# CLINICAL OUTCOMES OF THE "*TEST AND START*" ANTI-RETROVIRAL THERAPY PROGRAMME AMONG PEOPLE LIVING WITH HIV IN MOMBASA, KILIFI AND KWALE COUNTIES IN COASTAL KENYA

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# Clinical Outcomes of the *"Test and start"* Anti-retroviral Therapy Programme among People Living with HIV in Mombasa, Kilifi and Kwale Counties in Coastal Kenya

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**A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Public Health of the Jomo Kenyatta University of Agriculture and Technology**

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## DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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This thesis has been submitted for examination with our approval as university supervisors:

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## DEDICATION

I dedicate this thesis to God for giving me life, the strength and opportunity to pursue postgraduate studies. I am also dedicating this thesis to my beloved wife Faith for the support and encouragement she gave me in this journey, and my children, Chellah and Fanuel for being a source of hope and inspiration for me to work hard. Also, to my parents, whose prayers and unwavering dedication have been my pillars of strength.

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| **aHR** | Adjusted hazard ratio |
| **AIDS** | Acquired immune deficiency syndrome |
| **ART** | Antiretroviral therapy |
| **ARVs** | Antiretroviral Drugs |
| **BMI** | Body mass index |
| **CD4** | Cluster of differentiation antigen 4 |
| **CHMT** | County Health Management Team |
| **DALYs** | Disability adjusted life years |
| **EID** | Early infant diagnosis |
| **ERC** | Ethical Review Committee |
| **HAART** | Highly active anti-retroviral therapy |
| **HIV** | Human immunodeficiency virus |
| **HIV-RNA** | Human immune virus -Ribonucleic Acid |
| **IQR** | Inter quartile range |
| **HR** | Hazard ratio |
| **KAIS** | Kenya AIDS Indicator Survey |
| **LTFU** | Lost to follow up |

| | |
|---|---|
| **NASCOP** | National AIDS & STI Control Program |
| **PEPFAR** | United States President's Emergency Plan for AIDS Relief |
| **PHDP** | Positive Health, Dignity & Prevention |
| **PLHIV** | People living with HIV |
| **PMTCT** | Prevention of mother to child transmission of HIV |
| **P-value** | Probability value |
| **UNAIDS** | Joint United Nations Programme on HIV/AIDS |
| **V**L | Viral load |
| **WHO** | World Health Organization |

## ABSTRACT

In 2016, Kenya adopted the universal testing and treatment of people living with HIV in line with WHO recommendations and as a fast track to achieving the UNAIDS 2030 target of 95:95:95. This "Test and start" program has been implemented for six years with little literature on its implementation challenges at the individual level and clinical outcomes, especially comparing to the previous period before "Test and start". This study compared the survivorship and viral load suppression among PLHIV who started ART in the period before "Test and start" and after "Test and start "and also determined the factors associated with survivorship among PLHIV. A retrospective cohort study design was used to study PLHIV aged more than 15 years and started on ART in the periods of April to August 2016, and April to August 2017, then followed up for 24 months. Primary outcomes were death or loss to follow up. Kaplan–Meier survival methods were used to describe time to primary outcome. Cox proportional regression analysis was used to determine features associated with poor clinical outcomes. In this study, 786 patients (470 pre "Test and start" ", and 316 in the "Test and start" cohorts) were enrolled. At 24 months after recruitment, retention rates for the pre and after "Test and start" groups were similar at 68% and 64% respectively (absolute difference: -4.0%, 95%CI -11-3.1, P=0.27). In multivariable regression model, the "Test and start" group showed no significant effect on risk of poor outcomes (aHR=1.17, 95% CI=0.89-1.54). Of the 240 with poor outcomes, 102 out of 316 (32%) and 138 out of 470 (29%) occurred among the "Test and start" group and pre "Test and start" patients respectively. Increasing age (aHR=0.98, 95% CI =0.97−0.99), formal employment (aHR=0.42, 95%CI=0.23- 0.76) and not being employed (aHR=0.53, 95% CI=0.34-0.81) were associated with lower risk of poor outcomes. The risk of poor outcomes was higher among males compared to female patients (aHR=1.37, 95%CI=1.03−1.82), and among divorced/separated patients compared to the married (aHR= 1.44, 95%CI= 1.04−1.99). Among 274 patients with a viral load reading at month 6 after starting ART, 15 (9.9%) were unsuppressed (VL≥1000 copies /ml) in the pre "Test and start" group while 12 (9.8%) were unsuppressed in the after "Test and start" group. The proportion of viral load suppression was not significantly different (P=0.95) in the two cohorts with similar findings found at 12 and 24 months. The viral load suppression rates, retention and attrition patterns for the "Test and start" cohort was comparable to those started on ART before "Test and start". Patients who are males, young, divorced/separated, with poor socio-economic status had higher risks for poor clinical outcomes. Therefore, the "Test and start" program is as effective as the previous policy in clinical outcomes and should be continued as the early ART treatment averts severe morbidity and mortality as outlined in previous studies.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background Information

Significant progress has been made in the fight against HIV/AIDS with over 21.7 million people living with HIV (PLHIV) being on Anti-Retroviral Therapy (ART) out of the 36.9 million People Living with HIV globally (UNAIDS, 2018). Majority of the People Living with HIV are in Eastern and Southern Africa accounting for 53% (19.6 million) of the global burden, with about 1.5 million being Kenyans (National AIDS Control Council-NACC, 2018). Among 19.6 million PLHIV in Eastern and Southern Africa at the end of 2017, 81% [64–95%] were aware of their HIV status; about 12.9 million (66%) PLHIV in the region were accessing antiretroviral therapy, and the estimated percentage of PLHIV who achieved viral suppression was 52% in 2017 in the region and 56-60% in Kenya (UNAIDS, 2018).

The uptake of ART accelerated in the recent six years due to increased access to ART as a result of the World Health Organization (WHO) guideline released in 2015 (World Health Organization, 2015) to countries for treatment of all HIV infected people with Highly Active Anti-Retroviral drugs (HAART) irrespective of their $CD_4$+ levels or WHO stage. Kenya adopted the guidelines in July 2016 with a campaign conducted to initiate ART to all the PLHIV who were in care but not started on ART (Ministry of Health - MoH, 2016). The coastal counties began implementing the guidelines after September 2016 after relevant capacity building of health care workers was done and adequate commodities made available. By March of 2017, all the clients in Mombasa, Kilifi and Kwale Counties who were on care had been started on ART. Newly identified PLHIV were immediately started on ART as per the new guidelines as soon as they were identified and adequately prepared to continue with treatment. The new guideline was famously referred to as the “Test and start”. Prior to the “Test and start”, the National AIDS and STI Control Program(NASCOP) guidelines of 2014 (NASCOP, 2014) were

in use which required only PLHIV who met one or more of the following criteria to be started on ART: pregnant or breastfeeding women, children below 10 years, people with $CD_4$ <500 cells/ml, WHO stage 3 or 4, TB/HIV co-infection and Hepatitis B co-infection. PLHIV who did not meet the above criteria were enrolled in HIV care and support programs. The package of services for these clients included Positive Health, Dignity and Prevention (PHDP), screening for and treatment for opportunistic infections, prophylaxis for opportunistic infections, screening and treatment for non-communicable diseases, screening for mental health conditions and nutritional services. With the "Test and start" ", all PLHIV are offered the above package including anti-retroviral therapy (ART).

Evidence from various studies support the provision of ART to all PLHIV which prolongs and improves the quality of life among PLHIV, as well as reducing transmission of HIV from those infected to their HIV negative partners. In the U.S.A and Canada, a study done between 2000 and 2007 among 22,937 PLHIV aged above 20 years on ART, contributing to 82,022 person years and 1622 deaths, reached a conclusion that "a 20-year-old HIV-positive adult on ART is expected to live into their early 70s, a life expectancy approaching that of the general population (Samji *et al.*, 2013). Based on scientific evidence that was available then, a mathematical model by Granich *et al.,(*2009) on universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission, showed that immediate ART for those identified as HIV positive would reduce HIV associated mortality to less than 1 case per 1000 and reduce HIV prevalence to less than 1% from the high of almost 5% in most Sub-Saharan Africa countries in 2009. A prospective cohort study by Donell *et al.*, (2010), with 3,381 African sero-discordant couples followed up for a period of 24 months, showed a 92% reduction in transmission rates in the group who were on ART compared to those who were not on ART with transmission rates of 0·37 per 100 person-years and 2·24 per 100 person-years respectively. In Uganda, a study by Reynolds *et al.*, (2011), showed that zero HIV transmission occurred among 32 sero-discordant couples in which the HIV-1 index partners started ART followed up for 53.6

person-years. These studies promoted the argument of using HAART as prevention to end the HIV epidemic.

The TEMPRANO ANRS 12136 study ("A Trial of Early Antiretrovirals and Isoniazid Preventive Therapy in Africa," 2015) and the Strategic Timing of Antiretroviral Treatment (START) study; Solomon, *et al.*, 2008) provided further important evidence to support universal ART by demonstrating better clinical outcomes in HIV asymptomatic patients who start ART at an early stage of their disease, when $CD_4$+ cell counts are above 500 cells per cubic millimeter. The two studies had viral suppression rates of >80%, with reduced incidence of Tuberculosis and other opportunistic infections, and significant lowering of the risk of death. These two cohort studies supported the provision of ART to all PLHIV because of the benefits to the PLHIV, and not just for reducing transmission of HIV. With the adoption of the "Test and start", new evidence was thus needed on its implementation successes, challenges and the individual factors that are associated with attrition and viral load suppression.

This study evaluated the effectiveness of the "Test and start" program in eighteen (18) facilities spread across three (3) coastal counties (Mombasa, Kilifi, and Kwale of Kenya, and provides evidence on implementation success, clinical outcomes and factors associated with attrition and viral load suppression.

### 1.2 Statement of the problem

HIV was the 2nd leading cause of Disability adjusted life years (DALYs) globally in 2019 after road injuries accounting for 4.8% of all DALYs (Abbafati *et al.*, 2020). PLHIV started on ART immediately after being diagnosed to be HIV infected have minimal time to go through the grieving cycle to accept their condition and develop coping mechanisms before they are started on ART. The immediate ART treatment does not give them adequate time to develop social support systems to support their adherence to clinical appointments, taking of drugs or making necessary lifestyle adjustments to allow them take their drugs on time (Horter *et al.*, 2017a). While

treatment preparation counseling is done just like it was before "Test and start" period, the lack of adequate time to grieve, develop support systems and lifestyle adjustments could have a negative impact on adherence to ART and clinical appointments, consequently leading to poor retention patterns, as well as clinical outcomes including viral load suppression (Farouki *et al.*, 2016; Domercant *et al.*, 2017; Horter *et al.*, 2017b; Ahmed *et al.*, 2018; Iwuji *et al.*, 2018). Since the "Test and start" program was implemented, its effectiveness has not been studied widely and there exists limited local literature on its impact on clinical outcomes.

The individual factors associated with attrition have been studied and documented for PLHIV who started ART in the period before "Test and start"(Hodgson *et al.*, 2014; Layer *et al.*, 2014; Forhan *et al.*, 2017). However, it is not known whether the same factors apply to the PLHIV who started ART in the "Test and start" period or not. There are limited local studies on the effectiveness of the "Test and start" program and the individual factors associated with clinical outcomes. This means that there is limited local evidence to inform policies and programmatic decisions which would lead to better implementation of the "Test and start" program in the Coastal region of Kenya and consequently have improved clinical outcomes among PLHIV on ART in the "Test and start" period. In the absence of local studies on the above, programs will rely on literature from other regions and countries which may not be entirely applicable to the Coast region given its unique population that highly values religion and local traditions, thus may lead to inaccurate programmatic and/or policy decisions.

### 1.3 Justification of the study

The "Test and start" program has been implemented for six years now. Globally there is limited literature on its implementation especially on patient experiences and clinical outcomes compared to the period before "Test and start" ". Locally, there are no published studies on the retention patterns, uptake of key components of the standard package of care like viral load monitoring and analysis of the individual factors associated with retention/attrition among clients started on ART during the "Test and

start" era. This study provides data on censorship (death and loss to follow up) and retention patterns, clinical outcomes and an analysis of individual factors associated with censorship among clients started on ART in the "Test and start" period. Additionally, there is little literature on the attrition and retention patterns for PLHIV on ART from facilities in the Coast of Kenya and what factors are associated with attrition/retention and viral load suppression. This study provides updated data and literature for the Coast region which will inform programmatic decisions and improve patient outcomes leading to the achievement of the 2030 UNAIDS 95:95:95 for HIV epidemic control and the 3rd Sustainable Development Goal of ensuring healthy lives and promote well-being for all at all ages.

### 1.4 Research Questions

i. What are the viral load suppression rates for cohorts of people living with HIV started on anti- retroviral therapy before and after implementation of "Test and start" in Mombasa, Kwale and Kilifi counties?
ii. What are the survivorship patterns at every 3 months for 24 months for cohorts of people living with HIV started on anti- retroviral therapy before and after implementation of "Test and start" in Mombasa, Kwale and Kilifi counties?
iii. What are the individual level factors associated with survivorship among people living with HIV started on anti- retroviral therapy before and after implementation of "Test and start" program in Mombasa, Kwale and Kilifi counties?

### 1.5 Objectives

#### 1.5.1 Broad Objective

To determine the clinical outcomes of the "Test and start" programme among people living with HIV on anti- retroviral therapy in Mombasa, Kwale and Kilifi counties.

### 1.5.2 Specific Objectives

i. To determine the viral load suppression rates among cohorts of people living with HIV started on anti- retroviral therapy before and after implementation of "Test and start" program in Mombasa, Kwale and Kilifi counties.
ii. To determine the survivorship patterns at every 3 months for 24 months for cohorts of people living with HIV started on anti- retroviral therapy before and after implementation of "Test and start" program in Mombasa, Kwale and Kilifi counties.
iii. To determine the individual level factors associated with attrition/survivorship among people living with HIV started on anti- retroviral therapy before and after implementation of "Test and start" program in Mombasa, Kwale and Kilifi counties

## 1.6 Null Hypothesis

The survivorship patterns and viral load suppression in cohorts of people living with HIV started on antiretroviral therapy before and after implementation of "Test and start" are similar.

## 1.7 Alternate Hypothesis

The survivorship patterns and viral load suppression in cohorts of people living with HIV started on antiretroviral therapy before and after implementation of the "Test and start" are not similar.

## 1.8 Conceptual Framework

The attrition, retention and viral suppression are influenced by individual socio-demographic, socio-economic and clinical factors (Ware *et al.*, 2013; Forhan *et al.*, 2017). From the earlier studies, age, gender, marital status, economic status, religion, education level, employment status, co-morbidities and under –nutrition (independent

variables) have been argued to either influence or not influence retention, attrition and viral suppression (dependent variables) and will be tested (Figure 1.1).

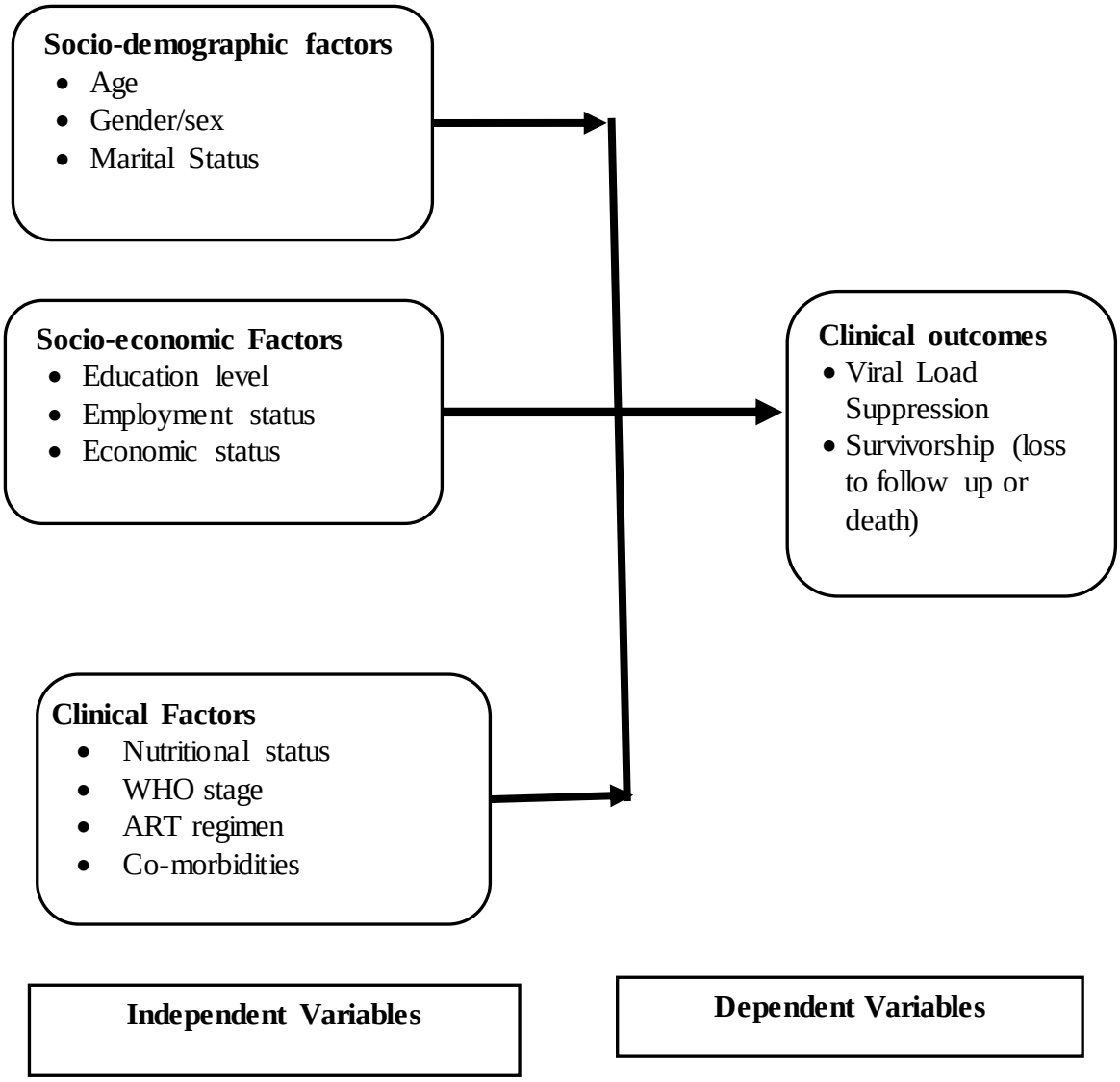


**Figure 1.1: Conceptual Framework of the study**

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

With scale up of the uptake of ART in the last decade in Eastern and Southern Africa which accounts for 53 % of the global HIV burden (19.6 million out of 36.9 million) (UNAIDS , 2018), there arose the need to address emerging issues such as dealing with retention/attrition in HIV programs(Geng, *et al.*, 2010). The aim of HIV treatment is to increase the longevity of life for PLHIV to that of non-infected individuals, improve their health status and quality of life by reducing morbidity from HIV or associated infections and/or conditions.

The WHO guidelines of 2016 (WHO, 2016) outlined the goals of HIV treatment as; maximally and durably suppress plasma HIV RNA, restore and preserve immunologic function, reduce HIV-associated morbidity, prolong the duration and quality of survival and prevent HIV transmission. To achieve the above goals, clients on ART must be retained on treatment and monitoring done using appropriate technology to ascertain viral suppression. Programs have used viral suppression, retention rates and attrition rates to measure the extent to which clients on ART continue treatment as some of the main indicators of the success of HIV programs (U.S. President's Emergency Plan for AIDS Relief, 2019; (UNAIDS, 2021). While retention, attrition and viral load suppression are influenced by health system and community level factors in addition to individual level factors, this study focusses on individual level factors especially for the "Test and start" period.

## 2.2. "Test and start" Program

Based on evidence from studies that ART reduces transmission of HIV (Granich, *et al.*,2008; Donnell *et al.*, 2010; Reynolds *et a*l., 2011; Kumarasamy *et al.*, 2016), suppresses HIV RNA from replicating (McMahon *et al.*, 2013; Boender *et al.*, 2015) and

leads to better clinical outcomes than delayed ART (Insight study Group, 2015; Temprano ANRS 12136 Study Group, 2015), universal ART for all PLHIV was adopted. ART also reduces the incidence of opportunistic infections which are the major causes of morbidity and mortality among PLHIV (Low *et al.*, 2016). Following the above and more evidence, the World Health Organization released guidance on starting ART to all PLHIV immediately after HIV diagnosis(WHO, 2015) which came to be commonly referred to as the "Test and start" ' program (Forhan *et al.*, 2017;Pell *et al.*, 2018). In a South African model, it was estimated that immediate ART would lead to an estimated decline of 3.3 million infections, 3.5 million deaths, 25.7 million DALYs, and $10 billion over 40 years, as compared with CD4 count ,350 cells/mm3(Granich *et al.*, 2012).

Before implementation of universal ART, some critics (Kulkarni *et al.*, 2013) opined that a safe, feasible, and effective test-and-treat implementation was possible but needed well thought out research and community engagement. For the success of "Test and start", the health systems have to be ready to offer universal HIV testing and ART to all the HIV infected people and put in place adherence and retention strategies in order to achieve the 3rd 95 suppression goal (Karim *et al.*, 2015).

Linkage to care and ART was identified as a key challenge to universal test-and-treat in the TasP cluster-randomized trial in rural South Africa (Farouki *et al.*, 2016). Factors that were associated with poor linkage included being young, more educated, new HIV diagnosis, not knowing anyone who is HIV positive, and more distance between their home and the ART clinic (Iwuji *et al.*, 2018).The same study found that "Test and start" was not associated with poor adherence or poor viral load suppression. However, Pell *et al.*, (2018) cited retention as the main challenge among PLHIV started on ART under the "Test and start" program.

## 2.3 Definition of Clinical Outcomes

### 2.3.1 Retention, attrition and viral suppression

Studies across countries have used the terms "*retention*" and **"***attrition*" to mean the opposite of each other. However, the definition of these terms has differed among authors. In Kenya, Hassan *et al.*, (2015) defined *attrition* as a state where "individuals who were either reported dead or lost to follow up (LTFU), ≥ 180 days (6 months) late since the last clinic visit" while Zechariah *et al.*, (2011) defined "*attrition"* as "a situation where a month or more has passed since the last scheduled appointment date". A systematic review of program reports and studies in Sub Saharan Africa defines "*attrition*" as discontinuation of ART for any reason, including death, loss to follow-up (LTFU), and stopping ARV medications (Rosen *et al.*, 2007 ; Fox & Rosen, 2016). An observational study done by Chi *et al.*, (2011) in 19 countries covering 111 facilities and representing 180,718 patients, recommended the adoption of ≥180 days since the last clinic visit as a standard LTFU definition. This study sought to establish the best-performing definition of LTFU to accurately report the status of clients as either active or lost to follow up.

Clients who undergo attrition from ART can be classified into four categories: 1) Lost to follow-up - those that don't appear for scheduled appointments or medication pick up for a specific time; 2) Deaths -clients who die after staring ART treatment; 3) Transfer out - clients who for any reason take their medication pick up and clinical appointments from a different site other than where they started' and 4) Discontinued - taking ART although client is still in care (Rosen *et al.*, 2007). Clients who are confirmed and documented to have moved to another site are retained on ART and therefore removed from the number of those under attrition.

An NGO supported program in DRC Congo defined "*retention"* in their ART program as any visit to the clinic (for a clinical visit, or laboratory monitoring, or for drug refill at the pharmacy) in the 4 months prior to "today's" date (Koole *et al.*, 2012). In their study

conducted in Malawi and Kenya, Zachariah *et al.*, (2011c) defined "*retention"* as "patients alive and on ART, alive in the preparatory phase and still on follow up, or formally transferred out to another facility. They defined "*attrition*" as "a situation where a month or more has passed since the last scheduled appointment date", where the client could be dead or stopped treatment. In conducting a meta-analysis of 32 publications reporting on 33 patient cohorts (74,192 patients in 13 countries) from Sub-Saharan Africa, Rosen *et al.*, (2007) defined "*retention*" as a state where patients are known to be alive and receiving highly active ART at the end of a follow- up period. While the general principle is similar among all studies and programs, the duration and methods of establishing retention may vary from study to study, and from country to country based on their in-country policies, guidelines and donor requirements (UNAIDS, 2005; PEPFAR, 2017).

According to WHO, a key goal of HIV treatment is to suppress plasma HIV RNA to <1000 copies/ml (Bennett *et al.*, 2008), which is termed as "*Viral Suppression*". Typically, viral load suppression is achieved within 3-4 months with good adherence after initiation of HAART. While viral load suppression is a measure of the success of ART treatment for the individual, cohort level viral suppression rates are used to measure the success of HIV programs. Viral suppression rates for cohorts can be measured in two ways; having the number of individuals achieving viral suppression divided by all the HIV positive clients started on ART in the cohort period known as Intention to treat population, or by the clients alive and on ART from the cohort known as On treatment population (Elliott *et al.*, 2019). Using data from the Kenya AIDS Indicator Survey 2012 (KAIS, 2012), Cherutich *et al.* (2016) described population level viral suppression as the total number of HIV infected people in an area used as the denominator and those achieving viral suppression as the numerator. While this is in line with the definition of the 3rd 90 of the UNAIDS 2020 goals (Joint United Nations Program on HIV/AIDS, 2014) which uses population level denominators, it is difficult to measure unless during a survey or census which are expensive to carry out. The viral

load suppression rates across many regions in Kenya range from 70% to 92% (https://viralload.nascop.org/partner).

### 2.3.2 Predictors of Attrition

For the last two (2) decades that HIV programs have been in operation across the globe, several studies have documented the factors associated with attrition for clients who were on care and those on ART. These factors included sex (male sex), age (<35 years and old age), socio-economic status, advanced HIV disease, malnutrition, active TB disease, history of non-adherence to ART among others (Cornell *et al.*, 2009; Geng, *et al.*, 2010; Zachariah *et al.*, 2011a; Zachariah *et al.*, 2011b; Fox & Rosen, 2016).

A rural medical center in South Africa recorded retention rates of 65% (476/735) with mortality (171/259, 66%) being the main cause of attrition. Most attrition occurred soon after initiation of ART with one in 5 persons not on care three months after start of treatment (Barth *et al.*, 2011). A prospective cohort study in Uganda that followed clients started on ART in 2004 and 2005 for 10 years reported retention of 72% (401/559), with death being the largest cause of attrition at 80% (127/158), 63% (n = 80) of the deaths in the first year of HIV therapy (Flynn *et al.*, 2017).

A study done in Thyolo in Rural Malawi and Kibera in Nairobi, Kenya (Zachariah *et al.*, 2011c) compared the retention and attrition during preparation phase and after start of ART with 11,309 and 3,633 clients being reviewed in the two sites respectively. In Malawi, 8421 (74%) of the 11,309 were on ART while 2792 (77%) of 3633 were on ART in Kibera, Kenya. The attrition rates in the two sites were comparable, with significant attrition occurring in the preparation phase. The risk factors for attrition were cited as male sex, age <35 years, advanced HIV disease and malnutrition. A retrospective cross-sectional study of program data in primary health centers in Kibera, Kenya (Zachariah *et al.*, 2011b) corroborated the above risk factors but also identified active TB, severe bacterial infections and prolonged unexplained fevers as other additional factors associated with loss to follow up. While the studies give some insight

into the risk factors for attrition, the fact that they were done in only two settings run by NGOs means that the sites might be well resources compared to most HIV clinics make the findings not generalizable.

A study done in Kilifi District Hospital in Kenya provided more local data on attrition in the Coast of Kenya which covers the area of focus for this study. The retrospective cohort study analyzed data for PLHIV who were started on ART between 2001 and 2008 when the eligibility criteria for ART was $CD_4$ <350 copies/ml (Hassan *et al.*, 2015). Of the 928 adults enrolled and followed up for 2 years, 620 (69%) were retained and on active follow up, 55 (5.9%) were reported dead and 253 (27.3%) were lost to follow up. While the attrition rates are comparable to other studies done elsewhere in Kenya; (Rosen *et al.*, 2007; Ekstro *et al.*, 2009; Zachariah *et al.*, 2011), the contribution of mortality to attrition is remarkably low at 5.9% in this local study. Pre-ART clients at the same facility showed similar attrition rates as ART clients (Hassan *et al.*, 2012).

Socio-economic status has been argued to be a factor contributing to loss to follow up. Cornell *et al.*, (2009) averred that having some monthly income was protective against LTFU at 1 year on ART in a South African study. Other studies concurred with the fact that socio-economic factors contributed to attrition (Cristina *et al.*, 2009; Elvin *et al.*, 2010). History of non-adherence to ART was associated with loss to follow up and mortality (Karcher *et al.*, 2007). Lower pre-ART $CD_4$+ T-cell count, older age, low blood pressure, and a central nervous system syndrome at the last clinic visit predicted deaths, hence attrition (Elvin *et al.*, 2010; Fenner *et al.*, 2011). According to country data reported to UNAIDS, even though the ratio of men to women living with HIV is 1:2, more men die of HIV (UNAIDS, 2018).

### 2.3.3 Predictors of Viral Suppression

Even though adherence to ART and drug efficacy are known to be the main predictors for viral suppression, there are other factors that directly or indirectly contribute to viral load suppression.

In a descriptive study by Jobanputra *et al.*, (2015) using laboratory data from the national ART database in Swaziland, being a child or adolescent, having a recent $CD_4$+ <350 cells/ml or a previous viral load between 1000 and 50,000 copies/ml were more likely to be associated with viral unsuppression. Barth *et al.* (2011) in a retrospective observational study in a rural site in South Africa, found male gender, low BMI and low $CD_4$+ count at initiation to ART to be predictive of non-suppression among clients on ART. In the SEARCH study (Petersen *et al.*, 2017), a community level cohort study done in Kenya and Uganda, found male gender, being young (15-24 years) and not having a formal employment to be associated with non-suppression. The influence of gender on treatment outcome has been controversial with some studies suggesting male gender to be at risk of poor outcomes (Laurent *et al.*, 2006; Chen *et al.*, 2008; Barth *et al.*, 2011) while others did not find any significant difference among the genders (Hacker *et al.*,2004; Laurent *et al.*, 2006; Nicastri *et al.*, 2007; Cornell *et al.*, 2009). Program data from Afya Pwani project which provides ART services to the Coast region in Kenya, does not show any significant differences in the viral load suppression and clinical outcomes among men and women (https://viralload.nascop.org/partner).

Recent data after the universal "Test and start" policy suggest the retention has not improved. In Democratic Republic of Congo, the retention rate was 77% after two years of starting ART following the adoption of test and treat policy (Id *et al.*, 2022). The same study found higher rate of attrition after the adoption of the universal test and treat policy. Another cohort study in Masaka, Uganda, found PLHIV starting ARTs within seven days of HIV diagnosis had higher risk of lost to follow-up (Kiwanuka *et al.*, 2020). Systematic reviews report varying interventions to improve retention on care but with mixed outcomes (Muhula *et al.*, 2022).

### 2.4 Research Gaps

Most all the literature available provides data for only clients who started ART before the "Test and start" era. Apart from linkage, adherence rates and viral suppression which were studied in one South African study, retention/attrition and other parameters

affecting PLHIV in the "Test and start" era have not been studied. Additionally, local literature on factors associated with attrition/retention among PLHIV started on ART in the "Test and start" period is non-existent. This study aimed at filling these gaps and provide literature for decision-making.

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.1 Study Sites

This study was done in eighteen (18) sites in three (3) coastal counties of Kenya; namely Mombasa, Kilifi, and Kwale and involve the six (6) public health facilities with the highest number of clients started on ART in the April to August 2017 period in each of the counties. The study sites were Kilifi County Referral Hospital, Malindi Sub County Hospital, Mariakani Sub County Hospital, Gede Health Centre, Muyeye Health Centre and Oasis Medical Centre in Kilifi County; Coast General Teaching and Referral Hospital, Tudor Sub County Hospital, Port Reitz Sub County Hospital, Likoni Sub County Hospital, Kongowea and Mikindani Health Centres in Mombasa County while in Kwale County I had Msambweni County Referral Hospital, Kwale Sub County Hospital, Kinango Sub County Hospital, Kinondo Kwetu Community Dispensary, Mkongani and Diani Health Centres. As earlier outlined, there is limited literature on factors associated with clinical outcomes for PLHIV on ART in the three (3) counties and no studies on the effectiveness of the "Test and start" program in the same counties. The six (6) public health facilities in each county with the highest number of clients started on ART in the April to August 2017 period are also referral sites for their counties and therefore gave a representation of PLHIV from all corners of the counties.

## 3.2 Study Design

This was a retrospective observational cohort study in which attrition, retention and viral load data for two cohorts of PLHIV was collected retrospectively, analyzed and compared. The first cohort was for those who started ART in the period of April to August 2016 before Kenya implemented the WHO recommendations of treating all HIV positive people with Highly Active Retro-viral drugs (HAART). The second cohort was of those started on ART in the period of April to August 2017 after the "Test and start"

guidance was implemented. The data for the period between the two cohorts was assumed to be unreliable since the old clients who had not started ART based on the recommendations of the old guidelines were being transitioned to the new guidelines.

### 3.3 Study Variables

In this study, the dependent variables were clinical outcomes which were measured using attrition, retention, and viral load suppression. Retention was defined as a state where patients were known to be alive and receiving ART at the end of the follow- up period (Rosen *et al.*, 2007), in this case every 3 months for 24 months after starting ART for both cohorts. Attrition was construed to have occurred in both cohorts if a client discontinued taking ART for any reason, including death and loss to follow-up. (Rosen *et al* 2007; Fox & Rosen, 2016). The NASCOP definition of viral load suppression was applied which is a state at which the HIV RNA is not detectable in blood or below 1000 copies/ml (NASCOP, 2018). Viral Load suppression rate was calculated as a proportion of clients in the cohorts who had HIV RNA of <1000 copies/ml and those with less than the lower detection limit (LDL) out of all those who had a viral load test done.

Socio-demographic factors **(**age, gender/sex, and marital status), socio-economic factors **(**education level, employment status, and economic status) and clinical factors **(**WHO stage, ART regimen, nutritional status and opportunistic infections**)** were the independent variables in this study.

### 3.4 Study Population

All people living with HIV initiated on ART in the periods April to August 2016 and April to August 2017 and recorded in the ART register formed the sampling frame for the study (Table 3.1).

**Table 3.1: Public health facilities in the three counties included in the study and number started on ART in 2016 and 2017**

| County | Study site | Number started on ART | | |
|---|---|---|---|---|
| | | April-Aug 2016 | April-Aug 2017 | Total |
| Kilifi | Kilifi County Hospital | 180 | 91 | 271 |
| | Malindi Sub County Hospital | 167 | 120 | 287 |
| | Muyeye Health Centre (Municipal) | 110 | 106 | 216 |
| | Oasis Medical Center | 62 | 40 | 102 |
| | Mariakani Sub-County Hospital | 65 | 24 | 89 |
| | Gede Health Centre | 62 | 44 | 106 |
| Kwale | Diani Health Centre | 49 | 58 | 107 |
| | Kinondo Kwetu Community Dispensary | 133 | 102 | 235 |
| | Kinango Sub County Hospital | 31 | 49 | 80 |
| | Msambweni County Referral Hospital | 44 | 39 | 83 |
| | Kwale Sub County Hospital | 34 | 30 | 64 |
| | Mkongani Health Centre | 46 | 15 | 61 |
| Mombasa | Likoni District Hospital | 157 | 273 | 430 |
| | Kongowea Health Centre | 89 | 62 | 151 |
| | Tudor District Hospital (Mombasa) | 145 | 148 | 293 |
| | Mikindani Health Centre | 59 | 76 | 135 |
| | Port Reitz Sub County Hospital | 108 | 69 | 177 |
| | Coast Province General Hospital | 82 | 150 | 232 |
| | **Total** | **1623** | **1496** | **3119** |

### 3.4.1 Inclusion criteria

Participants included in the study met the below criteria:

i. HIV positive and started on ART in the periods of April to August 2016 and April to August 2017.
ii. Age > 15 years old at the time of ART initiation.
iii. At least 24 months had elapsed from the time they were started on ART at the start of this study.

### 3.4.2 Exclusion criteria

- Patients whose files were missing bio data.

### 3.5 Sample Size Determination

The sample size was estimated on the basis of having statistical power to show significantly higher hazard of LTFU among the test and treat patients compared to the delayed treatment as was shown in a South African Cohort (adjusted Hazard ratio of 1.58) (Hirasen *et al.*, 2020). The proportion of LTFU among HIV patients was estimated to be approximately 30%: it was 33.6% in Kilifi, Kenya (Hassan *et al.*, 2012) and 34% in Nigeria*(*Stafford *et al.*, 2019).

Assuming a LTFU of about 30%, a two-tailed alpha of 0.05, with statistical power >80%, a sample size of at least 600 (300 in each cohort) HIV patients was enough to show a 58% higher risk of LTFU among the HIV patients starting ARTs under test and treat policy (aHR 1.58) with 207 expected LTFUs. However, because of the long follow-up of 24 months, 786 patients were recruited(316 for "Test and start" and 470 for the pre-"Test and start" group)(Schoenfeld, 1981). During data collection, patients that had been sampled to be in the "Test and start" period were found to have started ART in the pre "Test and start" period due to errors done in information entry into ART registers. It was decided to classify them correctly in the pre "Test and start" group hence the higher sample size in that cohort. Since higher numbers also provides more strength to the evidence generated by a study, it was opted to include the study participants in the analysis. (Table 3.2)

**Table 3.2: Number of study participants whose data was collected per study site in Mombasa, Kwale and Kilifi Counties**

| County | Study site | Sample study participants per facility | | |
|---|---|---|---|---|
| | | Pre-"Test and start" cohort | "Test and start" cohort | Total sample |
| Kilifi | Kilifi County Hospital | 53 | 34 | 87 |
| | Malindi Sub County Hospital | 36 | 50 | 86 |
| | Muyeye Health Centre | 24 | 40 | 64 |
| | Oasis Medical Centre | 17 | 31 | 48 |
| | Mariakani Sub-County Hospital | 19 | 6 | 25 |
| | Gede Health Centre | 11 | 11 | 22 |
| Kwale | Diani Health Centre | 11 | 8 | 19 |
| | Kinondo Kwetu Community Disp. | 24 | 19 | 43 |
| | Kinango Sub County Hospital | 7 | 7 | 14 |
| | Msambweni County Referral Hosp. | 7 | 6 | 13 |
| | Kwale Sub County Hospital | 6 | 6 | 12 |
| | Mkongani Health Centre | 9 | 2 | 11 |
| Mombasa | Likoni District Hospital | 59 | 17 | 76 |
| | Kongowea Health Centre | 30 | 13 | 43 |
| | Tudor District Hospital | 35 | 25 | 60 |
| | Mikindani Health Centre | 18 | 11 | 29 |
| | Port Reitz Sub County Hospital | 46 | 11 | 57 |
| | Coast Province General Hospital | 58 | 19 | 77 |
| | **Total** | **470** | **316** | **786** |

### 3.6 Sampling techniques

Multi-stage sampling was applied with age bands of ten (10) years being used to stratify the study population at each study site (Figure 3.1) and a probability proportional to size sampling applied to each age band started on ART in the periods of April to August 2016 and April to August 2017. Random sampling using lottery method was applied within the age bands (Table 3.3).

**Table 3.3: Age stratification in sampling and data collection**

Age stratification used in sampling and eventual data collected

| | **Sample size calculated per age band** | | **Data collected per age band** | |
|---|---|---|---|---|
| **Age band** | Pre "Test and Start" cohort | Test and treat cohort | Pre "Test and Start" cohort | Test and treat cohort |
| 15-24 | 45 | 45 | 65 | 48 |
| 25-34 | 117 | 110 | 178 | 117 |
| 35-44 | 84 | 91 | 124 | 94 |
| 45-54 | 37 | 38 | 65 | 40 |
| >55 | 17 | 16 | 38 | 17 |
| **Total** | **300** | **300** | **470** | **316** |

### 3.7 Data collections tools

Quantitative data was collected using a quantitative data collection tool (Appendix II) designed in excel worksheet to capture both dependent and independent variables. This tool was uploaded in an online Open Data Kit (Kobocollect©) to reduce errors in data collection and entry. The tool captured individual level variables such as patient unique number, gender, date of birth, marital status, entry point, registration date, date of HIV diagnosis, start of ART date, ART regimen, WHO stage at entry, opportunistic infections presence at HIV diagnosis and nutritional status.

### 3.8 Pre-testing of data collection tools

The quantitative data collection tool described above was pre-tested at Moi County Referral Hospital in Voi, Taita Taveta County, which has similar characteristics to the selected study sites. Reliability and validity were established by triangulation and having three different research assistants collect data for the same clients and comparing the responses for consistency. This process showed that many errors in data collection and

entry occurred which informed the translation of the data collection questionnaire to an online Open Data Kit (Kobocollect©) to reduce the errors.

### 3.9 Data collection procedure

Data collection commenced after approval of the research proposal by the Jomo Kenyatta University of Agriculture and Technology (JKUAT) and ethical clearance from the Pwani University Ethical Review Committee (Appendix IV). Permission was also sought from the County Health Departments of Mombasa, Kilifi and Kwale to collect data from the facilities (Appendix III). Pre-visits were done to facilities to explain the research to the head of the facilities and introduce the research assistants and share a schedule for data collection. Research assistants were trained on the data collection tools, handling of data, research ethics, privacy and confidentiality of patients' data.

Quantitative data was extracted from ART registers and patient files in the selected facilities using a data abstraction tool (Appendix II) translated in the online Open Data Kit (Kobocollect©), downloaded and stored in Microsoft excel database then backed up externally. Patient names were hidden from the point of collection and coded to ensure there is no subject identifiable information. The study team reserve the rights to edit the reports generated from the study and measures were put in place to ensure data cannot be altered. The exclusive rights to reuse or publish research data was retained by the principal investigator.

Data collection process involved the following steps;

(1) Getting the patient files for the study participants sampled above,
(2) Entering the county name, facility name, patient unique number, gender, date of birth, marital status, entry point, registration date, date of HIV diagnosis, start of ART date, ART regimen, WHO stage at entry, opportunistic infections presence at HIV diagnosis, nutritional status. In the subsequent data collection

points, comorbidity/opportunity infection present, nutrition status, whether active or lost to follow up and viral load results if available.

(3) If any bio data information was missing, the client was called, given explanation about the study, written consent sought if nearby (if far away, verbal consent) to participate in the study and the missing information collected directly from him/her.

(4) All the viral load results for each client and the date was taken and recorded. If missing in the file but clients reports to have had the test, the results in the national viral load/EID dashboard was checked.

Measures were put in place to ensure data confidentiality. All electronic data was protected with a password, access limited to the research team. Hard copies of the data were also kept in lockable cabinets.

### 3.10 Data management and analysis

Study data were extracted from patients' records using standard questionnaire designed on Open Data Kit (Kobocollect©) and exported to STATA Version 16.1 (College Station, Texas 77845 USA) for analysis. Continuous variables were assessed for outliers by plotting visual aids like histogram, scatter plots and q-q plots for assessing normality. Outliers and illogical variables were flagged and corrected by checking correct values in patient records. Viral loads were classified as suppressed for patient with either undetectable or viral load ≤1000/ml and unsuppressed for patient with viral load > 1000/ml. Body Mass Index (BMI) was calculated as weight (Kg) divided by square of height in metres and grouped following WHO classification: <18.5, 18.5 to 24.9, 25.0 to 29.9 and ≥30.0. Data was assumed not to be missing at random, an extra category `missing' was added to each variable to ensure all patients were included in the regression models.

Continuous variables were reported as means (±SD) or medians, depending with the underlying distribution. Categorical variables were reported as counts with their

respective percentages. The study main exposure was a binary variable classified as patients who were diagnosed with HIV and started on ARTs before the policy of "Test and start" was introduced in 2016 and those diagnosed from 2017 onwards. Because the study was designed as a cohort with 24 months of follow-up after starting ARTs, the `"Test and start" patients were those diagnosed and started ARTs in the course of 2017 and followed up for 24 months ending in 2019. Other exposures explored in the regression analysis were demographic, clinical features at time of starting ARTs and health systems features. Viral loads were tested at months 6, 12 and 24 after starting ARTs on selected patients. At each follow-up point where viral loads were tested, they were compared between patients diagnosed and starting ARTs before and from 2017 using chi-square/fishers exact test as appropriate. Features associated with unsuppressed viral loads were assessed using logistic regression analysis including the county variable as random intercept. A *base model* including the dependent variable i.e. viral load, main exposure ("Test and start" vs Pre "Test and start"), and *a priori* confounders; age, sex and county as random intercept were fixed for each time point (months 6, 12 and 24). Then multivariable logistic regression including all other collected potential confounders were added. Only patients with a viral load results were included in this analysis.

The four study outcomes assessed were retention in the study, death, lost-to-follow-up (LTFU) and transfer out. The retention rates in the study at all the time points were calculated as follows:

% RTt = (Co- Tt-Dt-LTFUt)/ (Co-Tt)

where *Co* is all patients initiated on ART in the cohort;

*Tt* is all patients transferred out of care by time *t*;

*Dt* is all patients who died by time t; and

*LTFUt* is all patients lost to follow-up by time t.

*%RTt* will therefore be the proportion of all patients-initiated ART in the cohort who did not transfer out of care, are still alive and in care at time *t*. The retention rates and other outcomes were reported as proportions and the differences in all the outcomes between "Test and start" "and Pre "Test and start" patients compared using two-sample test of proportions and absolute differences reported.

Time to death, LTFU and transfer out was defined from date of starting ARTs to date of the events or completing 24 months of follow-up for those who were actively on ARTs and on follow-up after 24 months. Probability distributions of each event during 24 months of follow-up were calculated using the Kaplan–Meier survival approach and compared between the groups (Pre "Test and start" and "Test and start" "groups) using log-rank test. To explore the effect of "Test and start" "versus Pre "Test and start" on each study outcome, Cox proportional hazard regression was performed for each outcome with the main exposure ("Test and start" or Pre "Test and start") and adjusted for confounders collected. The proportional hazard assumption was tested using Schoenfeld residuals method. To account for HIV treatment care and other unobserved heterogeneity across the three counties (Kwale, Mombasa and Kilifi), shared gamma frailty Cox regression model was performed. To start with, a *base model* was run with the main exposure adjusted for age and sex with the three counties as random effect component in the shared gamma frailty Cox regression models. The final multivariable models included all other confounders collected at time of starting ARTs. CD4 counts were excluded in the regression models because a large proportion of patients (>50%) had no $CD_4$ results at the time of starting ARVs. The measure of effect reported was adjusted hazard ratios and their respective 95% confidence intervals. Final multivariable discriminatory power was assessed using Area Under the Receiver Operating Characteristics curve (AUC).

Finally, retention was assessed in the ART programme after 24 months of starting ARTs versus the collapsed poor outcomes (deaths or LTFU). Transfer out were right censored at the time of leaving the cohort. A binary outcome was created; either being active on ARTs at the end of 24 months follow-up or having one of the poor treatment outcomes.

Using the same approach as with other outcomes above, shared gamma frailty Cox regression models were run and reported adjusted hazard ratios.

### 3.11 Ethical considerations

In accordance with the principles governing research involving human participants, this study ensured that respondents' ethical rights were upheld:

a. The proposal was submitted to the Pwani University Ethical Review Committee (ERC) for approval.
b. Approval by the County Health Management Teams was sought to access patient records.
c. The management of each health facilities was also informed of this study and their consent sought to access medical records to collect data. All data collected as part of this study was handled with utmost confidentiality as elaborated above in the section on data collection and management.

# CHAPTER FOUR

# RESULTS

## 4.1 Characteristics of study participants

### 4.1.1 Demographic characteristics of study participants

The study enrolled 786 patients with 470 (60%) being from the pre "Test and start" cohort and 316 (40%) in the "Test and start" cohort. Overall, the mean age was 40.4 years and 539 (69%) of the patients were female. A total of 341 (44%) patients were from Kilifi county, 332 (42%) were from Mombasa and 113(14%) from Kwale county and majority of the patients; 423 (54%) were married (Table 4.1).

**Table 4.1: Demographic characteristics of study participants at start of ART ("Test and start" group =316, Pre "Test and start" group =470, Total patients =786)**

| Characteristic | | "Test and start" group n (%) | Pre "Test and start" group n (%) | Total patients n (%) |
|---|---|---|---|---|
| **Sex** | Female | 212 (67.1) | 327 (69.6) | 539 (68.6) |
| | Male | 104 (32.9) | 143 (30.4) | 247 (31.4) |
| **Age in years**: mean (sd) | | 40.0 (10.5) | 40.7 (11.1) | 40.4 (10.8) |
| | <30 years | 53 (17) | 76 (16) | 129 (16) |
| | 30 to 40 years | 115 (36) | 166 (35) | 281 (36) |
| | 40 to 50 years | 99 (31) | 137 (29) | 236 (30) |
| | ≥50 years | 49 (16) | 91 (20) | 140 (18) |
| **Recruiting County** | Mombasa | 85 (26.9) | 247 (53) | 332 (42) |
| | Kwale | 49 (15.5) | 64 (14) | 113 (14) |
| | Kilifi | 182 (57.6) | 159 (34) | 341 (44) |
| **Marital status** | Married | 165 (52) | 258 (55) | 423 (54) |
| | Single | 48 (15) | 94 (20) | 142 (18) |
| | Divorced/separated/ Widowed | 103 (33) | 118 (25) | 221 (28) |

### 4.1.2 Socio-economic characteristics of study participants

Of the socio-economic characteristics, 136 (17%) were dependent, 236 (30%) were unemployed and 321 (41%) had secondary level education (Table 4.2).

**Table 4.2: Socio-economic characteristics of study participants ("Test and start" group =316, Pre "Test and start" group =470, Total patients =786)**

| Characteristic | | "Test and start" group n (%) | Pre "Test and start" group, n (%) | Total patients n (%) |
|---|---|---|---|---|
| **Education level** | No school | 24 (8) | 26 (6) | 50 (6) |
| | Primary | 136 (43) | 143 (30) | 279 (36) |
| | Secondary | 117 (37) | 204 (43) | 321 (41) |
| | Tertiary | 39 (12) | 97 (21) | 136 (17) |
| **Employment status** | Self employed | 87 (28) | 178 (38) | 265 (33) |
| | Informal employment | 89 (28) | 112 (24) | 201 (26) |
| | Formal employment | 34 (11) | 50 (10) | 84 (11) |
| | Not employed | 106 (33) | 130 (28) | 236 (30) |
| **Economic status** | Independent | 99 (31) | 151 (32) | 250 (32) |
| | Semi-independent | 168 (53) | 232 (49) | 400 (51) |
| | Dependent | 49 (16) | 87 (19) | 136 (17) |

### 4.1.3 Clinical characteristics of study participants

Approximately half of the patients had normal BMI (18.5 to 24.9), while 119 (15%) were underweight (BMI<18.5). A total of 732 (93%) patients were initiated on TDF/3TC/EFV as their starting regimen. Approximately two-thirds; 527 (67%) of the patients were classified as WHO stage I while only two (0.3%) were stage IV. Only 73 (9.3%) had baseline CD4 ≥500 cells/mm^3 while 279 (36%) had CD4 <500 cells/mm^3. There were only 62 (7.9%) patients with opportunistic infections with 36(59%) having

TB, 9(14%) with herpes simplex virus, 4 (6.3%) sexual transmitted infections, 6 (9.4%) bacterial infections and 7 (11%) had oral candidiasis (Table 4.3).

**Table 4.3: Clinical characteristics of study participants ("Test and start" group =316, Pre "Test and start" group =470, Total patients =786)**

| Characteristic | | "Test and start" group n (%) | Pre "Test and start" group, n (%) | Total patients n (%) |
|---|---|---|---|---|
| **Nutritional status** (BMI in Kg/m$^2$) | <18.5 | 59 (19) | 60 (13) | 119 (15) |
| | 18.5 to 24.9 | 147 (47) | 243 (52) | 390 (50) |
| | 25 to 29.9 | 45 (14) | 75 (16) | 120 (15) |
| | ≥ 30 | 20 (6) | 44 (9) | 64 (8) |
| | Missing | 45 (14) | 48 (10) | 93 (12) |
| **Starting ART regimen** | TDF/3TC/EFV | 301 (95) | 431 (92) | 732 (93) |
| | AZT/3TC/NVP | 4 (1.5) | 17 (3.4) | 21 (2.7) |
| | TDT/3TC/NVP | 6 (1.9) | 5 (1.2) | 11 (1.5) |
| | Others* | 5 (1.6) | 17 (3.4) | 22 (2.8) |
| **WHO stage** | Stage I | 208 (66) | 319 (68) | 527 (67) |
| | Stage II | 86 (27) | 107 (23) | 193 (25) |
| | Stage III | 20 (6.3) | 44 (9) | 64 (7.7) |
| | Stage IV | 2 (0.7) | 0 (0) | 2 (0.3) |
| **$CD_4$ level before ART initiation** | Mean (sd) (cells/mm^3) | 328.5 (237) | 395.0 (320) | 377.9 (302) |
| **Number of adherence sessions before ART initiation** | ≤1 | 125 (40) | 140 (30) | 265 (34) |
| | 2 | 47 (15) | 82 (18) | 129 (16) |
| | ≥3 | 109 (34) | 171 (36) | 280 (36) |
| | Missing data | 35 (11) | 77 (16) | 112 (14) |
| | Had opportunistic infection | 29 (9.2) | 33 (7.0) | 62 (7.9) |

*ABC/3TC/LPV/r, ABC/3TC/EFV, AZT/3TC/EFV, D4T/3TC/NVP, TDF/3TC/NVP, AZT/3TC/ATV/r, TDF/3TC/ATV/r or TDF/3TC/LPV/r

### 4.2 Viral load suppression rates at months 6, 12 and 24 among "Test and start" and pre "Test and start" groups

Table 4.4 shows results of analysis for viral load suppression among the groups at 6, 12 and 24 months. Among the 274 (35%) patients with a viral load reading at month six (6) after starting ARTs, 12 (9.8%) and 15 (9.9%) were unsuppressed among the "Test and start" and pre "Test and start" group respectively, adjusted odd ratio 0.96 (95% CI =0.52−1.75) ,there was no difference in suppression rates in the two groups.

**Table 4.4: Analysis for viral load suppression at months 6, 12 and 24 among "Test and start" and pre "Test and start" group ("Test and start" group =316, Pre "Test and start" group =470, Total patients =786)**

| Period after initiating ARVs | "Test and start" group n (%) | Pre "Test and start" group n (%) | Chi-square value | P-value[#] | Adjusted Odds ratio (95% CI) * |
|---|---|---|---|---|---|
| **At month 6 (N=274)** | | | | | |
| Suppressed | 110 (90) | 137 (90) | 1.10 | 0.95 | Reference |
| Unsuppressed | 12 (10) | 15 (10) | | | 0.96 (0.52−1.75) |
| **At month 12 (N=288)** | | | | | |
| Suppressed | 117 (93) | 155 (96) | 1.08 | 0.30 | Reference |
| Unsuppressed | 9 (7) | 7 (4) | | | 1.71(0.95−3.09) |
| **At month 24 (N=339)** | | | | | |
| Suppressed | 117 (91) | 195 (93) | 0.51 | 0.48 | Reference |
| Unsuppressed | 12 (9) | 15 (7) | | | 1.31 (0.79−2.15) |

*[#]P-value from the chi-square test; *Odds ratios from a logistic regression model adjusted for age, sex, and county as random intercept.*

Chi-square test did not show any significant difference in the viral load suppression rates between the two groups at month 6 (P=0.95), at month 12 (P=0.30) and at month 24 (P=0.48) as shown in fig 4.1.

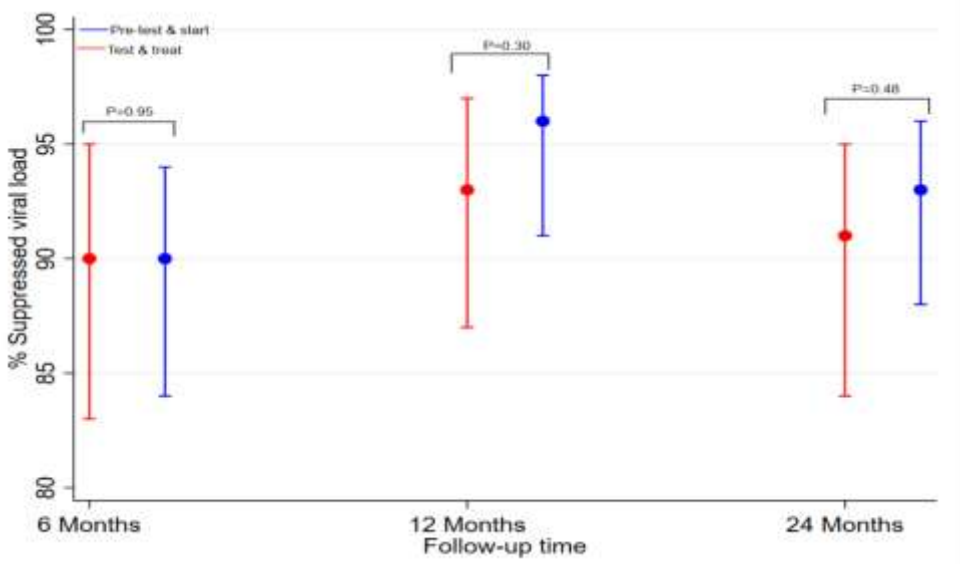


**Figure 4.1: Comparing the viral load suppression rate (with their 95% CI) for the two groups at 6, 12 and 24 months using Chi-square test***

### 4.2.1 Socio-demographic factors as determinants of viral load unsuppression at months 6, 12 and 24

The results are presented in Table 4.5. At 6 months into the study, being older than 30 years of age and single marital status (aOR=0.53 (95%CI 0.35−0.81, P=0.003) had protective effect on odds of unsuppressed viral load respectively. All other factors had no significant effect.

**Table 4.5: Multivariate analysis for socio-demographic characteristics as determinants of viral load unsuppression at months 6, 12 and 24**

| Characteristic | | Month 6 (n=274) | | Month 12 (n=288) | | Month 24 (n=339) | |
|---|---|---|---|---|---|---|---|
| | | Adjusted OR (95%CI) * | P-value | Adjusted OR (95% CI) * | P-value | Adjusted OR (95% CI) * | P-value |
| **Age in years** | | | | | | | |
| <30 | | Reference | | Reference | | Reference | |
| 30 to 40 | | 0.27 (0.09-0.84) | **0.02** | 1.06 (0.23-5.71) | 0.94 | 0.46 (0.13-1.58) | 0.22 |
| 40 to 50 | | 0.45 (0.26-0.80) | **0.006** | 2.90 (0.29-28.9) | 0.37 | 0.13 (0.01-2.80) | 0.19 |
| ≥ 50 | | 0.21 (0.05-0.80) | **0.02** | 0.79 (0.04-14.1) | 0.88 | 0.22 (0.03-1.57) | 0.13 |
| **Sex** | Female | Reference | | Reference | | Reference | |
| | Male | 1.31 (0.53−3.23) | 0.56 | 1.07 (0.55−2.07) | 0.85 | 0.59 (0.30−1.13) | 0.11 |
| **Marital status** | Married | Reference | | Reference | | Reference | |
| | Single | 0.53 (0.35−0.81) | **0.003** | 1.80 (0.83−3.90) | 0.14 | 0.49 (0.07−3.29) | 0.46 |
| | Divorced/ Separated/Widowed | 0.83 (0.29−2.37) | 0.73 | 3.22 (0.47−22.2) | 0.24 | 2.18 (0.74−6.41) | 0.16 |

### 4.2.2 Socio-economic factors as determinants of viral loads unsuppression at months 6, 12 and 24

At 6 and 24 months, compared to patients who are self-employed, patients in informal employment had significantly higher odds of being unsuppressed, aOR1.63 (95%CI 1.11−2.40) and aOR 2.09 (95%CI 1.09−4.03) respectively. Patients who did not attend any school at all were found to have significantly higher odds of unsuppressed viral load, aOR 2.47 (95%CI 1.04−5.86) when compared to those with secondary education & above at month 12. Compared with patients with independent economic status, semi-independent patients had significantly lower odds of having unsuppressed viral load, aOR 0.49 (95%CI 0.30−0.81) at month 24 (Table 4.6).

**Table 4.6: Multivariate analysis for socio-economic features as determinants of viral load unsuppression at months 6, 12 and 24**

| Characteristic | Month 6 (n=274) | | Month 12 (n=288) | | Month 24 (n=339) | |
|---|---|---|---|---|---|---|
| | Adjusted OR (95%CI) * | P-value | Adjusted OR (95% CI) * | P-value | Adjusted OR (95% CI) * | P-value |
| **Education level** | | | | | | |
| No school | 3.07 (0.61−15.3) | 0.17 | 2.47 (1.04−5.86) | **0.02** | 0.94 (0.32−2.75) | 0.91 |
| Primary | 1.01 (0.29−3.51) | 0.98 | 0.45 (0.23−1.08) | 0.08 | 1.72 (0.42−7.01) | 0.45 |
| Secondary & above | Reference | | Reference | | Reference | |
| **Employment status** | | | | | | |
| Self employed | Reference | | Reference | | Reference | |
| Informal employment | 1.63 (1.11−2.40) | **0.01** | 3.29 (0.34−32.2) | 0.31 | 2.09 (1.10−4.03) | **0.03** |
| Formal employment | 0.32 (0.05−1.99) | 0.22 | 0.64 (0.37−1.14) | 0.13 | 1.55 (0.26−9.20) | 0.63 |
| Not employed | 0.37 (0.06−2.13) | 0.27 | 3.76 (0.70−20.3) | 0.12 | 1.85 (0.54−6.29) | 0.33 |
| **Economic status** | | | | | | |
| Independent | Reference | | Reference | | Reference | |
| Semi-independent | 0.47 (0.18−1.19) | 0.11 | 0.32 (0.07−1.37) | 0.12 | 0.49 (0.30−0.81) | **0.006** |
| Dependent | 2.92 (0.55−15.5) | 0.21 | 0.22 (0.04−1.08) | 0.06 | 0.53 (0.10−2.83) | 0.46 |

### 4.2.3 Clinical features as determinants of viral loads unsuppression at months 6, 12 and 24

As for clinical factors, it was found that at month 6, there was no clinical feature determining viral load unsuppression. However, at month 12, being in WHO stage II and number of adherence sessions were important determinants. Those in WHO stage II were 2.6 times likely to be virally unsuppressed compared to those in WHO stage 1, aHR 2.60 (0.98−6.90), though this was statistically not significant. Patients with only two adherence counseling sessions had significantly higher (more than four times) odds of being unsuppressed compared to those with three adherence counseling sessions (aOR=4.60, 95%CI=1.65−12.9, P=0.004).

At month 24, important determinants were being in WHO stage II and having two adherence counseling sessions before starting ART. Those in WHO stage II were three times more likely to be unsuppressed compared to those in WHO stage 1 (aOR=3.13, 95%CI=1.26−7.78, P=0.01), while those with two adherence counseling sessions had significantly higher odds (three times) of not being virally suppressed compared to those with three adherence counseling sessions (aOR=3.01, 95%CI =1.03−8.75, P=0.04). Although not significant, those with one or less adherence counseling sessions has almost twice the odds of having no viral suppression compared to those with ≥3 adherence sessions (Table 4.7**).**

**Table 4.7: Multivariate analysis for clinical features as determinants of viral load unsuppression at months 6, 12 and 24.**

| Characteristic | Month 6 (n=274) | | Month 12 (n=288) | | Month 24 (n=339) | |
|---|---|---|---|---|---|---|
| | Adjusted OR (95%CI) * | P-value | Adjusted OR | P-value | Adjusted OR (95% CI) * | P-value |
| *BMI group* | | | | | | |
| <18. | 2.54 (0.69−9.43) | 0.16 | 0.72 (0.28−1.88) | 0.51 | 0.35 (0.06−1.89) | 0.22 |
| 18.5 to 24.9 | Reference | | Reference | | Reference | |
| ≥ 25 | 1.46(0.41−5.24) | 0.56 | 1.36(0.85−2.18) | 0.2 | 1.02 (0.27−3.90) | 0.97 |
| Missing data | -$ | | 0.95 (0.24−3.75) | 0.94 | 0.65 (0.07−5.74) | 0.7 |
| *Type of ART* | | | | | | |
| TDF/3TC/EFV | Reference | | Reference | | Reference | |
| Others# | 0.64(0.04−9.95) | 0.75 | 1.46 (0.34−6.36) | 0.61 | 1.52 (0.33−6.95) | 0.59 |
| *WHO stage* | | | | | | |
| Stage I | Reference | | Reference | | Reference | |
| Stage II | 1.03 (0.31−3.42) | 0.96 | 2.60 (0.98−6.90) | 0.06 | 3.13 (1.26−7.78) | **0.01** |
| Stage III & IV | 1.78 (0.48−6.60) | 0.39 | 1.30 (0.01−256) | 0.92 | 0.85 (0.24−3.03) | 0.8 |
| *Number of adherence* | | | | | | |
| *sessions before ART initiation* | | | | | | |
| ≤1 | 1.15 (0.32−4.17) | 0.83 | 1.45 (0.37−5.62) | 0.59 | 1.93 (0.99−3.77) | 0.05 |
| 2 | 1.14(0.35−3.71) | 0.83 | 4.60 (1.65−12.9) | **0.004** | 3.01 (1.03−8.75) | **0.04** |
| ≥3 | Reference | | Reference | | Reference | |
| *Missing data* | 2.69 (0.23−31.3) | 0.43 | -$ | | 0.65 (0.26−1.64) | 0.36 |
| *Had opportunistic infections* | 0.46 (0.12−1.82) | 0.27 | 0.69 (0.06−7.39) | 0.76 | 0.40 (0.04−3.73) | 0.42 |

### 4.3 Survivorship patterns every 3 months for 24 months for patients started on ART during "Test and start" and pre "Test and start" period.

#### 4.3.1 Retention patterns at every 3 months for 24 months among "Test and start" and pre "Test and start" cohorts.

In the first three months after starting ARVs, the retention rates were 88% for the Test "Testand start", cohort and 84% for those started on treatment before "Test and start". Using the two-sample test of proportions, no significant differences were found between the two cohorts (absolute difference =4.2%, 95%CI =-0.8 to 9.2, P=0.10) as shown in Table 4.8. After two years of ARVs, the retention rates declined in both the "Test and start" and pre "Test and start" groups to 64% and 68% respectively, with no significant differences between the cohorts (absolute difference =-4.0%, (95%CI = -11 to 3.1, P=0.27).

**Table 4.8: Two sample test of proportions for cumulative retention rates from month 3 to 24 for "Test and start" and pre "Test and start" cohorts.**

| Months | "Test and start" cohort (n=316) | Pre- "Test and start" cohort (n=470) | Absolute difference (95% CI) | P-value* |
|---|---|---|---|---|
| Month 3 | 269 (88) | 375 (84) | 4.2 (-0.8 to 9.2) | 0.10 |
| Month 6 | 243 (81) | 358 (81) | -0.2 (-5.9 to 5.6) | 0.95 |
| Month 9 | 237 (79) | 340 (77) | 1.6 (-4.5 to 7.6) | 0.62 |
| Month 12 | 228 (76) | 330 (75) | 1.1 (-5.2 to 7.4) | 0.74 |
| Month 15 | 210 (71) | 316 (72) | -1.4 (-8.1 to 5.2) | 0.67 |
| Month 18 | 204 (69) | 312 (71) | -2.3 (-9.1 to 4.5) | 0.50 |
| Month 21 | 191 (66) | 305 (70) | -3.9 (-10.9 to 3.0) | 0.26 |
| Month 24 | 183 (64) | 295 (68) | -4.0 (-11.1 to 3.1) | 0.27 |

*p –values from two-sample test of proportions

The retention rates for the two cohorts were not significantly different on any of the follow-up months (Figure 4.2).

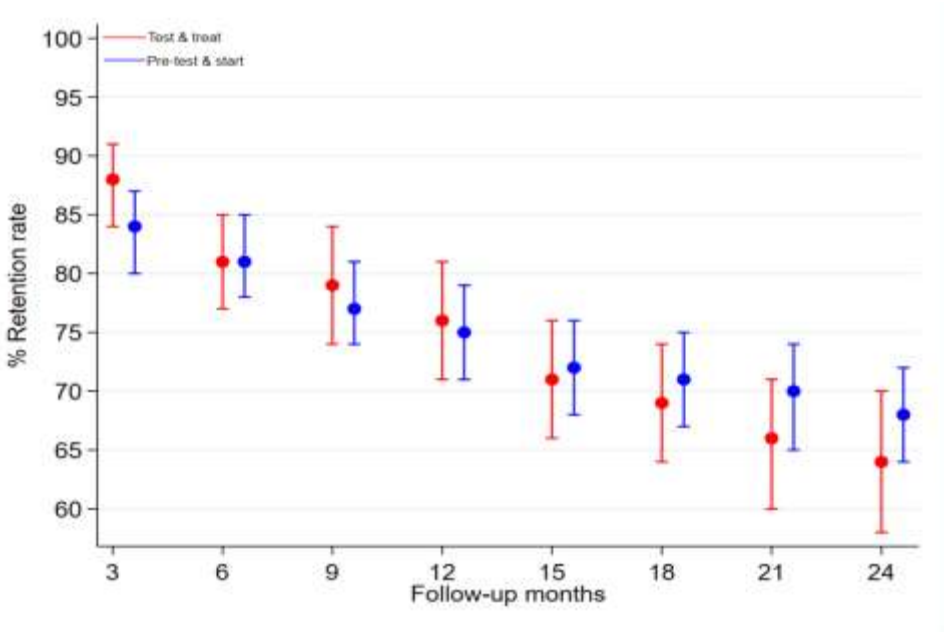


**Figure 4.2: Comparison of retention rates at 3 months intervals for 24 months for "Test and start" and pre "Test and start" cohorts with their 95% confidence intervals**

### 4.3.2 Attrition patterns for 24 months among "Test and start" and pre "Test and start" cohorts.

The attrition patterns are shown in Figure 4.3. In this study, the 786 participants were followed up for 1,144 person-years. Thirty-one percent (240/786) of the patients had a poor outcome (died or LTFUs); a rate of 211 (95%CI= 186 - 240) poor outcomes per 1000 person-years. Out of the 240 poor outcomes, 214/240 (89%) and 26/240 (11%) were LTFUs and deaths respectively. The proportion of poor outcomes among the "Test and start" ' cohort was 32% (102/316) while for the pre "Test and start" cohort was 29%

(138/470) equivalent to rates of 227 (95%CI=187 - 275) and 202 (95%CI=171 - 238) per 1000 person-years respectively, with age, sex and county adjusted HR of 1.09

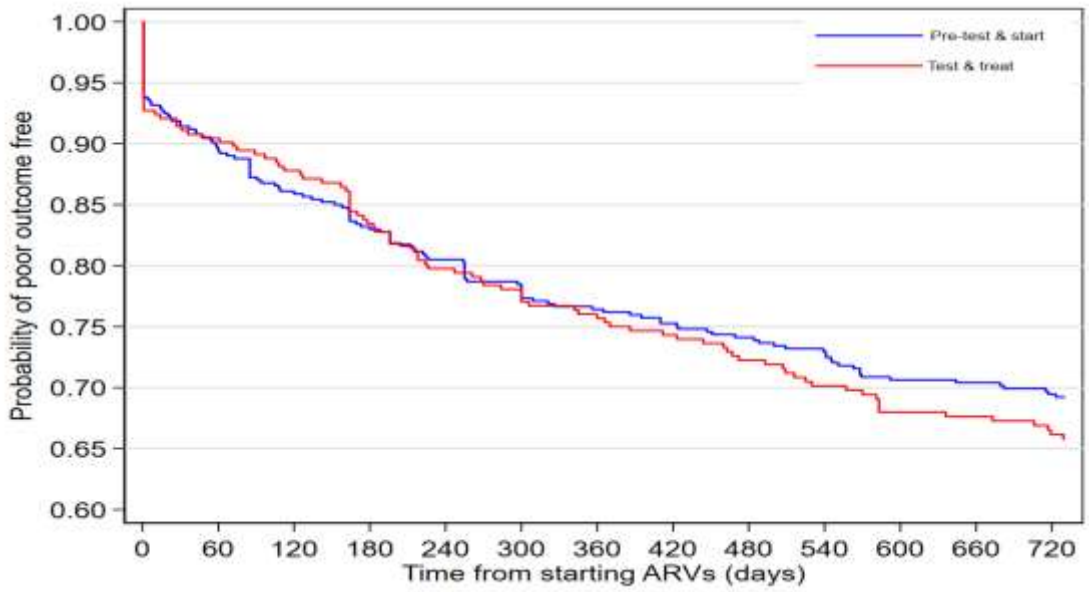


**Figure 4.3: Kaplan-Meier curve of not having poor outcomes for 24 months after starting ARTs for "Test and start" and pre "Test and start" cohorts *(95%CI=0.84 - 1.42, Log-rank P=0.42***

*The KM curve starts after day one because of the poor outcomes that occurred at day zero, of the 240 poor outcomes, 52/240 (22%) occurred on the day of starting ARVs.*

### 4.3.3 Mortality patterns for 24 months among patients started on ART for "Test and start" and pre "Test and start" cohorts

Mortality patterns are shown in Figure 4.4. During the 1,144 person-years of follow-up, 26 (3.3%) patients died, a mortality rate of 21.7 (95%CI=14.8 - 31.8) deaths per 1000 person years. Of the total 26 deaths: 15/316 (4.7%) occurred among the "test and treat" group and 11/470 (2.3%) among the pre "Test and start" group; a mortality rate of 31.9 (95%CI 19.2 to 52.9) and 15.1 (95%CI= 8.35 - 27.2) deaths per 1000 person years, respectively. The probability of death during the 24 months of follow-up between the

two groups was on borderline (Log-rank P=0.06, crude Hazard ratio = 2.10, 95%CI= 0.97−4.58) (Figure 4.4). However, the effect of "Test and start" attenuated after adjusting for age, sex and county in the base model (adjusted HR=1.72, 95%CI= 0.78−3.83, P=0.18).

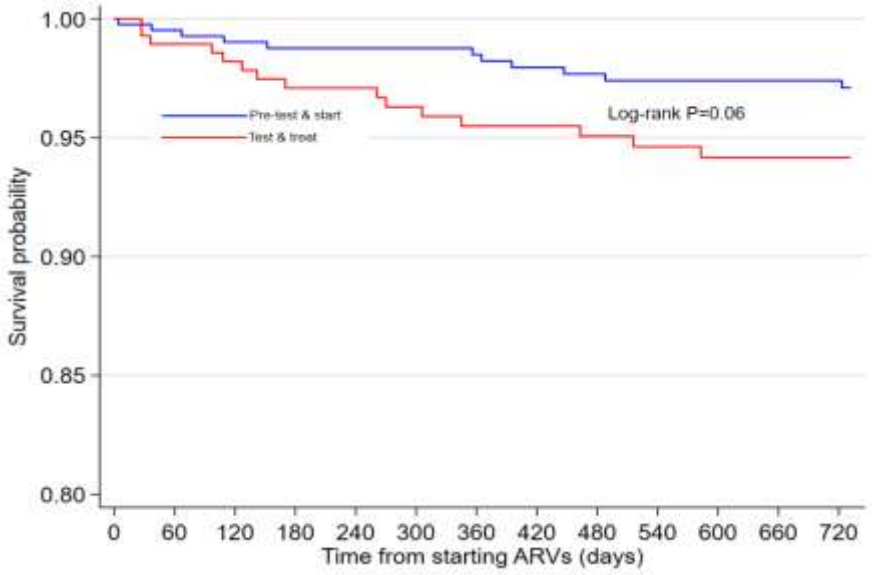


**Figure 4.4: Kaplan–Meier survival curve for 24 months after starting ARTs for the "Test and start" and pre "Test and start" cohorts.**

### 4.3.4 Lost to follow up patterns for 24 months among patients started on ART for "Test and start" and pre "Test and start" cohorts.

A total of 215 (27%) patients were lost to follow-up, a rate of 189 (95%CI=165−216) LTFU per 1000 person-years. Among the "Test and start" patients, 87/316 (28%) were LTFU and 128/470 (27%) among the pre "Test and start" patients: rates of 195 (95%CI 158−240) and 185 (95%CI 155−220) LTFU per 1000 person-years respectively. Of the 215 LTFUs, 52/215 (24%) occurred on the day of starting ARTs; 23/87 (26%) and 29/128 (23%) among the `"Test and start" ' and pre "Test and start" patients respectively (P=0.52). The probability of LTFU during the 24 months of follow-up was not

significantly different between the two groups (Log-rank P=0.31, age, sex and county adjusted HR=1.04, 95%CI= 0.79 -1.38) (Figure 4.5).

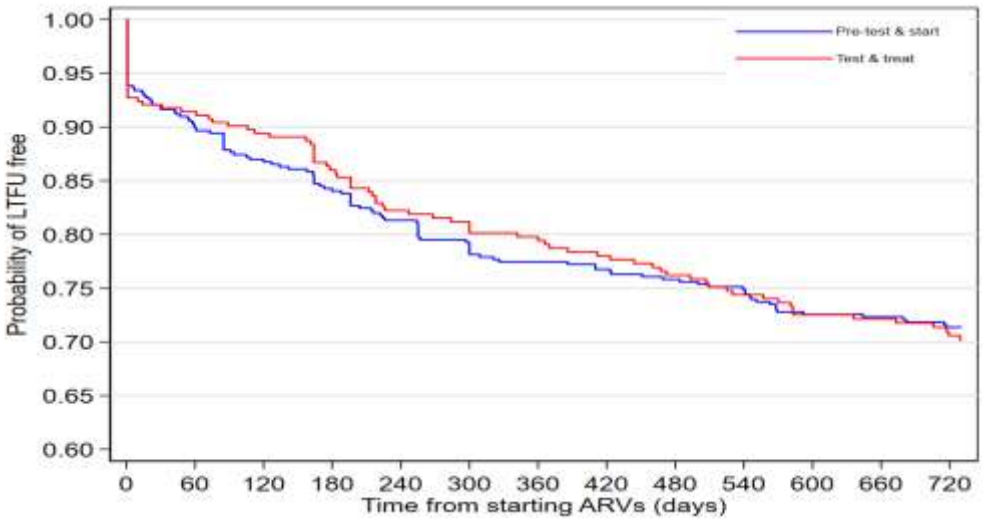


**Figure 4.5: Kaplan–Meier (KM) curve of not being LTFU for 24 months after starting ART.** The KM curve starts after one because of the 52 LTFUs that occurred at day zero**.**

### 4.3.5 Transferring out patterns for 24 months among patients started on ART in the "Test and start" and pre "Test and start" period.

In the 24 months follow up period, 71 (9.0%) patients were transferred out, at a rate of 59.7 (95%CI=47.3−75.4) transfer out per 1000 person-years. Among the `"Test and start" ' patients, 32/316 (10%) were transferred out and 39/470 (8.3%) among the pre "Test and start" patients, at rates of 68.7 (95%CI=48.6−97.1) and 53.9 (95%CI =39.4−73.8) transfer out per 1000 person-years, respectively. Of the 71 transferred-out patients, 16/71 (23%) occurred on the day of starting ARTs; 6/32 (19%) and 11/39 (28%) among the "Test and start" and pre "Test and start" respectively (P=0.36) (Figure 4.6). The probability of transfer out during the 24 months of follow-up was not significantly different between the two groups (Log-rank P=0.13, age, sex and county adjusted HR= 1.52, 95%CI =0.91 to 2.55).

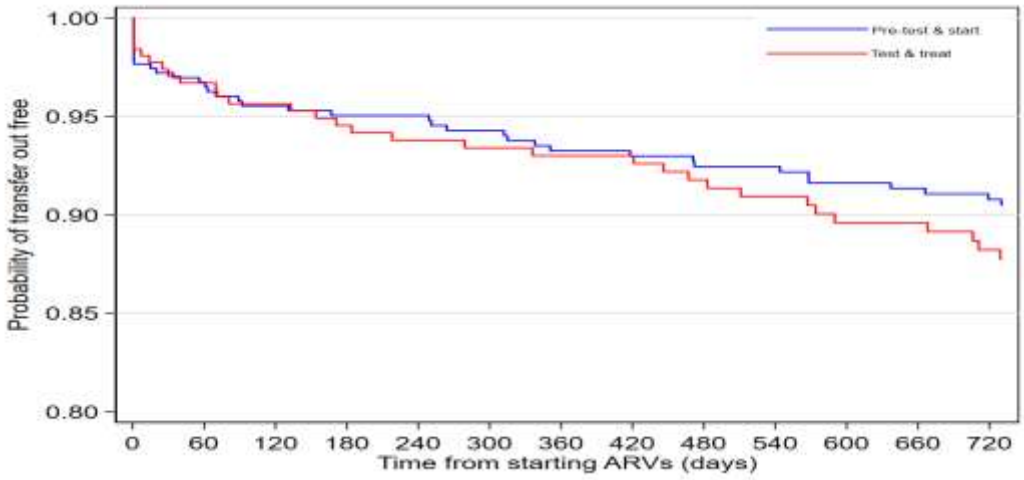


**Figure 4.6: Kaplan–Meier curve of being not transferred out for 24 months after starting ART for pre "Test and start" and "Test and start" cohorts.**

### 4.4 Individual level factors associated with survivorship for 24 months among people living with HIV started on ART in the "Test and start" and pre "Test and start" period.

#### 4.4.1 Individual level factors associated with overall poor outcomes

**Socio-demographic characteristics associated with overall poor outcomes among patients in the "Test and start" and pre "Test and start" cohorts.**

In the multivariable regression model, "Test and start" had no significant effect on risk of poor outcomes, aHR 1.20 (95%CI 0.94 to 1.53). Among the socio-demographic factors, old age was significantly associated with protective effect on hazards of poor outcomes, with those >50 years having almost half the risk for poor outcomes compared to those <30 years, aHR 0.54(95%CI0.32–0.91). The hazard of poor outcomes was higher among males compared to female patients, aHR 1.40 (95%CI 1.05−1.86) (Table 4.9**).**

**Table 4.9: Multivariable analysis of socio-demographic characteristics associated with overall poor outcomes among patients in the "Test and start" and pre "Test and start" cohorts.**

| Characteristics | | Poor outcomes (n=240) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|---|
| *Cohort type* | Delayed treatment | 138 (58) | Reference | |
| | Test and treat | 102 (4) | 1.20 (0.94−1.53) | 0.15 |
| Age in years | <30 | 43 (18) | Reference | |
| | 30 to 40 | 85 (35) | 0.84 (0.56–1.27) | 0.41 |
| | 40 to 50 | 74 (31) | 0.70 (0.44–1.10) | 0.13 |
| | ≥ 50 | 38 (16) | 0.54 (0.32–0.91) | **0.02** |
| *Sex* | Female | 150 (62) | Reference | |
| | Male | 90 (38) | 1.40 (1.05−1.86) | **0.02** |
| *Marital status* | Married | 118 (49) | Reference | |
| | Single | 46 (19) | 0.98 (0.67−1.44) | 0.94 |
| | Divorced/ separated/ widowed | 76 (32) | 1.32 (0.96−1.81) | 0.08 |

**Socio-economic characteristics associated with overall poor outcomes among patients on ART from both cohorts**

Compared to self-employed patients, formally employed and not employed patients had significantly lower risks of poor outcomes, aHR 0.42 (95%CI 0.23-0.76) and 0.53 (95%CI 0.34-0.81) respectively as shown in the table below on socio-economic features associated with overall poor outcomes in the two cohorts (Table 4.10).

**Table 4.10: Multivariable analysis of socio-economic characteristics associated with overall poor outcomes among patients on ART from both cohorts**

| Feature | | Poor outcomes (n=240) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|---|
| *Education level* | No school | 18 (7.5) | 1.31 (0.79−2.19) | 0.18 |
| | Primary | 82 (34) | 0.92 (0.71−1.21) | 0.53 |
| | Secondary & above | 140 (58) | Reference | |
| *Employment status* | Self employed | 88 (37) | Reference | |
| | Informal employment | 76 (32) | 1.16 (0.86−1.55) | 0.33 |
| | Formal employment | 14 (5.0) | 0.42 (0.25−0.71) | **0.001** |
| | Not employed | 62 (26) | 0.57 (0.39−0.82) | **0.003** |
| *Economic status* | Independent | 74 (31) | Reference | |
| | Semi-independent | 124 (52) | 1.12 (0.83−1.50) | 0.45 |
| | Dependent | 42 (17) | 1.42 (0.90−2.24) | 0.13 |

**Clinical features associated with overall poor outcomes among patients on ART from both cohorts**

Clinical features explored were not associated with poor outcomes (Table 4.11).

**Table 4.11: Multivariable analysis of clinical features associated with overall poor outcomes among patients on ART from both cohorts**

| Feature | | Poor outcomes (n=240) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|---|
| *Nutritional status* | <18.5 | 46 (19) | 1.28 (0.92−1.76) | 0.14 |
| | 18.5 to 24.9 | 115 (48) | Reference | |
| | ≥ 25 | 44 (18) | 0.77 (0.57−1.05) | 0.1 |
| | Missing | 35 (15) | 1.39 (0.95−2.04) | 0.09 |
| *ART regimen* | TDF/3TC/EFV | 219 (91) | Reference | |
| | Others** | 21 (9.0) | 1.10 (0.71−1.71) | 0.66 |
| *WHO stage* | Stage I | 155 (65) | Reference | |
| | Stage II | 59 (25) | 1.14 (0.84−1.54) | 0.4 |
| | Stage III & IV | 26 (10) | 1.24 (0.77−1.98) | 0.38 |
| *Number of adherence sessions before ART initiation* | ≤1 | 78 (33) | 0.97 (0.73−1.30) | 0.84 |
| | 2 | 43 (18) | 1.13 (0.80−1.61) | 0.48 |
| | ≥3 | 77 (32) | Reference | |
| *Had opportunistic infection* | | 19 (7.9) | 1.08 (0.66−1.77) | 0.75 |

*Adjusted HR from shared gamma frailty Cox model with the county as a random intercept.

**ABC/3TC/LPV/r, ABC/3TC/EFV, AZT/3TC/EFV, D4T/3TC/NVP and TDF/3TC/NVP

### 4.4.2 Individual level factors associated with mortality in pre "Test and start" and "Test and start" cohorts.

**Socio-demographic factors associated with mortality in pre "Test and start" and "Test and start" cohorts**

In the multivariable regression model, "Test and start" did not have significant effect on the hazards of mortality as shown in table 4.12. Patients in the "Test and start" group had almost twice higher risk of mortality than those in the pre "Test and start" group, aHR 1.87 (95%CI 0.76 to 4.62), though this was not significant. As for socio-demographic characteristics, being male was associated with significant higher risk of death at almost 5 times compared to being female, aHR 4.60 (95%CI 1.83 to 11.5). Compared to the married patients, divorced/separated/widowed had four times higher risk of death, aHR 3.96 (95%CI 1.36-11.5).

**Table 4.12: Multivariable analysis of socio-demographic factors associated with mortality in pre "Test and start" and "Test and start" cohorts.**

| Feature | Deaths (n=26) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|
| *Type of treatment* | | | |
| Pre "Test and start" " | 11 (2.4) | Reference | |
| Test and treat | 15 (4.8) | 1.87 (0.76−4.62) | 0.18 |
| *Age in years* | | | |
| *<30* | 2 (1.7) | Reference | |
| *30 to 40 years* | 5 (1.8) | 1.03 (0.17-6.41) | 0.97 |
| *40 to 50 years* | 12 (5.1) | 1.70 (0.28-10.3) | 0.57 |
| *≥ 50 years* | 7 (5.0) | 1.26 (0.20-8.07) | 0.81 |
| *Sex* | | | |
| Female | 11 (2.1) | Reference | |
| Male | 15 (6.2) | 4.60 (1.83−11.5) | **0.001** |
| *Marital status* | | | |
| Married | 9 (2.2) | Reference | |
| Single | 2 (1.4) | 0.90 (0.14−5.64) | 0.91 |
| Divorced/separated/widowed | 11 (6.2) | 3.96 (1.36−11.5) | **0.01** |

**Socio-economic factors associated with mortality in both cohorts.**

Among socio-economic factors, not attending school at all and having primary level of education was associated with significantly higher risks of death compared with having secondary education and above, aHR 6.92 (95%CI 1.33 to 36.1) and 3.34 (95%CI 1.02 to 10.9) respectively as shown in table 4.13 below on multivariable analysis of socio-economic factors associated with mortality in the pre "Test and start" and "Test and start" cohorts. Compared to patients who were economically independent, the semi-independent were associated with lower risk of death, aHR 0.24 (95%CI 0.07 to 0.83).

**Table 4.13: Multivariable analysis of socio-economic factors associated with mortality in both cohorts.**

| Feature | Deaths (n=26) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|
| *Education level* | | | |
| No school | 5 (10) | 6.92 (1.33−36.1) | **0.02** |
| Primary | 14 (5.1) | 3.34 (1.02−10.9) | **0.04** |
| Secondary & above | 7 (1.6) | Reference | |
| *Employment status* | | | |
| Self employed | 10 (3.8) | Reference | |
| Informal employment | 4 (2.1) | 0.31 (0.08−1.12) | 0.07 |
| Formal employment | 2 (2.4) | 0.47 (0.08−2.92) | 0.42 |
| Not employed | 10 (4.3) | 0.23 (0.04−1.30) | 0.10 |
| *Economic status* | | | |
| Independent | 12 (4.8) | Reference | |
| Semi-independent | 5 (1.3) | 0.24 (0.07−0.83) | **0.03** |
| Dependent | 9 (6.6) | 2.19 (0.31−15.3) | 0.43 |

**Clinical factors associated with mortality in both cohorts**

Table 4.14 below shows the multivariate analysis of clinical factors associated with mortality in both cohorts. Patients on other regimens were more than seven times likely to die compared with those on TDF/3TC/EFV, aHR 7.68 (95%CI 1.97 to 29.9). Other clinical features were not associated with mortality.

**Table 4.14: Multivariable analysis of clinical factors associated with mortality in both cohorts.**

| Feature | Deaths (n=26) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|
| *Nutritional status (BMI)* | | | |
| <18.5 | 10 (8.5) | 1.38 (0.53−3.57) | 0.51 |
| 18.5 to 24.9 | 13 (3.4) | Reference | |
| ≥ 25 | 1 (0.6) | 0.21 (0.03−1.70) | 0.14 |
| Missing | 2 (2.2) | 0.81 (0.14−4.70) | 0.81 |
| *Type of ART* | | | |
| TDF/3TC/EFV | 22 (3.0) | Reference | |
| Others** | 4 (7.6) | 7.68 (1.97−29.9) | **0.003** |
| *WHO stage* | | | |
| Stage I | 8 (1.5) | Reference | |
| Stage II | 11 (5.8) | 1.68 (0.58−4.90) | 0.34 |
| Stage III & IV | 7 (11) | 2.87 (0.67−12.3) | 0.15 |
| *Number of adherence sessions before ART initiation* | | | |
| ≤1 | 9 (3.5) | 1.27 (0.41−3.92) | 0.68 |
| 2 | 5 (4.0) | 1.14 (0.33−4.00) | 0.84 |
| ≥3 | 8 (2.9) | Reference | |
| *Missing data* | 4 (3.6) | 1.45 (0.37−5.78) | 0.59 |
| *Had opportunistic infections* | 5 (8.2) | 1.60 (0.34−7.55) | 0.55 |

*Adjusted HR from shared gamma frailty Cox model with the county as a random intercept;

**ABC/3TC/LPV/**r**, ABC/3TC/EFV, AZT/3TC/EFV, D4T/3TC/NVP and TDF/3TC/NVP

### 4.4.3 Individual level factors associated with loss-to-follow-up

**Socio-demographic factors associated with loss to follow up in cohorts before and after "Test and start".**

In the multivariable regression model, "Test and start" had no significant effect on risk of LTFU: aHR 1.13 (95%CI 0.84 to 1.52) as shown in table 4.15. Among socio-demographic factors associated with loss to follow up in cohorts before and after "Test and start", ≥ 50 years of age had protective effect on risk of LTFU, aHR 0.54 (0.31-0.93) .Other demographic features analyzed were not associated with LTFU.

**Table 4.15: Multivariable analysis of socio-demographic factors associated with loss to follow up in cohorts before and after "Test and start".**

| Feature | LTFUs (n=215) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|
| *Type of treatment* | | | |
| Pre "Test and start " | 128 (60) | Reference | |
| "Test and treat" | 87 (40) | 1.13 (0.84−1.52) | 0.42 |
| *Age in years* | | | |
| <30 years | 41(32) | Reference | |
| 30 to 40 years | 81 (28) | 0.86 (0.56-1.31) | **0**.47 |
| 40 to 50 years | 62 (26) | 0.69 (0.43-1.12) | 0.13 |
| ≥ 50 years | 31 (22) | 0.54 (0.31-0.93) | **0.03** |
| *Sex* | | | |
| Female | 140 (65) | Reference | |
| Male | 75 (35) | 1.25 (0.92−1.69) | 0.15 |
| *Marital status* | | | |
| Married | 109 (51) | Reference | |
| Single | 45 (21) | 1.03 (0.70−1.53) | 0.86 |
| Divorced/separated | 61 (28) | 1.23 (0.87−1.73) | 0.25 |

**Socio-economic factors associated with loss to follow up in both cohorts**

In the multivariable analysis of socio-economic factors associated with loss to follow up in both cohorts, patients in formal employment and those not employed had significantly lower risk of LTFUs compared to those in self-employment: aHR 0.42 (95%CI 0.22 to 0.79) and 0.58 (95%CI 0.37 to 0.91) respectively as shown in table 4.16. Other socio-economic characteristics analyzed were not associated with LTFU.

**Table 4.16: Multivariable analysis of socio-economic factors associated with loss to follow up in pre "Test and start" and "Test and start" cohorts.**

| **Feature** | **LTFUs (n=215)** | **Adjusted HR (95% CI) *** | **P-value** |
|---|---|---|---|
| *Education level* | | | |
| No school | 13 (6.0) | 1.19 (0.63−2.28) | 0.59 |
| Primary | 68 (32) | 0.82 (0.59−1.14) | 0.24 |
| Secondary & above | 134 (62) | Reference | |
| *Employment status* | | | |
| Self employed | 78 (36) | Reference | |
| Informal employment | 72 (33) | 1.35 (0.96−1.90) | 0.09 |
| Formal employment | 12 (5.5) | 0.42 (0.22−0.79) | **0.007** |
| Not employed | 53 (25) | 0.58 (0.37−0.91) | **0.02** |
| *Economic status* | | | |
| Independent | 62 (29) | Reference | |
| Semi-independent | 120 (56) | 1.24 (0.87−1.77) | 0.23 |
| Dependent | 33 (15) | 1.54 (0.89−2.67) | 0.13 |

**Clinical factors associated with loss to follow up in pre "Test and start" and "Test and start" cohorts**

Table 4.17 shows the multivariable analysis of clinical factors associated with loss to follow up in among pre "Test and start" and "Test and start" cohorts. Patients missing information on their nutritional status and whether they had adherence counseling sessions before starting ART had significantly higher risk of being lost to follow up, aHR 1.62 (95%CI 1.04−2.51) and 1.83(95%CI 1.18−2.83) . Other clinical features analyzed were not associated with loss to follow up.

**Table 4.17: Multivariable analysis of clinical factors associated with loss to follow up in pre "Test and start" and "Test and start" cohorts.**

| Feature | LTFUs (n=215) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|
| *Nutritional status (BMI)* | | | |
| <18.5 | 36 (17) | 1.31 (0.88−1.95) | 0.19 |
| 18.5 to 24.9 | 102 (47) | Reference | |
| ≥ 25 | 43 (20) | 0.90 (0.62−1.29) | 0.56 |
| Missing | 34 (16) | 1.62 (1.04−2.51) | **0.03** |
| *Type of ART* | | | |
| TDF/3TC/EFV | 198 (92) | Reference | |
| Others** | 17 (8.0) | 1.14 (0.69−1.90) | 0.61 |
| *WHO stage* | | | |
| Stage I | 147 (68) | Reference | |
| Stage II | 48 (22) | 1.14 (0.79−1.65) | 0.49 |
| Stage III & IV | 20 (9.3) | 1.30 (0.73−2.32) | 0.37 |
| *Number of adherence counselling sessions before starting ART.* | | | |
| ≤1 | 69 (32) | 1.10 (0.78−1.56) | 0.59 |
| F2 | 38 (18) | 1.25 (0.83−1.89) | 0.28 |
| ≥3 | 69 (32) | Reference | |
| *Missing* | 39 (18) | 1.83 (1.18−2.83) | **0.007** |
| *Had opportunistic infection* | 15 (7.0) | 0.83 (0.44−1.58) | 0.56 |

*Adjusted HR from shared gamma frailty Cox model with the county as a random intercept;

**ABC/3TC/LPV/r, ABC/3TC/EFV, AZT/3TC/EFV, D4T/3TC/NVP and TDF/3TC/NVP

### 4.4.4 Individual level factors associated with transferring out

**Socio-demographic factors associated with transferring out in pre "Test and start" and "Test and start" cohorts**

In the multivariable regression model, "Test and start" had no significant effect on risk of transferring out to other facilities, aHR 1.59 (95%CI 0.92 to 2.73). Table 4.18 shows the multivariable analysis of demographic factors associated with transferring out in both cohorts with male patients having significantly lower risk of transferring out compared to female patients , aHR 0.44 (95%CI 0.23 to 0.82).

**Table 4.18: Multivariable analysis of socio-demographic factors associated with transferring out in pre "Test and start" and "Test and start" cohorts.**

| Feature | Transfer out (n=71) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|
| *Type of treatment* | | | |
| Delayed treatment | 39 (55) | Reference | |
| Test and treat | 32 (45) | 1.59 (0.92−2.73) | 0.09 |
| *Age in years* | | | |
| <30 years | 15 (12) | Reference | |
| 30 to 40 years | 27 (9.6) | 0.71 (0.36-1.40) | 0.32 |
| 40 to 50 years | 18 (7.6) | 0.51 (0.24-1.12) | 0.09 |
| ≥ 50 years | 11 (7.9) | 0.63 (0.26-1.54) | 0.31 |
| *Sex* | | | |
| Female | 58 (82) | Reference | |
| Male | 13 (18) | 0.44 (0.23−0.82) | **0.01** |
| *Marital status* | | | |
| Married | 44 (62) | Reference | |
| Single | 10 (14) | 0.62 (0.30−1.30) | 0.21 |
| Divorced/separated | 17 (24) | 0.74 (0.40−1.37) | 0.33 |

**Socio-economic factors associated with transferring out in pre "Test and start" and "Test and start" cohorts**

Socio-economic features were not associated with any increased or decreased hazards for transferring out of their facilities as shown in table 4.19 on the multivariable analysis of socio-economic factors associated with transferring out in cohorts before and after "Test and start".

**Table 4.19: Multivariable analysis of socio-economic factors associated with transferring out in pre "Test and start" and "Test and start" cohorts.**

| Feature | Transfer out (n=71) | Adjusted HR (95% CI) * | P-value |
|---|---|---|---|
| *Education level* | | | |
| No school | 4 (5.6) | 0.37 (0.09−1.35) | 0.13 |
| Primary | 27 (38) | 0.80 (0.44−1.42) | 0.44 |
| Secondary & above | 40 (56) | Reference | |
| *Employment status* | | | |
| Self employed | 31 (44) | Reference | |
| Informal employment | 18 (25) | 0.81 (0.41−1.57) | 0.53 |
| Formal employment | 4 (5.6) | 0.32 (0.09−1.15) | 0.08 |
| Not employed | 18 (25) | 0.54 (0.25−1.15) | 0.11 |
| *Economic status* | | | |
| Independent | 22 (31) | Reference | |
| Semi-independent | 40 (56) | 1.13 (0.59−2.16) | 0.64 |
| Dependent | 9 (13) | 1.09 (0.38−3.17) | 0.86 |

**Clinical factors associated with transferring out in pre "Test and start" and "Test and start" cohorts**

Table 4.20 shows the multivariate analysis of clinical factors associated with transferring out in the cohorts before and after "Test and start". Patients who did not have any

information on the number of adherence counselling sessions were more than twice likely to transfer out compared to those with three or more adherence counselling sessions, aHR 2.35 (95%CI 1.09−5.03). Other clinical features analyzed were not associated with increased or reduced hazards of transferring out.

**Table 4.20: Multivariable analysis of clinical factors associated with transferring out in pre "Test and start" and "Test and start" cohorts.**

| **Feature** | **Transfer out (n=71)** | **Adjusted HR (95% CI) *** | **P-value** |
|---|---|---|---|
| *Nutritional status (BMI)* | | | |
| <18.5 | 11 (15) | 1.23 (0.61−2.49) | 0.56 |
| 18.5 to 24.9 | 38 (54) | Reference | |
| ≥ 25 | 16 (23) | 0.71 (0.37−1.36) | 0.30 |
| Missing | 6 (8.5) | 0.55 (0.18−1.72) | 0.31 |
| *ART regimen* | | | |
| TDF/3TC/EFV | 68 (96) | Reference | |
| Others** | 3 (4.0) | 0.76 (0.23−2.51) | 0.65 |
| *WHO stage* | | | |
| Stage I | 48 (68) | Reference | |
| Stage II | 18 (25) | 1.30 (0.69−2.44) | 0.43 |
| Stage III & IV | 5 (7.0) | 0.72 (0.23−2.26) | 0.57 |
| *Number of adherence sessions before ART initiation* | | | |
| ≤1 | 19 (27) | 0.86 (0.46−1.60) | 0.63 |
| 2 | 8 (11) | 0.56 (0.21−1.48) | 0.24 |
| ≥3 | 29 (41) | Reference | |
| *Missing data* | 15 (21) | 2.35 (1.09−5.03) | **0.03** |
| *Had opportunistic infection* | 7 (10) | 2.22 (0.82−6.03) | 0.12 |

*Adjusted HR from shared gamma frailty Cox model with the county as a random intercept.

**ABC/3TC/LPV/**r**, ABC/3TC/EFV, AZT/3TC/EFV, D4T/3TC/NVP and TDF/3TC/NVP

# CHAPTER FIVE

# DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Discussion

This retrospective cohort study followed up 786 patients with about two for every three being from the cohort before "Test and start". At the end of the 24 months follow up period, about two thirds of patients in both cohorts were still on ART.

### 5.1.1 Viral load suppression

In this cohort study, the proportion of patients with unsuppressed viral load in the before and after "Test and start" cohorts was not significantly different at month 6 (P=0.95), 12 (P=0.30) and month 24 (P=0.48). These findings are comparable to other studies that compared viral load suppression among those who started ART immediately after HIV diagnosis and those started later. Hoenigl *et al.*,(2016) and the RAPID study (Christopher *et al.*,2018) and found similar viral load suppression rates at 24 and 48 weeks among those who started ART on same day of diagnosis, within one week of diagnosis and those who started later. However, both studies had only 86 participants each which are small sample sizes. In a Ugandan study of 367 children, Ssebunya *et al.*, 2017, found better viral load outcomes among those who started ART within 7 days of diagnosis than those who delayed in starting ART contradicting our findings.

### Predictors of viral load suppression

In this study, there was no significant difference in viral load suppression among males and females, which is in keeping with data from the NASCOP viral load dashboard for Kenya (NASCOP, 2021). Similar findings were obtained in a cross-sectional study involving 1255 PLHIV in Vietnam where gender did not affect viral load suppression (Rangarajan *et al.*, 2016). A meta-analysis by Soon *et al.*, (2012) did not find gender as

a significant factor in viral load outcomes at 48 weeks; this is supported by other studies (Nicastri *et al.*, 2005, Prins *et al.*, 2005; Thorsteinsson *et al.*, 2012). Barth *et al.*, (2011) found male gender to be predictive of viral load suppression in South Africa, while Haider *et al.*, (2019) found male gender to have higher odds for viral load suppression in South Carolina, USA. The two studies above analyzed retrospective data from one clinic each while this study analyzed data from 18 sites across 3 counties with a larger sample size, randomly selected, and covers for the bias that may have arisen in the two studies. In Kenya, and at the coast in particular, there are no socio-economic, cultural or health system factors that would favor males on ART or otherwise, which may be the case in the South African and American studies.

Older age was associated with lower odds for viral load unsuppression in this study consistent with program data from the NASCOP dashboard (National AIDS and STI Control Programme (NASCOP, 2021). A study in Swaziland by Jobanputra *et al.*, (2015) and the SEARCH study (Petersen *et al.*, 2017), a community level cohort study done in Kenya and Uganda also found that being young (15-24 years) was associated with of viral load unsuppression. At the age of 15-24 years, many people are in the phase of self-awareness, in new relationships and most have not disclosed their HIV status to their mates, thus finding it difficult to adhere to taking their drugs leading to viral load unsuppression.

Low socio-economic status has been strongly associated with poor HIV outcomes, including poor adherence to ART and subsequently low rates of viral load suppression (Mcallister *et al.*, 2013; Burch *et al.*, 2016). Improving the economic status was found to improve viral load suppression rates among adolescents living with HIV in Uganda (Bermudez *et al.*, 2018). In this study, PLHIV in informal employment and those with no education had significantly higher odds of having viral load unsuppression compared to those in self- employment or with secondary level education and above respectively, results which is in keeping with the above studies. Patients who were semi-independent economically had significantly lower odds of having viral load suppression compared to those who are independent, unlike in the above studies. This could be due to higher

levels stigma among this class of people, who often miss their clinical appointments, do not enroll in support group sessions, and pick drugs from far facilities from their homes. They thus lack treatment accountability partners, treatment buddies and home visit support by peer educators or community health volunteers for closer adherence counselling and support. The semi-independent, due to their low socio-economic status could also lack transport to visit their facilities for drug pick up as well as for other support services.

### 5.1.2 Survivorship / attrition patterns up to 24 months

In this study, the retention rates between the cohorts of PLHIV started on ART before and after implementation of "Test and start" were not significantly different**.** In the first three months after starting ARVs, the retention rates were 84% for the "Test and start" cohort while that for the cohort before was 88%. After two years of ARVs, the retention rates declined in both the "Test and start" and pre "Test and start" groups to 64% and 68% respectively. The retention at one year is comparable to that of 89% found in a 2017 study for "Test and start" patients in Kenya and Uganda (Hassan *et al.*, 2015, Kwarisiima *et al.*, 2017)) . A cohort study done in Uganda at almost the same time (January 2015 to December 2017) involving 646 patients by Opio *et al.*, (2019) concluded that "there was no significant mean difference ($p = 0.231$) in the retention times of patients initiated on ART based on $CD_4$ cell count, compared to those initiated under the "test and treat" strategy. The retention rates are similar to other studies globally such as Rosen *et al.*, (2007) and Fox & Rosen (2016), where the averaged retention was 78% at 12 months, 71% at 24 months, and 69% at 36 months across all regions in a meta-analysis of 154 cohorts of PLHIV from 42 countries (24 in Africa (114 cohorts), 10 in Asia (28 cohorts), and 8 in LAC (12 cohorts). However**,** in a Malawi retrospective study, immediate ART was found to be associated with low retention rates among PMTCT mothers (Chan *et al.*, 2016). The study which analyzed 456 pregnant women on ART in Malawi showed that "initiation of ART on the same day as HIV diagnosis, was independently associated with reduced retention in the first six months.

This study found that 1 in 10 cases of attrition were caused by deaths, results that are not consistent with a Ugandan prospective cohort study by Flynn *et al.*, (2017) who observed that death was the largest cause of attrition at 80% (127/158) and 63% (n = 80) of the deaths occurred in the first year of HIV therapy. In this study, of the 240 poor outcomes, about 1 in 5 occurred on the day of starting ART, 23/102 (23%) for the "Test and start" cohort and 29/138 (21%) for the delayed treatment cohort underlying the fact that starting patients on ART immediately upon diagnosis did not lead to poor outcomes. More thorough adherence counselling and treatment preparation will improve outcomes for both cohorts.

### 5.1.3 Individual level factors associated with poor outcomes

Just like in previous studies (Cornell *et al.*, 2009; Tayler-Smith *et al.*, 2011, Kwarisiima *et a*l., 2017) increasing age was significantly associated with protective effect on hazard of poor outcomes, with the risk of poor outcomes reducing by 2% for every year gained. This could be due to the reason that older people living with HIV are able to accept their HIV status, adhere to treatment hence the better outcomes as opposed to adolescents who often struggle with self-stigma, relationship and self-identify issues.

Males had higher likelihood of having poor outcomes compared to female patients (aHR=1.37, 95%CI=1.03−1.82) although it was not statistically significant. These findings are supported by Chen *et al.,* (2008); Barth *et al.,* (2011) and Hassan *et al.,* (2015) who found male gender to be associated with poor outcomes in Malawian, Ugandan and Kenyan studies respectively. Among the reasons the for the poor outcomes among men in Kenya are the poor health seeking behavior, less psychosocial support systems and higher levels of stigma compared to women.

Divorced/separated patients were one and half more times likely to have poor outcomes compared to married patients which may be due to the lack of consistent support systems that may be lacking. This is in contrast to a study in Kilifi (Hassan *et al.*, 2015) which did not find marital status to be associated with attrition. Compared to self-

employed patients, formally employed patients had half the risk of having poor clinical outcomes which is supported by other studies like the systematic review and meta-analysis by Nachega *et al.,* (2015) which included 28 studies published between 1996 and 2014 involving 8743 HIV-infected individuals from 14 countries.

**Predictors of mortality**

In this study, it was found that males had more than 4 times risk of mortality than females. This is consistent with other studies (Chen *et al.,* 2008; Lawn *et al.,* 2008; Hassan *et al.,* 2015; Angdembe *et al.,* 2019) although the risk was not as high as found in this study. In this study, compared to the married patients, divorced/separated/widowed had more than threefold risk of mortality, which is consistent with the findings in assessment of overall poor outcomes. This study found that patients with no education or with primary school education had a significant risk of death compared to those with secondary education and above, which is contradictory to findings of a meta-analysis done by Probst *et a*l., (2016) for 10 studies comprising of 175,000 patients and 6700 deaths in South Africa. Consistent with studies in Ethiopia(Tekola *et al.*, 2008) and Zambia (Tshikuka *et al.*, 2014) that concluded "poor households are more likely to experience an AIDS death" and "low socioeconomic status in patients hospitalized for HIV/AIDS were more likely to die than high socioeconomic status inpatients" respectively. This study found that patients who were economically dependent had an increased risk of mortality while those who are semi-independent had significantly lower risk of death. Patients who were not on the first line recommended ART regimen are often treatment failure clients or those who had defaulted and therefore not yet switched to more efficacious regimen. Though these deaths formed a small proportion of all the mortalities (4/26), they had a risk of mortality which was more than 7 times of those on the recommended first line ART at the time of Tenofovir/ Lamivudine and Efavirenz combination.

**Predictors of loss to follow up**

The rates of LTFU were 185 (95%CI 155−220) and 195 (95%CI 158−240) losses per 1000 person-years for the before and after "Test and start" cohorts respectively with almost 1 in 4 LTFU occurring on the day of starting ART. Increasing age and formal employment were protective on being lost to follow up which is consistent with findings from Uganda in a "Test and start" setting where they found age ≥25 years to be associated with reduced risk of being lost to follow up (Kiwanuka *et al.*, 2020). This is probably due to the fact the younger patients are undergoing life transforming events at this age including decisions on relationships, careers, studies, self-awareness and discovery which get complicated with HIV diagnosis with its associated stigma and discrimination. Patients who missed nutritional assessments in their records had higher risk of being lost to follow up in this study which is in contrast to Opio *et al.* (2019) who found patients with normal BMI being at higher risk for loss to follow up.

**Predictors of transferring out**

In this study, we found males to have a third the likelihood of transferring out to other health facilities compared to females. Patients without documented adherence counselling sessions before starting ART were more likely to transfer out than those who had documented adherence counselling sessions. The findings in this study reflect those of a South African study with 4511 participants of which 597 transferred out to other facilities during the study period, found being female and having >1000 copies/ml viral load as risk factors for transferring out (Nglazi *et al.*, 2013). Given that in the Kenyan set up we have men being employed more than women, it is expected that we will have more men migrating due to work hence more transfers out. The findings in this study are contrary to this expectation. Majority of formal employers in Kenya require tertiary level of education for employment. In this study, only 1 in 5 of the male respondents had tertiary level of education, meaning that they were less likely to be employed in jobs that would require them to migrate hence less chances of transferring out. Marriage and start

of new relationship could have contributed to the higher likelihood of transferring out for women.

## 5.2 Conclusions

1. The viral load suppression rates among cohorts of people living with HIV started on anti- retroviral therapy before and after implementation of "Test and start" program are similar in Mombasa, Kwale and Kilifi counties.
2. The survivorship patterns at every 3 months for 24 months for the two cohorts were also similar. Males, the young, divorced/separated/widowed, poor socio-economic status, and those not on recommended first line regimen had a higher risk for poor clinical outcomes.
3. Individual level factors associated with higher risk for poor clinical outcomes included being of male gender, young >30 years, divorced/separated/widowed, poor socio-economic status and not receiving adherence counselling sessions before starting ART.

## 5.3 Recommendations

1. The "Test and start" program is as effective as the previous policy in clinical outcomes and should be continued as the early ART treatment averts severe morbidity and mortality as outlined in previous studies. All people living with HIV should be on optimized ART regimen which have better clinical outcomes.
2. This study focused on individual level factors that affect viral load suppression rates and survivorship patterns in the cohorts under study. It is recommended that other studies look at the health system factors that affect viral load suppression rates and survivorship patterns, particularly the effects of each of the WHO building blocks for the health system.
3. Programs should implement strategies tailored towards addressing the specific challenges faced by males, young adults, those with poor socio-economic status, the divorced or separated and widowed

4. In this study, patients who were semi-independent economically were found to have significantly lower odds of achieving viral load suppression compared to those who are independent, unlike in the other studies. It is recommended that both qualitative and quantitative studies be done to explain the lower odds for viral load suppression in this group of patients.

### 5.4 Limitation of the study

Our study had some limitations. First, there are various thresholds used for the definition of viral load suppression ranging from ≤20, ≤50, ≤200, ≤400 to <1000 copies/ml (Lesko, *et al.*, 2020). As guided by the Ministry of Health's guidelines in Kenya, this study used a threshold of <1000 copies/ml which is different from many other studies. This threshold will have to be put into consideration when interpreting the viral load suppression rates for both cohorts. Secondly, the study did not select sites randomly but selected the high-volume facilities which are mostly well resourced that small volume facilities. The level of resources may affect the clinical outcomes for facilities and individuals.

Though this study followed all the laid out guidelines including the STROBE guidelines(Vandenbroucke *et al.*, 2007) for reporting, it still has a few limitations. This study relied on data in patient files and registers. Follow up for patients who were found to be lost to follow up was not done. In some studies, some of the lost to follow up patients restarted treatment in other facilities and could be active on ART while others could be dead. The study also lacked the capacity to identify clients that had been diagnosed earlier, started ART, stopped, and later came back as newly diagnosed PLHIV. Lastly, since this is retrospective study, bias arising from unmeasured features cannot be entirely ruled out.

## REFERENCES


Abbafati, C., Abbas, K. M., Abbasi-Kangevari, M., Abd-Allah, F., Abdelalim, A., Abdollahi, M., Abdollahpour, I., Abegaz, K. H., Abolhassani, H., Aboyans, V., Abreu, L. G., Abrigo, M. R. M., Abualhasan, A., Abu-Raddad, L. J., Abushouk, A. I., Adabi, M., Adekanmbi, V., Adeoye, A. M., Adetokunboh, O. O., … Murray, C. J. L. (2020). Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*, *396*(10258), 1204–1222.

Ahmed, S., Autrey, J., Katz, I. T., Fox, M. P., Rosen, S., Onoya, D., Bärnighausen, T., Mayer, K. H., & Bor, J. (2018). Social Science & Medicine Why do people living with HIV not initiate treatment ? A systematic review of qualitative evidence from low- and middle-income countries. *Social Science & Medicine*, *213*(November 2017), 72–84.

Angdembe, M. R., Rai, A., Bam, K., & Pandey, S. R. (2019). Predictors of mortality in adult people living with HIV on antiretroviral therapy in Nepal: A retrospective cohort study, 2004-2013. *PLoS ONE*, *14*(4), 2004–2013.

Barth, R. E., Tempelman, H. A., Moraba, R., & Hoepelman, A. I. M. (2011). Long-term outcome of an HIV-treatment programme in Rural Africa: Viral suppression despite early mortality. *AIDS Research and Treatment*, *2011*.

Bennett, D. E., Bertagnolio, S., Sutherland, D., & Gilks, C. F. (2008). The World Health Organization's global strategy for prevention and assessment of HIV drug resistance. In *Antiviral Therapy*.

Bermudez, L. G., Ssewamala, F. M., Neilands, T. B., Lu, L., Jennings, L., Nakigozi, G., Mellins, C. A., McKay, M., & Mukasa, M. (2018). Does Economic Strengthening

Improve Viral Suppression Among Adolescents Living with HIV? Results From a Cluster Randomized Trial in Uganda. *AIDS and Behavior*, *22*(11).

Boender, T. S., Sigaloff, K. C. E., Mcmahon, J. H., Kiertiburanakul, S., Jordan, M. R., Barcarolo, J., Ford, N., Rinke De Wit, T. F., & Bertagnolio, S. (2015). Long-term virological outcomes of first-line antiretroviral therapy for HIV-1 in low- and middle-income countries: A systematic review and meta-analysis. *Clinical Infectious Diseases*, *61*(9), 1453–1461.

Burch, L. S., Smith, C. J., Anderson, J., Sherr, L., Rodger, A. J., O'Connell, R., Geretti, A. M., Gilson, R., Fisher, M., Elford, J., Jones, M., Collins, S., Azad, Y., Phillips, A. N., Speakman, A., Johnson, M. A., & Lampe, F. C. (2016). Socioeconomic status and treatment outcomes for individuals with HIV on antiretroviral treatment in the UK: cross-sectional and longitudinal analyses. *The Lancet Public Health*, *1*(1), e26–e36.

Chan, A. K., Kanike, E., Bedell, R., Mayuni, I., Manyera, R., Mlotha, W., Harries, A. D., Van Oosterhout, J. J., & Van Lettow, M. (2016). Same day HIV diagnosis and antiretroviral therapy initiation affects retention in Option B+ prevention of mother-to-child transmission services at antenatal care in Zomba District, Malawi. *Journal of the International AIDS Society*, *19*(1), 1–6.

Chen, S. C., Yu, J. K., Harries, A. D., Bong, C., Kolola-dzimadzi, R., Tok, T., King, C., & Wang, J. (2008). *Increased mortality of male adults with AIDS related to poor compliance to antiretroviral therapy in Malawi*. *13*(4), 513–519.

Cherutich, P., Kim, A. A., Kellogg, T. A., Sherr, K., Waruru, A., De Cock, K. M., & Rutherford, G. W. (2016). Detectable HIV Viral Load in Kenya: Data from a Population-Based Survey. *PLoS ONE*.

Chi, B. H., Yiannoutsos, C. T., Westfall, A. O., Newman, J. E., Zhou, J., Cesar, C., Brinkhof, M. W. G., Mwango, A., Balestre, E., & Carriquiry, G. (2011). *Universal*

*Definition of Loss to Follow-Up in HIV Treatment Programs : A Statistical Analysis of 111 Facilities in Africa , Asia , and Latin America*. *8*(10).

Christopher D. Pilcher, M., , Clarissa Ospina-Norvell, FN-P1, Aditi Dasgupta, BS2, D., Jones, RN1, Wendy Hartogensis, PhD1, Sandra Torres, MSW1, Fabiola Calderon, M., Erin Demicco, MPH1, Elvin Geng, MD1, Monica Gandhi, MD1, Diane V. Havlir, MD1, A., & Hiroyu Hatano, M. (2018). The Effect of Same-Day Observed Initiation of Antiretroviral Therapy on HIV Viral Load and Treatment Outcomes in a U.S. Public Health Setting. *J Acquir Immune Defic Syndr*, *74*(1), 44–51.

Cornell, M., Myer, L., Kaplan, R., Bekker, L. G., & Wood, R. (2009). The impact of gender and income on survival and retention in a south african antiretroviral therapy programme. *Tropical Medicine and International Health*, *14*(7), 722–731.

Cristina, M., Silva, F., Arraes, R., Ximenes, D. A., Barros, D., Filho, M., Wagner, L., & Santiago, D. M. (2009). Risk-factors for non-adherence to antiretroviral therapy. *51*(3), 135–139.

Domercant, J. W., Puttkammer, N., Young, P., Yuhas, K., François, K., Pierre, R. G., Lowrance, D., Adler, M., Wysler, J., Puttkammer, N., Young, P., Yuhas, K., François, K., Pierre, R. G., Lowrance, D., & Adler, M. (2017). Attrition from antiretroviral treatment services among pregnant and non-pregnant patients following adoption of Option B + in Haiti. *Global Health Action*, *10*(1).

Donnell, D., Baeten, J. M., Kiarie, J., Thomas, K., Stevens, W., Cohen, C. R., Mcintyre, J., Lingappa, J. R., & Celum, C. (2010). *therapy : a prospective cohort analysis*. *375*(9731), 2092–2098.

Ekstro, A. M., Unge, C., Carter, J., Waweru, M., Ilako, F., Ragnarsson, A., & Thorson, A. (2009). *Challenges for Scaling up ART in a Resource-Limited Setting : A Retrospective Study in Kibera , Kenya*. *50*(4), 397–402.

Elliott, J. H., Bertagnolio, S., & Jordan, M. R. (2019). *ulletin of the World Health Organization iral suppression after 12 months of ntiretroviral therapy in low- and middle- income countries: a systematic review*. 1–16.

Farouki, K. El, Iwuji, C., Okesola, N., & Orne-gliemann, J. (2016). *Access to HIV care in the context of universal test and treat : challenges within the ANRS 12249 TasP cluster-randomized trial in rural South Africa*. 1–12.

Fenner, L., Brinkhof, M. W. G., Keiser, O., Weigel, R., Cornell, M., Moultrie, H., Prozesky, H., Technau, K., Eley, B., Vaz, P., Pascoe, M., Giddy, J., & Van, G. (2011). NIH Public Access. *Journal of Acquired Immune Deficiency Syndrome*, *54*(5), 524–532.

Flynn, A. G., Anguzu, G., Mubiru, F., Kiragga, A. N., Kamya, M., Meya, D. B., Boulware, D. R., Kambugu, A., & Castelnuovo, B. C. (2017). *Socioeconomic position and ten-year survival and virologic outcomes in a Ugandan HIV cohort receiving antiretroviral therapy*. 1–12.

Forhan, S. E., Modi, S., Houston, J. C., Broyles, L. N., & Branch, C. H. (2017). *HHS Public Access*. *31*(10), 1489–1493.

Fox, M. P., & Rosen, S. (2016). Retention of Adult Patients on Antiretroviral Therapy in Low- and Middle-Income Countries: Systematic Review and Meta- analysis 2008–2013. *J Acquir Immune Defic Syndr*, *69*(1), 98–108.

Geng, E. H., Bangsberg, D. R., Musinguzi, N., Emenyonu, N., Bwana, M. B., Yiannoutsos, C. T., Glidden, D. V., Deeks, S. G., & Martin, J. N. (2010). Understanding reasons for and outcomes of patients lost to follow-up in antiretroviral therapy programs in Africa through a sampling-based approach. *Journal of Acquired Immune Deficiency Syndromes*, *53*(3), 405–411.

Geng, E. H., Nash, D., Kambugu, A., Zhang, Y., Braitstein, P., Christopoulos, K. A.,

Muyindike, W., Bwana, M. B., Yiannoutsos, C. T., Petersen, M. L., & Martin, J. N. (2010). Retention in care among HIV-infected patients in resource-limited settings: Emerging insights and new directions. In *Current HIV/AIDS Reports* (Vol. 7, Issue 4).

Granich, R., Dye, C., & Williams, B. G. (2008). *Universal Voluntary HIV Testing with Immediate Antiretroviral Therapy as a Strategy for Elimination of HIV Transmission : A Mathematical Model*. *6736*(December).

Granich, R., Kahn, J. G., Bennett, R., Holmes, C. B., Garg, N., Serenata, C., Sabin, M. L., Makhlouf-Obermeyer, C., de Filippo Mack, C., Williams, P., Jones, L., Smyth, C., Kutch, K. A., Ying-Ru, L., Vitoria, M., Souteyrand, Y., Crowley, S., Korenromp, E. L., & Williams, B. G. (2012). Expanding ART for treatment and prevention of HIV in South Africa: Estimated cost and cost-effectiveness 2011-2050. *PLoS ONE*, *7*(2).

Granich, R. M., Gilks, C. F., Dye, C., De Cock, K. M., & Williams, B. G. (2009). Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *The Lancet*, *373*(9657), 48–57.

Guoxing (Greg) Soon, Min Min, Kimberly A. Struble, Kirk M. Chan Tack, Thomas Hammerstrom, Karen Qi, Susan zhou, Rafia Bhore, Jeffrey S Murray, & Debra Birnkrant. (2012). Meta-Analysis of Gender Differences in Efficacy Outcomes for HIV-Positive Subjects in Randomized Controlled Clinical Trials of Antiretroviral Therapy (2000–2008). *AIDS Patient Care and STDs*, *26*(8).

Hacker, M. A., Petersen, M. L., Enriquez, M., & Bastos, F. I. (2004). *Highly active antiretroviral therapy in Brazil : the challenge of universal access in a context of social inequality*. *3*(2), 78–83.

Hassan, A. S., Fielding, K. L., Thuo, N. M., Nabwera, H. M., Sanders, E. J., & Berkley,

J. A. (2012). *Early loss to follow-up of recently diagnosed HIV-infected adults from routine pre-ART care in a rural district hospital in Kenya : a cohort study*. *17*(1), 82–93.

Hassan, A. S., Mwaringa, S. M., Ndirangu, K. K., Sanders, E. J., De Wit, T. F. R., & Berkley, J. A. (2015). Incidence and predictors of attrition from antiretroviral care among adults in a rural HIV clinic in Coastal Kenya: A retrospective cohort study. *BMC Public Health*, *15*(1), 1–9.

Hirasen, K., Fox, M. P., Hendrickson, C. J., Sineke, T., & Onoya, D. (2020). HIV Treatment Outcomes Among Patients Initiated on Antiretroviral Therapy Pre and Post-Universal Test and Treat Guidelines in South Africa. *Therapeutics and Clinical Risk Management*, *Volume 16*, 169–180.

Hodgson, I., Plummer, M. L., Konopka, S. N., Colvin, C. J., Jonas, E., Albertini, J., Amzel, A., & Fogg, K. P. (2014). *A Systematic Review of Individual and Contextual Factors Affecting ART Initiation , Adherence , and Retention for HIV-Infected Pregnant and Postpartum Women*. *9*(11).

Hoenigl, M., Chaillon, A., Moore, D. J., Morris, S. R., Mehta, S. R., Gianella, S., Amico, K. R., & Little, S. J. (2016). Rapid HIV Viral Load Suppression in those Initiating Antiretroviral Therapy at First Visit after HIV Diagnosis. *Scientific Reports*, *6*(1), 32947.

Horter, S., Thabede, Z., Dlamini, V., Bernays, S., Stringer, B., Mazibuko, S., Dube, L., & Rusch, B. (2017a). Social Science & Medicine " Life is so easy on ART , once you accept it ": Acceptance , denial and linkage to HIV care in Shiselweni , Swaziland. *Social Science & Medicine*, *176*, 52–59.

Horter, S., Thabede, Z., Dlamini, V., Bernays, S., Stringer, B., Mazibuko, S., Dube, L., & Rusch, B. (2017b). Social Science & Medicine " Life is so easy on ART , once you accept it ": Acceptance , denial and linkage to HIV care in Shiselweni ,

Swaziland. *Social Science & Medicine*, *176*, 52–59.

Iwuji, C. C., Orne-gliemann, J., Larmarange, J., Balestre, E., Thiebaut, R., Tanser, F., & Okesola, N. (2018). *Articles Universal test and treat and the HIV epidemic in rural South Africa : a phase 4 , open-label , community cluster randomised trial*. *5*(March).

Jobanputra, K., Parker, L. A., Azih, C., Okello, V., Maphalala, G., Kershberger, B., Khogali, M., Lujan, J., Antierens, A., Teck, R., Ellman, T., Kosgei, R., & Reid, T. (2015). Factors associated with virological failure and suppression after enhanced adherence counselling, in children, adolescents and adults on antiretroviral therapy for HIV in Swaziland. *PLoS ONE*, *10*(2), 1–12.

Joint United Nations Program on HIV/AIDS. (2014). to help end the AIDS epidemic. *United Nations*.

Karcher, H., Omondi, A., Odera, J., Kunz, A., & Harms, G. (2007). *Risk factors for treatment denial and loss to follow-up in an antiretroviral treatment cohort in Kenya*. *12*(5), 687–694.

Karim, S. S. A., Ch, B., & Ph, D. (2015). *Edi t or i a l Overcoming Impediments to Global Implementation of Early Antiretroviral Therapy*. 875–876.

Kiwanuka, J., Waila, J. M., Kahungu, M. M., Kitonsa, J., & Kiwanuka, N. (2020). Determinants of loss to follow-up among HIV positive patients receiving antiretroviral therapy in a test and treat setting: A retrospective cohort study in Masaka, Uganda. *PLoS ONE*, *15*(4), 1–17.

Koole, O., Kalenga, L., Kiumbu, M., Menten, J., & Ryder, R. W. (2012). *Retention in a NGO Supported Antiretroviral Program in the Democratic Republic of Congo*. *7*.

Kulkarni, S. P., Shah, K. R., Sarma, K. V., & Mahajan, A. P. (2013). Clinical

uncertainties, health service challenges, and ethical complexities of hiv “test-and-treat”: A systematic review. In *American Journal of Public Health* (Vol. 103, Issue 6).

Kumarasamy, N., Hakim, J. G., Kumwenda, J., Grinsztejn, B., Pilotto, J. H. S., Godbole, S. V, Chariyalertsak, S., Santos, B. R., Mayer, K. H., Hoffman, I. F., Eshleman, S. H., Manning, E. P., Cottle, L., Zhang, X. C., Makhema, J., Mills, L. A., Panchia, R., Faesen, S., Eron, J., … Swindells, S. (2016). *Antiretroviral Therapy for the Prevention of HIV-1 Transmission*.

Kwarisiima, D., Jain, V., Ruel, T., & Clark, T. (2017). *universal test-and-treat in East Africa*. *30*(18), 2855–2864

Laurent Ferradini MD, Arnaud Jeannin MD, Loretxu Pinoges, Jacques Izopet, Didakus Odhiambo, Limangeni Mankhambo, Gloria Karungi, Elizabeth Szumilin, Serge Balandine, Gaelle Fedida, M. PatriziaCarreri, Bruno Spire, Nathan Ford, Jean-MichelTassie, Philippe J Guerin, & Chris Brasher. (2006). Scaling up of highly active antiretroviral therapy in a rural district of Malawi: an effectiveness assessment. *The Lancet*, *367*(9519), 1335–1342.

Lawn, S. D., Harries, A. D., Anglaret, X., Myer, L., & Wood, R. (2008). Early mortality among adults accessing antiretroviral treatment programmes in sub-Saharan Africa. *Aids*, *22*(15), 1897–1908.

Layer, E. H., Kennedy, C. E., Beckham, S. W., Mbwambo, J. K., Likindikoki, S., Davis, W. W., Kerrigan, D. L., & Brahmbhatt, H. (2014). *Multi-Level Factors Affecting Entry into and Engagement in the HIV Continuum of Care in Iringa , Tanzania*. *9*(8).

Low, A., Gavriilidis, G., Larke, N., Drouin, O., Stover, J., Muhe, L., & Easterbrook, P. (2016). *Incidence of Opportunistic Infections and the Impact of Antiretroviral Therapy Among HIV-Infected Adults in Low- and Middle-Income Countries : A*

*Systematic Review and Meta-analysis*. *62*, 1595–1603.

Lundgren, J. D., Babiker, A. G., Gordin, F., Emery, S., Grund, B., Sharma, S., Avihingsanon, A.-C., Cooper, D. A., Fätkenheuer, G., Llibre, J. M., Moli-Na, J.-M., Munderi, P., Schechter, M., Wood, R., Klingman, K. L., Collins, S., Clifford Lane, H., Phil-Lips, A. N., & Neaton, J. D. (2015). The members of the writing group (. *N Engl J Med*, *9*, 795–807.

Mcallister, J., Beardsworth, G., Lavie, E., Macrae, K., & Carr, A. (2013). Financial stress is associated with reduced treatment adherence in HIV-infected adults in a resource-rich setting. *HIV Medicine*, *14*(2), 120–124.

McMahon, J. H., Elliott, J. H., Bertagnolio, S., Kubiak, R., & Jordan, M. R. (2013). Viral suppression after 12 months of antiretroviral therapy in low- and middle-income countries: A systematic review. *Bulletin of the World Health Organization*, *91*(5), 377–385.

Mohammad Rifat Haider, Monique J. Brown, Sayward Harrison, Xueying Yang, LaDrea Ingram, Amir Bhochhibhoya, Akeen Hamilton, Bankole Olatosi, & Xiaoming Li. (2019). Sociodemographic factors affecting viral load suppression among people living with HIV in South Carolina. *AIDS Care*, *33*(3), 290–298.

Nachega, J. B., Uthman, O. A., Peltzer, K., Richardson, L. A., & Mills, E. J. (2015). *Systematic reviews Association between antiretroviral therapy adherence and employment status : systematic review and meta-analysis*. *March 2014*, 29–41.

NASCOP. (2014). Guidelines on use of Antiretroviral Drugs. *Ministry of Health, Kenya*.

NASCOP, M. of H. (2018 E. . G. on U. of A. D. for T. and P. H. in K. N. A. and S. C. P., & 217:pp, V. (2018). *Kenya-ARV-Guidelines-2018-Final_20thAug2018*. *217*, 6.

National AIDS and STI Control Programme (NASCOP). (2021). *NASCOP viral load*

*dashboard*.

National AIDS Control Council (NACC). (2018). Kenya HIV Estimates Report 2018. *Ministry of Health, Kenya*, 1–28.

Nglazi, M. D., Kaplan, R., Orrell, C., Myer, L., Wood, R., Bekker, L. G., & Lawn, S. D. (2013). Increasing Transfers-Out from an Antiretroviral Treatment Service in South Africa: Patient Characteristics and Rates of Virological Non-Suppression. *PLoS ONE*, *8*(3).

Nicastri, E., Angeletti, C., Palmisano, L., Sarmati, L., Chiesi, A., Geraci, A., Andreoni, M., & Vella, S. (2005). Gender differences in clinical progression of HIV-1-infected individuals during long-term highly active antiretroviral therapy. *Aids*, *19*(6), 577–583.

Nicastri, E., Leone, S., Angeletti, C., Palmisano, L., Sarmati, L., Chiesi, A., Geraci, A., Vella, S., Narciso, P., Corpolongo, A., & Andreoni, M. (2007). *Sex issues in HIV-1-infected persons during highly active antiretroviral therapy : a systematic review*. *August*, 724–732.

Opio, D., Semitala, F. C., Kakeeto, A., Sendaula, E., Okimat, P., Nakafeero, B., Nankabirwa, J. I., Karamagi, C., & Kalyango, J. N. (2019). Loss to follow-up and associated factors among adult people living with HIV at public health facilities in Wakiso district, Uganda: A retrospective cohort study. *BMC Health Services Research*, *19*(1), 1–10.

Pell, C., Vernooij, E., Masilela, N., Simelane, N., Shabalala, F., & Reis, R. (2018). False starts in "Test and start" ": A qualitative study of reasons for delayed antiretroviral therapy in Swaziland. *International Health*, *10*(2), 78–83.

PEPFAR. (2017). *Monitoring, Evaluation, and Reporting (MER 2.0) Indicator Reference Guide*. *October*, V2.2.

Petersen, M., Balzer, L., Kwarsiima, D., Sang, N., Chamie, G., Ayieko, J., Kabami, J., Owaraganise, A., Liegler, T., Mwangwa, F., Kadede, K., Jain, V., Plenty, A., Brown, L., Lavoy, G., Schwab, J., Black, D., Laan, M. Van Der, Bukusi, E. A., … Havlir, D. (2017). *Association of Implementation of a Universal Testing and Treatment Intervention With HIV Diagnosis, Receipt of Antiretroviral Therapy, and Viral Suppression in East Africa*. *94110*(21), 2196–2206.

Prins, M., Meyer, L., & Hessol, N. A. (2005). Sex and the course of HIV infection in the pre- and highly active antiretroviral therapy eras. *Aids*, *19*(4), 357–370.

mortality in South Africa. *Tropical Medicine and International Health*, *21*(7), 846–855.

Rangarajan, S., Colby, D. J., Giang, L. T., Bui, D. D., Hung Nguyen, H., Tou, P. B., Danh, T. T., Tran, N. B. C., Nguyen, D. A., Hoang Nguyen, B. T., Doan, V. T. N., Nguyen, N. Q., Pham, V. P., Dao, D. u. G., Chen, M., Zeng, Y., Van Tieu, T. T., Tran, M. H., Le, T. H., … West, G. (2016). Factors associated with HIV viral load suppression on antiretroviral therapy in Vietnam. *Journal of Virus Eradication*, *2*(2), 94–101.

Reynolds, S. J., Makumbi, F., Nakigozi, G., Kagaayi, J., Gray, R. H., Wawer, M., Quinn, T. C., & Serwadda, D. (2011). HIV-1 transmission among HIV-1 discordant couples before and after the introduction of antiretroviral therapy. *Aids*, *25*(4), 473–477.

Rosen, S., Fox, M. P., & Gill, C. J. (2007). *Patient Retention in Antiretroviral Therapy Programs in Sub-Saharan Africa : A Systematic Review*. *4*(10).

Samji, H., Cescon, A., Hogg, R. S., Modur, S. P., Althoff, K. N., Buchacz, K., Burchell, A. N., Cohen, M., Gebo, K. A., Gill, M. J., Justice, A., Kirk, G., Klein, M. B., Korthuis, P. T., Martin, J., Napravnik, S., Rourke, S. B., Sterling, T. R., Silverberg, M. J., … Gange, S. J. (2013). Closing the gap: Increases in life expectancy among treated HIV-positive individuals in the United States and Canada. *PLoS ONE*,

*8*(12), 6–13.

Schoenfeld, D. (1981). The asymptotic properties of nonparametric tests for comparing survival distributions. *Biometrika*, *68*(1), 316–319.

Ssebunya, R., Wanyenze, R. K., Lukolyo, H., Mutto, M., Kisitu, G., Amuge, P., Maganda, A., & Kekitiinwa, A. (2017). Antiretroviral therapy initiation within seven days of enrolment: Outcomes and time to undetectable viral load among children at an urban HIV clinic in Uganda. *BMC Infectious Diseases*, *17*(1), 1–8.

Stafford, K. A., Odafe, S. F., Lo, J., Ibrahim, R., Ehoche, A., Niyang, M., Aliyu, G. G., Gobir, B., Onotu, D., Oladipo, A., Dalhatu, I., Boyd, A. T., Ogorry, O., Ismail, L., Charurat, M., & Swaminathan, M. (2019). Evaluation of the clinical outcomes of the Test and Treat strategy to implement Treat All in Nigeria: Results from the Nigeria multi-center ARt study. *PLoS ONE*, *14*(7), 1–20.

Tayler-Smith, K., Zachariah, R., Manzi, M., Kizito, W., Vandenbulcke, A., Dunkley, S., von Rege, D., Reid, T., Arnould, L., Suleh, A., & Harries, A. D. (2011). Demographic characteristics and opportunistic diseases associated with attrition during preparation for antiretroviral therapy in primary health centres in Kibera, Kenya. *Tropical Medicine and International Health*, *16*(5), 579–584.

Tekola F, G. Reniers, D. Haile Mariam, T. Araya, & G. Davey. (2008). The economic impact of HIV/AIDS morbidity and mortality on households in Addis Ababa, Ethiopia. *AIDS Care*, *20*(8), 995–1001.

The TEMPRANO ANRS 12136 Study Group. (2015). *A Trial of Early Antiretrovirals and Isoniazid Preventive Therapy in Africa*. 808–822.

Thorsteinsson, K., Ladelund, S., Jensen-Fangel, S., Johansen, I. S., Katzenstein, T. L., Pedersen, G., Storgaard, M., Obel, N., & Lebech, A. M. (2012). Impact of gender on response to highly active antiretroviral therapy in HIV-1 infected patients: A

nationwide population-based cohort study. *BMC Infectious Diseases*, *12*.

Tshikuka, J. G. ab., Okenge, L., Lukuka, A., Mengema, B., Mafuta, J., Itetya, J., Ne-Kimole, K., & Eloko, G. (2014). Severity of outcomes associated to illnesses funded by GFATM initiative and socio demographic and economic factors associated with HIV/AIDS, TB and malaria mortality in Kinshasa Hospitals, DRC. *Ethiopian Journal of Health Sciences*, *24*(4), 299–306.

U.S. President's Emergency Plan for AIDS Relief. (2019). *Monitoring , Evaluation , and Reporting Indicator Reference Guide. Available from: https://www.state.gov/wp-content/uploads/2019/10/PEPFAR-MER-Indicator-Reference-Guide-Version-2.4-FY20.pdf. Accessed April 1, 2021*. *0*(September).

UNAIDS. (2005). *United Nations General Assembly Special Session on HIV / AIDS Monitoring the Declaration of Commitment on HIV / AIDS GUidelines on Construction of Core iNdicators*. *July*.

UNAIDS. (2018). *UNAIDS Data 2018*.

UNAIDS. (2021). *End Inequalities. End AIDS. Global AIDS Strategy 2021-2026 [draft]*. https://www.unaids.org/sites/default/files/media_asset/PCBSS_Global_AIDS_Strategy_2021--2026_EN.pdf

Vandenbroucke, J. P., Von Elm, E., Altman, D. G., Gøtzsche, P. C., Mulrow, C. D., Pocock, S. J., Poole, C., Schlesselman, J. J., & Egger, M. (2007). Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and elaboration. *PLoS Medicine*, *4*(10), 1628–1654.

Ware, N. C., Wyatt, M. A., Geng, E. H., Kaaya, S. F., Agbaji, O. O., Muyindike, W. R., Chalamilla, G., & Agaba, P. A. (2013). *Toward an Understanding of Disengagement from HIV Treatment and Care in Sub-Saharan Africa : A Qualitative Study*. *10*(1).

World Health Organization. (2015). *Guideline on When To Start Antiretroviral Therapy and on Pre-Exposure Prophylaxis for HIV*. *September*, 1–76.

World Health Organization (WHO). (2016). *The use of antiretroviral drugs for treating and preventing hiv infection*.

Zachariah, R., Manzi, M., Kizito, W., Vandenbulcke, A., Dunkley, S., Rege, D. Von, & Reid, T. (2011). *Demographic characteristics and opportunistic diseases associated with attrition during preparation for antiretroviral therapy in primary health centres in Kibera , Kenya*. *16*(5), 579–584.

Zachariah, R., Manzi, M., Kizito, W., Vandenbulcke, A., Sitienei, J., & Chakaya, J. (2011). *Antiretroviral treatment uptake and attrition among HIV-positive patients with tuberculosis in Kibera , Kenya*. *16*(11), 1380–1383.

Zachariah, R., Tayler-Smith, K., Manzi, M., Massaquoi, M., Mwagomba, B., van Griensven, J., van Engelgem, I., Arnould, L., Schouten, E. J., Chimbwandira, F. M., & Harries, A. D. (2011). Retention and attrition during the preparation phase and after start of antiretroviral treatment in Thyolo, Malawi, and Kibera, Kenya: Implications for programmes? *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *105*(8), 421–430.

# APPENDICES

## Appendix I: Quantitative Data Collection Tool

| DATA COLLECTION TOOL | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AT ART INITIATION | | | | | | | | | | | | | | | | | | |
| | County | Site Name | Patient Unique ID | Gender | DOB | Marital Status | Entry Point | Registration Date | HIV Diagnosis Date | Start ART Date | ART regimen | WHO stage at entry | OI presence at HIV Diagnosis | Nutritional status | Cadre of health care worker | Presence of regular staff meetings ,MDT,WIT/QITs | | |
| 1 | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | 3 months follow up | | | | | | 6 months follow up | | | | | | 9 months follow up | | | | | |
| | Cormorbidity/OI presence at 3 months | Nutrition at 3 moths | Status at 3 months | VL date after 3 months | Viral load results 3 months | Cadre of health care worker | Cormorbidity/OI presence at 6 months | Nutrition at 6 moths | Status at 6 months | VL date after 6 months | Viral load results 6 months | Cadre of health care worker | Cormorbidity/OI presence at 9 months | Nutrition at 9 moths | Status at 9 months | VL date after 9 months | Viral load results 9 months | Cadre of health care worker |
| 1 | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | 12 months follow up | | | | | | 15 months follow up | | | | | | 18 months follow up | | | | | |
| | Cormorbidity/OI presence at 12 months | Nutrition at 12 moths | Status at 12 months | VL date after 12 months | Viral load results 12 months | Cadre of health care worker | Cormorbidity/OI presence at 15 months | Nutrition at 15 moths | Status at 15 months | VL date after 15 months | Viral load results 15 months | Cadre of health care worker | Cormorbidity/OI presence at 18 months | Nutrition at 18 moths | Status at 18 months | VL date after 18 months | Viral load results 18 months | Cadre of health care worker |
| 1 | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
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| 5 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | 21 months follow up | | | | | | 24 months follow up | | | | | | | | | | | |
| | Cormorbidity/OI presence at 21 months | Nutrition at 21 moths | Status at 21 months | VL date after 21 months | Viral load results 21 months | Cadre of health care worker | Cormorbidity/OI presence at 24 months | Nutrition at 24 moths | Status at 24 months | VL date after 24 months | Viral load results 24 months | Cadre of health care worker | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | |

**Appendix II: Informed Consent**

Principal Investigator: Dr. Isaac Chome Mwamuye; Phone: +254724804516

**Purpose**

This study investigates the effectiveness of the "Test and start" program of starting ART immediately after HIV diagnosis. As part of this study, you will be asked to answer structured questions. This study will take at most 45 minutes.

**Participants' Rights**

I understand that my responses will be kept in the strictest of confidence and will be available only to the researcher. No one will be able to identify me when the results are reported, and my name will not appear anywhere in the written report. I also understand that I may skip any questions or tasks that I do not wish to answer or complete. I understand that the consent form will be kept separate from the data records to ensure confidentiality. I may choose not to participate or withdraw at any time during the study without penalty. I agree to have my verbal responses tape-recorded and transcribed for further analysis with the understanding that my responses will not be linked to me personally in any way.

I understand that upon completion, I will be given full explanation of the study. If I am uncomfortable with any part of this study, I may contact the Ethic and Research Committee at Jomo Kenyatta University of Agriculture and Technology.

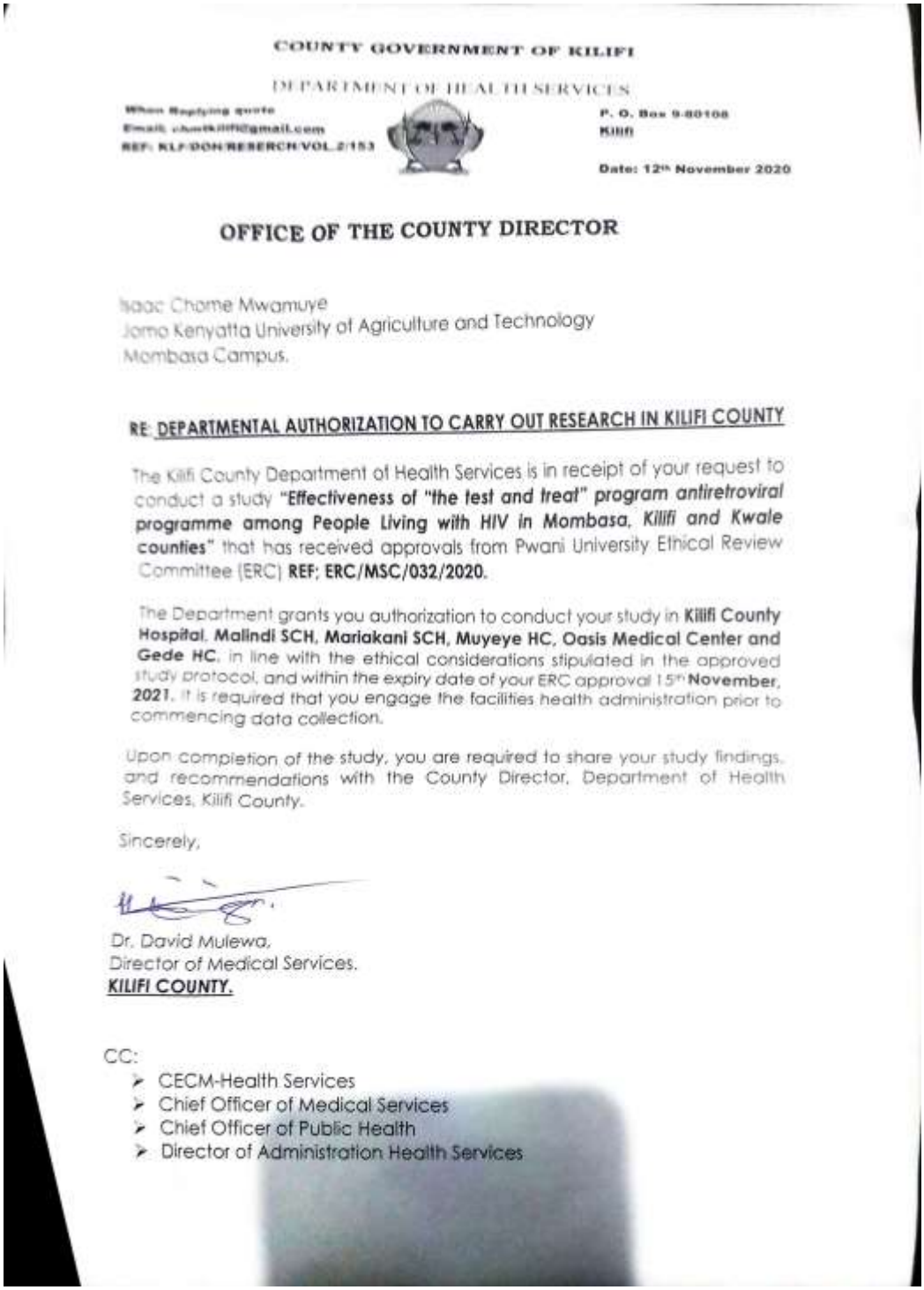
I understand that I am participating in a study of my own free will.

**Consent to Participate**

I acknowledge that I am at least eighteen years old, and that I understand my rights as a research participant as outlined above. I acknowledge that my participation is fully voluntary.

Name: _____ Signature: _____ Date: _____

## Appendix III: County Government Approval Letters



COUNTY GOVERNMENT OF KILIFI

DEPARTMENT OF HEALTH SERVICES

When Replying quote
Email: chiefkilifi@gmail.com
REF: KLF/DON/RESERCH/VOL.2/153

P. O. Box 9-80108
Kilifi

Date: 12th November 2020

**OFFICE OF THE COUNTY DIRECTOR**

Isaac Chome Mwamuye
Jomo Kenyatta University of Agriculture and Technology
Mombasa Campus.

**RE: DEPARTMENTAL AUTHORIZATION TO CARRY OUT RESEARCH IN KILIFI COUNTY**

The Kilifi County Department of Health Services is in receipt of your request to conduct a study **"Effectiveness of "the test and treat" program antiretroviral programme among People Living with HIV in Mombasa, Kilifi and Kwale counties"** that has received approvals from Pwani University Ethical Review Committee (ERC) **REF: ERC/MSC/032/2020.**

The Department grants you authorization to conduct your study in **Kilifi County Hospital, Malindi SCH, Mariakani SCH, Muyeye HC, Oasis Medical Center and Gede HC**, in line with the ethical considerations stipulated in the approved study protocol, and within the expiry date of your ERC approval 15th **November, 2021.** It is required that you engage the facilities health administration prior to commencing data collection.

Upon completion of the study, you are required to share your study findings, and recommendations with the County Director, Department of Health Services, Kilifi County.

Sincerely,

Dr. David Mulewa,
Director of Medical Services.
**KILIFI COUNTY.**

CC:
- CECM-Health Services
- Chief Officer of Medical Services
- Chief Officer of Public Health
- Director of Administration Health Services

# DEPARTMENT OF HEALTH SERVICES
## OFFICE OF THE CHIEF OFFICER, PUBLIC HEALTH

Email : chiefofficerpublichealth2020@gmail.com

P. O. BOX 90441 - 80100
Msanifu Kombo Street
MOMBASA

When replying please quote
Ref: **MCG/COPH/RSCH. /22**

Date: 20th November 2020

Dr. Isaac Chome Mwamuye
Jomo Kenyatta University of Agriculture.
**Mombasa CBD Campus.**

**RE: AUTHORIZATION TO CARRY OUT RESEARCH IN MOMBASA COUNTY**

The Mombasa County Department of Health Services is in receipt of your request letter to conduct a study on: **"Effectiveness of "the test and treat" program antiretroviral programme among People Living with HIV in Mombasa, Kilifi and Kwale counties"** that received ethical approval by the Pwani University Ethical Review Committee.

The Department is glad to grant you authorization to conduct your study over a period of 2 years (Expires on **20th November 2022**) in **Mombasa County** in line with the approved study protocol.

Upon completion of study, you are required to share your findings and recommendations with the Department of Health Services, Mombasa County.

Sincerely,

COUNTY GOVERNMENT OF MOMBASA
CHIEF OFFICER
-2 0 NOV 2020
PUBLIC HEALTH

**PAULINE A. OGINGA**
**COUNTY CHIEF OFFICER – PUBLIC HEALTH**
**DEPARTMENT OF HEALTH SERVICES**
**COUNTY GOVERNMENT OF MOMBASA**

# COUNTY GOVERNMENT OF KWALE

P.O. BOX 4 - 080403
Kwale, KENYA

**DEPARTMENT OF HEALTH SERVICES**
**OFFICE OF THE COUNTY DIRECTOR**

Email:info@kwale.go.ke
Website: www.kwale.go.ke

RE: CG/KWL/6/CDH/6/VOL.1/63

DATE: 18th November, 2020

Dr. Isaac Chome Mwamuye
C/O Jomo Kenyatta University of Agriculture,
**Mombasa CBD Campus.**

**RE: APPROVAL TO COLLECT DATA FOR STUDY ENTITLED: EFFECTIVENESS OF "THE TEST AND TREAT" PROGRAM ANTIRETROVIRAL PROGRAMME AMONG PEOPLE LIVING WITH HIV IN MOMBASA, KILIFI AND KWALE COUNTIES.**

Following your request for approval to collect data for the above named study, the County grants the approval to collect data from patient files and registers in Msambweni CRH, Kwale SCH, Kinango SCH, Diani SCH, Mkongani HC and Kinondo Kwetu Health Centre.

Name of study: **"Effectiveness of "the test and treat" program antiretroviral programme among People Living with HIV in Mombasa, Kilifi and Kwale counties"**

The principal investigator of the study: **Dr Isaac Chome Mwamuye,**

**Contacts of the PI: 0724804516**, email address **isachome@gmail.com**

The study should adhere to the ethical approvals granted by the Pwani University Ethical Review Committee and county regulations.

Best regards,

18 NOV

Dr. Hajara El-Busaidy
**COUNTY DIRECTOR- HEALTH SERVICES**

## Appendix IV: Ethical approval

NACOSTI ACCREDITED

IERC/MSc/032/2020

Pwani UNIVERSITY
P.O. Box 195-80108
Kilifi, Kenya.

**REF:** ERC/MSc/032/2020 **Date:** 16th Nov 2020

**TO:** Issac C. Mwamuye

Dear Sir/madam

**RE: STUDY TITLE: Effectiveness of the "TEST AND START" Anti-retroviral therapy program among people living with HIV in Mombasa, Kilifi and Kwale Counties in Coastal Kenya.**

This is to inform you that ***Pwani University Ethics Review Committee*** has reviewed and approved your above research proposal. Your application approval number is **ERC/MSc/032/2020.**The approval period is **16TH, *Nov. 2020 – 15th Nov, 2021.*** This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***Pwani University Ethics Review Committee***.
iii. Death and life threatening problems and serious adverse events or must be reported to ***Pwani University Ethics Review Committee*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***Pwani University Ethics Review Committee*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***Pwani University Ethics Review Committee***.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

**Chair, IERC**

NACOSTI ACCREDITED

ERC/MSc/032/2020

Pwani UNIVERSITY

## ETHICS REVIEW COMMITTEE

ACCREDITED BY THE NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION (NACOSTI, KENYA)

# CERTIFICATE OF ETHICAL APPROVAL

THIS IS TO CERTIFY THAT THE PROPOSAL SUBMITTED BY:

**ISAAC C. MWAMUYE**

REFERENCE NO:
**ERC/MSc/032/2020**

ENTITLED:
**Effectiveness of the "TEST AND START" Anti-retroviral therapy program among people living with HIV in Mombasa, Kilifi and Kwale Counties in Coastal Kenya**

TO BE UNDERTAKEN AT:
**COASTAL REGION, KENYA**

FOR THE PERIOD
**FROM: 16/11/2020 TO: 15/11/2021**

HAS BEEN **APPROVED** BY THE ETHICS REVIEW COMMITTEE

AT ITS SITTING HELD AT PWANI UNIVERSITY, KENYA

**ON THE 15/11/2020**

| CHAIRMAN | SECRETARY | LAY MEMBER |
|---|---|---|

Pwani UNIVERSITY
Ethics Review Committee

Pwani University, www.pu.ac.ke, email: r.rawa@pu.ac.ke, r.ndisa@pu.ac.ke cell: 0719 182218, 0720785791
*The ERC: Giving Integrity to Research for Sustainable Development*