cox-proportional Hazard Analysis of exposed group shows predictors of Viral Load Suppression ART Patients after EAC from November 2019 to December 2022, in Lideta Sub City, Addis Ababa, Ethiopia, 2023.

Variables	Category	Viral load(exposed)		
		Crude Hazard Ratio (95% CI)	Adjusted hazard ratio(95% CI)	p-value
Occupation	Daily labor	1	2.069(1.075-3.985)	0.030*
	Merchant	0.580(0.301-1.116)	1.089(0.697-1.699)	0.709
	Employed	0.387(0.199-0.752)	0.768(0.491-1.203)	
	Student	0.520(0.272-0.997)	1	0.249
Disclosure status	Disclosed	1	1	
	Not disclosed	1.465(0.998-2.152)	1.475(1.001-2.174)	0.050*

*Their p-values less than 0.05 (statistically-significantly associated), 1 reference category.

Table 6. Multivariable Cox-proportional Hazard Analysis of integrated both group show predictors of Viral Load Suppression ART Patients After EAC from November 2019 to December 2022, in Lideta Sub City, Addis Ababa, Ethiopia, 2023.

Variables	Category	Viral load		
		Crude Hazard Ratio (95% CI)	Adjusted hazard ratio(95% CI)	p-value
Duration on ART	≤12 months	1	1	<0.001*
	13-35 months	5.263(2.667-10.387)	6.586(3.307-13.117)	
	36-59 months	7.277(4.623-11.455)	6.826(4.316-10.796)	<0.001*
	≥60 months	7.451(5.107-10.870)	6.596(4.485-9.700)	<0.001*
OI status	No OI	1	2.186(1.447-3.303)	<0.001*
	Had OI	0.455(0.310-0.669)	1	
Drug discontinuation history	Had	1	1.663(1.269-2.181)	<0.001*
	Not had	0.678(0.528-0.869)	1	

*Their p-values less than 0.05 (statistically-significantly associated), 1 reference category.

In this study participants who were on ART between 12 and 35 months were 6.6 times more likely had viral suppression when compared to participants with <12 months of ART duration(AHR=6.586, 95% CI: 3.307-13.117), who were on ART for 36-59 months were 6.8 times more likely had viral load suppression when compared with who had <12months ART duration(AHR=6.826, 95% CI: 4.316-10.796) and who had ART duration ≥60 months were 6.6 times more likely to have viral load suppression compared to participants had ART duration ≤12 months (AHR=6.596, 95% CI: 4.485-9.700). Patients who are free of opportunistic were 2 times more likely had viral load suppression when compared with who had opportunistic infection (AHR= 2.186, 95% CI: 1.447-3.303). Participants who had history of ART drug discontinuation were 1.7 times more likely had viral load sup-

pression when compared with participants who had not history of ART drug discontinuation(AHR= 1.663, 95% CI: 1.269-2.181). Participants who were daily laborer were 2 times more likely had viral load suppression when compared with participants who were students (AHR= 2.069, 95% CI: 1.075-3.985). With other predictors; Participants who had not disclosed their sero-status were 1.5 times more likely had viral load suppression when compared with participants who had disclosed their sero-status (AHR=1.475, 95% CI: 1.001-2.174)

4. Discussion

This study assessed the viral load suppression and its predictors among HIV seropositive with high viral load in Lideta

Sub-City at four health centers. It is one of the few studies in Ethiopia which assessed the outcome of the EAC program on HIV seropositive people with high viral load count. Our findings suggested that the overall viral load suppression after enhanced adherence counseling sessions was 76.2%. From 175 unexposed participants, 80% had viral load suppression and 72.6% of exposed participants attained viral load suppression. From all HIV seropositive with suppressed viral load and high viral load who were eligible for EAC, more than three-fourths of patients had viral load suppression (viral load result less than 1000 copies/ml) after the EAC sessions conducted for 3–6 months. This viral load suppression rate is less than to the WHO's target (90%) [13]. But it is higher than the viral suppression rates reported by WHO (70%), in Ethiopia at North Wollo, West Gojjem [10, 14], Zimbabwe [9] and Uganda [15]. Most importantly, the current finding supports WHO recommendations that suspected virologic failure (viral load count >1,000 copies/μl at the first test) should be addressed by enhanced adherence counseling as well as repeat measurement before consideration of treatment switching to second-line drug [2, 16, 17]. Thus, enhanced adherence counseling interventions can preserve the first-line treatment regimen. This could decrease health care costs and the transmission of resistant strains from the newly infected people. In the current study, there is evidence on delay between ascertaining high viral load count (date of high viral load) and initiating EAC sessions. The result showed that all participants of individuals started the EAC session within 2 months of high viral load detected. This suggests relatively somewhat good management of high viral load patients which might affect timely detection of treatment failure when compared with study done in North Wollo which was one-third of individuals started the EAC session after 2 months of high viral load detected [10].

In this study, the EAC sessions were not completed within the recommended time. Of those with high viral loads, only 53.7% of participants completed their EAC sessions within the recommended time which is 12 weeks. Viral load suppression probability of exposed group at the end of the 3rd, 4th, 5th, and 6th month was 57.14%, 43.74%, 29.97% and 10.79%, respectively. The median viral load suppression time was 3 months. For unexposed group viral load suppression probability at the end of the 5th, 6th, 7th, and 8th month was 97.71%, 70.70%, 32.87% and 10.60% respectively. The study results showed that the highest percentage of viral suppression was seen at 3 months of EAC sessions. In this study participants who were on ART more than 12 months had more probability of viral load suppression (13-35 months AHR = 6.586, 95% CI: 3.307-13.117, 36-59 months AHR = 6.826, 95% CI: 4.316-10.796, ≥60 months AHR = 6.596, 95% CI: 4.485-9.700) when compared with ART experience ≤ 12 months. This is supported by study done in Nigeria indicates that most of participants participated in study have been on ART for a long time had more viral load suppression than have been short time on ART [18, 19]. The possible reason for this could be because

ART slows the progression of HIV to AIDS and reduces infections and mortality among those living with HIV. In addition, ART lowers viral load in HIV-infected individuals, thereby reducing the risk of on ward HIV transmission [20]. But in study done in North Wollo it was reported that more than 12 months on ART was associated with decreased probability of viral load suppression as compared to less than 12 months on ART. This could be associated with destruction of CD4 cells over time [10].

Patients who were free of opportunistic infection were 2 times more likely had viral load suppression when compared with who had opportunistic infection (AHR= 2.186, 95% CI: 1.447-3.303). This finding is supported by the study done in West Gojjem, Ethiopia, South Africa and Uganda [14, 21, 22]. This could be explained a large number of the study participant was put on cotrimoxazole and isoniazid prophylaxis that might prevent the occurrence opportunistic infections as well as had role in viral load suppression.

Participants who had not disclosed their sero-status were 1.5 times more likely had viral load suppression when compared with participants who had disclosed their sero-status (AHR=1.475, 95% CI: 1.001-2.174). This study was contrasted by exploratory study done in South Africa, among women who tested HIV-positive during pregnancy and initiated ART subsequently, disclosure to a male partner was associated with a reduced risk of VL ≥50 copies/mL at delivery [23]. By another study done in Tanzania, disclosure of HIV-status before initiation of ART due to improve patients' adherence and has a positive influence on CD4+ T-cell counts recovery as well as viral load suppression [24].

With other significantly associated factors Participants who had history of ART drug discontinuation were 1.7 times more likely had viral load suppression when compared with participants who had not history of ART drug discontinuation (AHR= 1.663, 95% CI: 1.269-2.181). This could be due to strong adherence counseling at the time of re engagement to care and treatment.

5. Strength and Limitation of the Study

5.1. Strength

The major strength of this study was having comparison groups for comparing and measuring the results relatively and summarized the results as overall including both groups. The data were collected from the patients' chart or medical card, follow-up chart, and high viral load registration books, which are the primary level of documentation of the patient information in the health facility of giving ART service.

5.2. Limitation

The major weakness of this study is that data were collected by documentary review, and hence, the analysis and interpretation of the data were restricted to only those variables

that are captured in the patient records. Some of the important variables, such as wealth index, distance to health institutions and full information of substance use history were not accessible which could have played a major role in initial viral load testing, enrolment for EAC, repeat viral load testing and viral suppression. In this study, there could have been selection bias arising from the fact that the samples with recorded second viral load and limited with duration on drug could have been obtained from individuals who had regular follow-up or that patients who did not have standardized regular follow-up, dropped out patients could have been more likely to be non-suppressed.

6. Conclusion

In this study, about 80% of unexposed and 72.6% of exposed group participants had viral load suppression at 3 months or later with the overall viral load suppression was 76.2%. The highest viral load suppression was observed after completion of the first 3 months of enhanced adherence counseling and having greater viral load suppression was seen among unexposed group. The factors that were statistically associated with viral load suppression on repeat testing were having long ART duration, disclosure status, being daily laborer, history of having ART drug discontinuation and not having recently opportunistic infection. Results highlighted the importance of duration on ART in viral load suppression rate. The study shows gaps in time to enrolment into EAC and repeat viral load testing after complete EAC. The more explanations for groups' comparison and those gaps need to be assessed in future research studies.

7. Recommendation

Even if the overall viral suppression rate of this study was greater than the findings reported from North Wollo, West Gojjem Ethiopia and WHO's finding, it was still significantly lower than the UNAIDS 90-90-90 target. So it is better to give attention by the Lideta Sub-City's health centers for viral suppression rate, gaps time to EAC enrollment, gaps of time to send second viral load test and not having regular follow-up, to attain viral suppression by following standardized services with their all contents of guidelines. The Lideta Sub-City's health office and other researchers to study for the more explanations for groups' comparison and those gaps need to be assessed widely.

Abbreviations

ABC	Abacavir
AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
AZT	Zidovudine
DTG	Dolutegravir

EAC	Enhanced Adherence Counseling
HAART	Highly Active Anti-Retroviral Therapy
HIV	Human Immunodeficiency Virus
PLHIV	People Living With HIV
3TC	Lamivudine
TDF	Tenofovir
TPT	TB Prophylaxis Therapy
UNAID	United Nation for HIV AIDS
VL	Viral Load
WHO	World Health Organization

Acknowledgments

First and for most my deepest thank and glory to God for his priceless and unlimited support and gift throughout my life. I also grate full thanks for my advisor Lemesa Assefa for his constructive advice and support and also like to thank Tefera Tezera who revised my thesis and made me to prepare manuscript for publishing my thesis. On last but not least I would like to thank my data collectors with their supervisor for their time to collect my data and show their efforts to its quality.

Author Contributions

Wakgari Dhinsa conceived the presented idea, drafted the manuscript and analyzed the data. Dr. Tefera Tezera read and approved the final manuscript. Dr. Gurmessa Bayecha, Dr. Getu Kusa and Dr. Zelalem Negash discussed the results and commented on the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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