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Research

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Factors associated with opportunistic infections (OIs) among HIV/AIDS patients attending comprehensive care clinic (CCC) at Mbagathi District Hospital, Nairobi Kenya: a cross-sectional study

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Abstract

Introduction: *the persistence of HIV/AIDS as a significant global health concern is particularly pronounced in developing nations, where 35 million people are affected, with 70% residing in sub-Saharan Africa. Annually, 2.1 million new infections emerge, translating to 5,700 daily cases. Sub-Saharan Africa experiences a staggering 1.1 million AIDS-related deaths each year, underscoring the imperative to manage opportunistic infections (OIs) among HIV/AIDS patients. This study aimed to discern the prevalence and associated factors of OIs among HIV/AIDS patients.* ***Methods:*** *a cross-sectional study was conducted between March and April 2019 as MDH CCC, a facility catering to outpatient care and serving as a referral center for OIs in HIV/AIDS patients in Nairobi County, Kenya. The study enrolled 196 HIV-positive patients aged 18 and above. Data collection involved the use of structured questionnaires, following ethical approval from KNH/UON ethical Review Committee.* ***Results:*** *females (62.4%) and individuals aged 36-50 years (69.6%) experienced a higher prevalence of OIs. The divorced/separated demographic exhibited the highest prevalence at 75.8%. Tuberculosis emerged as the predominant infection (41.5%), particularly affecting those with two to five sexual partners (75%). Significant associations were established with age group (p=0.003), income (p=0.0001), and treatment duration (p=0.041).* ***Conclusion:*** *opportunistic infections exhibited a higher prevalence among females and individuals aged 36-50 years. Education and income were correlated with tuberculosis, the most prevalent infection, especially in patients with diminished CD4+ T-cell counts. Addressing these factors is paramount for effective HIV/AIDS management and public health interventions.*

Introduction

HIV/AIDS continues to be a leading public health concern, especially in developing countries, with 35 million people living with it and 70% of them living in sub-Saharan Africa [1]. Approximately 2.1 million infections occur every year, hence 5,700 new infections occur daily [2]. Every year, about 1.1 million children and adults die of AIDS in sub-Saharan Africa [2]. The introduction of HAART has led to the decline of HIV-related opportunistic infections and mortality. The need to have control over opportunistic infections among HIV/AIDs patients is urgent [3]. This helps to control the impact on them and affected people around them [3]. Opportunistic infections are infections caused by organisms that take advantage of a weakened immune system and cause disease when they ordinarily cause mild or no disease in the immune-competent host [4]. When they occur, opportunistic infections often are associated with significant morbidity and mortality [5]. Although microorganisms that cause disease often receive the most attention, it is important to note that most microorganisms do not cause disease. Many probably provide some protection against harmful microorganisms because they effectively compete with the harmful organisms for resources, preventing them from growing [6].

Since the introduction of highly active antiretroviral therapy (HAART), a significant decline in opportunistic infections (OIs) and AIDS progression has been observed [7]. However, significant differences still exist in the burden of OIs between the high-income and low-income resource settings [8]. Most of the evidence for the decrease of OIs has come from high-income resource settings with relatively less burden of OIs in the pre-HAART era, early and widespread access to ART, and sophisticated diagnostic tools [9,10]. In developing regions such as sub-Sahara Africa and South East Asia, where an estimated 90% of people living with HIV/AIDS (PLWHA) reside, the predominant HIV-associated OIs in the pre-ART era were TB (Tuberculosis), candidiasis, infective diarrhea, meningitis, dermatitis, and recurrent herpes simplex infection [11]. Opportunistic pathogens are potentially infectious agents that rarely cause disease in individuals with healthy immune systems [12]. Diseases caused by opportunistic pathogens typically are found among groups such as the elderly (whose immune systems are failing), cancer patients receiving chemotherapy (which adversely affects the immune system), or people who have AIDS or are HIV-positive [1]. An important clue to understanding the effect of HIV on the immune system was the observation of a rare type of pneumonia among young men caused by *Pneumocystis carinii*, an organism that causes disease only among the immune suppressed [13].

An infection results when a pathogen invades and begins growing within a host. Disease results only if and when, as a consequence of the invasion and growth of a pathogen, tissue function is impaired [14]. Bodies have defense mechanisms to prevent infection and, should those mechanisms fail, to prevent disease after infection occurs [15]. Some infectious agents are easily transmitted (that is, they are very contagious), but they are not very likely to cause disease (that is, they are not very virulent). The polio virus is an example: It probably infects most people who contact it, but only about 5 to 10 percent of those infected develop clinical disease. Other infectious agents are very virulent, but not terribly contagious. The terror surrounding Ebola hemorrhagic fever is based on the virulence of the virus (50 to 90 percent fatality rate among those infected); however, the virus itself is not transmitted easily by casual contact. The most worrisome infectious agents are those that are both very contagious and very virulent [16].

Prophylaxis for the management of OIs and the introduction of HAART have significantly decreased the incidence of OIs and mortality in infected persons [17]. However, despite the availability of HAART in developing countries, OIs continue to cause considerable morbidity and mortality. The prevalence of OIs may vary in the different segments of the PLHA (people living with HIV/AIDS) [18]. HIV causes progressive depletion of the CD4 cells, leading to life-threatening opportunistic infections or malignancies during the natural cause of the disease [19]. More than 90% of opportunistic infections are responsible for the development of AIDS morbidities and mortalities [20]. In this study, we sought to establish the factors associated with opportunistic infections among patients attending CCC clinic at Mbagathi Hospital. From the existing data, it´s clear that OI is a major contributor to morbidity mortality in those living with HIV/AIDS. It is prudent to understand and classify these factors for proper policy-making and care for this group of people.

Methods

Data collection and analysis

Data collection tools: a structured questionnaire was used to collect demographic data (age, sex, marital status, education level, herbal drug use, and ART adherence) and a checklist was used to collect the clinical data (CD4 count, WHO staging, ARV regiment, and duration of HIV diagnosis).

Data collection: a pre-tested questionnaire was used to collect demographic information of the participants. The trained interviewers then, using the checklist, collect clinical data of the consenting patients from their files. Any participant whose file had missing data was automatically excluded from the study. Patients visiting the CC Clinic on the study dates were first seen by the attending clinician before consent was sought for them to be included in the study.

Sample size: using anecdotal information, the estimated incidence was assumed to be 15%. Thus, the sample size for this study was calculated based on a prevalence of 15%, precision of 5% and 95% confidence interval. The Jung *et al*. formula:

$$n = \frac{z^2pq}{d^2}$$

for determining the minimum sample size was used [21]. Where n is the desired sample size, Z is the standard normal deviation which is 1.96, and the required confidence level (p) of 0.15. The estimated prevalence or proportion (q= l-p) is 0.85 and a precision (d) of 0.05. Hence, a total of 196 patients were included in the study.

Sampling procedure: simple random sampling was used to select the participants from among the HAART patients scheduled to visit the CC clinic during the period of data collection. After applying the exclusion criteria, a sampling frame of 980 patients scheduled to visit the clinic was generated. On each day of data collection, individuals in the sampling frame scheduled to attend the clinic on that day were identified. Thereafter, systemic random sampling was used to interview participants on each day of the visit. Every 5th patient being attended by the clinicians was interviewed after consenting to be part of the study. This process continued until the required sample size of 196 patients was reached, with 125 participants being male and 71 being female. A random starting point was chosen from the subset of patients attending the clinic on each day of data collection, after which every 5th patient was subsequently selected. The patients were interviewed for any active or new OIs recorded on that day's visit. OIs occurring at earlier visits and not currently active were not considered.

Data analysis procedure: the data collected from the questionnaire and the checklist were coded (where applicable and entered separately into the Microsoft Access 2010 database), cleaned, and then analyzed using STATA version 13, which is a software for data manipulation and analysis. A p-value less than or equal to 0.05 was considered to indicate statistical significance. The Chi-square test was used to test for associations between the various variables. Those factors that showed some significant associations at the 95% confidence level were subjected to regression analysis. The results are presented as the mean, percentage, and frequency; in charts, tables and graphs.

Data quality control: the data collection tool was pretested to ensure quality, effective, and efficient data collection during the study. The data entered were thoroughly checked for accuracy and completeness. Errors and omissions identified were rectified. Upon completion of the data entry, data cleaning was carried out to correct any mistakes that might have occurred during the data entry.

Ethical considerations: this study was approved by the KNH/UON Ethical Review Committee. Courtesy calls and permission to access the MDH-CCC premises and to access patient files were sought from the Mbagathi Hospital Medical Superintendent. Critically ill patients who were unable to communicate were not included in the study. Guardians accompanying the patients who agreed to participate in the study were requested to leave a way for one-to-one interviews with the patients to answer the questions on their own. To ensure confidentiality, all the data obtained were kept locked and keyed or in password-protected computer files to prevent unauthorized access to the data. The data sources did not include patient names or clinic numbers. Patients were identified using unique identifiers. A separate code list containing the study numbers and patients' clinic numbers was constructed. Demographic data were only used for this study.

Written informed consent was obtained from the participants before they were enrolled in the study. A research assistant was trained after which he assisted in obtaining informed consent via a non-coercive approach; providing information about the study, which included study objectives, procedures, and benefits; responding to all questions from the participants; and collecting the socio-demographic data. To access/use their clinical records, patients were interviewed privately in a room at the clinic for consent to join the study. The participant, who consented to participate in the study, signed the consent agreement. The signed and dated consent was then given to the principal investigator for safekeeping, and a copy of the consent was given to the study participant. Those not willing to take a copy with them were required to document that they declined to do so. Guardians accompanying the patients were requested to allow individual patients to provide their own consent.

Results

Socio-demographic analysis: nearly two-thirds of these participants (62.78%) were females, and the remaining (37.22%) were males. More than half (57.14%) of the respondents were aged between 36 and 50 years. The 18-35 years age group had the lowest percentage (16.84%). Regarding marital status, almost half of the participants (46.43%) were married, followed by widowed individuals (19.39%), with the fewest (2.55%) being divorced (Table 1, Table 2).

Descriptive analysis: on average, the study participants had been diagnosed with HIV for almost 11 years (67.9%). The average age was 9.8 years since the start of ARV treatment. The interquartile range (IQR) showed that 75% of the respondents had 14 years since diagnosis and the start of treatment (Table 3, Table 4). Most of the respondents (59.18%) reported having OIs at the time of the interviews. Females were the most affected (62.4%) by OIs. By age group, those aged between 36 and 50 years were most affected (69.6%). Two-thirds (75.8%) of the patients in the divorced/separated group were affected. Concerning education, more than half of the respondents (60%) with OIs had attained a tertiary level of education. Those with no education were the least affected (33.3%) (Table 2).

Bivariate analysis of factors associated with OIs: the researcher sought to understand common types of OIs that the clients suffered from. This was a multiple-response question, and a participant could list all the OIs that had occurred within the last 6 months. Most of the participants (41.2%) had suffered from tuberculosis. This was followed by pneumonia (15.1%) and candidiasis (12.6%). Candidiasis infection was most common in females (93.3%). The most common infection among males was STI, which affected 66.7% of the males (Figure 1). About marital status, those who were married were mostly affected by STI, herpes zoster infection, and gastritis/diarrhea (66.7%, 60.0%, and 60.0%, respectively). The common cold and headache were more common among those separated, at 50%. Few respondents (14%) reported having suffered from sexually transmitted diseases. Those who suffered from sexually transmitted diseases despite always using protection were low (12.5%). However, more of those who occasionally used protection had sexually transmitted infections (31.8%) (Table 4).

Multivariate analysis: treatment duration in years, household size, length of time in years since diagnosis, marital status, time in years since diagnosis (categorical), and ARV combinations did not show any association with suffering from OIs. However, age group, sex, income level, and duration of treatment were significantly associated with suffering from OIs. Factors with P value <0.299 were subjected to multivariate regression. After controlling for treatment duration in years, household size, time in years since diagnosis, sex, marital status, income level, time in years on treatment (grouped), and ARV combinations, the odds of those aged between 18 and 35 years suffering from OIs decreased by 70% compared to those aged between 36 and 50 years (CI, 0.0958171-0.999895; p=0.05).

After controlling for treatment duration in years, household size, time in years since diagnosis, sex, marital status, income level, time in years on treatment (grouped), and ARV combinations, the odds of those aged ≥50 years suffering from OIs decreased by 72% compared to those aged between 36 and 50 years (CI, 0.1098377-0.752939; p=0.011). After controlling for treatment duration in years, age group, household size, time in years since diagnosis, sex, marital status, time in years on treatment (grouped), and ARV combinations, the odds of those with incomes between Kshs 20000 and Kshs 39999 suffering from OIs decreased by 89% compared to those earning between Kshs 10000 and Kshs 19000 (CI, 0.0335415-0.388321; p=0.001). After controlling for treatment duration in years, age group, household size, time in years since diagnosis, sex, marital status, time in years on treatment (grouped), and ARV combinations, the odds of those with incomes greater than Kshs 40000 suffering from OIs decreased by 75% compared to those earning between Kshs 10000 and Kshs 19000 (CI, 0.07121-0.897389; p=0.033). Adjusting for treatment duration in years, age group, income, household size, time in years since diagnosis, sex, marital status, and ARV combinations, the odds of those who had been on treatment for a period between 5 and 9 years and who were suffering from OIs decreased by 92% compared to those who had been on treatment for a period between 10 and 15 years (CI, 0.0105694-0.739487; p=0.025) (Table 5).

Discussion

Opportunistic infections occurring due to bacteria, fungi, viruses, or commensal organisms are still a threat to human life [4]. They normally inhabit the human body and do not cause disease in healthy people but become pathogenic when the body's defense system is impaired and as a result may cause serious health problems [22]. Present study results revealed that most of the respondents (59.18%) reported having an opportunistic infection currently. Females were the most affected (62.4%) with opportunistic infection compared to males. This can be explained by the fact that women tend to seek medical attention earlier and faster following any certain detection/and or feeling of ill health compared to males. This trend is also observed in other studies, which indicate that more women always survive after treatment due to immunological adherence [23]. By age group, those aged between 36 and 50 years were most affected (69.6%). This is the most mobile and productive age group. Their higher mobility increases their chances of exposure to disease-causing organisms, hence the infection. A study done in Nigeria to understand the demography and characteristics of HIV and opportunistic diseases also reveals that the younger generation is more exposed to opportunistic diseases, while the rate of HIV infection is still high in adults [24]. The difference in these studies could be because middle age has higher interaction and mobility.

The divorced/separated were the most affected (75.76%). This can be attributed to the socio-economic and psychological challenges that this group undergoes. These factors coupled with individual immune status will increase their chances of contracting an opportunistic infection. Even though OIs are prevalent in this study, the duration of staying free from acquiring opportunistic infections and its determinant factors are merely mentioned and state of mind due to factors like divorce can contribute [25]. As expected, study results show that those with income below Kshs 5000 were the most affected by OIs. This highlights the fact that those with low income have fewer coins at their disposal for all their needs. As a result, fewer quantities and qualities of food items are bought, which subsequently affects dietary intake and gives rise to lower the body's immune system. It is also well documented in the study done in Public Hospitals in Sidama National Regional State, Southern Ethiopia, which shows that people already living with HIV are more prone to OIs and present high prevalence [26]. HIV and opportunistic infections (OIs) occurred in 88.9% of pre-ART (Antiretroviral Therapy) people living with HIV/AIDS (PLWHA).

This study results show Tuberculosis as the most common type of infection, affecting 41.5% of the participants. This negates the findings of the twenty-six patients (26) who reported a tuberculosis prevalence of 21.2%. HIV/TB Co-infection has continued to rise in the recent past, with a co-infection rate of between 20%-50 % reported in Ethiopia [27]. On the other hand, a retrospective cohort study done in Ethiopia reveals that tuberculosis with a prevalence of 29.8% was the most commonly encountered OI at follow-up and was the most common [28]. This is also supported by a study conducted in Kenyatta National Hospital which indicated that 3 of the most common OIs as TB (35%), Herpes Zoster (HZ;

15.4%), and oral thrush (OT; 8% [29]. Widespread use of pneumocystis pneumonia (PCP) prophylaxis has been proven to reduce the incidence of PCP infection among HIV patients [30]. This is supported by the findings of this study, which reports a prevalence rate of 15.1% among HIV-positive clients. Candidiasis has also been reported as a common opportunistic infection among HIV patients. This study shows a prevalence of 12.6% which suggests a downward trend compared to a range of 55.8-69.7% reported by Porter *et al*. in their study.

Study results didn´t show an association between low CD4 and the acquisition of OIs among PLWHAs. This is in contrast to findings by Mitiku [27] who suggested that people with CD4 cell counts of <200 were more likely to develop OIs compared to those with higher CD4 cell counts. It´s worth noting that bacterial/fungal infection was more common in females (88.9%) compared to males. In other studies, it is shown that older males often have an association with inadequate immunity and ultimately low baseline CD4 counts [31]. Also, a study conducted among HIV-infected patients attending at antiretroviral therapy clinic of Gondar University Hospital, Northwest Ethiopia shows Common opportunistic infections and their CD4 cell correlates to be equated to CD4 count less than 200/mm^3 and advanced WHO clinical stages of the disease were found to be predictors of OIs [32]. Few respondents (15.52%) reported taking alcohol. Alcohol use has been reported to increase the risk of contracting and transmitting HIV. However, little is known about its interaction with HIV. A recent study shows alcohol and HIV to accelerate liver disease. As regards sexual practices, 31% of those who occasionally used protection suffered from sexually transmitted infections [33]. Alcohol use disorder (AUD) is common among people living with HIV/AIDS (PLWHA) and is associated with a greater risk of poor medication adherence, unsafe sexual behaviors as well as poor quality of life [34]. Multivariable regression analysis depicts that the odds of those aged between 18-35 years suffering from opportunistic infection decreases by 70% compared to those aged between 36 and 50 years old (CI, 0.0958171-0.999895; p=0.05). These findings are in agreement with the previous findings of Vazquez who found out that infants and the elderly are more susceptible compared to the youthful population [35].

Study results further reveal that the odds of those with income between Kshs 20000 and Kshs 39999 suffering from opportunistic infection shrinks by 89% compared to those earning between Kshs 10000 and Kshs 19000 (CI, 0.0335415-0.388321; P=0.161). Again, the odds of those with income over Kshs 40000 suffering from opportunistic infection decreases by 75% compared to those earning between Kshs 20000 and Kshs 39000 (CI, 0.07121-0.897389; p=0.001). This is in agreement with the findings of other studies that found that people from low socio-economic have an increased risk of OIs [14]. Regarding the length of time on ART, the odds of those who have been on ARV treatment for a period between 5 and 9 years suffering from opportunistic infection decreases by 92% compared to those who have been on treatment for a period between 10 and 15 years (CI, 0.0105694-0.739487; p=0.237). The results contrast those done in Uganda, which suggests a higher incidence of OIs during the early years of ART initiation and reduced incidence as CD4 count increases [36]. This can be attributed to adherence behavior or time taken for diagnosis. However, multivariate analysis shows the direct association of the CD4 counts at baseline concerning the existence of opportunistic infections.

Conclusion

This study determined the prevalence of opportunistic infections and risk factors associated with these infections among HIV/AIDS patients. Age group, income level, sex, marital status, and duration of treatment were identified as some of the factors associated with opportunistic infections among this group of people.

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Recommendations: the Ministry of Health should engage all stakeholders in health, including county governments, in advancing feasible health education and promotion strategies that will increase the level of awareness of adherence, the effect of alcohol use on ARVs, and dietary intake among HIV-positive individuals. The Ministry of Health should enhance mutual interactions with government agencies and development partners to ensure realistic and sustainable provision of food supplements and spearhead the identification of local nutritious food at subsidized prices to PLWHAs from low-income societies. The Ministry and County Departments of Health should develop sustainable health promotion programs for newly diagnosed HIV-positive patients. They should be put on the training as soon as they are diagnosed. A special package for HIV/AIDS patients established by the Ministry of Health will enhance the general management and treatment of OIs at the CCC Clinic. The MOH should develop an M&E framework for the treatment and management of OIs in PLWHA. The framework should capture progress at all levels of care, from entry to consumption and adherence to treatment. The ministry should undertake feasible health education and promotion strategies that will increase awareness, prevention and management of OIs among PLWHA.

What is known about this topic

- *Tuberculosis was the most common type of infection, affecting 41.5% of the participants;*
- *A high prevalence rate of OIs was observed, with females being the most affected.*

What this study adds

- *There is a decrease in alcohol use among those taking ARVs. Few respondents (15.52%) reported consuming alcohol;*
- *The divorced/separated individuals and those with incomes less than Kshs 5000 were the most affected by OIs.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Jacinta Simalo Teeka: development and actualization of the study. Joseph Mutai and Mourine Kangogo: supervision. All the authors have read and agreed to the final manuscript.

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Tables and figure

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Table 1: demographic characteristics of participants		
Variables	**Values**	**Frequency n (%)**
Gender	Female	125(63.78)
	Male	71(36.22)
Age group	18-35 years	33(16.84)
	36-50 years	112(57.14)
	51+ years	51(26.02)
Marital status	Divorced/separated	33(16.84)
	Married	91(46.43)
	Single	34(17.35)
	Widowed	38(19.39)
Level of education	None	3(1.53)
	Primary	66(33.67)
	Secondary	97(49.49)
	Tertiary	30(15.31)

Table 2: assessing demographic information and occurrence of OIs					
Variable name	**description/values**	**OIs**		**X^2**	**P-value**
		No, n(%)	**Yes, n(%)**		
Gender	Female	47(37.6)	78(62.4)	1.4777	0.224
	Male	33(46.5)	38(53.5)		
Age group	18-35	18(54.5)	15(45.5)	11.8357	0.003
	36-50	34(30.4)	78(69.6)		
	51+	28(54.9)	23(45.1)		
Marital status	Divorced/separated	8(24.24)	25(75.76)	4.8537	0.183
	Married	42(46.2)	49(53.8)		
	Single	14(41.2)	20(58.8)		
	Widowed	16(42.1)	22(57.9)		
Level of education	None	2(66.7)	1(33.3)	0.8533	0.872
	Primary	27(40.9)	39(59.1)		
	Secondary	39(40.2)	58(59.8)		
	Tertiary	12(40)	18(60)		
Level of income	Below 5000 Kshs	8(23.5)	26(76.5)	21.7842	0.0001
	5000-9999 Kshs	14(38.9)	22(61.1)		
	10000-19999 Kshs	11(24.4)	34(75.6)		
	20000-39999 Kshs	26(66.7)	13(33.3)		
	≥40000Kshs	11(55)	9(45)		
Household size	<3 members	28(35.9)	50(64.1)	1.945	0.378
	3-5 members	43(42.6)	58(57.4)		
	≥6 members	9(52.9)	8(47.1)		
OIs: opportunistic infections, X^2: Chi-square test, Kshs: Kenya shillings, p-value: probability value					

Table 3: assessing the history of illness and occurrence of OIs					
Variable name	**description/values**	**OIs**		**X^2**	**P-value**
		No, n(%)	**Yes, n(%)**		
Duration of HIV diagnosis	Below 5 yrs	13(56.5)	10(43.5)	5.38	0.145
	5-9 yrs	22(45.8)	26(54.2)		
	10-15 yrs	25(32.1)	53(67.9)		
	≥15 yrs	20(42.6)	27(57.4)		
Base WHO stage	Stage 1	18(51.4)	17(48.6)	2.48	0.487
	Stage 2	31(41.3)	44(58.7)		
	Stage 3	28(36.4)	49(63.6)		
	Stage 4	3(33.3)	6(66.7)		
ARV type	ABC/3TC/LPVIR	3(50)	3(50)	12.76	0.099
	AZT/3TC/ATVIR	0(0)	5(100)		
	AZT/3TC/NVP	8(34.8)	15(65.2)		
	Others	1(25)	3(75)		
	TDF/3TC/ATVIR	2(50)	2(50)		
	TDF/3TC/DTG	37(48.7)	39(51.3)		
	TDF/3TC/EFV	26(38.2)	42(61.8)		
	TDF/3TC/LPVIR	0(0)	6(100)		
	TDF/3TC/NVP	3(75)	1(25)		
Current CD4count	200-499	4(36.4)	7(63.6)	0.25	1.000
	<200	2(50)	2(50)		
	≥500	9(37.5)	15(62.5)		
Base CD4	200-499 cells	33(43.4)	43(56.6)	0.36	0.834
	<200 cells	23(38.3)	37(61.7)		
	≥500 cells	24(40.7)	35(59.3)		
Treatment duration	Below 5 yrs	15(46.9)	17(53.1)	8.26	0.041
	5-9 yrs	27(50.9)	26(49.1)		
	10-15 yrs	20(27.8)	52(72.2)		
	≥15 yrs	18(46.2)	21(53.8)		

ARV: antiretroviral, CD4: cluster of differentiation cells, OIs: opportunistic infections, 3TC: lamuvidine antiretroviral, EFV: efavirenz antiretroviral, ABC: abacavir antiretroviral, LPVIR: lopinavir/ritonavir antiretroviral, P: probability value, AZT: zidovudine antiretroviral, ATVIR: atazanavir antiretroviral, NVP: nevirapine antiretroviral, TDF: tenofovir disoproxil antiretroviral, DTG: dulotegravir antiretroviral, X^2: chi-square test, WHO: World Health Organisation

Table 4: social practices and occurrence of opportunistic infections		
Variable	**Description/values**	**Frequency, n(%)**
where sought treatment (n=87)	Missing response	2(2.3)
	Private hospital	16(18.39)
	Public hospital	69(79.31)
How fast sought treatment (n=87)	Missing response	4(4.6)
	After a while	27(31.03)
	Immediately	39(44.83)
	When it got worse	17(19.54)
Take alcohol (n=116)	Yes	18(15.52)
Take narcotics (n=116)	Yes	3(2.59)
Use herbal medicine (n=116)	Yes	3(2.59)
Use herbal and ART concurrently (n=116)	Yes	2(1.72)
Use herbal only (n=116)	Yes	1(0.86)
No of sexual partners in last 6 months (n=116)	No response	35(30.17)
	1	52(44.83)
	2-5	6(5.17)
	None	23(19.83)
ART: antiretroviral therapy		

Table 5: multivariable analysis of factors associated with suffering from OIs						
OIs	**Odds Ratio**	**Std. Err.**	**z**	**P>z**	**[95% Conf. Interval**	
Treatment duration (cont)	0.88	0.1402865	-0.8	0.421	0.6435478	1.202459
Household size	0.92	0.1076973	-0.74	0.461	0.7284316	1.154336
Time since diagnosis (cont)	1.23	0.2721914	0.96	0.338	0.8017398	1.902208
Age group (ref: 36-50 yrs)						
18-35	0.31	0.1851835	-1.96	0.05	0.0958171	0.999895
51+	0.29	0.1412224	-2.54	0.011	0.1098377	0.752939
Gender (ref: female)						
Male	2.98	1.661304	1.96	0.05	1.00107	8.886147
Marital status (ref: married)						
Divorced/separated	3.18	2.111921	1.74	0.082	0.863941	11.69004
Single	1.39	0.8430697	0.54	0.589	0.422304	4.564427
Widowed	1.85	1.092717	1.04	0.296	0.582558	5.886705
Income level (ref: 10000-19999 Kshs)						
Below 5000 Kshs	1.14	0.7180956	0.21	0.831	0.3337885	3.915593
5000-9999 Kshs	0.45	0.2568304	-1.4	0.161	0.1453981	1.378161
20000-39999 Kshs	0.11	0.0713027	-3.47	0.001	0.0335415	0.388321
≥40000 Kshs	0.25	0.1634047	-2.13	0.033	0.07121	0.897389
Time in years on treatment (Grouped) (Ref: 10-15 yrs)						
Below 5 yrs	0.06	0.1044795	-1.63	0.103	0.002115	1.755427
5-9 yrs	0.09	0.0958068	-2.24	0.025	0.0105694	0.739487
≥15 yrs	0.30	0.3055733	-1.18	0.237	0.0404899	2.213375
ARV combinations (Ref: TDF/3TC/DTG)						
ABC/3TC/LPVIR	1.78	1.749007	0.59	0.557	0.2595558	12.21068
AZT/3TC/ATVIR	1	(empty)				
AZT/3TC/NVP	1.16	0.7705675	0.22	0.823	0.3155753	4.264668
Others	3.16	4.446464	0.82	0.414	0.2001732	49.85131
TDF/3TC/ATVIR	4.67	7.593247	0.95	0.342	0.1936495	112.834
TDF/3TC/EFV	1.93	1.001621	1.26	0.207	0.6958184	5.337293
TDF/3TC/LPVIR	1	(empty)				
TDF/3TC/NVP	1	(empty)				
OIs: opportunistic infections, EFV: efavirenz antiretroviral, Std. err: standard error, ABC: abacavir antiretroviral, 3TC: lamuvidine antiretroviral, LPVIR: lopinavir/ritonavir antiretroviral, AZT: zidovudine antiretroviral, ATVIR: atazanavir antiretroviral, NVP: nevirapine antiretroviral, TDF: tenofovir disoproxil antiretroviral, P: probability value, z: standard deviation, DTG: Dulotegravir antiretroviral						

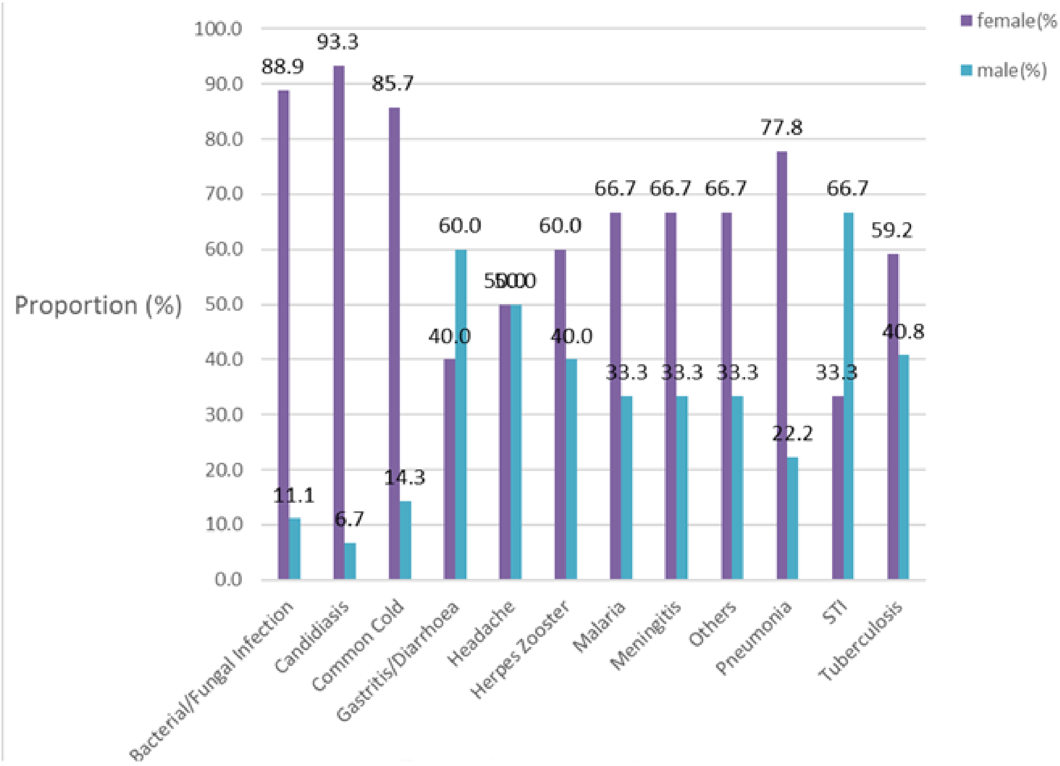

Figure 1: prevalence of opportunistic Infections by sex