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Predictors of Retention Among Individuals With HIV Initiating Antiretroviral Therapy in Ghana

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This is to certify that the doctoral dissertation by

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Walden University
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Abstract

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Managing HIV requires lifelong therapy. Retaining clients on lifelong therapeutic antiretroviral therapy (ART) ensures the suppression of viral replication and better health outcomes. The time of the start of ART management is also a factor in determining better health outcomes for persons living with HIV. This study examined the association between initiation criteria (treat all, Option B+, and CDC T-cell count < 500) and retention on ART at 12 months for 17,974 randomly selected clients in the Ghana Health Service's HIV patient electronic database. Analyses controlled for age, gender, educational status, alcohol use, treatment/adherence monitoring, and tuberculosis disease treatment. Bronfenbrenner's ecological systems theory guided the interpretation of the findings. Results shows that retention was positively associated with all treatment initiation criteria. Clients initiated with CD4 count ≤ 500 criteria seemed to be retained at 12 months on ART at a higher rate than initiation criteria based on Option B+ and treat all. The study results may contribute to positive social change by supporting CD4 testing for clients before initiation of ART to improve retention and ensure the availability and use of adherence counseling, no tuberculosis disease and its prevention, and low use of alcohol among people living with HIV. The results of this study may also provide opportunities for public health policy intervention efforts requiring a personalized, group-based approach to service delivery at the intrapersonal level, interconnected with interpersonal, meso, and meta factors at the community level.

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Dedication

I dedicate this PhD to the entire family, especially my mother, sister, brother, husband, and children: Emmanuel, Lilly, and Paul.

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I sincerely thank God for this opportunity and daily strength. I thank my mother, Madam Comfort Ampomah, who practically took care of the children with tremendous support from my sister, Akua Frimpomah Okae. I also thank my big brother, Bryan Acheampong, for funding my education and the additional support as a big brother. I also thank my husband and children for your love and for coping with a mother who is also busy with school.

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Table of Contents

List of Tables

Chapter 1: Introduction to the Study

Advances in HIV management (Pendse et al., 2016) and reduction in the progression to an AIDS diagnosis for persons living with the human immunodeficiency virus (Jiang et al., 2013) should result in retention in care on antiretroviral therapy (Dunne et al., 2019). Sub-Saharan Africa has high rates of patient non adherence to ART and the development of HIV drug resistant strains of the virus, contributing to persistently low CD4 cell counts (Rosen et al., 2016). According to Yu et al. (2018), satisfactory adherence to HIV antiretroviral medication regimens, typically defined in the literature as 80–95% of doses, is required to achieve health benefits. Nevertheless, PLHIV report challenges with adherence, leading to reduced health outcomes and viral load as copies per milliliter are not significantly reduced (Dunne et al., 2019). Cook et al. in 2017 reported 95% non adherence among nearly one third of PLHIV. However, although ART initiation rates have increased, retention has not been studied among this population on ART in Ghana.

Further information on how ART initiation criteria (independent variables) associate with ART retention (dependent variable) will be available, including recommendations on providing long-term retention strategies that, according to Phillips et al. (2015), could reduce clinic and laboratory investigation costs and provide differentiated ART for suppressed and unsuppressed clients, such as all-week ART clinic days, community antiretroviral (ARV) refill, and off-site viral load and CD4 sample taking irrespective of initiation time. Retention on therapy and HIV care are directly related to viral suppression to undetectable levels, reducing community transmission.

Public health benefits include rapidly reducing new infections and ending the epidemic with early initiation of asymptomatic patients (due to achieving viral suppression early) and mitigating lack of retention on treatment.

As a social change strategy, early initiation and retention strategies to prevent individuals from disengaging from HIV care are central to optimizing treatment outcomes. Vrazo et al. in 2018 confirmed that early initiation could be a factor in determining the effectiveness of HIV interventions. Targeting groups with attrition can most be assisted with designed strategies to increase engagement and retention in care (Kasaie et al., 2018; Kerkhoff et al., 2020; Stevens et al., 2017). In addition, higher attrition (low retention) among patients initiating ART at lower CD4 counts and higher viral loads (Fox et al., 2018) can benefit from this study and related recommendations, especially where treatment monitors have become irrelevant. Retention in care and medication adherence greatly reduces viral load to undetectable levels, making it difficult to transmit the virus. Again, because there are no days when the client misses taking in the medicine to give the virus a chance to mutate, viral-resistant strains will not be present to circulate in the general population. Additionally, with a suppressed viral load, pregnant women cannot transmit to their unborn baby or child, reducing new infections and contributing to ending the pandemic (Harris & Yudin, 2020).

Chapter 1 presents a description of the study, its significance, and its social change implications. It also contains a summary of related literature and a description of the gap this study focused on. The chapter provides the study's purpose, hypothesis,

theoretical framework, nature, assumptions, scope, delimitations, limitations, and significance.

Background of the Study

Advances in HIV management (Pendse et al., 2016) and reduction in the progression to an AIDS diagnosis for PLHIV (Jiang et al., 2013) should result in retention in care on ART (Dunne et al., 2019). The definition of *retention on ART* is the process whereby a PLHIV who is diagnosed with HIV and has been initiated/put on ART is still on ART and is assessed at intervals post initiation and has not died, transferred out, stopped treatment, or been lost to follow-up (LTFU).

Although ART initiation rates have increased, their effect on retention has not been fully studied. Retention in care is critical to HIV transmission management and reducing new infections (Holtzman et al., 2015). The literature shows that sub-Saharan Africa has high patient non adherence to ART and the development of HIV-resistant drug strains (Rosen et al., 2016). Satisfactory adherence to HIV ARV medication regimens, typically defined in the literature as 80–95% of doses, results from retention in care and is required to achieve health benefits (Yu et al., 2018). Nevertheless, PLWHIV report challenges with adherence, leading to reduced health outcomes and relatively high viral load (Dunne et al., 2019), with 95% of non adherence reported among nearly one third of PLHIV (Cook et al., 2017).

Epidemiology of Global HIV/AIDS

Globally, HIV/AIDS is a major public health concern. Sub-Saharan Africa is the world's most HIV-affected region, accounting for over 60% of all new HIV infections.

Asia and the Pacific, Latin America and the Caribbean, Eastern Europe, and Central Asia are among the other regions with high HIV/AIDS prevalence (Centers for Disease Control and Prevention [CDC], n.d.). Surveillance data revealed significant and persistent discrepancies in HIV cases, disproportionately impacting those in the south, racial or ethnic minorities, and critical populations (Sullivan et al., 2021).

"Health is a condition of total physical, mental, and social well-being, not only the absence of disease or infirmity," according to the World Health Organization (WHO, n.d.). Furthermore, "informed opinion and active cooperation on the side of the public/individual are of the highest importance in advancing people's health," according to the WHO (n.d.). Remaining in care after being tested, diagnosed, and started on medicine has been shown to improve quality of life and well-being, and retention in care is especially crucial for asymptomatic HIV positive people who are not sick but need to perform the sick role. As a result, when the sick role is finally accepted, the immune system may be weakened, and the individual becomes crippled with opportunistic illnesses or comorbidities, reducing the chances of survival and reducing secondary HIV prevention (Brown et al., 2020).

HIV treatment and management can either be integrated into a patient's general health and well-being or managed as a distinct condition unrelated to factors that directly affect quality of life and health status. According to Mugavero et al. (2012), Schommer et al. (2020), and Sikazwe (2019), lack of retention in care could fail to decrease HIV viral replication and the rise of HIV drug resistant strains. Since the pandemic, HIV has been a public health concern. Reducing virus replication within individuals is one way to ensure

that the virus does not spread in the population and that the pandemic does not continue to become a public health issue. Early initiation and retention in care are crucial to ensure viral suppression across all populations living with the virus (Fauci et al., 2019). Despite early concepts on patient retention on ART and general health, some early research hypothesized that initiation in care has little effect on retention and general health. However, the time of initiation of ART impacts retention and general health. The most commonly used measures of retention are encounter-based retention (REB) and laboratory-based retention (Rebeiro et al., 2015).

Epidemiology of HIV/AIDS in the United States

According to the CDC (n.d.), HIV in the United States is an urban disease; the South has the highest number of people, and the Northeast has the highest rate per 100,000 people. The CDC estimated that 1,044,977 million people in the United States had HIV at the end of 2019, with around 1 in 7 (14%) unaware of their status. HIV and AIDS continue to be a persistent public health concern in the United States and worldwide, with 1 in 7 people unaware that they carry the virus.

Primary Prevention

Primary prevention is critical in ending the pandemic (Cohen et al., 2011). As a current primary prevention strategy, preventing HIV infection among women, especially young women or parents-to-be, will help prevent HIV transmission to infants and young children and help towards other prevention goals (Kiragu et al., 2017). For the general population, health information and education (LaCroix et al., 2014); HIV testing and counseling; regular retesting for those with exposure, including HIV self-testing within

the community as a test for triage (Johnson et al., 2014; WHO, 2018); couple counseling and partner testing; safer sex practices, including dual protection (condom promotion); delay of onset of sexual activity; and behavioral change communications are needed to avoid risky behavior (Dehne et al., 2016). Additionally, counseling services are required to ensure that women can make informed decisions about their reproductive health (RH), access HIV testing and counseling in RH and family planning (FP), RH/FP services, and safer sex practices, including dual protection such as condom promotion and use (Mbalinda et al., 2020).

Secondary Prevention

As a secondary prevention strategy, the current 90 90 90 strategies involve an effort to test 90% of the HIV population, put on therapy, 90% of identified individuals, and ensure viral suppression in 90% within 6 to 12 months (Baggaley et al., 2016). This 90 90 90 approach relies on the treat-all strategy, which encourages same-day ART initiation for persons testing positive for HIV while removing all barriers to ART initiation (Kerschberger et al., 2021). The current strategy for testing, ART initiation, and viral suppression also relies on the differentiated testing approach, a client-centered approach to provide differentiated service to the client, where and however convenient to the client (Kerschberger et al., 2021). As part of secondary prevention measures, actions to reduce HIV transmission from HIV-infected women to their infants are still critical for HIV positive women who become pregnant. WHO has identified a package of interventions for prevention of mother-to-child transmission (PMTCT) to prevent perinatal transmission. It includes ARV drug regimens for HIV-infected pregnant women

and their newborns, safe obstetric practices, and counseling and support for pregnant women on infant feeding options. Quality antenatal and delivery care, HIV testing, and counseling in antenatal clinics (ANC), retesting in late pregnancy in high prevalence settings, clinical (staging) and immunological (CD4) assessment of pregnant women, ART for pregnant women eligible for treatment, safer obstetric practices, and infant feeding counseling and support (Walsh et al., 2020).

Tertiary Prevention of HIV

Agliullina and Khasanova (2018) defined tertiary prevention as preventing disease progression and comorbidities. Tertiary prevention includes HIV treatment, rehabilitation, and social support. Primary preventive initiatives have left a gap filled by tertiary prevention measures. Patients who take ART reduce their chances of transferring the virus to their sexual partners due to reduced viral replication, therefore limiting the disease's spread in the population—bridging barriers to ARV drug access and ART compliance; according to Agliullina and Khasanova, this is another tertiary HIV/AIDS strategy.

HIV Therapies and Management Strategies

According to the WHO (n.d.), a focus on current management strategies accelerates and intensifies the health sector response in ending the HIV and AIDS epidemic aiming at reducing global HIV related deaths to below 500,000, reducing new HIV infections to below 500,000, and ensuring zero new infections among infants by 2020.

The early ART initiation strategy reduces the time between HIV diagnosis and ART initiation. With accelerated initiation of ART, people may begin ART earlier with expedited commencement. Related determinants of health such as alcohol use, age, gender, educational status, treatment/adherence monitor(s), and opportunistic infections such as tuberculosis (TB) could lead to adverse ramifications for adherence and treatment and retention in care (Okonji et al., 2022). The WHO noted a study in Malawi in which nearly 22,000 women started ART under Option B+ (which allows an HIV-positive pregnant woman to take ARVs daily lifelong and not as prophylaxis); 17% were LTFU 6 months after ART initiation. LTFU was highest in the first 3 months of therapy among women who began ART at large clinics on the day they were diagnosed with HIV and initiated on "Option A" and Option B+. HIV positive women pregnant daily taking ARVs lifelong and not as prophylaxis (Option B+) were 5 times more likely than women who started ART in WHO Stage 3/4 or with a CD4 cell count ≤ 350 cells/μl to never return after their initial clinic visit (odds ratio 5.0, 95% CI 4.2-6.1). Option B+ patients who started therapy while breastfeeding were twice as likely to miss their first follow-up visit (odds ratio 2.2, 95% CI 1.8-2.8). LTFU also varied considerably between facilities, ranging from 0% to 58%.

Key Social and Economic Factors as Key Determinants of Health

Socioeconomic factors are also key social determinants of health. Socioeconomic factors can also limit access to strategies for testing, treatment, and retention in care and reduce persons' survival with HIV (Saracino, 2018). Social determinants of health, such as depression and anxiety, could be a factor that negatively impacts public health

outcomes and quality of life among PLWHIV (Dunne et al., 2019), facilitating the progression of the individual's ill-health stage and inability to work and provide for the family and being LTFU and not being retained. Again, chronic non retention leaves healthcare workers in despair regarding their clients' whereabouts, health status, and the possibility of the PLWHIV returning deteriorated and unstable after seeking help from non clinical sources or just being at home. Agreeably, in people initiated on ART and adhering, retention can be hampered by unsupported healthy lifestyles (Booker & Mullan, 2013) differences such as physical activity, cessation of smoking and alcohol intake, increased side effects, and presentation with comorbidities that could reduce the chances of responding to ART (Saracino, 2018). Reduced social support and non disclosure could also hamper strategies for retention, coupled with entrenched gender norms concerning health, fueling stigma (Brown, 2018). Retention is negatively affected by stigma; in much the same way, increasing out-of-pocket spending impoverishes patients. Job insecurity also affects retention, especially among clients who regularly have a leave of absence to receive ART (Ankomah et al., 2016).

Methodological Perspective on Retention

From the methodological perspective, a controlled environment tends to increase retention in care, as shown by McNairy et al. (2017b). Increasing retention may not be feasible in a natural setting, and although retention after initiation was high, monetary form incentives to remain in care for a lifelong chronic condition are not sustainable (Elul et al., 2017; Thabane et al., 2020). Adolescents joining a teen club, adolescent age at the time of initiation, and year of ART initiation are independently associated with attrition,

and adolescents living with HIV without teen club exposure were less likely to be retained on treatment than those with teen club exposure irrespective of sex, ART initiation age, current age, the reason for ART initiation, and year of ART initiation (MacKenzie et al., 2017; MacPherson et al., 2015). Other factors, such as task sharing among health care workers, ideally should also contribute to ensuring that clients are retained in care, but task sharing was ineffective in allowing other cadres of health workers to care for the patient to improve retention. Also noted as a contributing factor was offering single-visit (same-day initiation) ART initiation to adult patients in South Africa, which increased ART uptake by 36% and viral suppression by 26%, but the study area/sites being only 2 sites were low to support the generalization of results (McNairy et al., 2017a; Rosen et al., 2016). However, retention among pregnant women was high, especially for health facilities with a system to ensure integrated comprehensive prenatal/focus antenatal care for pregnant women (Landes et al., 2015).

Retention

Retention in care has variously been defined as "spectrum of the continuum of care packages starting from diagnosis of HIV infection till lifelong services, and is still on ART, assessed at intervals post-initiation and has not died, transferred out, stopped treatment or been lost-to follow-up" (Umeokonkwo et al., 2018).

The Gap in the Literature/Sample Size

The gap in the literature was related to the use of a small number of clusters. In this study, all patients in the e-tracker database were eligible for the evaluation to provide a population-wide view of retention on ART (McNairy et al., 2017b). Again, the gap was

with the use of existing medical records to assess outcomes and its inability to isolate the effect of different (multiple) strategies implemented simultaneously. This inability results in the exclusion of many patients newly diagnosed with HIV, a critical group in evaluating retention in care (Elul et al., 2017). As such, for this study, all positive patients with a unique identifier/registration number were eligible and evaluated separately to identify the effect of each strategy on retention. Sample size measuring retention among children/pediatric population, when small, may give findings not generalizable to other HIV programs with larger pediatric populations. For this study, the population was teenagers aged 13 to adults 50 years and above. The current study did not evaluate retention in children. Rosen et al.'s (2016) study was also limited by the small number of sites and small sample size, making the results' generalizability to other settings and non research conditions uncertain. All ART sites in the country were included in the study to allow for the generalization of results. The study results thus can be generalized to the entire country.

Use of Individual Cases, Not Aggregate Data

Other studies have found that using individual data instead of aggregated data has inherent limitations. Aggregate data could have missing data and offer limited ability to assess the association of individual characteristics such as sex, age, and CD4+ count with retention, loss to follow-up, and death. There is also the likelihood of misclassifying patients as some outcomes, such as LTFU, are complex to ascertain in large HIV programs (McNairy et al., 2017b). As a result, the study did not use aggregated data for the analysis but individual data on each patient. Landes et al. (2015) also noted the need

to undertake targeted research to understand factors associated with ART uptake during pregnancy. Retention in care could improve the efficacy of allowing an HIV-positive pregnant woman to take ARVs daily lifelong and not as prophylaxis as in Malawi, where all pregnant women are initiated on a triple ARV medication/therapy for life (Option B+) as compared to prophylaxis for the pregnancy period (WHO, n.d.).

Generalizability of Study Findings

Vrazo et al. (2018) recommend implementing science studies in different contexts to understand and address barriers in PMTCT Option B+ interventions to provide triple-dose ARVs rather than prophylaxis to HIV positive pregnant women. However, the studies described herein by Vrazo et al. were geographically limited to sub-Saharan Africa, with Thailand as the only non African country represented. Studies conducted in South Africa and Kenya constituted the majority of identified articles, with only 10 other countries and one multicountry study represented. Results from these studies cannot necessarily be generalized to sub-Saharan Africa or all lower middle income countries. This limitation also makes a compelling case and appeals to the PMTCT community to contribute country- and context-specific data on interventions that improve retention.

The study on the predictors of retention of PLHIV in Ghana was not multinational, and results may be limited to Ghana. However, the study findings can benefit countries with similar population characteristics and health settings. Identifying an association between the predictors and retention is critical in reducing barriers to retention in Ghana. This study on predictors of retention among PLHIV in Ghana thus fills the identified gap in ensuring that all eligible patients in the HIV patient e-tracker

database were used in the evaluation to provide a population-wide view of retention on ART. Included in the study were all ART sites in the country. The study results thus can be generalized to the entire country. The study population consisted of teenagers aged 13 to adults 50 years and above. The current study did not evaluate retention in children. This study did not use aggregated data for analysis but individual data on each patient. The study was not multinational.

The Gap the Study Was Intended to Fill

Through this study, I sought to fill the gap in understanding the benefit or otherwise of the early start of therapy using a criterion among the selected study participants, among whom there is limited study or no study on initiation criteria and retention on ART at 12 months after start of ART. The gap was addressed using a relatively large sample size of all eligible clients from a national program. Analyses of patients were based on individual patient initiation criteria to identify any possible association to retention rather than analyzing all eligible clients in aggregate form. Findings can be generalized due to the relatively large sample size from the national program. Additionally, aggregate results are provided among specific age groups for adolescents 13 years to adults 50 years and above. This study provides valuable data for researchers in similar environments and geographical characteristics.

Problem Statement

Advances in HIV disease management (Pendse et al., 2016) and reduction in the progression to an AIDS diagnosis for PLWHIV (Jiang et al., 2013) should result in retention in care on ART (Dunne et al., 2019). Retention in care is critical to HIV

transmission management and reducing new infections (Holtzman et al., 2015). Sub-Saharan Africa has high rates of patient non adherence to ART and the development of HIV drug resistant strains of the virus, contributing to persistently low CD4 cell counts (Rosen et al., 2016). Satisfactory adherence to HIV ARV medication regimens, typically defined in the literature as 80–95% of doses, is required to achieve health benefits (Yu et al., 2018). Nevertheless, the PLHIV report challenges adhering, leading to reduced health outcomes and viral load as copies per milliliter are not significantly reduced (Dunne et al., 2019). According to Cook et al. (2017), one third of PLHIV experience 95% non adherence. Although ART initiation rates have increased, their effect on retention has not been studied. It is thus critical to study retention in care after the increased initiation rates among patients on treatment in Ghana. All eligible patients in the HIV patient e-tracker database on ART and all sites in the country were included in the study to fill the identified gap and provide a population-wide view of retention in care to generalize the results to the entire population.

Purpose of the Study

This study examined the association between the time of initiation criteria and retention in care at 12 months. This study hypothesized the association between the initiation criteria and retention 12 months after initiation.

This study was a quantitative secondary analysis of archived data from the Ghana Health Service (GHS) HIV patient electronic tracking database, which includes objective ratings of groups initiated at different infection and disease progression times. The database has data that can be accessed from 2002 to 2022. Data analysis was conducted

with descriptive statistics and inferential statistics using binary logistics and multiple regression because the dependent variable is binary and dichotomous. Not being retained is defined as attrition 12 months after testing HIV positive. Thus, retention is rated at 12 months after the initiation of treatment. The study fills in the gap in the literature related to the use of a large sample size by including all eligible patients and ART sites in the HIV patient e-tracker database for evaluation to provide a population-wide view of retention in care. The study population was teenagers aged 13 to adults 50 years and above, but the study did not evaluate retention among children. The gap in using aggregate data was filled by using individual patient level data for the analysis. However, the study was not multinational but provides relevant information for settings with similar characteristics.

Research Questions and Hypotheses

Listed below are the study research question (RQs) according to simple and multiple logistic regression.

What is the association between patient initiation criteria and retention at 12 months, considering four initiation criteria while controlling for age, gender, educational and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates?

RQ1: What is the association between Patient Criterion 1 (initiated based on treat-all criteria) and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is an association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

RQ2: What is the association between Patient Criterion 2 (initiated based on Option B+) and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is an association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

RQ3: What is the association between Patient Criterion 3 (initiated based CD4 T-cell count ≤ 500) and retention on ART at 12 months, controlling for

age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is no association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

The hypothesis is further discussed in Chapter 3, along with other multi level models developed to test the hypothesis for the study.

Theoretical Framework for the Study

Ecological systems theory was the basis for the framework by Urie Bronfenbrenner (Busza et al., 2012). According to Busza et al. (2012), Bronfenbrenner's theory shows how the surrounding ecology, environment, and systems characteristics influence individual behavior. Ecological systems theory was applied to child development and the effects of social influences on the development of children and has since been used in public health research and ways to prevent mother-to-child transmission in resource-poor areas (Busza et al., 2012). This theory again recognizes that embedded within health problems are complex social and environmental contexts and that there are dynamic interrelationships among numerous personal and

environmental elements that influence an individual's decision or outcome and their retention in care. As a result, the individual must comprehend the full ecological context that influences care retention (Busza et al., 2012). The social ecology of public health is a framework for comprehending the various levels of public health.

As applied to this study, the social ecology of public health provides a framework for understanding the numerous layers of effect on health outcomes and identifying factors that lead to and influence ART retention. The microsystem (intrapersonal); mesosystem (interpersonal and social networks); exosystem (organizational and, or policy and environmental) constructs are the three areas of influence identified by the model. The concept provides a realistic framework for accounting for the reciprocal interaction of behavior and environment and its implications for public health and care retention (Kaufman et al., 2014). Coping with antecedent childhood and/or adolescent sexual trauma, substance misuse, depression and mental health disorders, intimate partner violence and the acquisition of sexually transmitted infections (STIs), including HIV, are all individual-level risk factors/constructs or ecosystems. Identifying multidimensional risk factors is critical to addressing health issues such as HIV among the sexes in a broader perspective. Factors determining HIV risk at the individual level include beliefs, sentiments, perceptions, attitudes, risk-taking behavior, and disease vulnerability awareness. The interpersonal social network or microsystem level significantly impacts an individual's health (Gabster et al., 2022).

Poverty, unemployment, insufficient access to healthcare, the sociocultural context, and broad skepticism of the healthcare system are all factors that may contribute

to the gender retention gap. Other factors that contribute to more significant health inequities, such as lack of job prospects, education, housing, social isolation, political powerlessness, and racial or gender discrimination, have been connected to gender discrepancies in retention (Dako-Gyeke et al., 2012). Because of the dyadic structure of human interactions, individuals frequently belong to many microsystems that overlap based on affiliations among the associations. The third level, mesosystem, reflects an individual's intersection and linkage with several microsystems. The external system, represented by the mesosystem, influences behavior through policies, rules, and regulations, influencing wider cultural and social norms (Creswell 2019; Mash, & Wolfe, 2019)

The socioecological theory holds, and my independent variable initiation criteria with four levels (i.e., treat-all policy strategy, Option B+, CD4 T-cell count above 500, CD4 T-cell count less than 500) influence or explain the dependent variable retention in care at 12 months, because each stage of being initiated and maintained on ART for the rest of one's life is influenced by individual factors, at the micro, mesosystem (peer and family influence), exo (community context), and macro (social-cultural environment; Creswell et al., 2019) levels to the individual. When a person is diagnosed with a particular ailment and given a treatment plan, the expectation is that they will stick to it. Individuals are expected to follow medical advice once diagnosed with a specific condition and assigned an appropriate treatment program. Failure to cooperate with therapy is frowned upon in society and can result in negative consequences such as losing sick role privileges. According to Coreil (2009), more than half of patients on long-term

care regimens fully comply with their therapies. Compliance rates for asymptomatic conditions, on the other hand, can approach 25%. Patient compliance is essential for virus suppression and retention. Coreil (2009) also stated that there is a need to address factors that lead to non adherence to therapy. I expected my independent variable (initiation criteria) to influence the dependent variable, retention among the sexes (Koirala et al., 2017).

This study followed a positivist paradigm in terms of research (a positivist way of looking at and understanding what reality is). A positivist paradigm involves the use of quantitative tools to solve problems, such as determining the association or cause and effect between variables (Park et al., 2020). Proponents consider reality absolute and knowable (Kawulich & Chilisa, 2012). Researchers adopting this paradigm feel that the only way to discover the truth is to isolate it from its context. Hence, studies are designed to omit contextual influences as much as possible (Kawulich & Chilisa, 2012).

The hypothesis (where applicable), research variables, and research instrument are identified early in a study using theories found in the literature, and the study's findings are frequently expanded to a broader population, with a focus on random sampling and statistical significance (Park et al., 2020).

Table 1

Variables Related to the Theoretical Framework

Constructs	List of Variables	Variable Nature/Coding Scheme
Microsystems, demographics, intrapersonal/individual characteristics (individual characteristics)		
	1. Age	Ratio scale. Recoded as a categorical variable
	2. Gender	Nominal variable. Coded as male = 0, female = 1
	3. Education status	Ordinal variable. 0 = preschool/primary, 1 = junior high school/middle school leaving certificate, 2 = high school/vocational training/technical training, 3 = tertiary, and 4 = none/NaN
Exosystems, environment/policy guidelines (independent variables)		
	1. Patients initiated based on CD4 T-cell count ≤ 500	Patients initiated based on CD4 T-cell count ≤ 500. Yes = 1, No = 0
	2. Patients initiated based on treat-all criteria	Patients initiated based on treat-all criteria. Yes = 1, No = 0
	3. Patients initiated based on Option B+	Patients initiated based on Option B+. Yes = 1, No = 0
	4. Outcome or dependent variable	Ordinal level variable. Retention at 12 months. Retained = 1, Not retained = 0.
	5. Retention in care	
Mesosystems, interpersonal/group/social network (confounding factors)		
	1. Alcohol use ever	Ratio scale variable. Yes = 0, No = 1
	2. Tuberculosis disease treatment	Ordinal. Treatment yes =1, treatment No = 0
	3. Treatment/adherence monitoring	Treatment monitoring, Yes = 1, No = 0
	4. Tuberculosis disease treatment	Ordinal. Treatment yes = 1, treatment no = 0

Note. Theoretical framework title: Ecological Systems Theory (framework) by Urie Bronfenbrenner. Study title: *Predictors of Antiretroviral Therapy and Retention Among Individuals With HIV in Ghana*.

Nature of the Study

This study was a quantitative observational study to examine the association between the independent variable initiation criteria at four levels—patients initiated based on treat-all criteria, patients initiated based on Option B+, patients initiated based on CD4 T-cell count ≥ 500, and patients initiated based on CD4 T-cell count ≤ 500—and the dependent variable, retention rate at 12 months. The RQ addressed whether there is an association between the initiation criteria and their effect on retention 12 months after initiation. Through this study, I sought to understand whether initiation criteria at the start of ART are related to retention at 12 months in care among males and females living with HIV in Ghana. The study was a quantitative observational epidemiological study using a secondary dataset. The study looked at four initiation criteria as independent variables. The four levels of the independent variables were (a) patients initiated based on treat-all/test-and-treat criteria, (b) patients initiated based on Option B+, (c) patients initiated based on CD4 T-cell count ≥ 500, and (d) patients initiated based on CD4 T-cell count ≤ 500. The variables for the regression-based model were entered in subsets based on an existing association. This was also because of the need to know the effect of initiation criteria from policy to policy and its effect on retention in care among males and females. The current study was developed to utilize regression models to respond to the RQ. The binary logistics regression model was justified and helpful in testing the stated hypothesis. The dependent variable was retention at 12 months. The study controlled for the confounding effect of age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment on the dependent variable,

retention. The RQ for multiple regression variables was the following: What variables predict retention at 12 months controlling for age, gender, education status, alcohol use, adherence/treatment monitors, and tuberculosis disease treatment? The dependent variable was retention at 12 months in care after initiation. The six confounding variables were identified as compounding variables for the multiple regression (IV): (a) age, (b) gender, (c) educational status, (d) alcohol use, (e) treatment/adherence monitor(s), and (f) TB disease treatment. Only the presence or absence of associations was possible with this study.

The HIV patient e-tracker has been used to collect patient data since 2018. Though relatively new, the data were initially entered and stored in software developed and managed by the National AIDS and STI Control program, the implementing arm of the GHS HIV strategy. One of the objectives of the e-tracker is to be a database to store patient data and uniquely identify patients within the country for the continuity of patient care and service. The e-tracker collects data on patients tested and initiated on ART together with follow-up care. Currently, it is not the primary source of data because data are captured from the patient folder, making the patient folder the primary source. The samples were drawn from the patient e-tracker using unique identifiers. Data entry for all clients initiated before 2018 was transferred/entered into the tracker. Thus, the tracker information lets one know if patient cohorts truly have attrition or are non adhering within one ART site and appearing in another. The system also tracks whether clinic and refile appointments have been kept. By these, the actual retention rate can be measured.

HIV-asymptomatic patients initiating treatment has a disadvantage. Treatment non adherence with reduced death or low survival results in not completing cohort years, attrition, and other contributing factors, could cause concern to public health practices compared to symptomatic HIV patients. This study fills the gap in knowing the lack of retention and retention rates due to disease progression 12 months after initiation. The demographic characteristics, including age and sex distributions, provide insight into non adhering groups for effective interventions.

Definition of Variables

Retention in HIV care: Defined as the process whereby a PLHIV who is diagnosed with HIV, is initiated/put on ART, and is still on ART is assessed at intervals post initiation and has not died, transferred out, stopped treatment, or been LTFU (Dandachi et al., 2020; Ramachandran et al., 2020; WHO, n.d.).

Treat-all criteria to initiation: Patients initiated on therapy without assessment for CD4 cell count level or WHO staging as a requirement from 2017 to date. WHO staging structure for HIV sorts patients (adults and children) into one of four hierarchical clinical stages ranging from Stage 1 (asymptomatic) to stage 4 (AIDS stage). Patients are assigned to a particular stage when they demonstrate at least one clinical condition in that stage's criteria (WHO, 2005). The start year should be specific to the initiation criteria for that period. When the CD4 count value is unavailable, the year of initiation and the WHO clinical staging indicate the initiation criteria (WHO, n.d.).

Option B+: Initiation criteria for pregnant women to be given three-dose therapy from the year of initiation. The start year should be specific to the initiation criteria from

that period. When the CD4 count value is unavailable, the year of initiation and the WHO clinical staging indicate the initiation criteria (Ahoua et al., 2020; WHO, n.d.).

CD4 T-cell count ≤ 500: Initiation of patients based on CD4 cell count level less than 500 from 2002 to 2008. The start year should be specific to the initiation criteria for that period. When the CD4 count value is unavailable, the year of initiation and WHO clinical staging 3 and 4 indicate the initiation criteria (WHO, n.d.).

Alcohol use: Indicates alcohol use at the time of the first assessment for initiation (WHO, n.d.).

Treatment/adherence monitor: Presence or absence of treatment or adherence monitor (WHO, n.d.).

Assumptions

Achieved data were used for the analysis. Data were presented in aggregated form; thus, no consent was required from individual clients. Data collection began once a client tested positive and was registered and enrolled in care. Before testing, early morning health education on selected topics was given in most healthcare settings, and HIV education, mode of transmission, prevention methods, and available screening and medication when tested positive were incorporated into the talks. At the time of education and sensitization, clients were encouraged to opt out of a request to have an HIV test done for them. Without opting out after the education was given, the client consented to the test, and data were collected and used for management and programmatic purposes. For walk-in clients, voluntary and inpatient units, verbal consent was requested and provided by the patient. Assent was obtained from the guardians of minors. As part of

routine service provision at ART sites in Ghana, each client testing positive was given a client/patient booklet, a replica of aspects of the e-tracker database.

The books are kept in the folder room/section of the ART clinic. Currently, the folders are not mixed with the general hospital folders. The ART folder room is locked and padlock protected. Folders are accessible to health workers on duty at the ART clinic. The key is kept with the ART clinic in charge. Data from the client folder are entered into the HIV patient e-tracker daily by ART data managers. At the program level, access to data is open to all interested individuals and institutions upon completing the data-sharing agreement form. It was assumed that patients were informed that their deidentified data could be used for research, but this was not confirmable. As a requirement for obtaining and using data from the HIV program in Ghana, a data-sharing agreement was signed with the HIV program on data use before its use.

The assumptions for logistics regression modeling were met with a priori power analysis calculated for a medium effect size *OR* = 1.5. This was recalculated to obtain the final study sample size once the data were cleaned and prepped (Deriba et al., 2020).

The variables each had a normal distribution. The test for normality was done in SPSS using the Kolmogorov–Smirnov test and the Shapiro–Wilk test. Alternatively, the frequency and normal distribution curves were plotted using SPSS.

The assumption of homoscedasticity was met. In this case, a scatterplot of residuals versus predicted values was used to check for homoscedasticity. A cone-shaped pattern indicates that the data were heteroscedastic. Where there is no clear pattern in the distribution, the data met the assumption for homoscedasticity. The study's samples were

nationally representative, and the association between the variables was generally linear for linear regression modeling.

Scope and Delimitations

Included in the study for analysis were patients who had been diagnosed with HIV infection, with data on ART initiation and with a unique identifier. Excluded from the study were patients not on ART. Data for clinical monitoring (i.e., viral load results and CD4 count results) were not available in the database for analysis (but in the client folder and not yet entered into the database) at the time of the study. Data on clinical monitoring are critical to retention and the subjective determination of the success of treatment strategies and the state of viral suppression. Retained or not retained is strongly related to being virally suppressed for better health outcomes. This study's design and related questions only sought an association between initiation criteria and retention in care while on ART.

Limitations

Secondary analysis draws upon data collected by other researchers, often for other purposes, or data created by nonresearchers outside the specific context of research (Babbie, 2016; Rudestam, 2014), and the researcher is not usually privy to information about how seriously the data are affected by problems such as low response rate or respondent misunderstanding of specific survey questions (Burkholder, 2016). Establishing cause and effect was not possible with the study design. Only the presence or absence of associations was possible with this epidemiological study. The sites were all ART sites in the country, and the study results were generalizable. Data collection was

based on services provided based on WHO standardized and nationally adopted protocols on service delivery. However, though standardized protocols were used, national characteristics and specific service provision settings may not make the results of the current study generalizable to other countries. Generalizing the results to populations outside the country may only apply to those with similar characteristics and service provision settings.

Significance of Study

The results of this study provide much-needed insights into the process by which ART initiation criteria (independent variable) are associated with the retention (dependent variable) on ART. The study's findings might provide insights that could result in sustainable retention strategies among different groups irrespective of initiation time. Retention on therapy and HIV care are directly related to viral suppression to undetectable levels, reducing community transmission. Early initiation of asymptomatic patients ideally should ensure and provide a greater public health benefit in rapidly reducing new infections and ending the epidemic (due to achieving viral suppression early) when lack of retention on treatment is mitigated.

Summary

Chapter 1 described the topic of the study on predictors of retention among HIV-positive clients in Ghana and the need to conduct the study to find a possible association between initiation criteria and retention and the importance of retention among the study population. The chapter also gave the background and problem statement as well as the purpose of the study, theoretical framework, nature of the study, definitions and

assumptions, limitations and delimitations, as well as the study purpose, design, and sampling frame. The potential positive social change implications of the study were also elaborated. Chapter 2 includes a comprehensive literature review and the underlying models for the study hypothesis.

Chapter 2: Literature Review

The primary aim of this study was to investigate the association between the time of initiation of HIV ART and retention in care among HIV-positive persons in Ghana, considering possible differences among males and females in a nationally representative sample. There is an unparalleled match in advances in HIV management and retention in care on ART. Advances in HIV management and reduced progression to an AIDS diagnosis (Jiang et al., 2013) should result in retention in care on ART (Dunne et al., 2019). Retention in care is a critical component of viral suppression, HIV transmission, management, and reduction in new infections (Holtzman et al., 2015). Sub-Saharan Africa has high rates of patient encounter based nonretention to ART, leading to the virus not being suppressed and resulting in the development of HIV-drug-resistant strains, which contributes persistently to low CD4 cell counts and high viral loads (Rosen et al., 2016) during laboratory-based retention evaluation. Satisfactory adherence to HIV ARV medication regimens, typically defined in the literature as 80–95% of doses, results from retention in care and is required to achieve health benefits (Yu et al., 2018). Nevertheless, PLWHIV report encountering laboratory-based retention challenges, leading to reduced health outcomes and viral load as copies per milliliter not significantly reduced (Dunne et al., 2019). Ninety-five percent of nonadherence is due to nonretention in care and has been reported among nearly one third of PLWHIV (Cook et al., 2017).

Encounter-based retention (EBR) and laboratory-based retention (LBR) are the main sources of retention evaluation and require a satisfactory agreement for a client to obtain optimal health benefits. EBR and LBR measures require a satisfactory retention

rate to achieve health benefits. Nevertheless, PLHIV report challenges with being retained in care, leading to reduced health outcomes and nonsuppression rate (Dunne et al., 2019). Due to a lack of EBR, 95% of nonadherence has been reported among nearly one third of PLWHIV (Cook et al., 2017). Although encounter-based ART initiation rates have increased due to reduced initiation time, the effect of EBR is unparalleled and has not been studied among this population. EBR measure evaluation can also use appointment keeping as part of the HIV early warning indicators by the WHO. LBR was not evaluated for this study.

This chapter introduces the concepts of health, public health, and HIV health care management and examines the conceptual domain that characterizes patient health and HIV health care management as a public health concern. This chapter also introduces the concept of health and HIV healthcare management. It examines the conceptual domain that characterizes patient time of initiation and retention in care among males and females concerning epidemiological data collection as well as the HIV patient e-tracker as an important source of secondary data. Subsequently, the document includes the literature search strategy, the theoretical foundation and conceptual framework, and the literature review related to key variables and concepts that provide an exhaustive review of the current literature.

Literature Search Strategy

Keywords searched were *initiation time*, *HIV disease progression*, *retention*, *HIV*, *AIDS*, *HIV and AIDS*, *epidemiology*, *early warning indicators*, *appointment time*, *attrition*, *ecological framework*, *HIV care models*, *antiretroviral*, *antiretroviral therapy*,

and *early initiation* in the U.S. National Library of Medicine National Institutes of Health BMJ open-access database, Biomed Central, PLoS ONE, and ProQuest Dissertations & Theses Global.

Years of research among HIV patients and initiation in care have shown an association with retention in care. The literature review on health, public health, and HIV health care management related to the time of initiation and retention in care began with internet searches on websites such as the U.S. National Library of Medicine and the National Institutes of Health. Search terms used for articles in the last 5years were the following: "initiation time," “HIV disease progression,” “retention,” “HIV,” “AIDS,” “HIV and AIDS,” “epidemiology,” and “early warning indicators,” “appointment time,” “attrition,” “ecological framework,” “antiretroviral,” and “early initiation.” Secondary research sources from the BMJ open-access database, Biomed Central, PLoS ONE, ProQuest Dissertations & Theses Global, and the HIV patient e-tracker database led to primary sources. Publication from the BMJ open-access database, Biomed Central, PLoS ONE, and ProQuest Dissertations & Theses Global served as the background. Scholarly research sources were from the Walden Library. The database utilized was the HIV patient e-tracker database.

Theoretical Framework

The theory adopted for use was the ecological systems theory (framework). It was developed by Urie Bronfenbrenner (Busza et al., 2012). Bronfenbrenner’s ecological model reflects that individual behavior is influenced and defined by the surrounding ecology, environment, and systems. The theory has been used in child development to

address the impact of social forces on children's development. It has subsequently found importance in studying public health and approaches for preventing mother-to-child transmission in resource-poor settings. This theory acknowledges framing health problems as embedded in complex social-environmental contexts. It indicates that dynamic interrelations among various personal and environmental factors influence an individual's decision or outcome and being retained in care (Yakob & Ncama, 2016). Thus, for the individual, one needs to understand the entire ecological frame that influences retention in care. The social ecology of public health provides a framework for understanding the multiple levels of influence on health outcomes. This theory was applied to my study in identifying factors that influence retention on ART by women and their exposed babies. The model identifies three categories of influence: the microsystem or intrapersonal level, the mesosystem or interpersonal level and social networks, and organizational and exosystem or policy and environmental constructs. The construct offers a concrete framework to account for the reciprocal interaction of behavior and the environment and its relation to public health and retention in care as an outcome (Kaufman et al., 2014).

Individual-level risk factors/constructs or ecosystems include coping with antecedent childhood and adolescent sexual trauma, substance abuse, depression, mental health disorders, intimate partner violence, and the acquisition of STIs, including HIV. It is thus important to identify multilevel risk factors to address health issues such as HIV among the sexes in a broader context. The individual level includes factors affecting HIV

risks, such as knowledge related to the condition, beliefs, feelings, perceptions, attitudes, risk-taking behavior, and awareness of disease vulnerability (Hodgson et al., 2014).

The second level, the interpersonal social network, or the microsystem, is theorized to strongly impact the individual's health. Community-level factors include poverty, unemployment, inadequate access to healthcare, the sociocultural environment, and generalized mistrust in the healthcare system. These community-level factors may contribute to retention disparity among the sexes. Other drivers of broader health inequities, including lack of employment opportunities, education, housing, social isolation, perceived political disempowerment, and racial or gender discrimination, have also been linked to disparities in retention among the genders. Due to the dyadic nature of personal relationships, an individual often belongs to several microsystems, which intersect based on affiliations among these relationships (Frew et al., 2016).

The third level, the mesosystem, represents an individual's intersection and linkage within multiple microsystems. Frew et al. (2016) also noted that the mesosystem represents the external system, which influences behavior through policies, laws, and regulations that influence larger cultural and social norms.

This theory holds, and I expect my independent variable, initiation criteria at the four levels (i.e., treat-all policy strategy, Option B+, CD4 T-cell count above 500, CD4 T-cell count less than 500) to influence or explain the dependent variable retention in care at 12 months because each of the stages of one being initiated and retained on ART lifelong is influenced by individual factors, in the micro, meso (peer and family

influence), exo (community context), and macro (social-cultural environment) systems (Mash & Wolfe, 2019) to the individual (Creswell, 2017).

Coreil (2009) noted that once an individual has been diagnosed with a specific illness and prescribed an appropriate treatment regimen, the expectation is that the individual will follow the medical advice given. Failure to comply with treatment is socially disapproved of and may even lead to negative sanctions, such as losing the sick role privileges. According to Coreil (2009), "it is estimated 30% to 60% of patients fail to comply fully with treatments, and only about 50% of patients adhere to long-term-care regimens and noncompliance rates rise to 75% for asymptomatic conditions". Again, improving patient compliance is an essential impetus for patient retention in care and viral suppression (Coreil, 2009), and therefore there is a need to resolve issues that result in nonadherence to treatment to improve retention. The patient factors could be other dynamics of the medical encounter that fuel patient adherence (Coreil, 2009). As applied to my study, identifying the extent to which initiation criteria to ART affect retention and applying this theory holds, and I expected my independent variables (initiation criteria) to influence the dependent variable retention among the sexes.

From a research perspective, this study followed a positivist paradigm (a positivist way of looking at and understanding reality). Researchers adopting a positivist paradigm employ quantitative methods and aim to address problems such as discovering the association, relationship, or cause and effect between or among variables (Park et al., 2020). The paradigm indicates that reality is absolute and can be known (Chilisa & Kawulich, 2012). Studies are planned to exclude contextual factors as much as possible

because the only way researchers believe truth can be discovered involves removing it from its context. Hypotheses (whenever necessary), research variables, and research instruments are identified early in a study through the theories explored in the existing literature. The study's outcome is usually generalized to a larger population, emphasizing random sampling and statistical significance (Park et al., 2020).

Literature Review Related to Key Variables and Concepts

Epidemiology of Global HIV/AIDS

HIV/AIDS continues to be a serious health issue globally. Worldwide, in 2018, there were about 1.7 million new cases, with 37.9 million people living with HIV and 24.5 million receiving ARV. Deaths have accounted for an estimated 770,000 people due to AIDS-related illnesses since the start of the epidemic. Sub-Saharan Africa is the region most affected by HIV and AIDS worldwide, accounting for about 61% of all new HIV infections. Other regions significantly affected by HIV and AIDS include Asia and the Pacific, Latin America and the Caribbean, Eastern Europe, and Central Asia (CDC, n.d.). The CDC (n.d.) identified opportunities to improve public health surveillance systems and data use for planning and monitoring public health responses. Surveillance data indicated profound and ongoing disparities in HIV cases, with disproportionate impact among people in the South, racial or ethnic minorities, and key populations.

The WHO defined and characterized the concept of health in the preamble of the WHO charter in 1946. According to the preamble, health is “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (WHO, n.d.). Additionally, “informed opinion and active cooperation on the part of the

public/individual are of the utmost importance in improving the health of the people" (WHO, n.d.). According to the WHO (2015), screening services should be followed by care and treatment once screening results turn positive. Care and treatment and being retained in care could be affected by the time of initiation after a positive screening test. Retention in care has been demonstrated to affect the quality of life and well-being and reduce mortality related to HIV disease. Retention in care is particularly important in asymptomatic HIV-positive individuals who are not sick to perform the sick role. Such individuals may not be motivated to remain in care, and as Brown et al. (2020) described when the sick role is eventually accepted, the immune system has already become weak. The individual could be crippled with several opportunistic infections or comorbidities that limit the chances of survival and a reduction in secondary HIV prevention (Brown et al., 2020).

HIV care and its management constitute an integral part of the patient's general health care and well-being or may be managed as a specialized condition removed from factors directly affecting the quality of life and health status. Studies show that the lack of retention in care results in nonsuppression of viral replication and the development of HIV-drug-resistant strains (Mugavero et al., 2012; Schommer et al., 2020; Sikazwe, 2019). In a retrospective review from 2015 to 2017 of 1,000 (57%) patients, 870 (87%) were suppressed. Further, between 2013 and 2016, decreases in annual (85% to 77%) and durable retention in care were noted: in 2-year (72% to 70%) and 3-year (63% to 59%) periods. However, annual increases were noted for 2017 (89%) and durable retention in the 2 years (79%; Mugavero et al., 2012; Schommer et al., 2020; Sikazwe, 2019). Other

population-based studies, such as Sikazwe et al. (2019), selected 64 facilities with 165,464 people on ART from 32 facilities with 104,966 patients. According to the findings, 17,602 (17%) of the 165,464 trial participants were LTFU, making it challenging to document genuine care status and HIV RNA levels.

Ghana's HIV epidemic is generalized; HIV prevalence is consistently over 1% among pregnant women, HIV is firmly established in the general population, and although subpopulations at high risk may continue to contribute disproportionately to the spread of HIV, sexual networking in the general population is sufficient to sustain an epidemic independent of subpopulations at higher risk for infection. In 2020, the estimated adult national HIV prevalence was 1.68% (CI: 1.44% -1.95%), with the number of people living with HIV and AIDS estimated at 346,120 and projected to increase to 349,362 in 2021(Ghana AIDS Commission [GAC], 2020). There were 18,928 new infections and 12,758 AIDS deaths. As of the end of December 2020, 577 ART sites and 5,760 PMTCT and HIV testing and counseling sites were established by the GHS and National AIDS/STI Control Programme (NACP, 2020).

Epidemiology of HIV/AIDS: Person

According to the Joint United Nations Programme on HIV/AIDS (UNAIDS, 2021) HIV and AIDS Estimate in 2020, the epidemiological situation presented in Table 2 shows that 37,700,000 adults and children live with HIV. For adults aged 15 to 49, the HIV prevalence rate was 0.7 (1,500,000), and children were newly infected with HIV, and the HIV incidence per 1,000 population (15–49) was 0.31. There were 680,000 adult and child deaths due to AIDS and 15,400,000 orphans aged 0 to 17 due to AIDS.

Table 2

HIV and AIDS Estimates, 2020

Population	Estimate
Adults and children living with HIV	37,700,000 [30,200,000–45,100,000]
Adults aged 15 and over living with HIV	36,000,000 [28,900,000–43,200,000]
Women aged 15 and over living with HIV	19,300,000 [15,500,000–23,100,000]
Men aged 15 and over living with HIV	16,700,000 [13,300,000–20,100,000]
Children aged 0 to 14 living with HIV	1,700,000 [1,200,000 –2,200,000]
Adults aged 15 to 49 HIV prevalence rate	0.7 [0.6–0.9]
Women aged 15 to 49 HIV prevalence rate	0.8 [0.6–1.0]
Men aged 15 to 49 HIV prevalence rate	0.6 [0.5–0.8]
HIV prevalence among young women	0.4 [0.2–0.5]
HIV prevalence among young men	0.2 [0.1–0.3]
Adults and children newly infected with HIV	1,500,000 [1,000,000–2,000,000]
Adults aged 15 and over newly infected with HIV	1,300,000 [910,000–1,800,000]
Women aged 15 and over newly infected with HIV	660,000 [450,000–920,000]
Men aged 15 and over newly infected with HIV	640,000 [460,000–890,000]
Children aged 0 to 14 newly infected with HIV	150,000 [100,000–240,000]
HIV incidence per 1,000 population (adults 15–49)	0.31 [0.21–0.43]
HIV incidence per 1,000 population (all ages)	0.19 [0.13– 0.27]
Adult and child deaths due to AIDS	680,000 [480,000–1,000,000]
Deaths due to AIDS among adults aged 15 and over	580,000 [400,000–850,000]
Deaths due to AIDS among women aged 15 and over	240,000 [170,000–360,000]
Deaths due to AIDS among men aged 15 and over	340,000 [230,000–490,000]
Deaths due to AIDS among children aged 0 to 14	99,000 [68,000–160,000]
Orphans due to AIDS aged 0 to 17	15,400 000 [10,600,000–20,900,000]

Note. Adapted from *National and Sub-National HIV and AIDS Estimates and Projections 2020 Report*, by Ghana AIDS Commission, 2021 (https://www.ghanaids.gov.gh/mcadmin/Uploads/2020%20HIV%20and%20AIDS%20Estimates%20and%20Projections%20PDF.pdf).

Epidemiology of HIV/AIDS: Place

The geographic distribution of HIV/AIDS is shown in Table 3 below. As of 2020, the regional data showing geographic distribution is depicted below in Table 3. In Eastern and Southern Africa, 20.6 Adults and Children were Living with HIV, compared to

Western and Central Africa (4.7million), Middle East and North Africa (230,000), Asia and the Pacific (5.8million), Latin America (2.1 Million), Caribbean (330,000), Eastern Europe and Central Asia (1.6million) and Western and Central Europe and North America (2.2million) (UNAIDS, 2020).

Table 3

Regional HIV and AIDS Statistics and Features, 2020

	Adults and Children Living With HIV	Adults and Children Newly Infected With HIV	Adults and Children Deaths Due To HIV
Eastern and Southern Africa	20.6 million	670,000	310,000
Western and Central Africa	4.7 million	200,000	150,000
Middle East and North Africa	230,000	16,000	7900
Asia and the Pacific	5.8 million	240,000	130,000
Latin America	2.1 million	100,000	31,000
Caribbean	330,000	13,000	6,000
Eastern Europe and Central Asia	1.6 million	140,000	35,000
Western and Central Europe & North America	2.2 million	67,000	13,000
Global	37.7 million	1.5million	680,000

Note. Adapted from *UNAIDS 2020: Estimates* [Publicly available resource of UNAIDS estimates for key HIV indicators at regional, national, and global levels] (https://aidsinfo.unaids.org/).

Epidemiology of HIV/AIDS: Time

The Joint United Nations Programme on HIV/AIDS UNAIDS (2020) shows a 31 percent decline in the new infection rate from 1970 to 2020. At the same time, the infection's prevalence ratio declined globally, from an average of 11 million in 2000 to a little over 2.5 percent in 2020.

Epidemiology of HIV/AIDS in the United States

According to the CDC (n.d), “HIV in the United States is largely an urban disease with the South having the highest number of people living with HIV but the Northeast having the highest rate per 100,000 people”, again “HIV and AIDS remains a persistent

public health problem for the United States and countries around the World. An estimated 1,044,977 million people in the United States had HIV at the end of 2019, with about 14%, or 1 in 7, not knowing they had HIV".

Prevalence: Persons Living With Diagnosed HIV Infection

The HIV epidemic in the United States began as a bicoastal epidemic concentrated in large cities, according to Sullivan et al. (2021), but the epidemiology of HIV has changed over nearly four decades. During the years 2009–18, overall HIV diagnoses decreased, whereas HIV diagnoses among people aged 25–34 years rose. According to the CDC (2019), 1,061,482 people were living with HIV infection, and more males (75 percent) than females (50 percent) were infected. Surprisingly, the elderly 65 and older had the highest rate (48%) of people living with HIV infection, with those aged 55–59 make up the biggest percentage (15 percent).

In studying the risk related to HIV transmission in other sub-populations in the US, such as the US military studied by Hakre et al. (2015), the authors noted links to HIV infection included morbidity as a critical factor in HIV transmission in this group. Also, in the United States Air Force, people who were young and unmarried had the highest risk of contracting HIV, especially those in higher-risk occupation groups in operations.

Age, Sex, Gender, and Retention in Care

Among the sexes considering age and gender, retention in care is critical for all HIV-infected people, according to Yehia et al. (2015), and is highly linked to ARV medication initiation and viral suppression and that retaining younger HIV-positive people in care may be especially crucial for improving clinical outcomes and lowering

HIV transmission, as well as having significant consequences for the future. However, Anderson et al. (2020) found inequalities in care retention based on race, gender, age, HIV exposure, incarceration history, place of birth, and U.S. geographic area. These inequalities highlighted by Anderson et al. (2020) and Babatunde et al. (2015) that younger PLWHIV have lower retention than older PLWHIV and that older age may be protective for retention, whereas compared to older age groups, people as young as 13 and in their early 20s had poor retention compared to people aged 40 and up. Disparities in retention have also been linked to age at the time of HIV enrollment which tends to be highest among those who join care around the age of 50, as opposed to those who enter care when they are younger, consistent with Mohammed et al. (2020) who also found that Gender discrimination is connected to gender differences in retention. It is, however, not consistent with the findings by Brown et al. (2017), who found that retention among those aged 15 to 24 was at 81%, compared to 94% for those aged 30 and 90% for those aged 25–29 after investigating predictors of 12-month HIV care retention among youth (15–24 years) who are linked to HIV care for the first time in rural Kenya by comparing young people (ages 25–29) and older adults (ages 30). However, the findings by Brown et al. were consistent with Brown et al. (2019), who found that younger age was a significant predictor of one-year attrition in both men and women. Nevertheless, Tassie et al. (2010) found no difference in 12-month ART retention between men (77.3%) and women (76.8%) or between children under 15 years old (77.9%) and adults/adolescents (78.3%) among the twenty-five countries that reported disaggregated 12-month retention rates by sex and the 21 countries that reported by age, aggregation of individual country

data. Gender still is a risk factor for retention in care (Brown et al., 2017) since females make up a considerable majority of youth aged 15–24 (89%) and are less likely than males to be retained in care, consistent with the findings by Fleishman et al. (2012) that women were more likely to be established, retained in care, and not LTFU. The findings by Fleishman et al. (2012) are consistent with Plazy et al. (2015), who identified that retention was higher in women and individuals aged >25 years, but inconsistent with studies that found that females are more likely to be retained in care, even though Charurat et al. (2010) identified that being a female puts the individual at a higher risk of nonadherence. For ethnic groupings, males were less likely than females to remain in care among non Hispanic Blacks, and this finding was equally true among Mexican and Central American Born Latinos.

MacKenzie et al. (2017) also noted that age at the time of initiation and year of ART initiation are independently associated with attrition and that adolescents living with HIV without teen club exposure were less likely to be retained on treatment than those with teen club exposure irrespective of sex, ART initiation age, current age, the reason for ART initiation and year of ART initiation. Mulongeni et al. (2019) and Zanoni et al. (2019) agree that adolescent-friendly services impact retention.

Even though Mackenzie et al. (2017) identified age at the time of initiation and year of ART initiation were independently associated with attrition. Lilian et al. (2020) recognized that same-day initiation on ART increased due to treating all, and as age declined, LTFU decreased, and virologic failure became more common. Thus age at initiation affects retention. This is consistent with Makurumidze et al. (2020), who also

examined gender differences between treat all and retention and found that the proportion of males starting ART after "Treat All" was greater (39.4% vs. 36.2%, p = 0.044). Male vs. female gender and WHO Stage IV vs. WHO Stage I-III predicted attrition before and after implementing "Treat All."

According to the CDC (n.d), the total HIV prevalence rate in 2019 was 11.1% among adults and 13.2% among adolescents, and in 2019, males were diagnosed with HIV infection at a rate of 79%, while females were diagnosed with HIV at a rate of 98%.

In Ghana, Dako-Gyeke et al. (2012) noted that as ART coverage increased, the proportion of males receiving ART declined from 41.7% in 2004 to 30.1% in 2008 and 27.6% in 2010.

CD4 Count Level and Retention

Namusobya et al. (2013) examined high retention in care among HIV-infected patients entering care with CD4 Levels >350 cells/μL under routine program conditions in Uganda. The authors noted that 20% of patients with a median CD4 count of 550 cells/μL became LTFU over 2.5 years. While at the same time, retention among patients who enrolled with CD4 levels >350 cells/μL was 88.2%. Other factors, such as lower income, unemployment, and rural residence, were associated with failure to be retained.

Having a high CD4 count and not being retained is also consistent with the findings by Gusset (2019), who noted that patients who exited care then “returned” after 4 (3–9) months had CD4 count >350 cells/mm3were and were less likely to have initiated ART within one month and more likely to be male, young (<29 years), and without a regular partner. High CD4 count and low retention in care were also consistent with

Charurat et al. (2010), who examined pharmacy refill records to evaluate risk factors for loss to follow-up (LTFU) and nonadherence to ART in a large treatment cohort in Nigeria. The authors identified that, consistent with Namusobya et al. (2013) and Gusset (2019), those with baseline CD4 counts (cell/ml3) >350 and CD4 count <100 were at a higher risk of LTFU. Additionally, Charurat et al. (2010) identified that having post secondary education and patients with only primary education, aged <35 years ($p=0.005$), who traveled for >2 hours to the clinic ($p=0.03$), had a total ART duration of >6 months ($p<0.001$), and CD4 counts >200 at ART initiation were at a higher risk of nonadherence.

However, Fleishman et al. (2012) examined establishment, retention, and loss to follow-up (LTFU) in a large, multi site cohort over a 2 to 8 years. Those with very low CD4 levels ≤50 cells/mm3 were likely to be established and retained in care, but among established patients, 57.4% did not meet the retention criterion, and 34.9% were LTFU. Consistent with the findings of Babatunde et al. (2015), who identified poor retention to be associated with high CD4 count, i.e., baseline CD4 above 400cell/mm3, pre ART clients, and HIV stage 1&IV clients., Plazy et al. (2015) identified that retention was higher in those with low CD4 count and high body mass index and settings with free cotrimoxazole use. Low CD4 count was, however, not consistent with Koening et al. (2016) findings that those with CD4 count strata ≤200, 201 to 350, 351 to 500, and >500 cells/mm3 who were initiated on ART within the first year after HIV testing had retention at 84%, 82%, 64%, and 64%. Conversely, individuals with low CD4 one year after

initiation were retained at 84 and 82% and remained the same 10 years into the study at 94%, 95%, 79%, and 74% (Koening et al., 2016).

In Ghana also, Kumar et al. (2015) identified that, Clinically, men were more likely than women to have a lower CD4 count at the start of treatment (260 vs. 311 cells/L, p0.01).

Treat-All Policy and Retention HIV Care

Tassie et al. (2010) noted that regional and global trends showed that most attrition from ART programs occurred within the first year and declined afterward. Retention was estimated at 75.2% at 12 months, 66.8% at 24 months, and remained at a similar level up to 48 months. Among countries in sub-Saharan Africa, retention on ART estimated at 12-48 months in low-income and middle-income countries was 54 (36%) at 12 months, 38 (26%) at 24 months, at 36 months, and 30 (20%) at 48 months.

Makurumidze et al. (2020), in a retrospective study, analyzed the retention of patients who started ART before and after "Treat All," respectively. The authors found that same-day ART initiation was more frequent after "Treat All" (43.2% vs. 16.4%) than before, and retention on ART was higher before "Treat All." Attrition was also higher after "Treat All" for males initiating with a WHO Stage 4 condition and being pregnant predicted attrition before and after Treat All. However, pregnancy became a less strong risk factor for attrition after the "Treat All" implementation. Consistent with Makurumidze et al. (2020); Matare et al. (2020), and Munkhondya et al. (2021), also identified that cumulative retention at 3, 6, and 12 months was consistently lower during "Treat all" and was significant at six months (74.9% vs.78.1%). However, Alhaj et al.

(2019) found results inconsistent with Makurumidze et al. (2020) and Matare et al. (2020), showing that retention on ART in the UTT cohort was higher at 83.0% than in the pre UTT cohort 76.2%. Also, that same day, ART initiation was a risk factor for retention (Alhaj et al., 2019).

Ahmed et al. (2020) also accessed the effect of same-day treatment initiation on individual-level retention at 6 and 12month follow-ups for PLHIV who started ART on the same day and those who started ART > 7 days following HIV diagnoses. The results showed that at 12 months, 75.8% (328) in the same-day group vs. 82.0% (455) in the > 7 days' group were retained-in-care. The major drop in retention was in the first 30 days following ART initiation among the same-day group. The same-day group was less likely to be retained on ART at 6 and 12 months after adjusting for baseline and nonbaseline covariates. Thus reduced retention-in-care can threaten the benefit of the same-day "test and treat" policy.

According to Burke et al. (2022) also, having TB and being HIV positive also could affect retention in care, especially when ARVs are initiated the same day since retention in care and viral load suppression at 8–12 months were relatively low (varied between 34% and 64%).

Long et al. (2020) also reviewed the recent literature on DSD models to describe what is known about clinical outcomes. This systematic review identified that Retention was reported for 29 (78%) of the models and viral suppression for 22 (59%). Where a comparison with conventional care was provided, retention in most DSD models was

within 5% of that for conventional care; where no comparison was provided, retention generally exceeded 80% (range 47% to 100%).

Option B+ and Retention in Care

"The World Health Organization (WHO) endorsed Option B+ in 2013 to prevent HIV transmission from mother to child. The aim is to reduce the Mother-to-Child Transmission of HIV (MTCT) rate to less than or equal to 5%. Its success is contingent on women continuing to use ART throughout their pregnancies, births, and lactation periods." Chimwaza et al. (2021).

However, Alhaj et al. (2019) noted that young adults and women who were pregnant or breastfeeding at the start of ART were at increased risk of attrition, and according to Joseph et al. (2017) also, the scale-up of Option B+ in Zimbabwe has increased ART coverage, but patient loss-to-follow-up remains high. Alhaj et al. (2019) also identified that lower retention on ART observed among pregnant and breastfeeding women aligns with previous studies of Option B+ women in Malawi, showing that pregnant women were at a higher risk of being LTFU, especially early on in the course of ART. Alhaj et al. (2019) noted additional risk factors for retention, including long travel distance to the clinic, lack of transport money, developing side effects, inability to reach the clinic due to severe illness, and noncomprehension of ART education, models of HIV care at the health facility.

Chimwaza et al. (2021) also noted that early initiation resulted in retention at 3 and 6 months post-ANC booking to be 84% and 73%, respectively. At delivery, 18% were lost-to-follow-up, consistent with Woelk et al. (2016) findings that loss to facility

occurred early, with 26% to 33% being lost within 30 days post-registration. This finding is contrary, however, to Alhaj et al. (2019), who identified early initiation as a predictor of retention in care among pregnant women and nondisclosure of HIV status between spouses being barriers for pregnant and breastfeeding mothers to remain engaged in HIV care.

In a retrospective cohort study, Woelk et al. (2016) also indicated that 81% of infants were retained in care within the same health facility at 12 months post-delivery and mother-infant paired mothers, retention at 12 months was 74% and 79% for their infants. This is high and consistent with other findings by Chimwaza et al. (2021) but contrary to Alhaj et al. (2019).

Loss to follow-up among pregnant women seems to be high and consistent with Knettel et al. (2018), who showed that over a year, 48.5% were LTFU, which increased to 57% vs. 56.9%. Retention among pregnant women on Option B+ was generally poor and mainly driven by early losses.

Dzangare et al. (2016) also examined the number and proportion of pregnant and lactating women in rural districts at six months. Six months retention was relatively high at 83%, but the loss to follow-up was the leading cause of attrition.

For ART naïve patients, Koss et al. (2017), in a cross-sectional study, identified that 90% of ARV naïve clients retained and 80.7% to 86.7% were virally suppressed.

Atanga et al. (2016) examined linkage and retention and prospectively determined the uptake of ART and retention in care after Option B+ initiation between October 2013 and December 2014 in pregnant and breastfeeding women. Retention at 12 months was

88.0%, slightly lower than at six months at 81.1%, respectively. This high retention rate in the first year on Option B+ is consistent with Koss et al. (2017) and consistent with the high rate of loss follow-up (44.6%). Additional factors identified for lack of retention were denial and stigma (52.8%), religious reasons (25.0%), and lack of transport fare (11.1%). Munkhondya et al. (2021) also identified in examining the evidence around facilitators and barriers to Option B+ retention by HIV-positive mothers. Munkhondya et al. (2021) identified risk factors for nonretention in PMTCT, including young age (15–24 years), initiating mothers on ART on the same day as diagnosis, anticipated stigma, and hospital factors, and concerns about side effects. The risk factor for same-day initiation is no different from the findings by Lilian et al. (2020), who identified that same-day initiators have reduced retention rates and high rates of loss to follow-up. The authors also identified that younger women are more susceptible to nonretention in PMTCT, which is consistent with Anderson et al. (2020) and Brown et al. (2019).

In Ghana also, Sakyi et al. (2019) identified a critical factor that is usually overlooked; caring for low birth weight, LBW, infants, and its effects on maternal ART adherence and retention in care, especially when on ARVs. Sakyi et al. (2021) also noted that retention in HIV care was more economically and socially expensive in the postpartum period than during pregnancy due to economic challenges associated with childbirth (such as unemployment, underemployment, and debt). Unemployment as a factor of low retention among pregnant and breastfeeding mothers was consistent with the findings by Namusobya et al. (2013). Only two-thirds of postpartum mothers stayed

in care after a year, with the rate of LTFU at 22% among women diagnosed during pregnancy and 13% among those with known HIV diagnoses (Reece et al., 2016).

Death With HIV

Evidence by Tassie et al. (2010) suggests that "the stage of the disease at the time of enrolment on ART and the quality of prior health care affect early high mortality rates and the most important predictor of survival and immunological recovery is the CD4 level at the start of treatment." Poorolajal et al. (2016) identified that without ART, death increases among HIV-positive clients showing that in 2, 4-, 6-, 8- 10-year survival rates were 87%, 86%, 78%, 78%, and 61% for clients on highly active ART, HAART and the 2-, 4- and 6-year survival probabilities of progression from AIDS onset to AIDS-related death in patients who did not receive HAART were 48%, 26%, and 18%, respectively. Tchounga et al. (2016) also found among HIV-2 infected patients, either on ART or not, that mortality was associated with late presentation, advanced age, male gender, CD4 count <500 cell/µl, high plasma viral load, hemoglobin rate <8 g/dl). Moreover, body mass index < 18 Kg/m2, and mortality was low in individuals with a high CD4 count of 350 and above, Namusobya et al. (2013).

According to Ford et al. (2016), in-hospital mortality due to TB was 24.9 percent among adults, and TB is still the primary cause of hospitalization and in-hospital death among adults and children living with HIV around the world.

Nliwasa et al. (2018) findings were consistent with Ford et al. (2016), who examined HIV and TB prevalence, and short-term (two to six months) mortality among adults with TB symptoms at the community- and facility levels. Mortality was 1.6% at

the community level, 22.6% among inpatients, and 3.1% at the primary care level. TB screening combined with HIV and TB testing for all asymptomatic patients should be a top priority for both disease programs. Interventions to reduce mortality in the short term are desperately needed.

With the CDC (n.d.) reporting, the death rate for people aged 60–64 and 65 has climbed again. Persons aged 20–24, 25–29, 35–39, 40–44, 45–49, and 50–54 years died at lower rates. Death rates for people in their 30s and 40s and those in their 50s and 60s were steady. Also, the number of deaths among the genders decreased for females while the number among males remained steady. Males (75 percent) had the highest percentage of people living with HIV infection, followed by females (50 percent) (23 percent). Adult and adolescent mortality rates in 2019 were 5.7 percent and 5.7 percent, respectively. Female deaths decreased, while male deaths remained constant. Death rates for people in their 30s and 40s and those in their 50s and 60s were stable.

Tuberculosis Disease and Retention

According to Ford et al. (2016), "HIV and tuberculosis (TB) are two of the most challenging infections faced by humanity and place an immense burden on health care systems worldwide since both impact one another's progression," and TB is the most common cause of death among People Living with HIV (PLHIV) (Rewari et al., 2021). TB remains a leading cause of HIV-associated mortality and morbidity among both adults and children worldwide and a cause of discontinuation of HIV medication intake (Dalbo & Tamiso 2016; Méndez-Samperio 2017), and retention was lower in individuals co-infected with TB (Plazy et al., 2015; Burke et al., 2022) at 34% and 64%. "Both low

and high-income settings have reported that TB contributes substantially to hospitalization among people living with HIV, and mortality among those hospitalized is high" (Nliwasa et al., 2018; Ford et al., 2016). As a result, "in 1997, at least 10.7 million people were co-infected with HIV and TB, accounting for 8% of all TB cases worldwide with more than 30% of TB cases in Africa. Males and those living in locations such as Sub-Saharan Africa and the Maghreb, where malnutrition and social deprivation are factors, have a higher chance of acquiring tuberculosis during HIV infection".

Adherence Monitors and Retention

Moges et al. (2020), in determining the pooled magnitude of HIV patient clinical retention and attrition, identified factors associated with retention and attrition in Ethiopia and identified major determinants of attrition, including non disclosed HIV status. Brown et al. (2017) also agree that having an HIV-infected household member (spouses, siblings, and parents) who know the status of the others provided some protection and was associated with increased retention among the age 15–24, with one-year retention of 90%. Conversely, one-year retention was 77% (95% CI 65–85%) among those without an HIV-infected household member with whom to disclose HIV status, especially when the disclosure is made to a spouse/family (Alhaj et al., 2019; Charurat et al., 2010; Koss et al., 2017; see also Munkhondya et al., 2021) were likely to be virally suppressed. Disclosure of HIV status also improved retention in care (Arrive et al., 2012). However, in Ghana, contrary to the notion that PLHIVs are unable to disclose their HIV status, the study by Obiri-Yeboah et al. (2016) identified that the majority of the study participants (78.6 %) had disclosed their HIV-positive status to their sexual partners, and this

invariably should improve retention, especially with the support to be gained from partners as adherence monitors, consistent with the findings by Alhaj et al. 2019; Charurat et al. 2010; Koss et al. (2017) and Munkhondya et al. (2021) and that disclosure to a spouse and spousal involvement in treatment was associated with improved initiation, adherence, and retention.

Alcohol Use and Retention

As a misused substance (Wechsberg et al., 2021), alcohol use causes potentially modifiable behavior and lack of retention (Monroe et al., 2021), with participants' mean (SD) visit adherence being 84% (25%) and heavy alcohol use associated with lower-than-expected retention rate with daily/weekly binge drinking being associated with lower visit adherence. Consistent with Monroe et al. (2021), Cook et al. (2017) identified the degree of drinking, such as heavy, binge, and low-level drinking, and abstinence resulted in retention as low as 9, 25, 37, and 30%, respectively. Exceeding weekly recommended levels of alcohol consumption (heavy drinking) was significantly associated with poor HIV viral suppression and ART nonadherence, while binge drinking was associated with suboptimal ART adherence. Alcohol use disorder (52% vs. 76% retained; $p < 0.01$) also affects retention in care to as low as 48% (Cichowitz et al., 2017).

Current HIV Prevention, Therapies, and Management Strategies

Primary Prevention

Primary prevention is critical in bringing the pandemic to an end. As a current primary prevention strategy, the prevention of HIV infection among women, especially young women or parents-to-be, will help to prevent HIV transmission to infants and

young children, as well as help towards other prevention goals. For the general population, health information, and education, HIV testing and counseling, regular retesting for those with exposure, including HIV self-testing within the community as a test for triage, couple counseling and partner testing, safer sex practices, including dual protection (condom promotion), delay of onset of sexual activity, and behavioral change communications to avoid risky behavior. Additionally, counseling and services are required to ensure women can make informed decisions about their RH, access to HIV testing and counseling in RH/FP services, and safer sex practices, including dual protection (condom promotion) Mbalinda et al., (2020).

Secondary Prevention

As a secondary prevention strategy, the current 90 90 90 strategies to test 90 percent of the HIV population, put on therapy 90 percent of identified individuals, and ensure that 90 percent are virally suppressed within 6 to 12 months (Kerschberger et al., 2021). This 909090 approach relies on the treat-all strategy, which encourages same-day ART for persons testing positive for HIV while removing all barriers to ART initiation (Kerschberger et al., 2021). The current strategy for testing, ART initiation, and viral suppression also relies on the differentiated testing approach, a client-centered approach to provide differentiated service to the client where, when, and however convenient to the client, Kerschberger et al., (2021). As part of secondary prevention measures, the Provision of specific interventions to reduce HIV transmission from HIV-infected women to their infants is still critical to ending the epidemic (Kiragu et al., 2017) for HIV positive women who become pregnant, WHO has identified a package of interventions

for the PMTCT to prevent perinatal transmission. It includes ARV drug regimens for HIV-infected newborns, safe obstetric practices, and counseling and support for pregnant women on infant feeding options (Walsh et al., 2020).

Tertiary Prevention of HIV

According to Agliullina and Khasanova (2018), tertiary prevention strives to avoid disease progression and the development of comorbidities. Treatment, rehabilitation, and social support for those living with HIV are all part of tertiary prevention. Tertiary prevention strategies are partially filling the gap left by primary prevention efforts. As a result of the reduction of viral replication, patients who adhere to ARV medication minimize their chance of spreading the virus to their sexual partners, reducing the spread among the population. The role of elements influencing the epidemic process varies by subpopulation and place. Additional tertiary HIV/AIDS strategies are barriers to ARV drug access and compliance with ART (Agliullina & Khasanova, 2018).

HIV Therapies and Management Strategies

According to the WHO (n.d), focusing on current management strategies accelerates and intensifies health sector response in ending the HIV and AIDS epidemic regarding access to ART, prevention, and testing. Further, the strategy aims by 2020 to reduce global HIV-related deaths to below 500 000, to reduce new HIV infections to below 500 000, and to ensure zero new infections among infants.

The early ART initiation strategy reduces the time between HIV diagnosis and ART initiation. ART initiation is often seen as a nonemergency intervention, and various approaches help prepare people to begin treatment. Individuals and communities are the

centers of any strategic efforts to reduce the initiation time. The concern, however, remains that accelerated initiation of ART may lead people to start before they are ready, with adverse consequences for adherence and treatment outcomes (Alhaj et al., 2019). WHO notes a study in Malawi in 2019, of which nearly 22 000 women who started ART under Option B+ in Malawi, 17% were LTFU six months after ART initiation. Loss to follow-up was highest among women who began ART at large clinics on the day they were diagnosed with HIV. The Malawian study explored the levels and determinants of loss to follow-up (LTF) under universal lifelong ART for pregnant and breastfeeding women and also identified the national program moved from Option A+ to Option B+ for PMTCT in 2002, where single dose Nevirapine was given to the mother at the onset of labor and the infant after birth. In 2007, the WHO "AZT combination prophylaxis" regimen was rolled out, initially at district hospitals and larger facilities. Similar to "Option A," this regimen provides daily Zidovudine (AZT) for the mother during pregnancy with an additional dose of lamivudine and Nevirapine during labor and 1-4-week prophylaxis with AZT syrup for the infant. Option B+ was introduced in September 2011, and pregnant and breastfeeding women began to receive a simple fixed-dose combination of Tenofovir, Lamivudine, and Efavirenz. Most losses occurred in the first three months of therapy.

Option B+ patients who started therapy during pregnancy were five times more likely than women who started ART in WHO stage 3/4 or with a CD4 cell count ≤350 cells/μl to never return after their initial clinic visit (odds ratio 5.0, 95% CI 4.2-6.1). Option B+ patients who started therapy while breastfeeding was twice as likely to miss

their first follow-up visit (odds ratio 2.2, 95% CI 1.8-2.8). LTF was highest in pregnant Option B+ patients who began ART at large clinics on the day they were diagnosed with HIV. LTFU varied considerably between facilities, ranging from 0% to 58%. The study's limitation is related to a lack of information on the date of delivery, parity, gestational age at ART initiation, duration of breastfeeding, and relevant health-system indicators. The limitation is related to socio-ecological factors that can directly affect retention. Program managers should consider focusing on these factors to help reduce the percentage of LTFU (Alhaj et al., 2019; Mpinganjira et al., 2020; Xie et al., 2022).

Socioeconomic factors are key social determinants of health (Frank et al., 2020; Moscrop et al., 2020; Plan et al., 2022; Singu et al., 2020). Socioeconomic factors can also limit access to strategies for testing, treatment, and retention in care and reduce persons' survival with HIV (Saracino, 2018). Psychological factors of depression and anxiety negatively impact public health outcomes and quality of life among PLWH, facilitating the progression of the individual's ill-health stage and inability to work and provide for the family and also being LTFU (Dunne et al., 2019). Again, chronic non retention also leaves healthcare workers in despair regarding their clients' whereabouts, health status, and the possibility of the PLWHIV returning deteriorated and unstable after seeking help from non clinical sources or just being at home. Agreeably, in people initiated on ART and adhering, retention can be hampered by an unsupported healthy lifestyle (Booker & Mullan, 2013), differences such as physical activity, cessation of smoking and alcohol intake chances to respond to ART, increased side effects and presenting with comorbidities (Saracino, 2018). Reduced social support and

nondisclosure could also hamper strategies for retention coupled with entrenched gender norms on health, fueling stigma (Brown, 2018). Stigma negatively affects Retention in the same way that increasing out-of-pocket spending impoverishes patients (Brown, 2018).

From the methodological perspective, a controlled environment tends to increase retention in care, as shown by McNairy et al. (2017b). In a cluster-randomized controlled trial, (McNairy, 2017b) showed the effectiveness of a combination intervention strategy (CIS) versus the standard of care (SOC) on the primary outcome of linkage to care within one month plus retention in care at 12 months after HIV-positive testing. Randomized control trials have shown that increasing retention may not be feasible in a natural setting. Using the traditional in-person laboratory-based test for retention evaluation may thus not show high results where clinical monitoring was feasible using point of care, POC. In a cluster-randomized trial, Elul et al. (2017) showed that although retention after initiation was high, monetary incentives to remain in care for a lifelong chronic condition are unsustainable. Thabane et al. (2020) targeted vulnerable populations (men who have sex with men, African, Caribbean, and Black people, sex workers, people who inject drugs, and indigenous people) that have received much attention to supporting retention in care. The support includes mixed, digital, behavioral or educational, peer or community-based, medication modification, economic/monetary, pharmacy-based, or task-shifting for effectiveness across the continuum of care.

At-risk subpopulations receiving attention have a high retention rate. Sustaining such retention efforts for a life-long medical condition should be revisited for

sustainability. MacPherson et al. (2015) also systematically searched the Medline, SCOPUS, and Web of Sciences databases and conference abstracts from the International AIDS Conference and International Conference on AIDS and STIs in Africa and identified limited evidence on the effectiveness of service delivery interventions to support adolescents' linkage from HIV diagnosis to ART initiation, retention on ART and adherence to ART (MacKenzie et al., 2017). MacKenzie noted that joining a teen club, age at the time of selection, and year of ART initiation are independently associated with attrition and that adolescents living with HIV without teen club exposure were less likely to be retained on treatment than those with teen club exposure irrespective of sex, ART initiation age, current age, the reason for ART initiation and year of ART initiation.

Task sharing among health care workers ideally should contribute to ensuring clients are retained in care due to increased contact hours with the clients. McNairy et al. (2017a) also reported that twenty-six public HIV facilities implemented a task-sharing model with either a nurse-with-onsite-physician or a nurse-with-visiting-physician model, but noted that active task-sharing was not effective in allowing other cadres of health workers to care for the patient to improve retention. Rosen et al. (2016) also used Rapid Initiation of Treatment, an unblinded randomized controlled trial of single-visit ART initiation in two public sector clinics in South Africa, a primary health clinic and a hospital-based HIV clinic. The authors noted that offering single-visit (same-day initiation) ART initiation to adult patients in South Africa increased ART uptake by 36% and viral suppression by 26%, but the study area/sites were too low to support the generalization of results. In a retrospective cohort analysis of women in Zomba District,

southern Malawi, from January 2012 to September 2013 pregnant women (Landes et al., 2015), however, noted that retention among pregnant women was high, especially for health facilities having integrated comprehensive prenatal/focus antenatal care for pregnant women. These sites have integrated HIV services into the comprehensive services of the health care system.

Retention Care Measures

Anderson et al. (2020) also reviewed the characteristics of Retention in Care Measures. Appointment-based definitions commonly followed a similar format as laboratory-based definitions. Several studies defined retention in care as greater than or equal to two HIV provider visits greater than or equal to 90 days apart within 12 months. Only one study used this definition and specified HIV provider visits as primary care encounters. One study defined retention as having two or more HIV visits within 12 months but did not indicate a time interval between each HIV appointment. Another definition of retention in care was attendance at one HIV appointment within four months.

Anderson et al. (2020) also highlighted the retention in care measures used (see Table 4).

Table 4

Highlights of Retention in Care Measures

Name	Study	Retention In Care Measure
Adeyemi et al.	Cross-sectional	≥ 2 HIV RNA measurements in 2010
Althoff et al.	Cross-sectional	Attended ≥ 1 HIV care visit from 1/2008 – 6/2008 and visits ≥ 90 days apart in each of the next 3 semesters from 1/1/2008 to 12/31/2009
Costa et al.	Matched Cohort	Attended 2 provider visits ≥ 90 days apart within a 12-month period
Cyrus et al.	Cohort	≥ 2 engagement in care opportunities ≥ 3 months apart in 2015 Engagement in care = evidence of ≥ 1 documented lab test; prescription filled through AIDS Drug Assistance Program; or physician visit documented in Ryan White databases
Dasgupta et al.	Cohort	≥ 2 CD4 or viral load tests ≥ 3 months apart within a 12-month period, assessed annually for 2011, 2012, and 2013 Consistently retained = retention in care for all 3 years
Ghiam et al.	Cohort	Laboratory and appointment definition: ≥ 2 CD4 or viral load tests or HIV provider visit ≥ 90 days apart
Hall et al.	Cohort	Attended ≥ 1 HIV appointment between 1/1/2009 and 4/30/2009
Hu et al.	Cohort	≥ 2 viral load tests ≥ 90 days apart in 2009
Lesko et al.	Cohort	≥ 2 clinical visits or HIV specific laboratory measurements > 90 days apart between 1/1 and 12/31 or present year
Mauck et al.	Cohort	≥ 2 engagement in care opportunities ≥ 3 months apart in 2015 Engagement in care = evidence of ≥ 1 documented lab test; prescription filled through AIDS Drug Assistance Program; or physician visit documented in Ryan White databases during 2015
Morales-Aleman et al.	Cohort	≥ 2 CD4 or viral load tests ≥ 3 months apart within 12 months of diagnosis
Muthulingam et al.	Cohort	Retention in care for 2nd visit: 2nd laboratory test within 3–6 months after entry into care Retention in care for 3rd visit: 3rd laboratory test within 3-6 months after 2nd laboratory test
Rebeiro et al.	Cohort	≥ 2 HIV primary care visits ≥ 90 days apart within a calendar year; subspecialty visits were not included in this definition
Rebeiro et al.	Cohort	≥ 2 healthcare provider visits in the calendar years of interest > 90 days apart
Sheehan et al.	Cohort	≥ 2 engagement in care opportunities ≥ 3 months apart in 2015 Engagement in care = evidence of ≥ 1 documented lab test; prescription filled through AIDS Drug Assistance Program; or physician visit documented in Ryan White databases during 2015
Sheehan et al.	Cohort	≥ 2 engagement in care opportunities ≥ 3 months apart in 2015 Engagement in care = evidence of ≥ 1 documented lab test; prescription filled through AIDS Drug Assistance Program; or physician visit documented in Ryan White databases during 2015
Singh et al.	Cohort	≥ 2 CD4 or viral load tests ≥ 3 months apart during 2010
Sohler et al.	Cohort	≥ 2 HIV related primary care visits over a 6-month period
Wester et al.	Cross-sectional	≥ 2 CD4 or viral load

Note. From "Disparities in Retention in Care Among Adults Living with HIV/AIDS: A Systematic Review," by A. N. Anderson, C. M. Higgins, R. Haardörfer, M. McDonnell Holstad, M. L. Y. Nguyen, and D. Waldrop-Valverde, 2020, *AIDS and Behavior*, *24*(4), p. 4 to 7 (https://doi.org/10.1007/s10461-019-02679-2). https://eds.p.ebscohost.com/eds/detail/detail?vid=2&sid=27ec4508-33f9-4466-ac29-7894525533f1%40redis&bdata=JkF1dGhUeXBlPXNoaWImc2l0ZT1lZHMtbGl2ZSZzY29wZT1zaXRl#AN=31555931&db=mnh

Encounter-Based Retention and Laboratory-Based Retention

Rebeiro et al. (2015) used Encounter-based retention (REB) and Laboratory-based retention (RLB) for accessing retention were used in a survey on engagement in care and future mortality among persons living with HIV. The REB and RLB were designed as the measurement of retention. The REB and RLB assume a percentage of agreement, and the κ statistic was used to characterize the agreement between RLB and REB. A kappa of 1 indicates perfect agreement, whereas a kappa of 0 indicates agreement equivalent to chance. Encounter-based clinical retention (REB), defined by the Institute of Medicine-based indicator, is ≥ 2 HIV primary care encounters within each calendar year, ≥ 90 days apart. The second, laboratory-based retention (RLB), is defined in the same fashion as REB but using dates of CD4-positive T-lymphocyte (CD4+ cell) count or HIV type 1 (HIV-1) RNA measurement rather than primary care encounters as markers of care (Rebeiro et al., 2015).

Again, Wilson et al. noted there are few interventions focused on improving healthcare worker (HCW) competencies and skills for providing high-quality adolescent care tailored towards retention. The authors noted that using Standardized Patients as trained actors who work with HCWs in mock clinical encounters improves clinical assessment, communication, and empathy skills. Standardized Patients are noted to be key in intervention toward retention in care. Thus using a stepped-wedge randomized controlled trial, the authors evaluated a clinical training intervention utilizing Standardized Patients to improve HCW skills in caring for HIV positive adolescents and young adults, resulting in increased retention in care. The stepped-wedge randomized

controlled trial, a modified, one-way, cross-over design, is a pragmatic study design to allow for the study intervention to be carried out at the clinic rather than at the individual level, uses routine clinic data for primary outcome measurement and would not be feasible to implement simultaneously at all facilities. All facilities will contribute to intervention and control periods. The randomized control trial consists of four intervention waves approximately nine months apart. Each wave includes HCW participants from six facilities. Once facilities receive the training intervention, they are considered "exposed" until the end of the trial. The trial is critical to contributing valuable information to HIV programs in Kenya and other low-resource settings, providing a potentially scalable strategy to improve the quality of care and retention in critical HIV services in this population.

Statistical Analysis Plan

Retention

Retention in care has been defined as "a spectrum of the continuum of care packages starting from diagnosis of HIV infection till lifelong services (Umeokonkwo et al., 2018).

Retention, Initiation Time, Health, and Public Health

Retention in care is required for the optimal health of the individual and community members. The clinical and population-level prevention benefits of ART are realized if programs can improve male engagement, diagnosis, earlier initiation of therapy, clinical outcomes monitoring, and can support long-term adherence and retention, Beckham et al. (2016) acknowledge the fundamental role of financial

insecurity underlying risk-taking behavioral pathways and not being retained in care (Frew et al., 2016). Dunne et al. (2019) also described suboptimal adherence results in treatment outcomes that do not improve health outcomes for persons living with HIV, mainly resulting from the use of alcohol by patients. Thus, prescribers should ensure HIV patients are not drinking alcohol since alcohol use will influence adherence and retention in care. Beckham et al. (2016) also present the disparity between men receiving ART and women. The researchers based their argument on fewer men on ART and higher mortality rates than women.

In a systematic review and meta-analysis, the authors, Beckham et al. (2016), aimed to assess differential all-cause mortality between men and women living with HIV and on ART in low and middle-income countries, using an observational study. The results of the systematic review and meta-analysis show that men living with HIV have consistently and significantly more significant hazards of all-cause mortality than women while on ART in low and middle-income countries. This effect persists over time on treatment. The clinical and population-level prevention benefits of ART are realized if programs can improve male engagement, diagnosis, earlier initiation of therapy, clinical outcomes monitoring, and can support long-term adherence and retention.

Frew et al. (2016) also performed a clinical trial to understand the multilevel syndemic factors that concurrently contribute to the HIV epidemic among women in the US—specifically examining community, network, dyadic, and individual factors to explain HIV vulnerability within a socioecological framework. The result shows the following themes were identified at four levels, including 1) exosystem (community):

poverty prevalence, discrimination, gender imbalances, community violence, and housing challenges; 2) mesosystem (network): organizational social support and sexual concurrency, 3) microsystem (dyadic): sex exchange, interpersonal social support, intimate partner violence; and 4) individual: HIV/STI awareness, risk-taking, and substance use. A strong theme emerged, with over 80 % of responses linked to the fundamental role of financial insecurity underlying risk-taking behavioral pathways.

Dunne et al. (2019) also described suboptimal adherence results in treatment outcomes that do not improve health outcomes for persons living with HIV. The study relies on the Florida Cohort Study, a longitudinal study designed to monitor and improve health outcomes for individuals living with HIV infection and to examine how individual, clinic, and community-level factors influence access to care and HIV outcome variables, including medication non adherence, CD4 count, and viral load. This study specifically examines the association between impulsivity and non adherence to ARV medication among persons living with HIV. The authors' primary aim was to utilize a brief version of the BIS (BIS-Brief) (an eight-item version of the 30-item BIS (BIS-11) to test the hypothesis that impulsivity would be associated with medication non adherence among participants in a large epidemiological study. The BIS-Brief uses a four-point Likert-type scale, ranging from "never" to "almost always or always. Also, the Patient Health Questionnaire (PHQ) and the Generalized Anxiety Disorder (GAD) scales were used to assess mental health symptoms. The PHQ-8 is an 8-item Likert-type scale and a valid and reliable measure of depressive symptoms in clinical and research samples.

Similarly, the GAD-7 is a 7-item Likert-type scale with strong psychometric properties for assessing anxiety symptoms in research and clinical practice. Higher scores on the PHQ and GAD are indicative of greater symptom severity. The authors acknowledge limitations since the study used secondary data from an ongoing epidemiological study. Thus, measures were not selected for the current hypotheses, except for the addition of the BIS Brief. The use of self-report data is also a limitation identified and hinders the ability to fully understand participants' response patterns. Self-report data introduces several biases, which may have influenced participant responses, including self-preservation and social desirability biases. The sample size may also limit the strength of the findings, as small effect sizes were observed. Future studies with HIV samples should assess the potential influence of bipolar disorder when examining impulsivity, particularly given the association between nonplanning impulsivity and medication non adherence previously detected among patients with bipolar disorder. This study is critical to prescribers in ensuring HIV patients are not drinking alcohol since alcohol use will influence adherence and retention in care (Dunne et al., 2019).

Barriers to Retention

Barriers to retention are varied and can be identified at all ecological model levels, especially social structures. Zanoni et al. (2019) conducted in-depth, semi structured interviews with adolescents ages 13 to 24 years who were living with HIV and being cared for in either an adolescent-friendly or standard government-supported clinic in KwaZulu-Natal South Africa. The authors described the rationale and theory behind barriers to retention in care. Specifically, Zanoni et al. (2019) used an inductive content

analysis approach based on a grounded theory derived from reviewing, coding, and interpreting data. The authors used purposeful sampling to recruit pediatric and adolescent clinic adolescents who were retained/not retained in care and those virally suppressed/not virally suppressed.

Thus, adolescent-friendly services improve viral suppression among adolescents compared to a standard pediatric clinic in South Africa, where no adolescent-friendly services are provided. However, the authors acknowledged that limitations in the study were related to structural barriers, such as transportation and food security. Food insecurity is critical to implementing adolescent-friendly services and would likely need different targeted interventions. Again, Zanano et al.'s scale-up of services, more specialized and short-term implementation of adolescent-friendly services, requires public-private partnerships while taking a relook or exploring differentiated staffing models to accommodate after-hours clinics.

Assefa et al. (2017) also reviewed the performance of the ART program in Ethiopia during the past decade and identified successes and weaknesses in ending AIDS in the country. The researchers based their review on key performance indicators, including access progress in ART access, utilization, coverage, and equity in the country. Specifically, the evaluation focus was a performance review of the ART program against globally accepted key performance indicators. The researchers reviewed and analyzed routine program data reported nationwide from 2005 to 2015. This retrospective study used a systematic random sampling technique to select individual patient medical charts for data on patient characteristics. The results showed that the number of health facilities

providing ART increased, ART coverage, in general, increased in the country, Patients were initiated on ART more promptly following diagnosis, and the percentage of patients retained after 12 months on ART increased from 82% (81%-83%) in the 2006/7 cohort to 92% (88%-93%) in the 2014/15 cohort. The shift to second-line ART has been slow and remains low over the period analyzed.

While Assefa et al. (2017) provided evidence that the Learn to Play program was successful, the authors also acknowledged that the limitations are related to routine program data that may lack quality because of inadequate documentation. However, this is not systematic (the types of missing data are not uniform across health facilities and overtime) to affect the conclusions; (2) the study did not assess the performance of the ART program for adolescents due to lack of data; and (3) the study did not assess retention in care comparing adults with children, and male with female.

The evidence from this study has implications for practice: the public health approach, including task shifting and decentralization, has been utilized and needs to be further employed toward the fast-track targets. It has policy implications: health systems strengthening, financing, and retention of health workers need due attention if the country is to achieve the fast-track targets. The study also has implications for future research: analysis of the treatment cascade (from testing to viral suppression) to pinpoint critical gaps and identify appropriate solutions.

Booker and Mullan (2013) also identified additional barriers when examining environmental cues' influence on maintaining a healthy lifestyle. The authors described the theory and rationale behind maintaining a healthy lifestyle in the environmental

context of temporal self-regulation theory (TST). In particular, the impact of perceptions about how supportive the environment is on TST-related factors is examined to determine whether there is a discernible pattern in undergraduates' health behaviors regarding the predictive value of the TST for leading a healthy lifestyle and whether environmental responsiveness differently affects the individual variables predicting a healthy lifestyle. The authors outlined the progress made on the subject by stating that young adults fail to adhere to Self-regulation and behavioral prepotency behaviors indicative of a healthy lifestyle. The research used a prospective study to collect data. Tasks were computer-based and completed online at the participant's time and location.

Again, Brown et al. (2019) discussed additional factors and barriers predictive of successful retention in care among HIV-infected men in a universal test-and-treat setting in Uganda and Kenya. Retention was not associated with the region, education level, occupation, access to a cell phone, or mobility. Younger age was a significant predictor of attrition at one year among both men and women, while initiating ART with a CD4+ count above country treatment guidelines (350 cells/mm3) was associated with higher retention at one year among men. Men who were linked to care and initiated ART quickly were more likely to be retained in care for one year, as compared to taking more than 30 days to be linked to care after the time of testing was associated with lower retention (aHR for non retention 1.67, 95% CI 1.02–2.74). The study is based on the Sustainable East Africa Research in Community Health (SEARCH) HIV 'test and treat' trial, which seeks to increase male engagement in care by addressing known barriers to care. The underlying rationale for the study is that even though the expansion of ART

programs in sub-Saharan Africa has dramatically increased the proportion of HIV-infected individuals accessing treatment, men have largely been left behind from the gains of ART. Reasons underpinning this disparity based on the literature have focused on gender norms and expressions of masculinities that run counter to health-seeking behaviors.

Additionally, the requirements of men's employment and livelihoods contribute to sub-optimal male testing and engagement in treatment. Entrenched gender norms promulgating the view that healthcare-seeking and healthcare spaces are primarily women's domain contribute to preventing HIV testing among men. The trial used a convergent mixed methods approach, in which quantitative and qualitative data were collected simultaneously and merged during the analysis phase.

The study's limitations were the high retention reported among men conditional on testing and linking to ART care. Testing coverage was 86% among all men in this population, and future analyses examine differences between men who remain untested and men who do not link to care. Also, only retention in the first year is captured, so longer follow-ups are necessary to evaluate the durability of retention in care. In addition, self-reported data from individuals and providers are subjective and potentially affected by recall and social desirability biases. Qualitative analyses are strengthened by the volume of interview data collected from heterogeneous sources and community settings, with strong convergence of themes emergent in the data across these sources and over time. The disparity in retention on ART is for the health professionals to know and better manage clients (Brown et al., 2019).

However, Cook et al. (2017) discussed the association of different patterns of alcohol consumption to HIV viral suppression and ART adherence and whether any associations of alcohol with HIV viral suppression were mediated by poor ART adherence. The authors in this observational study relied on the Florida Cohort from 2014 to 2016. The results showed that heavy alcohol consumption was associated with approximately twice the odds of having suboptimal HIV viral suppression compared to non drinkers, even when accounting for several potential confounding variables. The authors, however, identified limitations related to the fact that although an item was utilized from a validated scale, self-reported ART adherence tends to overestimate adherence. A traditional cut-point of 95% adherence was utilized to distinguish adequate from inadequate adherence, although viral suppression can now be achieved with lower adherence (e.g., 80%) with more current ART regimens. The convenience sampling of persons in care during the previous year may not represent the entire population living with HIV. The proportion of persons who met the criteria for heavy drinking (exceeding weekly drinking limits) was also somewhat lower than the proportion found in other samples of PLWH. Again, there was the likelihood of under estimated actual consumption, partly due to limited response options on the alcohol assessment instrument. Some unmeasured variables could act as confounding variables acting as the actual cause of poor viral suppression in heavy drinkers. This study is relevant in showing that since alcohol consumption contributes to HIV treatment failure, Patsis et al. (2020) and Vagenas et al. (2015), interventions to address heavy alcohol consumption should become more routine in HIV clinical and public health settings.

In Ghana, however, studies published by Sakyi et al. (2020) linked barriers to retention in HIV care to economically and socially expensive costs in the postpartum period than during pregnancy. This is because of poor maternal physical health (from birth complications and cesarean section), socio-cultural factors (norms about newborn health and pregnancy), and economic difficulties linked to childbirth (such as unemployment, under employment, and debt). Sakyi et al. (2020) also attributed the barriers to HIV-related stigma and the need to safeguard the newborn, resulting in mothers relying on private transportation. This increased transportation costs and increased reliance on a partner to pay for the postpartum period. If the partner is unwilling and unable to pay, then the mother-baby pair will not attend the clinic, reducing their retention rate in care. Similar to the findings by Sakyi et al. and Ankomah et al. 2016 also identified high financial costs in accessing and receiving ART (26%), stigma (8.8%), job insecurity arising from the regular leave of absence to receive ART (5.3%), delays associated with receiving care from treatment centers (24%), shortage of drugs and other commodities (23%), fear of side effects of taking ARVs (7.9%), and long-distance to treatment centers (4.9%) were contributed to lack of retention.

Reecee et al. (2015) also found that lack of inadequate adherence counseling and lack of family planning increased the possibility of not being retained. In addition, Ayisi et al. 2018, identified that low retention rates could be because of the shortage of test reagents for EID sample collection and testing and ARV medication. Abraham 2018 also identified support from the diligence of mothers, midwives, and community health care nurses to the healthy HIV-infected mothers and ‘exposed’ infants on the mother-infant

pair's journey in the PMTCT program contributes to retention in care. Moreover, being a male with a lower CD4 count (260 v. 311 cells/μL, $p<0.01$) and entering into care late was a barrier to retention (Kumar et al. 2015), and the availability of their parents or caregivers during transitioning from a pediatric clinic to an adult clinic was a predictor of retention (Abaka & Nutor, 2021).

Studies Employing Correlation Analysis Successfully

In HIV patients who have been infected for a long time, ART reduces HIV antibody responses. The timing of ART start and baseline HIV levels, as measured by CD4 and viral load test levels (quantitative HIV antibody measurement), have an impact on the reduction of HIV antibodies and could be used as a biomarker of ART success showing ART-induced reduction of anti HIV antibodies correlates with the decline of HIV-1 viral load (Liang and et al., 2020). Liang et al. (2020) by collecting blood specimens and testing for CD4+/CD8 + T cell counts, HIV-1 VL, and anti HIV antibodies at the time of ART initiation (0 months) as well as 3, 6, 12, 18, and 24 months following treatment, the results showed that ART led to 36.0% (27/75) and 52.1% (38/73) of the patients whose anti-HIV levels reduced by more than 75% of the baseline levels at 12 and 24 months post-ART, respectively. The reduction of anti HIV antibodies correlated with the decline of HIV-1 viral load with correlation coefficients in the range $0.556-0.848$ or R2 value of $0.576-0.873$ ($P < 0.001$). However, no negative detection of anti HIV antibodies was observed at 24 months post-ART. The time from HIV-1 diagnosis to ART initiation and the baseline anti HIV levels were the key factors associated with the quick decline of anti HIV antibodies. Consequently, it is essential to characterize the anti HIV antibody profile

and demonstrate that anti HIV antibody responses are reduced in individuals receiving ART.

The use of Mobile Health Intervention could be critical to improving HIV/AIDS care and retention, reducing the rate at which pregnant women were LTFU, and helping monitor closely individuals with increasing viral load, Jaffer (2015), which is critical in measuring antibodies levels as stated by Liang and at al. (2020). Jaffer (2015) also, in the evaluation of a Mobile Health Intervention to improve antiretroviral treatment retention in South Africa, used a quantitative, retrospective cohort approach and binary logistic regression analyses to add evidence to the existing literature on the effectiveness of using mHealth-based interventions to improve HIV/AIDS care. Based on these findings, LTF among pregnant women and those clients with increasing viral loads is reduced. Mobile health interventions thus could make healthcare accessible and removes barriers to access and retention.

While providing psychiatric evaluation and treatment to HIV patients, Wubetu et al. (2021) found no significant associations between loneliness and illicit drug use. Heavy drinking in men and substance use among women in this population may be linked to loneliness and can impart retention in care, Mannes et al. (2016). Wubetu et al. (2021), in examining adherence and retention and the prevalence of neurocognitive impairment and associated factors among PLHIV in highly active ARV treatment in Ethiopia, the authors used binary logistic regression analysis to identify associated factors of HIV-associated neurocognitive impairment. Factors with a p-value of ≤ 0.2 on bivariate analyses were recruited for multivariate logistic regression analyses, and 95% CI at p-value < 0.05 was

considered statistically significant. Variance inflation factors for continuous variables and Spearman rank correlation for categorical variables were performed. There was no multicollinearity between suspected predictor variables. Model fitness was checked using Hosmer and Lemeshow Test, and its p-value was 0.45. The results showed that the 422 individuals on HAART gave a response rate of 99.8%. The prevalence of HIV-associated neurocognitive impairment was 41% (95% CI=36.3, 45.6). Older individuals, low monthly income, having comorbid depression and anxiety, having no communication about safe sexual intercourse, higher duration of HIV illness, and having poor social support were statistically significant associated factors of HIV neurocognitive impairment. The authors concluded that HIV patients should be consulted for psychiatric evaluation and treatment.

Cognitive impairment and relation to adherence and retention are consistent with the findings by Kim et al. (2020) that baseline anxiety was a predictor of post-quit nicotine withdrawal symptoms due to cognitive impairment with the use of nicotine and that HIV-tailored smoking cessation intervention showed a greater decline in craving symptom and a relative increase in retention. Kim et al. (2020) investigated the predictability of smoking cessation in women infected with the human immunodeficiency virus. The authors based their findings on secondary data analysis from two HIV-positive women's smoking cessation studies. Researchers used binary logistic regression analysis to find determinants of short-term smoking abstinence. The findings revealed that baseline anxiety, not baseline depression, was a predictor of post-quit nicotine withdrawal symptoms.

Kalolo and Kibusi (2015) also noted that perceived behavior control and positive attitudes predicted intentions to use condoms, whereas empowerment predicted reported condom use for HIV-positive patients. Condom use could act as a barrier method in HIV prevention efforts. Kalolo and Kibusi (2015), in their study, examined the influence of perceived behavior control, attitude, and empowerment on reported condom use and intention to use condoms as a barrier method among adolescents in rural Tanzania. The binary logistic regression analysis indicated that Perceived behavior control predicted intentions to use condoms (AOR = 3.059, 95 % CI 1.324-7.065), thus demonstrating its importance in the decision to use a condom. Empowerment (odds ratio = 3.694, 95 % CI 1.295-10.535) and a positive attitude (AOR = 3.484, 95 % CI 1.132-10.72) predicted reported condom use, thus turning the decision into action. Subjective norms only indirectly affected the intention and reported use of condoms. The authors noted that unsafe sex practices are prevalent among school adolescents in rural areas of Tanzania. The findings may imply that safe sex promotion interventions that simultaneously address socio-cognitive and ecological determinants of sexual behaviors may improve adolescents' safe sex behaviors, consistent with the study by Wubetu et al. (2021) on the fact that alcohol drinking also has an effect on the cognitive ability of the individual and being retained in care.

Using multivariate binary logistic regression analysis, Abdulrahman et al. (2017) also studied socioeconomic predictors of adherence behavior among HIV-positive patients receiving ART in Selangor, Malaysia, among a cohort of 242 adults. A total of 224 (93%) patients completed six months of adherence assessment, of which 135 (60.3%) achieved

optimal adherence. The multivariate binary logistic regression analysis revealed that patients' income and ethnicity significantly influenced adherence behavior. Abdulrahman et al. (2017), however, identified additional predictors of socio-economic determinants of health, such as the patient's income and ethnicity, to be significant predictors of retention behavior. However, social self-disclosure among adolescents living with HIV in Eastern Africa and disclosure to peers was significantly related to being older, being a paternal orphan, contributing to family income, having regular visits to the HIV clinic, and having greater social support through peers was strongly related to being retained in care not only being earning income and being of a particular ethnicity Nöstlinger et al. (2015), Alamdo, and King, (2021). Disclosure could also be a notable predictor of retention, as shown by Nöstlinger et al. (2015). The authors conducted secondary data analysis to assess the degree of social disclosure, reactions received, and influencing factors among 582 ALHIV aged 13–17 years in Kampala, Uganda, and Western Kenya. Descriptive, bivariate, and logistic regression analyses were performed with social self-disclosure to peers with gender as a covariate. Logistic regression models revealed that having disclosed to peers was significantly related to retention, being older, being a paternal orphan, contributing to family income, regular visits to the HIV clinic, and greater social support through peers. Mulongeni et al. (2019), however, put forth that being a young person with TB as a comorbidity was a factor for loss to follow-up and non retention, inconsistent with Nöstlinger et al. (2015) and Alamdo & King (2021) who stated one needs to be older to have disclosure skills and to be retained.

Mannes et al. (2016) tested the hypothesis that there would be an association between loneliness and substance use moderated by gender in HIV-positive older adults. The authors used Pearson correlations to examine associations between loneliness and substance use. Binary logistic regression analyses stratified by gender examined the association between loneliness and substance use while controlling for covariates. The results indicated that among women, loneliness was associated with illicit drug use, AOR = 3.37, 95% CI: 1.23–9.21, p = .018 and heavy drinking, AOR = 2.47, 95% CI: 1.07–5.71, p = .033. No significant associations were found between loneliness, illicit drug use, and heavy drinking in men. Substance use among women in this population may be linked to loneliness and can impart retention in care. Consistent with the findings by Ramachandran et al. (2020).

A retrospective cohort study was conducted in selected public health facilities of Addis Ababa among 356 mother-baby pairs (Alamdo & King 2021) analyzed Loss to follow-up, LTFU, and used Kaplan–Meier survival curve to estimate the Cumulative probability of LTFU among the different groups. e LTFU rate was 13.2% (95% CI= 9.83– 17.6%), and the overall HIV transmission rate was 0.61%. Younger women (AHR=0.90, 95% CI = 0.83– 0.97) and newly diagnosed at entry to PMTCT (AHR=0.35, 95% CI = 0.18– 0.68) were less likely to complete PMTCT. To successfully achieve the PMTCT program outcomes, service providers and program officers must emphasize younger women and those newly enrolled in the PMTCT program.

Lilian et al. (2020), in a study on Same-day ART initiation, for HIV-infected adults in South Africa, analyzed routine data of 32,290 records using Kaplan Meier

survival analysis and multivariate logistic regression. The authors showed that same-day ART initiators were younger, more likely to be female, and presented with less advanced clinical disease than those initiating treatment at later times following diagnosis ($p<0.001$ for all), consistent with the findings by Alhaj et al. (2019); Anderson et al. (2017) and Brown et al. (2019). Same-day ART initiation was also associated with disengagement from care: LTFU was 30.1% in the Same-day ART initiation group compared to 22.4%, 19.8%, and 21.9% among clients initiating ART 1–7 days, 8–21 days, and ≥22 days after HIV diagnosis, respectively ($p<0.001$). LTFU was significantly more likely among same-day versus later initiators (aOR = 1.45, $p<0.001$) while increasing age reduced LTFU (aOR = 0.97, $p<0.001$). Increasing age-reducing LTFU was consistent with the findings by Anderson et al. (2020) and Babatunde et al. (2015)

Mulongeni et al. (2019) also employed logistic regression analysis to identify risk factors for loss from TB care among 23,737 patients aged 10–24. Being an older adolescent (aOR 1.75 [95% CI: 1.38–2.21]) or young adult (aOR: 1.96 [95% CI: 1.57–2.45]) increased the risk of loss-to-follow-up relative to being a younger adolescent. Further risk factors for loss from TB care were male gender (aOR: 1.33 [95% CI:1.20–1.46]), being a TB/HIV co-infected young person (aOR 1.74 [95% CI: 1.57–1.93]) and having had prior treatment for TB (aOR 3.17 [95% CI 2.87–3.51]).

Mohammed et al. (2020) also studied annual and durable HIV retention in care and viral suppression among patients of Peter Ho Clinic in a retrospective review of medical record data in an urban clinic. Descriptive statistics were used to summarize sample characteristics by retention in care, virologic failure, and viral suppression with Pearson

Chi-square; p-value <0.05 was statistically significant.

Multiple logistic regression models identified patient characteristics associated with retention in medical care, virologic failure, and suppression. Results: 57% of patients were retained in medical care, and 87% were suppressed. Viral suppression was more likely among patients retained in medical care up to 2017 versus those who were not (aOR: 5.52, 95% CI: 4.08–7.46). Those less likely to be suppressed were 20–29 vs. 60 years or older (aOR: 0.52, 95% CI: 0.28–0.97), had public vs. private insurance (aOR: 0.29, 95% CI: 0.15–0.55), and public vs. private housing (aOR: 0.59, 95% CI: 0.40–0.87).

Summary and Conclusions

Chapter 2 discussed the methods used to select peer-reviewed literature and the databases employed for the literature search for the study in relation to the concept of health, health-related quality of life, early initiation of therapy, and its relation to retention in care. The literature review related, specifically looked at the global epidemiology of HIV/AIDS and the epidemiology of HIV/AIDS in the U.S. Key variables included current HIV/AIDS prevention strategies, current HIV therapies and management strategies, Encounter-based retention (REB), and Laboratory-based retention (RLB), retention and how it is related to, initiation time, health and public health and barriers as well as studies employing correlation analysis.

According to the CDC (n.d.), HIV and AIDS remain a persistent public health problem around the World and in the United States. The epidemiology search indicated that Sub-Saharan Africa is most affected by HIV and AIDS worldwide. Primary

prevention strategies aimed at screening services and secondary prevention strategies and management are affected by the initiation of care after a positive screening test. Early initiation and retention in care are thus critical to ensuring viral suppression among all populations living with the virus. Early concepts on patient retention in care and general health were hypothesized, with early work suggesting that initiation to care has no impact on retention and general health. However, unsuppressed HIV RNA is high when lost patients are accounted for. Reducing the replication of the virus within the individual is one surety to ending the community's spread of the virus and ending the pandemic as a public health problem.

Current primary prevention strategies include health information and education, which have gone down drastically in recent times LaCroix et al., (2014), screening (HIV testing and counseling), regular retesting for those with exposure, HIV self-testing within the community as a test for triage, Johnson et al. (2014) and WHO (2018), couple counseling, and partner and or index client testing, safer sex practices, including dual protection (condom promotion), delay of onset of sexual activity, and behavioral change communications to avoid risky behavior Dehne et al. (2016). Additionally, counseling and services provision; post-exposure; and pre-exposure prophylaxis are primary prevention strategies.

Also, as a secondary prevention strategy, the current 90 90 90 strategies ensure that there is early testing treatment and monitoring of viral lead levels to a minimum threshold for a minimum cascade of 90 percent of the population, Baggaley et al. (2016). As part of secondary prevention measures, providing specific interventions to reduce HIV

transmission from women pre conception to their infants during pregnancy and post-natal remains a critical part of ending the epidemic, Kiragu et al. (2017). For the general population, men and women, an early ART initiation strategy reduce the time between HIV diagnosis and ART initiation (Kerschberger et al., 2021). The concern, however, remains that accelerated initiation of ART may lead people to start before they are ready, with adverse consequences for adherence and treatment outcomes. In Malawi, most losses occurred in the first three months of therapy. Socioeconomic factors are key social determinants of health and can also limit access to strategies for testing, treatment, and retention in care and, consequently, reduce persons' survival with HIV Saracino (2018).

Psychological factors of depression and anxiety by an unsupported healthy lifestyle, Booker and Mullan (2013) differences such as physical activity, cessation of smoking, and alcohol intake reduces chances to respond to ART, increase side effects, and the likelihood of presenting with comorbidities, Saracino (2018). Reduced social support and non disclosure could also hamper strategies for retention coupled with entrenched gender norms on health, fueling stigma, Brown (2018). Retention is negatively affected by stigma, in much the same way increasing out-of-pocket spending impoverishes patients.

Identified barriers in the literature related to the socioecological framework identify the fundamental role of financial insecurity as an underlying risk-taking behavioral pathway, Frew et al. (2016) mainly describe suboptimal adherence to be due to impulsivity from alcohol intake (Dunne et al., 2019), lack of social structures, lack of adolescent-friendly services, lack of task shifting and decentralization, inadequate health

systems strengthening, financing, and retention of health workers (Assefa et al., 2017), as well as the influence of environmental cues on maintaining a healthy lifestyle in the context of temporal self-regulation theory (TST) to the predictive value of the TST for healthy lifestyle performance. Booker and Mullan (2013). The disparity in gender and being old or young was also seen as a barrier to care retention (Brown et al., 2019).

From the methodological perspective, ART reduces anti HIV antibody responses in chronic HIV-infected patients, the timing of ART initiation and baseline anti HIV levels influence the decline of anti-HIV antibodies, ART induced reduction of anti HIV antibodies correlates with the decline of HIV-1 viral load and quantitative anti HIV antibody measurement may be a biomarker of the efficacy of ART, Liang et al. (2020). A controlled environment tends to increase retention in care, as shown by McNairy et al. (2017b), even though retention among pregnant women was high, especially for health facilities having integrated comprehensive prenatal/focus antenatal care for pregnant women, Landes et al. (2015) and Beckham et al., (2016) notes the disparity among men receiving ART compared to women. To assess the disparity in retention in care, Encounter-based retention (REB) and Laboratory-based retention (RLB) (Rebeiro et al., 2015). REB and RLB were The REB and RLB assume the percentage of agreement, and the κ statistic was used to characterize agreement between RLB and REB. A kappa of 1 indicates perfect agreement, whereas a kappa of 0 indicates agreement equivalent to chance. The WHO early warning indicators have also been known to be used to measure retention in care at 12 months after treatment with ARVs.

Bronfenbrenner's ecological model reflects that individual behavior is influenced and defined by the surrounding ecology, environment, systems, and factors related to retained in care. It identifies three categories of influence: the microsystem or intrapersonal, the mesosystem or interpersonal and social networks, and organizational and exosystem or policy and environmental constructs. The construct offers a concrete framework to account for the reciprocal interaction of behavior and the environment and its relation to public health and retention in care as an outcome (Coreil, 2009).

Chapter 3 includes explanatory models and concepts related to the study. Some conceptual models discussed how measures found in the electronic patient tracker were used to address the hypothesis for this study

Chapter 3: Research Method

This study examined the association between ART initiation criteria and retention on ART at 12 months among men and women. This study was a quantitative secondary analysis of archived data (2002 to 2022) from the GHS HIV patient electronic tracking database that included objective ratings of groups initiated on ART at different infection and disease progression times. Data analysis was conducted with descriptive and inferential statistics using binary logistic regression because the dependent variable was binary and dichotomous. Not being retained was defined as missing the last appointment date due to death, transferring out, stopping treatment, or being LTFU. Thus, retention was rated at 12 months after being on ART.

This chapter is on methodology and addresses the research design and rationale, methodology, operationalization for each variable, data analysis plan, and ethical procedures/considerations. Chapter 3 also introduces the data source, the HIV patient e-tracker, the data collection procedures and sampling technique, the power analysis, the data handling strategy, the definition of variables for the study, the hypotheses tested, and the statistical methods utilized. The data utilized were private data owned by the ministry of health and GHS, which were housed by the National HIV/STI control program and Policy, Planning, Monitoring & Evaluation Division (PPMED).

Research Design and Rationale

Through this study, I sought to understand whether initiation criteria at the start of ART were related to retention at 12 months in care among males and females living with HIV in Ghana. The study was a quantitative observational study using secondary data. I

looked at four initiation criteria as independent variables. The independent variables were (a) patients initiated based on treat-all/test-and-treat criteria, (b) patients initiated based on Option B+, and (c) patients initiated based on CD4 T-cell count ≤ 500. The variables for the regression-based model were entered in subsets based on an existing association. This was also because of the need to know the effect of initiation criteria from policy to policy and their effect on retention in care among males and females. The current study was developed to utilize regression models to respond to the RQ. The binary logistic regression model was justified and helpful in testing the stated hypothesis. The RQ for multiple regression variables was: What variables predict retention at 12 months, controlling for age, gender, education status, alcohol use, adherence/treatment monitors, and tuberculosis (TB) disease treatment? The dependent variable was retention at 12 months in care—the variable for multiple regression (IV). Six confounding variables were identified: age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment.

The literature review provided the basis for the dependent, independent, and confounding factors. In the literature, younger age at initiation for both males and females and being a male were significant predictors of attrition (Brown et al., 2019). Additionally, being an older adolescent or young adult with TB increases the risk of LTFU relative to being a younger adolescent (Mulongeni et al., 2019). Cook et al. (2017), Dunne et al. (2019), and Saracino (2018) noted that impulsivity in relation to alcohol could hinder retention in care and result in suboptimal drug concentration levels. Because

postpartum retention is low (Sakyi et al., 2020), optimal follow-up (Reece et al., 2016) is required to prevent unwanted pregnancies (Vu et al., 2017).

The study design was a quantitative research study, a retrospective cohort study that examined the association between the independent and dependent variables, which was the primary focus of this study. Objective ratings of groups initiated with different criteria at different times of infection/disease progression and retention rate were examined. Other factors, controlling factors such as the availability of treatment monitoring, alcohol, and TB disease treatment, were analyzed.

Time and Resource Constraints Consistent With the Design Choice

The study design was a retrospective cohort quantitative secondary analysis of archived data (Warner, 2012). HIV patient data were collected and stored in the GHS e-tracker database. The database contained the variables of interest, and permission was received to analyze the deidentified data. Patient data are routinely collected as patients/clients present themselves for the clinic after initiating ART.

Methodology

Population

The study population was teenagers and adults enrolled in ART in Ghana. The e-tracker has data from 2002 to the present date. Cases were selected from the database. The database had approximately 353,471 cases of persons living with HIV in Ghana across the 10 regions (currently demarcated into 16 regions). The database had initial assessment and follow-up details. As of 2021, there were 153,901 clients currently on treatment.

Sampling and Sampling Procedures

There were 577 ART sites, per the NACP 2020 annual report. This selection provided a sample size of 153,901 ART clients. However, for logistic regression, G Power analysis recommends 16,940 as the sample size for a statistical power of 0.95 at an alpha of 0.05 and odds of 1.3. However, the final sample size was obtained when the analysis was performed.

For each year of initiation, systematic random sampling was applied. The line list of the data, including all analyzed variables, facility name, and region, was arranged from 2017 to 2021, after which each seventh case was selected. The position of every 7^{th} case was obtained by dividing the number of clients available, 124,371, by the total sample provided by the G Power analysis, 16,940. Once this 7^{th} position was obtained, random values between 1 and 0 were generated using the RAND function in Excel to obtain probability values. The probability values were sorted, ordered, and frozen to prevent the probability numbers from changing and to ensure that each was selected by chance. For the 7^{th} case, a sequence at one was selected at the first position, and then the function MOD in Excel was applied to ensure that the results increased by 1 to 7. Every 7^{th} case was selected to be included in the analysis.

Sampling Strategy

Two strategies were used for the analysis of these archival data. First, health workers routinely collect data at the health facility or ART site level when clients visit for services, and the data are entered into the HIV patient electronic tracker as described

below. Second, the strategy also describes how data was sampled from the larger data set for this study on predictors of retention.

Procedures for Recruitment, Participation, and Data Collection

Data Collection and Entry Into the Electronic Patient Tracker

The HIV patient e-tracker has been used to collect patient data since 2018. Though relatively new, the data was initially entered and stored in software developed and managed by the HIV program and PPMD. One of the objectives of the e-tracker is to serve as a database to store patient data and uniquely identify patients within the country for the continuity of patient care and service. The e-tracker collects data on patients tested and initiated on ART together with follow-up care. Currently, it is not the primary source of data because data was captured from the patient folder. The samples were drawn from the patient e-tracker using unique identifiers. Data entry for all clients initiated before 2018 was transferred/entered into the tracker. Thus, the tracker information lets one know if patient cohorts truly have attrition or are non adhering within one ART site and appearing in another. The system also tracks whether clinic and refile appointments have been kept. By these, the actual retention rate can be measured. HIV-asymptomatic patients initiating treatment has a disadvantage. Treatment non adherence with reduced death or survival results in not completing the cohort years, attrition, and other contributing factors, causing concern to public health practices compared to symptomatic HIV patients. This study fills the lack of retention due to disease progression 12 months after initiation and retention rates. The demographic characteristics, including age and

sex distributions, provide insight into non adhering groups for effective interventions (Akullian et al., 2021; Haeuser et al., 2022).

Patient data are routinely collected as patients present themselves to the clinic after initiating ART. Each patient has a folder/booklet/book in which the health worker writes and fills in the patient details to capture data on registration, assessment for initiation, and follow-up visits. During an individual's registration as a new client, the officer in charge or on duty collects patient registration details. The registration details provide the date of registration for initiation of ART and the health facility the client is attending, in addition to the other demographics of sex, date of birth, name, identification number, insurance number, marital status, occupation, educational level, HIV serostatus, family and partner status, and treatment supporters' details, among others. Following the registration details, the initial assessment date when the HIV test was performed and HIV type are indicated in addition to the vital signs and TB screening results. Past ARV medication use is indicated as to whether for treatment or prophylaxis. History and physical examination results are also indicated, including comorbidities, habits (including smoking, alcohol, and injection drug use), and reproductive and sexual health history. As part of the routine assessment of clients, other services provided include cotrimoxazole eligibility assessment and provision, TB therapy prophylaxis, and baseline laboratories (lab results are not received before initiating ART if clients are clinically stable).

Additionally, if necessary, adherence counseling sessions are planned. Treatment initiation is then indicated for using first-line or second-line ARV medication. This first-line medication is a treatment that is accepted as best for the initial treatment of the HIV

condition or disease. These recommended first-line HIV treatment regimens are safe, effective, and convenient for most people with HIV who have never taken ARVs.

Second-line treatment is used after the initial first-line treatment has failed, has stopped working, or has side effects that are not tolerated (HIV.gov, n.d.). At this point, the health worker also indicates the next appointment date based on the months of medication given. The appointment date also aids in calculating LTFU or attrition. The health worker fills in the patient follow-up details for follow-up visits and confirms if a patient came on the appointment date/day. At the end of each clinic day, data managers enter the data from the client book into the e-tracker database.

Data Collection for Predictors of Retention Among HIV Clients in Ghana

Data was downloaded from the GHS HIV patient electronic-tracker database and into Excel format for cleaning and data organization. The clients were selected randomly per facility per the year of initiation. All region and ART sites were eligible to be included for selection and analysis. Systematic random sampling was used to select all clients. The next client selection was continued for missing data until the sample size was attained. The interval of 7 ensured that even ART sites with fewer clients were selected; thus, there was no need to recalculate the interval.

Procedure for Gaining Access to the Data Set

The study design was a retrospective quantitative secondary analysis of archived data (Warner, 2012). HIV patient data are collected and stored in the "Ghana Health Service HIV patient electronic-tracker database." The database contains the variables of interest, and permission was received to analyze the deidentified data. Access to the

database was based on an email request to the officer working on the database who directed me to write an email request to the program manager of the national AIDS/STI control program. After granting access to the database, the officer gave assurance of the variables to be available in the database. Further, I was allowed access to the database with a log-in to check that the variables were present and accessible in the database. Assessment and use of the database depended on signing a letter of agreement with the owners of the database (included as Appendix A).

Demographic Information

Sociodemographic measures used in the study were known covariates associated with retention in care and criteria for initiation. Demographic and social variables used in the HIV patient e-tracker were sex, age of the patient at testing positive, self-reported educational status, date of birth, name, identification number, insurance number, marital status, occupation, educational level, HIV serostatus, family, partner status, and treatment supporters' details. For analysis, the age covariate was categorized into adolescents 13 to 19 years and adults 20 years and above. Gender was categorized into male and female. Educational status was categorized into educated and uneducated.

Sampling Frame

Included in the study for analysis were patients who had been diagnosed with HIV infection, with data on ART initiation and with a unique identifier. Excluded from the study were patients not on ART.

Instrumentation and Operationalization of Constructs

Dependent Variable

The dependent variable was retention in care at 12 months. Retention in HIV care was defined as the process wherein a PLHIV diagnosed with HIV is initiated/put on ART, is still on ART, is assessed at intervals post initiation, and has not died, transferred out, stopped treatment, or been LTFU. Not being retained was defined as attrition by the individual to mean stopped treatment or being LTFU. Thus, retention was rated at 12 months after an HIV-positive test.

Retention can be described at the initiating facility, national, and individual patient levels (Fox et al., 2018). Clinic visit dates were available, and thus retention was defined as not missing any appointments during the 12 months after initiation in care. According to a study by Fox et al. in 2018, patients can exist and enter care during this period and contribute person-time (the number of years, months, or days a study participant has contributed from the start of the research to the end or until stopping the study) from initiation to 12 months on ART. Due to the possibility of individuals moving in and out of care within the follow-up period, Conbrach's alpha, α, 0.70 at a 95% confidence interval, is considered acceptable for internal consistency and reliability measures. The current study used similar categorization related to retention in care as either retained or not retained in care as missing patient appointments 12 months after initiation into care (coded as 1 for retained and 0 for not retained).

Independent Variable

The independent variable was the initiation criteria which had 3 levels.

1. Treat-all criteria. This includes patients initiated on therapy without assessment for CD4 cell count, viral load copies per mill level, or WHO staging as a requirement from 2017 to date. The WHO HIV staging structure sorts patients, adults, and children into one of four hierarchical clinical stages ranging from Stage 1 (asymptomatic) to Stage 4 (AIDS). Patients are assigned to a particular stage when they demonstrate at least one clinical condition in that stage's criteria (WHO, 2005). The start year is specific to the initiation criteria for that period. When the CD4 count value is unavailable, the year of initiation and the WHO clinical staging indicate the initiation criteria.
2. Option B+. Pregnant women were given three-dose therapy at ART initiation. The therapy is lifelong. The year of start is specific to the initiation criteria from that period. When the CD4 count value is unavailable, the year of initiation and the WHO clinical staging indicate the initiation criteria.
3. CD4 T-cell count ≤ 500. Initiation of patients is based on CD4 cell count levels less than 500 (2002 to 2008). The year of start is specific to the initiation criteria for that period. When the CD4 count value is unavailable, the year of initiation and WHO Clinical Staging 3 and 4 indicate the initiation criteria.

Confounding Variables

The study controlled for the confounding effect of age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment on the dependent variable, retention.

1. Age. Indication of age as a confounding factor for retention
2. Gender. Indication of gender as a confounding factor for retention
3. Educational status. Indication of educational status as a confounding factor for retention
4. Alcohol use. Indication of alcohol use at the time of first assessment for initiation.
5. Presence or absence of a Treatment/adherence monitor/monitoring.
6. Treatment of TB disease in a patient. Indicating successful completion of the intensive and continuation phase.

Coding

The data was coded as shown in Table 5 below: Also, in Chapter 4, each independent variable was run with the covariates in separate models. Pearson chi-square and the Nagelkerke R square are presented.

Measuring Retention

Individuals are said to be retained 12 months after being in HIV care or on ART. The next appointment date should be available for all clients at the 12^{th} month.

A. All individuals initiating ART attend ≥ 2 clinics first six months and attend ≥ 1 or 2 HIV care visits or provider visits 30 to 90 days apart, leading to the 12 months.
    1. This will be being on ART after testing HIV positive for individuals under Treat All, Option B+ and having CD4 count more than 500 copies per mil.

2. If an individual is on ART and has been dispensed medication by or extending to and beyond the 12th month, the individual is said to be retained in care and not miss an appointment.

B. For individuals on CD4 count less than 500, it will mean being in care at 12 months with or without ART.
    1. If an individual is on ART and has been dispensed medication by or extending to and beyond the 12th month, the individual is said to be retained in care and not miss an appointment.
    2. For individuals on Pre ART, all individuals should attend a minimum of 2 provider visits 30 to 90 days apart within 12 months
    3. If an individual is not on ART, the individual record should show the next appointment date or be clearly indicated as not missed appointment.

Data Analysis Plan

The current study aims to test the association between the four levels of initiation criteria and retention after 12 months in care while controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. The HIV patient e-tracker data obtained for the study on predictors of retention among HIV patients in Ghana were analyzed using IBM SPSS V28 software. The data were extracted from the HIV patient electronic-tracker database as an excel, xlsx extension file, and the results were generated using SPSS functionality. Further, descriptive statistics, binary logistic regression, and multiple logistic regression analyses

were used for this statistical data analysis to examine the association between initiation criteria and retention while controlling for sociodemographic covariates.

The study RQs are:

RQ1: What is the association between Patient Criterion 1 (initiated based on treat-all criteria) and retention on ART at 12 months, controlling for age, gender, educational and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates?

Null: There is no association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, educational and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates.

Alternative: There is an association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, education and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates.

RQ2: What is the association between Patient Criterion 2 patients initiated based on Option B+ and retention on ART at 12 months, controlling for age, gender, education and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates?

Null: There is no association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age,

gender, education and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates.

Alternative: There is an association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age, gender, educational and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates.

RQ3: What is the association between Patient Criterion 1 initiated based CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, education and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates?

Null: There is no association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates.

Alternative: There is no association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational and alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment as covariates.

Data Selection and Preparation

Data in the database has already been prepared and is ready for download as a line list or aggregated data/reports. Data were downloaded as a line list for analysis. However,

information on individuals aged 12 and below was excluded from the data. Data prior to 2002 was not included in the study since the study looks at data from 2002. A client with missing data on initiation criteria was replaced to obtain a sample size of 17,940. Individuals missing data on sex and age at initiation or gender and age not identified at follow-up appointments were replaced until the sample size was obtained. The dataset does not have an initiation criteria table; however, individuals are initiated per the year of initiation and existing policy.

1. 2017 to date_Treat All criteria to initiation: Patients initiated on therapy without assessment for CD4 cell count level or WHO staging as a requirement
2. 2010_Option B+: Initiation criteria for pregnant women to be given three doses of therapy from the year of initiation.
3. 2011 to 2017_ CD4 T- cell count ≥ 500: Initiation of patients based on CD4 cell count level of more than 500
4. 2002 to 2008_CD4 T- cell count ≤500: Initiation of Patients based on CD4 cell count level less than 500

For each criterion (period of initiation), the individual data were extracted from the database using the year of initiation, age, sex, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. Where extraction and download are difficult due to size download, extraction was divided using the same unique identifier and merged. For missing data, the interval of every 7^{th} client was used to select the next eligible client until the sample size was obtained. The line list for analysis

thus had data on the year of initiation (initiation criteria), age, sex, gender, educational status, alcohol use, treatment/adherence monitoring, and TB disease treatment.

Power Analysis and the Assumption for Logistic Regression Testing

The assumptions for logistics regression modeling were met with a Priori Power Analysis calculated for a medium effect size OR = 1.5. Recalculated once the data was cleaned and prepped, and the final study sample size was obtained. Cases were replaced to obtain a complete data set.

The test for normality was performed in SPSS using the Kolmogorov–Smirnov test and the Shapiro–Wilk test (Mishra et al., 2019). Alternatively, the frequency and normal distribution curves are plotted using SPSS.

The samples represented in the study are genuinely nationally representative. The multiple logistic regression includes all independent variables-preferably those which turned out to be significant from the bivariate stage- along with the covariates. The stepwise logistic regression starts with those significant independent variables from the bivariate logistic regression analyses and omits the highest insignificant variable at a time. Also, in Chapter 4, each independent variable was run with the covariates in separate models. The chi-square results and the Nagelkerke R square are presented.

Descriptive Statistics

The descriptive statistics for the sample are represented as shown in Table 5. The demographics include age, gender, and educational status. Covariates also include age, gender, educational status, alcohol use, TB disease treatment, and presence or absence of treatment/ adherence monitor.

Table 5

Description of Variables and Coding Scheme

Variables	Variable Nature/Coding Scheme
Demographics	
1. Age	Ratio scale. Recoded as a categorical variable. Age in age groups
2. Gender	Nominal variable. Coded as 0 for male and 1 for female
3. Education status	Ordinal variable. 0 = primary school, 1 = secondary, 3 = tertiary
Covariates	
1. Age	Ratio scale. Recoded as a categorical variable. Age in age groups
2. Gender	Nominal variable. Coded as 0 for male and 1 for female
3. Education status	Ordinal variable. 0 = primary school, 1 = secondary, 3 = tertiary
4. Ever Alcohol use	Ratio scale variable. Yes = 1 and No = 0
5. Tuberculosis disease treatment	Ordinal. Treatment yes = 1, treatment No = 0
6. Treatment/adherence monitor(s)	Presence of treatment monitors, Yes = 1, presence of treatment monitors, No = 0
Independent variables	
1. Patients initiated based on CD4 T- cell count ≤500	Ordinal. Categorical variable. Yes = 1 and No = 0
2. 1-Patients initiated based Treat All criteria	Ordinal. Categorical variable. Yes = 1 and No = 0
3. 2-Patients initiated based on Option B+	Ordinal. Categorical variable. Yes = 1 and No = 0
Dependent variable	Ordinal level variable. Retention at 12 months. Yes =1 and No = 0
1. Retention in care	

Inferential Statistics

Bivariate Regression Analysis: Initiation Criteria and Retention at 12 Months

Data analysis was conducted with descriptive statistics and inferential statistics using simple logistic regression since the dependent variable is binary and dichotomous. Odds Ratio; Chi-Square; P-Value; Nagelkerke R square, and stepwise logistic regression were performed on the variables. The Wald procedure was used to derive p-values for differences between estimates and, in addition, quantify the relative effect size between the reference category value and comparison category values. WHO appointment keeping early warning indicator provides the threshold for retained and not retained. A simple linear regression model was used to examine the factors assessed in this study that may directly affect retention in care. Regression Analysis and the Dependent Variable: Logistic regression modeling procedure was also used to determine which variables affect the probability of being retained on ART. Also shown is the data analysis matrix in Table 6.

Table 6

Data Analysis Matrix

Question	Constructs	Data Source	Analysis Procedures	Variables	Variable Nature/Coding Scheme	Statistics
1 [a]	Microsystems, demographics, Intrapersonal/individual characteristics	Archived Data	Frequencies, means, percent description, Cross tabulations, multiple regression	Age	Ratio scale. Recoded as a categorical variable	Frequencies, means, percent description Chi-square, odds ratio, p-value
				Gender	Nominal variable. Coded as 0 and 1	
				Educational status	Ordinal variable. 0 = primary school, 1 = secondary, 3 = tertiary	
	Mesosystems, Interpersonal /group/social network	Archived Data	Frequencies, means, percent description, Cross tabulations, multiple regression	Alcohol use	Ratio scale variable. Yes = 0 and No = 1	Frequencies, means, percent description, Cross tabulations, multiple regression Chi-square, odds ratio, p-value
			Frequencies, means, percent description, Cross tabulations, multiple regression	Tuberculosis disease treatment	Ordinal. Treatment yes = 1, treatment No=0	
			Frequencies, means, percent description, Cross tabulations, multiple regression	Treatment/adherence monitor(s)	Presence of treatment monitors, Yes = 1, presence of treatment monitors, No = 0	
2 [b]	Independent variables Exosystems, Environment /policy guidelines		Frequencies, means, percent description, binary logistics regression	Patients initiated based on CD4 T-cell count ≤500	Ordinal. Categorical variable	Chi-square , odds ratio, p-value
			Frequencies, means, percent description,	1-Patients initiated based on Treat All criteria	Ordinal. Categorical variable	Chi-square , odds ratio, p-value

Question	Constructs	Data Source	Analysis Procedures	Variables	Variable Nature/Coding Scheme	Statistics
			binary logistics regression			
			Frequencies, means, percent description, binary logistics regression	2-Patients initiated based on Option B+	Ordinal. Categorical variable	Chi-square, odds ratio, p-value
3 [c]	Outcome			Retention on ART	Ordinal level variable. Retention at 12 months	Binary logistics regression Hypothesis testing

[a] Demographic variables: To what extent do age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment affect retention at 12 months in care? [b] Independent variables: What is the association between patients initiated based CD4 T-cell count ≤ 500 and retention on ART at 12 months? What is the association between Patient Criterion 1 (initiated based on treat-all criteria) and retention on ART at 12 months? What is the association between patients initiated based on Option B+ and retention on ART at 12 months? [c] Outcome variable: What is the association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months?

Threats to Validity

Retention in HIV Care is defined as the process where a PLHIV who is diagnosed with HIV, initiated/put on ART, and is still on ART, assessed at intervals post-initiation, and has not died, transferred out, stopped treatment or been lost-to-follow-up. Follow-up time is defined based on the time of diagnosis of HIV positive and the year of initiation or initiation criteria up until the client dies, is LTFU, is transferred out, or is active in care. All clients who have dispensed medication in the year of initiation were included in the analysis. Also, Pe-to pe-to prentice quality test for survivors' quality is not affected by differences in censoring patterns across groups and is appropriate when hazard function is not proportional (Hazra & Gogtay, 2017).

Ethical Procedures

Archived data was used for analysis. For this study, individual clients were not identified to consent because consent to provide data has already been given as part of the clinical treatment process.

Data collection begins once a client tests positive and is registered and enrolled in care. Prior to testing, early morning health education on selected topics is given in most healthcare settings, including HIV education, mode of transmission, prevention methods, available screening, and medication when tested positive are incorporated into the talks. At the time of education and sensitization, clients are encouraged to opt out of a request to have an HIV test done for them. The client has consented to the test without opting out after the education is given, and data are collected and used for management and programmatic purposes. For walk-in clients, voluntary and inpatient units, verbal consent is requested and provided by the patient. Ascent is obtained from guardians of minors. Each client testing positive is given a client/patient booklet, a replica of aspects of the e-tracker database. The books are kept in the folder room/section of the ART clinic. Currently, the folders are not mixed with the general hospital folders. The ART folder room is looked at and padlock protected. Folders are accessible to health workers on duty at the ART clinic. The key is kept with the ART clinic in charge. Data from the client folder is entered into the HIV patient e-tracker daily by ART data managers. At the program level, access to data is open to all interested individuals and institutions. A data-sharing agreement is, however, signed with the HIV program on data use before its use.

Protection of Human Subjects

Protecting human subjects in behavioral and biomedical research falls under federal regulations (45 CFR 46, 2003). Although Institutional Review Board (IRB) approval is required for human subject research as outlined in 45 CFR 46; some records based research may be exempt from such approval if the following conditions are generally met and verified by the IRB of the participating Institution, Walden University:

1. The sources of information are publicly available
2. The information collected is recorded such that the subjects cannot be identified either directly or indirectly through identifiers linked to the subjects.

An exempt request was sought and approved by the Walden University IRB before the data was obtained and analyzed for the study to ensure that human subjects were protected under 45 CFR 46 provisions and the provisions of Walden University IRB. The IRB, Walden University, gave this study the approval number.

Summary

Summary of design and methodology of the method of inquiry.

In summary, Chapter 3 addressed the statistical, software methods, and procedures used for the current dissertation.

The study design is a quantitative, retrospective cohort study of archival data examining the association between the independent, IV, and dependent variables. Other controlling factors, such as the availability of treatment monitoring, alcohol, and TB disease treatment, are analyzed as confounders. The literature review provided the basis for the dependent, independent, and confounding factors. The study population is

teenagers and adults enrolled in ART in Ghana. The HIV patient data were obtained from the GHS e-tracker database. The current study utilized regression models to respond to the RQ using the SPSS version 28. Demographic and inferential analysis such as age, gender, Odds Ratio, Chi-Square, P-Value, Nagelkerke R square, and stepwise logistic regression were performed on the variables.

Chapter 4 presents the analyzed data results, showing possible associations between dependent and independent variables and covariates.

Chapter 4: Results

The purpose of this study was to examine the association between the time of initiation criteria for HIV treatment and retention in care at 12 months. This study hypothesized a statistically significant association between the initiation criteria and retention at 12 months after initiation.

This study was a quantitative secondary analysis of archived data from the GHS HIV patient electronic tracking database, which includes objective ratings of groups initiated at different infection and disease progression times. The database consists of data from 2002 to 2022 that can be accessed. Data for the study were, however, from 2012 to 2021. Data analysis was conducted with both descriptive statistics and inferential statistics using binary logistic and multiple regression because the dependent variable was binary and dichotomous. “Not being retained” was defined as being in attrition 12 months after testing HIV positive. Thus, retention was rated at 12 months after the initiation of treatment. The study fills a gap in the literature related to the use of a large sample size by including all eligible patients and ART sites in the HIV patient e-tracker database for evaluation to provide a population-wide view of retention in care. The study population was teenagers aged 13 to adults 50 years and above, but the study did not evaluate retention among children. The gap in using aggregate data was filled by using individual patient-level data for the analysis. However, the study was not multinational but provided relevant information for settings with similar characteristics.

Research Questions and Hypotheses

The study RQs are listed according to simple and multiple logistic regression:

RQ1: What is the association between Patient Criterion 1 (initiated based on treat-all criteria) and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is an association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

RQ2: What is the association between Patient Criterion 2 (patients initiated based on Option B+) and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is an association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age,

gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

RQ3: What is the association between Patient Criterion 1 (patients initiated based on CD4 T-cell count ≤ 500) and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is an association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

Chapter 4 provides a succinct description of the study's findings, including the study sample's fundamental descriptive and demographic features, external validity, and sample-to-population proportionality. I discuss univariate analyses crucial for variables, intervention fidelity, and adverse outcomes. Along with the necessary statistical presumptions, inferential statistical analysis based on the study's query and hypothesis are presented. A the variables is also included.

Data Collection

The Time Frame for Data Collection

Secondary archival data were used for the study. Data collection, cleaning, and reorganizing started in May 2022 and ended in August 2022. Retention on ART at 12 months was derived from the start date of ART to the date per the initiation criteria. In instances where clients were dispensed months of medication, the current clinic visit date plus the months of medication were added to obtain the 12 months on ART.

Discrepancies in Data Collection From the Plan Presented in Chapter 3

There were no discrepancies in data collection. Secondary data collection was carried out as planned, except for data collection from 2008 to 2011. I deemed the data to be too old and therefore excluded them. The exclusion did not affect the sample size and study power. G Power software gave a sample size of 16,940. However, a final sample size of 17,974 was used. Hypothesis 4 (What is the association between patients initiated based on CD4 T-cell count ≥ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment?) was not included in the study. Hypothesis 4 was about the same as the hypothesis for the treat-all criteria. In the treat-all criteria, clients are initiated irrespective of the CD4 count test. This basically means that the initiation of a person with CD4 500 and above, in addition to those already being initiated with CD4 counts less than 500. Treat-all initiation also meant that no laboratory CD4 count test was performed before initiation. Additionally, the criteria for initiating clients on ART with CD4 count 500 and above was not implemented/rolled out by the National AIDS/STI Control Program due to

logistical constraints. Rollout of the policy meant having a laboratory test for CD4 for all clients yet to be initiated on ART to ascertain their eligibility. The CD4 machines and reagents required for the testing were insufficient to support implementation. Not long after the policy on initiating clients on CD4 more than 500, policy guidance was updated for the treat-all policy. Thus, initiating for clients with CD4 count of less than 500 continued until the start of the treat-all initiation policy.

Employment status was also not included in the analysis because the variable could not be identified in the database. What was available was the name of the employer. In this case, those self-employed or unemployed were not indicated. Excluding the demographic on employment status did not affect data analysis.

Descriptive and Demographic Characteristics of the Study Population

The study population was teenagers aged 13 to adults 50 and above. A total of 17,974 cases were used for the analysis. The study population was people who attended ART clinics in ART sites throughout Ghana. The sample represents the total number of people living with HIV in the country. The sample size obtained from the power analysis was 16,940 cases; however, 17,974 cases were used in the analysis; see Table 7.

Table 7

Statistics of Variables

		Age In Years	Gender	Education	Referred To Adherence Counselor	TB Treatment Initiated	Alcohol Consumption
N	Valid	17,974	17,974	17,974	17,974	17,974	17,974
	Missing	0	0	0	0	0	0
Mean		4.99	.26	1.95	.28	.09	.01
Std. error of mean		.015	.003	.011	.003	.002	.001
Median		5.00	.00	1.00	.00	.00	.00

Gender

The population subgroups selected for this analysis were classified by gender (male and female), age, and educational status. Tables 7 and 8 summarize the demographic characteristics of the sampled population using SPSS. In Table 8, more than half of the sampled clients, 13,350 (74.3%), were female, and 4,624 (25.7%) were male—a standard error of 0.003. Females are still the predominant group affected by the pandemic. Strategies targeting females should be intensified.

Table 8

Demographic Distribution of the Study Sample (N = 17,974)

Variable Name	Number	Percentage (%)	*SE*	Mean	Median	*SD*
Gender			0.003			
Female	13,350	74.30				
Male	4,624	25.70				
Age group			.015	37.99	5	1.995
13–19	485	2.7				
20–24	1,571	8.7				
25–29	2,685	14.9				
30–34	3,084	17.2				
35–39	2,952	16.4				
40–44	2,302	12.8				
45–50	2,109	11.7				
50+	2,782	15.5				
Educational status			0.011	1.95	1	.011
Preschool/primary	2,597	14.40				
Junior high school/middle school leaving certificate	6,888	38.30				
Senior high school/vocational training/technical training	2,049	11.40				
Tertiary	1,770	9.80				
None/NaN	4,670	26.00				

Age

Age, a string variable, was recoded into a different variable (categorical variable) with an ordinal measurement level called “age group.” The age ranges were 13 to 19, 20 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, 45 to 49, and 50 and above. Table 8 shows the breakdown of the age groups of the study sample. The age group 30 to 34 (17.2%) had the highest sample representation of 3,084 people, followed by 2,952 (16.4%) for the 35 to 39 age group. Following this, there were 2,685 (14.9%) cases for the 25 to 29 age group, then 2,302 (12.8%) cases for the 40 to 44 age group. The 45 to 59 age group made up 1,793 (10.0%) cases, followed by 1,571 (8.7%) cases for the 20 to 24 age group, and, lastly, 58 (0.3%) cases for the 13 to 15 age group. The mean age of the sample was 37.98

years (*SE* = 0.03, 95% CI, and standard deviation), and the median was 35-39; see Table 8.

Educational Status

Study participants had educational status categorized into preschool/primary, junior high school/middle school leaving certificate, senior high school/vocational training/technical training, tertiary, and none/NaN. Categorizing educational status was per the educational level identified in the database. Junior high school and middle school leaving certificates were certified at the same standard. The only difference was that the middle school leaving certificate was the educational system in place up to the 1980s to early 1990s, and junior high school was present to date. Further, senior high school, vocational, and technical training were at the same level and grouped as one.

Of the total population of 17,974 analyzed, most clients had a junior high school/middle school leaving certificate 6,888 (38.3%), followed by 4,670 (26.0%) who had no educational level, 2,049 (11.4%) who had senior high school/vocational training/technical training, and finally 1,770 (9.8%) individuals with tertiary education. The standard error for educational status was 0.011, and the mean was 1.95; see Tables 7 and 8.

Representation of Sample to the Population

The study population was teenagers aged 13 years to adults 50+ years, and the study did not evaluate retention among children. Age was categorized as 13 to 19, 20 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, 45 to 49, and 50 and above for meaningful comparison with other documents or studies. The study population was ART clinic

attendants in Ghana. Data were collected routinely as services were provided. The sample for this study was obtained using systematic random sampling to select a sample among the eligible clients. The sample represents the total number of people living with HIV in the country. The sample size obtained from the power analysis was 16,940 cases; however, 17,974 cases were used in the analysis.

Z test was performed using the G Power software, performing logistics regression as the statistical test. For priori, the required sample size was computed given the alpha, power, and effective size. The parameters showed two-tailed, binomial distribution, the odds ratio of 1.5*Pr(y = 1|x = 1) HO* was 0.05, the alpha error probability of 0.05, and power *(1-B err prob)* of 0.95. *r*2 other *x* at 0.1 and *x parm phi* of 0.1. At a critical *Z* of 1.9599640 and power of 0.9500004, the sample size was 16,940.

Descriptive Statistics of Univariate and Covariates

The covariates in the analysis were age, gender, educational status, treatment/ adherence monitor(s), TB disease treatment, and alcohol use. Tables 7 and 8 represent the covariate gender, the same as described for the demographic variable sex and educational status.

Referral to an Adherence Counselor

The covariate referral to an adherence counselor was analyzed as one variable that could act as a confounding variable. Its effect, if statistically significant, meant that it was a confounding variable to the independent variable and affected the dependent variable retention at 12 months on ART. The analysis was performed by controlling for its effect on the independent variable. Clients not referred for adherence counseling numbered

12,977 (72.2%), compared to 4,997 (27.8%; *SE* of 0.0031) who were referred for adherence counseling; see Table 9.

Table 9

Demographic Distribution of Covariates in the Study Sample (N = 17,974)

Covariate	Response	Number	Percentage (%)	*SE*
Referred for adherence counseling				0.003
	No	12,977	72.20	
	Yes	4,997	27.80	
	Total	17,974	100.00	
TB treatment initiated				0.002
	No	16,303	90.70	
	Yes	1,671	9.30	
	Total	17,974	100.00	
Alcohol use				0.001
	No	17,818	99.10	
	Yes	156	0.90	
	Total	17,974	100.00	

Tuberculosis Disease and Treated for TB

The covariate TB disease treated for TB was analyzed as a possible confounder. A statistically significant association with the independent variable meant that it was a confounding variable and likely affected the dependent variable retention at 12 months on ART. The analysis was performed by controlling for its effect on the independent variable. Of the 17,974 patients, 16,303 (90.7%; *SE* 0.002) had no TB, and 1,671 (9.3%; *SE* of 0.002) had TB disease and its treatment; see Table 9.

Alcohol Use

The use of alcohol was also a possible confounder. Data on use of alcohol among those sampled showed that almost all clients did not use alcohol (17,818 [99.1%]; *SE* 0.001), with just around 156 (0.9%; *SE* 0.001) using alcohol while on ART; see Table 9.

Treatment Intervention Fidelity and Validity

The study reported on treatment initiation as a variable. The study design was a quantitative study of secondary data from the GHS. Included for analysis were clients who started ART per the initiation criteria. Each initiation criterion corresponded to an initiation date. Data were collected in a line list to include demographic characteristics and covariates. The population subgroups selected for this analysis were classified by age (male and female), age group (13–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–50, and 50+), and education level (preschool/primary, junior high school/middle school leaving certificate, senior high school/vocational training/technical training, tertiary education, or none/NaN). The covariates analyzed included gender (male and female), educational level as stated, alcohol use, presence or absence of an adherence monitor, alcohol use, and TB disease treatment. The entire database of clients started in a particular year was eligible and included in the analysis. Systematic random sampling was used, considering an interval of 7 to obtain the required sample for analysis. Clients on treatment numbered 124,371, and considering the sample size of 16,940, an interval of 7 was obtained. Patients were retained at 12 months or not after the start of ART.

Validity and reliability were further assured by using the WHO criteria of retention at 12 months on ART. Client data was included at 12 months on ART,

including those presented at 12 months to the ART clinic and those who had medication 12 months and beyond and did not need to be at the ART clinic. Triangulating the months of medication dispensed and last visit date, all clients whose medication refills show they are on medication 3 to 6 months and 12 months after starting ART are also included because they were 12 months on ART while at home. The data were analyzed using SPSS statistical analysis tool.

Additionally, the criteria for initiating clients on ART with CD4 Count 500 and above was not implemented. Thus, initiating for clients with a CD4 count less than 500 continued until the start of the treatment for all initiation policy.

Study Results

Research Question 1

RQ1. What is the association between Patient Criterion 1 (initiated based on treat-all criteria) and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is an association between patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender,

educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

Covariates and Patients Initiated Based on Treat-All Criteria

For patients initiated on ART based on treat all initiation criteria, the age group retained was 50 and above. For this age group, 39 were initiated based on treat all, Table 10 of which (0.02) were retained at 12 months' chi-square of 763.662 at a *df* of 1 and *p* value of <.001 statistical significance Tables 10 and 11.

Table 10

Patients Initiated Based on Treat All and Age in Years

			Count		
Age In Years			No	Yes	Total
13–19	Retained on ART	No	458		458
		Yes	27		27
	Total		485		485
20–24	Retained on ART	No	1,495		1,495
		Yes	76		76
	Total		1,571		1,571
25–29	Retained on ART	No	2,562		2,562
		Yes	123		123
	Total		2,685		2,685
30–34	Retained on ART	No	2,936		2,936
		Yes	148		148
	Total		3,084		3,084
35–39	Retained on ART	No	2,809		2,809
		Yes	143		143
	Total		2,952		2,952
40–44	Retained on ART	No	2191		2,191
		Yes	111		111
	Total		2,302		2,302
45–50	Retained on ART	No	2,016		2,016
		Yes	93		93
	Total		2,109		2,109
50+	Retained on ART	No	2,645	0	2,645
		Yes	98	39	137
	Total		2,743	39	2,782
Total	Retained on ART	No	17,116	0	17,116
		Yes	819	39	858
	Total		17,935	39	17,974

Table 11

Chi-Square Tests of Patients Initiated on Treat-All Criteria and Age in Years

	Age In Years	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
13-19	Pearson Chi-Square	.[c]				
	N of Valid Cases	485				
20-24	Pearson Chi-Square	.[c]				
	N of Valid Cases	1,571				
25-29	Pearson Chi-Square	.[c]				
	N of Valid Cases	2,685				
30-34	Pearson Chi-Square	.[c]				
	N of Valid Cases	3,084				
35-39	Pearson Chi-Square	.[c]				
	N of Valid Cases	2,952				
40 - 44	Pearson Chi-Square	.[c]				
	N of Valid Cases	2,302				
45-50	Pearson Chi-Square	.[c]				
	N of Valid Cases	2,109				
50+	Pearson Chi-Square	763.662 [d]	1	<.001		
	Continuity Correction[b]	743.205	1	<.001		
	Likelihood Ratio	246.642	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	763.387	1	<.001		
	N of Valid Cases	2782				
9	Pearson Chi-Square	.[e]				
	N of Valid Cases	4				
Total	Pearson Chi-Square	779.692 [a]	1	<.001		
	Continuity Correction[b]	758.839	1	<.001		
	Likelihood Ratio	238.998	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	779.648	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.86. [b] Computed only for a 2x2 table. [c] No statistics are computed because patients initiated based treat-all criteria is a constant. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.92. [e] No statistics are computed because retained on ART and patients initiated based on treat-all criteria are constants.

Patients Initiated Based on Treat-All Criteria and Gender

Of the total females of 12,726 starting ART, 596 were initiated based on treat all. Of the 596 females, 39 were retained on ART at 12 months, with chi-square of 572.239, *df* of 1, and *p*-value of <.001, as compared to the 439 males starting ART, 223 males were initiated based on treat all of which 11 were retained, chi-square value of 206.860. 28 females were retained. As shown in Table 4, the cross tab with females and males are statistically significant at a p-value of <.001, Table 12 and 13.

Table 12

Patients Initiated Based on Treat All and Gender

			Count		
Gender			No	Yes	Total
Female	Retained on ART	No	12,726	0	12,726
		Yes	596	28	624
	Total		13,322	28	13,350
Male	Retained on ART	No	4,390	0	4,390
		Yes	223	11	234
	Total		4,613	11	4,624
Total	Retained on ART	No	17,116	0	17,116
		Yes	819	39	858
	Total		17,935	39	17,974

Table 13

Chi-Square Tests of Patients Initiated on Treat-All Criteria and Gender

	Gender	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Female	Pearson Chi-Square	572.239 [c]	1	<.001		
	Continuity Correction [b]	551.000	1	<.001		
	Likelihood Ratio	172.752	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	572.196	1	<.001		
	N of Valid Cases	13350				
Male	Pearson Chi-Square	206.860 [d]	1	<.001		
	Continuity Correction [b]	187.526	1	<.001		
	Likelihood Ratio	66.140	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	206.815	1	<.001		
	N of Valid Cases	4624				
Total	Pearson Chi-Square	779.692 [a]	1	<.001		
	Continuity Correction [b]	758.839	1	<.001		
	Likelihood Ratio	238.998	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	779.648	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.86. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.31. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .56.

Patients Initiated Based on Treat-All Criteria and Educational Status

Of all the educational levels examined, 13 of the clients responding none/NaN (chi-square of 338.868, *df* of 1, and *p*-value of <.001 were retained at 12 months on ART, followed by 12 clients among the Junior High School/Middle School Leaving Certificate (chi-square of 247.541 and *df* of 1) were retained in care out of the 307 who initiated based on treat all, chi-square of 247.541, *df* of 1 and *p*-value of <.001. Also, 6, 5 and 3

clients, were retained on ART at 12 months from an educational level of Pre School/Primary (chi-square of 119.938, *df* of 1), Senior High School/Vocational Training/Technical Training (chi-square of 70.503 and *df* of 1), and Tertiary (chi-square of 47.174 and *df* of 1) respectively. All the educational level, when tested with patients initiated on treat, was significant at a *p*-value of <.001, Tables 14 and 15.

Table 14

Patients Initiated Based on Treat All and Educational Status

Educational Status			Count		
			No	Yes	Total
Pre School/Primary	Retained on ART	No	2,473	0	2,473
		Yes	118	6	124
	Total		2,591	6	2,597
Junior High School/Middle School Leaving Certificate	Retained on ART	No	6,569	0	6,569
		Yes	307	12	319
	Total		6,876	12	6,888
Senior High School/Vocational Training/Technical Training	Retained on ART	No	1,913	0	1,913
		Yes	131	5	136
	Total		2,044	5	2,049
Tertiary	Retained on ART	No	1,664	0	1,664
		Yes	103	3	106
	Total		1,767	3	1,770
None/NaN	Retained on ART	No	4,497	0	4,497
		Yes	160	13	173
	Total		4,657	13	4,670
Total	Retained on ART	No	17,116	0	17,116
		Yes	819	39	858
	Total		17,935	39	17,974

Table 15

Chi-Square Test on Educational Status for Patients Initiated Based on Treat-All Criteria

Educational Status		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Pre School/Primary	Pearson Chi-Square	119.938 [c]	1	<.001		
	Continuity Correction [b]	99.865	1	<.001		
	Likelihood Ratio	36.783	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	119.892	1	<.001		
	N of Valid Cases	2,597				
Junior High School/Middle School Leaving Certificate	Pearson Chi-Square	247.541[d]	1	<.001		
	Continuity Correction [b]	226.383	1	<.001		
	Likelihood Ratio	74.173	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	247.505	1	<.001		
	N of Valid Cases	6,888				
Senior High School/Vocational Training/Technical Training	Pearson Chi-Square	70.503 [e]	1	<.001		
	Continuity Correction [b]	56.209	1	<.001		
	Likelihood Ratio	27.298	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	70.469	1	<.001		
	N of Valid Cases	2,049				
Tertiary	Pearson Chi-Square	47.174 [f]	1	<.001		
	Continuity Correction [b]	31.930	1	<.001		
	Likelihood Ratio	16.972	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	47.148	1	<.001		
	N of Valid Cases	1770				
None/NaN	Pearson Chi-Square	338.868 [g]	1	<.001		
	Continuity Correction[b]	312.339	1	<.001		
	Likelihood Ratio	86.652	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	338.796	1	<.001		
	N of Valid Cases	4670				
Total	Pearson Chi-Square	779.692[a]	1	<.001		
	Continuity Correction [b]	758.839	1	<.001		
	Likelihood Ratio	238.998	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	779.648	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.86. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .29. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .56. [e] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .33. [f] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .18. [g] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .48.

Patients Initiated Based on Treat-All Criteria and Referred for Adherence Counseling

Of the total, 39 clients have retained on treat all criteria at 12 months follow-up, 11 were referred for adherence counseling (chi-square of 176.351 and *df* of 1 and *p*-value of <.001). The cross tab with referred to adherence counselor has a chi-square value of 0.003, *df* of 2, and is statistically not significant at 0.955 in Tables 16 and 17.

Table 16

Patients Initiated Based on Treat All and Referred To Adherence Counselor

			Count		
Referred To Adherence Counselor			No	Yes	Total
No	Retained on ART	No	12,413	0	12,413
		Yes	536	28	564
	Total		12,949	28	12,977
Yes	Retained on ART	No	4,703	0	4,703
		Yes	283	11	294
	Total		4,986	11	4,997
Total	Retained on ART	No	17,116	0	17,116
		Yes	819	39	858
	Total		17,935	39	17,974

Table 17

Chi-Square Tests of Patients Initiated on Treat-All Criteria and Referred To Adherence Counselor

		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Referred to Adherence Counselor						
No	Pearson Chi-Square	617.581 [c]	1	<.001		
	Continuity Correction [b]	594.737	1	<.001		
	Likelihood Ratio	176.962	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	617.533	1	<.001		
	N of Valid Cases	12977				
Yes	Pearson Chi-Square	176.351 [d]	1	<.001		
	Continuity Correction [b]	159.728	1	<.001		
	Likelihood Ratio	62.719	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	176.315	1	<.001		
	N of Valid Cases	4997				
Total	Pearson Chi-Square	779.692 [a]	1	<.001		
	Continuity Correction [b]	758.839	1	<.001		
	Likelihood Ratio	238.998	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	779.648	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.86. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.22. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .65.

Patients Initiated Based on Treat-All Criteria and Tuberculosis Treatment

None who had TB were retained. Also, none who used alcohol was retained. For TB treatment initiated, the Pearson chi-square is 4.006, (*df*) of 1, and is not statistically significant at 0.045; see Tables 18 and 19.

Table 18

Patients Initiated Based on Treat All and TB Treatment Initiated

			Count		
TB Treatment			No	Yes	Total
No	Retained on ART	No	15,452	0	15,452
		Yes	812	39	851
	Total		16,264	39	16,303
Yes	Retained on ART	No	1,664		1,664
		Yes	7		7
	Total		1671		1,671
Total	Retained on ART	No	17,116	0	17,116
		Yes	819	39	858
	Total		17,935	39	17,974

Table 19

Chi-Square Test on Tuberculosis Treatment Initiated for Patients Initiated Based on Treat-All Criteria

TB Treatment Initiated		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided	Exact Sig. (1-Sided)
No	Pearson Chi-Square	709.839[c]	1	<.001		
	Continuity Correction[b]	690.766	1	<.001		
	Likelihood Ratio	232.032	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	709.796	1	<.001		
	N of Valid Cases	16303				
Yes	Pearson Chi-Square	.[d]				
	N of Valid Cases	1671				
Total	Pearson Chi-Square	779.692[a]	1	<.001		
	Continuity Correction[b]	758.839	1	<.001		
	Likelihood Ratio	238.998	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	779.648	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.86. [b] Computed only for a 2x2 table

[c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.04. [d] No statistics are computed because Patients initiated based Treat All criteria is a constant.

Patients Initiated Based on Treat-All Criteria and Alcohol Consumption

None who had TB were retained. Also, none who used alcohol were retained. For TB treatment initiated, the Pearson chi-square is 4.006, (*df*) of 1, and is not statistically significant at 0.045, Tables 20 and 21.

Table 20

Patients Initiated Based on Treat All and Alcohol Consumption

			Count		
Alcohol Consumption			No	Yes	Total
No	Retained on ART	No	16,968	0	16,968
		Yes	811	39	850
	Total		17,779	39	17,818
Yes	Retained on ART	No	148		148
		Yes	8		8
	Total		156		156
Total	Retained on ART	No	17,116	0	17,116
		Yes	819	39	858
	Total		17,935	39	17,974

Table 21

Chi-Square Test on Alcohol Consumption for Patients Initiated Based on Treat-All Criteria

		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Alcohol Consumption						
No	Pearson Chi-Square	780.240 [c]	1	<.001		
	Continuity Correction [b]	759.373	1	<.001		
	Likelihood Ratio	239.065	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	780.196	1	<.001		
	N of Valid Cases	17,818				
Yes	Pearson Chi-Square	.[d]				
	N of Valid Cases	156				
Total	Pearson Chi-Square	779.692 [a]	1	<.001		
	Continuity Correction [b]	758.839	1	<.001		
	Likelihood Ratio	238.998	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	779.648	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.86. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.86. [d] No statistics are computed because Patients initiated based Treat All criteria is a constant.

Research Question 2

RQ2. What is the association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on Option B+ and retention on ART at 12 months controlling for age,

gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

- Alternative: There is an association between patients initiated based on Option B+ and retention on ART at 12 months controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

Covariates and Patients Initiated Based on Option B+

A total of 17,928 (%) were not retained at 12 months compared to 46 who were retained at 12 months.

Age. Option B is among pregnant women. Of the 46 clients retained, 2 were aged 13 to 19 years (chi-square of 34.066, *df* 1 and p-value <.001), 6 between 20 to 24 years(chi-square of 118.479, *df* 1 and *p*-value <.001), 12 in the 25 to 29-year group (chi-square of 251.073, *df* 1 and *p*-value <.001), 13 in the 30 to 34 group(chi-square of 258.984, *df* 1 and p-value <.001), 8 in the 35 to 39-year group (chi-square of 157.574 *df* 1 and *p*-value <.001), 1 in the 40 to 44-year group (chi-square of 39.512, *df* 1 and *p*-value <.001), 1 in the 45 to 50 group (chi-square of 21.688, *df*1 and *p*-value <.001) and 2 among the 50+ year group (chi-square of 38.641, *df* 1 and p-value <.001); see Tables 22 and 23.

Table 22

Patients Initiated Based on Option B+ and Age in Years

			Count		
	Age in Years		No	Yes	Total
13-19	Retained on ART	No	458	0	458
		Yes	25	2	27
	Total		483	2	485
20-24	Retained on ART	No	1,495	0	1,495
		Yes	70	6	76
	Total		1,565	6	1,571
25-29	Retained on ART	No	2,562	0	2,562
		Yes	111	12	123
	Total		2,673	12	2,685
30-34	Retained on ART	No	2,936	0	2,936
		Yes	135	13	148
	Total		3,071	13	3,084
35-39	Retained on ART	No	2,809	0	2,809
		Yes	135	8	143
	Total		2,944	8	2,952
40 - 44	Retained on ART	No	2,191	0	2,191
		Yes	109	2	111
	Total		2,300	2	2,302
45-50	Retained on ART	No	2,016	0	2,016
		Yes	92	1	93
	Total		2,108	1	2,109
50+	Retained on ART	No	2,645	0	2,645
		Yes	135	2	137
	Total		2,780	2	2,782
Total	Retained on ART	No	17,116	0	17,116
		Yes	812	46	858
	Total		17,928	46	17,974

Table 23

Chi-Square Tests of Patients Initiated Based on Option B+ and Age in Years

	Age in Years	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
13-	Pearson Chi-Square	34.066[c]	1	<.001		
19	Continuity Correction[b]	18.417	1	<.001		
	Likelihood Ratio	11.697	1	<.001		
	Fisher's Exact Test				.003	.003
	Linear-by-Linear Association	33.996	1	<.001		
	N of Valid Cases	485				
20-	Pearson Chi-Square	118.479[d]	1	.000		
24	Continuity Correction[b]	98.637	1	<.001		
	Likelihood Ratio	36.809	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	118.403	1	.000		
	N of Valid Cases	1571				
25-	Pearson Chi-Square	251.073[e]	1	<.001		
29	Continuity Correction[b]	229.625	1	<.001		
	Likelihood Ratio	75.155	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	250.980	1	.000		
	N of Valid Cases	2685				
30-	Pearson Chi-Square	258.984[f]	1	<.001		
34	Continuity Correction[b]	238.480	1	<.001		
	Likelihood Ratio	80.078	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	258.900	1	.000		
	N of Valid Cases	3084				
35-	Pearson Chi-Square	157.574[g]	1	<.001		
39	Continuity Correction[b]	137.554	1	<.001		
	Likelihood Ratio	48.873	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	157.521	1	<.001		
	N of Valid Cases	2952				
40 -	Pearson Chi-Square	39.512[h]	1	<.001		
44	Continuity Correction[b]	21.481	1	<.001		
	Likelihood Ratio	12.163	1	.000		
	Fisher's Exact Test				.002	.002
	Linear-by-Linear Association	39.495	1	.000		
	N of Valid Cases	2302				
45-	Pearson Chi-Square	21.688[i]	1	<.001		
50	Continuity Correction[b]	4.933	1	.026		
	Likelihood Ratio	6.253	1	.012		
	Fisher's Exact Test				.044	.044
	Linear-by-Linear Association	21.677	1	<.001		
	N of Valid Cases	2109				
50+	Pearson Chi-Square	38.641[j]	1	<.001		
	Continuity Correction[b]	20.991	1	<.001		
	Likelihood Ratio	12.072	1	.001		
	Fisher's Exact Test				.002	.002
	Linear-by-Linear Association	38.627	1	.000		
	N of Valid Cases	2782				
Total	Pearson Chi-Square	919.996[a]	1	<.001		
	Continuity Correction[b]	899.113	1	<.001		

	Age in Years	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
13-	Pearson Chi-Square	34.066[c]	1	<.001		
19	Continuity Correction[b]	18.417	1	<.001		
	Likelihood Ratio	11.697	1	<.001		
	Fisher's Exact Test				.003	.003
	Linear-by-Linear Association	33.996	1	<.001		
	N of Valid Cases	485				
20-	Pearson Chi-Square	118.479[d]	1	.000		
24	Continuity Correction[b]	98.637	1	<.001		
	Likelihood Ratio	36.809	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	118.403	1	.000		
	N of Valid Cases	1571				
25-	Pearson Chi-Square	251.073[e]	1	<.001		
29	Continuity Correction[b]	229.625	1	<.001		
	Likelihood Ratio	75.155	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	250.980	1	.000		
	N of Valid Cases	2685				
30-	Pearson Chi-Square	258.984[f]	1	<.001		
34	Continuity Correction[b]	238.480	1	<.001		
	Likelihood Ratio	80.078	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	258.900	1	.000		
	N of Valid Cases	3084				
35-	Pearson Chi-Square	157.574[g]	1	<.001		
39	Continuity Correction[b]	137.554	1	<.001		
	Likelihood Ratio	48.873	1	.000		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	157.521	1	<.001		
	N of Valid Cases	2952				
	Likelihood Ratio	282.265	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	919.944	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.20. [b] Computed only for a 2x2 table. [c] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .11. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .29. [e] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .55. [f] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .62. [g] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .39. [h] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .10. [i] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .04. [j] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .10. [k] No statistics are computed because Retained on ART and Patients initiated based on Option B+ are constants.

Gender. Females who were retained after starting on Option B+ were 291 (chi-square of 6066.971, *df* 1 and *p*-value .0001), as compared to 95 males (chi-square of 1819.650, *df* 1 and *p*-value .0001; see Tables 24 and 25.

Table 24

Patients Initiated Based on Option B+ and Gender

			Count		
Gender			No	Yes	Total
Female	Retained on ART	No	12,726	0	12,726
		Yes	579	46	624
	Total		13,305	46	13,350
Male	Retained on ART	No	4390	0	4,390
		Yes	233	0	234
	Total		4,623	0	4,624
Total	Retained on ART	No	17,116	0	17,116
		Yes	812	46	858
	Total		17,928	46	17,974

Table 25

Chi-Square Tests of Gender of Patients Initiated Based on Option B+ and Gender

Gender		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Female	Pearson Chi-Square	920.844[c]	1	<.001		
	Continuity Correction[b]	899.503	1	<.001		
	Likelihood Ratio	278.855	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	920.775	1	<.001		
	N of Valid Cases	13350				
Male	Pearson Chi-Square	18.765[d]	1	<.001		
	Continuity Correction[b]	4.204	1	.040		
	Likelihood Ratio	5.971	1	.015		
	Fisher's Exact Test				.051	.051
	Linear-by-Linear Association	18.761	1	<.001		
	N of Valid Cases	4624				
Total	Pearson Chi-Square	919.996[a]	1	<.001		
	Continuity Correction[b]	899.113	1	<.001		
	Likelihood Ratio	282.265	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	919.944	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.20. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.10. [d] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .05.

Educational Status. Also, among the 46 clients who were retained when initiated on Option B+, 19 had Junior High School/Middle School Leaving Certificate (chi-square of 392.339, *df* 1 and *p*-value <.001)., 9 had Tertiary education (chi-square of 142.005, *df* 1 and *p*-value <.001), 7 Senior High School/Vocational Training/Technical Training (chi-square of 98.801, *df* 1 and *p*-value <.001), 6 Pre School/Primary (chi-square of 119.938, *df* 1 and *p*-value <.001), and 5 None/NaN (chi-square of 130.110, *df* 1 and *p*-value <.001), 26 and 27.

Table 26

Patients Initiated Based on Option B+ and Educational Status

Educational Status			Count No	Yes	Total
Pre School/Primary	Retained on ART	No	2,473	0	2,473
		Yes	118	6	124
	Total		2,591	6	2,597
Junior High School/Middle School Leaving Certificate	Retained on ART	No	6,569	0	6,569
		Yes	300	19	319
	Total		6,869	19	6,888
Senior High School/Vocational Training/Technical Training	Retained on ART	No	1,913	0	1,913
		Yes	129	7	136
	Total		2,042	7	2,049
Tertiary	Retained on ART	No	1,664	0	1,664
		Yes	97	9	106
	Total		1,761	9	1,770
None/NaN	Retained on ART	No	4,497	0	4,497
		Yes	168	5	173
	Total		4,665	5	4,670
Total	Retained on ART	No	17,116	0	17,116
		Yes	812	46	858
	Total		17,928	46	17,974

Table 27

Chi-Square Tests of Educational Status of Patients Initiated Based on Option B+

Educational Status		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Pre School/Primary	Pearson Chi-Square	119.938[c]	1	<.001		
	Continuity Correction[b]	99.865	1	<.001		
	Likelihood Ratio	36.783	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	119.892	1	<.001		
	N of Valid Cases	2597				
Junior High School/Middle School Leaving Certificate	Pearson Chi-Square	392.339[d]	1	<.001		
	Continuity Correction[b]	370.986	1	<.001		
	Likelihood Ratio	117.851	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	392.282	1	<.001		
	N of Valid Cases	6888				
Senior High School/Vocational Training/Technical Training	Pearson Chi-Square	98.801[e]	1	<.001		
	Continuity Correction[b]	84.261	1	<.001		
	Likelihood Ratio	38.317	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	98.753	1	<.001		
	N of Valid Cases	2049				
Tertiary	Pearson Chi-Square	142.005[f]	1	<.001		
	Continuity Correction[b]	125.718	1	<.001		
	Likelihood Ratio	51.416	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	141.925	1	<.001		
	N of Valid Cases	1770				
None/NaN	Pearson Chi-Square	130.110[g]	1	<.001		
	Continuity Correction[b]	104.490	1	<.001		
	Likelihood Ratio	33.097	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	130.083	1	<.001		
	N of Valid Cases	4670				
Total	Pearson Chi-Square	919.996[a]	1	<.001		
	Continuity Correction[b]	899.113	1	<.001		
	Likelihood Ratio	282.265	1	<.001		
	Fisher's Exact Test				<.001	<.001

Educational Status		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
	Linear-by-Linear Association	919.944	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.20. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .29. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .88. [e] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .46. [f] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .54. [g] 2 cells (50.0%) have expected count less than 5. The minimum expected count is .19.

Referred for Adherence Monitoring. A total of 22 out of 272 who were referred for adherence counseling were retained (chi-square of 353.481, *df* 1 and p-value <.001). No one with TB disease starting ART on Option B+ out of 1,664 who had TB was retained at 12 months, Table 28 and 29.

Table 28

Patients Initiated Based on Option B+ and Referred To Adherence Counselor

			Count		
Referred to Adherence Counselor			No	Yes	Total
No	Retained on ART	No	12,413	0	12,413
		Yes	540	24	564
	Total		12,953	24	12,977
Yes	Retained on ART	No	4,703	0	4,703
		Yes	272	22	294
	Total		4,975	22	4,997
Total	Retained on ART	No	17,116	0	17,116
		Yes	812	46	858
	Total		17,928	46	17,974

Table 29

Chi-Square Tests of Patients Referred to Adherence Counseling Initiated Based on Option B+

Referred to Adherence Counselor		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
No	Pearson Chi-Square	529.191[c]	1	<.001		
	Continuity Correction[b]	506.391	1	<.001		
	Likelihood Ratio	151.514	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	529.151	1	<.001		
	N of Valid Cases	12977				
Yes	Pearson Chi-Square	353.481[d]	1	<.001		
	Continuity Correction[b]	336.616	1	<.001		
	Likelihood Ratio	126.245	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	353.411	1	<.001		
	N of Valid Cases	4997				
Total	Pearson Chi-Square	919.996[a]	1	<.001		
	Continuity Correction[b]	899.113	1	<.001		
	Likelihood Ratio	282.265	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	919.944	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.20. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.04. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.29.

Tuberculosis Treatment Initiated. None with TB disease was retained on Option B+ at 12 months on ART. While TB treatment initiated is statistically is significant at a p-value of 0.000, Pearson chi-square of .0, and a (*df*) of 1, Tables 30 and 31.

Table 30

Patients Initiated Based on Option B+ and TB Treatment Initiated

			Count		
	TB Treatment Initiated		No	Yes	Total
No	Retained on ART	No	15452	0	15452
		Yes	805	46	851
	Total		16257	46	16303
Yes	Retained on ART	No	1664		1664
		Yes	7		7
	Total		1671		1671
Total	Retained on ART	No	17116	0	17116
		Yes	812	46	858
	Total		17928	46	17,974

Table 31

Chi-Square Tests of Patients Initiated Based on Option B+ and TB Treatment Initiated

TB Treatment Initiated		Value	df	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
No	Pearson Chi-Square	837.607[c]	1	<.001		
	Continuity Correction[b]	818.505	1	<.001		
	Likelihood Ratio	274.050	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	837.555	1	<.001		
	N of Valid Cases	16303				
Yes	Pearson Chi-Square	.[d]				
	N of Valid Cases	1671				
Total	Pearson Chi-Square	919.996[a]	1	<.001		
	Continuity Correction[b]	899.113	1	<.001		
	Likelihood Ratio	282.265	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	919.944	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.20. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.40.

[d] No statistics are computed because Patients initiated based on Option B+ is a constant.

Alcohol Use. Also, of the 156 who used alcohol initiating ART on Option B+, none were retained at 12 months on ART. While alcohol use is statistically significant at a *p*-value of 0.000, Pearson chi-square of 0.0, and a (*df*) of 1, Tables 32 and 33.

Table 32

Patients Initiated Based on Option B+ and Alcohol Consumption

			Count		
	Alcohol Consumption		No	Yes	Total
No	Retained on ART	No	16968	0	16968
		Yes	804	46	850
	Total		17772	46	17818
Yes	Retained on ART	No	148		148
		Yes	8		8
	Total		156		156
Total	Retained on ART	No	17116	0	17116
		Yes	812	46	858
	Total		17928	46	17,974

Table 33

Chi-Square Tests of Patients' Alcohol Consumption Initiated Based on Option B+

	Alcohol Consumption	Value	*df*	Asymptotic Signi (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
No	Pearson Chi-Square	920.645[c]	1	<.001		
	Continuity Correction[b]	899.748	1	<.001		
	Likelihood Ratio	282.348	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	920.593	1	<.001		
	N of Valid Cases	17818				
Yes	Pearson Chi-Square	.[d]				
	N of Valid Cases	156				
Total	Pearson Chi-Square	919.996[a]	1	<.001		
	Continuity Correction[b]	899.113	1	<.001		
	Likelihood Ratio	282.265	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	919.944	1	<.001		
	N of Valid Cases	17,974				

[a] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.20. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.19. [d] No statistics are computed because Patients initiated based on Option B+ is a constant.

Research Question 3

RQ3. What is the association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment?

- Null: There is no association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.
- Alternative: There is an association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months,

controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and tuberculosis disease treatment.

Patients Initiated Based on CD4 T-Cell Count ≤ 500

The comparison and chi-square test for patients initiated based on CD4 T- cell count ≤ 500, covariates and patients initiated based on CD4 T-cell count ≤500. A total number of 17,588 (97.9%) who were initiated based on CD4 Tcell count ≤500 were not retained as compared to 386 (2.1%) who were retained on ART at 12 months.

Age

Among the 30 to 34 age group, 77 were retained who were initiated based on CD4 Tcell count ≤500 (chi-square of 1566.628, *df* 1 and p-value <.001), 61 in the 35 to 39 age group (chi-square of 1223.528, *df* 1 and p-value <.001), 54 in the 25 to 29 age group (chi-square of 1147.866, *df* 1 and p-value <.001), 53 in the 50 plus group (chi-square of 1043.121, *df* 1 and p-value <.001), 43 in the 45 to 43 (chi-square of 951.530, *df* 1 and p-value <.001), 20 to 25 (chi-square of 601.620, *df* 1 and p-value <.001), and 10 among the 13 to 19 year group (chi-square of 173.201, *df* 1 and p-value <.001), Table 34 and 35.

Table 34

Patients Initiated Based on CD4 T-Cell count ≤ 500 and Age in Years

			Count		
	Age in Years		No	Yes	Total
13-19	Retained on ART	No	458	0	458
		Yes	17	10	27
	Total		475	10	485
20-24	Retained on ART	No	1,495	0	1,495
		Yes	46	30	76
	Total		1,541	30	1,571
25-29	Retained on ART	No	2,562	0	2,562
		Yes	69	54	123
	Total		2,631	54	2,685
30-34	Retained on ART	No	2,936	0	2,936
		Yes	71	77	148
	Total		3,007	77	3,084
35-39	Retained on ART	No	2,809	0	2,809
		Yes	82	61	143
	Total		2,891	61	2,952
40 - 44	Retained on ART	No	2,191	0	2,191
		Yes	53	58	111
	Total		2,244	58	2,302
45-50	Retained on ART	No	2,016	0	2,016
		Yes	50	43	93
	Total		2,066	43	2,109
50+	Retained on ART	No	2,645	0	2,645
		Yes	84	53	137
	Total		2,729	53	2,782
Total	Retained on ART	No	17,116	0	17,116
		Yes	472	386	858
	Total		17,588	386	17,974

Table 35

Chi-Square Test of Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Age in Years

	Age in Years	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
13-19	Pearson Chi-Square	173.201[c]	1	<.001		
	Continuity Correction[b]	155.345	1	<.001		
	Likelihood Ratio	61.829	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	172.844	1	<.001		
	N of Valid Cases	485				
20-24	Pearson Chi-Square	601.620[d]	1	<.001		
	Continuity Correction[b]	580.731	1	<.001		
	Likelihood Ratio	194.955	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	601.237	1	<.001		
	N of Valid Cases	1571				
25-29	Pearson Chi-Square	1,147.866[e]	1	<.001		
	Continuity Correction[b]	1,125.697	1	<.001		
	Likelihood Ratio	360.123	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1147.439	1	<.001		
	N of Valid Cases	2685				
30-34	Pearson Chi-Square	1,566.628[f]	1	.000		
	Continuity Correction[b]	1,545.330	1	.000		
	Likelihood Ratio	515.420	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1,566.120	1	.000		
	N of Valid Cases	3084				
35-39	Pearson Chi-Square	1,223.528[g]	1	<.001		
	Continuity Correction[b]	1,202.540	1	<.001		
	Likelihood Ratio	398.868	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1,223.113	1	<.001		
	N of Valid Cases	2952				
40 - 44	Pearson Chi-Square	1,174.437[h]	1	<.001		
	Continuity Correction[b]	1,153.259	1	<.001		
	Likelihood Ratio	387.879	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1,173.927	1	<.001		
	N of Valid Cases	2,302				

	Age in years	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
45-50	Pearson Chi-Square	951.530[i]	1	<.001		
	Continuity Correction[b]	928.521	1	<.001		
	Likelihood Ratio	291.497	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	951.078	1	<.001		
	N of Valid Cases	2109				
50+	Pearson Chi-Square	1,043.121[j]	1	<.001		
	Continuity Correction[b]	1,022.522	1	<.001		
	Likelihood Ratio	341.964	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1,042.746	1	<.001		
	N of Valid Cases	2782				
Total	Pearson Chi-Square	7,869.200[a]	1	.000		
	Continuity Correction[b]	7,847.806	1	.000		
	Likelihood Ratio	2,547.976	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7,868.762	1	.000		
	N of Valid Cases	17,974				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.43. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is .56. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.45. [e] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.47. [f] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.70. [g] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.95. [h] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.80. [i] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.90. [j] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.61. [k] No statistics are computed because Retained on ART and Patients initiated based on CD4 T- cell count ≤ 500 are constants.

Gender

Females who were retained after starting with a CD4 Tcell count ≤500 were 291 (chi-square of 6066.971, *df* 1 and *p*-value .0001), as compared to 95 males (chi-square of 1819.650, *df* 1 and *p*-value .0001), Tables 36 and 37.

Table 36

Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Gender

Gender			No	Yes	Total
Female	Retained on ART	No	12,726	0	12,726
		Yes	333	291	624
	Total		13,059	291	13,350
Male	Retained on ART	No	4,390	0	4,390
		Yes	139	95	234
	Total		4,529	95	4,624
Total	Retained on ART	No	17,116	0	17,116
		Yes	472	386	858
	Total		17,588	386	17,974

Table 37

Chi-Square Test of Patients Initiated Based on CD4 T-Cell count ≤ 500 and Gender

	Gender	Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Female	Pearson Chi-Square	6,066.967[c]	1	.000		
	Continuity Correction[b]	6,045.116	1	.000		
	Likelihood Ratio	1,940.094	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	6,066.513	1	.000		
	N of Valid Cases	13350				
Male	Pearson Chi-Square	1,819.650[d]	1	.000		
	Continuity Correction[b]	1,799.530	1	.000		
	Likelihood Ratio	610.141	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1,819.256	1	.000		
	N of Valid Cases	4,624				
Total	Pearson Chi-Square	7,869.200[a]	1	.000		
	Continuity Correction[b]	7,847.806	1	.000		
	Likelihood Ratio	2,547.976	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7,868.762	1	.000		
	N of Valid Cases	17,974				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.43. [b] Computed only for a 2x2 table. [c] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.60. [d] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.81.

Educational Status

Of these 386 who were retained, 143 were clients with Junior High School/Middle School Leaving Certificate (chi-square of 1566.628, *df* 1 and *p*-value <.001), 106 had Tertiary Education (chi-square of 479.063, *df* 1 and p-value <.001), 80 clients with None/NaN as educational status (chi-square of 2115.782, *df* 1 and *p*-value <.001), 75Senior High School/Vocational Training/Technical Training (chi-square of 1095.045, *df* 1 and *p*-value <.001), and 58 clients with Pre School/Primary (chi-square of 1183.150, *df* 1 and *p*-value <.001) Tables 38 and 39.

Table 38

Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Educational Status

			Patients Initiated Based On CD4 T-Cell Count ≤ 500		
Educational Status			No	Yes	Total
Pre School/Primary	Retained on ART	No	2,473	0	2473
		Yes	66	58	124
	Total		2,539	58	2597
Junior High School/Middle School Leaving Certificate	Retained on ART	No	6,569	0	6569
		Yes	176	143	319
	Total		6,745	143	6888
Senior High School/Vocational Training/Technical Training	Retained on ART	No	1,913	0	1913
		Yes	61	75	136
	Total		1,974	75	2049
Tertiary	Retained on ART	No	1,664	0	1664
		Yes	76	30	106
	Total		1,740	30	1770
None/NaN	Retained on ART	No	4,497	0	4497
		Yes	93	80	173
	Total		4,590	80	4670
Total	Retained on ART	No	17,116	0	17116
		Yes	472	386	858
	Total		17,588	386	17,974

Table 39

Chi-Square Test of Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Educational Status

Educational Status		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
Pre School/Primary	Pearson Chi-Square	1183.150[c]	1	<.001		
	Continuity Correction[b]	1161.825	1	<.001		
	Likelihood Ratio	384.305	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1182.694	1	<.001		
	N of Valid Cases	2597				
Junior High School/Middle School Leaving Certificate	Pearson Chi-Square	3007.155[d]	1	.000		
	Continuity Correction[b]	2985.145	1	.000		
	Likelihood Ratio	952.364	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	3006.718	1	.000		
	N of Valid Cases	6888				
Senior High School/Vocational Training/Technical Training	Pearson Chi-Square	1095.045[e]	1	<.001		
	Continuity Correction[b]	1079.463	1	<.001		
	Likelihood Ratio	456.271	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1094.511	1	<.001		
	N of Valid Cases	2049				
Tertiary	Pearson Chi-Square	479.063[f]	1	<.001		
	Continuity Correction[b]	462.228	1	<.001		
	Likelihood Ratio	177.835	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	478.792	1	<.001		
	N of Valid Cases	1770				

Educational Status		Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
None/NaN	Pearson Chi-Square	2115.782[g]	1	.000		
	Continuity Correction[b]	2088.407	1	.000		
	Likelihood Ratio	570.473	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	2115.329	1	.000		
	N of Valid Cases	4670				
Total	Pearson Chi-Square	7869.200[a]	1	.000		
	Continuity Correction[b]	7847.806	1	.000		
	Likelihood Ratio	2547.976	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7868.762	1	.000		
	N of Valid Cases	17,974				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.43. [b] Computed only for a 2x2 table. [c] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.77. [d] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.62. [e] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.98. [f] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.80. [g] 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.96.

Referred for Adherence Counseling

A total of 108 individuals were retained who were referred for adherence counseling, Tables 40 and 41.

Table 40

Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Referred To Adherence Counselor

			Count		
Referred to Adherence Counselor			No	Yes	Total
No	Retained on ART	No	12,413	0	12,413
		Yes	286	278	564
	Total		12,699	278	12,977
Yes	Retained on ART	No	4,703	0	4,703
		Yes	186	108	294
	Total		4,889	108	4,997
Total	Retained on ART	No	17,116	0	17,116
		Yes	472	386	858
	Total		17,588	386	17,974

Table 41

Chi-Square Test of Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Referred To Adherence Counselor

Referred to Adherence Counselor		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
No	Pearson Chi-Square	6252.407[c]	1	.000		
	Continuity Correction[b]	6228.916	1	.000		
	Likelihood Ratio	1905.127	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	6251.925	1	.000		
	N of Valid Cases	12977				
Yes	Pearson Chi-Square	1765.797[d]	1	.000		
	Continuity Correction[b]	1748.467	1	.000		
	Likelihood Ratio	655.266	1	<.001		
	Fisher's Exact Test				<.001	<.001
	Linear-by-Linear Association	1765.443	1	.000		
	N of Valid Cases	4997				
Total	Pearson Chi-Square	7869.200[a]	1	.000		
	Continuity Correction[b]	7847.806	1	.000		
	Likelihood Ratio	2547.976	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7868.762	1	.000		
	N of Valid Cases	17,974				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.43. [b] Computed only for a 2x2 table. [c] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.08. [d] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.35.

Tuberculosis Disease

A total of 386 each were retained on treatment at a p-value of 0.000, Tables 42 and 43.

Table 42

Patients Initiated Based on CD4 T-Cell Count ≤ 500 and TB Treatment Initiated

			Count		
TB Treatment Initiated			No	Yes	Total
No	Retained on ART	No	15,452	0	15,452
		Yes	465	386	851
	Total		15,917	386	16,303
Yes	Retained on ART	No	1,664		1,664
		Yes	7		7
	Total		1,671		1,671
Total	Retained on ART	No	17,116	0	17,116
		Yes	472	386	858
	Total		17,588	386	17,974

Table 43

Chi-Square Test of Patients Initiated Based on CD4 T-Cell Count ≤ 500 and TB Treatment Initiated

TB Treatment Initiated		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
No	Pearson Chi-Square	7178.749[c]	1	.000		
	Continuity Correction[b]	7159.140	1	.000		
	Likelihood Ratio	2480.198	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7178.308	1	.000		
	N of Valid Cases	16303				
Yes	Pearson Chi-Square	.[d]				
	N of Valid Cases	1671				
Total	Pearson Chi-Square	7869.200[a]	1	.000		
	Continuity Correction[b]	7847.806	1	.000		
	Likelihood Ratio	2547.976	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7868.762	1	.000		
	N of Valid Cases	17,974				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.43. [b] Computed only for a 2x2 table. [c] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 20.15.

[d] No statistics are computed because Patients initiated based on CD4 T- cell count ≤ 500 is a constant.

Alcohol Use

A total of 386 each were retained on treatment who had no history of alcohol consumption at a p value of 0.000, Tables 44 and 45.

Table 44

Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Alcohol Consumption

			Count		
Alcohol Consumption			No	Yes	Total
No	Retained on ART	No	16,968	0	16,968
		Yes	464	386	850
	Total		17,432	386	17,818
Yes	Retained on ART	No	148		148
		Yes	8		8
	Total		156		156
Total	Retained on ART	No	17,116	0	17,116
		Yes	472	386	858
	Total		17,588	386	17,974

Table 45

Chi-Square Test of Patients Initiated Based on CD4 T-Cell Count ≤ 500 and Alcohol Consumption

Alcohol Consumption		Value	*df*	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)
No	Pearson Chi-Square	7876.092[c]	1	.000		
	Continuity Correction[b]	7854.680	1	.000		
	Likelihood Ratio	2550.796	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7875.650	1	.000		
	N of Valid Cases	17818				
Yes	Pearson Chi-Square	.[d]				
	N of Valid Cases	156				
Total	Pearson Chi-Square	7869.200[a]	1	.000		
	Continuity Correction[b]	7847.806	1	.000		
	Likelihood Ratio	2547.976	1	.000		
	Fisher's Exact Test				.000	.000
	Linear-by-Linear Association	7868.762	1	.000		
	N of Valid Cases	17,974				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.43. [b] Computed only for a 2x2 table. [c] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.41. [d] No statistics are computed because Patients initiated based on CD4 T- cell count ≤ 500 is a constant.

Logistic Regression

Variables in the equation, as per Table 46, show a beta constant of -2.993, the standard error, SE of 0.035, Wald statistics of 7319.916, *df* (1), and the odds ratio, Exp(B) of 0.050, and the significance level at $p = .000$. The combined effort as shown by the omnibus test for the model coefficient, was also significant at the *p*-value of 0.000 with a chi-square value of 2774.319 and df(3). Like the Pearson r, the model summary in Table 33 shows a -2 Log likelihood of 4120.261, Cox & Snell R Square of 0.143, and a

Nagelkerke R^2 of 0.449. Thus, per the Nagelkerke R^2, 4.49 percent of the variation in the dependent variable is due to the confounding variables, while Cox & Snell R Square reports a 14.3% variation.

Table 46

The Output of Logistic Regression

Output				Description			
Variables in the equation							
		B	SE	Wald	df	Sig.	Exp(B)
Step 0	Constant	-2.993	0.035	7319.916	1	0	0.05
Omnibus Tests of Model Coefficients							
		Chi-square	df	Sig.			
	Step	2774.319	3	0			
Step 1	Block	2774.319	3	0			
	Model	2774.319	3	0			
Model Summary							
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square				
1	4120.261[a]	0.143	0.449				

[a] Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Variable in the Equation

Per Table 47 also, the variable in the equation showed the regression coefficients, B, for patients initiated based on Treat All criteria to be 0.102 (significant at p-value =0.000), for patients initiated based on Option B+ 24.001 (not significant at p-value =0.996) and patients initiated based on CD4 Tcell count ≤500, 24.760 (not significant at p-value =0.991). The alpha constant of -3.659 is statistically significant at a *p*-value of 0.000 SE (0.48), Table 46 on the output of the logistics regression.

Per the test statistics in Table 45, the chi-square test shows 17818.338, 17790.471, and 16463.158 for patients initiated based on Treat All criteria, patients initiated based on

Option B+, and patients initiated based on CD4 Tcell count ≤500, respectively. The *df* is 1, and all independent variables are significant at a *p*-value of 0.000.

Table 47

Variables in the Equation

Variables in Equation 1						
		B	*SE*	Wald	*df*	Sig.
Step 1[a]	Patients initiated based Treat All criteria(1)	0.102	6768.855	0	1	1
	Patients initiated based on Option B+(1)	24.001	4695.413	0	1	0.996
	Patients initiated based on CD4 T-cell count ≤ 500(1)	24.76	2096.419	0	1	0.991
	Constant	-3.659	0.048	5755.06	1	0
Variables in the Equation 2						
		Exp(B)	95% C.I.for EXP(B) Lower			Upper
Step 1[a]	Patients initiated based Treat All criteria(1)	1.107			0	.
	Patients initiated based on Option B+(1)	26526076021		0		.
	Patients initiated based on CD4 T-cell count ≤ 500(1)	56631486878		0		.
	Constant	0.026				

[a] Variable (s) entered on step 1: Patients initiated based Treat All criteria, Patients initiated based on Option B+, Patients initiated based on CD4 T- cell count ≤ 500.

Table 48

The Output of Logistic Regression

Test statistics	Patients initiated based on treat-all criteria	Patients initiated based on Option B+	Patients initiated based on CD4 T-cell count ≤500
Chi-Square	17818.338[a]	17790.471[a]	16463.158[a]
Df	1	1	1
Asymp. Sig.	0	0	0

[a] 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8987.0.

Hypothesis Testing

Hypothesis Testing: Patients Initiated Based on Treat-All Criteria

Chi-square analysis was conducted to test the hypothesis of no statistically significant association between patients initiated based on treatment for all criteria and retention on ART at 12 months. The results from the analysis revealed a statistically significant association between patients initiated based on treat all criteria and retention on ART at 12 months (χ^2 17818.338, p=0.000), Table 43. The null of no association is rejected at a significance level of 0.000, Table 46, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment as covariates, Table 49 on Results of Nonparametric Tests.

Table 49

Results of Nonparametric Tests Hypothesis Test Summary

Number	Decision
1	Reject the null hypothesis.
2	Reject the null hypothesis.
3	Reject the null hypothesis

Hypothesis Testing: Patients Initiated Based on Option B+

Chi-square analysis was also conducted to test the hypothesis of no statistically significant association between patients initiated based on Option B+ and retention on ART at 12 months. The results from the analysis revealed a statistically significant association between patients initiated based on Option B+ and retention on ART at 12 months (χ^2 17790.471, p=0.000), Table 43. The null of no association is rejected at a significance level of 0.000, Table 44, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment as covariates, Table 33 on Results of Nonparametric Tests.

Hypothesis Testing: Patients Initiated Based on CD4 T-Cell Count ≤ 500

The third hypothesis for the RQ, what is the association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. Chi-Square analysis was conducted to test whether there is a statistically significant association between patients initiated based on Option B+ and retention on ART at 12 months. The results from the analysis revealed a statistically significant association between patients initiated based on Option B+ and retention on ART at 12 months (χ^2 16463, p=0.000), Table 43. The null of no significant association is rejected

at a significance level of 0.000, Table 44 controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment as covariates, Table 44 on Results of Nonparametric Tests.

Summary

The data were analyzed using SPSS software version 28. Statistical analyses were conducted in 4 separate stages to address this research's hypotheses adequately. Summary statistics with cross-tabulation were conducted, followed by design-based chi-square analysis, regression analysis or binary logistic regression, and hypothesis testing analysis as appropriate. The chi-squared analysis demonstrated significant associations between the independent variables and retention at 12 months.

For RQ1 for patients who were initiated based on treat all initiation criteria, the statistics show that 17,935 (99.8%) clients were not retained at 12 months compared to 39 (0.2%) clients who were retained at 12 months. The analysis shows that starting ART, irrespective of CD4 count results is statistically significantly associated with being retained on ART at 12 months. Gender, educational status, referral to an adherence counselor, TB treatment initiated, and alcohol use, compared with the independent variable of patients initiated based on Treat All criteria, are statistically significant, with *SE* of 0.00. The null hypothesis was thus rejected in favor of r the alternative of significant association between patients initiated based on Treat All criteria and retention on ART at 12 months controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. For RQ1, gender, educational status, referral to an adherence counselor, TB treatment initiated, and alcohol use are not

significant confounders to the independent variable of initiation criteria of treat all to affect retention at 12 months on ART.

RQ2 for patients initiated based on option + and retention at 12 months shows that 17,928 (%) clients were not retained at 12 months compared to 46 (%) who were retained at 12 months. Pregnancy and starting lifelong treatment of ARVs were significantly associated with 12 months retention rates. Gender is statistically significant at <.001; educational status is not statistically significant at 0.55. Referred to adherence counselor is statistically significant at 0.002, TB treatment initiated statistically significant at a p-value of 0.030, and alcohol use is statistically not significant. The null hypothesis is thus rejected for the alternative of significant association between patients initiated based on Option B+ and retention on ART at 12 months controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. For RQ2, gender referred to adherence counselor and TB treatment initiated are significant confounders. However, the educational status and alcohol use are not significant confounders to the independent variable of initiation criteria Option B+ to affect retention at 12 months on ART.

The third RQ for patients initiated based on CD4 T- cell count ≤ 500 and retention on ART at 12 months controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. A total of 17,588 (97.9%) who were initiated based on CD4 Tcell count ≤500 were not retained compared to 386 (2.1%) who were retained on ART. A CD4 count value of 500 or less is also significantly associated with being retained at 12 months. Gender was not statistically significant at a

p-value of 0.613; educational status is statistically significant at 001, referred to an adherence counselor, is similarly statistically not significant at 0.937, for TB treatment is statistically significant at.001, and alcohol use is not statistically significant at 0.063. The null hypothesis is thus rejected for the alternative of significant association between patients initiated based on CD4 T- cell count ≤ 500 and retention on ART at 12 months controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. Educational status and TB treatment initiated for RQ3 are significant confounders. Gender, referred to adherence counselor, and alcohol use are also significant confounders to the independent variable of initiated based on CD4 T- cell count ≤ 500 to affect retention at 12 months on ART.

Chapter 5 includes an interpretation of the findings, recommendations for further study, and a discussion of the potential positive social change impact of the study.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to examine the association between the time of initiation criteria for HIV treatment and retention on ART at 12 months. This study hypothesized a statistically significant association between the initiation criteria and retention at 12 months after initiation.

This study was a quantitative secondary analysis of archived data from the GHS HIV patient electronic tracking database, which includes objective ratings of groups initiated at different infection and disease progression times. The database consists of data from 2002 to 2022 that can be accessed. Data for the study were, however, from 2012 to 2021. Data analysis was conducted with both descriptive statistics and inferential statistics using binary logistic and multiple regression because the dependent variable was binary and dichotomous. “Not being retained” was defined as being in attrition 12 months after testing HIV positive. Thus, retention was rated at 12 months after the initiation of treatment. The study fills in the gap in the literature related to the use of large sample size by including all eligible patients and ART sites in the HIV patient e-tracker database for evaluation to provide a population-wide view of retention in care. The study population was teenagers aged 13 years to adults 50 years and above, but the study did not evaluate retention among children. The gap in using aggregate data was filled by using individual patient-level data for the analysis. However, the study was not multinational but provided relevant information for settings with similar characteristics.

The data were analyzed using SPSS software version 28. Statistical analyses were conducted in 3 separate stages to adequately address this research's hypotheses. Summary

statistics with cross-tabulation were conducted, followed by design-based chi-square analysis, regression analysis or binary logistic regression, and hypothesis testing analysis as appropriate. The chi-squared analysis demonstrated significant associations between the independent variables and retention at 12 months. However, the significance levels varied among the covariates.

Summary

For RQ1 on patients who were initiated based on treat-all initiation criteria, the statistics showed that a total of 17,935 (99.8%) clients were not retained at 12 months, compared to 39 (0.2%) clients retained at 12 months on ART. Stratifying per age group, the number retained was the older age group of 50 and above. A total of 39 females and 11 males were retained on ART at 12 months. In terms of educational level, 13 of the clients responded none/NaN; 12 clients responded that they held a junior high school/middle school leaving certificate; and 6, 5, and 3 clients were retained on ART at 12 months with the educational levels of preschool/primary, senior high school/vocational training/technical training, and tertiary, respectively. Of those retained on the treat-all initiation, 11 were referred for adherence counseling. None of those who used alcohol or had TB disease were retained. The analysis showed that starting ART, irrespective of CD4 count was significantly associated with being retained on ART at 12 months. Gender, educational status, referral to an adherence counselor, TB treatment initiated, and alcohol use, compared with the independent variable of patients initiated based on treat-all criteria, were statistically significant, with *SE* of 0.00. The null hypothesis was thus rejected in favor of the alternative of significant association between

patients initiated based on treat-all criteria and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. For RQ1, gender, educational status, referral to an adherence counselor, TB treatment initiated, and alcohol use were significant confounders to the independent variable of initiation criteria of treat all to affect retention at 12 months on ART.

Results for RQ2 on patients initiated based on Option B+ and retention at 12 months on ART showed that 17,928 (%) clients were not retained at 12 months, compared to 46 who were retained at 12 months. Of the 46 clients retained, 13 were in the 30 to 34 group, eight were in the 35 to 39 group, six were between 20 and 24 years, two were aged 13 to 19 years, two were in the 50+ year group, one was in the 40 to 44 group, and one was in the 45 to 50 group. Younger and older ages were more likely not to be retained. Further, among the 46 clients who were retained when initiated on Option B+, 19 had a junior high school/middle school leaving certificate, nine had tertiary education, seven had senior high school/vocational training/technical training, six had preschool/primary, and five reported none/NaN. A total of 22 referred for adherence counseling were retained. Referral for adherence counseling encouraged retention at 12 months on treat-all criteria. No one with TB disease starting ART on Option B+ who had TB or used alcohol was retained at 12 months.

Pregnancy and starting lifelong treatment with ARVs were significantly associated with 12-month retention rates. Gender was statistically significant at < .001; educational status was statistically significant at 0.00. Referred to an adherence counselor

was statistically significant at 0.000, TB treatment initiated at a *p*-value of 0.000, and alcohol use was statistically significant. The null hypothesis was thus rejected for the alternative of significant association between patients initiated based on Option B+ and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. For RQ2, age, gender, educational status, referred to adherence counselor, TB treatment initiated, and alcohol use were significant confounders to the independent variable of initiation criteria Option B+ to affect retention at 12 months on ART.

The third RQ concerned patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. A total of 17,588 (97.9%) who were initiated based on CD4 T-cell count ≤ 500 were not retained, compared to 386 (2.1%) who were retained on ART. Of the 386 (2.1%) initiated based on CD4 T-cell count ≤ 500 were retained on ART at 12 months. Among the 30 to 34 age group, 77 were retained, compared to 61 in the 35 to 39 age group, 54 in the 25 to 29 age group, 53 in the 50-plus group, 43 in the 45 to 43 group, 30 in the 20 to 25, and 10 among the 13 to 19 group. Younger age was a predictor of non retention when starting with a CD4 count of less than 500. Females who were retained after starting with CD4 T-cell count ≤ 500 numbered 291, as compared to 95 males. Of these 386 who were retained, 143 were clients with a junior high school/middle school leaving certificate, 106 had tertiary education, 80 reported none/NaN for educational status, 75 reported senior high school/vocational training/technical training, and 58 clients reported preschool/primary.

Having a CD4 count value of 500 or less was also significantly associated with being retained at 12 months. Gender was not statistically significant at a *p*-value of 0.613; educational status was statistically significant at. 001, 108 individuals were retained who were referred for adherence counseling. TB treatment was statistically significant at.001, and alcohol use was statistically significant at .0.000. The null hypothesis was thus rejected for the alternative of significant association between patients initiated based on CD4 T-cell count ≤ 500 and retention on ART at 12 months, controlling for age, gender, educational status, alcohol use, treatment/adherence monitor(s), and TB disease treatment. For RQ3, all confounders were statistically significant.

Interpretation of Findings

Retention at 12 Months of Patients Initiated Based on Treat All

A total of 39 participants/patients (0.2%) were retained in care, compared to 17,935 (99.8%) who were not retained in care at 12 months. However, this is contrary to the findings by Alhaji et al. in 2019, who identified that for a cohort of 911 patients at 12 months, retention on ART cohort was higher at 83.0%; thus, non retention was 17% in the study by Alhaji et al., when the authors systematically reviewed retention in care after ART initiation among general adult populations in sub-Saharan Africa. Fox and Rosen, in 2015, also identified a relatively low 22% non retention rate compared to 78% retention at 12 months. This is comparable with the study by Stafford et al. in 2019 to evaluate the clinical outcomes of the test-and-treat strategy to implement treat-all in Nigeria. For those newly initiated, by 12 months post-ART initiation, 34% of the patients who initiated ART under the test-and-treat strategy were LTFU. Also consistent with McNairy et al. in

2017, retention in care, regardless of time to linkage or ART status, at 12 months was significant. Except for my study, retention on treat-all was relatively high for Alhaji et al. (2019); Fox and Rosen (2015); McNairy et al. (2017); and Stafford et al. (2019). Treating all as an initiation criterion has been started in all countries, including the sampled population; the vast difference in the very low retention rates was probably due to individual factors. The ecological framework by Bronfenbrenner (Busza et al., 2012) mentions individual factors and experiences and even acceptance of the sick role. ART is daily medication intake at the prescribed time and quantity. To start ART on the treat-all initiation criteria, one needs only a positive test result, symptomatic or not symptomatic. Almost all initiated on ART among the studied population were asymptomatic. Accepting and acknowledging being sick when not symptomatic and needing lifelong medication among the study's population was critical to ensure retention at 12 months.

Patients initiated based on treatment for all criteria and gender variables were not statistically significant. A total of 39 females and 11 men were retained on ART out of a total sample of 819 (4.6%) initiated based on treat all. Gender as a social construct may not contribute to retention. As separate variables, being a male was statistically significant. Being a female was also statistically significant. Being a male or female can thus be a contributing factor to being retained or not. However, Tassie et al. (2010) found no difference in 12-month ART retention between men (77.3%) and women (76.8%). My study was, however, consistent with findings by Fleishman et al. (2012) that women were more likely to be established, retained in care, and not LTFU, which is also consistent with Plazy et al. (2015), who identified that retention was higher in women but

inconsistent with studies that found that females are more likely to be retained in care. According to Brown et al. (2017), gender still is a risk factor to retention in care, as females make up a huge majority of the infected. Females, according to Brown, are less likely than males to be retained in care, and Charurat et al. (2010) identified that being a female placed an individual at a higher risk of non adherence. Ford et al. (2018) indicated that ART started on the same day increased retention in care at 12 months (RR 1.11, 95% CI 0.99–1.26) but mentioned that pregnant women receiving care in the context of routine programs with rapid initiation could lead to increased loss to follow-up post-ART initiation, likely because of insufficient time to accept and disclose HIV status. However, as an interpersonal factor in the ecological theory put forth by Bronfenbrenner, the males' health-seeking behavior is relatively low, and especially when not symptomatic, may not focus on routine hospital/clinic attendance or daily medication intake, especially when side effects are high, and there is no social motivation to continue. It could also be the failure of health systems to motivate and encourage males to seek and be retained on ART.

Song et al. (2018) also noted that the risk of mortality and development of AIDS state decreases with early initiation as compared to those with deferred initiation of ART having CD4 count (< 500 cells/mm3) when the authors systematically reviewed the literature to estimate differences in clinical benefits between individuals starting treatment with baseline CD4+ T-cell counts ≥ 500 cells/mm3 (early initiation) as compared to < 500 cells/mm3 (deferred initiation).

Among the samples, retention was mainly among the older age group (50+) for those initiated based on treat-all criteria. All age groups 49 and below were not retained at 12 months. Consistent with Stafford et al.'s (2019) finding that rates of LTFU decreased as patient age increased, Plazy et al. (2015) identified that retention was higher in individuals aged > 25 years. Higher LTFU was observed for younger patients (46% for those aged 16–24 vs. 33% for those aged >55 years; $p < 0.0001$). However, MacKenzie et al. (2017) also noted that age at the time of initiation and year of ART initiation are independently associated with attrition and adolescents living with HIV. Younger ages not being retained when starting on treat all could be because of the absence of adherence structures among the selected groups, as MacKenzie et al. noted that with adherence support/teen club structures among the youth, retention increased. This is also agreeable with the ecological theory that better health outcomes are achieved with dependence on support structures, especially for PLHIV, and with prevailing high stigma, this is required to encourage retention. National programs in accordance with WHO guidelines in recent times have introduced cadres such as the models of hope, mentor mothers, adherence support groups, and adolescent adherence support teams to achieve retention on ART, among others.

Retention was low among all educational status groups, but of the 39 who were retained, the uneducated (13) and individuals with a junior high school/middle school leaving certificate (12) seemed to have relatively higher retention than individuals with senior high school/vocational training/technical training (5) and tertiary education (3). Consistent with Atanga et al. (2017), individuals with lower educational status were

relatively retained compared to those with higher education. On the contrary, Stafford et al. (2019) noted that attrition was high among individuals with secondary education or lower. What could account for this, as higher education should have resulted in better retention on treat all?

This could imply that higher levels of education reduce the risk of being retained. A total of 11 individuals who were referred for adherence counseling when started based on treat all were retained at 12 months. This is relatively lower compared to Alhaj et al. (2019), Brown et al. (2017), Charurat et al. 2010, Koss et al. (2017), Moges et al. (2020) and Munkhondya et al. (2021), and Patients initiated based on treat-all criteria and referred to adherence counselor were statistically significant, especially for the *yes* and *no* response when initiated based on treat all but not statistically significant as a variable referred to adherence counseling. This is consistent with Stafford et al.'s (2019) findings that adherence counseling does not affect retention when initiated based on treat-all criteria. Being given adherence counseling is seen as a significant confounder to being retained at 12 months when started on treat all. As an interconnected interdependence nation of the ecological model, adherence is at the level of mesosystems, interpersonal/group/social networks. This represents an individual's intersection and linkage within multiple external systems, which influence behavior through policies, laws, and regulations that influence larger cultural and social norms (Frew et al., 2016). Strengthening support for adherence will reduce the influence of the burden of HIV on the larger cultural and social structure.

No patients were initiated based on treat-all criteria, and TB treatment initiated was retained at 12 months, consistent with Stafford et al.'s (2019) findings that those with prior history of TB compared to those without TB or those currently receiving TB treatment ($p = 0.02$) had lower retention rates. TB disease is a known cause of mortality among persons living with HIV. Burke et al. (2022) and Plazy et al. (2015) also found that retention was lower in individuals co-infected with TB. It is also noted as a significant cause of discontinuation of HIV medication intake (Dalbo & Tamiso, 2016; see also Méndez-Samperio, 2017). According to Burke et al. (2022), having TB and being HIV positive also has an effect on retention in care, especially when ARVs are initiated same day, as retention in care and viral load suppression at 8–12 months was relatively low (varied between 34% and 64%). As a significant confounder, TB screening should be done routinely at all entry points in the facility for PLHIV, and point-of-care testing for all identified who show signs of TB disease per national protocols should be given.

None of the patients initiated based on treat-all criteria, and alcohol use was retained at 12 months. Consistent with a study by Monroe et al. in 2016 to determine the association between alcohol use and retention on ART, at first assessment, 37% of participants reported never drinking, 38% reported moderate drinking, and 25% reported heavy drinking, and 89% of the patients were retained (Institute of Medicine retention measure). Participants' mean (*SD*) visit adherence was 84% (25%). Heavy alcohol use was associated with inferior retention (adjusted *OR* (a*OR*) 0.78, 95% *CI* 0.69, 0.88), and daily/weekly binge drinking was associated with lower visit adherence (a*OR* = 0.90, 95%

CI 0.82, 0.98). So even though alcohol use was high in the study by Monroe et al., it did not affect retention, which is consistent with my current findings when clients initiated based on treat all.

Retention at 12 Months of Patients Initiated Based on Option B+

A total of 17,928 (%) were not retained at 12 months compared to 46 who were retained at 12 months. Of the 46 clients retained, 13 in the 30 to 34 group, 12 in the 25 to 29-year group, 8 in the 35 to 39-year group, 6 between 20 to 24 years, 2 were aged 13 to 19 years, 2 among the 50+ year group, 1 in the 40 to 44-year group and 1 in the 45 to 50 group. Among the ages, retention was lowest among the younger and older age groups and higher among the mid ages of 20 to 39. This is consistent with Alhaji et al. (2019) and Joseph et al. (2017), who noted that young adults and women who were pregnant or breastfeeding at the start of ART were at increased risk of attrition. Also consistent with the findings by Anderson et al. (2020); Brown et al. (2019); Nsanzimana (2019) retention appeared to be lowest among pregnant women and younger age (≤30 years). Alhaji et al. (2019), Lilian et al. (2020) and Munkhondya et al. (2021) identified early initiation as a predictor of retention in care among pregnant women. Retention on ARVs for the pregnant woman has a double-fold benefit in reducing transmission to the unborn baby and keeping the mother healthy when virally suppressed. Monitoring of the mother on ART is crucial in ensuring viral suppression. Among the study participants and as a measure related to retention, laboratory monitoring of viral load for the period of pregnancy should be mandatory. However, the mother, once pregnant to a large extent, is no longer part of the ART clinic but the responsibility of the antenatal care clinic until

delivery and post-natal care is complete and the mother returns to the care of the ART clinic. The interdependence of the ART and antenatal clinic per the ecological model put forth by Urie should depend on each other for better health outcomes in retaining the woman on ART.

Stratifying patients initiated on ART when pregnant and gender are statistically significant. Thus, being pregnant and on ARVs affects ART retention at 12 months. This was also consistent with Atanga et al. (2017) findings which identified that in a PMTCT cascade in HIV-positive pregnant and breastfeeding women initiating Option B+ in Cameroon, overall, 65 (24.3%) discontinued treatment, either defined by loss to follow-up (44.6%) or actively stopped treatment (55.8%). Retention in care was, however, higher (81.1%) at 12 months, comparable to Woelk et al. (2016), that retention at 12 months in mother-infant paired mothers was 74% and 79% for their infants. Also consistent with other findings by Chimwaza et al. (2021) but contrary to Alhaji et al. (2019) and Knettel et al. (2018), retention among pregnant women on Option B+ was generally poor and mainly driven by early losses. However, Atanga found retention at 12 months was 88.0%. This high retention rate in the first year on Option B + is consistent with Koss et al. (2017) and consistent with the high rate of loss follow-up (44.6%).

Also, among the 46 clients who were retained when initiated on Option B plus, 19 had Junior High School/Middle School Leaving Certificate, 9 had Tertiary education, 7 Senior High School/Vocational Training/Technical Training, 6 had Pre School/Primary, and 5 None/NaN. Patients initiated based on Option B+, and educational status is statistically insignificant but significant at the individual educational levels. Thus, the

individual educational status does confound retention at 12 months. However, patients initiated based on Option B+ and referred to an adherence counselor is statistically significant. Clients who were not referred for adherence counseling were 12,977 (72.2%) compared to 4,997 (27.8%) (*SE* of 0.0031) who were referred for adherence counseling. Adherence counselors and the support to be gained in reducing the rate of retention are in line with the findings by Alhaj et al. (2019); Charurat et al. 2010; Koss et al. (2017); Obiri-Yeboah et al. (2016) and Munkhondya et al. (2021) since adherence support is critical and a factor to reducing retention rates and minimize the chance of spreading the virus to baby at all stages of the pregnancy period. Also consistent with Reecee et al. (2015) findings, lack or inadequate adherence counseling increased the possibility of not being retained. Adherence to counseling while pregnant reduces not being retained on ART at 12 months after initiation. Adherence support can also be a kind of social support for teens and young people, among whom non retention is high.

No one with TB disease starting ART on Option B+ out of 1664 who had TB was retained at 12 months. The results of the cross tab for TB disease initiated on Option B+ are statistically significant. Thus, having TB disease is a significant confounder to being retained on ART while pregnant. Thus, even though of the 17,974 patients, 16,303 (90.7%) (SE 0.002) had no TB and 1,671 (9.3%) (SE of 0.002) had TB disease, this figure is significantly small; however, having TB disease significantly affects retention. This is consistent with findings by Burke et al. (2022); Dalbo & Tamiso (2016); Méndez-Samperio (2017) and, Plazy et al. (2015) who identified that retention was lower in individuals co-infected with TB. TB disease while pregnant and on ART at 12 months

affects retention. Pregnancy, PLHIV, TB disease, and possibly other comorbidities could be the source of not being maintained due to being overburdened with the disease. The lightening of the burden could be the provision of support in the form of enablers while having TB disease, TB, and HIV collaboration to streamline clinic visit days and hours, community ARV refills, and laboratory monitoring needed.

Also, of the 156 who used alcohol initiating ART on Option B+, none were retained at 12 months on ART. Although the use of alcohol could be a possible confounder, almost all clients among the sampled did not use alcohol 17, 818 (99.1%) (SE 0.001), with just around 156 using alcohol. While alcohol and patient-initiated based on Option B+ are statistically insignificant, it implies that alcohol use is not a significant contributor to not being retained for pregnant women on ART among the sampled population. This is not consistent with most authors (Cichowitz et al., (2017); Cook et al., 2017; Monroe et al., 2021; Wubetu et al., 2021) who identified that as an abused substance, alcohol use causes potentially modifiable behavior and lack of retention. The results among the sample of pregnant women suggest alcohol use did not affect retention, contrary to the findings of other studies.

Retention at 12 Months of Patients Initiated Based on CD4 T-Cell Count ≤ 500

A total number of 17,588 (97.9%) who were initiated based on CD4 Tcell count ≤500 were not retained as compared to 386 (2.1%) who were retained on ART at 12 months. This high non retention rate by 12 months when initiated with a relatively low CD4 count was consistent with findings by Nsanzimana (2019) that defaulting from care was associated with CD4 cell count ≤500 cells/mm3 at initiation and Ekouevi et al. in

2010 that the probability of retention in care was lower in patients with baseline CD4 count <50 cells/mm^3. However, Fleishman et al. (2012), on the contrary, identified those with very low CD4 levels ≤50 cells/mm3 less than 500 were likely to be established and retained in care, also among established patients, 57.4% did not meet the retention criterion, and 34.9% were LTFU. Retention was, however, high (194/197 (98%)) for patients enrolled in the CD4+ >350, when Jain et al. (2014) determined the virologic efficacy and safety of ART among asymptomatic HIV-positive Ugandan adults with high CD4+ counts ≥350 cells/uL via a streamlined model of care. Jain et al. study was also in line with that of Koenig et al. in 2016, that later year of HIV test was associated with retention in care for patients in all CD4 count strata: CD4 count ≤200 cells/mm^3 (OR 1.16; 95% *CI:* 1.12–1.19); 201 to 350 cells/mm^3 (OR 1.24; 95% *CI:* 1.19–1.29); 351 to 500 cells/mm^3 (*OR* 1.08; 95% *CI*: 1.05–1.12). Being pregnant with lower baseline CD4 counts (≤200 cells/μl) had 6.06 times the hazard (95% *CI* 2.20 - 16.71) of LTFU at 6 months compared with men, Wang et al. (2011). Also, Arnesen et al. (2017) showed that having a CD4 count under 200 cells/μL and being on ART for under six months was associated with non retention.

My study, however, showed that among the 30 to 34 age group, 77 were retained, 61 in the 35 to 39 age group 54 in the 25 to 29 age group, 53 in the 50 plus group, 43 in the 45 to 43, 10 among the 13-to-19-year group and 0 in the 20 to 25 age group. The trend indicates retention is highest among the 30 to 40s and low below the 30s. Younger age and starting ART with a CD4 count less than 500 and non retention are consistent with Charurat et al. (2010), who identified non retention as high among those aged <35

years, and Jain et al. In 2014, those who found the age and median age to be 36 (29-41) for a person initiating treatment with a CD4 count of less than 500 and with a CD4 count less than 500 are more likely to be non retained.

Also, females, who were retained after starting with a CD4 Tcell count ≤500 were 291, as compared to 95 males. Consistent with Ekouevi et al. that men with baseline CD4 count <50 cells/mm^3 had a lower probability of retention in care. However, inconsistent with the findings by Kumar et al. (2015) that men were more likely than women to have a lower CD4 count at the start of treatment (260 vs. 311 cells/L, p0.01). Also, according to Koenig et al. in 2016 and Jain et al. in 2014, females were the predominant age group, 64.5%, to attrition with a lower CD4 count.

Even though my findings indicate no retention for the sampled individuals with CD4 count less than 500 and TB, having TB is statistically significant to retention starting at a cd4 count less than 500. Nsanzimana (2019), however, contrary to my findings, identified 90.7% retention among patients screened positive for TB. Educational status was also statistically significant to being retained while starting ART with a CD4 count less than 500, consistent with Koenig et al. in 2016, who found secondary education was associated with retention in care for all CD4 strata: CD4 count ≤200 cells/mm^3 (*OR* 1.54; 95% *CI*: 1.29–1.84); 201 to 350 cells/mm^3 (*OR* 1.27; 95% *CI*: 1.04–1.55); 351 to 500 cells/mm^3 (OR 1.48; 95% CI: 1.24–1.77).

Per the stratification by educational level retention was among 143 clients with Junior High School/Middle School Leaving Certificate were retained, 106 had Tertiary Education, 80 clients with None/NaN as educational status, 75Senior High

School/Vocational Training/Technical Training, and 58 clients with Pre School/Primary. However, Charurat et al. (2010) noted that post-secondary education and patients with only primary education were at a higher risk of non retention. Also, 108 individuals were retained who were referred for adherence counseling. Adherence counseling was statistically significant and thus is a significant determinant of being retained on treatment even at a lower CD4 count. No client was retained while using alcohol or with TB while initiated based on CD4 count of less than 500. Adekanmbi et al. (2022) however found low retention among clients attending a large HIV clinic in Nigeria who were treated for TB. Though diseased individuals with TB need treatment, the prophylaxis for TB should be scaled up to all individuals to reduce the risk of acquiring TB. Routine screening should be mandatory as well.

Alcohol use significantly contributes to retention among individuals with a low CD4 count of less than 500.

Limitations of the Study

The secondary analysis used data collected by the national program on the management of persons living with HIV, often for other purposes and outside the specific context of research (Babbie, 2016); Rudestam, 2014). Each client initiated into care is given a client folder after a positive test result. The folder contains details required for initial assessment, initiation, and follow-up visits. The folder is filled at each visit with the history taken, laboratory investigations, medications are given, and any other comments for management. The data is entered into the HIV patient electronic database. I was not privy to information about how seriously the data entered are affected by

problems such as low response rates or respondent misunderstanding of specific survey questions (Burkholder, 2016) and measures put in place to restrict, for example, entering 0 years as the age for an adult with tertiary education, and pregnant. Due to the nature of this correlational study, only an assessment of the association between variables and not cause and effect was possible. The sites are all ART sites in the country. Data were randomly collected, and the study results will be generalizable. Data collection was based on services provided based on WHO standardized and nationally adopted protocols on service delivery. However, though standardized protocols were used, national characteristics and specific service provision settings may not make the results of the current study generalizable to other countries. Generalizing the results to populations outside the country may only apply to those with similar characteristics and service provision settings. Therefore, the interpretation of results should be made with caution.

Recommendations

Generally, retention in ART among the sample population per treatment initiation criteria was very low. Initiated based on treat all stratified with age, gender, educational status, referred for adherence counseling, having TB disease and alcohol use was not statistically significant. However, when the question is interrogated further based on age group, the various educational levels, and yes and no responses to adherence counseling having TB disease and alcohol use, the responses were all significant. Among the samples, retention was mainly among the older age group (50+) for those initiated based on treat al criteria. All age groups 49 and below were not retained at 12 months.

Persons initiating at younger age must be well-educated and counseled before starting this life-long treatment (Ekholuenetale et al., 2021). Additionally, readiness to start must be assured by ensuring the individual is psychologically prepared (Monges et al., 2021). Disclosure has been shown to improve adherence, and thus as much as possible, it should be encouraged and supported to disclose for self (Recken et al., 2021) support from trusted others and better health outcomes such as retention and viral suppression. Community adolescent supports, mentor mothers, and adherence supporters within the community and health system must be engaged to support adherence and retention among this age group. Again, community interventions such as medication refills and laboratory monitoring services should be implemented (Barnabas et al., 2020). The age group represents individuals working for economic gains, and while not symptomatic may not want to visit clinics with long queues, community interventions are likely to meet their needs while making room for hospital review periodically. Multi months scripting and dispensing as part of the WHO-recommended DSD model should be implemented fully and monitored. Persons with TB disease or using alcohol must also be encouraged to initiate ART on treat all while benefiting from DSD as a special population needing closer monitoring (Yu et al., 2021). Reclassification of the special population should thus include TB-diseased individuals and individuals using alcohol to obtain the needed care.

Among the ages, retention was lowest among the younger and older age groups and higher among the middle ages of 20 to 39.

While patients initiated based on Option B+, and gender was statistically significant. Thus, being pregnant and on ARVs affects ART retention at 12 months. ANC testing and retesting of pregnant women should be encouraged and adhered to within national protocols (Njuki, 2021). Educational status and pregnancy do not necessarily mean one will be retained on the ART. Enhance education should be provided for the best-informed decision-making among both educated and uneducated pregnant women (Lifanu, 2021). Referred for adherence counseling is statistically significant with initiation on Option B+. Thus, where possible pregnant women should be provided individualized counseling/ education to ensure ART adherence to higher concentration to protect the unborn baby from infection. Having TB disease is a significant confounder to being retained on ART while pregnant. TB screening should be offered at every clinic visit for the pregnant woman. Alcohol intake in pregnancy should be discouraged since it contributes to not being retained on ART.

Retention is highest among the 30 to 40s and low below the 30s. Also, females who were retained after starting with a CD4 Tcell count ≤500 were 291, compared to 95 males. When the CD4 count is less than 500, retention was 143 among clients with Junior High School/Middle School Leaving Certificate, 106 clients had Tertiary Education, 80 clients with None/NaN as educational status, 75 Senior High School/Vocational Training/Technical Training, and 58 clients with Pre School/Primary. Closer monitoring is required for individuals initiating based on lower cd4 count without educational status. No retention for the sampled individuals with CD4 count less than 500 and having TB. Closer monitoring is also required for individuals with co-infection with TB. Adherence

and alcohol use does affect retention at 12 months when initiating with a cd4 count less than 500. As a result, an abused substance, such as alcohol is, and also due to its effect on cognitive ability, should not be encouraged during pregnancy (Weber et al., 2021).

Targetted social interventions that encourage retention should also be the focus considering the individual related to Bronfenbrenner's model of social ecology for health interventions.

Implications

This research has the potential to influence positive social change at the individual, household, and community levels, as well as the formulation of public health policy.

At the level of the individual, it has been demonstrated that ART allows people to return to everyday life and support themselves, their families, and their dependents and that families and communities benefit greatly from individuals who would not have otherwise been beneficial (Whyte et al., 2020). At the level of the individual, the sick role must be adhered to, to enjoy and benefit from ART care, be retained, and receive other support services (Brown et al., 2020).

Due to men's health-seeking behavior, Narasimhan et al. (2021), their role in the community as heads and leaders, and personality traits, men should be approached individually at the individual level of gender, particularly in places where they are not likely to be grouped. However, this individual approach should not detract from the fact that men can be reached for testing and prevention efforts when they gather in groups.

Information, education, and counseling materials regarding prevention should be available at all such locations. Testing efforts to determine one's status is also crucial.

At the level of the health system, pregnancy affects retention. For the benefit of the unborn child, the mother, and the family, the pregnant mother should be closely monitored for adherence to the medication to ensure optimal blood concentration on the ARVs and be retained to prevent mother-to-child virus transmission. Since not all pregnant women who receive adherence monitoring are retained, periodic viral load monitoring is necessary (O'Kelly et al., 2020). Women aged 13 to 24 and older than 35 were not retained at comparable rates. Teenagers, younger women, and older adults should be the focus of targeted efforts.

To encourage retention, adequate information on the benefits of ART and its lifelong use should be provided. However, those who did not adhere were retained more effectively. This demonstrates that policy efforts should not directly target pregnant women in order to attract their attention and cause them to stop taking their medication or attending the clinic. Women of all educational levels should be encouraged to use ART during pregnancy.

Per the 2030 goal of eradicating AIDS, individuals initiating treatment with a low CD4 count must be monitored more closely to ensure early suppression and reduce the likelihood of disease spread. Teenagers with a lower CD4 level were not retained, but a greater proportion of females were (Cassim et al., 2020).

Teenagers with a lower CD4 level were not retained, but a greater proportion of females were (Cassim et al., 2020). The pandemic is still stigmatized in the eyes of

society (Greenwood et al., 2022). HIV is still stigmatized in Ghana, as those who received adherence counseling were not retained. The policy regarding monitoring patient adherence by health professionals or other Cadres should be reconsidered. Ghana's cadre monitoring efforts are relatively new, and innovations should produce the same retention results as in other nations.

Policy and advocacy interventions to enable the uneducated and undereducated to attend or begin schooling. The inequities in HIV infection rates attributable to low or lack of education will be eliminated if the government, along with family and individual support, emphasize ensuring school attendance.

Policy efforts should focus on preventing individuals on ART from contracting TB or abusing alcohol. At the individual level, however, efforts should be made to prevent TB infection and alcohol consumption. Social support for alcohol use should always be encouraged among individual users.

The study used a quantitative study design. Qualitative study design is encouraged to know from the person when is the possible predictor of retention. This and quantitative methods strengthen the justification for prevention or implementation efforts. In addition, a prospective cohort study will mitigate some of the difficulties associated with using secondary archival data.

Generally, in the study's sample, retention at 12 months after initiation is relatively low. As a lifelong intervention, health workers should encourage medication adherence based on age, gender, educational level, presence or absence of adherence counseling, TB disease, and alcohol consumption.

Retention should be evaluated at 6, 8, and 24 months to determine if confounding variables such as age, gender, adherence counseling, TB disease, and alcohol use are statistically significant at 6 and 8 months and beyond 12 months after ART initiation.

Conclusion

Retention on ART is guided by multifaceted personal, intrapersonal, and interpersonal factors (Mimiaga et al., 2020). The provision of ART is one major part of it. Individualized factors such as age, adolescence, middle age or older, male or female imparts on retention. Additionally, referral to adherence counseling of all forms provides support to be retained (Okonji et al., 2020)

Individualize support and approach to service provision at the interpersonal level within the health facility, societal level, and policy level interconnected with personal and intrapersonal factors within the health system, family, and support groups are critical to retention (Pugh et al., 2020)

All null hypotheses of no association were rejected for the alternative of an association. The Nagelkerke R^2 gave 4.49 percent of the variation in the dependent variable due to the confounding variables, while Cox & Snell R Square reports a 14.3% variation. Retention was generally low. However, the independent variable and confounding factors were statistically significant but could not adequately account for the low retention, per the study 14.3% variability in the dependent variable of the independent and confounding variables.

However, the study's results can be generalized to the population and related settings, allowing for targeted interventions and policy planning.

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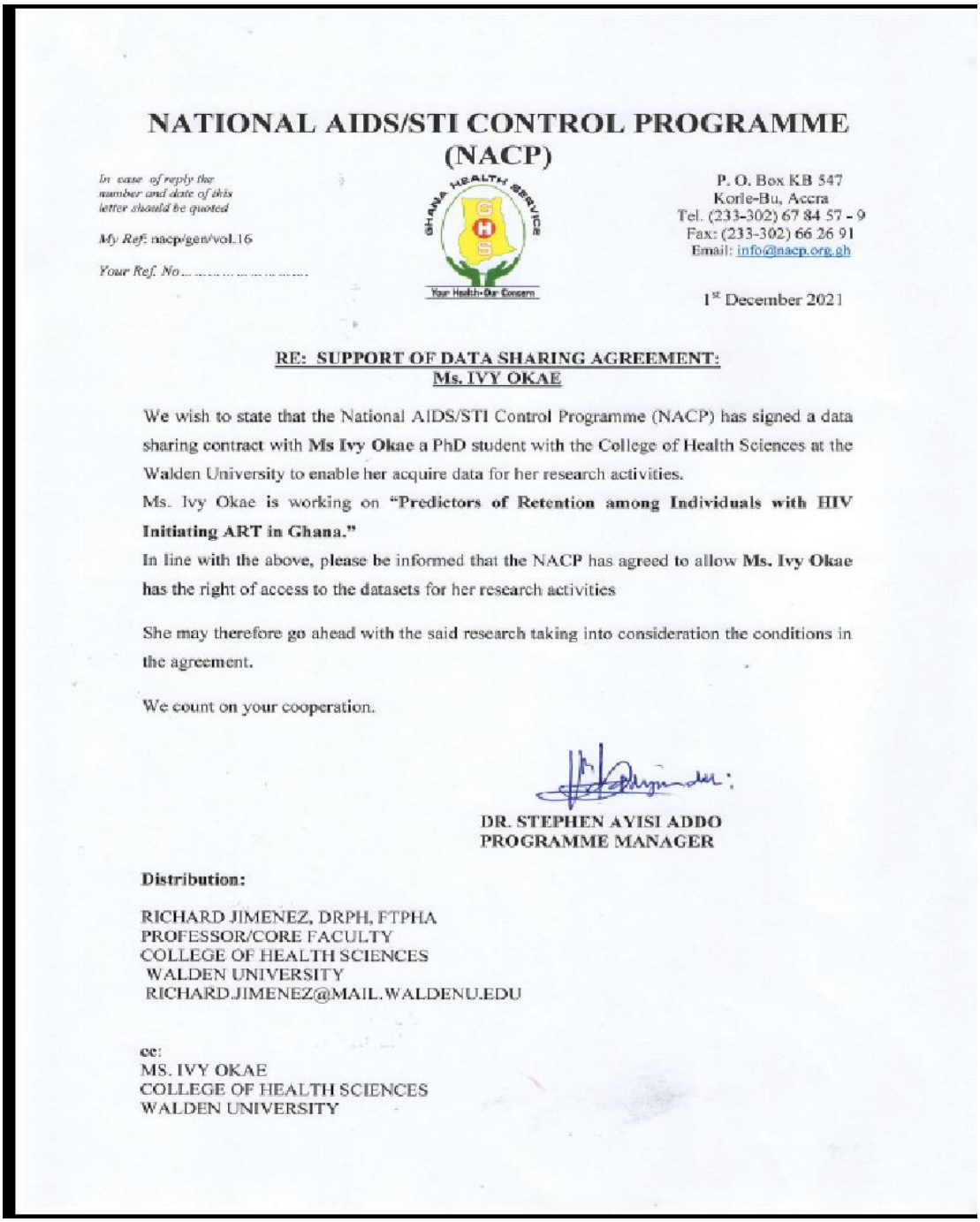
Appendix A: National AIDS/STI Control Programme Collaborator Data Assessment Agreement and Confidentiality



NATIONAL AIDS/STI CONTROL PROGRAMME (NACP)

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Korle-Bu, Accra
Tel. (233-302) 67 84 57 - 9
Fax: (233-302) 66 26 91
Email: info@nacp.org.gh

1st December 2021

RE: SUPPORT OF DATA SHARING AGREEMENT: Ms. IVY OKAE

We wish to state that the National AIDS/STI Control Programme (NACP) has signed a data sharing contract with **Ms Ivy Okae** a PhD student with the College of Health Sciences at the Walden University to enable her acquire data for her research activities.

Ms. Ivy Okae is working on **"Predictors of Retention among Individuals with HIV Initiating ART in Ghana."**

In line with the above, please be informed that the NACP has agreed to allow **Ms. Ivy Okae** has the right of access to the datasets for her research activities

She may therefore go ahead with the said research taking into consideration the conditions in the agreement.

We count on your cooperation.

DR. STEPHEN AYISI ADDO
PROGRAMME MANAGER

Distribution:

RICHARD JIMENEZ, DRPH, FTPHA
PROFESSOR/CORE FACULTY
COLLEGE OF HEALTH SCIENCES
WALDEN UNIVERSITY
RICHARD.JIMENEZ@MAIL.WALDENU.EDU

cc:
MS. IVY OKAE
COLLEGE OF HEALTH SCIENCES
WALDEN UNIVERSITY

NATIONAL AIDS/STI CONTROL PROGRAMME (NACP)

In case of reply the number and date of this letter should be quoted

My Ref: nacp/gen./vol.

Your Ref. No......

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1st December 2021

NACP CONFIDENTIALITY UNDERTAKING

AN ANNEX TO THE NATIONAL AIDS/STI CONTROL PROGRAMME (NACP) DATA SHARING AGREEMENT WITH COLLABORATOR (AN AGREEMENT FOR ACCESS TO HIV/AIDS/STI DATA ARCHIVED BY NACP)
THIS IS AN UNDERTAKEN MADE BY MS IVY OKAE, **A PHD STUDENT** WITH THE COLLEGE OF HEALTH SCIENCES WALDEN UNIVERSITY.
TO ENSURE CONFIDENTIALITY UNDER THE AFORE-MENTIONED AGREEMENT FOR A RESEARCH ON THE TOPIC
"PREDICTORS OF RETENTION AMONG INDIVIDUALS WITH HIV INITIATING ART IN GHANA."

The purpose of this Uundertaking is to ensure that NACP can secure the confidentiality of any information it provides under this agreement. It is required that trust is built to allow for current and future program of joint work, collaboration, and collective publication to proceed effectively in good faith This Undertaking must be signed by all persons, including reviewers of manuscripts for publication, who shall be given access to any data of NACP in the course of the duties under this agreement.

1. In line with the terms and conditions of the agreement:

i. The NACP, may grant the undersigned access to the Information in its custody during his/her participation in above mentioned research/project activities.
ii. the NACP is willing to provide to the undersigned the information for the explicit purpose of performing his/her responsibilities under this agreement, provided only that the undersigned undertakes to disclose the information only to persons who are bound by like obligations of confidentiality and non-disclosure as contained in this undertaking.

2. The Undersigned undertakes to regard the Information as confidential and proprietary to the NACP and agrees to take all reasonable measures to ensure that the Information is not used, disclosed, or copied, in whole or in part, other than as provided in paragraph 1 above, except that the Undersigned shall not be bound by any such obligation if he/she is clearly able to demonstrate that the Information:

THE NATIONAL AIDS/STI CONTROL PROGRAMME (NACP) DATA SHARING AGREEMENT WITH COLLABORATOR

AN AGREEMENT FOR ACCESS TO HIV/AIDS/STI DATA ARCHIVED BY NACP

PREAMBLE

With the accumulation of data by the National AIDS/STI Control Programme, many requests are being received from researchers to access datasets produced by the National AIDS/STI Control Programme. It has therefore become important for the National AIDS/STI Control Programme to develop a controlled and efficient system to manage access to these datasets. This agreement hereby sets out to achieve that purpose.

This agreement is undertaken by the undersigned research collaborator of the National AIDS/STI Control Programme (NACP) AND the NACP and it is aimed at providing access to specific data for the purpose of collaborative research between the two parties and shall come into force on the date of execution of this agreement as indicated hereunder.

The parties hereby agree as follows:

1. That the National AIDS/STI Control Programme (NACP) remains the legal custodian of the said data.
2. That the following documents must accompany this agreement:
    a. A short description of the intended purpose and method of analysis of the data (an analysis plan)
    b. A list of names and organizational affiliations of all those who will engage in this analysis. **In the case of a student a statement by his/her supervisor that they will ensure that the student abides by these conditions.**
    c. A description of how the investigator will restrict access to confidential NACP data.
    d. A signed confidentiality agreement form, annexed to this agreement.

That NACP has agreed to allow the undersigned collaborator right of limited access to the datasets for a research on the topic **"Predictors of Retention among Individuals with HIV Initiating ART in Ghana."**

3. That the undersigned collaborator has agreed not to disseminate the said data or any sub-sample thereof to any third party, except with the written permission of the Programme Manager of NACP. The undersigned research collaborator assumes direct responsibility for any unauthorized or illegal access to the data entrusted to her/him/it or its agents.
4. That any investigator acting for or on behalf of the undersigned research collaborator, shall not release or permit others to release any data that would in any way disclose the identity of persons captured in the data, directly or indirectly.
5. That the undersigned collaborator has agreed to send to the Programme Manager, for review before publication and for the agreement of the two parties, a draft of each paper or any publication to be produced as part of the research.
6. That the undersigned collaborator has agreed to acknowledge the use of the NACP database on each paper or publication produced as part of the research, and such acknowledgement must first be approved by the Programme Manager of NACP.

7. That the undersigned collaborator has agreed to transfer to the Programme Manager of NACP and delete all the copies of the data after completing the research.
8. That the undersigned collaborator has agreed to deliver all copies of the data to the Programme Manager of NACP.
9. That the data remain the property of the National AIDS/STI Control Programme which shall reserve the right to request the return of the dataset to NACP upon breach of any of the above stated terms and conditions by the undersigned research collaborator.
10. That any dispute arising out of this agreement shall be amicably settled by the two parties; and where there is no agreement as to the settlement of the matter, the matter shall be referred to an arbitrator agreeable to both parties, for the settlement of the dispute.

The two parties, NACP and the undersigned research collaborator, hereby sign this agreement to affirm their strict adherence to the terms and conditions herein.

1. SIGNED.....

PROGRAMME MANAGER
NATIONAL AIDS/STI CONTROL PROGRAMME
P. O. BOX KB 547
KORLE-BU, ACCRA

Date: 06/12/2024

2. SIGNED.....

MS. IVY OKAE
COLLEGE OF HEALTH SCIENCES
WALDEN UNIVERSITY

Date: 2/12/24