OPPORTUNISTIC INFECTION AND ASSOCIATED FACTOR AMONG ADULT PEOPLE LIVING WITH HIV POST TEST AND TREATMENT AT PUBLIC HOSPITALS, DIRE DAWA, EASTERN ETHIOPIA

A Thesis Submitted to the School of Public Health

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MASTERS OF EPIDEMIOLOGY IN PUBLIC HEALTH

AlemsegedAlemu (BSc)

Advisors:

Major advisor: Degu Abate (MSc, Assistant professor)

Co-advisor: Hirbo Shore (MPH, Assistant professor)

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APPROVAL SHEET

HARAMAYA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

I hereby certifying that I have read and evaluated this entitled opportunistic infection and associated factors among adult people living with HIVpost test and treat treatment approach at public hospitalsin Dire Dawa administration; eastern Ethiopia thesis prepared under my guidance byAlemsegedAlemu. I recommend that it be submitting as fulfilling the thesis requirement.

Degu Abate (MSc, Assistant Professor)_____ _____

Major Advisor Signature Date

Hirbo Shore (MPH, Assistant Professor)_____ _____

Co-Advisor Signature Date

As a member of the Board of Examiners of MPH Thesis-Open Defense Examination, I certify that I have read and evaluated the thesis prepared by AlemsegenAlemuand examined the candidate. I recommend that the thesis be accepted as fulfilling the thesis requirement for the degree of Master of Public Health in Epidemiology.

_____ _____ _____

Chairperson Signature Date

_____ _____ _____

Internal Examiner Signature Date

_____ _____ _____

Eternal Examiner Signature Date

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Name: AlemsegedAlemu

Signature _____Date: _____

School /Department: Public Health

BIOGRAPHICAL SKETCH

I was born in 1984 G.C at Micheta town in west Hararghe Zone of Oromia Regional State,Ethiopia. I have completed aDiploma in clinical nurse in 2006/7 from Harar Nursing College and a bachelor of sciences in Nursing from Haramaya University in 2013, and I have worked in the Dire Dawa Administration Health Bureau in different health facilities since 2007 as a health professional. Then I joined the Masters of Epidemiologyprogram at Haramaya University in 2018/19.

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ACRONYMS AND ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
AOR	Adjusted Odds Ratio
ART	Anti-retroviral Therapy
BMI	Body Mass Index
CDC	Center for Disease Control and Prevention
CD4	Cluster Differentiation Cells
CIConfidence Interval	
CHMS	College of health and medical science
CNS	Central Nervous System
COR	Crude Odds Ratio
CPT	Cotrimoxazole preventive therapy
DDRHB	Dire Dawa Regional Health Bureau
EPHI	Ethiopian Public Health Institute
FMOH	Federal Minister of Health
HIV	Human Immune Virus
HUERB	Haramaya University Ethical Review Board
HZ	Herpes Zoster
IHRERC	Institutional Health Research Ethics Review Committee
IPT	Isoniazid preventive therapy
OI	Opportunistic Infections
PCP	PnuemocistisCarni Pneumonia
PI	Principal Investigator
PLHIV	People Living with HIV
TB	Tuberculosis
UNAIDS	United Nations program on HIV/AIDS
VL	Viral Load
WHO	World Health Organization

ABSTRACT

Background: Opportunistic infections are infections more frequent and/or severe in people living with HIV due to immune suppression. They are the top clinically presented illness and contribute to almost all AIDS-related deaths even after rapid antiretroviral treatment.

O**bjective:** To assess the prevalence and its associated factors of opportunistic infections among adult people living with HIVpost test and treat antiretroviral treatmentat public hospitals in Dire Dawa from June 12-26, 2020.

Method: A hospital-based cross-sectionalstudy design was used. The totalstudy samples were 340. A stratified random sampling technique was done. All included study participants have at least one follow-up visit between October 2018 and September 2019, also took antiretroviralfor a minimum of six months. The data was extracted by extraction tool from routinely collected secondary data and entered into Epi-data and export to SPSS for analysis. Univariable, bi-variable, also multivariable analysis was done.

Results: Of the total participant, 235(70.57%) and 98(29.43%) were fromDilchora and Sabian hospitals, respectively. Nearly two-thirds (63.96%) were female. Out of the total included, 100 of them were diagnosed with an opportunistic infection. The overall prevalence of the study was (37.24%). The top three types of infection were all types tuberculosis 37(29.94%), bacterial pneumonia 20(16.23%), and diarrheal diseases 17(13.81%). The independent factors, advanced disease stage AOR= 8.32(4.13, 16.74), CD4 < 200 cells/mm^3 AOR= 6.18(2.14, 17.88), current weight < 60 kg AOR= 2.90(1.36, 6.16) and antiretroviral adherence level fair/poor AOR= 6.17(3.11, 12.21) were significantly associated.

Conclusion and Recommendation: Opportunistic infections were prevalent among HIV-infected adultson antiretroviral based on test and treatin Dire Dawa.The disease stage, CD4 count, adherence, and weight were independently associated factors. Therefore, proactively identified, managed, and preventing opportunistic infections had better strengthen.

Keywords: Opportunistic Infection, Test and Treat, Dire Dawa, Ethiopia.

1. INTRODUCTION

1.1. Background

The Human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) pandemic is among the health crises ever faced by humanity since the initial case identifies on 5 June 1981 in Los Angeles, USA (De Cocka *et al*., 2012). According to the global estimation of the Joint, United Nations Program on HIV/AIDS (UNAIDS) in 2019 of 2018, 74.9 and 32.0 million people have infected and died respectively from the start of the epidemic.

Similarly, 37.9 million people were living with HIV, in which 36.2 million of them were adults and 1.7 million children (UNAIDS, 2019) and from a total global 25.6 million found in sub-Sahara Africa (FMOH, 2018a). Besides, In Ethiopia, a total of 610, 335 PLHIV, 0.96% national prevalence, and 13,488 annual new infections were estimated by Ethiopian Public Health Institute (EPHI) HIV related estimate and projection for 2018 (FMOH, 2018b).

Opportunistic infections (OIs) are infections that are more severe and or more frequent due to immune-suppression in HIV-positive clients (CDC, 2019). They are the principal cause of morbidity and mortality among HIV- infected individuals (Low *et al*., 2016), and frequently affected organ systems are the nervous, gastrointestinal, respiratory, and skin (FMOH, 2018a). There are many AIDS-related OIs, like bacterial pneumonia, pneumocystis pneumonia, Tuberculosis (TB), different skin infections, diarrheal disease, toxoplasmosis, oral and esophageal candidacies, Cryptococcus infections (WHO, 2016).

The best and provencurrently action used for the prevention opportunistic infection is timelyinitiationof antiretroviral treatments. Within ultimate goals to reduce HIV-related morbidities and mortalities, improve the quality of life, and suppress viral loads (WHO, 2016). The present-day antiretroviral therapy (ART) initiation recommended treatment approach isbased on the new treatment for all people living with HIV, regardless of Cluster Differentiation (CD4)cell count and disease stages that are the test and treatment methods (WHO, 2016; FMOH, 2018a). Ethiopia takes-on this treatment strategy in 2016 and implemented it in the Dire Dawa administration (DDA) since October 2016 (FMOH, 2016).

1.2. Statement of the Problem

In the prevention and control measures of opportunistic infections, reducing exposure and risk factors, chemoprophylaxis, and timely ART initiationhas a significant rolein developing countries include Ethiopia (FMOH, 2018a). Thus the impacts among HIV-infected who do not access ART are more prevalent, and late presentation for treatment, also associated with high early mortality rates, higher direct health-care costs, and pooradherence in care and treatments(WHO, 2016).The report of UNAIDS estimated that 14.6 million, 6.8 million (UNAIDS, 2019) and 173, 372 (FMOH, 2018b) people living with HIV had no access to ART in the World, in Eastern and Southern Africa and Ethiopia respectively in the year 2018. Hence, several people with no access to ART and start ART after immune-suppression due to different factors that may amplify these infections.

Likewise, 23.3 million globally, 13.8 million in Eastern and Southern Africa (UNAIDS, 2019), and 436963 in Ethiopia (FMOH, 2018b) access to ARTwith an urban Ethiopian coverage of 98.6% in 2018(EPHI, 2018). On the other hand, 770,000 in the world, 310,000 inEastern and Southern Africa (UNAIDS, 2019), and 13,556 in Ethiopia (FMOH, 2018b) annual AIDS-related deaths occurred. In the same way, OI isthe top clinical presentation and main causes of morbidity and mortality (FMOH, 2018a). As well, it accounts for nearly whole AIDS-related deaths even after ART and the provided treatment did not fully address death and the need for prevention(Mihiretu*et al*., 2017).Similarly, the opportunistic infectionwas generally an existing illnessin Ethiopia among PLHIV (Genet *et al*., 2018;Teklu*et al*., 2018). Therefore, measuring the prevalenceis a crucial and first step in reducing.

Different practical challenges in test and treat may be the result of an emphasis on accelerating (same-day) ART initiation leads to a lack of efficient establishment of general HIV care packagesto reduce transmission, prevent illness and improve their quality of life (WHO, 2016).Besides, weak early warning indicators for drug resistance, absence of a proven method for retention in care, patient loads, and poor treatment adherence are also existing problems (FMOH. 2018a). The reason might be to start ART before they are ready, with adverse consequences for adherence and treatment outcomes (WHO, 2016), which serve for the increasing.At that point, identify factors affect (risks)will be needed for effectiveprevention and management intervention at the improvement of the quality of life.

Although, there are studies that show prevalence and factor associated with opportunistic infection among HIV-infected adults in some parts of the country based on the previous treatment approaches. Still, OI remains prevalent in Ethiopia vary from region to region, and settingsranging from 21% to 48% (Habtamu*et al*., 2015; Teklu*et al*., 2018). Inversely, there is a lack of study in the new test and treat treatment approach, particularly the burden in Dire Dawa is not studied and well documented. Besides, this study is unique from the pastby taking extra factor that is ART enrolment period, inclusion, and exclusion criteria. In conclusion, knowing the present prevalence, type, and factors related that are critical and effective will enable to use of the limited resource for prevention and management properly and bring the desired impact shortly.Therefore, the purpose of this study is to assess the prevalence and associated factors among adult people living with HIV started antiretroviral based on test and treat at public hospitals in Dire Dawa administration.

1.3. Significance of the Study

This study provides vital information for the Dire Dawaadministration health bureau and hospital management to design appropriate modifications on opportunistic infection prevention and management intervention plan for the allocation of resources, as well as drugs and trained service providers**.** Further,the factors (risk) identify as contributors for OI were enabled hospital managers, stakeholders, and ART providers to address them in clinical management, assess their quality of care, and improve it accordingly. Furthermore, use asbaseline data for further research investigators and also abstracted or separated data on the prevalence and their associated factors in the current treatment approaches.

1.4. Objective

1.4.1. General Objective

- To assess the prevalence and associated factors with opportunistic infections among adult people live with HIV posttest and treat antiretroviral treatmentapproachat public hospitals in Dire Dawafrom June 12-26, 2020.

1.4.2. Specific Objectives

- To measures the prevalence of opportunistic infections.
- To identify factors associated with opportunistic infections.

2. LITERATURE REVIEW

2.1. HIV/AIDS and Antiretroviral Treatment

Human Immunodeficiency Virus (HIV) is a virus in the group of retroviruses that destroys CD4 cells type of white blood cells (Goud and Ramesh, 2014). The epidemic has remained one of the public health challenges in the globe as well in Ethiopia since first identified in 1984 (Yibeltal *et al*., 2014). ARV has made known to decrease viral replication, increase CD4 count, decrease the frequency of OIs, improve quality of life, and prolong life expectancy (WHO, 2016). Bring into being in 2003 and free of charge was launched in 2005, and ART initiated based on disease stage and or CD4 count criteria. Also, criteria changed over time, and now it applies to the test and treats approach (WHO, 2016).

2.2. Test and treat approach

World Health Organization newly released guidelines that removed all restrictions on eligibility for ART and recommend that anyone living with HIV ought to begin ART as soon after diagnosis (WHO, 2016). After the release of these guidelines, Ethiopia starts the implementation and applied test and treat in October 2016, till now (FMOH, 2016). However, the prevalence of OI among PLHIV adults not reduced (Genet *et al*., 2018).

2.3. Prevalence of opportunistic infections

Opportunistic infections are late complications of HIV-infection but prevalent and occurred at any time in patients with less than 200 CD4 cell count. The causative agents are opportunistic organisms such as PCP, mycobacterium complex, and cytomegalovirus (CMV) that cause illnesses in compromised immune systems. The commonest were bacterial, fungal and protozoan parasites are also severe in people living with HIV (WHO, 2016). People living with HIV are vulnerable to opportunistic infections because they take advantage of the opportunity offered by a weakened immune system. Since the beginning of HIV-infected, opportunistic infections have to recognize as common complications of HIV-infection individuals and the leading causes of morbidity and mortality despite the existence of prevention and treatment modalities (FMOH, 2018a). The prevalence among adult people living with HIV on antiretroviral treatment is still high in different countries, as well in Ethiopia requires several protective activities or strategies from the ministry of health, health facilities, health professionals, and patients (Genet *et al*., 2018).

Even if a remarkable variation in spreading and pattern across the country, residences in low and middle-income countries are affected, particularly sub-Sahara Africa (Low *et al*., 2016). The prevalence in the USA and Canada 9%, 26% in Nigeria, 43.1% in Uganda, and 50.63% in India (Shehu *et al*., 2014; Bhuvana *et al*., 2015; Buchacz *et al*., 2016; Weissberg *et al*., 2018). Similarly, vary in Ethiopia across the regions and setting a national-level study conducted; was found 21.3% (Teklu *et al*., 2018). Also, regional study conduct in Harar, Debre-Markos, Addis Abeba, Arba Minch, and Gondar indicates that 48%, 42.8%, 41.4%, 28.18%, and 19.7% respectively (Debasu *et al*., 2013; Nurilign and Getachew, 2014; Habtamu *et al*., 2015; Mebrahtu *et al*., 2015; Getaneh *et al*., 2018).

The main types and distribution of OI also varying studies in India reviled; the commonest is TB 56%, candidacies 46%, and PCP 15% (Goud and Ramesh, 2014). At the same token, in Uganda, oro-pharyngeal candidacies are the lidding 43.6%, TB 21.6%, HZ 19.9%, and cryptococcal meningitis 4.6% (Weissberg *et al*., 2018). Studies result in Ethiopia showed, all forms of TB are the leader by 43.49% of cases, oral candidacies 35.2%, HZ 19%, and recurrent bacterial pneumonia 12.1% (Addisu and Wbeshat, 2018). A similar study indicates a high prevalence among observed OI was Pulmonary TB 21.23%, followed by HZ 11.2% and oral candidiasis 9.5% of cases (Habtamu *et al.*, 2015).

2.4. Factors affecting the occurrence of opportunistic infection

The factors that affect the occurrence of opportunistic infection have been investigating in some studies, and it ranges from socio-demographic factors to clinical characteristics. And also include adherence to medication as follows detailed blow.

2.4.1. Socio-demographic factors

Among sociodemographic factors associated with opportunistic infections, studies show that in India and Nigeria, older age is less likely, compared to younger (Iroenzindu *et al*., 2013; Bhuvana *et al*., 2015). A comparable study in southern Ethiopia reported disapproval of the above which means, older age were more likely to develop OIs (Getaneh *et al*., 2018). Individuals with divorced marital were more likely, to develop OI when compared to married according to a study in Addis Ababa and Gonder university hospital (Debasu *et al*., 2013; Addisu and Webeshet, 2018). A study-at Gonder-university hospital revealed a single marital status at a higher risk to develop (Debasu *et al*., 2013).

Agreeing on the way to the national-level cross-sectional and Arba Minch studies, females were more likely to develop OIs (Getaneh *et al*., 2018; Teklu *et al*., 2018). Conversely, the risk of-occurrence did not significantly differ between gender in studies done in India, Nigeria, Addis Ababa, and Debre-Markos (Shehu *et al*., 2014; Nurilign and Getachew, 2014; Patil *et al*., 2015; Addisu and Webeshet, 2018). As also seeing educational and employment status, the primary education level was less likely than related to no education (Nurilign and Getachew, 2014), and employed people were more likely as related to unemployed (Bhuvana *et al*., 2015; Buchacz *et al*., 2016).

2.4.2. Clinical factors

The study revealed that people living with HIV has a baseline CD4 count <200cells/mm^3 were at higher risk of or more likely to develop opportunistic infection than theirs compared to baseline CD4 ≥200cells/mm^3as study conducted in the United States and Canada (Buchacz*et al*., 2016), India (Bhuvana*et al*., 2015), and also in Ethiopia; Wolita Hospital, Addis Abeba and eastern Ethiopia (Mebrahtu*et al*., 2015; Habtamu*et al*., 2015; Mihiretu*et al*., 2017). As relating current Hemoglobin level <10mg/dl were at higher risk of when compared to whose ≥10mg/dl (Mebrahtu*et al*., 2015).

The studies in the United States (Sharma *et al*., 2015), Nigeria (Iroenzindu*et al*., 2013), and Addis Abeba(Eyasu*et al*., 2015) report that with base-line BMI<18.5 kg/m^2 was at higher risk of OI and deaths. Also, the current weight of <60 kg was more likely of OIs (Nurilign and Getachew, 2014). Addingstudies result in India (Bhuvana*et al*., 2015) and Ethiopia (Nurilign and Getachew, 2014; Genet *et al*., 2018) report that advanced disease stage was more likely for opportunistic infection than associated with early disease stages.

Concerning clinical features, the functional status identifies to be affected opportunistic infections occurrence as the study conducted in HiwotFana Specialized Hospital report, bed-ridden more likely associated with opportunistic infections compared to ambulatory and working functional status (Habtamu *et al*., 2015). While relating preventive chemoprophylaxis intake (INH and CPT), patients took opportunistic infections preventive prophylaxis therapy less likely to develop opportunistic infections than when compared to those who do not take preventive prophylaxis evidence from DebreMarkos, and HiwotFana Specialized Hospital (Nurilign and Getachew, 2014; Habtamu *et al*., 2015).

2.4.3. Adherence to treatment factors

The levels of adherence to treatments are the main contributors to the incident of opportunistic infection(Genet *et al*., 2018). The results of a study in Addis Ababa admit that the antiretroviral therapy adherence level poor were more likely to develop an opportunistic infection than good (Nurilign and Getachew, 2014; Mebrahtu *et al*., 2015). And allowing the national-level study transfer out and lost to follow-up status of study participant is more likely to opportunistic infections occurrences as compared to having active on antiretroviral treatment follow up status (Teklu *et al*., 2018).

2.5. Conceptual framework

Opportunistic infections are best to determine by using culture. But access to cultural testing is limited in study hospitals and hence uses routine laboratory results and/or clinical diagnosis. Main associated factors that are review from the literature put in the conceptual framework of the study figure1.

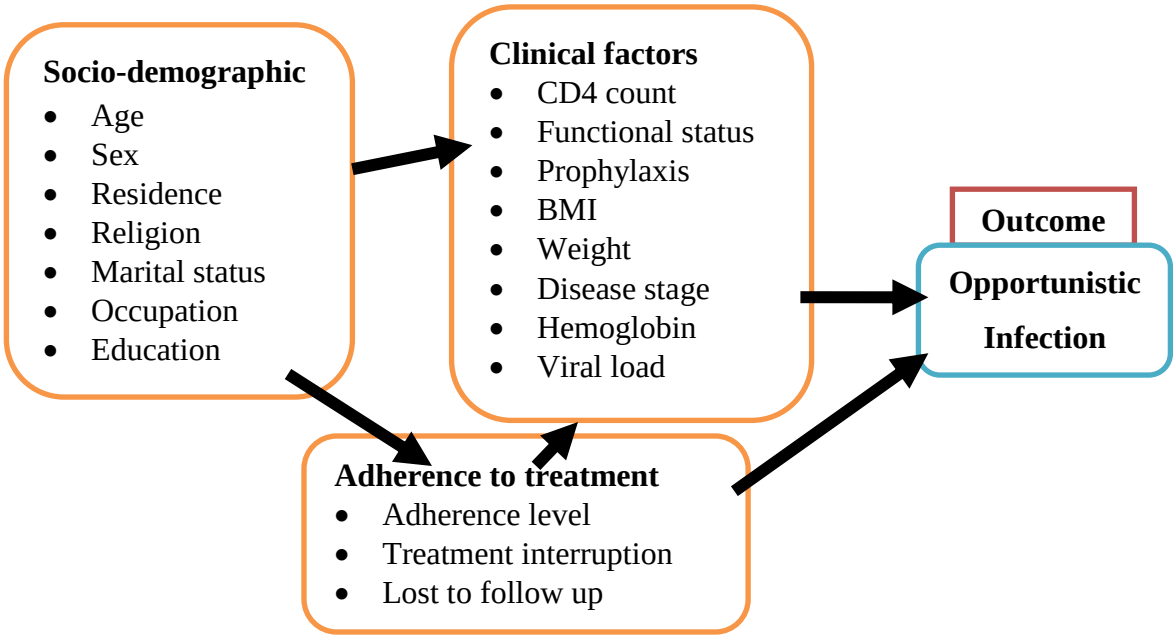

Figure1: Conceptual framework of opportunistic infection among adult PLHIV at public hospitals in Dire Dawa, eastern Ethiopia, 2021

Adapted from different works of literature(Nurilign and Getachew, 2014; Mebrahtu*et al*., 2015; Mihiretu*et al*., 2017; Teklu*et al*., 2018).

3. METHODS

3.1. Study Area and Period

Dire Dawa Administration is found in the eastern part of Ethiopia, 515 kilometers away from Addis Ababa. It bordered by Somali Regional State in the east, west, and north, and Oromia in the south and east. The city has a total area of about 1558.61 square kilometers, and the administrative division of 9 urban and 38 rural Kebeles (DDA, 2016). The recent projection data indicates a population of 493,000 for 2019, with an estimated annual population growth of 2.5%, and 64% of the population resides in urban areas **(**DDA, 2016).

The health system has organized to play the pivotal roles of managing and coordinating the operation of the primary health care services, which currently consists of 2 hospitals that present study conducted, 16 health centers (7 in rural), and 31 health posts owned by the government. There are four hospitals and 21 clinics that are privately own (DDA, 2016). According to the EPHI HIV-related estimate and projection for Dire Dawa Administration for 2018, the urban adult HIV prevalence estimated to be 4.6%, with almost increased twofold from 2016 is 2.5% (EPHI, 2018).

Antiretroviral treatment service was initiated for the first while in February 2005 atDilchora hospital, and the test and treat treatment approach implementedsinceOctober 2016 inthe Dire Dawaadministration(DDA, 2016).As per the Dire Dawa administration health bureau report in September 2019, a total of 2451 and 916 patients received antiretroviral treatmentcare and servicesatDilchora and Sabian hospitals, respectively; it confines nearly two-third of the region patient loads. Of the total**,** 2286 and 889 were adultsin both hospitals current on antiretroviral treatments.The data extraction wascarried out in both selected hospitalsas of June 12 to 26, 2020.

3.2. Study Design

A hospital-based cross-sectional study design was used.

3.3. Source Population

All adult peoples living with HIV ever startantiretroviraltreatmentbased on tests and treat treatment approaches in Dire Dawa administration.

3.4. Study Population

Adult people living with HIV who have at least one follow-up visit over the twelve months, October 2018 to September 2019at selected public hospitals.

3.5. Inclusion and Exclusion Criteria

3.5.1. Inclusion Criteria

All adult people living with HIV take antiretroviral treatmentfor a minimum of six month.

3.5.2. Exclusion Criteria

The study participant has on second-line antiretroviral therapy excluded.

3.6. Sample Size Determination

The sample size calculates used different assumptions and Epi-Info 7 software sample size calculator. Finally, take the maximum sample size estimates.

A. Sample size calculation used for the first objective that the prevalence of opportunistic infection in the period of test and treat from a similar study conducted in Gedeo Zone (Genet *et al*., 2018). Was done using a single population proportion formula:

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

Where, Zα/2 at 95 % Confidence level =1.96; P =38.7 % (Genet *et al*., 2018); d is degree of precision =4%.Hence, the sample size (n) calculated was 570. Since the total study population is less than 10,000, the correction formula needs to be used (Daniel, 2009).

$$n = \frac{n_0}{1+\frac{n_0}{N}}$$

Where N (total included population) was 697; n_0 is 570. The calculated sample (n) was 310.

B. Sample size calculation used for the second objective presented in Table 1,calculated by using Epi-Info 7 software and opportunistic infectionpredictors such as antiretroviral treatment adherence level and WHO clinical stages were 36 and 188, respectively. Take the maximum sample size from the calculation with the assumption "A" is 310, and adding 10% compensation is 30. Therefore, the final total sample size required for this study was 340.

Table 1: Sample size calculation of opportunistic infection among adult PLHIV at public hospitals in Dire Dawa, eastern Ethiopia, 2021

Estimate	Two-sided CI	Power	Ratio (Unexposed : Exposed)	% of outcome in unexposed group	AOR	Calculated sample	Source
ART adherence (B1)	95%	80%	1	26.30%	10.05	36	Genet *et al*., 2018
WHO stage (B2)	95%	80%	0.5	23.70%	2.72	188	Genet *et al*., 2018

3.7. Sampling Technique

A stratified random sampling technique was done. The list of medical record numbers of the included study population enrolled in the given study period extracted from the ART database stratified for each hospital on an excel sheet is a sampling frame. When data extract from ART SMART care, May 25, 2020,the total sample units that fulfill the inclusion criteria of the study taken from both hospitals over the three consecutive years were 697. That was since the start of the test and treat antiretroviral treatment approach implemented, October 2016 to September 2019 (October 2016 to September 2017, October 2017 to September 2018, and October 2018 to September 2019). Similarly, the total eligible numbers of the study population were 494 from Dilchora and 203 from Sabian hospitals. Also, the appointment of the sample size based on the proportion of the patient load to Dilchora and Sabian hospital is 240 and 100, respectively.

Furthermore, the sampling interval was determined (K) by dividing the number of units in the population of each year by the sample size proportionally allocated and calculatesthe K value for each hospital. The random start numbers were hand-picked by the lottery method and were first included in the sample and select every K^{th} unit until it reached the final samplesize. Finally, the total eligible study units, earmarked proportionally and taken for each year and hospitals were 185 (89), 180 (88) and 129 (63),and 95 (47), 65 (32) and 43 (21) from Dilchora and Sabin ascending respectively first the third year. A schematic sampling procedure of the study is demonstrated already in figure 2.

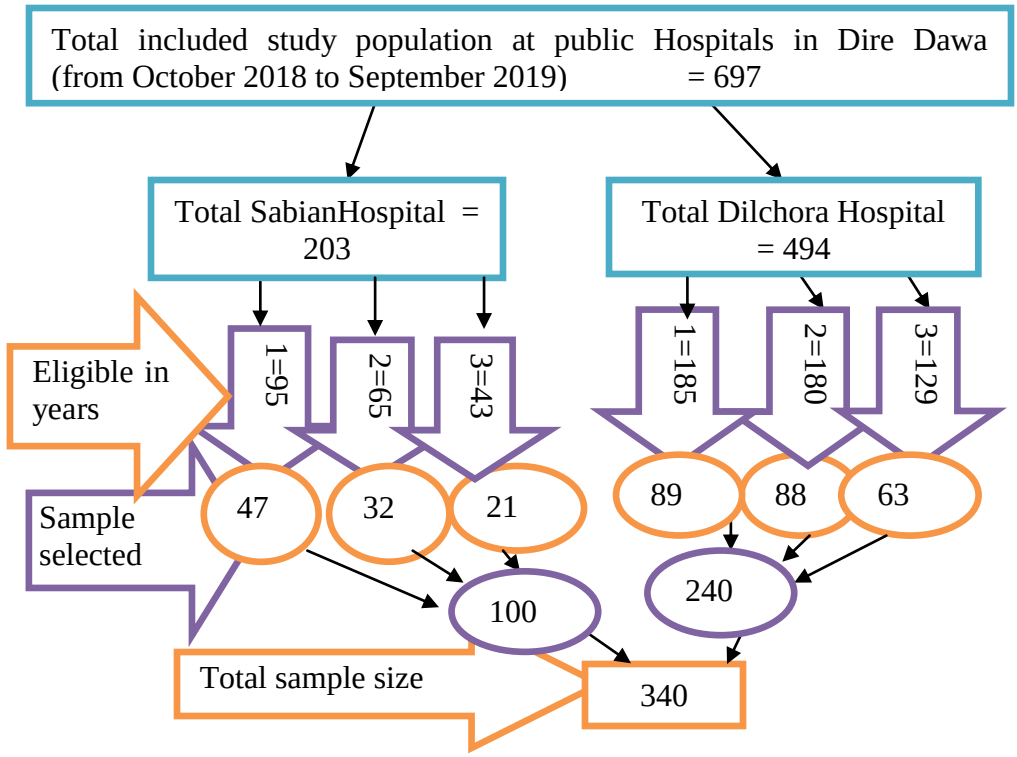

Figure 2:Sample size allocation of opportunistic infection among adult PLHIV at public hospitals in Dire Dawa, eastern Ethiopia, 2021

3.8. Instruments and Extraction Procedure

The data extraction instrument was developed from the national standardized HIV patientregisters, intake and follow-up formats.The format includedclinical, socio-demographic,adherence to treatment, and opportunistic infection diagnosis. The data were extracted from routinely collected secondary data of adult people living with HIV starting antiretroviral treatment based on test and treattreatment approach.

The data wereextracted by two data collectors who are currently working as ART clinic data clerksand have work experience. Primarily all the data were extracted from theSMART care of antiretroviral therapy databases. However, if there were a missed data registration books, follow-upcard,and any laboratory requests were used.The data extractors were trained on how to extract and familiar to understand all the information in the data extraction instrument. Orientation was alsogiven for a supervisor on objectives, the contents of data extraction tools, procedures, and ethical standards.

3.9. Study Variables

3.9.1. Dependent Variable

Opportunistic infection

3.9.2. Independent Variable

- ✓ Clinical factors; functional status, CD4, Viral load, Hgb., OI chemoprophylaxis, ART enrolment period, disease stage, BMI and Weight.
- ✓ Socio-demographic; age, sex, residence, religion, occupation, education, and marital status of the study participant.
- ✓ Adherence to treatment; antiretroviral treatment adherence level, lost to follow-up, and treatment interruption.

3.10. Operational Definition

Opportunistic infections: the occurrence of associated infections after ART initiation due to immune suppression. Under the lists of opportunisticinfections indicated on the Ethiopian National Guideline for Comprehensive HIV Prevention, Care, and Treatment (FMOH, 2018a). The study only collected information on opportunistic infections that were diagnosed between October 2018 and September 2019.

Test and treat approach: which recommends starting ART for HIV positive clients rapidly regardless of CD4 count and WHO clinical stage (WHO, 2015).

Same-day ART initiation: is initiating antiretroviral treatment on the date of confirmed HIV diagnosed (FMOH, 2018a).

Lost to follow up: PLHIV on comprehensive HIV cares miss-appointment a month/above but less than three months at a chronic care clinic (Nurilign and Getachew, 2014).

Adherence: adherence to medication is defined as the act of conforming adherence level and assessed by using tablet counting and self-reporting methods. **Good,** if adherence is >95% (<2 doses of 30 doses or < 3 doses of 60 doses are missed). **Fair**, if adherence is between 85 % and 95 % (3-5 doses of 3o doses or 3-9 doses of 60 doses are missed). **Poor**, if adherence is <85 % (>6 dose of 3o doses or >9 doses of 60 doses is missed) (WHO, 2006).

On advanced disease stage: people living with HIV who on WHO clinical stage III, and IV (WHO, 2016).

3.11. Data Quality Control

Data quality control maintained by designed proper data extraction tools, trained data collectors, and continuously supervised the data extraction process. Daily checked the data completeness, consistency and accuracy also done by a supervisor and principal investigator. Further, cross-checkedsome data extracted from the database with registration books and follow-up cards and alsomaintained through data cleaning and editing.

3.12. Methods of Data Analysis

The data completenessand consistency re-checked manually. Then sorted, coded, and entered into Epi- data version 3.1 and exported to SPSS version 25for data recording, cleaning and statistical analysis. Before subjected to the data analysis, frequencies distribution generatedto identify the outliers and missing data. Outliers and missing data were re-checked from the data extraction tools. Descriptive statistics calculated and presented through tables, percentages, and frequencies to describe the overall study pieces of information.

To ascertain significant association: - and also to reduce the number of parameters and improved the precision of the estimates of the final multivariable models. The independent variables are significant at $P < 0.25$ in the bi-variable analysis used to construct a multivariable model. Finally, do a logistic regression analysis to control possible confounders and to determine factors that may be significantly associated with the occurrence of opportunistic infection. To measure the strength of association between dependent and independent variables, adjusted odds ratios with the 95% confidence interval (CI) were calculated. Also, the considered statistical significant association is along with two side p-value of< 0.05.

Further, some statistical tests were donefor the final multivariable models, and their results were:**Hosmer-Lemeshow Statistic**: is a Pearson chi-square, calculated from a 2 ×g table of observed and estimated expected. Assess the fit of a logistic model against actual outcomes. Non-significance ($P \geq 0.05$) means the model adequately fits the data.Logistic model for OI, goodness-of-fit test: Number of observations = 333, Number of covariate patterns = 181, Pearson chi2 (169) = 188.73, Prob> chi2 = **0.1423.**

Variance Inflation Factors (VIF): The presences of multi-collinearity among independent variables were checked.The calculated Mean VIF = **1.38**.

Classification Table: Are 2 x 2 tables which that that cross-tabulate the observed value with the predicted value. Evaluates the predictive accuracy of the model, and If the model predicts > **70%** of the cases correctly, it is accepted discriminatory power.Logistic model for opportunistic infection = **86.79%.**

ROC curve for the Models: it indicates the area under the curve and model goodness.Used as a measure of the predictive power: A model with no predictive power has an area of 0.5; a perfect model area 1. Logistic models for opportunistic infection, Number of observations = 333**,** The Area under the ROC curve = **0.9051**.

3.13. Ethical Consideration

The Institutional Health Research Ethics Review Committee (IHRERC) of Haramaya University had approved the study. The official letter of co-operation addressed for each hospital written from the college of health and medical sciences of Haramaya University. Obtained informed written and signed consent from hospitals for their participation after the nature of the study was fully explained.

The review of the database and medical records is secondary data extraction. The study participant voluntarily signed written consent excluded. However, explain to the facility that confidential and private information is protected. To protect the confidentiality, the names of the participant did not include in the data extraction tools. Also, informed that the hospitals have the right to stopover from being showed if any misdeeds and unethical procedure observed in the data extraction process in the hospital's principles.

3.14. Information Dissemination

The result of the study will will disseminate to the School of Public Health, College of Health and Medicine Sciences, Haramaya University, Dire Dawa Administration Health Bureau, and both hospitals. It will also submit to any concerned non-governmental organizations. The final report will disseminate by seminars, workshops, and conferences, and it will publish in peer-reviewed journals.

4. RESULTS

4.1. Socio-demographic characteristics

This study assessed the prevalence and associated factors for opportunistic infections among adult people living with HIV who ever start antiretroviral based on a test and treat treatment approach. The study population took a minimum of six-month antiretroviral treatment at selected public hospitals (Dilchora and Sabina) in the Dire Dawa administration. As well, all the included study participants have at least one chronic care follow-up visit over the twelve months, October 2018 to September 2019. Hence, this is a one-year study period that opportunistic infection prevalence was measured or the only time collects information on the diagnosis of opportunistic infections.

The study reviewed a total of 340 medical records of individuals who take antiretroviral treatments. Out of the planned sample, 333 (97.94%) were on the first-line antiretroviral. While 7 (2.06%) of them were on second-line antiretroviral treatment that excluded from the study in which 5 and 2 were from Dilchora and Sabin hospitals, respectively. Of the total included, 235 (70.57%) and 98 (29.43%) attended care and treatment services at Dilchora and Sabian hospitals, respectively. Nearly two-thirds of 213 (63.96%) of the study participants were females. The majority of 116 (34.83%) participants' age group was between 30-39 years. The mean and median age of the study participants was 35.67 and 34.00, correspondingly. The majority 112 (33.63%) of individuals on the reviewed records were married, and regarding religions, closes to half 161 (48.35%) were orthodox Christian followers, and also equivalent to one third 115 (34.53%) were at primary educational status. All the socio-demographic characteristics of the study participants are present in Table 2.

Table2: Socio-demographic characteristics of participant toward OI among adult PLHIV at public hospitals in Dire Dawa, eastern Ethiopia, 2021

Variables	Categories	Frequencies (n)	Percentage (%)
Hospital Name	Dilchora	235	70.57
	Sabin	98	29.43
Age of Participant	18-29 years	101	30.33
	30-39 years	116	34.83
	40-49 years	73	21.92
	≥50 years	43	12.91
Sex of Participant	Male	120	36.04
	Female	213	63.96
Marital Status	Never Married	88	26.43
	Married	112	33.63
	Divorced	83	24.92
	Widowed	50	15.02
Educational Status	No Education	78	23.42
	Primary Education	115	34.53
	Secondary Education	108	32.43
	Tertiary Education	32	9.61
Residence	Dire Dawa	278	83.48
	Out of Dire Dawa	55	16.52
Religion	Muslim	122	36.64
	Orthodox	161	48.35
	Protestant	39	11.71
	Catholic	11	3.30
Occupational Status	Unemployed	99	29.73
	Government Employee	64	19.22
	NGO Employee	48	14.41
	House Wife	43	12.91
	Merchant	48	14.41
	Others	31	9.31

4.1.1. Baseline clinical characteristics

The initial clinical characteristics of the current study result showed that two-thirds of 224 (67.27%)study members weight was less than 60 kilograms. However, just about three fourth 247 (74.17%) of the study subject baseline body mass index (BMI) was ≥ 18.5 kg/m^2. The majority of 91 (27.33%) of the respondent's initial CD4 cell count had greater or equal to 500 cells/mm^3, and more than the two-thirds of 227 (68.17%) study participants WHO clinical stages were early disease stages (WHO clinical stage I and II). Almost all 291 (87.39%) the study participant initial antiretroviral treatment regimens were TDF-3TC-EFV. Furthermost, more than half of 198 (59.46%) of the study participant, the antiretroviral treatment enrolment periodor the day between HIV diagnosis and antiretroviral therapy start were less than seven days (Table 3).

Table 3: Baseline clinical characteristics of opportunistic infection among adult PLHIV at public hospitals in Dire Dawa, eastern Ethiopia, 2021

Variables	Categories	Frequencies (n)	Percentage (%)
Baseline Weight	< 60 kg	224	67.27
	≥ 60 kg	109	32.73
	Total	333	100
Baseline BMI	< 18.5 kg/m^2	86	25.83
	≥ 18.5 kg/m^2	247	74.17
	Total	333	100
Baseline CD4 Count	< 200 cells/mm^3	75	22.52
	200-349 cells/mm^3	84	25.23
	350-499 cells/mm^3	83	24.92
	≥ 500 cells/mm^3	91	27.33
	Total	333	100
WHO clinical stages	Early disease stage	227	68.17
	Advanced disease stage	106	31.83
	Total	333	100
Baseline (initial) ARV Regimen	TDF-3TC-EFV	291	87.39
	TDF-3TC-DTG	27	8.11
	Others	15	4.5
	Total	333	100
ART enrolment period	< 7 days	198	59.46
	≥ 7 days	135	40.54
	Total	333	100

4.1.2. Current clinical characteristics

The results of the current clinical characteristics of the study respondents showed that above half of 194 (58.26%) study participant's current weight was less than 60 kilograms. The majority of 272 (81.68%) of the BMI was greater or equal to 18.5 kg/m2. Besides, the majority of 191 (57.36%) of the current antiretroviral therapy regimen of study participants were TDF-3TC-EFV, and also higher than one-third of 129 (38.74%) were on TDF-3TC-DTG that is a currently recommended ART regimen. Above three fourth of 258 (77.48%) respondents duration (stay) on ART or months on ART was found to be greater or equal to 12 months. Also, a maximum of 43 and a minimum of six months of participant stay on ART documented. Further, the value of the mean and median stay of the participant on ART was 22.76 and 22.00, respectively (Table 4).

As well, the result of this study showed that out of the total 269 eligible for opportunistic infectionpreventivechemoprophylaxis, 142 (52.79%) and 235 (87.36%) of them took Cotrimoxazole and Isoniazid preventive therapy, respectively. Among those who took Cotrimoxazolepreventive therapy, nearly three fourth of 106 (74.6%) participants had good adherence. Further, of the total included study participant above two-thirds of 227 (68.17%), participant antiretroviral treatment adherence levels were at a good while the rest wasfair or poor.

Table 4: Current clinical and ART adherence characteristics of OI among adult PLHIV at public hospitals in Dire Dawa, eastern Ethiopia, 2021

Variables	Categories	Frequencies (n)	Percentage (%)
Current Weight	< 60 kg	194	58.26
	≥ 60 kg	139	41.74
	Total	333	100
Current BMI	< 18.5 kg/m^2	61	18.32
	≥ 18.5 kg/m^2	272	81.68
	Total	333	100
Current ART Regimen	TDF-3TC-EFV	191	57.36
	TDF-3TC-DTG	129	38.74
	Other	13	3.9
	Total	333	100
Months on ART	< 12 Month	75	22.52
	≥ 12 Month	258	77.48
	Total	333	100
CPT prophylaxis (n=269)	Yes	142	52.79
	No	127	47.21
	Total	269	100
CPT adherence (n=142)	Good	106	74.65
	Fair/Poor	36	25.34
	Total	142	100
INH prophylaxis (n=269)	Yes	235	87.36
	No	34	12.64
	Total	269	100
ART Adherence Level	Good	227	68.17
	Fair/Poor	106	31.83
	Total	333	100

4.2. Prevalence of opportunistic infection

Out of the total included study participants, this study outcome identifies, 100 of them had been diagnosed with opportunistic infection during the study period. Types and the frequencies of opportunistic infection diagnoses per patient ranged from one to three cases of infections. Most 78 of them had once, 20 of them had twice, and the remaining only 2 of them had three times. As a result, a total of 124 infection cases identify. Therefore, the overall prevalence of opportunistic infection in the study was 37.24% (95% CI = 32.10, 42.38). Besides, common and top four types of opportunistic infection identified by the current study were all form of tuberculosis 37 (29.94%), bacterial pneumonia 20 (16.23%), diarrheal diseases 17 (13.81%), and oral candidiasis 14 (11.39%) descended respectively (Table 5).

Table 5: Typeand frequenciesof opportunistic infection among adult PLHIV at public hospitals in Dire Dawa, eastern Ethiopia, 2021

S.N	Name of Opportunistic Infection	Frequencies (n)	Percentage (%)
1	All form TB	37	29.94
2	BacterialPneumonia	20	16.23
3	Diarrheal Diseases	17	13.81
4	Oral Candidiasis	14	11.39
5	PCP	11	8.97
6	CNS Toxoplasmosis	10	7.36
7	Cryptococci meningitis	8	6.55
8	Others	7	5.75
	Total	124	100

4.3. Results of bi-variable analyses for factors associated

The bi-variable logistic regression analyses identified the factors that fulfill the inclusion criterion of multivariable analysis and which study categoriesmostaffected by an opportunistic infection. As a result, the highest prevalence of opportunistic infection was found among the assumed independent factors. Those individuals who were on widow marital status (40.0%), no education level (34.6%), Dire Dawa dwellers (30.9%), with others (daily laborer or farmers) occupation status (41.9%), who have an antiretroviral treatment enrolment period less than seven days (30.8%) and months on antiretroviral treatment greater or equal to twelve months (30.2%). However, the prevalence of opportunistic infection was not significantly different among the above socio-demographic and clinical factors ($P > 0.25$) that do not include multivariable logistic regression analysis (Table 6).

The independent variables affirmed to have a significant association with opportunistic infections in the bi-variable analysis were, study participants being female sex is protective (COR= 0.74, 95%; CI=0.46, 1.20). The study participants whose age group 30-39 (COR= 1.87, 95% CI= 0.99, 3.53), age group 40-49 (COR= 2.53, 95% CI= 1.27, 5.05) and age group ≥ 50 years (COR= 3.42, 95% CI= 1.56, 7.47) were more likely to develop OI as compared to age group 18-29. The study participants with a baseline BMI less than 18.5 kg/m^2 (COR= 3.57, 95% CI=2.13, 5. 99) and current weight less than 60 kg (COR= 2.50, 95% CI= 1.50, 4.17) were a higher probability of OI as compared to counterpart BMI and weight respectively.

Furthermore, the study members who's advanced disease stage (WHO clinical stages III and IV) (COR= 13.85, 95% CI= 7.90, 24.29), Baseline CD4 count < 200 $cells/mm^3$ (COR= 16.46, 95% CI = 6.95, 38.95), CD4 count between 200-349 $cells/mm^3$ (COR= 6.07 95% CI= 2.59, 14.20) and CD4 count between 350-499 $cells/mm^3$ (COR= 2.29, 95% CI= 0.92, 5.72) were more likely develop opportunistic infections as compared to those participants at early disease stages (WHO clinical stages I and II), and CD4 cell count ≥ 500 $cells/mm^3$ respectively. Additionally, the study subjects who have current BMI less than 18.5 kg/m^2 (COR=37.90, 95% CI= 16.2, 88.6) were more likely OI occurrences. However, this independent variable was not included in multivariable analysis, because it has wide CI, and it decreases the model goodness of fit estimates and also increased variance inflation factors.

Likewise, a participant who has antiretroviral treatment adherence level fair/poor (COR= 10.90, 95% CI= 6.32, 18.81) found to be a higher probability for opportunistic infection occurrences as compared to good antiretroviral adherences. In conclusion, it decided significantly associated factorswith opportunistic infection fromthe final multivariable model. It included all that fulfill the inclusion criteria of multivariable analysis from bi-variable, as they all had a p-value of <0.25. Such as the total study participants (n=333), sex, age, disease stages, baseline CD4 count, baseline body mass index, current weight, and antiretroviral treatment adherence levels.

Table 6: Result of bi-variable analysis for factors associated with OI among adult PLHIVat public hospitalsin Dire Dawa, eastern Ethiopia, 2021

Variables	Categories	OI		COR, 95% CI	p-value
		Yes (%)	No (%)		
Sex					0.219*
	Male	41(34.2)	79(65.8)	1	1
	Female	59(27.7)	154(72.3)	0.74 (0.46-1.20)	0.217
Age					0.007*
	18-29 years	19(18.8)	82(81.2)	1	1
	30-39 years	35(30.2)	81(69.8)	1.87 (0.99-3.53)	0.055
	40-49 years	27(35.5)	46(64.5)	2.53 (1.27-5.05)	0.008
	≥ 50 years	19(44.2)	24(55.8)	3.42 (1.56-7.47)	0.002
Marital Status					0.339
	Never Married	25(28.4)	63(71.6)	1	1
	Married	29(25.9)	83(74.1)	0.88 (0.47-1.65)	0.691
	Divorced	26(31.3)	57(68.7)	1.15 (0.60-2.21))	0.677
	Widowed	20(40.0)	30(60.0)	1.68 (0.81-3.49)	0.164
Educational					0.698
	Not Educational	27(34.6)	51(65.4)	1.59 (0.64-4.01)	0.328
	Primary	35(30.4)	80(69.6)	1.31 (0.54-3.20)	0.551
	Secondary	30(27.8)	78(72.2)	1.15 (0.47-2.85)	0.759
	Higher	8(25.0)	24(75.0)	1	1
Residence					0.412
	Dire Dawa	86(30.9)	192(69.1)	1	1
	Out of Dire Dawa	14(25.5)	41(74.5)	0.76(0.39-1.47)	0.419
Religion					0.826
	Muslim	40(32.8)	82(67.2)	1	1
	Orthodox	47(29.2)	114(70.8)	0.85 (0.51-1.40)	0.517
	Protestant	10(25.6)	29(74.4)	0.71 (0.31-1.59)	0.403
	Catholic	3(27.3)	8(72.7)	0.77 (0.19-3.05)	0.709
Occupational					0.355
	Unemployed	33(33.3)	66(66.7)	1	1
	Government employee	13(20.3)	51(79.7)	0.51 (0.24-1.07)	0.074
	NGO Employee	16(33.3)	32(66.7)	1 (0.48-2.08)	1.000
	House Wife	11(25.6)	32(74.4)	0.69 (0.31-1.53)	0.360
	Merchant	14(30.4)	34(69.6)	0.82 (0.39-1.74)	0.612
	Others	13(41.9)	18(58.1)	1 (0.24-4.25)	1.000
ART enrolment period					0.707
	< 7 days	61(30.8)	137(69.2)	1	1
	≥ 7 days	39(29.1)	95(70.9)	0.91(0.57-1.47)	0.708
Baseline BMI					0.000*

	< 18.5 kg/m^2	44(51.2)	42(48.8)	3.57(2.13-5.99)	0.000
	≥ 18.5 kg/m^2	56(22.7)	191(77.3)	1	1
Baseline CD4 count					0.000*
	< 200 cells/mm^3	46(61.3)	29(38.7)	16.46(6.95-38.95)	0.000
	200-349 cells/mm^3	31(36.9)	53(63.1)	6.07(2.59-14.20)	0.000
	350-499 cells/mm^3	15(18.1)	68(81.9)	2.29(0.92-5.72)	0.076
	≥ 500 cells/mm^3	8(8.8)	83(91.2)	1	1
Months on ART					0.881
	< 12 months	22(29.3)	53(70.7)	1	1
	≥ 12 months	78(30.2)	180(69.8)	1.04(0.59-1.83)	0.881
Disease Stage					0.000*
	Early stage	29(12.8)	198(87.2)	1	1
	Advanced stage	71(67.0)	35(33.0)	13.85(7.90-24.29)	0.000
Current BMI					0.000
	< 18.5 kg/m^2	54(88.5)	7(11.5)	37.90(16.22-88.6)	0.000
	≥ 18.5 kg/m^2	46(16.9)	226(83.1)	1	1
Current weight					0.000
	< 60 kg	73(37.6)	121(62.4)	2.50(1.50-4.17)	0.000
	≥ 60 kg	27(19.4)	112(80.6)	1	1
ART Adherence					0.000*
	Good	32(14.1)	195(85.9)	1	1
	Fair/poor	68(64.1)	38(35.9)	10.90(6.32-18.81)	0.000

***Significant at p-value <0.25 in unadjusted logistic regression analysis**

4.4. Results of multivariable analyses for factors associated

The final multivariable logistic regression analysis was identified four independently associated factors that increased the prevalence of opportunistic infections. Such as CD4 cell count, current weight, disease stage, and antiretroviral treatment adherence. Hence the study participant who have a baseline CD4 cell count < 200 cells/mm^3 and between 200 to349 cells/mm^3 (AOR= 6.18, 95%; CI= 2.14, 17.88) and (AOR= 3.15, 95%; CI = 1.11, 8.95) was increased the morbidity of opportunistic infection by six-fold and three times, respectively as compared CD4 cell count≥ 500 cells/mm^3(Table 7).

By the same token, the study members current weight < 60 kg had nearly three times the likelihood of opportunistic infection (AOR= 2.90, 95%; CI= 1.36, 6.16), as likened to the current weight ≥ of 60 kg. Similarly, the study subject having advanced disease stage had a higher than eight times probability of opportunistic infection occurrences (AOR= 8.32, 95 %; CI= 4.13, 16.74), than those who have early stages. Additionally, a participant on antiretroviral treatment

adherence level fair/poor were six times probabilities of opportunistic infectionoccurrences (AOR= 6.17, 95%; CI= 3.11, 12.2), as compared to good.

Table 7: Result of Multivariable analysis for factors associated with opportunistic infection among adult PLHIV at public hospitals of Dire Dawa, eastern Ethiopia, 2021

Variables	Categories	OI		COR, 95% CI	AOR, 95% CI	P-values
		Yes	No			0.000
Age	18-29 years	19	82	1	1	1
	30-39 years	35	81	1.87 (0.99-3.53)	2.63 (0.93-5.27)	0.071
	40-49 years	27	46	2.53 (1.27-5.05)	2.51 (0.90-7.00)	0.079
	≥ 50 years	19	24	3.42 (1.56-7.47)	2.47 (0.82-7.43)	0.107
Sex	Male	41	79	1	1	1
	Female	59	154	0.74 (0.46-1.20)	0.79 (0.39-1.63)	0.525
Baseline CD4	< 200 count	46	29	16.46(6.95-38.95)	6.18 (2.14-17.88)	0.001**
	200-349 count	31	53	6.07(2.59-14.20)	3.15 (1.11-8.95)	0.031**
	350-499 count	15	68	2.29(0.92-5.72)	1.95 (0.66-5.71)	0.225
	≥500 count	8	83	1	1	1
Baseline BMI	< 18.5 kg/m^2	44	42	3.57(2.13-5.99)	1.23 (0.56-2.73)	0.609
	≥ 18.5 kg/m^2	56	191	1	1	1
Current Weight	< 60 kg	73	121	2.50 (1.50-4.17)	2.90 (1.36-6.16)	0.006**
	≥ 60 kg	27	112	1	1	1
Disease Stage	Early stage	29	198	1	1	1
	Advanced	71	35	13.85(7.90-24.29)	8.32 (4.13-16.74)	0.000**
ART Adherence	Good	32	195	1	1	1
	Fair/poor	68	38	10.90(6.32-18.81)	6.17 (3.11-12.21)	0.000**

** **Significant at p-value < 0.05 in adjusted logistic regression analysis**

5. DISCUSSIONS

The purpose of this study was to measure prevalence and identify related factors of opportunistic infection among adult people living with HIV started antiretroviral based on test and treattreatment approach. Similarly, it determines the common typesand their frequencies of opportunistic infection.Then, the overall prevalence of opportunistic infection in theDire Dawa

administration was 37.24% (95% CI = 32.10, 42.38). This finding was comparable withthestudy conducted in EthiopiaGedio Zone, and Addis Abebawith aprevalence of 38.7%,and41.2%,respectively (Mebrahtu*et al*., 2015; Genet *et al*., 2018). However, it is lower than the report from Harar (48.0%) and DebreMarkos (42.8%),and higher thanthe national level(21.3%)studies(Nurilign and Getachew, 2014; Habtamu*et al*., 2015; Teklu*et al*., 2018).

Despite these comparisons, the observed difference, in general,may due to dissimilarities in diagnostic capacity (health centers vs. hospitals), study period, treatment approach (based on CD_4 count and/ or disease stages vs. tests and treatment), or method used (inclusion and exclusion criteria).For thehighestprevalenceof 48.0% and 42.8% vs. 37.2%, the potential explanation might bestudy duration, treatment approach, and/orstudy settings where most of the previous studies were single hospital-based (Nurilign and Getachew, 2014; Habtamu*et al*., 2015).Although settingand diagnostic capacitymight be the mainreasons to lower the prevalence (21.3% vs. 37.24%) that may result from severe types of opportunistic infection were less diagnosed in health centerscompared to hospitals that showed in the national level study it covers 29 hospitals and 31 health centers(Teklu*et al*., 2018).

Furthermore, the top four types of opportunistic infectionsidentified in the current study were all forms of tuberculosis, bacterial pneumonia, diarrheal diseases, and oral candidiasis descended, respectively. The observed types and frequencies (co-infections)weresimilarto the finding studies conducted in Ethiopia; Dawro Zone, Gedio Zone,and HararHiwotFana Specialized hospital(Habtamu*et al*., 2015; Fithamlak*et al*., 2018; Genet *et al*., 2018). On the other hand, the national-level study conducted in 2014 found out that the commontype of opportunistic infectionwasskin diseases, diarrhea diseases,bacterial pneumonia, and recurrent upper respiratory infections (Teklu*et al*., 2018). The aforementioned could be the difference instudyhealth institutions(health centers vs. hospitals) usedand period differences.

The study showed that having a baseline CD4 count of less than 200cells/mm^3, and also between 200-349cells/mm^3had increased OImorbidity above six and three folds compare to a CD4 count $\geq$ 500 cells/mm^3. This finding comparable with the studiesconducted inAddis Abeba, Gedio Zone, and Harar, reported that2.17(p=<0.05), 9.14(p=<0.001), and 1.65(p=<0.05) timesrespectively(Mebrahtu*et al*., 2015; Habtamu*et al*., 2015; Genet *et al*., 2018).The finding of this study sounds true because People who have low CD4 count are in severe immune

suppression that increases viral flare-upalso turnsthem to various OIs. Additionally, CD4 cells play a central role in the activation of both humoral and cellular immune responses to fight against infection. Hence, low CD4 count increases susceptibility to OIs (WHO, 2016; FMOH, 2018a).

The study participant who has advanced disease stagewas more than eight times more likely to be affected by opportunistic infection than those who were in the early disease stages. This resultis in agreement with studies from Gondar, Gedio Zone, and Harar; reported9.42(p=<0.001), 2.72(p=<0.05),and 2.81(p=<0.05) more likelihood of OIsas compared to those in early stages respectively(Debasu*et al*., 2014;Habtamu*et al*., 2015; Genet *et al*., 2018).This result also sounds true because clinical staging is made based on OIs, and those in the advanced stage have more OIs than early-stage clients (WHO, 2016; CDC, 2019).

As related to the current weight of adult people living with HIV on ART, those who have less than 60 kilograms were three folds more likely of OI occurrence as related to having resent weight, more or equal to 60 kilograms. This result also similar to the study conducted in DebreMarkosAOR=3.66(p=<0.05) (Nurilign and Getachew, 2014).Weight loss might be by food insecurity, and may it cause a lack of adequate diet that replaces the increased demand for energy and nutrients due to HIV/AIDS; resulting in malnutrition was an opportunity to weaken the immune system leads to opportunistic infections (WHO, 2016).

What is more, in the current study, participants with fair/poor antiretroviral treatment adherence levels also had 6.17times the probability of opportunistic infection occurrencesas compared to the studysubject with good adherence.Comparable studies conducted in Ethiopia,DebreMarkos0.16(p=<.05), andGedio Zone 10.05(p=<0.001)support the current study result(Nurilign and Getachew, 2014; Genet *et al*., 2018). It might be because good adherence to antiretroviral will suppress viral replication and would increase CD4 cells that intern decrease the risk of new opportunistic infection(Nurilign and Getachew, 2014; Genet *et al*., 2018).

Strengths and Limitations of the study

Strengths

The use of already available data as a source of information may encourage others to do the same enabling programmers to access evidence for decision making.

Because of the secondary data limitation, the data was evaluated four requirements must be satisfied for this specific study like availability (want data available or not), relevance (measurement, problem statement, concept and not outdated), accuracy (specification and methodology), and sufficiency (data adequacy).

Furthermore, data quality control maintains thoroughly by giving training and continuous supervision of the extraction process.

The study included both public hospitals found in the region and sampling based on patient loads to make the study representative.

Moreover, available research on opportunistic infection and associated factors among adult people living with HIV started antiretroviral based on the test and treat treatment approach limited in Ethiopia.

Despite these limitations, the study had a retrieval rate of 97.97%, and also it provided important information on opportunistic infection and associated factors in Dire Dawa administration, where scarce information exists.

From the public health point of view, such data could be of vital importance in developing effective facility-based preventive and management modification plans.

Limitations

As the study was cross-sectionalcould not show (established temporal sequence between independent and dependent variables)cause and effect relationship between different factors with the outcome variable.

The hospitals the study conducted did not perform cultures for the diagnosis of opportunistic infections. Hence, the majority of the opportunistic infection diagnosed clinically; it may have affected the diagnostic accuracy.

The non-inclusive nature of the study for private hospitals may hide the prevalence of the opportunistic infection and factors associated in those facilities.

The data extraction technique was retrospectively secondary data, faced lack of gating detailed and clarified data on some questions (limited source of information), lack of control over some data quality. Therefore, challenged by some missed data and accuracy problems.

Besides, measuring treatment adherence was best by combined counting tablets and self-reporting methods but limited to validate the information.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

Over-allstudy findingsconfirmedand put forward that the prevalence of opportunistic infections was highin the Dire Dawa administration. Thisstudy results were similar to reports of previous

studies conducted in Ethiopia. The clinical factors such asCD4 cell count, disease stage, weight, and antiretroviraltreatment adherence areindependent predictors.

6.2. Recommendations

To Dire Dawa Administration Health Bureau and Hospitals

First of all, knowing the existing prevalence,type,and predictors ofopportunistic infections that are principal, critical, and effective will allowthe prevention and management actionscorrectly.

Therefore,regional or facilitylevel action to prioritize quantification, procurement,and supplyfor the prevention and management had better take the findings of this study into consideration. Likewise, stakeholders should jointly work to strengthen measures to prevent and manage OIs.

To health care providers and ART focal

To strengthen the provision of prophylaxis, proper screening of eligible, assessing adherence, and act accordingly.

To strengthen timely antiretroviral therapy initiation, provide intensive follow-up, and strengthen adherence counseling.

To provide health education about nutrition and create awareness on the advantage of having a balanced diet and promote weight increment, also prevent lowering of the weight.

Clients with advanced disease stage and who have low CD4 count should emphasize to aggressively evaluation for opportunistic infection, and practical effort to optimize theirimmunological recovery be made. As well, strengthen the monitoring of viral loads.

To Stakeholders and other researchers

Recommend conducting a longitudinal study to identify risk factors that have a direct and indirect association with the prevalence.

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8. APPENDICES

8.1. Participant Information Sheet and Informed Consent Form

My name is _____. I am working as a data collector for the study being conducted in this Hospital by AlemsegedAlemu who is studying Masters of public health in Epidemiology at Haramaya University, College of Health Sciences. I kindly request to lend me your attention to explain the study, your hospital being selected as a study participant

The Study title:

Opportunistic Infection and Associated factors among adult PLHIV post test and treat treatment approaches in _____ Public Hospital, Dire Dawa administration.

Purpose of the Study:

The study will be conducted through the extraction of secondary data already collected in the ART database, patients' follow up cards, and ART registers found either manually or an electronic database or both. Knowing the prevalence and associated factors of OI is an important undertaking to show what interventions to take in the ART program modification. This study is aimed to fill the information gap and provide evidence for ART programmers and managers at different levels for designing effective prevention programs in the health facility and region.

Data Extraction Procedure and Duration:

The data extraction procedure involves the collection of pertinent information from the electronic database for randomly selected samples. Any missing information will be completed from the patients' charts and ART registers. There are 44 questions to be filled and the whole process will take about 25-30 minutes for each subject depending on the completeness of the information in the database and patient records. A total of _____data will be extracted from this Hospital.

Confidentiality:

The information extracted in the way explained above will be confidential. There will be no information that will identify a particular study subject. The findings of the study will be general for the study community and will not reflect anything particular of a person. The data collection instrument will only use codes to avoid the use of names.

Risk and Benefits:

The risk of extracting information in this way is very minimal risks. But the findings from this study may reveal important information for the local as well as regional health.

Rights:

Participation inthe study is fully voluntary. You have the right to declare to participate or not. If you decided to participate, you have the right to withdraw from the study at any time.

Contact Address:

If there is any question or enquires about any time the study or the procedures, please contact AlemsegedAlemu, Mobile phone: 0912727830, Dire Dawa, Ethiopia.
Email: alemseged_alemu@yahoo.com or alem336695@gmal.com
Haromaya University, Institutional Health Research Ethics Review Committee (IHRERC) at office phone 0254662011 or P.O.Box 235, Harar, Ethiopia

Declaration of Informed Voluntary Consent:

I have read the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights of participating, and the contact address for any queries. I have been allowed to ask questions for things that may have been unclear. I was informed that the hospital has the right to withdraw from the study at any time or not to answer any question that they do not want. I am also informed that the hospital has the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during the data extraction process in the Hospital's premises. Therefore, I declare my voluntary consent on behalf of hospital management to allow this study to be conducted here in with my initials (signature).

Name and Signature of Head of the Hospital: _____ Date _____

Name and Signature of Data Collector: _____ _____ Date _____

8.2. Data Extraction Instrument

Date of data collection [___/___/_____] (dd/mm/yyyy)

Name of the data collector _____Time (Started/ Ended) /_____; ____/(hr/min)

Signature _____

Hospital Name: 1. Dilchora 2. Sabian

Part 1; Socio-demographic Characteristics

S.N	Question	Alternative	Code	Skip
101	Age in years	……..		
102	Sex	Male Female	1 2	
103	Marital status	Never married Married Divorced Widowed Others specify…….	1 2 3 4 5	
104	Educational Background	No education Primary education(grade 1-8) Secondary education(grade 9-12) Higher education(> 12)	1 2 3 4	
105	Religion	Muslim Orthodox Protestant Catholic Other specify	1 2 3 4 5	
106	Residence	Dire Dawa Hariri Somali Oromia Other specify……	1 2 3 4 5	
107	Occupational status	Unemployed Government employee Non- government employee Housewife Merchant Farmer Daily laborer Others specify……	1 2 3 4 5 6 7 8	

Part II: Clinical and Laboratory Determinants

S.N	Questions	Alternatives	Code	Skip
201	Unique ART Number	……		
202	HIV diagnosed date of the client in Ethiopia Calendar	……/…/….		
203	ART started date of the client in Ethiopia Calendar	……/…/….		
204	Baseline weight in Kg	…… Kg		
205	Recent and/or last recorded weight near to OI occurrence	…… Kg		
206	Baseline BMI in kg/m2 or MUAC for pregnant women	…….		
207	Recent and/or last recorded BMI near to OI occurrence	…….		
208	Baseline functional status	Working Ambulatory Bedridden	1 2 3	
209	Recent and/or last recorded functional status near to OI occurrence	Working Ambulatory Bedridden	1 2 3	
210	Baseline CD4 count	…….cells/mm3		
211	Recent and/or last recorded CD4 result near to OI occurrence	…….cells/mm3		
212	Baseline Hemoglobin	…… Mg/dl		
213	Recent and/or last recorded Hemoglobin near to OI occurrence	…… Mg/dl		
214	First Viral load test result	…….copies/ml		
215	Recent and/or last recorded VL result near to OI occurrence	…….copies/ml		
216	WHO clinical stage	WHO stage I WHO stage II WHOstage III WHO stage IV	1 2 3 4	
217	Recent and/or last recorded T-stage near to OI occurrence	T-stage I T-stage II T-stage III T-stage IV	1 2 3 4	
218	Baseline ART regimen drugs the client take	TDF-3TC-EFV TDF-3TC-NVP AZT-3TC-NVP AZT-3TC-EFV Others specify…	1 2 3 4 5	
219	What are the current ART drugs the clients take?	TDF-3TC-EFV TDF-3TC-NVP AZT-3TC-NVP AZT-3TC-EFV Others specify…	1 2 3 4 5	

220	Months on ART (ART treatment duration in Months)	……		
221	Does the client take any family planning?	Yes No	1 2	
222	Does it take any OI prophylaxis during the study period?	Yes No	1 2	
223	If 'yes' for question no 222 what type of prophylaxis? CPT	Yes No	1 2	
224	If 'yes' for question no 222 what type of prophylaxis? INH	Yes No	1 2	
225	If CPT was given what was the last recorded adherence level of the client to the prophylaxis?	Good Fair Poor	1 2 3	
226	Does the client have OI at the time of diagnosis of HIV?	Yes No	1 2	
227	If' yes' for question number 226, what type of OI does the patient have at the time of the first diagnosis of HIV?	…… …..		
228	OI occurrence in the study period (October 2018 to September 2019)	Yes No		
229	If the answer to question no 228 is 'yes', what type of OI occurred? **NB**. More than one answer is possible	Bacterial pneumonia TB Oral trash Candidiasis Mouth Ulcers Diarrheal Disease PCP CNS toxoplasmosis Cryptococci meningitis Others specify…	 1 2 3 4 5 6 7 8 9 10	
230	Number of OIs occurred in the client during the study period	One Two Three&Above	1 2 3	
231	Does the client have any non-communicable disease?	Yes No	1 2	
232	If' yes' for question number 231, what type of non-communicable disease?	Hypertension Diabetes Mellitus Mental illness Others specify…	1 2 3 4	

III. Adherence to treatment and outcomes of follow up factors

301	Recent and/or last recorded adherence level near to OI occurrence	Good Fair Poor	1 2 3	
302	If 'fair/poor 'for question 301 What is the reason behind?	Toxicity/side effect Share with others Feel better Too ill Stigma Drug stock out Lost/run out of pill Alcohol Others specify……	1 2 3 4 5 6 7 8 9	
303	Last recorded outcome of care	Active on ART Lost/drop out Transfer out Died	1 2 3 4	
304	The recorded history of treatment interruption	Yes No	1 2	
305	If yes question 304. The number of recorded history of treatment interruption during the study period.	One Two Three Above three	1 2 3 4	

8.3. Curriculum Vitae

Personal information

Name: AlemsegedAlemu

Place of birth: Micheta, West Hararghe

Date of birth: June 13, 1984

Sex: Male

Marital Status: Married

Nationality: Ethiopian

Phone Number: 0912727830

Education

Bachelor of Science in Nursing from Haramaya University, 2009 – 2013

Strength and Skills

- Multi-lingual and excellent knowledge of diversity
- Excellent in Comprehensive HIV/AIDS, PMTCT/MNCH care and nutrition program coordination
- Good in monitoring and evaluations
- Strong interpersonal skills and ability to work well under pressure
- Leadership and excellent role-playing ability
- Responsible, dependable, and punctual
- Able to succeed in a fast-paced setting while attending to the needs of diverse clients
- Ability to assess broader needs and integrate services
- High attention to detail and excellent conflict resolution skill

Language Ability

- Fluent in Afaan Oromo, Amharic, and English.

Computer Skills

- Possess Excellent in-depth working skills in Microsoft Word, Spreadsheet, Outlook, PowerPoint and various Microsoft features knowledge of MS Office Suite along with an urge to learn new software applications.
- High skill in internet research, web hosting, and social media

Professional Experience

Organization	Position	Duration	Key responsibility/ objectives
Dechatu Health Center	Adult OPD RN. BSc Nurse	June 2019-present	Responsible for overall health care of adult out-patient departments. Treating accordingly all patients attending OPD. Treating all STI patients and screen for risk factors and perform provider initiative HIV testing and counseling Fulfill the risk assessment tools for all adult client and perform target HIV testing and counseling Reporting weekly and monthly reports Ensuring all equipment and material are available regularly Participating in different regional and based meetings
Dechatu Health Center	<5 OPD and nutrition program RN. BSc Nurse	May 2018-2019	Coordinate health and nutrition program, Screening of all <5 children for malnutrition, giving of deworming, and admit to therapeutic feedings. Providing EPI and growth monitoring, and work <5 and adult OPD Coordinate and supervise EPI campaign, static, and outreach Counseling and providing FP service
Ethiopian Public Health Association (EPHA)	Interviewer and Tester Nurse	Oct 2017-Apr 2018	Clearly explain the survey procedures to the participant. Ensure that the SOP in implemented and utilized as written. Ensure that the participant has fully understood the information. Ensure that they have all the logistics required to perform the survey. Ensure that the participant is comfortable with the survey procedure. Conduct study visit activities with the participant. Seeks consent for the study and blood draw. Conduct blood draw via vein puncture as per study SOP. Conduct CD4 testing on the PIMA machine, complete PHIA sample tracking form, affixes barcode label to the completed forms and specimens Provide pre and post-test counseling for HIV, HBV, and Syphilis. Assisted team members with the blood draw as needed;Served as supervisor to ensure adherence to HIV counseling and testing Upload data from completed HH & Submit weekly report to the

			supervisor; Performed other duties as assigned by the immediate supervisor
Dechatu Health Center	ART Focal	Sep. 2012-Sep. 2017	Provided technical assistance at facility level in specific HIV service areas, including STI/HIV prevention, HIV testing and counseling, PMTCT integration with maternal and child health services, and/or laboratory monitoring for HIV and TB Assisted the planning and implementation of HIV related activities Clinical care and treatment of adult, pediatric, and exposed infant including palliative care, and adherence counseling of patient at the ART clinic. Assisted in the implementation, monitoring, and documentation of project outputs, outcomes, and best practices, Prepared progress reports of each site and implements activities of management and quality assurance Ensured the preparation of reports for facilities in specific HIV service areas, including STI/HIV prevention, HIV testing and counseling, PMTCT integration with maternal and child health services, and/or laboratory monitoring for TB/HIV Monitoring PITC activates and performance,and Collecting DBS Facilitate MDAT and HIV/AIDS committee meeting at the facility level and Home-based care of PLHIV as a supervisor
Legehare Health Center	ART Nurse	2011-2012	Clinical care and treatment of adult, pediatric, and exposed infant including palliative care and collecting DBS, and adherence counseling of patient at the ART clinic Monitoring PITC activates and performance at the health center Facilitate MDAT and HIV/AIDS committee meeting at the facility level and Home-based care of PLHIV as a nurse supervisor
Legehare Health Center	MNCH Focal	2008 - 2011	Coordinating MNCH activities and Monitor all MNCH activities Providing ANC, delivery, postnatal, family planning, EPI, nutrition services and Participating in the planning of MNCH activities. PMTCT service provider and Ensure quality service is provided Conducting internal supportive supervision on MNCH services in the facility. Providing insertion and removal of long term contraceptives Ensuring all equipment and material are available regularly

Legehare Health Center (Beke Halo Health Post)	Head	2007-2008	Responsible for overall health care of the Kebele population Giving emergency care and Work under five and adult OPD Coordinate and supervise VCT and EPI outreach and campaign Counseling and providing FP service, Supervise health extension workers Work as surveillance focal and Giving OTP and TB treatment

Key workshop/ seminars/ training attended

Training name	Organized by	Duration
Electronic Data and Blood sample collector	EPHI, CDC and ICAP	2 mon Oct.-Dec. 2017
Female and Family[e]Education	EMA, EmA, University of Amsterdam	Three-months May to July 2017
ART clinical mentorship	DDRHB with CDC	June 19 -24,2017
Malaria case management	DDRHB with USAID	Jan 2 – 6,2017
National TOT on comprehensive MNCH/PMTCT	FMOH	June 19 – July 2, 2016
Training methodology for B-level industrial tra	RHB &RTVT college	Feb 18 – 22,2016
Basic clinical nutrition care for PLHIV an OVCs	DDRHB with CDC	April 22 – 24,2015
National comprehensive HIV care refresher	DDRHB with CDC	Sep 15 -20,2014
Comprehensive MNCH/PMTCT as per option B+	DDRHC	June 23 – July 2, 2014
Nutrition Assessment counseling and support	ORHB with USA/ID	July 11–13,2013
Comprehensive TB/HIV	HRHBwith CU-ICAP	June 3 – 8,2013
PMTCT option B+ update training	DDRHB & CU-ICAP	May 14–May 16, 2013
Comprehensive HIV/AIDS & Pediatric ART	HRHB &CU-ICAP	April 8–April 19, 2013
Comprehensive HIV/AIDS care and adult ART	DDRHB & CU-ICAP	Mar 28 – Apr 10, 2011
Comprehensive PMTCT/MNCH and adult ART	DDRHB & CU-ICAP	Jan 24 – Feb 4, 2011
Basic EmONC training	DDRHB &CU-ICAP	Oct 18 – Nov 6, 2010
TB, leprosy and TB/HIV data management	DDRHB &CU-ICAP	Feb 10 –12,2010
Tb infection control training	DDRHB with-ICAP	Dec 23 –Dec25, 2009

PIC, Palliative care, Home-based care PLHIV	DDRHB with CU-ICAP	
IMNCI training	DDRHB	Feb 24 – Mar1, 2008
VoluntaryCounseling and Testing (VCT) Training	MOH, JHPIEGO, CDC	July 9 -24, 2007
Long term FP, HMIS, PHM, EPI, and OTP	DDRHB and FMOH	

Reference

- Dr. GetnetAbera (MD, MPH),CDC Program Officer, +251911653362
- AtoEphrem Israel (HO, MPH), The Former Dechatu H.C. Head, 0913285488
- AtoTeklu Mole (HO, MPH), Global fund TB/HIV Coordinator, 0912098075