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MSc in Epidemiology in the field of Population-based Field Epidemiology

Research Report

Factors associated with antiretroviral treatment (ART) uptake at primary health care level in the Africa Centre Surveillance Area of the Hlabisa HIV Treatment and Care Programme

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Epidemiology in the field of Population-based Field Epidemiology.

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Declaration

I Pelagia Ndambakuwa declare that this report is my own work being submitted to the School of Public Health, University of Witwatersrand, Johannesburg in partial fulfilment of the requirement of Master of Science in Epidemiology in the field of Population-Based Field Epidemiology. It has not been submitted before to any other University for any other degree.

Signed: Ndambakuwa Date: 25 October 2012

Dedication

I dedicate this report to my husband Oliver for his support throughout my studies and to all the people living with HIV worldwide.

Abstract

Worldwide, an estimated 34 million people were living with HIV, but only 47% of the people in low- and middle-income countries eligible for antiretroviral therapy (ART) were receiving treatment at the end of 2010. The aim of this study was to investigate factors associated ART initiation as well as to determine ART uptake by age-group, gender and clinic catchment in a typical rural sub-Saharan African setting.

Methods: Data from the Africa Centre 2010 population-based HIV surveillance (including C4 count measurement) was linked to the HIV treatment and care programme database. Those successfully initiating treatment (n=482) were then compared against those eligible for treatment but had not yet been initiated (n=117). The variables for analysis included gender, age, education level, employment status, number of individuals in the household, household asset index, distance of homestead from the nearest clinic, number of prior pregnancies and live births a woman ever had as well as the baseline CD4 count (at ART initiation and 2010 measurement for those not yet initiated). ART uptake by age-group, gender and across six clinic catchments was calculated using the population-based HIV surveillance from 2011 through linkage to the HIV treatment and care programme database.

Results: Of the 1 308 HIV infected individuals who had CD4 count results, 599 were eligible for therapy based on a CD4 count criteria of <200 cells/mm^3. Of these 80.5% (482/599) had initiated ART as of 31 October 2011. In the adjusted logistic regression model, males were 71% (OR = 0.29, p<0.001) less likely to have initiated therapy compared to females. Those in the 30 - 44 year age-group were 84% more likely to initiate therapy (OR =1.84, p=0.039) compared to those in the 15 - 29 year age-group. Individuals who had secondary and higher levels of education and those who lived far away (≥4 kilometres) from the nearest clinic

were less likely to initiate ART (OR = 0.29, p = 0.001 and OR = 0.67, p = 0.337) compared to those with primary and lower levels of education and those who lived within 2 kilometres of the clinic respectively. Employed individuals were about twice as likely to initiate ART (OR 1.99, p = 0.017) compared to the unemployed. Overall the ART uptake across the study area among all HIV positive individuals was 32.5%. ART uptake and median CD4 count at initiation by clinic catchment ranged from 31.0% to 43.2% and 132 to 153 cells/mm^3 respectively across the six clinic catchments.

Conclusion: Although the overall rate of ART initiation was high, certain population groups were not covered well. Interventions that target younger people, males and unemployed individuals can help in reaching as many treatment eligible individuals as possible.

Acknowledgements

I would like to thank Prof Marie-Louise Newell for the opportunity to do my research at Africa Centre and for her guidance throughout this research as well as the grant for my accommodation during my attachment at the Centre. I would also like to thank my supervisors Prof Frank Tanser and Mr Eustasius Musenge for their assistance during the preparation of this report. To Portia Mutevedzi, Colin Newell, all my Wits lecturers and colleagues as well as Africa Centre staff, thank you for your support.

This analysis is based on data collected by the Africa Centre Demographic Information System.

List of Abbreviations

AC - Africa Centre

AC DSA – Africa Centre Demographic Surveillance Area

AC DIS – Africa Centre Demographic Information System

AIDS - Acquired Immune Deficiency Syndrome

ART – Antiretroviral treatment/therapy

ARTemis - ART Evaluation and Monitoring Information System

ARV - Antiretroviral

HIV – Human Immunodeficiency Virus

HPTN - HIV Prevention Trials Network

KZN – KwaZulu-Natal

PMTCT – Prevention of Mother-to-Child Transmission

TB – Tuberculosis

UKZN – University of KwaZulu-Natal

UNAIDS – Joint United Nations Programme on HIV/Acquired Immune Deficiency Syndrome

UNGASS – United Nations General Assembly Special Session on HIV/AIDS

WHO – World Health Organisation

Glossary of terms

ART uptake - ART initiation was used as an indicator of ART uptake.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1: Background

Worldwide, by the end of 2010 an estimated 34 million people were living with Human Immunodeficiency Virus (HIV), an increase of 17% over a nine year period from 2001. HIV remains a major public health challenge, with about 68% (22.9 million) of people living with HIV globally residing in sub-Saharan Africa (UNAIDS, 2011). The epidemic is most severe in Southern Africa and South Africa has the highest number of people living with HIV globally, estimated at 5.6 million people (UNAIDS, 2011), for a national HIV prevalence of 17.9% in 2010 (Department of Health, 2011). Within South Africa, KwaZulu-Natal (KZN) has the highest prevalence of the nine provinces at 39.5% among antenatal clinic attendees and 25.9% in the general population (both adults and children) (Department of Health, 2011).

HIV infection causes a progressive deterioration of the human immune system by infecting and destroying CD4+ T-lymphocytes (Grossman et al., 2002), which are important in the cellular immune defence against infections. Antiretroviral treatment (ART) for HIV infection reduces the viral load to low levels by interfering with the way HIV replicates and spreads from cell to cell and thus delays HIV disease progression (UNAIDS, 2009). The reduction in viral load allows the immune system to recover from earlier damage and thus improves survival amongst people living with HIV (Dieffenbach and Fauci, 2009, Lima et al., 2007). The improvement in survival among people living with HIV at population level in developing countries has been demonstrated in studies in Malawi (Jahn et al., 2008) and South Africa (Herbst et al., 2009, Herbst et al., 2011). The median survival after HIV acquisition without treatment was 10 years (Jaffar et al., 2004, Sax, 2008) whereas with ART the life expectancy

has improved to near normal (Lohse et al., 2007, ScienceDaily, 2011). Hence the need for HIV infected people to get onto therapy.

Initiation of ART depends on clinical and immunological criteria (Ford et al., 2010). The World Health Organisation set out treatment guidelines as new evidence emerges on when to start ART in HIV infected individuals. These guidelines integrate the best available evidence highlighting a feasible and acceptable public health approach to the scaling up of quality HIV treatment and care. The current guidelines are that all adults and adolescents should commence ART when their CD4 counts drop to ≤ 350 cells/mm^3 or when they have advanced clinical disease (WHO clinical stage 3 and 4) (World Health Organisation, 2010). In South Africa these guidelines were adopted in August 2011 (Boyles and Wilkinson, 2011). ART initiation is used as an indicator of ART uptake in this report.

1.2: Statement of the Problem

According to UNAIDS and WHO estimates, in 2010 only 47% (6.6 million of 14.2 million) of treatment-eligible people in low- and middle-income countries were accessing antiretroviral treatment (UNAIDS, 2011). Although there had been a 16-fold increase in the number of people living with HIV accessing antiretroviral therapy from 2003 to 2010 worldwide, a significant proportion of them were still not accessing treatment (World Health Organisation, 2011). Using the WHO 2010 ART guidelines (ART initiation at CD4 count ≤ 350 cell/mm^3 in all people living with HIV), South Africa had an estimated ART coverage of 55% in 2010 (WHO/UNAIDS/UNICEF, 2011). There is a significant gap between ART coverage and those in need of therapy in low- and middle-income countries. Although antiretroviral

treatment is provided free of charge in South Africa, a substantial proportion of eligible individuals are still not on therapy. Therefore much more work and resources are required in order to reach all treatment eligible individuals.

1.3: Justification of Study

South Africa has the greatest burden of HIV in the world and KwaZulu-Natal has the highest prevalence of the nine provinces with an HIV prevalence of 25.9% in the general population (Department of Health, 2011). Antiretroviral treatment does not reach all treatment eligible individuals, so in order to understand why people are not accessing care, we will look at factors associated with initiating ART. If we understand factors linked to ART uptake then we can inform on interventions to improve the number of eligible people on treatment (ART coverage).

There is limited literature on the characteristics of people who access ART at population level. Most of what is known on factors associated with ART uptake is based on hospital-based studies. Data from the population-based Africa Centre surveillance provides an opportunity to evaluate this in more detail than is possible in hospital-based programmes. Unlike hospital-based programmes, these population-based data provide information about those individuals who are known to be HIV infected and have not yet accessed the treatment and care programmes. In this study, we are going to investigate factors associated with ART uptake by comparing the characteristics of those who initiated ART against those who appear to be eligible but did not (yet) start ART. ART uptake by age and clinic catchment will be determined regardless of eligibility criteria. This information will enlighten us on the individual and household level factors that are associated with access to

treatment and care programmes hence the possible success or failure of treatment as prevention programmes.

1.4: Literature Review

1.4.1: Factors associated with ART uptake

A number of factors have been found to be associated with ART uptake in developing countries, ranging from socio-demographic, economic, clinical and structural factors (Geng et al., 2011, Msellati et al., 2003, Ingle et al., 2010a). Among other challenges, service delivery and health seeking behaviour have been cited as barriers to treatment and care (Sarna, 2010).

1.4.1.1: Socio-demographic factors

Among 109 countries reporting to WHO/UNAIDS, estimated ART coverage was higher among women (53%) than men (40%) (WHO/UNAIDS/UNICEF, 2011); this was also the case in a number of studies in developing countries (Ingle et al., 2010a, Geng et al., 2011, Msellati et al., 2003). In a cross-sectional study analysing the characteristics of HIV-infected adults initiating ART between 2002 and 2009 in Kenya, Malawi and Uganda, sixty-five percent of the patients were female (Geng et al., 2011). In this study the HIV prevalence and population by gender was not stated. Among HIV infected patients surveyed in a study comparing the socio-economic and health characteristics of HIV infected patients with regards to access to the Drug Access Initiative (DAI) and to antiretroviral drug (ARV) treatment in Cote d'Ivore, males were less likely to be on ART (Msellati et al., 2003). In Free State (South Africa) public health facilities, males were found to be less likely to initiate ART (OR 0.67, 95% CI 0.64 to 0.71) and were more likely to die within one year of enrolment into

the programme (OR 1.30, 95% CI 1.23 to 1.37) (Ingle et al., 2010a). In a study on ART access in South Africa, women accessed ART (60% of eligible women) more than men (41%) (Johnson, 2012). According to old South African ART guidelines, pregnant women initiated ART at a higher CD4 count than men (National Department of Health, 2010).

Older age (35 years and older) was found to be associated with accessing ART as there are older people in many programmes. The median age at ART initiation was 37 years in a study conducted in Kenya, Uganda and Tanzania (Geng et al., 2011). In a cohort profile of Hlabisa HIV Treatment and Care Programme in KwaZulu-Natal, South Africa the median age of those on ART was 35 years (Houlihan et al., 2011). This is in keeping with HIV incidence peaks which were found to be 24 and 29.5 years in females and males respectively in the same demographic surveillance area (Tanser et al., 2011). Being a migrant was also mentioned as a barrier to ART access in some countries like South Africa and Thailand (Saether et al., 2007, Amon and Todrys, 2009).

1.4.1.2: Socio-economic and structural factors

Socio-economic factors such as lack of money for transport, food and poor access to grants have been cited as barriers to ART access in children (Yeap et al., 2010). This was a qualitative study done at private clinics providing ART free of charge in and around Gauteng Province, South Africa. In a cross-sectional study among 800 HIV infected patients in Zambia on barriers to ART perceived by patients on ART and those who were on home-based care and not on treatment, having to pay for transport and other non-transport costs were mentioned as barriers to ART initiation (Fox et al., 2010). In a study on barriers to ART in

Mozambique, transportation cost was also found to hinder access to ART especially in areas where the public transport system is not well developed leading to higher costs due to increased demand (Posse and Baltussen, 2009). Transportation as a barrier to ART is multi-faceted as this includes the direct cost of transport and other incidental costs of spending time away from home (Tuller et al., 2010). In relation to this, increased distance of homestead from the nearest clinic was found to hinder access to ART in the Africa Centre Demographic Surveillance Area (Cooke et al., 2010) and in a review of barriers to ART access in developing countries (Posse et al., 2008). Hence the need to bring healthcare services to the people through primary health care clinics as well as mobile clinics.

In a study done in Free State Province, South Africa, fewer patients from rural or less staffed clinics initiated ART than in urban/peri-urban or highly staffed clinics (Ingle et al., 2010b). In a retrospective study of children attending urban and rural clinics in four provinces of South Africa, living in rural areas was associated with delayed access to ART, increasing the risk of poor outcomes while on ART. At presentation, a higher proportion of children from rural areas had lower CD4 count percentages and severe underweight compared to urban children (Fatti et al., 2010).

A study on unequal access to ART: exploring results from rural and urban case studies of ART use in four sub-districts of four provinces in South Africa, rural ART users were found to be of lower socio-economic status and spent more time travelling to the health facility compared to their urban counterparts. However, decentralisation of ART services was found to reduce travel time in the Hlabisa sub-district (rural) leading to higher ART coverage. Despite ART being provided free of charge at public health facilities in South Africa rural ART

users spent a considerable portion of their income on travel to the health facility and self-care (Chimbindi and Bärnighausen, 2010, Cleary et al., 2012). This self-care may be a reflection of perceived poor quality of care at rural healthcare centres and unequal access to ART in rural compared to urban areas (Cleary et al., 2012) as well as the culture of using traditional medicines. The differences in ART access between rural and urban areas was also highlighted in a study on barriers to ART in Mozambique where rural ART users had longer waiting time at the clinic due to shortage of staff which impacted on the quality of care at rural health facilities. (Posse and Baltussen, 2009).

The perceived high costs for ART were also cited as a barrier to ART in a review of studies on barriers to ART access in developing countries (Posse et al., 2008). Not having health care insurance was also found to hinder the efficient movement of HIV infected patients from diagnosis to treatment (Msellati et al., 2003, Dieffenbach and Fauci, 2009). Homelessness was also found to impede access to treatment (Dieffenbach and Fauci, 2009). Therefore economic factors influence access to treatment and for this reason poverty eradication programmes should go hand-in-hand with HIV prevention, treatment and care programmes.

However, in some studies socio-economic status was not associated with being on treatment. In a study conducted in the Africa Centre surveillance area on population's uptake of antiretroviral treatment, socio-economic status was not associated with being on ART (Cooke et al., 2010). This is probably because the study population was relatively homogeneous in terms of socio-economic status with the majority very poor with two in

five adults unemployed (Muhwava et al., 2008). Thus socio-economic factors affect ART uptake in a complex way and depend on the environment in which studies are conducted.

1.4.1.3: Clinical and behavioural factors

Clinical factors which were found to hinder access to ART were severe immuno-suppression, loss of functional capacity and Pre-ART assessment (Ingle et al., 2010a, Murphy et al., 2010). After HIV diagnosis, there is clinical and laboratory assessment to determine the stage of HIV infection and need for ART as well as prophylaxis for opportunistic infections. The patients also undergo psychosocial assessment focusing on financial resources, social support and readiness to disclose as well as understanding of HIV. Adherence counselling (where three sessions are needed) should be completed before ART is commenced (World Health Organisation, 2007). This pre-ART readiness assessment was cited as a barrier to ART access among HIV-infected patients admitted with opportunistic infections at McCord Hospital in Durban (Murphy et al., 2010).

In a study at public sector treatment facilities in Free State Province, South Africa, severe immuno-suppression (CD4 cont <50 cells/mm^3 and underweight (weight < 50kg) were found to be associated with lower chances of initiating ART (Ingle et al., 2010a). In this study, a large number of people died before they initiated therapy (83% of the deaths). Loss of functional capacity due to hospitalisation was also found to hinder access to ART among patients admitted with opportunistic infections (Murphy et al., 2010).

Fear of stigmatisation has also been suggested to play an important role in delaying people from accessing treatment (Yeap et al., 2010, Dieffenbach and Fauci, 2009, Posse et al.,

2008), although this may diminish with widespread use of ART in a community with high HIV prevalence (Bor et al., 2011). Misperceptions about HIV like maternal guilt may hold back mothers from seeking treatment for their children. Negative staff attitude at clinics was also cited as a barrier to ART (Yeap et al., 2010). In addition to these barriers, substance abuse, mental illness and denial were also found to impede the smooth movement of patients from HIV diagnosis to treatment (Dieffenbach and Fauci, 2009).

1.4.2: Mathematical modelling based importance of high ART coverage and uptake

In addition to the role of ART in improving survival among people living with HIV, antiretroviral drugs have been shown to reduce HIV transmission. ART use in prevention of mother-to-child transmission of HIV has resulted in virtual elimination of neonatal HIV infection (Hammer, 2011). ART has been routinely used for post-exposure prophylaxis (PEP) after considerable potential occupational exposure to HIV at healthcare facilities (Hamlyn and Easterbrook, 2007). Observational data show that PEP reduces HIV sero-conversion by 80% so PEP is recommended in both occupational and non-occupational exposure to HIV (Landovitz and Currier, 2009).

Mathematical modelling exploring the case reproduction number and long-term dynamics of HIV epidemic of HIV testing of all people in the test-case community (aged 15 years and older) every year and starting ART immediately after HIV positive diagnosis using data from South Africa as a test case was done. This model showed that this strategy could speed up the transition from the current endemic phase to an elimination phase where most HIV infected people are on ART within 5 years. The HIV incidence and mortality rate could be reduced to less than one per 1000 people per year within 10 years of full implementation of

the strategy. As a result, universal voluntary HIV testing and immediate ART, combined with current prevention strategies could have a major effect on severe generalised HIV/AIDS epidemics (Granich et al., 2009). However, this model shows a theoretical approach to treatment as prevention and requires that every adult person be tested for HIV. The current global coverage of HIV counselling and testing programmes are very low so there is need for stakeholders to come-up with new approaches towards HIV counselling and testing (World Health Organisation, 2012b).

Another model using Hlabisa sub-district in KwaZulu-Natal, South Africa supported that early initiation of antiretroviral therapy i.e. at CD4 count ≤ 350 cell/mm^3 instead of CD4 count ≤ 200 cell/mm^3 would significantly reduce HIV incidence and prevalence. This model showed that the HIV prevalence will be lowered from a peak of 24% in 2015 to 14% and incidence from 2.6/100 person years in 2010 to 1.5/100 person years in 2040 if people initiate treatment at CD4 count ≤ 350 cell/mm^3 compared to 20% and 2.0/100 person years in 2040 respectively when ART is initiated at count ≤ 200 cell/mm^3 (Hontelez et al., 2011).

The results of the HPTN 052 study conducted by HIV Prevention Trials Network (HPTN) in HIV discordant couples (couples in which one partner was HIV infected and the other was HIV negative) were strongly in favour of the use of ART as an HIV prevention strategy among sero-discordant couples. In this study couples were randomised to immediate arm (infected partner initiated ART at CD4 count of 250 - 550 cells/mm^3) and delayed arm where the infected partner initiated ART at CD4 count <250 cells/mm^3. The study showed a 96% efficacy of ART in preventing HIV transmission to the uninfected partner. In addition the

benefits to the infected partner who received early treatment were significant (Hammer, 2011).

Also at population level, higher levels of ART coverage were found to be associated with lower chances of HIV acquisition among the uninfected individuals (every percentage point increase in ART coverage was associated with a 1.7 decline in hazard of HIV acquisition) (Tanser et al., 2012). This study was done in the Africa Centre DSA, KwaZulu-Natal, South Africa. All this provide strong evidence of the impact of treatment in reducing HIV transmission hence ART can be successfully used in combination with other preventive strategies in the fight against HIV/AIDS pandemic.

Although factors associated ART access and the importance ART as an HIV prevention strategy are well documented, there are knowledge gaps at population-level as to why some people at are not accessing ART even if it is offered free of charge.

1.5: Study aim and objectives

1.5.1: Study aim

The aim of this study is to investigate factors associated with antiretroviral treatment uptake and to determine ART uptake by gender and clinic catchment in individuals who are 15 years and older.

1.5.2: Specific objectives

1. To investigate factors associated with antiretroviral treatment uptake among eligible HIV infected individuals in the Africa Centre Surveillance Area of the Hlabisa HIV Treatment and Care Programme between August 2004 and October 2011.

2. To determine antiretroviral treatment uptake in all HIV infected individuals 15 years and older by age-group, gender and clinic catchment in the Africa Centre Surveillance Area of the Hlabisa HIV Treatment and Care Programme.

3. To map ART uptake and median CD4 counts at initiation by clinic catchment.

Chapter 2: Methodology

This chapter describes the study design, site and population, including variables for analysis as well as data extraction, cleaning and management.

2.1: Study Design

This was a cross-sectional secondary data analysis of routinely collected data from Africa Centre Demographic Information System (ACDIS), the surveillance database (data was analysed at a point in time i.e. at ART initiation for those who were on therapy and as of the interview data for those who were not on ART). This data was linked to Hlabisa HIV Treatment and Care programme database, the ART Evaluation and Monitoring Information System (ARTemis) for individuals who are members of households in the Africa Centre Demographic Surveillance Area (AC DSA). The Africa Centre Demographic Surveillance and the Hlabisa HIV Treatment and Care Programme are longitudinal studies being done at the Centre.

2.2: Study Site

This study was conducted at the Africa Centre for Health and Population Studies, University of KwaZulu-Natal, which is based in the Umkhanyakude district of Northern KwaZulu-Natal, South Africa. The Centre was set up to conduct and support research on population and reproductive health questions in sub-Saharan Africa and has a major focus on HIV. The DSA covers an area of approximately 435km^2. The Centre runs a large socio-demographic household surveillance with a nested HIV and health surveillance among adults ≥ 15 years. Household data is collected twice yearly and the individual HIV surveillance is done once per year and is updated at each subsequent visit. This data is stored in the Africa Centre Demographic Information System (ACDIS) (Tanser et al., 2008).

2.3: Study Population and sampling methods

HIV infected individuals who are 15 years and older and are members of households (residents and non-residents) in the Africa Centre Demographic Surveillance Area who participated in the 2010 and 2011 HIV surveillance rounds. Since the aim of this study was to investigate factors associated with ART uptake at population level, we focused on adults aged 15 years and older because they are the ones who are eligible to participate in the population-based HIV surveillance. In this research, two datasets were used. The first dataset was collected during the 2010 HIV Surveillance which included measurement of CD4 count. This dataset was used for investigating factors associated with ART uptake among treatment-eligible individuals. The second dataset was collected during the 2011 HIV Surveillance round. This dataset was used in the determination of ART uptake by age-group, gender and clinic catchment among all HIV positive adults (15 years and older).

Inclusion and exclusion criteria for factors associated with ART uptake among treatment-eligible individuals

Inclusion criteria: All individuals who had CD4 count measurement and were already on ART on the 2010 interview date regardless of their CD4 count result.

Exclusion criteria: Individuals who had missing CD4 count results and individuals who were not yet eligible for treatment i.e. CD4 count >200 cells/mm^3 and >350 cells/mm^3 in pregnant women.

Inclusion and exclusion criteria for ART uptake among all HIV positive adults

Inclusion criteria: All individuals aged 15 and older who were eligible to participate in the 2011 HIV surveillance round were included as a denominator in the calculation of estimates

of HIV positive individuals and all individuals who participated in the 2011 HIV surveillance round were used as a denominator in the calculation of HIV prevalence.

2.4: Data Sources

The Africa Centre Demographic and Surveillance Area (AC DSA) had a population of 92 975 of which 30.6% (28 495) were non-residents (members of households in the DSA who resided outside the area) as of 31 October 2011. The Hlabisa HIV Treatment and Care Programme is a partnership between the Africa Centre and the South African Department of Health. It is an ongoing longitudinal HIV treatment and care programme which started in August 2004. The programme receives additional funding from the President's Emergency Plan for AIDS Relief (PEPFAR) and aims to provide safe, effective, efficient, equitable and sustainable ART to all those who need it. The treatment programme covers the whole of Hlabisa sub-district which has 17 primary health care clinics. Six of these clinics are located within the Africa Centre Surveillance Area and approximately 40% of the patients are from the DSA (Houlihan et al., 2011).

Information on those HIV infected individuals who access the treatment and care programme is captured into the ART Evaluation and Monitoring Information System (ARTemis) which is kept at Africa Centre. Data from the AC DIS is linked to the ARTemis in order to get the socio-demographic charcteristics of those individuals from the DSA who access the treatment and care programme. As of 31 October 2011, 19 299 individuals had ever initiated ART within the Hlabisa HIV treatment and care programme with 14 102 of

these actively on treatment as of 31 October 2011 and 30.5% (4 306) of them were matched to AC DIS.

ART initiation within the programme is according to the National Department of Health eligibility criteria. The eligibility criteria in the 2010 ART guidelines state that adults and adolescents should initiate therapy when their CD4 count drops to ≤200 cells/mm^3 and ≤350 cells/mm^3 in pregnant women and TB patients (Department of Health, 2010). These guidelines were changed in August 2011 to ART initiation at ≤350 cells/mm^3 in all adults and adolescents.

2.5: Data Collection

2.5.1: Data Collection Procedures

Fieldworkers at Africa Centre collect data twice yearly in the DSA for household surveillance and once yearly for HIV surveillance. The main areas of interest are bounded structures, households and Individuals. Questionnaires are administered and key information about homesteads, households and individuals is recorded. These individuals form the surveillance population. In addition, information on conjugal relationships, births, deaths, household and individual residences, migration and vaccination is collected longitudinally over the eligible population. Household socio-economic data is also collected once per year and it contains information on household facilities e.g. water source, toilet type, cooking fuel, electricity as well as assets, grants, economic shocks and crime.

In addition to the Demographic surveillance, there is a nested population-based HIV surveillance. All resident individuals who are 15 years and older are eligible to participate.

(Africa Centre, 2012). The results of the HIV surveillance are not reported back to the individual.

2.5.2: Data collection instruments

Each individual in the DSA has a unique identification number and all forms are printed with barcodes. These barcodes serve as unique identifiers of the forms. Data is then entered into the Africa Centre Demographic Information System (ACDIS). Single data entry is done by data capturers and there are constraints and validation rules in the database which help with quality control. In addition a supervisor checks the data entered by data capturers.

2.6: Factors associated with ART uptake (2010) dataset

During the 2010 HIV Surveillance round, instead of previous approach using filter paper (dry blood spot (DBS)), micro-capillary blood was collected to allow measurement of CD4 counts as well as HIV sero-status. The change in collection method was for one round only, and aimed to estimate the CD4 distribution across the population; it also allows the determination of treatment eligibility for HIV positive adults (which is the way it is used in this thesis).

A total of 10 477 individuals gave micro-capillary blood samples for HIV and CD4 count testing. Of these 10 381 individuals had HIV test results. HIV infected individuals were 2 487 and the remaining 7 894 were HIV negative. A total of 599 individuals were eligible for therapy using the South African 2010 national ART guidelines. Among the eligible, 482 individuals had ever initiated ART (regardless of whether they were still active) and 117 had not yet initiated as of 31 October 2011.

2010 HIV Surveillance
10 477 Gave a sample for HIV and CD4 count testing

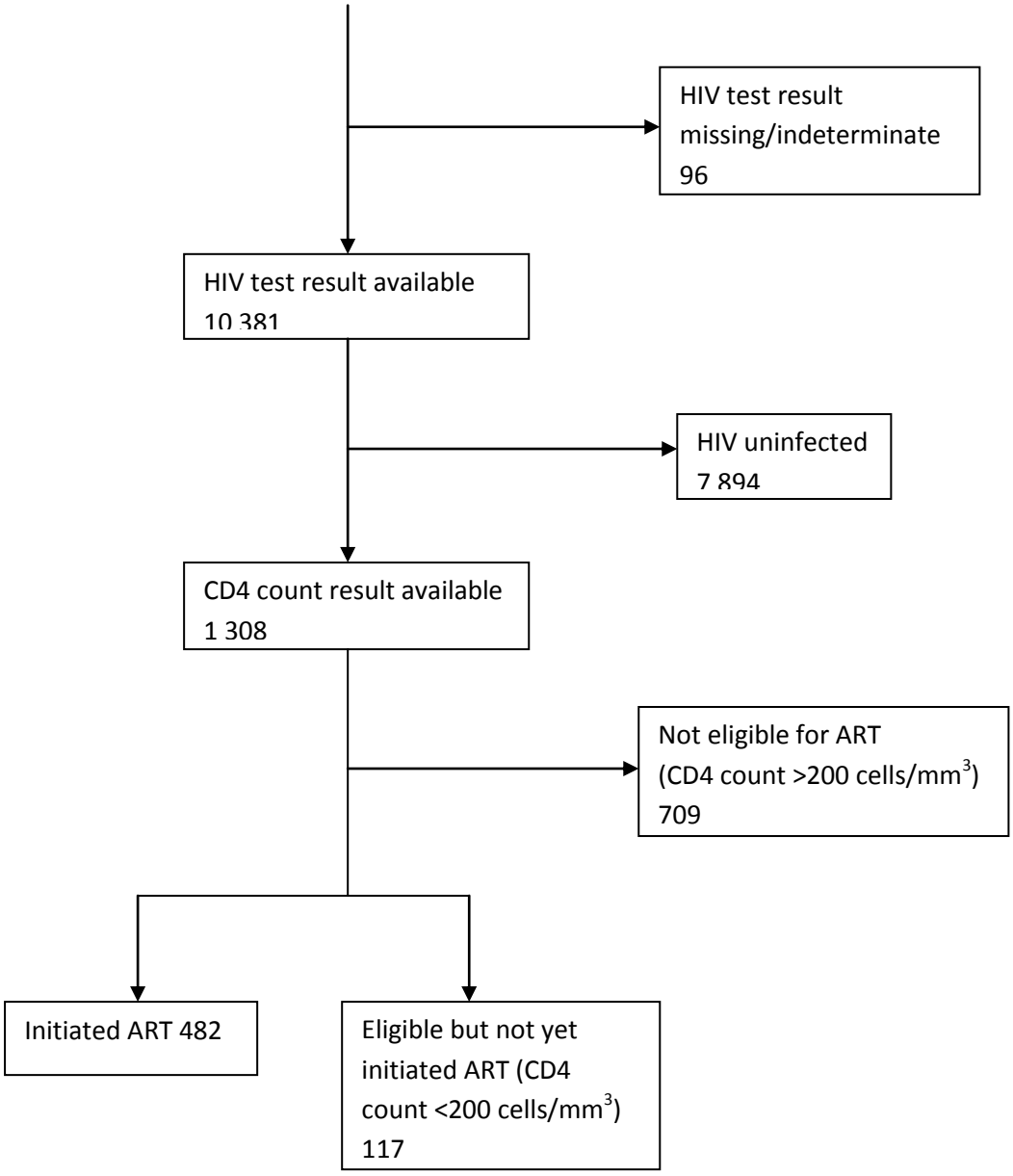

Figure 2.1: Study Sample - Factors associated with ART uptake

Figure 2.1 illustrates the study population for factors associated with ART uptake. This objective investigated factors that are associated with initiating ART in people who are HIV positive and eligible for therapy.

Of note is that results of the HIV surveillance are not reported back to individuals. Individuals who wish to learn their status and seek treatment and care have to go to the clinic for HIV services which are provided free of charge so all things being equal we expect

that individuals who needed HIV treatment and care in the study area had equal chances of accessing it.

2.6.1 Description of variables for analysis

All explanatory variables for those who initiated ART were measured at initiation so as to compare them at the same level with those who were not yet on ART although they were eligible for therapy, except for household asset index which was analysed as of 2010 for both groups. For those who did not initiate the variables were measured at 2010 date when the individual was interviewed during the HIV Surveillance.

Explanatory variables

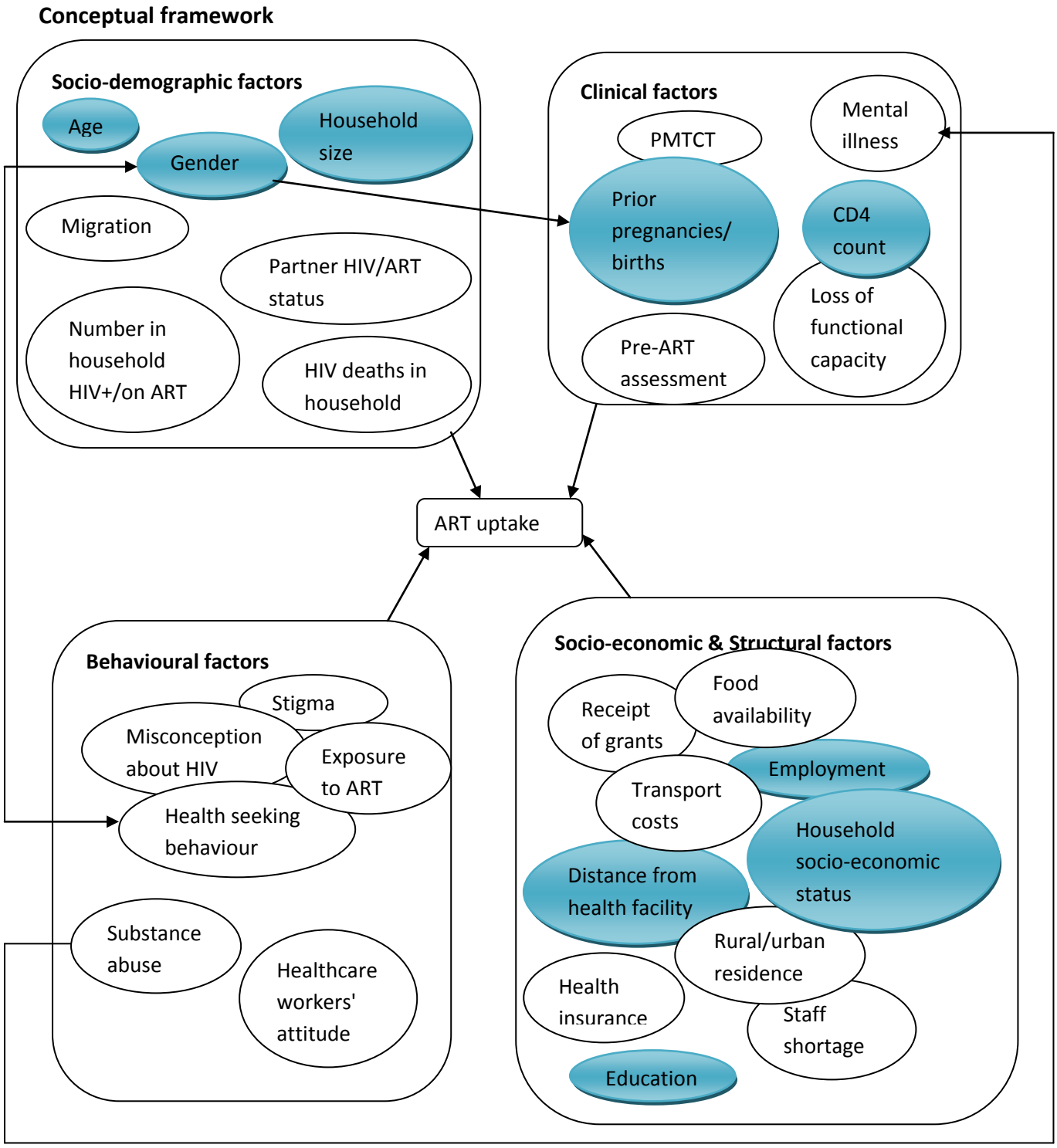

Figure 2.2: Conceptual framework, adapted from Posse et al (2008)

Figure 2.2 shows the factors associated with ART uptake and how they are correlated e.g. women get pregnant and access antenatal care where they get tested for HIV and the positive individuals go through PMTCT and access ART for their own health. Gender is also linked to health seeking behaviour. The highlighted factors (blue) are the ones which were

analysed in this report and the remaining factors were found to be associated with ART access in literature review.

Below are the explanatory variables and how they were defined:

- Gender - Male or Female
- Age - age of an individual analysed as a continuous variable.
- Age-group - The age-groups were categorised into 15-year age-bands i.e. 15 - 29, 30 - 44 and greater or equal to 45 years.
- Education - This is the level of education attained by an individual, categorised as primary & lower and secondary & higher.
- Employment - whether an individual was employed, categorised as unemployed and employed. The employed group included those who were self-employed as well as those who had part-time jobs.
- Household Asset Index - This was measured as of 2010 interview date due to the way it is calculated, it was difficult to measure at initiation since the individuals initiated ART at different times. Also the socio-economic status of a household takes a long time to change so the effect of ART was not likely to influence this variable. This was calculated using principal component analysis. The components which are included in the calculation of the asset index include; electricity, water source, type of toilet, cooking fuel and other assets like, car, stove, television, livestock, etc. This variable was categorised as 1 - 5, 1 being poorest and 5 being the least poor.

- Individuals in household - Total number of individuals in the household, including non-residents.

- Individuals resident in household - The number of individuals who were resident in the household.

- Distance from nearest clinic - The distance of an individual's homestead from the nearest clinic measured in kilometres. This variable was also categorised as less than 2, between 2 and 4 and greater or equal to 4, measured in kilometres.

- Number of pregnancies a woman ever had - A count of pregnancies a woman has ever had including those which did not result in a live birth and was categorised as none, 1 and greater than 1.

- Number of prior live births - A count live births a woman has ever had and was categorised as none, 1 and greater than 1.

- Baseline CD4 count - The baseline CD4 count measured in cells per cubic millimetre (mm^3)

- The following variables were only available for those who initiated antiretroviral treatment:

- TB treatment at ART initiation - whether an individual was on tuberculosis treatment at ART initiation, categorised as Yes and No.

- Pregnancy at initiation - whether a woman was pregnant at the time of ART initiation categorised as Yes and No

- World Health Organisation HIV staging - The clinical stage of HIV infection in an individual which has 4 stages (1-4). The stages 1 and 2 were combined and stages 3 and 4 were combined to make two categories.

- Clinic of ART initiation - The clinic where an individual initiated ART. These were categorised as township clinic (KwaMsane), other DSA clinics combined and other non-DSA clinics. These was done because the township clinic is the largest clinic and catered for more people in the DSA.

2.6.2: Outcome variable

The outcome variable was having initiated ART (as registered in the Hlabisa HIV Treatment and Care programme), for those eligible for therapy on the basis of CD4 count.

2.7: Determining ART uptake by age-group, gender and clinic catchment (2011) Dataset

This dataset consisted of individuals who were eligible to participate in the 2011 HIV surveillance (24 329 individuals). A total of 9 669 individuals participated and had HIV test results. HIV infected individuals were 2 315, this number was used as a numerator in the calculation of HIV prevalence which was then applied to the total population in each age-group, gender and clinic catchment in order to estimate the number of HIV positive individuals. A total of 1 911 individuals had ever initiated ART as of 31 October 2011. This number was used as a numerator in the calculation of ART uptake.

2.7.1: Variables for analysis

- Gender - Male and Female

- Age - age of an individual on the date of 2011 HIV surveillance interview, analysed as 15-year age bands.

- Clinic catchment area - The study area was divided into six clinic catchment areas using the distance of homesteads to the nearest clinic. The six clinic catchments were as follows: 1 - Rural, 2 - Rural, 3 - Township, 4 - Rural, 5 - Rural and 6 - Rural.

- ART initiation - Used as the numerator in the calculation of ART uptake by age-group, gender and clinic catchment.

2.7.2: Outcome variable

The outcome variable was having initiated ART (as registered in the Hlabisa HIV Treatment and Care programme).

2.8: Data Processing , Management and Analysis

Data was extracted by the senior database scientist from the Africa Centre Demographic Information System (AC DIS) and the HIV treatment and care database (ARTemis) using SQL queries. The data from the two databases was linked using the individual unique identification number. The data was exported into STATA version 11 for analysis.

Data Management

Duplicates were removed from the dataset and consistency checks were done on all variables e.g. checking that date of birth is smaller than date of ART initiation, male had no children, etc. Variables were renamed and coded for analysis e.g. ART initiation was coded 0 for those who had not initiated ART and 1 for those who had initiated therapy. Some variable like age, employment status and education were categorised. A category for missing data was created; this category was included in one of the multivariable logistic regression models for model stability.

Data analysis

For objective 1, descriptive analysis was done and for categorical variables e.g. gender and education level, frequencies and percentages were recorded and for continuous variables e.g. age and CD4 count, medians and inter-quartile ranges were recorded in a frequency distribution table because the data was not normally distributed. The results of normality testing are shown in appendix 1.

Univariable analysis was done for the outcome variable against each explanatory variable. The significance level was $p<0.05$. For categorical variables Chi-squared test was used and for continuous variables Mann Whitney Rank-sum test was used. Simple logistic regression was also done to determine factors associated with ART initiation. Those variables which were found to be associated with the outcome at 0.2 significance level were included in the multivariable logistic regression. In the multivariable logistic regression, two models were built with the first one including the missing observations for model stability and the second one without the missing observations. Log likelihood test was performed to confirm the importance of variables in the model. Analysis of marginal effects at representative values was also done to illustrate how the predicted probability of initiating therapy changes as categorical variables change from 0 to 1.

In order to determine the likelihood of ART access, ordinal logistic regression was used across three groups. Those who were not on therapy and did not know their status (not matched to ARTemis), those who were not on therapy and knew their status (matched to ARTemis) and those who had initiated therapy (category 1, 2 and 3 respectively). All the variables which were included in the ordinal logistic regression model met the proportionality of odds (or parallel regression coefficients) assumption.

For objective 2, ART uptake was determined by gender, 15-year age bands and clinic catchment since consent for participation in the HIV surveillance differ by age and gender. HIV prevalence was calculated by gender and age-group (Refer to Appendix 2). This prevalence was then applied to the population in each clinic catchment to get an estimate of HIV infected individuals. ART uptake was then calculated as a proportion of all HIV infected individuals in each clinic catchment.

For objective 3, chloropleth maps for ART uptake and median CD4 counts at initiation by clinic catchment were plotted using MapInfo.

2.9: Ethical Considerations

Data collection in the Africa Centre Surveillance and the Hlabisa HIV Treatment and Care Programme is approved annually by the University of KwaZulu-Natal Biomedical Research Ethics Committee. Africa Centre has permission for linkage of data from ARTemis to the surveillance and analysis using both sources of data collection. The current ethics number for the linkage is E134/06 (renewable annually). The people who participate in the demographic surveillance and HIV treatment programme go through an informed consent process and have given consent for their data to be used for research. All data released for research purposes is anonymised hence does not contain names or similar identifiers. Ethics approval for this study was sought from University of the Witwatersrand Human Research Ethics Committee. The ethical clearance certificate number for this research is M111132 (appendix 3).

Chapter 3: Results

This chapter contains the findings of this study which are presented in form of tables, figures and maps.

3.1: Objective 1 – Factors associated with ART initiation

A total of 482 individuals out of the 599 eligible initiated ART before the 31st of October 2011 which is 80.5% of the study sample.

3.1.1: Descriptive statistics

Table 3.1: Clinical Characteristics at ART initiation

Variable	n (482)	(%)
TB Treatment		
No	352	(73.03)
Yes	71	(14.73)
Missing	59	(12.24)
WHO Clinical Stage		
1&2	114	(23.65)
3&4	176	(36.51)
Missing	192	(39.83)
Clinic		
1 (Township)	253	(52.49)
2 (Other DSA)	167	(34.65)
3 (Other non-DSA)	53	(11.00)
4 Missing	9	(1.87)
	n (404)	(%)
Pregnancy		
No	261	(64.60)
Yes	38	(9.41)
Missing	105	(25.99)
Median CD4 count	148	(90 - 194)

Table 3.1 shows the characteristics of the individuals who initiated ART. The median CD4 count at initiation was 148cells/mm^3. A number of individuals (14.7%) were on TB treatment at initiation and 9.4% of the females were pregnant. Most (87.1%) of those who initiated ART, initiated at a clinic within the Africa Centre Demographic Surveillance Area, majority of them initiating at the township clinic (52.5%).

Table 3.2 compares baseline socio-demographic characteristics (at initiation) in those initiating ART against those not initiating therapy (at CD4 count date in 2010) by the 31st of October 2011 as well as the p-values for Chi-squared (Chi2) and rank-sum tests.

Table 3.2: Socio-demographic Characteristics

Variable	Initiated ART n = 482 (%)	Did not Initiate ART n= 117 (%)	Total n= 599 (%)	Chi2/Rank-sum P-value
Gender				
Female	404 (83.82)	82 (70.09)	486 (81.14)	0.001
Male	78 (16.18)	35 (29.91)	113 (18.86)	
Age (median IQR)	37. 3 (30.2 - 45.1)	32 (27 - 41)	36.1 (29.1 - 44.2)	<0.001
Age-group				
15-29	119 (24.74)	48 (41.03)	167 (27.93)	
30-44	240 (49.90)	52 (44.44)	292 (48.83)	0.001
≥45	122 (25.36)	17 (14.53)	139 (23.23)	
Education				
Primary & Lower	150 (31.12)	15 (12.82)	165 (27.55)	
Secondary & Higher	201 (41.70)	73 (62.39)	274 (45.74)	<0.001
Missing	131 (27.18)	29 (24.79)	160 (26.71)	
Employment				
Unemployed	223 (46.27)	61 (52.14)	284 (47.41)	
Employed	216 (44.81)	29 (24.79)	245 (40.90)	<0.001
Missing	43 (8.92)	27 (23.08)	70 (11.69)	
Household Asset Index				
1 (Poorest)	55 (11.41)	11 (9.40)	66 (11.02)	
2	81 (16.80)	15 (12.82)	96 (16.03)	
3	95 (19.71)	23 (19.66)	118 (19.70)	
4	85 (17.63)	19 (16.24)	104 (17.36)	0.723
5 (Least Poor)	73 (15.15)	22 (18.80)	95 (15.86)	
Missing	93 (19.29)	27 (23.08)	120 (20.03)	
Median Number in Household	7 (4 - 11)	7 (4 - 12)	7 (4 - 11)	0.5765
Median Number resident in household	5 (3 - 8)	5 (3 - 8)	5 (3 - 8)	0.8937
Median Distance from nearest clinic (km)	1.9 (1.2 - 2.9)	2.0 (1.4 - 3.0)	1.9 (1.2 - 2.9)	0.1820
Distance from nearest clinic (Km)				
<2	239 (49.59)	59 (50.43)	298 (53.21)	
2-<4	157 (32.57)	35 (29.91)	192 (34.29)	0.001
≥4	47 (9.75)	23 (19.66)	70 (12.50)	
Missing	39 (100)	0 (0.00)	39 (6.51)	

The study sample comprised of 81.1% females. About half (49.9%) of those who had initiated therapy were in the age-group 30-44 years with a median age at initiation of 37.3

years. The median age of those who had not yet initiated therapy was 32 years. A majority of the study participants had secondary and higher level of education i.e. 41.7% of those who had initiated therapy and 62.4% of those who had not yet initiated ART and more than half (52.1%) of those who had not yet initiated therapy were unemployed. The distribution of the household asset index, household size and median distance from the nearest clinic were similar between the two groups. After performing the chi-squared/rank-sum test, gender, age, age-group, education, employment and distance of homestead from the nearest clinic were significantly associated with the outcome at p-value < 0.05.

Table 3.3: Clinical Characteristics

Variable	**Initiated ART n = 482 (%)**	**Did not Initiate ART n= 117 (%)**	**Total n= 599 (%)**	**Chi2/Rank-sum P-value**
Baseline CD4 Count	148 (90 - 194)	151 (111 - 179)	149 (94 - 191)	0.6743
Pregnancies and children ever born to a woman	n= 404 (%)	n= 82 (%)	n= 486 (%)	
Number of pregnancies ever had				
None	45 (11.14)	12 (14.63)	57 (11.73)	
1	62 (15.35)	26 (31.71)	88 (18.11)	0.001
>1	297 (73.51)	44 (53.66)	341 (70.16)	
Number of prior live births				
None	50 (12.38)	12 (14.63)	62 (12.76)	
1	64 (15.84)	28 (34.15)	92 (18.93)	0.001
>1	290 (71.78)	42 (51.22)	332 (68.31)	

Table 3.3 shows the baseline CD4 count and number of prior pregnancies and live births a woman ever had. The baseline CD4 count was similar in both groups and it was not significantly associated with the outcome. Both number of prior pregnancies and prior live births were significantly associated with ART initiation.

3.1.2: Binary logistic regression

Table 3.4: **Factors associated with initiating ART**

Variable	Univariable analysis OR (95% CI) p-value	Multi variable analysis OR (95% CI) p-value (**Model 1**)	Multi variable analysis OR (95% CI) p-value (**Model 2**)
Gender			
Female	1		
Male	0.45 (0.28 - 0.72) 0.001	0.31 (0.18-0.54) <0.001	0.29 (0.15-0.55) <0.001
Age	1.03 (1.01 - 1.06) 0.002		
Age-group			
15 - 29	1		
30-44	1.86 (1.19 - 2.92) 0.007	1.34 (0.80 - 2.25) 0.268	1.84 (1.03 - 3.28) 0.039
≥45	2.89 (1.58 - 5.32) 0.001	1.42 (0.68 - 2.97) 0.347	2.03 (0.83 - 4.94) 0.118
Education			
Primary & Lower	1		
Secondary & Higher	0.29 (0.15 - 0.50) <0.001	0.26 (0.13 - 0.51) <0.001	0.29 (0.14 - 0.59) 0.001
Employment			
Unemployed	1		
Employed	2.04 (1.26 - 3.29) 0.004	2.40 (1.41-4.08) 0.001	1.99 (1.13 - 3.48) 0.017
Household Asset Index			
1 (Poorest)	1		
2	1.08 (0.46 - 2.53) 0.859		
3	0.83 (0.37 - 1.82) 0.636		
4	0.89 (0.40 - 2.02) 0.789		
5 (Least Poor)	0.66 (0.30 - 1.48) 0.317		
Missing	0.69 (0.32 - 1.50) 0.347		
Number in household	0.99 (0.95 - 1.02) 0.418		
Number resident in household	0.99 (0.95 - 1.04) 0.710		
Distance from nearest clinic	0.88 (0.78 - 0.99) 0.034		
Distance from nearest clinic category (Km)			
<2	1		
2-<4	1.11 (0.70 - 1.76) 0.667	1.13 (0.69-1.87) 0.628	1.07 (0.61 - 1.88) 0.820
≥4	0.50 (0.28 - 0.90) 0.020	0.51 (0.27-0.96) 0.038	0.67 (0.3o - 1.51) 0.337
Baseline CD4 Count	1.00 (0.999-1.004) 0.176		
Goodness of fit		0.470	0.512

Table 3.4 shows the odds ratios, 95% confidence intervals and p-values for logistic regression. At p-value of <0.2 after univariable logistic regression, gender, age, age-group,

education, employment and distance of homestead from the nearest clinic as well as baseline CD4 count, were significantly associated with the outcome.

In the first model with missing observations, male gender, secondary and higher levels of education and a distance of 4 kilometres or more from the nearest clinic were significantly associated with lower odds of initiating therapy. Males were 69% (OR = 0.31, p<0.001) less likely to initiate therapy compared to females. Those who had secondary and higher levels of education were 74% less likely to initiate ART (OR = 0.26, p<0.001). Employed individuals were more than twice likely to initiate ART (OR = 2.43, p = 0.001) compared to the unemployed group. Those whose homesteads were far (≥4 kilometres) away from the nearest clinic were 49% less likely to initiate ART (OR = 0.51, p = 0.038) compared to those who lived within 2 kilometres of the clinic.

In the second model without the missing observations, males were 71% less likely to initiate ART (OR = 0.29, p<0.001). Those in the 30 - 44 age-group were 84% more likely to initiate therapy (OR = 1.84, p = 0.039) compared to those in the 15 - 29 age-group. Those who had secondary and higher levels of education were 71% less likely to initiate ART (OR = 0.29, p = 0.001) than those with primary and lower levels of education. The employed individuals were about twice more likely to initiate therapy (OR = 1.99, p = 0.017) compared to the unemployed. Although it was not statistically significant, those whose homesteads were 4 kilometres or more from the nearest clinic were 33% less likely to initiate ART (OR = 0.67, p = 0.337) compared to those who lived within 2 kilometres of the clinic. The trend in odds ratios between model 1 and 2 are the same and based on model goodness of fit test, model 2 was used for further interpretation of results and conclusion.

3.1.3: Marginal effects analysis

Table 3.5: Marginal effects at different age-groups

Variable	Marginal effects (95% CI)
Males	
15 - 29	-0.25 (-0.38 - (-0.11)) 0.001
30 - 44	-0.20 (-0.31 - (-0.08)) 0.001
≥45	-0.19 (-0.31 - (-0.06)) 0.003
Secondary & higher education	
15 - 29	-0.20 (-0.30 - (-0.11)) <0.001
30 - 44	-0.14 (-0.22 - (-0.07)) <0.001
≥45	-0.14 (-0.24 - (-0.03)) 0.013
Employed	
15 - 29	0.12 (0.03 - 0.21) 0.012
30 - 44	0.09 (0.02 - 0.16) 0.017
≥45	0.08 (0.01 - 0.15) 0.025

Table 3.5 shows the marginal effects for males, education and employment by age group. Males in the 15 - 29 age-group had a 0.25 lower predicted probability of initiating ART than females in the same age-group while males in the 45 years and older age-group had a 0.19 lower predicted probability of initiating therapy than females in the same age-group. Individuals with some form of secondary education in the 15 - 29 and 45 years and older age-group had a 0.20 and 0.14 lower predicted probability of initiating therapy respectively than those with primary and lower levels of education in the same age-groups. Employed individuals in the 15 - 29 and 45 years and older age-group had 0.12 and 0.08 higher predicted probabilities of initiating ART respectively than unemployed individuals in the same age-groups. These results are in keeping with results of the logistic regression where males and individuals with secondary and higher levels of education were less likely to initiate ART whereas employed individuals were more likely to initiate therapy. Overall, males who are educated had lower chances of initiating ART which get better with age. However, this trend is reversed with employment and as more employed males initiated ART compared to females.

3.1.4: Ordinal Logistic Regression

Ordinal logistic regression was used to determine likelihood of ART access across three groups. Those who were not on therapy and did not know their status (not matched to ARTemis), those who were not on therapy and knew their status (matched to ARTemis) and those who had initiated therapy (category 1, 2 and 3 respectively).

Table 3.6: Ordinal logistic regression - determining likelihood of ART access

Variable	Odds Ratios (95%CI) p-value
Gender	0.28 (0.15 - 0.52) <0.001
Age-group	1.52 (0.995 - 2.32) 0.053
Education	0.30 (0.15 - 0.59) 0.001
Employment	2.05 (1.18 - 3.56) 0.011
Distance	0.89 (0.62 - 1.28) 0.53

Table 3.6 shows the results of ordinal logistic regression. Males were 72% (OR = 0.28 $p<0.001$) less likely to be in category 3 versus the combined categories 1 and 2 compared to females and males were also 72% less likely to be in category 2 and 3 combined versus category 1 compared to females given that the other variables are held constant. Educated individuals were 70% (OR = 0.30, $p = 0.001$) less likely to be in category 3 whereas employed individuals were twice (OR = 2.05, $p = 0.011$) more likely to be in category 3 versus combined categories 1 and 2 compared to those with primary and lower levels of education and unemployed individuals respectively given that the other variables are held constant. Likewise educated individual were 70% less likely to be in categories 2 and 3 combined versus category 1 whereas employed about twice more likely to be in categories 2 and 3 combined versus category 1 compared to those with lower levels of education given that

the other variables are held constant. The results of ordinal logistic regression were consistent with those obtained in the binary logistic regression and marginal effects. Younger age, male gender and higher levels of education were found to be significantly associated with lower odds of knowing their HIV status and initiating ART whereas being employed was associated with higher odds of knowing their status and initiating therapy.

3.2: Objective 2 - ART uptake among all HIV positive individuals

ART uptake by age-group, gender and clinic catchment as well as median CD4 counts at initiation were described in this section.

3.2.1: Description of participants

Table 3.7: Population eligible for 2011 HIV Surveillance round

Age-group	**Female**		**Male**		**Combined**	
	n	(%)	n	(%)	n	(%)
Eligible to participate						
15 - 29	5 755	(23.65)	5 149	(21.16)	10 904	(44.82)
30 - 44	3 408	(14.01)	1 791	(7.36)	5 199	(21.37)
≥45	5 948	(24.45)	2 278	(9.36)	8 226	(33.81)
Total	15 111	(62.11)	9 218	(37.89)	24 329	(100)
Participated						
15 - 29	2 420	(25.03)	1 663	(17.20)	4 083	(42.23)
30 - 44	1 337	(13.37)	442	(4.57)	1 779	(18.40)
≥45	2 942	(30.43)	865	(8.95)	3 807	(39.37
Total	6 699	(69.28)	2 970	(30.72)	9 669	(100)

Table 3.7 shows the population which was eligible to participate in the 2011 HIV surveillance round. Almost a quarter of individuals who were eligible to participate in the 2011 HIV surveillance were females in the 45 years and older age-group (24.45%). Females and males in the 15-29 years contributed high proportions of participants at 23.7% and 21.0%

respectively. Compared to other age-groups the 30-34 age-group contributed the least proportions of participants. Overall there were more females (62.4%) who were eligible to participate than males (37.6%).

A total of 9 669 individuals consented to participate in the 2011 HIV Surveillance round. About a third of these were females in the 45 years and older age-group (30.4%) and a quarter of them were females in the 15-29 age-group (25.0%). Compared with the other age-groups, the 30-34 age-group contributed the least proportions of the people tested. Overall more females (69.3%) than males (30.7%) consented to participate in the HIV surveillance. Of the eligible females, 44.33% (6699/15111) participated in the surveillance and among male 32.21% (2970/9218) participated (prtest, p<0.001).

Table 3.8: Population eligible for 2011 HIV Surveillance round and number initiated ART by clinic

Clinic	Catchment population n	(%)	Number ever initiated n	(%)
1 - Rural	1 226	(5.04)	160	(2.18)
2 - Rural	2 476	(10.18)	438	(5.96)
3 - Township	7 874	(32.36)	4 007	(54.52)
4 - Rural	1 958	(8.05)	441	(6.00)
5 - Rural	5 845	(24.02)	968	(13.17)
6 - Rural	4 950	(20.35)	1 335	(18.17)
Total	24 329	(100)	7 349	(100)

Table 3.8 shows the numbers and proportions of individuals who were eligible to participate in the 2011 HIV surveillance round and those ever initiated on ART since the programme's

inception until 31 October 2011 by clinic catchment as well. The catchment population and the number initiated on ART show the size of each clinic catchment. Clinic 1 is the smallest of them all with 5.0% of eligible population and only 2.2% of individuals ever initiated treatment at this clinic. The township clinic is the largest, contributing 32.4% of the eligible population and 54.5% of ART initiation. The results of HIV prevalence by gender age-group and clinic catchment are shown in Appendix 2.

3.2.2: ART uptake by age-group, gender and clinic catchment

Table 3.9: **ART uptake by gender and age-group**

Age-group	Female % (95% CI)	Male % (95% CI)	Pr test p-value	Combined (%)
15-29	17.29 (15.39 – 19.19)	11.3 (7.91 – 14.69)	0.007	16.21
30-44	39.6 (37.35 – 41.85)	27.99 (24.81 – 31.17)	<0.001	36.15
≥45	46.5 (43.35 – 49.55)	48.5 (43.64 – 53.36)	0.494	47.07
Chi2 p-value	<0.001	<0.001		<0.001

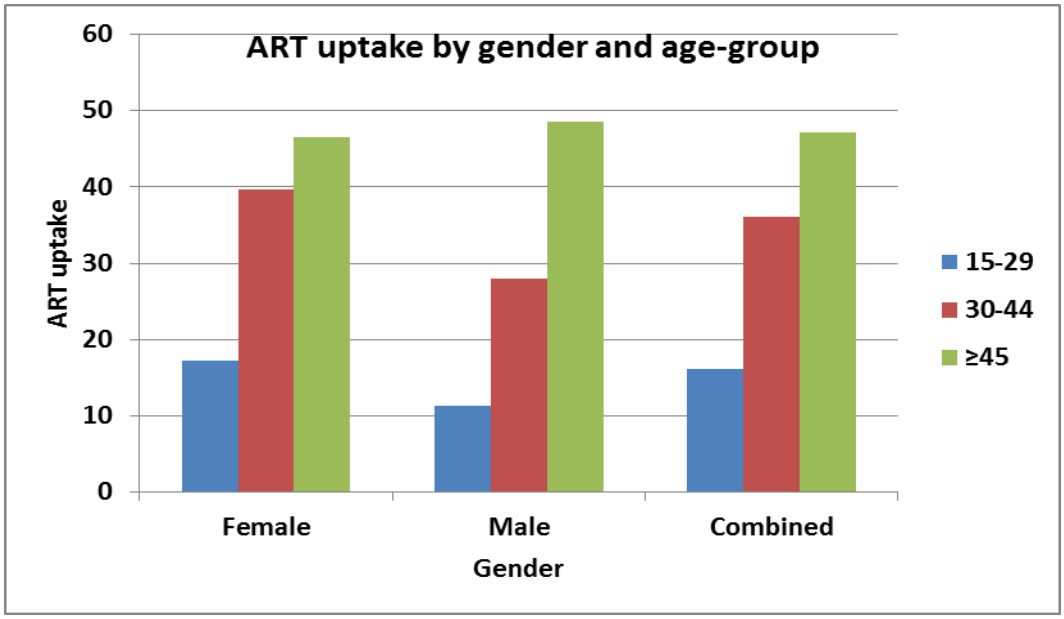

Figure 3.1: ART uptake by gender and age-group

Table 3.9 and Figure 3.1 show ART uptake by age-group and gender. In both groups, ART uptake increased with age and this was statistically significant (p<0.001). The uptake was higher in females in the 15-29 and 30-44 age-groups compared to males and this was statistically significant (p = 0.007 and p < 0.001 respectively). In the 45 years and older age-group, males had higher uptake (48.5%) than females (46.5%) but this was not statistically significant (p=0.494).

Table 3.10: ART uptake by gender, age-group and clinic catchment

Clinic Catchment/ Age-group	Female Estimate HIV+	Female Initiated ART	Female ART uptake (%)	Chi2 p-value	Male Estimate HIV+	Male Initiated ART	Male ART uptake (%)	Chi2 p-value	Overall
1 (Rural)									
15-29	56	6	6/56=10.6		0	0	0		10.6
30-45	55	31	56.1	<0.001	12	5	41.2	0.219	53.4
≥45	44	27	61.2		17	11	63.6		61.9
2 (Rural)									
15-29	125	17	13.6		22	2	9.1		12.9
30-45	122	49	40.3	<0.001	72	17	23.9	<0.001	34.2
≥45	80	40	49.7		24	15	62.2		52.6
3 (Township)									
15-29	581	100	17.2		149	12	8.1		15.4
30-45	785	293	37.3	<0.001	301	88	29.2	<0.001	35.1
≥45	353	166	47.1		149	60	40.3		45.1
4 (Rural)									
15-29	101	20	19.9		10	3	30.6		20.8
30-45	141	61	43.2	<0.001	55	13	23.4	0.023	37.6
≥45	79	35	44.1		28	15	53.1		46.5
5 (Rural)									
15-29	392	76	19.4		95	10	10.5		17.6
30-44	426	163	38.2	<0.001	196	55	28.0	<0.001	35.0
≥45	259	117	45.2		98	50	51.1		46.8
6 (Rural)									
15-29	266	44	16.6		60	11	18.3		16.9
30-45	286	122	0.42.6	<0.001	131	37	28.2	<0.001	38.1
≥45	215	94	0.43.8		90	46	51.1		45.9
Overall									
15-29	1 521	263	17.3		336	36	11.3		16.2
30-45	1 816	719	39.6	<0.001	768	201	27.99	<0.001	36.2
≥45	1 030	479	46.5		406	195	48.5		47.1

Table 3.10 shows the estimates of HIV infected individuals and ART uptake by age-group and gender in each clinic catchment. ART uptake by gender increased with age and this was statistically significant in all clinics among females and in five of the six clinics among males.

Figure 3.2 shows ART uptake by age-group in each clinic catchment.

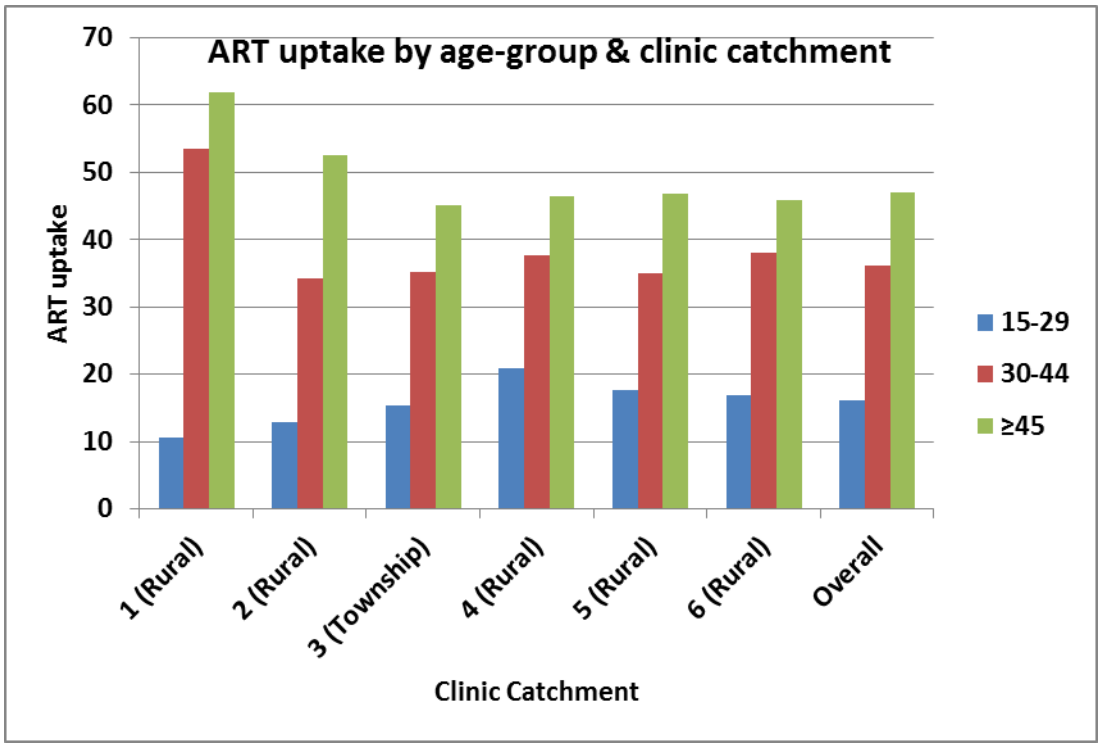

Figure 3.2: ART uptake by age-group and clinic catchment

ART uptake increased with age in all clinic catchments. The uptake of ART in the age-group 15-29 ranged from 10.6% in clinic catchment 1 to 20.8% in clinic 4. In the 30-44 age-group it ranged from 34.2% in clinic 2 to 53.4% in clinic 1. In the 45 years and older age group, the lowest uptake was 45.1% in the township clinic and the highest was 61.9% in clinic 1.

Table 3.11: **ART uptake by gender and clinic catchment**

Clinic	Female (%)	Male (%)	p-value	Combined (%)
1 - Rural	41.09	54.37	0.185	43.20
2 - Rural	32.36	28.94	0.494	31.46
3 - Township	32.54	26.74	0.008	31.04
4 - Rural	36.11	33.15	0.598	35.44
5 - Rural	33.05	29.5	0.198	32.11
6 - Rural	33.90	33.36	0.870	33.78
Overall	**33.46**	**29.79**	**0.009**	**32.52**

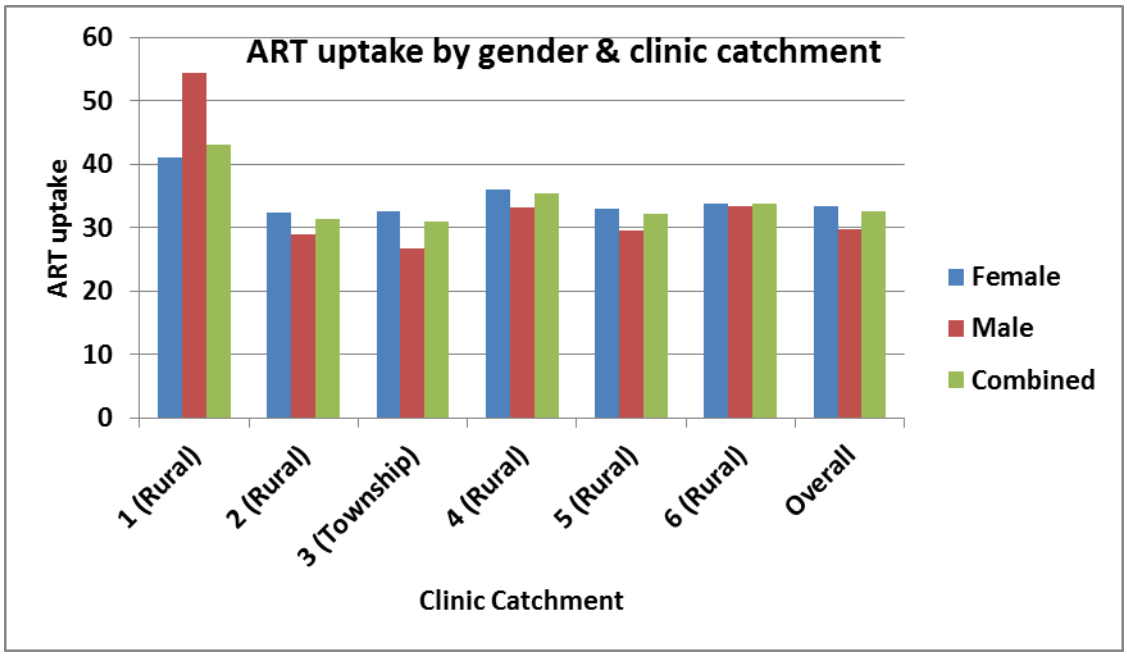

Figure 3.3: ART uptake by gender and clinic catchment

Table 3.11 and Figure 3.3 show ART uptake by gender and clinic catchment. ART uptake was higher in females in all clinic catchments except for clinic catchment 1 where it was higher in males. These differences were not statistically significant in five of the six clinics. Among the females, it ranged from 32.4% in clinic 2 to 41.1% in clinic 1. Among males, it ranged from

26.7% in the township clinic to 54.4% in clinic 1. The overall ART uptake was 33.5% in females and 29.8% in males and this was statistically significant (p=0.009).

3.3: Objective 3 - Mapping ART uptake and Median CD4 counts by clinic catchment

Table 3.12: ART uptake by clinic catchment

Clinic	ART uptake (%)
1 - Rural	43.20
2 - Rural	31.46
3 - Township	31.04
4 - Rural	35.44
5 - Rural	32.11
6 - Rural	33.78
Overall	32.52
Chi2 p-value (6 clinics)	0.012
Chi 2 p-value(5 clinics)	0.335

Table 3.12 and Figure 3.5 show the combined uptake for both males and females by clinic catchment ranging from 31% in the township clinic (largest) to 43.2% in one of the rural clinics i.e. clinic 1 which is the smallest (p-value = 0.012). The difference in ART uptake across the remaining 5 clinics after removing the one with the highest uptake was not statistically significant (0.335).

Figure 3.4 shows the choropleth map of ART uptake by clinic catchment

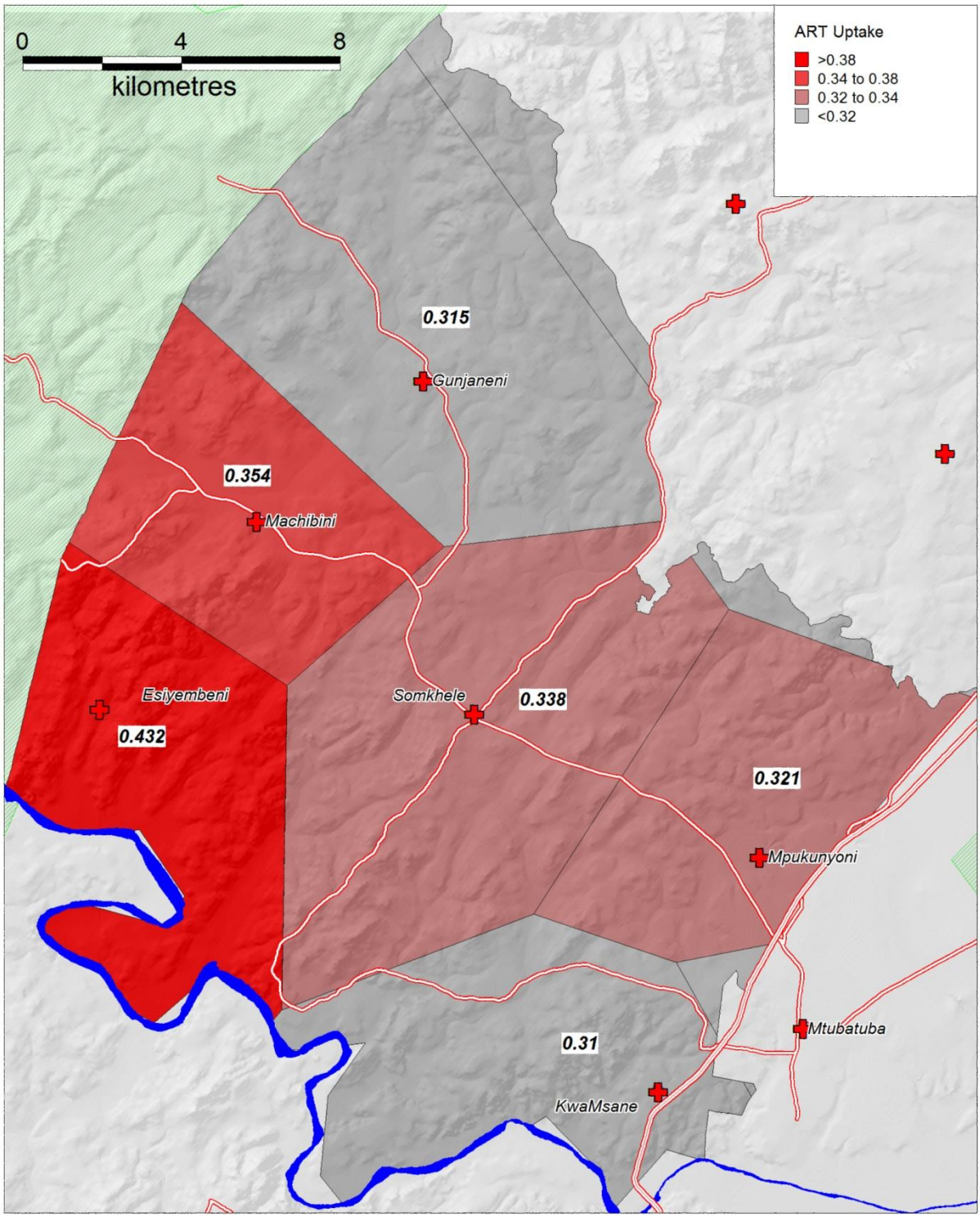

Figure 3.4: ART uptake by clinic catchment

Key: Esiyembeni-1(Rural), Gunjaneni-2 (Rural), KwaMsane-3(Township), Machibini-4(Rural), Mpukunyoni-5(Rural) and Somkhele-6(Rural)
ART uptake 0.315 = 31.5%

Table 3.13: Median CD4 Counts by Clinic Catchment

Clinic Catchment	Median CD4 Count (IQR)
1 - Rural	147.5 (93-197)
2 - Rural	132 (78 - 191)
3 - Township	145 (88 - 187)
4 - Rural	144 (87 - 193)
5 - Rural	153 (84 - 196)
6 - Rural	136.5 (71-184)
Overall	145 (82 - 190)
Ch2 p-value	0.169

Table 3.13 and Figure 3.5 show the median CD4 count at initiation by clinic catchment. There were no significant differences in median CD4 counts per clinic catchment (p=0.169). The lowest was 132 (78 - 191) cells /mm^3 in clinic 2 and the highest was 153 (84 - 196) cells /mm^3 in clinic 5. The overall median CD4 Count at ART initiation was 145 (82 - 190) cells /mm^3.

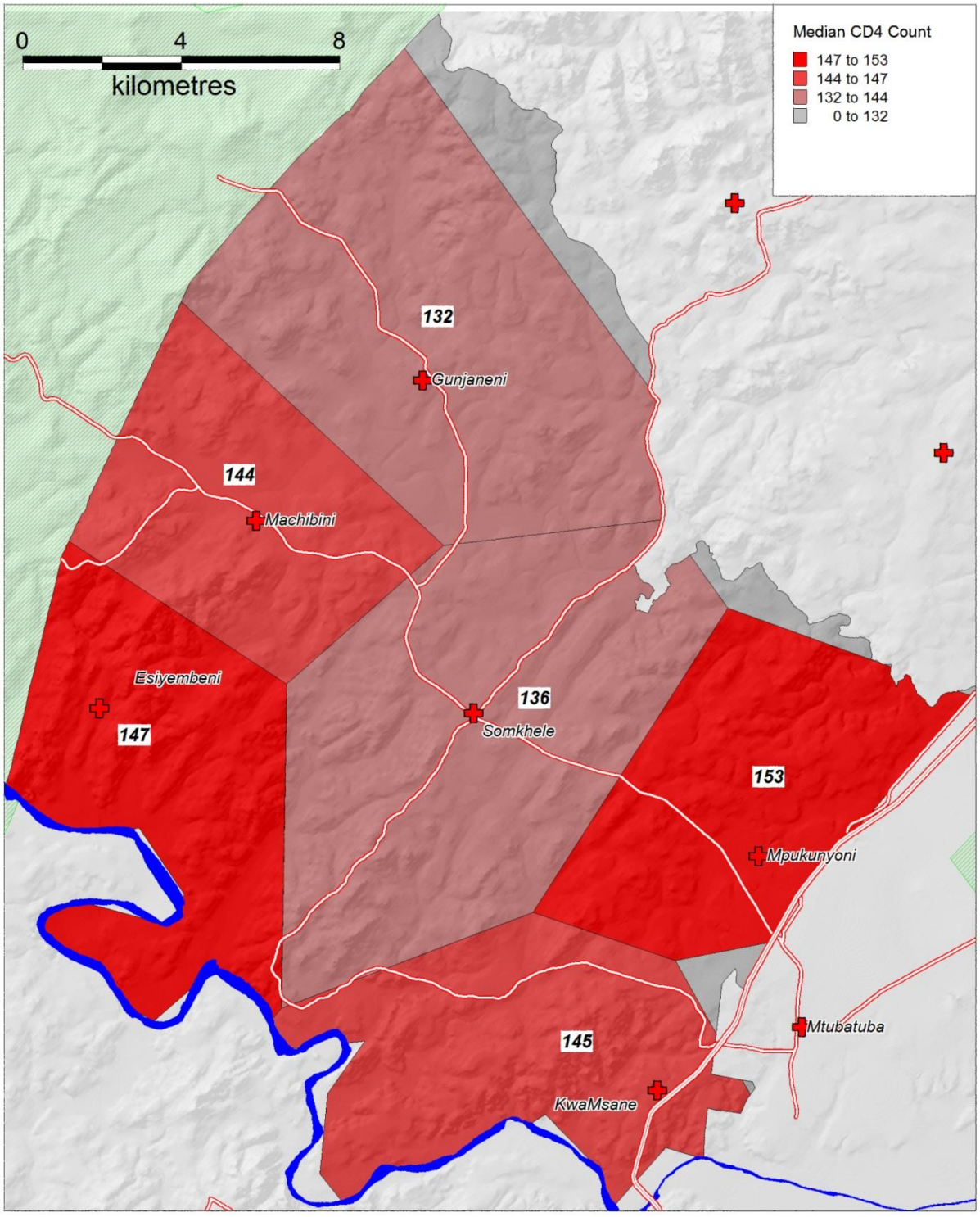

Figure 3.5: Median CD4 counts at initiation by clinic catchment

Key: Esiyembeni-1(Rural), Gunjaneni-2 (Rural), KwaMsane-3(Township), Machibini-4(Rural), Mpukunyoni-5(Rural) and Somkhele-6(Rural)

Box 3.1: Key Results

- Males and individuals with secondary and higher levels of education were less likely to initiate ART compared to females and those with primary and lower levels of education respectively
- Older people (30 - 44 years age-group) and employed individuals were more likely to initiate therapy compared to those in the 15 - 29 years age-group and unemployed individuals respectively
- Individuals whose homesteads were far away (≥4 kilometres) from the nearest clinic were less likely to initiate therapy compared to those who live within 2 kilometres of the clinic although this statistically not significant
- ART uptake increased with age and females had higher uptake levels than males across the six clinics in the AC DSA

Box 3.1 shows the key findings of this study.

Chapter 4: Discussion, Conclusion and Recommendations

This chapter presents the discussion of the results, conclusion as well as the recommendations.

4.1: Discussion

4.1.1: Factors associated with ART initiation

The aim of this study was to investigate the factors associated with ART uptake as well as to determine ART uptake by age-group, gender and clinic catchment in the Africa Centre Demographic Surveillance Area. ART initiation was used to measure uptake so those who were lost to follow-up, deceased and transferred out were included in the analysis. This was done in order to understand the characteristics of individuals who accessed care against those who were eligible for ART but had not yet initiated therapy as well as to allow comparison of the two groups at more or less the same level i.e. when they became eligible for therapy. ART uptake in this cohort was 80.5% (482/599). This uptake is similar to the KwaZulu-Natal coverage for 2010/2011 which was estimated at 81% (KwaZulu-Natal Department of Health, 2011).

In this study, gender, employment status and education level were found to be significantly associated with ART initiation in the multivariable model. Males were 71% less likely to initiate ART than females. This is in keeping with findings from other studies and reports where higher proportions of eligible females are on ART compared to males (Johnson, 2012, WHO/UNAIDS/UNICEF, 2011). In other studies in Africa, being male was also associated with lower chances of initiating or accessing therapy (Ingle et al., 2010a, Msellati et al., 2003).

The gender differences in ART access can be partly explained by PMTCT which gives pregnant women greater opportunities of accessing ART. With particular reference to South Africa between April 2010 and August 2011, pregnant women could access ART at higher CD4 count levels (≤350 cells/ mm^3) whereas males only became eligible at CD4 count of ≤200 cells/ mm^3 (Johnson, 2012). In this study sample, a significant proportion (9.4%) of females was pregnant when they initiated therapy. However, in other studies PMTCT was not responsible for higher proportions of females initiating therapy (Pirkle et al., 2011). These gender differences in ART access may be a reflection of differences in health seeking behaviours among the two group (Johnson, 2012).

Employed individuals were twice likely to initiate ART compared to the unemployed group. This was expected since it was found that people living with HIV face affordability barriers to ART access where they have to spend a significant proportion of their income visiting healthcare facilities (Cleary et al., 2012, Chimbindi and Bärnighausen, 2010, Duff et al., 2010). The most likely explanation for this is that employed individuals can afford to pay for transport to health facilities. The other reason employed individuals were more likely to be on ART compared to their unemployed counterparts could be exposure to workplace-based HIV treatment and care programmes.

Having some form of secondary school and higher level of education was found to be associated with lower odds of initiating therapy. This could be due to the fact that these individuals access care outside the sub-district or in the private sector. Contrary to this, lack of education in women was found to be significantly associated with late ART initiation in Mali (Pirkle et al., 2011). Lack of education on ARVs was also cited as a barrier in a study on barriers to ART use in Uganda (Kunihira et al., 2010). In previous analysis in this study area

education level was not associated with being on ART (Cooke et al., 2010). In this previous analysis, education was categorised as years of completed education from grade 1 - 12.

Household asset index was not associated with ART initiation which is in keeping with what was observed in previous analysis in the same study area (Cooke et al., 2010). This could be because the study population is homogeneous in terms of socio-economic status. Patient resource availability i.e. availability of food, transportation were found to hinder access to ART in Mozambique (Posse and Baltussen, 2009)

Those who lived far away from the nearest clinic (≥ 4 kilometres) were less likely to initiate therapy compared to those who lived within 2 kilometres of the clinic. In previous analysis in same study site, increased distance from the nearest clinic was also found to be associated with being on ART expressed as a percentage of estimates of all HIV infected people (Cooke et al., 2010). Increased distance from the clinic was also cited as a barrier to ART in Mozambique, Uganda and other developing countries (Posse and Baltussen, 2009, Kunihira et al., 2010, Posse et al., 2008).

No significant association was found between size of household and ART initiation. However, the size of the household was found to be associated with enrolment into HIV care in Uganda. Individuals who belonged to families of less than three individuals were less likely to enrol into HIV treatment and care programmes. The reason suggested for this was lack of social support in smaller families (Nakigozi et al., 2011).

Other factors which were of interest but could not be explored due to some challenges in linkage as a result of migration were number of individuals in the household known to be HIV positive and/or registered in the Hlabisa HIV treatment and care programme. A

significant proportion of people in this study area have been socially exposed to HIV and ART (Bor et al., 2011) as a result this social exposure may lead to diminished stigma hence acceptance of treatment among the infected individuals and high ART uptake.

4.1.2: ART uptake among all HIV positive individuals

ART uptake by age-group and gender increased with age throughout the DSA. The higher uptake among older people are in keeping with the median ages at ART initiation (35 years) which were reported in the Hlabisa HIV Treatment and Care Programme (Houlihan et al., 2011) and other treatment programmes in Kenya, Uganda and Tanzania (Geng et al., 2011) In a population-based study conducted in Uganda younger age was associated with non-enrolment into HIV care programme even when the individuals knew their HIV status (Nakigozi et al., 2011). Considering that the median time from HIV sero-conversion to AIDS is about 10 years (Babiker et al., 2001), it is expected for older people to be on ART compared to younger individuals as HIV incidence in this study area peaks at 24 years in females and 29.5 years in males (Tanser et al., 2011).

There were also significant gender differences in consent for HIV testing in the HIV surveillance i.e. 44.3% (6699/1511) of the eligible females compared to 32.2% (2970/9218) among males ($p < 0.001$). Overall, 69.3% of those who participated were females. The findings of this study demonstrated that higher proportions of females than males initiated ART in almost all age-groups and clinic catchments. The uptake by clinic catchment ranged from 31% in the urban clinic to 43.2% in one of the rural clinics. The difference in ART uptake across the six clinics was significant ($p = 0.012$), otherwise the difference across the remaining clinics after removing the one with the highest uptake was not statistically

significant. In as much as we would expect those in the urban areas to have better access to HIV treatment and care (Cleary et al., 2012), in this study the urban clinic had the least uptake of ART. Therefore, ART can be delivered equally across different geographical locations through decentralisation of ART services. There were no significant differences in median CD4 counts at initiation by clinic catchment across the DSA (p = 0.169).

4.2: Strengths of the study

1. The availability of two sources of comprehensive data which can be linked allowed comparison of those who had accessed the HIV treatment care programme against those who are eligible for therapy but have not yet accessed care.
2. The availability of population-based CD4 count results enabled accurate determination of eligible individuals and accurate classification of outcome.
3. Confounding was controlled using multiple logistic regression models.

4.3: Limitations of the study

1. For people who did not initiate treatment, we were not able to tell whether they had TB or not at the time of CD4 count testing so they were excluded from analysis if they had CD4 >200 cells/mm^3.
2. Some blood samples clotted and CD4 count tests were not performed so not everyone who gave a sample for CD4 count and HIV test had results which affected our sample size so this may not be representative of all those who were eligible to participate.
3. Since the results of the HIV surveillance are not reported back to individuals, the results of this study may not be generalised.

4. This was secondary data analysis therefore some important variables which were not collected as part of the socio-demographic and HIV surveillance were not included although they impact greatly on accessing treatment and care e.g. behavioural and cultural factors
5. Given the complexity of the database coupled by migration within and outside the DSA it was difficulty to successfully link the individual data with other household variables like number in the household who are HIV positive and/or on ART as well as the number of HIV deaths in the household

4.4: Conclusion

- Although the overall rate of ART initiation was high, certain population groups were not covered well. Results of marginal effects analysis were consistent with those of binary and ordinal logistic regression where gender, education employment and age were significantly associated with ART initiation.

- The gender differences in ART initiation could be due to differences in health seeking behaviours between the two groups and PMTCT. Behaviour change communication with particular focus on males could help reverse this pattern.

- Limited literature on how education level is associated with ART initiation made it difficult to explain why individuals with secondary and higher levels of education were less likely to initiate therapy than those with primary and lower levels of education**.**

- Availability of financial resources and exposure to workplace HIV programmes among employed individuals could be the reason they were more likely to initiate

therapy compared to their unemployed counterparts. This pattern is detrimental to the fight against HIV in the study area where about 40% of adults in the area are unemployed (Muhwava et al., 2008).

- Older people (30 - 44 years) were more likely to initiate therapy compared to those in the 15 - 29 years age-group where the HIV incidence peaks**.** Most of those who get infected in the 15 - 29 age-group would require treatment at a later stage in their lives which is on average around 10 years after infection.

- Increased distance from the nearest health facility continues to be a barrier to ART as those who lived far away from the clinic (4 kilometres and more) were less likely to initiate therapy than those who lived within 2 kilometres of the clinic. The trend observed in preliminary analysis that those living within 1 kilometre of the clinic were less likely to initiate therapy could be due to fear of stigmatisation.

- There was geographical heterogeneity in ART uptake across the six clinics in the Africa Centre Surveillance Area. The clinic catchment with the highest uptake has a rural catchment with very low population levels and low prevalence of HIV and this was responsible for that heterogeneity. ART was delivered equally at primary healthcare level in this typical rural sub-Saharan setting as there were no significant differences in median CD4 counts at initiation by clinic catchment. This was expected since the eligibility criteria for ART initiation was the same throughout the AC DSA.

4.5: Recommendations

- Males should be encouraged to actively support their partners in PMTCT programmes and also get tested for HIV. Couple and partner HIV counselling with

mutual disclosure should also be encouraged as recommended by the World Health Organisation (World Health Organisation, 2012a). This could impact on their health seeking behaviour resulting in improved access to treatment and care among males.

- Income generating interventions that target the youth and unemployed individuals can be used in order to reach these individuals through workplace based programmes. The reason these individuals are not accessing care could be lack of sufficient exposure to HIV treatment and care programmes or lack of information and misconceptions about HIV.

- Further research on how education is associated with ART is needed since the findings of this study were not consistent with findings from other studies.

- Partnering with the private sector could enlighten policymakers on the characteristics of individuals accessing care at private facilities thus assisting in strategic planning in order to reach as many treatment eligible individuals as possible.

- HIV programmes targeting the youth should be put in place in order to sensitise this group about the availability of HIV treatment and care.

- Mobile clinics could help in making HIV services more accessible to those who live far away from the clinics.

- Use of healthcare workers who are not part of the communities where they work could help reduce stigma related barriers to ART and patients' confidentiality concerns.

- Further spatial analysis on the geographical heterogeneity of ART uptake need to be strengthened in order to identify the hot spots.

- Overall, interventions that target younger people, males, educated and unemployed individuals can help in reaching as many treatment eligible individuals as possible and integral to an HIV free future South Africa

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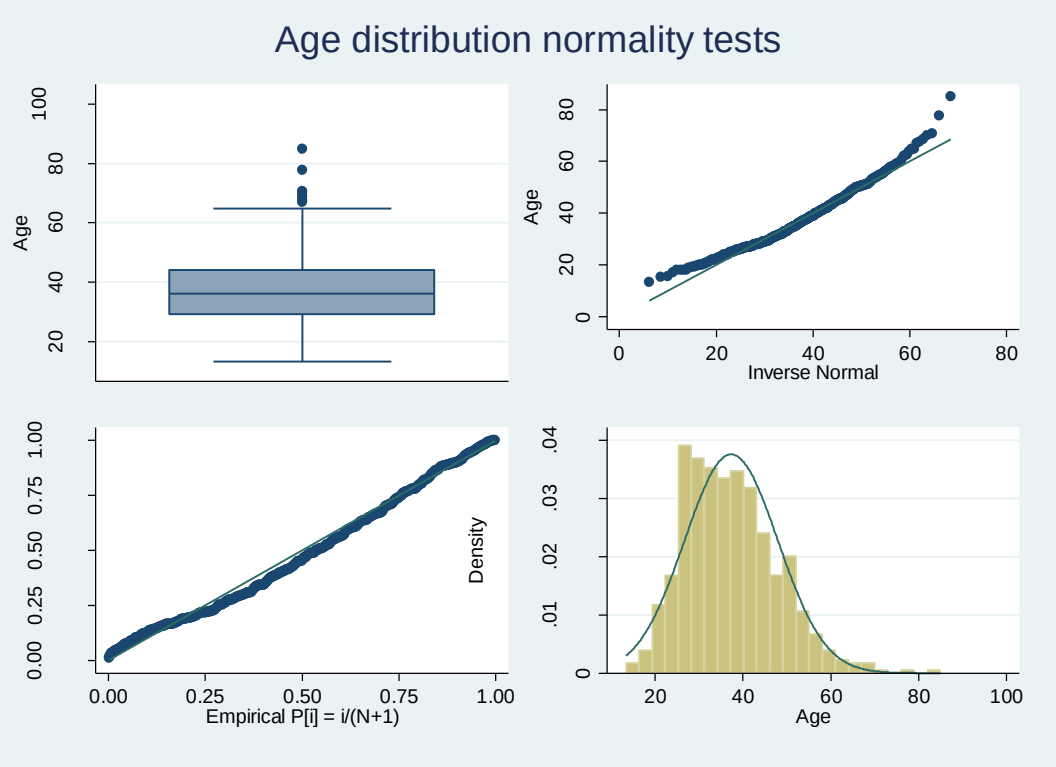
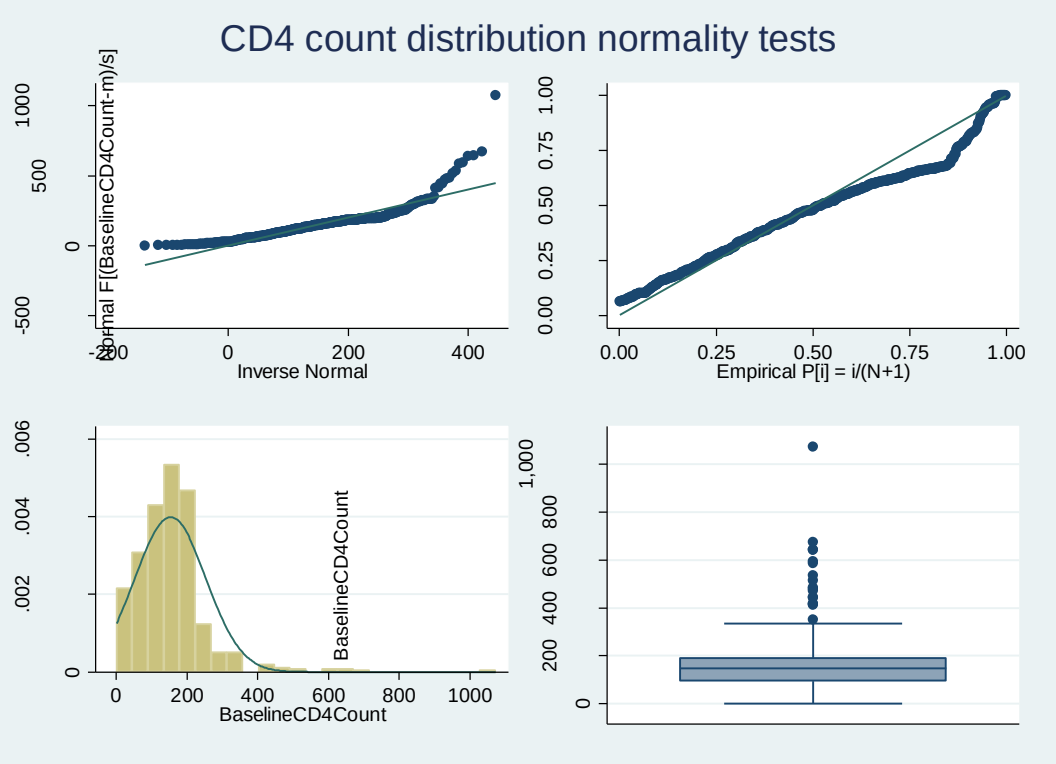
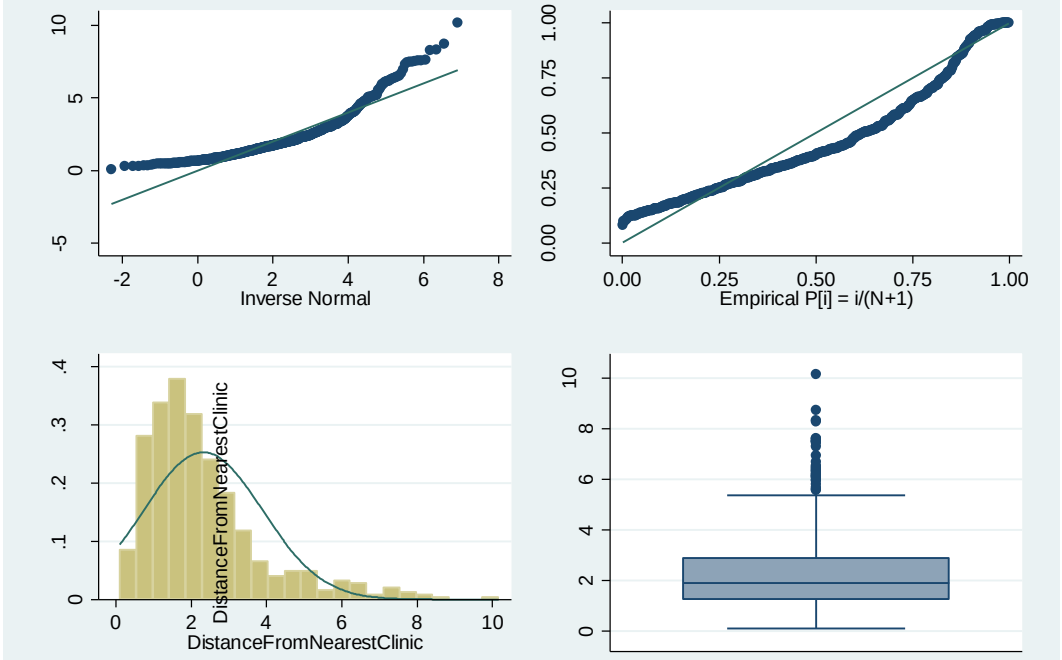
Appendix

Appendix 1: Testing for normality

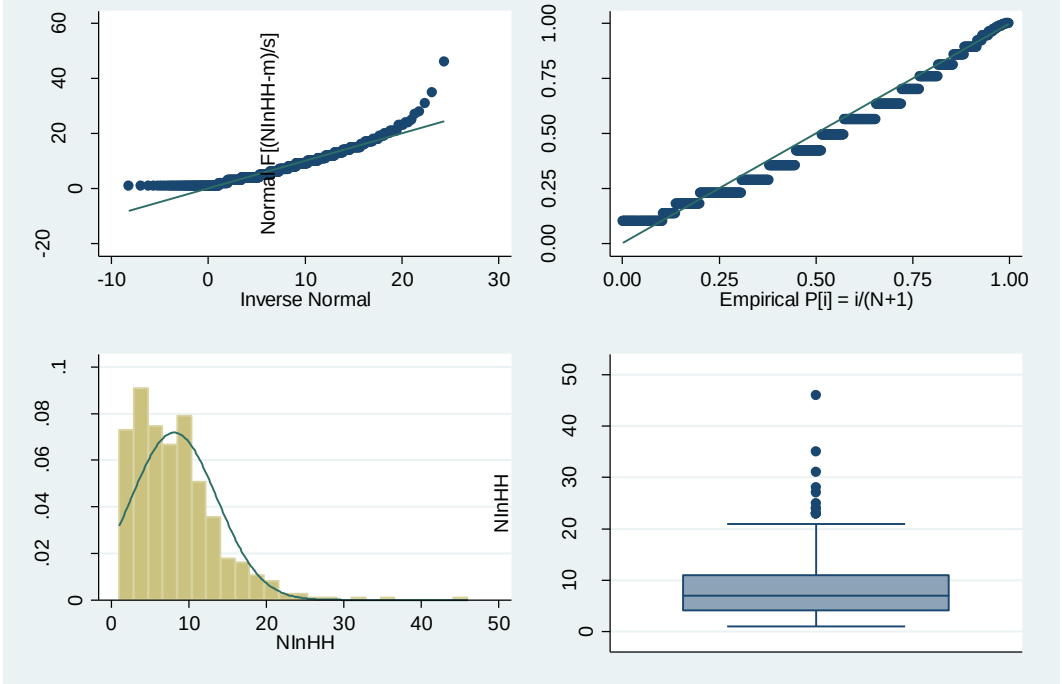




Distance from nearest clinic normality tests



Distribution of household size normality tests



Appendix 2: HIV prevalence by age-group, gender and clinic catchment

Clinic Catchment/ Age	Female	Female tested	Female HIV infected	Prevalence	Male	Male tested	Male HIV infected	Prevalence
1 (Rural) Age Category								
15-29	289	123	24	0.195	238	75	0	0
30-45	163	59	20	0.339	85	21	3	0.143
≥45	330	172	23	0.134	121	42	6	0.143
2 (Rural) Age Category								
15-29	579	254	55	0.217	474	152	7	0.046
30-45	292	132	55	0.417	142	44	22	0.5
≥45	717	383	43	0.112	270	112	10	0.089
3 (Urban) Age Category								
15-29	1 694	780	252	0.323	1 520	583	52	0.089
30-45	1 205	471	283	0.601	618	166	70	0.422
≥45	1 692	830	169	0.204	629	239	54	0.226
4 (Rural) Age Category								
15-29	465	199	43	0.216	383	117	3	0.026
30-45	275	113	58	0.513	122	22	10	0.455
≥45	520	262	40	0.153	191	68	10	0.147
5 (Rural) Age Category								
15-29	1 433	625	171	0.274	1 282	443	33	0.074
30-44	760	344	193	0.561	413	103	49	0.476
≥45	1 401	731	135	0.185	556	233	41	0.176
6 (Rural) Age Category								
15-29	1 191	439	98	0.223	1 104	293	16	0.055
30-45	611	218	102	0.468	314	86	36	0.419
≥45	1248	564	97	0.185	481	171	32	0.187

Appendix 3: Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Dr Palagia Ndambakuwa

CLEARANCE CERTIFICATE	M111132
PROJECT	Factors Associated with Antiretroviral Treatment (ART) Coverage at Primary Health Care Level in the Africa Centre Surveillance of the Hlabisa HIV Treatment and Care Programme
INVESTIGATORS	Dr Palagia Ndambakuwa.
DEPARTMENT	School of Public Health
DATE CONSIDERED	28/10/2011
M1111320DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 28/10/2011 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : E Musenge

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...