HIV Mortality and Associated Factors in Patients Admitted at a Tertiary-care Hospital in Uganda, A Cross-sectional Study

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Research Article

Keywords: HIV, Mortality, Inpatient, Hospitalization, Africa

Posted Date: September 18th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-3273548/v1

Additional Declarations: Competing interest reported. DO, PA, DSN, RK, SW, MM, SK, NK, and CK & FCS receive financial remuneration from CDC/PEPFAR as part of employee remuneration benefits. DO & CK have received remuneration benefits from the Government of Uganda. However, the findings and conclusions in this report are those of the authors and do not represent the official position of PEPFAR or CDC Uganda or the Government of Uganda.

Version of Record: A version of this preprint was published at BMC Infectious Diseases on February 22nd, 2024. See the published version at https://doi.org/10.1186/s12879-024-09112-7.

Abstract

Background: Outcomes for Persons living with HIV (PLHIV) admitted to hospitals in Uganda are relatively unknown. We determined the prevalence of mortality and associated factors in PLHIV admitted at a tertiary-level public hospital in Uganda.

Methods: We used routinely collected data for PLHIV admitted at Kiruddu National Referral Hospital (KNRH) from March 2020 to March 2023 to perform a cross-sectional analysis for mortality (using proportions) and associated factors using a logistic regression model.

Results: Of the 5,827 PLHIV admitted, 3293 (56.51%) were female and the median age was 39 years (interquartile range [IQR] 31-49, range 12-98). CD4+ cell count was documented in 3,715 (63.75%) admitted PLHIV with a median count of 109 cells/μL (IQR 25-343, range 0-1,475). At admission, 3,710 (63.67%) were actively taking their antiretroviral therapy (ART), 1,144 (19.63%) had interrupted ART for more than three months and 973 (16.70%) were not on ART. Functional status impairment (measured using Eastern Cooperative Oncology Group [ECOG] score 3-4) was observed in 2,225 (38.18%) PLHIV.

Overall mortality was 26% (1,524) with a median time-to-death of 3 days (IQR 1-7, range 0-88). Factors associated with mortality included Function impairment odds ratio 7.23 (95%CI 6.31-8.29; undocumented CD4+ cell count 1.53 (95%CI 1.33-1.76, P<0.001); distance >20 Km from hospital 1.21 (95%CI 1.03-1.43, P=0.024); ART interruption 1.34 (95%CI 1.14-1.59; P<0.001); being male 1.16 (95%CI 1.02-1.32, P=0.029); severe malnutrition 1.81 (95%CI 1.51-2.16; P<0.001); COVID19 disease 1.74 (95%CI 1.24-2.43; P=0.001); liver disease 1.75 (95%CI 1.35-2.28; P<0.001); kidney disease 1.64 (95%CI 1.31-2.05; P<0.001); non-opportunistic infections 1.52 (95%CI 1.30-1.77, P<0.001); and anaemia 1.25 (95%CI 1.02-1.54, P=0.034).

Conclusion: One in every four admitted PLHIV died during hospitalization. Early identification and management of associated risk factors such as ART interruption, function impairment, baseline CD4+ tests and screening for non-communicable diseases, may avert poor hospital outcomes.

Introduction

Universal access to antiretroviral therapy (ART) has significantly decreased HIV-associated mortality globally, with close to 29 million people currently on ART and deaths averted by up to 64% (1). In Uganda, a similar trend is observed with over 90% of people living with HIV (PLHIV) initiated on ART. However, despite the improved access to ART for the treatment and prevention of HIV, an estimated 54,0000 new HIV cases and 17,000 HIV-associated deaths are reported annually in Uganda (2).

Mortality among hospitalized PLHIV remains high in several geographical regions in Africa, ranging between 13.6% – 38% (3–8). Several factors have been identified to predict mortality among hospitalised PLHIV such as Malnutrition (9–11); Tuberculosis[TB] (5, 12); low CD4 + cell count (8); Unknown HIV status before admission (13); Anaemia (5, 14); infections and AIDS-defining illnesses (3, 5, 6); and unemployment (15).

Whereas Uganda has made significant strides towards bridging the gap in achieving the UNAIDS 95-95-95 HIV care cascade targets (2), there is a paucity of data on HIV-associated mortality among patients admitted at healthcare facilities. We describe the prevalence of mortality and associated factors among PLHIV admitted at a tertiary-level urban hospital in Kampala, Uganda.

Methods

Study Design and Setting

This was a cross-sectional study conducted at Kiruddu National Referral Hospital (KNRH), a public tertiary-level hospital located in Makindye Division, one of the administrative zones of Uganda's Capital City, Kampala. The 200-bed capacity hospital was gazetted by the Uganda Ministry of Health in 2016 to provide medical and surgical-related health services including HIV care and treatment to the adult population (aged 15 years and older). Being a national referral hospital, the hospital receives a high volume of patients with approximately 30,000 outpatient visits and 10,000 in-patient admissions annually. Services offered at the KNRH include medical sub-specialities (in-patient and outpatient) including renal replacement therapy, general surgery, burns

and reconstructive surgery, as well as laboratory, radiologic diagnostic services, and pharmacy services. The institution is also a teaching and research centre (16).

In March 2020, with funding from CDC/PEPFAR, KNRH partnered with Makerere University Joint AIDS Program (MJAP), to establish a support program that extended comprehensive HIV services for PLHIV admitted at KNRH with an overall goal to reduce HIV-associated mortality as well as building the capacity for health workers in managing advanced HIV disease through training and mentorship (17). The services provided under the support program included HIV testing and counselling at the Emergency department, financial aid to support paid-for diagnostic tests, strengthening the screening and treatment of OIs and comorbidities through capacity-building initiatives (e.g. staff training, quality improvement initiatives and logistic support to the laboratory), and post-discharge counselling and follow-up services for at least one month.

Study Population

The study population comprised patients aged ≥ 15 years who tested positive or were aware of their HIV status during their hospital admission in the period between March 2020 and March 2023.

Study Procedure

At the admission point (emergency room), patients were screened and offered bedside HIV testing and counselling services by a trained nurse counsellor, following the National HIV testing algorithms (18). *Those* who were identified as “HIV-positive” during pre-testing screening assessments were offered a CD4 cell count test using the Point of Care *BD FACSPresto (USA)* or *PIMA CD4 (Abbott, USA)* machines.

Patients with low CD4 + cell count (below 200 cells/μL) are screened for Tuberculosis (TB) using the urine lateral flow lipoarabinomannan antigen test (*Abbott Determine TB LAM Ag*) or additional diagnostic tests such as molecular DNA tests (GeneXpert), Microscopy or Radiologic tests as determined by the attending physician and local guidelines. Screening for Cryptococcal disease using lateral flow Cryptococcal Antigen test (*CRAG LFA, USA*) for serum or cerebrospinal fluid (CSF) samples was also done. Patients who tested positive for TB or Cryptococcal disease were initiated on treatment for the respective opportunistic infection (OI) with the deference of ART initiation/re-initiation by 2–6 weeks as per the local guidelines (18). All patients were also screened and treated for concurrent comorbidities depending on the assessment by the attending physicians. Where indicated, a viral load test was performed for monitoring patients who are active on ART and eligible for the test according to the local guidelines (18).

The patients’ ART status was documented as "Active on ART” if consistent taking ART medication in the past three months was reported. Patients who interrupted ART medication for ≥ three months were documented as “Interrupted ART” while patients who were not on ART were documented as “ART Naïve”. Patients who were ART Naïve or who interrupted their ART received trimethoprim-sulfamethoxazole prophylaxis and were counselled for ART initiation/re-initiation following the exclusion of important OIs. ART initiation was deferred in scenarios of ongoing treatment for OIs or contraindications (e.g. drug toxicity), to be started later during hospitalization or in the post-discharge period.

A nurse was assigned to follow up with patients during their admission up until discharge. During this time, additional information relating to the patient's HIV care and treatment was collected and entered into an improvised register. Data collected included demographic information, diagnoses and treatment of comorbidities and OIs, ART status and CD4 cell count, Function assessment (measured using the Eastern Cooperative Oncology Group (ECOG) score), ART initiation/re-initiation, Viral load results, nutrition assessment, psychosocial factors impeding adherence, date, final diagnosis and outcome of the patient at the time of discharge, and telephone contacts to enable post-discharge follow-ups via telephone calls. Functional assessment was performed using ECOG because of its easy-to-use functionality and ability to predict mortality in other non-oncologic illnesses (19). ECOG scores of 3–4 were categorized as “poor function scores”.

OIs were classified as *Tuberculosis* (whether new diagnosis or already on anti-TB treatment before admission), *Cryptococcal disease* (meningitis + non-meningeal forms), *Candidiasis* (oral + oesophagal), *Toxoplasmosis* and *Kaposi sarcoma.* Comorbidities were grouped and classified into broad categories of *non-opportunistic infections* (when tuberculosis, Cryptococcal disease, toxoplasmosis, and candidiasis were excluded), *cardiovascular disease* [comprising hypertension, heart

disease, heart failure and strokes (20)*], diabetes mellitus, kidney disease* (acute and chronic kidney disease), *liver disease* (acute or chronic liver disease, liver injury or failure), *mental illness* (defined as neurologic or psychiatric disorders e.g. depression, epilepsy, seizure disorders (20)), *anemia* (defined as hemoglobin concentration below 129g/L in men > 15 years of age or 119g/L in women > 15 years of age and adolescents aged 12–14 years; (21)), *chronic lung disease* (comprising asthma, chronic obstructive pulmonary disease, Interstitial lung disease or other respiratory illnesses, excluding tuberculosis), *COVID19 (*confirmed by polymerase chain reaction test or rapid antigen diagnostic tests) and *cancer* (any oncologic diagnosis excluding Kaposi sarcoma).

Patient outcome at discharge was categorized as *Discharged* (when the patient was alive at the time of release from the hospital) or *Died* (when the patient outcome was death). Patients who self-discharged against medical advice or were transferred to other health facilities for specialized care were also classified as *discharged*.

Sampling Methods

All identified PLHIV who were admitted at KNRH between March 2020 and March 2023 were included in the study.

Data Collection

Routinely collected data were extracted from the paper-based register and entered into an Excel workbook. The independent variables included patient demographics and clinical data such as HIV status at admission, CD4 cell count, ART status at admission, OIs, comorbidities, and final diagnoses at discharge. The dependent variable was the patient outcome at the time of discharge. Data were de-identified and analysed anonymously to protect patient's privacy.

Statistical Analysis

The primary outcome, mortality, was determined as the proportion of deaths over total admissions. Univariate analysis was performed to summarize the baseline characteristics of the study participants.

Both bivariate and multivariable analyses were done using the binary response variable of death (1) versus survival (0). Using the Pearson chi-square test, a bivariate analysis was performed to determine the association between mortality at discharge and patient baseline characteristics, OIs and comorbidities. Variables used in bivariate analysis with a p-value greater than an arbitrary value of 0.25 were excluded from the multivariable analysis.

Adjusted odds ratios from a multivariable binary logistic regression model were used to determine factors associated with HIV inpatient mortality at a 5% significance level. Two-sided P-values < 0.05 were considered statistically significant. The Likelihood Ratio chi-square test was used to assess overall model significance at a 5% significance level. Overall, the regression model was statistically significant ($p < 0.001$) using the likelihood ratio chi-square test. Data analysis was done using Stata/MP 14 (StataCorp LLC, Texas, USA).

Ethical Approval

Ethical approval for the study, including a waiver for informed consent to review secondary data, was obtained from The Infectious Diseases Institute Research Ethics Committee under Reference IRB00011353. A waiver of consent was sought since routinely collected secondary data was used and no anticipated harm was inflicted on the patients.

Results

Baseline Characteristics

A total of 30,537 persons were admitted at Kiruddu National Referral Hospital from March 2020 to March 2023. Of these, 5827 (19.1%) were identified as PLHIV with 3,293 (56.5%) females. The median age of admitted PLHIV was 39 years (IQR 31-49 years), and the median duration of hospitalization was 5 days (IQR 2-10 days). CD4+ cell count was documented in 3,715 (63.8%), median CD4+ cell count of 109 cells/µl (IQR 25 – 343 cells/µl). A total of 2,271 (39%) had advanced HIV disease (CD4+ cell counts below 200 cells/µL).

A total of 4,854 (83.3%) PLHIV had initiated ART before admission of which 3,710 (63.7%) were active on their treatment while 1,144 (19.6%) had interrupted ART longer than three months; 973 (16.7%) were ART naïve. Poor function assessment (ECOG score 3-4) was observed in 2,225 (38.2%) admitted PLHIV. Table 1 summarizes the baseline characteristics of the patients at admission.

Opportunistic Infections and Comorbidities

A total of 3,198 (54.9%) PLHIV were diagnosed with an opportunistic infection (OI), while 4,495 (77.1%) were diagnosed with comorbidities. These diagnoses were not mutually exclusive as 2,169 (37.22%) were diagnosed with both an OI and comorbidity while 1,029 (17.7%) were diagnosed with only an OI and 2,326 (39.9%) were diagnosed with a comorbidity.

The common OIs comprised Tuberculosis (1954, 33.5%), Cryptococcal disease (739, 12.7%) and Candidiasis (443, 7.6%) while the common comorbidities comprised non-opportunistic infections (1,367, 23.46%), cardiovascular disease (975, 16.7%), severe malnutrition (807, 13.9%) and anaemia (646, 11.1%). Fifty per cent (2914) of the comorbidities were non-communicable diseases. Final diagnoses could not be determined in 303 (5.2%) of the admitted PLHIV (Table 1).

HIV Mortality

A total of 4,303 (73.85%) were discharged from the hospital with a median duration of hospitalization of 6 days (IQR 3-11 days), while 1,524 (26.15%) died with a median time to death of 3 days (IQR 1-7 days).

Factors Associated with HIV Mortality

At multivariate analysis, factors that were associated with mortality comprised: ART interruption (OR 1.34, 95%CI 1.14-1.59, P=0.001); Severe Malnutrition (OR 1.81, 95%CI 1.51-2.16, P<0.001); Kidney disease (OR 1.64, 95%CI 1.31-2.05, P<0.001); Liver disease (OR 1.75, 95%CI 1.35-2.28, P<0.001); non-opportunistic infections (OR 1.52, 95%CI 1.30-1.77, P<0.001); COVID-19 disease (OR 1.74, 95%CI 1.24-2.43, P=0.001); Function Impairment ECOG score 3-4 (OR 7.23, 95%CI 6.31-8.29, P<0.001); Male sex (OR 1.16, 95%CI 1.02-1.32, P=0.029); Anaemia (OR 1.25, 95%CI 1.02-1.54, P=0.034), Undocumented CD4+cell count (OR 1.53, 95%CI 1.33-1.76, P<0.001); Distance > 20KM from hospital (OR 1.21, 95%CI 1.03-1.43, P<0.024) and Mental illness (OR 0.50, 95%CI 0.34-0.74, P<0.001) (Table 2).

Discussion

In this study, we sought to determine the survival outcomes of PLHIV who were hospitalized in Uganda and factors that predicted mortality. We found that one in every four PLHIV died during hospitalization. These findings reveal that HIV-associated mortality remains relatively high with up to one in four admitted PLHIV dying from HIV-associated complications. These findings generally agree with studies conducted in different African settings where mortality amongst hospitalized PLHIV ranges between 13.6 – 38% (3–6,8,22,23). The majority of the deaths in our study occurred in less than one week of hospitalization (median time to death 3 days, IQR 1-7), which agrees with a similar study conducted in Sierra Leone (5). We observed that male PLHIV were 16% times more likely to die despite being comparatively fewer than the females. The poor hospital outcomes observed in male PLHIV could be attributable to poor health-seeking behaviours (24), late presentation (25) and ART interruption (26).

In this study, we observed that close to two-fifths of the admitted PLHIV were not on ART (both ART Naïve and those who interrupted ART longer than three months) at the time of hospitalization. These statistics fall short of the 95-95-95 HIV care cascade targets (27) and are unfortunately associated with poorer hospital outcomes. We observed that PLHIV who interrupted antiretroviral treatment (ART) were 34% more likely to die compared to those who were active on ART. The Ugandan Ministry of Health defines ART Interruption as a PLHIV who disengages from HIV care for more than 3 months (*Lost-to-Follow-up)* (28). Community-based studies reveal that between 12 – 27.2% of PLHIV disengage from care and are at a higher risk of dying (10,15,29–31). Thus, strengthening and optimizing Retention-in-care for PLHIV on ART could be an important intervention in reducing HIV-associated mortality.

A significant number of hospitalized PLHIV (38%) in our study had poor functional status assessment scores, findings which suggest the high burden of morbidity associated with HIV disease despite the widespread availability of ART in the current era of "Test-and-Treat". Functional Impairment demonstrated the strongest correlation with HIV-associated mortality with odds of 7.23, findings which generally agree with other similar studies (32,33). Multiple factors could explain the high prevalence of function impairment among hospitalized PLHIV, such as the high burden of OIs (55%) and comorbidities (77%) or absence of ART (36%) observed in our study. Some studies suggest that delayed diagnosis and initiation of ART could also potentially increase disease morbidity and function impairment (34,35). The interaction between all these factors appears to be complex and was beyond the scope of this study. However, we believe that assessing functional status among hospitalized PLHIV could be an important predictor of mortality, necessitating rapid interventions such as early referrals to specialized care.

Screening for CD4 cell count is integral to the optimal management of advanced HIV disease (18,36). Whereas several studies demonstrate an increased risk of mortality among PLHIV with low CD4 cell counts below 200 cells/μL (37–41), we observed that undocumented CD4 screening was associated with HIV mortality among hospitalized PLHIV in our study. This correlation between non-screening for CD4 and HIV mortality could probably be attributed to the missed opportunities to screen and diagnose important OIs which could have contributed to in-hospital deaths. A recent national survey found suboptimal levels of CD4 testing among PLHIV, which translated into a missed opportunity to screen 80% of potential TB and Cryptococcal disease cases (42). Thus, strengthening CD4 screening among hospitalized PLHIV could improve screening for OIs and potentially avert poor hospital outcomes.

Our study showed a growing burden of non-communicable diseases (NCDs) in the hospitalized PLHIV population, with half of our study population being diagnosed with an NCD. Of these, Malnutrition, Kidney disease, Liver disease and Anaemia were significantly associated with poor survival outcomes following hospitalization. Several studies have reported similar correlations between HIV mortality and associated comorbidities such as malnutrition (9–11), anaemia (5,11,14), Kidney disease (43) and Liver disease (44). The growing burden of non-communicable diseases in African HIV subpopulations suggests the need to strengthen existing health systems to respond to the dual burden of non-communicable diseases and OIs in HIV subpopulations across Uganda and Africa (5,11,52,53,44–51). Health system bottlenecks such as limited access to intensive care support (54), organ support therapy such as renal replacement therapy (55), respiratory support and ventilation (56) or blood transfusion (57) could potentially impede optimal care for hospitalized PLHIV who are diagnosed with comorbidities and related complications. Long distance to the hospital could be another limiting factor, as observed in our study where PLHIV who lived >20km from the hospital had a 21% higher risk of mortality compared to those who stayed <10km from the hospital.

Infections such as COVID-19 and non-opportunistic infections (e.g. severe bacterial infections) were also associated with an increased risk of mortality in our study population. COVID-19 was associated with a 74% higher risk of mortality, which agreed with a large South African study involving over 3000 PLHIV admitted with COVID-19 infection where the risk of mortality was 2.14 (58). Non-opportunistic infections were also associated with a 52% higher risk of mortality in our study population, findings which were supported by other studies of similar contexts (5,6). However, we found that OIs such as Tuberculosis and Cryptococcal disease, which were highly prevalent in our study population at 34% and 13% respectively, were not statistically associated with mortality in our study despite being known predictors of mortality among hospitalized HIV patients (3,5–7,12,32,59–62). One plausible explanation might be due to the declining incidence of OIs in the "test-and-treat" era (4,7) possibly decreasing the impact on mortality. Another reason might be due to the widespread availability of rapid diagnostics such as the lateral flow antigen tests (e.g. Urine LAM, CRAG) which results in early diagnosis and treatment of these infections thus improving survival outcomes (63,64). Indeed, PLHIV who were diagnosed with Cryptococcal disease in our study had reduced odds of death, supporting the hypothesis that early detection and treatment of OIs avert mortality. This justifies the need to strengthen the screening and treatment of such OIs to improve hospital outcomes.

To the best of our knowledge, this is the largest study that characterizes outcomes of PLHIV hospitalized in Uganda. Our study informs of shortfalls in the HIV 95-95-95 care cascade targets and highlights the growing impact of HIV-associated comorbidities on patient survival following hospitalization. However, we observed and acknowledge a few limitations associated with our study. One was the lack of autopsy reports to confirm the causes of death among the patients. In our study, the cause of death was inferred from the final diagnoses made by the attending physicians based on the available test results. Autopsies are not

routinely done at the hospital due to multiple reasons including refusal by family members (65,66). As a result of no autopsies performed, some important diagnoses including TB are likely to have been missed(67). Being a single-site study, the findings may not be readily generalizable to other community-based study settings. Being a tertiary-level healthcare facility, the findings were likely skewed towards patients who required specialist services, not reflecting the majority who access their HIV care and treatment from primary-level health facilities. Nonetheless, the findings of this study highlight important health system indicators that could impact survival among hospitalized PLHIV.

Conclusion

HIV-associated mortality remains high in hospitalized PLHIV with one in every four at risk of dying from related complications. Identifying and addressing important risk factors such as Male PLHIV, ART interruption, CD4 screening, Function Assessment, Infections and Non-communicable diseases could improve the outcomes of hospitalized PLHIV.

Abbreviations

KNRH
Kiruddu National Referral Hospital
MJAP
Makerere University Joint AIDS Program
CDC
Center for Disease Control and Prevention
PEPFAR
President's Emergency Plan for AIDS Relief
PLHIV
Persons Living with HIV
ART
Antiretroviral therapy.

Declarations

Ethical Approval

Ethical approval for the study, including a waiver for informed consent to review secondary data, was obtained from The *Infectious Diseases Institute* Research Ethics Committee under Reference IRB00011353. A waiver of consent was sought since routinely collected secondary data was used and no anticipated harm was inflicted on the patients.

Consent for Publication

Not Applicable

Availability of Data and Materials

The datasets generated and/or analysed during the current study are not publicly available due to the privacy and confidentiality of hospital records but are available from the corresponding author on reasonable request.

Competing Interests

The authors DO, PA, DSN, RK, SW, MM, SK, NK, and CK & FCS receive financial remuneration from CDC/PEPFAR as part of employee remuneration benefits. DO & CK have received remuneration benefits from the Government of Uganda. However, the findings and conclusions in this report are those of the authors and do not represent the official position of PEPFAR or CDC Uganda or the Government of Uganda.

Funding

This research has been supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centre for Diseases Control and Prevention, under the terms of GH002022.

Authors Contributions

DO, DSN, MM, CK & FCS conceptualized the project. DO, DSN & PA implemented the project and collected the data. DO & PA analysed the data. RK, SW, MM, SK, CK, NK & FCS supervised the implementation of the project. All authors were major contributors to writing the manuscript. All authors read and approved the final manuscript.

Acknowledgements

Sincere appreciation is extended to the administration and staff of Kiruddu National Referral Hospital (KNRH[1]) for striving hard to improve the outcomes of the admitted patients at the hospital. Special recognition is extended to the staff of Makerere University Joint AIDS Program (MJAP[2]) for the efforts to build capacity in the management of HIV disease at the hospital. We appreciate the efforts of Atine Edgar, Namugenyi Christabellah, Nabatanzi Cecilia, Kasirye Esther, Kakande Amina, Kabira Deborah, and Adong Florence among others in supporting the program.

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Tables

Table 1

Baseline Characteristics for HIV + Patients admitted at KNRH (March 2020 – March 2023)

Variable	Survivors (N = 4,303)	Died (N = 1,524)	Total (N= 5,827)	P-value
Median Age (IQR)	39(31–48)	40(31–50)	39 (31–49)	0.677
Age group (years) (%)				
<24	333 (7.74)	101 (6.63)	434 (7.45)	
25–49	2,976 (69.16)	1,029 (67.52)	4,005 (68.73)	0.272
≥50	994 (23.10)	394 (25.85)	1,388 (23.82)	0.037
Gender				
Female	2,483 (57.70)	810 (53.15)	3,293 (56.51)	
Male	1,820 (42.30)	714 (46.85)	2,534 (43.49)	0.002
Address				
Distance < 10km from the hospital	1,720 (39.97)	550 (36.09)	2,270 (38.96)	
Distance 10-20km from the hospital	1,550 (36.02)	537 (35.24)	2,087 (35.82)	0.968
Distance > 20km from the hospital	1,033 (24.01)	437 (28.67)	1,470 (25.23)	0.024
Admission status				
New admission	3,790 (88.08)	1,390 (91.21)	5,180 (88.90)	
Readmission	513 (11.92)	134 (8.79)	647 (11.1)	0.001
ART Status at Admission				
Active on ART	2,824 (65.63)	886 (58.14)	3,710 (63.67)	
ART Naïve	717 (16.66)	256 (16.80)	973 (16.70)	0.116
ART Interruption	762 (17.71)	382 (25.07)	1,144 (19.63)	< 0.001
Median duration of Hospitalisation (IQR)	6 (3–11)	3 (1–7)	5 (2–10)	< 0.001
Median Viral Load (n = 216)	50 (0–13,900)	95(0-119,000)	50(0–28,290)	0.801
Median CD4 cell count (µL, IQR)	133 (30–380)	57 (16–197)	109 (25–343)	< 0.001
CD4 cell count category (n = 3,715)				
<200	1,624 (57.73)	647 (71.73)	2,271 (61.13)	
201–499	732 (26.02)	182 (20.18)	914 (24.60)	< 0.001
500–999	411 (14.61)	61 (6.76)	472 (12.71)	< 0.001
1000+	46 (1.64)	12 (1.33)	58 (1.56)	0.311
CD4 Documentation Status				
Documented	2,813 (65.37)	902 (59.19)	3,715 (63.75)	
Not Documented	1,490 (34.63)	622 (40.81)	2,112 (36.25)	< 0.001
Function Assessment				
ECOG Score 1–2	3,175 (73.79)	427 (28.02)	3,602 (61.82)	

Variable	Survivors (N = 4,303)	Died (N = 1,524)	Total (N= 5,827)	P-value
ECOG Score 3–4	1,128 (26.21)	1,097 (71.98)	2,225 (38.18)	< 0.001
Diagnosis Categorization				
Opportunistic Infection (O.I) only	803 (18.66)	226 (14.83)	1,029 (17.66)	
Comorbidity only	1,763 (40.97)	563 (36.94)	2,326 (39.92)	
Both O.I & Comorbidity	1,518 (35.28)	651 (42.72)	2,169 (37.22)	
Diagnosis Undetermined	219 (5.09)	84 (5.51)	303 (5.20)	
Opportunistic Infections (O.I.)				
Tuberculosis	1,429 (33.21)	525 (34.45)	1,954 (33.53)	0.378
Cryptococcal Disease	558 (12.97)	181 (11.88)	739 (12.68)	0.272
Toxoplasmosis	102 (2.37)	40 (2.62)	142 (2.44)	0.580
Candidiasis	331 (7.69)	112 (7.35)	443 (7.60)	0.664
Kaposi Sarcoma	91 (2.11)	33 (2.17)	124 (2.13)	0.906
Comorbidities				
Non-Opportunistic Infections	910 (21.15)	457 (29.99)	1,367 (23.46)	< 0.001
Cardiovascular disease	757 (17.59)	218 (14.30)	975 (16.73)	0.003
Severe Malnutrition	475 (11.04)	332 (21.78)	807 (13.85)	< 0.001
Anaemia	454 (10.55)	192 (12.60)	646 (11.09)	0.029
Kidney Disease	338 (7.85)	176 (11.55)	514 (8.82)	< 0.001
Diabetes Mellitus	304 (7.06)	86 (5.64)	390 (6.69)	0.057
Liver Disease	214 (4.97)	124 (8.14)	338 (5.80)	< 0.001
COVID19 Disease	114 (2.65)	77 (5.05)	191 (3.28)	< 0.001
Mental Illness	191 (4.44)	38 (2.49)	229 (3.93)	0.001
Lung Disease	148 (4.04)	37 (2.86)	185 (3.73)	0.056
Cancer	108 (2.51)	39 (2.56)	147 (2.52)	0.916
ART - Antiretroviral therapy; ECOG - Eastern Cooperative Oncology Group; IQR – Inter quartile range				

Table 2
Multivariate analysis for predictors of HIV Mortality in Patients Admitted at KNRH

Variable	Unadjusted OR (95% CI)	P-value	Adjusted OR (95%CI)	P-value
Gender				
Female	Ref		Ref	
Male	1.20 (1.07–1.35)	0.002	1.16 (1.02–1.32)	0.029
Address				
Distance < 10km from hospital	Ref		Ref	
Distance 10-20km from hospital	1.08 (0.94–1.24)	0.253	1.00 (0.86–1.17)	0.968
Distance > 20km from hospital	1.32 (1.14–1.53)	< 0.001	1.21 (1.03–1.43)	0.024
Admission Status				
New	Ref		Ref	
Readmission	0.71 (0.58–0.87)	0.001	0.66 (0.53–0.83)	< 0.001
ART Status at Admission				
Active on ART	Ref		Ref	
ART Naïve	1.14 (0.97–1.34)	0.116	1.10 (0.91–1.32)	0.32
ART Interruption	1.60 (1.38–1.85)	< 0.001	1.34 (1.14–1.59)	0.001
CD4 Documentation status				
Documented	Ref		Ref	
Not Documented	1.30 (1.15–1.47)	< 0.001	1.53 (1.33–1.76)	< 0.001
Function Assessment				
ECOG Score 1–2	Ref		Ref	
ECOG Score 3–4	7.23 (6.34–8.24)	< 0.001	7.23 (6.31–8.29)	< 0.001
Opportunistic Infections				
Tuberculosis	1.06 (0.93–1.20)	0.378	0.96 (0.83–1.12)	0.606
Cryptococcal Disease	0.90 (076–1.08)	0.272	0.81 (0.66–0.99)	0.045
Comorbidities				
Severe Malnutrition	2.24 (1.92–2.62)	< 0.001	1.81 (1.51–2.16)	< 0.001
COVID19	1.96 (1.46–2.63)	< 0.001	1.74 (1.24–2.43)	< 0.001
Liver disease	1.69 (1.35–2.13)	< 0.001	1.75 (1.35–2.28)	< 0.001
Kidney disease	1.53 (1.26–1.86)	< 0.001	1.64 (1.31–2.05)	< 0.001
Non-Opportunistic Infections	1.60 (1.40–1.82)	< 0.001	1.52 (1.30–1.77)	< 0.001
Anaemia	1.22 (1.02–1.46)	0.029	1.25 (1.02–1.54)	0.034
Mental illness	0.55 (0.39–0.78)	0.001	0.50 (0.34–0.74)	< 0.001
Cardiovascular disease	0.78 (0.66–0.92)	0.003	0.83 (0.68–1.01)	0.061

Variable	Unadjusted OR (95% CI)	P-value	Adjusted OR (95%CI)	P-value
Gender				

OR: Odds Ratio; CI: Confidence Intervals; ART: Antiretroviral therapy; ECOG: Eastern Cooperative Oncology Group