



**Magnitude and factors contributing to opportunistic infection in
HIV patients visiting at
St. Paul's Hospital Millennium Medical College**

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Abstract

Introduction: Opportunistic infections are the predominant causes of morbidity and mortality among HIV-infected patients. The level of immunity determines the occurrence and type of OIs. It accounts for more than 90% of HIV/AIDS death. Numerous studies have explored the prevalence of opportunistic infections and their associated factors in people living with HIV (PLHIV). This study aimed to determine the Magnitude and factor contributing to opportunistic infection in HIV/AIDS patients visiting at St. Paul's Hospital Millennium Medical College. This research can guide the hospital policymakers in developing programs that improve the quality of life for people living with HIV and reduce OI-related morbidity and mortality, ultimately strengthening public health responses in high-burden regions.

Methods: An institution based cross-sectional study was conducted at St. Paulo's Hospitals millennium medical college Addis Ababa, Ethiopia. The research encompassed individuals visiting ART clinic with an HIV/AIDS diagnosis during the period from November 1, 2021, to December 30, 2024. Data were collected using structured questionnaire by reviewing patient charts and analyzed by SPSS version 27.0. Bi-variable and multi-variable binary logistic regression analyses used to identify factors contributing for the development of opportunistic infections in HIV/AIDS patients.

Result: A total of 311 study participant medical records were reviewed from their follow-up charts. The mean age of the participant was 39.89 years (± 11.53 SD), majority of participants were females (55%). The overall prevalence of OIs among the study participants was 44.1%. The most frequent OIs from this study were Tuberculosis (both pulmonary and extra pulmonary) at (28.6%), oral/oesophageal candidiasis at (8.4%), CNS Toxoplasmosis at (5.8%) and chronic diarrhoea at 5.5%. Baseline advanced WHO clinical staging III/IV ((aOR=45.59; 95% CI:(16.17- 128.53), aOR=171.93; 95% CI: (40.75 – 725.4)) was found to have statistically significant association with opportunistic infection.

Conclusion: This study found a high prevalence of opportunistic infections (OIs) among HIV/AIDS patients visiting at St. Paulo's millennium medical collage. Advanced base line WHO clinical staging (III and IV) is the single strongest and most powerful predictor for developing an opportunistic infection.

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List of Acronyms and Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ART	Anti-Retroviral Therapy
BMI	Body Mass Index
CD4	Cluster of Differentiation 4
FMOH	Federal Ministry of Health
FSW	Female sex worker
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
HMIS	Health Medical Information System
INH	IsoNicotinyl Hydrazide
OIs	Opportunistic Infections
PCP	Pneumocystis Carnie Pneumonia
PLWHA	People living with HIV/AIDS
SSA	Sub-Saharan Africa
SPHMMC	St.Paul's hospital millennium medical college
SPSS	Statistical Package Forth Social Scien
TB	Tuberculosis
WHO	World Health organization

1. Introduction

1.1 Background

Human immunodeficiency virus (HIV) is an infection that attacks the body's immune system, specifically the white blood cells called CD4 cells. HIV destroys these CD4 cells, weakening a person's immunity against opportunistic infections, such as tuberculosis and fungal infections, severe bacterial infections and some cancers.[1]

According to UNAIDS 2023 Global HIV & AIDS statistics, approximately 39.9 million people were living with HIV globally, while 1.3 million individuals were newly infected with the virus. The year also saw around 630,000 deaths due to AIDS-related illnesses. Despite these challenges, 30.7 million people were accessing antiretroviral therapy. [2]

The HIV epidemic in Ethiopia is mixed, with substantial regional variations, concentrated in urban areas and in some geographic hotspots driven by key and priority populations. In 2022, the national HIV prevalence among adults (aged 15 years and above) is 0.91 percent, with the highest values in Gambella and Addis Ababa (3.7% and 3.47% respectively) and the lowest in Somali region (below 0.1%). An estimated 610,350 people are living with HIV (PLHIV), of whom 61 percent are women. Amhara, Oromia, and Addis Ababa account for 75 percent of PLHIV. In 2022, the number of new infections and AIDS-related deaths were estimated to be 8,257 and 11,322 respectively. Following the initiation large scale training about HIV the incidence has markedly decreased by 85% and AIDS related death has decreased to 93% which attribute introduction and scale up of ART programmed. [3]

According to EPHI HIV related estimation and projection in Ethiopia for year 2023 -2024, this report indicates that a gradual decline in PLHIV that were estimated 610,350 for the year 2022 to 605,238 in 2023, also new HIV infection declined from 8,355 in the year 2022 to 7,428 for the 2023. [4]

HIV/AIDS remains a significant public health issue in Ethiopia, with varying prevalence and challenges across different regions and populations. In the last three years, multiple crises, including the COVID-19 pandemic, widespread conflict, and severe drought, have adversely impacted the health system and complicated the HIV response. At the macroeconomic level, shortages of foreign currency are a chronic foundational problem. [5]

WHO defines advanced HIV disease for adults and adolescents (and children five years and older) as having a CD4 cell count of less than 200 cells/mm³ or WHO clinical stage 3 or 4 disease [3]. All children younger than five years living with HIV are considered to have advanced HIV disease. [6]

The earliest clinical signs that informed clinicians that AIDS was occurring were opportunistic infections (OIs), which are defined in the context of HIV as infections that are more common or more severe due to HIV-mediated immunosuppression. [7]

Since the late 1980s, chemoprophylaxis, immunization, and better strategies for managing OIs have enhanced the quality of life and lengthened the survival of people with HIV.¹ Profound reduction in OI-related morbidity and mortality in people with HIV resulted from the introduction of highly effective combination ART in the mid-1990s. [8]

The most frequent causes of opportunistic infections in HIV are viruses, bacteria, fungus, and protozoa. The skin, gastrointestinal tract, respiratory system, and neurological system are the primary areas impacted. The frequency and kind of opportunistic infections are determined by immunity levels. [9]

1.2 Statement of the problem

Globally, 630,000 [500,000–820,000] individuals worldwide lost their lives to HIV-related causes in 2023. HIV-related fatalities have decreased from 1.3 million [1.0 million–1.7 million] a (51%) decrease since 2010. Among this Africa has highest number of death with estimated amount of (62%); of this East and South Africa has account (61%) of deaths in the region. [10]

HIV continues to be a major global public health issue, claiming 42.3 million lives so far. However, with successful implementation of HIV prevention, diagnosis, treatment and care, including for opportunistic infections, HIV infection has become a manageable chronic health condition, enabling people living with HIV to lead long and healthy lives.

Despite the advanced antiretroviral therapy that has led to reduction in HIV viral load, OIs and death rate of AIDS, OIs is still a major cause of hospitalization and death among HIV patients on ART. More than 90% of HIV/AIDS deaths are due to opportunistic infections and malignancies[11]. OIs are the leading cause of morbidity and death among individuals living with HIV (PLHIV), particularly in areas with inadequate access to medical care. Determining the scope of OIs and the causes of their recurrence is essential for enhancing PLHIV treatment plans, re-

source distribution, and general health outcomes. There has been no nationally representative information on the prevalence of OIs in our country but a systemic review and meta-analysis was done in 2022 to estimate the pooled prevalence of OI at the national level, it reviewed 12 studies which were done over different areas of the country. The pooled prevalence of OI is 43.97%.[12] In addition some regional studies which were done later than the year of 2020 shown the prevalence ranges from 31.8% to 44%.[13], [14])

Even though, a numerous pioneering studies have investigated to assess prevalence of opportunistic infections and associated factors among HIV positive patients those started ART. These researches conducted out of Addis Abeba with the studies shown the prevalence and associated factors of opportunistic infections among HIV patients ([23], [14],[25], [26]). However, there is a lack of recent published data on OI prevalence from Addis Ababa, creating a gap in understanding the current burden within the capital city's specialized treatment centers. Therefore, the purpose of this research to determine the magnitude and factors contributing to opportunistic infection in HIV patients presenting at SPHMMC. So this research will add value about recent prevalence and common associated factors of OI in our hospital.

The leading cause of morbidity and death among individuals living with HIV (PLHIV), particularly in areas with inadequate access to medical care. OIs are still common because they depress the immune system, even with advances in antiretroviral therapy (ART). Determining the scope of OIs is essential for enhancing PLHIV treatment plans, resource distribution, and general health outcomes.

1.3 Significance of the Study

As indicated in the literature the global burden of HIV/AIDS is decreasing from time to time and the degree of morbidity and mortality is decreasing in both developed and developing countries. Even though the burden of HIV infection in Ethiopia has been decreased from the last 2 decades. There is no published data supporting an increment in the incidence of HIV. Hospitals are reporting significant number of new cases. With the cumulative reports still HIV is a major public health problem the country. Opportunistic infection is an important factor that is responsible for increasing morbidity and mortality among HIV patients and together with HIV/AIDS related malignancies accounts for more than 90% of HIV/AIDS death. The type of opportunistic infection affecting people living with HIV/AIDS varies from region to region.

This study provides critical data to inform targeted healthcare interventions for those most at risk. It helps to understand the prevalence and associated factors of opportunistic infection, health care providers can enhance prevention, treatment, and resource allocation efforts. This research can guide the hospital policymakers in developing pro-

grams that improve the quality of life for people living with HIV and reduce OI-related morbidity and mortality, ultimately strengthening public health responses in high-burden regions.

2. Literature review

2.1 Magnitude of opportunistic infection

Opportunistic infections (OIs) remain a significant concern for individuals living with HIV worldwide, contributing to morbidity and mortality. The magnitude of these infections varies across different regions and is influenced by factors such as access to antiretroviral therapy (ART) and socioeconomic conditions.

According to Iroezindu (2016) systemic review and meta-analysis was done in 2013; highlights the significant disparities in HIV-related opportunistic infections (OIs) between high-income and low/middle-income countries. While Highly Active Antiretroviral Therapy (HAART) has led to a reduction of over 70% in OI rates in high-income regions, low/middle-income countries continue to face a high burden, with 60-80% of HIV patients presenting with OIs. Limited access to HAART, delayed HIV diagnosis, and weak healthcare systems are key contributing factors, emphasizing the need for improved access and healthcare infrastructure to address these inequalities effectively. [15]

A cross-sectional study was conducted on hospitalized patients in southern China. The findings show that 71.2% of the 12,612 patients evaluated between 2011 and 2019 had at least one OI, the majority of which were caused by pneumonia, tuberculosis, or candidiasis. Individuals with low CD4 counts (<200 cells/ μ L) and multiple OIs were significantly more likely to die. Patients with co-infections frequently developed dermatitis and cryptococcal meningitis. To improve patient outcomes in this location, the findings highlight the need for better HIV/AIDS diagnosis and treatment techniques. [16]

In a tertiary care setting in Thailand, Wongkittipong and Kiertiburanakul (2024) carried out a retrospective cohort study to look into the prevalence and contributing factors of opportunistic infections (OIs) among treatment-naïve HIV-infected people after starting antiretroviral therapy (ART). The study discovered that the median onset of OI was 26.5 days after the start of ART, and the incidence rate was 9.5% (25.6 per 1,000 person-years). The most common OIs were pulmonary tuberculosis, cytomegalovirus infection, and extrapulmonary or disseminated tuberculosis. The use of dolutegravir-based ART regimens (4.39-fold increased risk), symptomatic HIV presentation (13.59-fold increased risk), elevated serum glutamate-pyruvate transaminase (SGPT >55 U/L), and low body mass index (BMI ≤ 18.5 kg/m²) were the main risk factors found by multivariate analysis.[17]

A cross-sectional study of various fasciitis was conducted in Semarang, Indonesia. This study examined the prevalence and risk factors for opportunistic infections (OIs) in individuals living with HIV. Twelve point three percent of the patients had OIs, and the most common causes were found to be tuberculosis (43%), diarrhea (9%), and can-

didiasis (21%). OI rates were associated with specific occupations, risk groups (e.g., sex workers, men who have sex with men), and patients aged 45–64 years. The prevalence of OI was found to be most significantly influenced by age. Results show targeted interventions for vulnerable populations. [18]

A cross-sectional study was carried out in a hospital in Gabon in 2022. The study examined the risk factors linked to opportunistic infections (OIs) in people with HIV/AIDS undergoing antiretroviral therapy (ART). Infections caused by bacteria were the most common (55.4%), followed by viral (39.7%) and parasitic (18%) infections, accounting for 57.9% of the 223 participants with OIs. The study found that OIs were more common in older age groups, especially those between the ages of 30 and 49, males, and those with lower CD4 counts. These results highlight Gabon's need for more potent OI prevention measures.[19]

A retrospective descriptive and analytical study was conducted across 12 accredited HIV treatment centers in Yaoundé and Douala, Cameroon, to assess the prevalence and risk factors associated with opportunistic infections (OIs) among HIV-positive patients. The study involved a cohort of 1,617 patients, revealing that 25.9% experienced at least one OI, with shingles and pulmonary tuberculosis being the most prevalent. Key risk factors identified included a CD4 count below 200 cells/ μ L, male gender, and age over 50 years.[20]

A cross-sectional descriptive study conducted in 2019 at Bombo Hospital in Tanga examined HIV/AIDS patients on antiretroviral therapy (ART). Among 360 participants, 35% experienced at least one opportunistic infection (OI), with pulmonary tuberculosis being the most common (18%). Factors associated with higher OI prevalence included late initiation of ART, poor medication adherence, lower educational attainment, and marital status, particularly among those who had experienced spousal loss. Notably, poor drug adherence was a critical risk factor, increasing the likelihood of OI occurrence by 19-fold. [21]

This cross-sectional study evaluated the prevalence and associated factors of opportunistic infections (OIs) among HIV/AIDS patients receiving antiretroviral therapy (ART) at a public hospital in Mogadishu, Somalia, between June 1 and August 30, 2022. Of the 329 participants, 37.1% experienced OIs, with pulmonary tuberculosis (8.2%), diarrhea (7.9%), and pneumonia (4.3%) being the most prevalent. Significant risk factors identified included low ART adherence, chronic comorbidities, exposure to domestic animals, and inadequate water sanitation, underscoring the need for targeted health interventions to mitigate these risks. [22]

A systematic review and meta-analysis investigated the prevalence and determinants of opportunistic infections (OIs) among HIV-positive individuals on antiretroviral therapy (ART) in Ethiopia. Analyzing data from 12 studies encompassing 6,163 patients, the review reported an overall OI prevalence of 43.97%. Contributing factors includ-

ed poor adherence to ART, undernutrition, low CD4 T-cell counts (<200 cells/ μL), and advanced HIV stages. Herpes zoster, pulmonary tuberculosis, and oral candidiasis emerged as the most prevalent OIs. The findings underscore the critical importance of enhancing nutritional support, adherence counseling, and early diagnosis to mitigate the burden of OIs in Ethiopia.[12]

A study conducted in North Wollo, Ethiopia, investigated the prevalence and associated risk factors of opportunistic infections (OIs) among HIV-positive adults receiving antiretroviral therapy (ART). Utilizing a cross-sectional design, the research included 405 participants and identified an OI prevalence of 42.2%. The most frequently reported OIs were tuberculosis (27.5%), herpes zoster (25.2%), chronic diarrhea (15.2%), and thrush (14%). Significant risk factors included advanced age, WHO clinical stages III/IV, CD4 counts ≤ 200 cells/ mm^3 , and the practice of chewing chat. These findings highlight the importance of early intervention and strengthened healthcare services to improve outcomes for individuals living with HIV.[23]

According to a cross-sectional study conducted by Gebreyohannes, Feleke, Belay, and Ayalew (2019) at the University of Gondar, the prevalence and predictors of opportunistic infections (OIs) among adults on antiretroviral therapy (ART) were assessed. The study found that 31.8% of participants experienced at least one OI, with key predictors including low CD4 counts, poor ART adherence, and the presence of comorbid conditions. The authors emphasize the need for early detection, adherence support, and integrated healthcare approaches to reduce the impact of OIs among HIV-positive individuals.[14]

2.2 Factor Associated with opportunistic infections

Factors associated with occurrence of OIs among HIV patients taking ART were also assessed in different countries at different time. Accordingly the risk for the advancement of OIs in HIV patients depends on exposure to potential pathogens, virulence of the pathogens, the degree of host immunity, and the use of antimicrobial prophylaxis. [24]

Clinical guidelines highlight several risk factors for opportunistic infections (OIs) in individuals with HIV, primarily due to immune system compromise. A CD4 count below 200 cells/ mm^3 is a critical indicator of immune suppression, heightening vulnerability to infections such as tuberculosis and pneumocystis pneumonia. Insufficient viral suppression, often stemming from poor adherence to antiretroviral therapy (ART), drug resistance, or metabolic issues, significantly increases OI risk. Additionally, co-infections, particularly with tuberculosis or syphilis, exacerbate HIV progression by raising viral loads. Health and lifestyle factors, including malnutrition, substance use, inconsistent access to care, and advanced age (over 50), further contribute to susceptibility to OIs.

A retrospective cohort study in the Gedeo Zone of Southern Ethiopia examined the prevalence of opportunistic infections (OIs) among people living with HIV/AIDS (PLWH) attending antiretroviral therapy (ART) clinics. Conducted from April to June 2018, the study analyzed data from 266 patients over a one-year period. Results showed that 42.5% of patients experienced at least one OI, with oral candidiasis (24.5%), pulmonary tuberculosis (19.5%), and herpes zoster (13.4%) being the most prevalent. Significant risk factors included low CD4 counts, advanced WHO clinical stages (III/IV), poor ART adherence, and khat chewing. The study underscores the importance of addressing these factors through targeted interventions to reduce OI prevalence in the region.[25]

A retrospective follow-up study by Tegegne et al. (2022) at Dessie Comprehensive Specialized Hospital in Ethiopia investigated the incidence and predictors of opportunistic infections (OIs) among adult HIV patients on antiretroviral therapy (ART). The analysis of 354 patients revealed an OI incidence of 32.2%, with tuberculosis as the most prevalent infection. Significant predictors of OIs included advanced WHO HIV stage IV, low CD4 counts, poor ART adherence, and bedridden functional status. The findings underscore the need for early initiation of ART, regular follow-up, and adherence-enhancing strategies to reduce OI occurrence and improve patient outcomes. [7]

A systematic review and meta-analysis assessed the prevalence of opportunistic infections (OIs) among HIV-positive adults on antiretroviral therapy (ART) in Ethiopia, reporting a high pooled prevalence of approximately 44%. Contributing factors included poor ART adherence, undernutrition, low CD4 counts (<200 cells/ μ L), and advanced HIV stage. The study highlights the critical need for enhanced adherence support and nutritional interventions to improve health outcomes for HIV patients. [12]

A case-control study by Tewachew et al. (2021) conducted at Debre Berhan Referral Hospital, Ethiopia, examined the determinants of opportunistic infections (OIs) among HIV-positive patients on highly active antiretroviral therapy (HAART). The study identified several key risk factors for OIs, including alcohol use, low body mass index, and a history of previous OIs. These factors were found to significantly increase the likelihood of OI occurrence. The study highlights the need for targeted interventions, such as improved screening and monitoring of high-risk patients, to reduce OI prevalence and enhance patient outcomes [26]

3 conceptual frame work

This conceptual framework is developed after extensive literature review to show factor associated with opportunistic infections [16-29]

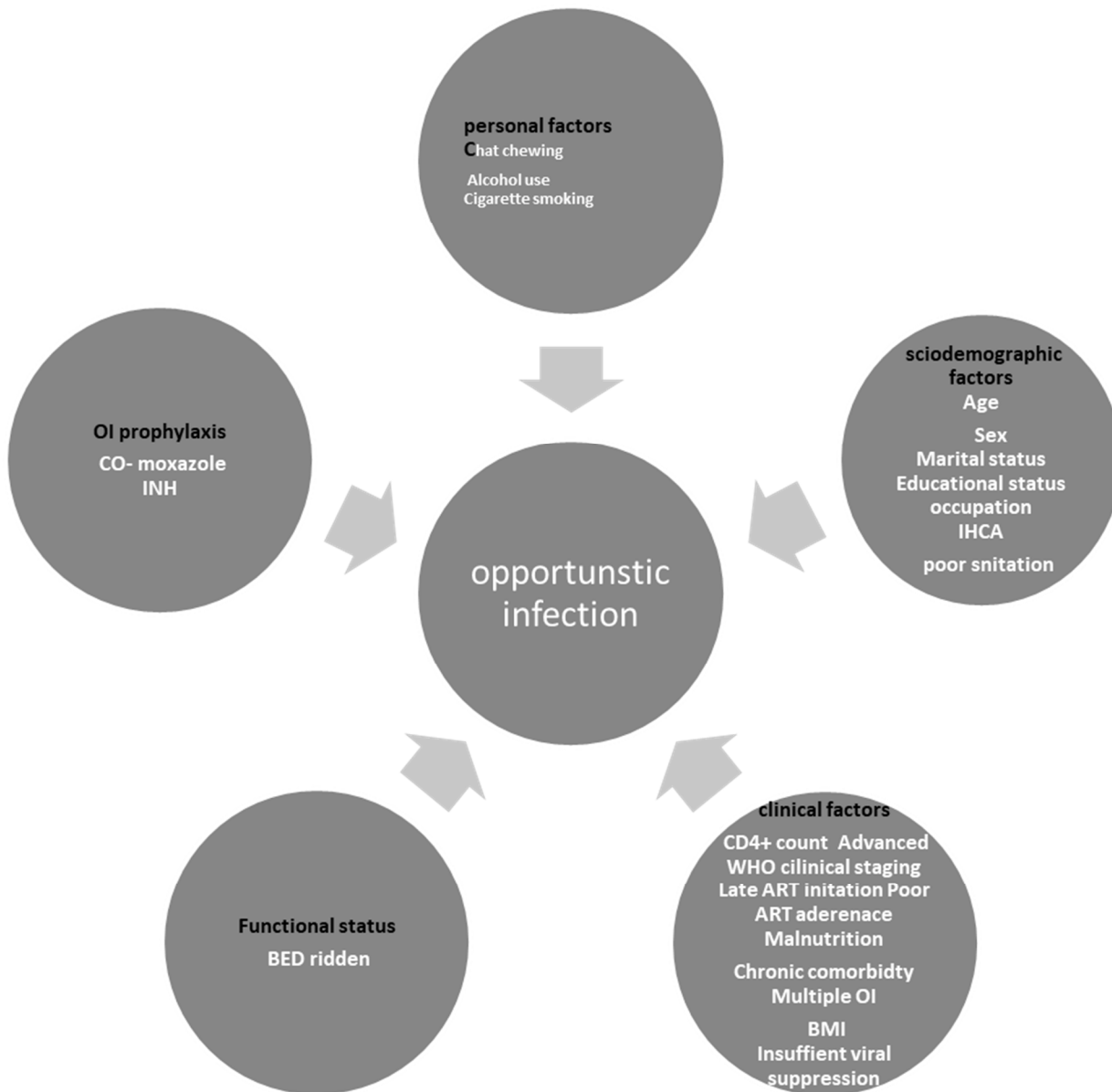


Figure 1 conceptual frame work, SPHMMC

4. Objective

4.1 General objective

Assess the Magnitude and factors contributing to opportunistic infection in HIV patients visiting at St. Paul's Hospital Millennium Medical College from November 1, 2021 to December 30, 2024

4.2 Specific objective

1. Determine the prevalence of opportunistic infection SPHMMC at ART clinic
2. Identify risk factors associated to the development of opportunistic infection

5 . Methods and Material

5.1 Study Setting and Period

An institution based cross-sectional study was conducted from November 1 2021 to December 30 2024. The study was conducted in ART clinic of SPHMMC located in Addis Ababa; Ethiopia. SPHMMC is one of two national referral medical centers. It was established through a decree of the council of Ministers in 2010, although the medical school opened in 2007 and the hospital was established in 1968 by the late Emperor Haile Selassie. It's governed by a board under Federal Ministry of Health. The college-initiated Ethiopia's first integrated modular and hybrid problem-based curriculum for its undergraduate medical education and diversifying post graduates programs. The college has more than 2800 clinical, academic and administrative and support staffs that provide medical specialty service to patients who are referred from all over the country. The inpatient capacity is more than 700 beds and an average of 1200 emergency and outpatient clients are seen daily in the hospital.

5.1.2 Study Design

Institution based cross-sectional study design was used.

5.2 Source and Study Population

5.2.1 Source Population

All patients diagnosed with HIV/AIDS and attending follow-up at public hospitals in Addis Ababa during the study period.

5.2.2 Study Population

All patients diagnosed with HIV/AIDS and attending follow-up at the ART clinic of SPHMMC during the study period.

5.2.3 Inclusion criteria

HIV-positive individuals aged 18 years and above, regardless of their antiretroviral therapy (ART) status.

5.2.4 Exclusion criteria

Patients with incomplete medical records, including those without documented CD4 counts or viral load results at the time the opportunistic infection was diagnosed.

5.3 Sample Size

The sample size for the primary objective was calculated using the single population proportion formula. The calculation is based on a 95% confidence level ($Z_{\alpha/2} = 1.96$) and a 5% margin of error. Published data from Ethiopia indicate that the prevalence of opportunistic infections among HIV patients is 43.97%. [12]

The total sample size required was calculated as follows:-

$$n = \frac{Z_{\alpha/2}^2 p(1-p)}{d^2}$$

Where;- n = minimum sample size

P= Proportion of prevalence

d = margin of error = 5%

$Z_{\alpha/2}$ = critical value for normal distribution at 95% confidence interval= 1.96 ($\alpha = 0.05$).

$$n = (1.96)^2 (0.4397) (1-0.4397) / 0.05^2 = 378$$

By adding to 10% to non-response $378 + 37 = 415$

So the calculated sample size is 415

5.5 Sampling technique

The medical records of all patients that fulfill the inclusion criteria visiting SPHMCC hospitals ART clinic from November 1, 2021 to December 30, 2024 was obtained. The accessible data comprised 311 entries from the medical record. We utilized all accessible data and incorporated it into the study.

5.6 Study Variables

5.6.1 Dependent Variables

Opportunistic infection

5.6.2 Independent Variables

- ✓ Age
- ✓ Sex
- ✓ CD4 +
- ✓ Viral load
- ✓ Marital status

- ✓ Educational level
- ✓ Employment status
- ✓ Duration of the illness
- ✓ ART
- ✓ Smoking
- ✓ Alcohol
- ✓ Health seeking behavior

5.7. Data Collection Procedure

A Structured questionnaire was prepared in English language adopted from previous literatures, ART clinic intake form of FMOH. It contains 42 questions divided in to six components that includes socio-demographic data, functional status, clinical characteristics, OIs prophylaxis, personal habit and diagnosed opportunistic infections.

Patient chart was traced and collected after getting patient card number and information from HMIS Data and the questionnaire was filled by 5 selected emergency department year one residents who got instruction session on how to fill the data from the patient charts.

5.8 Operational Definition

Opportunistic infections- the presence of at least one diagnosed opportunistic infection at any point during the patient's follow-up at the ART clinic.

Adherence: Adherence to medication defined as the act of conforming to the recommendations made by the provider with respect to timing, dosage, and frequency of medication taking. And assessed by using both tablet counting and self-reporting methods, is defined as poor, fair and good, poor if adherence is <85 %(>6 dose of 30 doses or >9 dose of 60 dose is missed). Fair, if adherence is between 85 % and 95 % (3-5 doses of 30 doses or 3-9 dose of 60 doses is missed). and good if adherence is >95% (<2 doses of 30 doses or <3 dose of 60 dose is missed)

Functional status: Is an individual's ability to perform normal daily activities required to meet basic needs, fulfill usual roles and maintain health and well-being. Functional status is classified in to the following categories:

Working- Able to perform usual work in or out of the house, harvest, go to school.

Ambulatory- Able to walk to or at treatment unit and walks at home unaided.

Bedridden-Most of time in bed at home.

Personal factor: are factors related to an individual habit like alcohol, khat and smoking that cannot be measured in amount but can be assessed HIV positive patient to be answered as Yes or No according to HIV care refill form

WHO Clinical Staging: is a way to categorize HIV disease severity based on new or recurrent clinical events. There are 4 WHO clinical stages which range from mild symptoms(WHO clinical stage 1) to severe symptoms WHO.

5.9 Data Quality Control

The overall activity was controlled by the investigators of the study. The data collection team was trained on data collection process for 02 hrs. Data quality was controlled by designing the proper data collection materials and through continuous supervision. The medical chart number of the patient was checked whether clinically matched or not. Completeness, accuracy and consistency of data collection were checked on each day of the data collection period, before using the filled questionnaires. All completed data collection form was examined for completeness and consistency during data storage and analysis.

5.10 Data Processing and Analysis

The collected data was checked manually for incompleteness and inconsistencies. Data was entered into Google format and analyzed by SPSS version 27.0. A bivariable and multivariable binary logistic regression analysis was used to identify factors significantly associated with opportunistic infection. Adjusted Odds Ratio (95% CI) and $P \leq 0.05$ was used to measure the association.

5.11 Ethical consideration

Ethical clearance and approval to conduct the research was obtained from St. Paul Hospital Millennium Medical College and department of emergency medicine and critical care, Addis Ababa. Study holds no harm to study population and the confidentiality was guaranteed.

5.12 Dissemination of the results

The result of the study will be communicated to St Paul hospital millennium medical college, Department of emergency medicine and critical care. Finally, it will be published on reputable journal.

6. Results

A total of 394 medical record numbers were obtained from the Health Management Information System (HMIS). Only 311 medical charts were retrieved from the chart storage box. We incorporated the entire available medical chart in to the study.

6.1 Socio-Demographic Characteristics

The study enrolled 311 individuals living with HIV/AIDS, with a gender distribution of 45% males and 55% females. The majority of participants (45.3%) were married, followed by those who were single. The mean age of the participant was 39.89 years (± 11.53 SD), with an age range of 17 to 76 years. Nearly all participants (97.1%) resided in urban areas, and of this group, 32.5% were employed in the private sector. A small minority (1.6%) were identified as female sex workers (FSW). All other socio-demographic characteristics data are detailed in the accompanying table.

Table 1 socio-demographic characteristics SPHMMC from November 1, 2021 to December 30, 2024

Variables	Frequency	Percentage
Patients' age group		
<18	2	0.6
18-29	59	19.0
30-39	96	30.9
40-49	82	26.4
≥ 50	72	23.2
Gender		
Male	140	45.0
Female	171	55.0
Marital Status		
Single	82	26.4
Married	141	45.3
Divorced	54	17.4
Widowed	34	10.9
Residency		
Urban	302	97.1

Rural	9	2.9
Occupation		
Government employee	39	12.5
Private Job	101	32.5
Daily Laborer	40	12.9
House wife	37	11.9
Driver	19	6.1
FSW	5	1.6
Unemployed	57	18.3
Student	13	4.2

6.2 Clinical characteristics and functional status of study participants

A majority of the participants received an HIV/AIDS diagnosis 1-3 years prior (62.4%), were functionally active (92.6%), and presented with an early WHO clinical stage (60.4%). Most patients (79.4%) showed good adherence to HAART. Over half had a baseline CD4+ count above 200 cells/ μ L (53.8%), and two-thirds had a hemoglobin level greater than 12 mg/dL (66.9%). Baseline BMI was comparable to current measurements. All other clinical data are detailed in the accompanying table.

Table 2 clinical characteristics and functional status, SPHMMC from November 1, 2021 to December 30, 2024

Variables	Frequency	Percentage
Duration of HIV Diagnosis		
< 1 year	18	5.8
1-3 years	194	62.4
≥ 3 years	99	31.8
Functional Status		
Working	196	63.0
Ambulatory	92	29.6
Bedridden	23	7.4
Known Comorbidity		
Yes	64	20.6
No	247	79.4

B/LWHO Clinical Staging

I	144	46.3
II	44	14.1
III	55	17.7
IV	68	21.9

Baseline CD4 Count

<200	144	46.3
200-349	83	26.7
350-500	35	11.3
>500	49	15.8

Baseline Hemoglobin

≥12	208	66.9
10-11.9	67	21.5
7-9.9	33	10.6
<7	3	1.0

HAART Adherence

Good	247	79.4
Fair	57	18.3
Poor	7	2.3

Baseline Weight

<60	163	52.4
≥60	148	47.6

Current Weight

<60	120	38.6
≥60	191	61.4

Baseline BMI

18.5-24.9	192	61.7
<18.5	65	20.9
≥25	54	17.4

Current BMI

18.5-24.9	198	63.7
17-18.4	41	13.1

6.3 Personal Habit and Usage of OIs Prophylaxis

The vast majority of patients received preventive therapies, with 87.5% on INH prophylaxis and 89.7% on cotrimoxazole prophylaxis. Regarding personal habits, alcohol was used by only 10.9% of participants, while the overwhelming majority (89.1%) were non-users. A complete summary of personal habits and opportunistic infection (OI) prophylaxis is provided in the table below

Table 3 personal habit and OIs prophylaxis, SPHMMC from November 1, 2021 to December 30, 2024

Variables	Frequency	Percentage
Cotrimoxazole		
Yes	279	89.7
No	32	10.3
INH		
Yes	272	87.5
No	39	12.5
Khat Chewing at the beginning of ART		
Yes	21	6.8
No	290	93.2
Alcohol Intake at the beginning of ART		
Yes	34	10.9
No	277	89.1
Cigarette Smoking at the beginning of ART		
Yes	8	2.6
No	303	97.4

6.4 Prevalence of Opportunistic infections

The overall prevalence of OIs among the study participants were (44.1%) the most frequent OIs from this study were Tuberculosis (both pulmonary and extra pulmonary) at (28.6%), oral/oesophageal candidiasis at (8.4%), CNS Toxoplasmosis at (5.8%) and chronic diarrhoea at 5.5%. The overall prevalence of OIs is presented in the figure below and prevalence of each OIs are presented table below

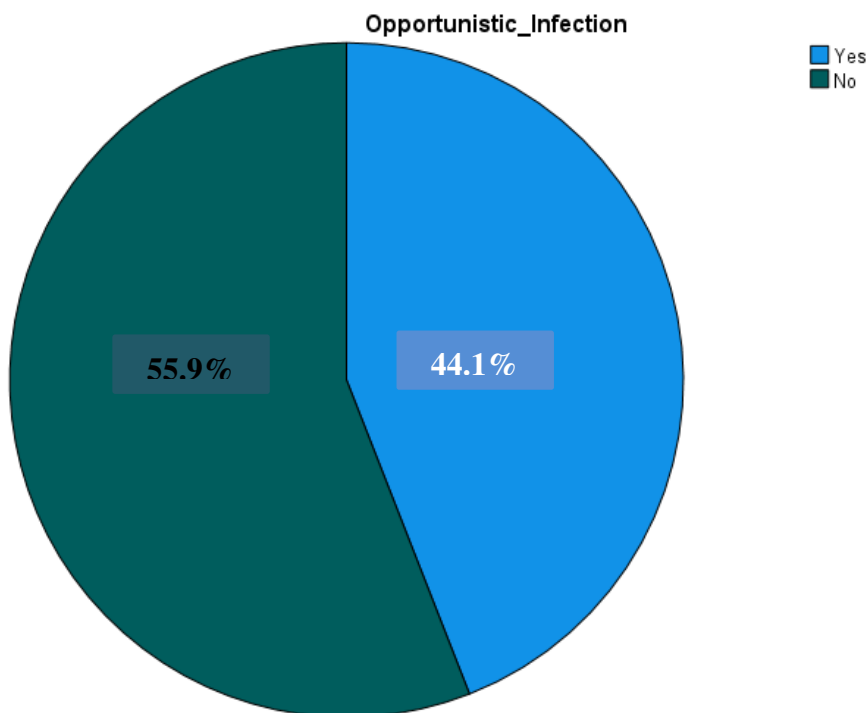


Figure 2 Prevalence of Opportunistic infection, SPHMMC from November 1, 2021 to December 30, 2024

Table 4 list of opportunistic infections, SPHMMC from November 1, 2021 to December 30, 2024

Variables	Frequency	Percentage
Oral Candidiasis	17	5.5
Esophageal Candidiasis	9	2.9
Pulmonary TB	61	19.6
Herpes Zoster	12	3.9
PCP	15	4.8
Recurrent bacterial pneum.	9	2.9

Extra-pulmonary TB	28	9.0
Kaposi Sarcoma	5	1.6
Cryptococcal meningitis	12	3.9
CNS Toxoplasmosis	18	5.8
Chronic Diarrhea	17	5.5
Lymphoma	11	3.5
Cervical Cancer	7	2.3

6.5 Factors Associated with opportunistic infections

On bivariable binary logistic regression, functional status, duration of HIV diagnosis, baseline WHO clinical staging, baseline CD4 count, baseline hemoglobin, baseline weight, baseline BMI and INH prophylaxis were found to have statistically significant association with opportunistic infection. But age, sex and other demographic factors weren't found to have statistically significant association.

On multivariable binary logistic regression, only baseline WHO clinical staging was found to have statistically significant association with opportunistic infection. Those participants who were in stage II were 7 times more likely to develop opportunistic infection than those whose baseline WHO clinical stage I. Those who were in stage III and IV were 45.6 and 171.9 more likely to develop opportunistic infection than those who were on stage I one respectively.

Table 5 Factors associated with opportunistic infections, SPHMMC from November 1, 2021 to December 30, 2024

Variables	OIs		COR (95% CI)	p-value	AOR (95% CI)	p-value
	Yes	No				
Functional Status						
Working	61	135	1.00			
Ambulatory	55	37	3.29 (1.97, 5.51)	.000	0.68 (0.29, 1.61)	.389
Bedridden	21	2	23.24 (5.28, 102.24)	.000	0.77 (0.16, 3.60)	.905
Duration of HIV Diagnosis						

< 1 year	5	13	1.00			
1-3 years	79	115	1.79 (0.61, 5.21)	.288	2.51 (0.29, 21.66)	.402
≥3 years	53	46	2.97 (0.99, 9.03)	.025	3.69 (0.41, 33.15)	.244
Baseline WHO						
Clinical stag-						
ing						
I	10	134	1.00			
II	18	26	9.28 (3.85, 22.36)	.000	7.02 (2.75, 18.90)	.000
III	45	10	60.30 (23.57, 154.26)	.000	45.59 (16.17, 128.53)	.000
IV	64	4	214.40 (64.759, 709.82)	.000	171.93 (40.75, 725.4)	.000
Baseline CD4						
C.						
<200	87	57	1.00			
200-349	28	55	0.33 (0.19, 0.59)	.000	0.90 (0.36, 2.25)	.820
350-499	9	26	0.23 (0.09, 0.52)	.000	0.58 (0.16, 2.11)	.410
≥500	13	36	0.24 (0.12, 0.48)	.000	0.70 (0.25, 2.01)	.508
Baseline Hg						
≥12	67	141	1.00			
10-11.9	44	23	4.03 (2.25, 7.21)	.000	1.61 (0.65, 3.96)	.308
7-9.9	24	9	5.61 (2.47, 12.74)	.000	1.60 (0.47, 5.49)	.453
<7	2	1	4.21 (0.38, 47.24)	.244	0.22 (0.01, 5.49)	.317
Baseline						
Weight						
<60 kg	79	84	1.46 (0.93, 2.29)	.100	1.05 (0.41, 2.65)	.927
>60 kg	58	90	1.00			
Baseline BMI						
18.5-24.9	83	109	1.00			
<18.5	38	27	1.85 (1.05, 3.27)	.035	0.66 (0.24, 1.85)	.429
≥25	16	38	0.55 (0.29, 1.06)	.075	0.75 (0.25, 2.29)	.614

INH

Yes	105	167	1.00			
No	32	7	7.27 (3.09, 17.07)	.000	3.62 (.99, 13.33)	062

7. Discussion

A single centred study was made to assess the magnitude and factor contributing to opportunistic infections in HIV visiting at ST. Paulo's millennium medical college.

This study determined the overall magnitude of opportunistic infections to be 44.1%. This finding is consistent to several studies conducted in Ethiopia, such as those in North Wollo (42.2%) [23], Debre Markos (42.8%) [27], Wolita zone Southern Ethiopia (42.2%) [28]) and a national meta-analysis (43.97%) [12]. This consistency suggests a persistent and high burden of OIs across various Ethiopian healthcare settings, likely reflecting similar challenges in early HIV diagnosis and linkage to care.

The finding was lower than the study conducted in south-western china (71.2%) [16], 55.3% and 52 % study conducted at southern and Ester zone of Tigray ([11],[27]) and eastern part of Ethiopia (48%) [24]. The higher prevalence observed in studies from South-western China and Tigray may be attributable to: a higher proportion of patients in the comparator studies presented with advanced immunodeficiency (WHO stage III/IV) and more significant barriers to accessing tertiary care.

However, it is higher when compared to similar studies carried out in Dessie, Ethiopia (32.2%) [28]; Gondar (4.1%) [29]; Semarang, Indonesia (12.3%) [18] and Mogadishu, Somalia (37.1%) [22]. Several factors may account for the higher prevalence of opportunistic infections in this study compared to findings from Gondar [29], Dessie [28], Semarang [18] and Mogadishu[22]. First, a fundamental difference in study design exists: this analysis captured the point prevalence of OIs, while the comparator studies measured incidence following ART commencement. Second, and more significantly, the baseline clinical profile of the participants differed markedly. Our study included a substantial number of patients with base line advanced immunodeficiency at presentation, including 46.3% with a baseline CD4+ count below 200 cells/ μ L and 39.6% in WHO stages III/IV. This advanced disease status at enrolment predisposes this population to a greater overall burden of OIs, unlike the Gondar cohort, which was largely comprised of patients in the earlier, less severe clinical stages (I/II).

The predominant opportunistic infections identified were Tuberculosis (both pulmonary and extrapulmonary) at 28.6%, oral/oesophageal candidiasis at 8.4%, CNS Toxoplasmosis at 5.8%, and chronic diarrhoea at 5.5%. This pattern is consistent with the established epidemiological profile of HIV in Ethiopia and other resource-limited settings. The predominance of tuberculosis aligns with findings from multiple regional studies in Ethiopia, including those in Northern Wollo [23], Dessie [31], and the Dawro zone [30], underscoring its endemic nature and potent synergy with HIV.

This trend is not confined to Ethiopia; international studies from China [32], Vietnam [18], and Bamako, Mali [30] also report tuberculosis as the leading OI, often followed by candidiasis. Similar spectra of infection, with tuberculosis and candidiasis as the most prevalent, have been documented in diverse geographical contexts such as Kolkata, India [31] and Surabaya, Indonesia [32].

While less common than tuberculosis and candidiasis, CNS toxoplasmosis persisted as a significant infection in our study. Its presence is a recognized marker of advanced immunosuppression. The prevalence observed in this study (5.8%) is comparable to rates reported in other settings with a high burden of advanced HIV disease, including Surabaya, Indonesia [32], Beijing, China [33], Rio de Janeiro, Brazil [34], and Bamako, Mali [33]. This consistency across studies is largely attributed to a shared risk factor: a substantial proportion of patients presenting with advanced WHO clinical stages and profoundly low CD4+ cell counts, which are the primary drivers for the development of this severe neurological infection [33, 34].

Factors influencing the occurrence of opportunistic infections among HIV patients were analyzed, revealing that advanced WHO staging at baseline increases the risk of developing OIs. Those participants who were in stage II were 7 times more likely to develop opportunistic infection than those whose baseline WHO clinical stage I. Those who were in stage III and IV were 45.6 and 171.9 more likely to develop opportunistic infection than those who were on stage I one respectively. The findings of this study confirm that the baseline WHO clinical stage is a robust and independent predictor of opportunistic infection (OI) risk, with patients initiating care at stages III or IV facing a substantially higher burden than those in stages I or II. This conclusion is strongly supported by a consensus within the existing literature. For instance, a dose-response relationship was clearly demonstrated in Gondar, where patients in stages III and IV were 9.4 and 22.6 times more likely, respectively, to develop an OI compared to those in stage I [29]. This pattern is consistent across Ethiopia, with similar findings reported from Debre Markos [35], the Wolita Zone [36], and Hiwote Fana Hospital, where a 52.4% OI prevalence in ART-naïve patients was significantly associated with advanced WHO staging (AOR=3.84) [39]. This association is robust across different patient populations, being observed in both ART-naïve and ART-experienced individuals [37, 39] and in both adults and children [38].

The predictive power of the WHO staging system extends beyond Ethiopia. A study in Ghana reported that advanced stages conferred a 15.88-fold increased risk of OIs [40], while similar findings have been documented in Tanzania [41]. A systematic meta-analysis of Ethiopian studies further confirms that advanced WHO stage is a paramount risk factor, even when other variables like low CD4+ count or educational status are considered [12]. While

these other factors are often significant [11, 39], the WHO staging system consistently retains high predictive value, affirming its utility as a fundamental tool for risk stratification in diverse clinical and demographic contexts.

8. Strength of the study

- The study has a reasonably large sample size, which increases the reliability and generalizability of the findings within the specific context
- The study has collected wide arrays of data that has allowed multifaceted analysis of factors at paly
- Broader discussion part comparing data's from Africa, Asia and Ethiopia

9. Limitation

- The records review revealed a number of missing files as well as charts with incomplete documentation.
- It measured all existing OIs at the time of the study (point prevalence), including those diagnosed long ago.
- The study population is predominantly urban (97.1%), from a single center. Therefore, the findings may not be representative of rural HIV populations in Ethiopia and the whole picture of the Addis Abeba
- Failure to attain sample size requirement, due to sever missing files.

10. Conclusion and Recommendation

10.1 Conclusion

This study found a high prevalence (44.1%) of opportunistic infections (OIs) among HIV/AIDS patients visting at St.Paulo's millennium medical collage. The most common OIs were Tuberculosis (both pulmonary and extrapulmonary), oral/esophageal candidiasis, and CNS Toxoplasmosis.

The most critical finding is that advanced baseline WHO clinical staging (III and IV) is the single strongest and most powerful predictor for developing an OI. Patients in WHO stage IV were 172 times more likely to have an OI compared to those in stage I.

10.2 Recommendation

Based on the result of the study, the following recommendation was provided

1. For Clinical Practice and Public Health Policy:

- **Strengthen Early HIV Diagnosis and Linkage to Care:** Intensify community awareness and testing campaigns to identify HIV-positive individuals earlier, *before* their immune systems are severely compromised. The goal is to enroll more patients in care at WHO stage I or II.

2 For ST. Paul's millennium medical collage

- We recommend implementing measures to improve the completeness and consistency of medical record documentation

3. . For Future Research

- **Conduct Multi-Center Studies:** Future studies should include multiple sites, especially including more hospital which can be a figure of the city.
- To better understand the impact of antiretroviral therapy on disease progression, subsequent research should focus on measuring the incidence rate of OIs

11. Reference

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12. Annexs

Annex1. Questionnaire

General information

For each question, make a circle around a Number that corresponds to answer; fill the blank answer.

Unique ART number_____

Unique patient ID number_____

Part 1: Socio-demographic characteristic

No	Variable	Descriptive Categories
1.1.	Age	_____

1.2.	Sex	1. Male 2. Female
1.3.	Marital Status	1. Single 2. Married 3. Divorced 4. Widowed 5. Separated
1.5.	Occupation	1. Government employee 2. Private employee 3. Daily labourer 4. House wife 5. Merchant 6. Factory worker 7. Unemployed 8. Other _____
1.6.	Residence	1. Urban 2. Rural
2.1.	Part II: Functional status	1. working 2. Ambulatory 3. Bedridden

Part III: Clinical characteristic

No.	Variables	Descriptive categories
3.1.	Duration of HIV diagnosis	_____
3.2.	Baseline WHO Clinical Stage	_____
3.3.	Baseline CD4 Cell count	_____
3.4.	Baseline Hemoglobin level	_____
3.5.	HAART Adherence	1. Good 2. Poor 3. Fair
3.6	HAART discontinuation	1 Yes 2 NO
3.7.	Weight	Baseline _____ Current _____
3.8.	BMI(Body Mass Index)	Baseline _____ Current _____
3.9	Any known comorbidity(more than one answer is possible)	1 Hypertension 2 Diabetes mellitus 3 Asthma /COPD 4 Dyslipidemia

		5 cardiac illness 6 others _____
	Part IV: OIs Prophylaxis	
4.1.	Co-trimoxazole	1. Yes 2. No
4.2	INH	1. Yes 2. No

Part v: Personal habits or Factors

No.	Variables	Descriptive categories
5.1	Khat chewing at the beginning of ART	1.Yes 2.No
5.2	Alcohol drinking at the beginning of ART	1.Yes 2.No
5.3	Cigarette smoking at the beginning of ART	1.Yes 2.No

Part VI: Diagnosed opportunistic infections

Taken from HIV care or ART follow- up form.

No	Types of opportunistic infection	
6.1.	Oral candidiasis	1. Yes 2.No
6.2.	Pulmonary TB	1. Yes 2.No
6.3.	Esophageal candidiasis	1. Yes 2.No
6.4.	Herpes zoster	1. Yes 2.No
6.5.	Pneumocystis carnie pneumonia (PCP)	1. Yes 2.No
6.6.	Recurrent bacterial pneumonia	1. Yes 2.No
6.7.	Extra pulmonary TB	1. Yes 2.No
6.8.	Kaposi's sarcoma	1. Yes 2. No
6.9.	Toxoplasmosis of the CNS	1. Yes 2.No
6.10.	Cryptococcal meningitis	1. Yes 2. No

6.11.	Chronic diarrhea	1. Yes 2. No
6.12.	Lymphoma	1. Yes 2. No
6.13.	Cervical cancer	1. Yes 2. No
6.14	Minor mucocutaneous manifestation	1. Yes 2. No
6.15	Wasting syndrome	1. yes 2. No
6.16	Fever (> 1month; unexplained)	1. Yes 2. No
6.17.	Others(specify)	

ANNEX 2: Assurance of Principal Investigator

I the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I will communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the student: _____

Signature: _____

Date: _____

Approval of the Primary Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

Approval of the Co-Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____