

*Addis Ababa University  
Office of Graduate Program*

*Faculty of Science  
Department of Statistics*

**Determinants of adherence  
to Antiretroviral treatment in  
Shashemene General Hospital**

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# **Determinants of adherence to Antiretroviral treatment in Shashemene General Hospital**

**By  
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**A Thesis submitted to the Office of Graduate Programs of Addis  
Ababa University in Partial fulfillment of the requirement for the  
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## **Acronyms**

AIDS	Acquired immune deficiency syndrome
ANOVA	Analysis of Variance
ART	Antiretroviral Treatment
ARV	Antiretroviral
AZT	Zidovudine (Retrovir)
CSA	Central Statistical Agency
DA	Discriminant Analysis
D4T	Stavudine (Zerit)
ECM	Expected Cost of Misclassification
EFZ	Efavirenz (Sustiva)
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
MEMS	Medication Event Monitoring System
MOH	Ministry of Health
NGO	Non Governmental Organization
NHAPCO	National HIV/AIDS Prevention and Control Office
PLWHA	People living with HIV/AIDS
NVP	Nevirapine (Viramune)
SNNPR	South Nations And Nationalities Peoples Region
SPSS	Statistical Package for Social Science
SRS	Simple Random Sampling
3TC	Lamivudine (Epivir)
UNAIDS	Joint United Nations Programme on HIV/AIDS
WHO	World Health Organization

## Abstract

In this study we have investigated the factors of adherence to ART and selected those factors or variables that can discriminate between adherent and non adherent patients on ART. Simple structured questionnaire was employed and self reported adherence measurement was used. Bivariate data analysis was used to investigate the association of the independent variables adherence to ART using Pearson Chi-square for categorical variables and parametric and non parametric measure of association was used for the opinion variables. Further more, Multivariate data analysis was used to investigate the combination effect of the variables using Principal component analysis, Factor analysis and Discriminant analysis.

The study sample comprises of 147 HIV patients who receive ART in the Shashemene General Hospital (SGH). They were interviewed using simple structured questionnaire. Using self report measure of adherence in the two weeks of study period 81% of the patients on ART were adherent. Where as 19% of the patients were non adherent. The mean non adherence percentage was calculated using only those non adherent patients and it was 81.19%. The major reasons of non adherence were: forget to take (28.6%), confused how and when to take (17.9%) and feel depressed (14.2%). The following factors were associated with adherence to ART using bivariate data analysis: occupation, Education level, Income, depression, and service hour. However, in the multivariate analysis some of the variables have been dropped. In multivariate analysis we used only the likert scale variables. Using principal component analysis and factor analysis four factors were extracted from the whole study variables. We labeled them as social support, HIV serostatus disclosure; Home based care and psychological well being. While using discriminant analysis we identified depression, poor NGO support and HIV serostatus disclosure as barriers of adherence and no transportation problem, strong NGO support, good reception in the service area and high CD4 count have been identified as facilitators of adherence

The mean self reported adherence rate was calculated and was found to be 84.62%. In addition to this, 81% of the patients are below the 95% threshold value for adherence. To improve adherence of patients on ART, the current ART program should strive to manage depression before and after the initiation of ART. Strong linkage between NGOs which are working in care and support program has to be established. A collaborative work with the community to increase the awareness of

ART in the community has to be implemented. Further more intervention on the service area to improve the service quality and a free transportation or equivalent method of alleviating the transportation problem has positive impacts on the results of the program.

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**Determinants of Adherence to ARV Treatment**  
**In Shashemene General Hospital**

# Chapter one

## INTRODUCTION

### 1.1 BACKGROUND

HIV/AIDS is an epidemic that affects every part of the globe. According to the latest figures an estimated 39.5 million people are living with HIV. There were 4.3 million new infections in 2006 with 2.8 million (65%) of these occurring in Sub-Saharan Africa. In 2006, 2.9 million people died of AIDS-related illnesses (UNAIDS/WHO AIDS epidemic update: December 2006).

Sub-Saharan Africa accounts to an estimated 24.7 million [21.8 million –27.7 million] adults and children infected with HIV. This is two thirds (63%) of all adults and children living with HIV globally. Declines in national HIV prevalence are being observed in some Sub-Saharan African countries, but such trends are currently neither strong nor widespread enough to diminish the epidemics. Almost three quarters (72%) of all adult and child deaths due to AIDS in 2006 occurred in Sub-Saharan Africa. (UNAIDS/WHO, December 2006). One of Sub-Saharan Africa country hit by HIV/AIDS epidemic, next to South Africa and Zambia, is Ethiopia. Based on the figures obtained from ministry of health (MOH), 1.3 million people are living with the virus, 744,100 are orphaned due to AIDS, and 277,800 are in need of antiretroviral treatment (ART) in 2005. AIDS accounted for an estimated 34% of all young adult deaths in rural Ethiopia and 66.3% of all young adult deaths in urban Ethiopia. The situation of HIV/AIDS epidemic in Amhara, Oromia, Addis Ababa, and South Nations and Nationalities Peoples Region (SNNPR) is worse than other regions. Together, they accounted for 86.6% of all People living with HIV/AIDS (PLWHA), 86.7% of the total estimated HIV positive pregnancies, 85.3% of new infections, 87.9% of new AIDS cases, and 88.2 % of AIDS deaths that occurred in Ethiopia in 2005. (Federal Ministry of Health Ethiopia/National HAPCO, 2006).

Antiretroviral treatment or ART refers to treatment of HIV infection using combination of antiretroviral drugs (HAART).The introduction of highly active antiretroviral therapy (HAART) in 1996 was a turning point for millions of people who are living with HIV/AIDS. Although it cannot cure HIV/AIDS, antiretroviral (ARVs) have dramatically reduced mortality and morbidity, prolonged lives, and improved the quality of life of many people living with HIV/AIDS in third world countries. Even though ART reduced mortality and morbidity, prolonged lives, and

improved the quality of life of many people living with HIV/AIDS; it faces many challenges due to the behavior of the treatment. Some of the challenges includes: pill burden, food and fluid restriction, temporal side effects such as nausea, vomiting, diarrhea and fatigue, long lasting side effects to mention some: neuropathy, lipoatrophy/lipodystrophy, metabolic dysfunction. To worsen the matter, ART treatment can not cure HIV/AIDS; so the treatment has to be taken regularly, long-term for the rest of the patients life with maximum adherence ( $\geq 95\%$ ) in order to obtain the full benefit of the treatment. Non adherence refers to not achieving near perfect adherence.

The term 'treatment adherence' refers to the ability of the patient to develop and follow a plan of behavioral and attitudinal change that ultimately serves to empower him/her to improve health and self-manage a given illness. The term 'medication adherence' in HIV/AIDS care specifically refers to the ability of the person living with HIV/AIDS to be involved in choosing, starting, managing and maintaining a given therapeutic combination medication regimen to control viral (HIV) replication and improve immune function. To reduce the mortality and morbidity rate caused by the HIV/AIDS epidemic different initiatives were made by international organizations and donors. One of the imitative, the launch of WHO's '3 by 5' initiative in 2003, three million HIV patients will have access to ART by 2005. This enables many Sub-Saharan African countries to establish national antiretroviral treatment (ART) programmes. By end of 2005 an estimated 1.3 million people in low and middle income countries had access to treatment (about 20% of those estimated to be in need) (WHO and UNAIDS, 2006). The WHO target of providing access to ART for 3 million people by 2005 was not achieved. But in mid-2005, the WHO target had already been overtaken by an even more ambitious aim. In July 2005, the G8 group of industrialized countries committed to the goal of achieving "as close as possible to universal access to treatment for all those who need it by 2010." (UNAIDS, 2006, G8 Gleneagles Summit, 2005). This program is called UNIVERSAL access 2010. One of the countries which benefited from this program is Ethiopia.

To address the problem of provision of a fair access to ART implementation program the government of Ethiopia launched the free ART program in January of 2005. Already 45,595 patients have started ART until the end of July, 2006, at 132 facilities across the country. Of these, 35,460 were currently on treatment (Federal Ministry of Health Ethiopia/ National HIV/AIDS Prevention and Control Office (NHAPCO), 2006).

## **1.2 Overview of HIV epidemic in Oromia Regional state**

The HIV/AIDS status in Oromia has not yet been studied with adequate coverage and good quality data. However, general trends and observations on the spread of HIV/AIDS in Oromia can be obtained from a number of sources. One of them is “AIDS in Ethiopia 6<sup>th</sup> report “published by the Ministry of Health (MOH) & National HIV/AIDS Prevention and Control Office (NHAPCO).

According to this report the adult HIV prevalence for Oromia in 2005 was 2.4%. HIV prevalence in the region is higher among females (15.5 %) than males (8.8%) but also in urban (8.4%) than rural (1.4%) areas. The rural HIV prevalence for Oromia is declining. (Federal Ministry of Health (MoH) and National HIV/AIDS Prevention and Control Office (NHAPCO)).

## **1.3 Statement of the Problem**

The level of adherence required for effective HIV therapy is high level , adherence below 95% are consistently associated with a poorer viral load or low CD4 count and response, and with faster disease progression (Petreson, 2000). Levels of adherence below this threshold value are termed as non adherence level. Unfortunately, Non- Adherence to treatment is common in patients receiving ART treatment. Several studies have shown varying levels of adherence: more than 10% of patients report missing one or more medication doses on any given day, and more than 33% report missing doses in the past two to four weeks (Chesney et al., 2000).

After the introduction of the free ART program in Ethiopia in 2005. Non Adherence to the ART medication or defaulting has become major problem of the ART program. Even if the general defaulter rate of the country is not calculated we can estimate it from the defaulting patients from the program through out the country; that is, the difference of patients currently on ART and patients ever started ART (7.2%).

By rapidly expanding access to HIV/AIDS care and treatment in the Oromia regional state. It is achieved that 6,450 patients had ever started on ART across the region in 23 hospitals until the end of July, 2006; out of these 5,314 were currently on ART treatment. (Federal Ministry of Health Ethiopia/National HAPCO, 2006). From this figure we can estimate the defaulter rate of Oromia regional state to be 8.2%. This shows 8.2% of the patients who started ART have discontinued the medication in the region. The needs to investigate the factors that contribute to

the defaulting patients arise from the fact that the intervention strategies which address these factors will improve the adherence rate in the region and insures the success of the program as defaulting is one form of non adherence.

Shashemene is a town in the central Ethiopia. It is located in the western Arsi zone of the Oromia regional state, about 250 Kms from the capital city, Addis Ababa. Based on figures from the Central Statistical Agency of Ethiopia published in 2005, the town has an estimated total population of 93,156 of whom 46,882 were males and 46,274 were females. Most of the Shashemene population and its surrounding rural community use Shashemene General Hospital. It is located in the small high way village called Kuyera about 12 Kms from Shashemene town. It is also one of the 23 health facilities in the region where free ART is provided. The hospital started the free ART access program in February 2006. Until end of January 2007 the number of patients who ever started ART in the facility were 495. The numbers of patients on ART at end of January 2007 reduced to 451. The estimated defaulter rate of the Shashemene General Hospital can be calculated as 9.1%. This shows about 9.1% of patients who started the medication has defaulted. In light of this, the need to investigate the factors which led to defaulting becomes very crucial.

In Ethiopia, especially in Shashemene General Hospital; there is a growing concern about loss to follow-up or non-adherence to antiretroviral therapy as significant barriers to HIV care and treatment. But with intervention to improve adherence better results were obtained in other countries. Adherence interventions generally aim to inform people about HIV treatments and thus improve adherence, or to generate behavior change through incentives, suggestions or emotional support. In order to make a sound intervention in the program the intervention area has to be identified. This study aims at identifying determinant factors to be addressed for the problem of non adherence to ART.

## **1.4 Objectives**

### **General objective**

The main objective of this study is to identify the main factors of non-adherence of ARV treatment using Shashemene General Hospital as case study area. This will be achieved by employing the tools of Multivariate techniques such as Principal component, factor analysis and discriminant analysis.

### **Specific objectives are:**

1. To investigate the general characteristic of non adherence patients in Shashemene General Hospital
2. To determine the factors responsible for non-adherence.
3. To develop statistical model that can discriminate the case population into Adherent groups and Non – adherent groups.
4. To identify intervention areas for the success of the ART program in the hospital as well as in the region.

# Chapter Two

## Literature Review

### 2.1 Introduction

The literatures review is discussed in this chapter starting with methods of adherence measurements. Then world wide literature reviews on factors of adherence. Following this, the experiences of three African countries, Uganda, Tanzania and Botswana regarding adherence to treatment were discussed. The chapter concludes with the discussion of study of adherence in Ethiopia.

### 2.2 Adherence Measurements

The measurement of medication adherence is a difficult endeavor both in clinical care and research settings. (Shuter J. 2001). There is no way to measure adherence in the outpatient setting with absolute precision and accuracy (Flexner, 1997). While there may be no gold standard with which to measure adherence, there are several strategies available, each with its respective strengths and weaknesses (Besch, 1995). There are so many adherence measurements to measure the patients adherence to the medication the most widely used method is **self-reports**, patients are asked to report their own adherence in a self-report. Different periods of recall may be used—four-day, one-week, fifteen days , one-month or most-recent recall of missing a dose. Self-report assessment can be obtained at the time of clinic/hospital visits, through a series of questions asked in a non-judgmental manner. But there are also other methods like **clinician assessments**, physicians overestimate patient adherence to HIV medication (Crespo-Fierro M. 1997). Studies have found this measure to be the most poorly correlated with medication intake; **pill counts**, to view the actual pill container and calculate how many pills should be left, given the date of the inspection, dosing and last refill. Because pill counts often occur in provider offices, clients are able to manipulate the number of pills remaining prior to the visit. In addition, studies within the AIDS Clinical Trials Group (ACTG) have not found pill counts to be helpful in assessing patient adherence, particularly in studies of combination antiretroviral medication (Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B, and Wu AW. 2000); **pharmacy refills**, Patients collecting their medications regularly on due dates are assumed to be adhering to treatment. The draw back of pharmacy

refill tracking in Ethiopia; It ignores patients are given monthly medicine while their appointment is for twenty eight days so some patients may have a month, a quarter month and a few days medicine whether they came by their appointment day or not; **Biological assays**, two main types of assays are available; Marker assays are based on materials that can be added to a drug and are easily detected, typically in the urine. Direct assays refer to testing for the presence of the medication itself in the blood or urine. Problem with this method is that viral load monitoring is very expensive and may not be available in resource-constrained settings like in Ethiopia; **Medication Event Monitoring System (MEMS)**, a computer chip embedded in the cap which transfers information to a computer when it opened and closed; it is very expensive and needs trained man power so it is not applicable in developing countries where more than 65% of HIV/AIDS patients live.

### **2.3 Factors Influencing Treatment Adherence**

Since 1996, an overwhelming amount of evidence from clinical trials has been published validating the use of HAART for the treatment of human immunodeficiency virus (HIV) infection. Suppression of HIV replication, immune reconstitution, a halt in disease progression, increased survival; reduced morbidity and a better quality of life have been defined as the biological and clinical goals of treatment.. Maximum and durable suppression of HIV viral replication to below the level of detection is necessary to achieve these biological and clinical goals. To achieve success requires near-perfect adherence to combination regimens. Failure to suppress viral replication completely inevitably leads to the selection of drug resistant variants limiting the effectiveness of therapy (Condra, 1998). Non-adherence in patients on anti- HIV therapy is the strongest predictor of failure to achieve viral suppression below the level of detection (Deeks, 1997), and faulty adherence to anti- HIV drugs most often underlies treatment failure. It would appear that > 95% percent adherence may be necessary to adequately suppress viral replication, produce a durable response and halt disease progression (Paterson, 2000). This means that missing more than one dose of a regimen per week may be enough to cause treatment failure. The challenge of adherence in the face of potential viral resistance, treatment failure and disease progression is worrying. Patients on long-term HAART with undetectable HIV in plasma still harbor replication-competent virus (Furtado, et al., 1999). It would mean that with current medications HAART, at best, would be a life- long process. Conscientious treatment adherence is difficult under any circumstances, the unforgiving nature of HIV replication, the

complexity of the HAART regimens, and associated short and long-term toxicity all pose particularly difficult challenges for patients. In addition to that small studies of antiretroviral therapy in developing countries show that there is already resistance circulating among patients who are starting their first "official" course of therapy. (Mugenyi, 2002).

### **2.3.1 Socio economic factors**

The literature consistently demonstrates that demographic characteristics are not strong predictors of adherence. Many studies have looked for a relationship between socio demographic characteristics and non-adherence, but results have been inconsistent, pointing to the difficulty in predicting non-adherence from socio demographics.

Non-adherence occurs in all groups and classes of people, and it is widespread and unpredictable. Furthermore, adherence varies between individuals who share certain socio demographic features, identities or behaviors, as well as within the same individual over time (Carrieri 2002). In a review of adherence to HIV clinical trials, none of the following variables were found to be consistently predictive of non-adherence: age, race/ethnic group, sex, marital status, religion, socioeconomic status, level of education, or occupation (Besch 1995). Even though some correlates of adherence are described below together with socio economic factors.

#### **❖ Age**

Age may influence adherence. Studies have found that apart from the most elderly adherence increases with age (Wenger, Gifford, Liu, Chesney & Golin, 1999). In two studies associated with HAART adherence, non-adherence showed a positive correlation with younger age (Jones, Nakashima & Kaplan, 1999).

#### **❖ Level of Education**

A Lower level of general education and poorer literacy impacts negatively on some patient's ability to adhere (Moralez, Figueiredo, Sinkoc, Gallani & Tomazin, 1998) whilst a higher level of education has a positive impact (Catz, Heckman & Kochman, 1999).

#### **❖ Economic status**

Literature reveals that patients on higher incomes have less difficulty with adherence (Martinez, Marques, Valdes & Santana, 1998). However, poverty is an increasing feature of the face of HIV especially in the third world where many people are living below the poverty line (Grierson, et al 2000). Lower income and less education have been linked to poor adherence (Golin 2002).

## ❖ **Social support**

Several other recent studies have found that social or family problems often play a part in the failure to take medications as prescribed. Living alone and a lack of support have been associated with an increase in non-adherence (Williams & Friedland, 1997) and social isolation is predictive of non-adherence (Besch, 1995). Not living alone, having a partner, social or family support, peer interaction, and better physical interactions and relationships are characteristics of adherent patients (Eraker, et al., 1984).

### **2.3.2 Regimen complexity**

Regimen complexity is commonly assumed to affect adherence. There are three key aspects to regimen complexity, which need to be considered: number of doses, food and drink restrictions associated with dosing, side effects and absolute number of pills.

Almost all PLWHA who are currently using anti-HIV drugs are on a regimen of 3 or more drugs (HAART) (Grierson, et al., 2000). The crucial factor in regimen complexity may not be the number of medications but the number of doses that have to be taken every day (Singh; Porter 1969). This is borne out in HIV therapy in several studies (Paterson 2000; Golin 2002), although others have found no association between adherence and either the number of doses or the number of pills (Carrieri 2001). The use of fewer adherence aids such as pill boxes and timers is also associated with poorer adherence (Golin 2002). The likelihood of a patient's adherence to a given regimen declines with polypharmacy, the frequency of dosing, the frequency and severity of side effects, and the complexity of the regimen (Williams & Friedland, 1997). Drug hypersensitivity is far more common in patients with HIV (Carr & Garsia, 1997) and regimen associated toxicity is a common predictor of, and reason for, non-adherence across many studies (Ickovics & Meisler, 1997).

## ❖ Side effects

Side effects associated with each individual antiretroviral drug are well described, and whilst not universal for every patient can be predicted. Usually they defect after the first few weeks of therapy but for some, they persist. However, the more specific variable of the experience of side effects has been associated with poor adherence (Halkitis et al., 2003). Anticipation and fear of side effects also impacts upon adherence (Broers, et al., 1994). Being able to manage side effects has been linked to improved adherence (Johnson et al 2003).

### 2.3.3 Treatment Characteristics

#### Physical state and disease stage

Prior opportunistic infection (Singh, et al., 1996), symptom severity (Bond& Hussar, 1991) and low CD4+ counts (Erlon & Mellors, 1999) can predict adherence. Seeing an improvement in the immune and virologic indices used to monitor HAART (T-cells and HIV viral load) may be a powerful incentive to maintain adherence (Kaplin, Golin, Beck, Lui & Hays, 1999). Lack of symptoms (despite laboratory evidence of the need for HAART) may affect adherence (Ickovics & Meisler, 1997).

There is contradictory evidence regarding the impact of duration or stage of HIV disease upon adherence to therapy. Some studies have reported that stage of disease does not influence adherence (Lorenzen 1998; Pratt 2001). However one study found that people with advanced HIV were more adherent to HAART (Gao et al 2000).

#### Depression and severe anxiety

Depression and severe anxiety are variables that predict non-adherence (Klosinski & Brooks, 1998; Ickovics & Meisler, 1997). Most people with HIV, at some time in the course of their illness, experience a psychiatric disorder (Buhrich & Judd, 1997) and depression and/or anxiety are reported in up to 70% of patients with symptomatic HIV-disease (Hayman & Buhrich, 1994). 'Feeling depressed' defined by patient self-report rather than clinical diagnosis has been associated with poor adherence (Pratt 2001). Adherent patients demonstrate significantly less

depression or other psychiatric disturbance (Catz, et al., 1999). Severity of depressive symptoms was correlated with non-adherence (Ammassari et al., 2004).

### **2.3.4 HIV Serostatus disclosure**

Participants who reported greater serostatus disclosure to others demonstrated higher rates of adherence (Michael J. Stirratt (2006)). Disclosure of serostatus to an adherence monitor (trusted relative or friend) increased adherence. The adherence monitors taking part in the pretreatment counseling sessions prepares them to support patient during therapy (Torpey K, Drah B, Enniful H, Tetteh T, Benefour S. ,2004)

### **2.3.5 Perceived attitude and knowledge**

A patient's beliefs about their illness and the effectiveness of medication are predictive of adherence (Wenger et al, 1999). A patient's level of knowledge about HIV disease, a belief that HAART is effective (Klosinski & Brooks, 1998) and prolongs life (Stone, et al., 1998), and a recognition that poor adherence may result in viral resistance and treatment failure (Wenger, et al, 1999) all impact favorably upon a patients ability to adhere. Conversely, a lack of interest in becoming knowledgeable about HIV (Kammann, Williams, Chesney & Currier, 1999) and a belief that HAART may in fact cause harm adversely affecting adherence (Horne, Pearson, Leake, Fisher, Weinman, 1999).

### **2.3.6 Aspects of the hospital and service provision**

The effect that the clinic setting has on adherence should not be underestimated. Clinic characteristics that impact on adherence include: proximity to the patient's home or place of work, the expense of getting there, lengthy delays between appointments, clinic opening and closing times, long waiting times, lack of services such as child care, privacy, confidentiality, and unsympathetic or inconsiderate staff (Kammann, et al., 1999).

## **2.4 Experience of three African countries**

All the facilities studied in Botswana, Tanzania and Uganda provide ARVs free of charge, but other related costs (e.g. transport expenditures, registration and user fees at the private health facilities, and lost wages due to frequent clinic visits and long waiting times) are obstacles to optimal adherence. It is significant that these same financial concerns were expressed in all three

country studies and at all the sites involved. Hunger in the initial treatment phase (when the patient is recovering) is an added concern for poor patients not covered by food support in the three countries. ARV treatment programmes need to find ways to confront these constraints. It is not enough to provide treatment free of charge.

Treatment programmes also urgently need to find ways to reduce waiting times for ARV patients coming for refills and take into consideration the work schedules of ARV users. Evening and early morning clinics may be a good option, though these would be an additional burden for health workers. Patients could also be given appointments to reduce waiting times. In addition, workplace policies should include provisions for patients to take time off work to attend to their treatment needs.

The studies showed that health workers have heavy workloads and are working in health facilities with sub-optimal health infrastructures. While the Botswana programme seems to have overcome some of these infrastructure problems, in Uganda and Tanzania the lack of CD4 machines to monitor treatment outcomes on-site and the reported stock-outs of ARVs in Tanzania are major challenges to the ART programmes.

A regular and reliable supply of the needed drugs is a pre-requisite for optimal adherence. A dynamic approach to adherence support is needed (Spire et al., 2002). Optimal adherence appears to be most critically important in the initial treatment phase, in terms of achieving undetectable viral loads (Carrieri et al. 2003). In the initiation stage, many patients suffer side-effects, some of which disappear over time. Treatment programmes need to emphasize adherence support in this stage. Health care workers should properly inform patients about the adverse effects they can expect, and how to confront these. The treatment programmes should consider providing or subsidizing both transport and food support to patients who are too poor to pay.

Once the health status of ARV users has improved, and optimal adherence levels are being achieved, these must be maintained. To this end, recurrent costs for ARV users can be reduced by providing patients with three-month refills, rather than the one month refills that are current practice in the facilities studied. It is ironic that the system of one-monthly refills, intended to help monitor adherence, in practice creates a constraint to adherence because of the transport costs incurred. Transport costs can also be reduced by setting up a more extensive network of facilities where ARV users can go for refills, adherence monitoring and counseling. In addition, treatment

programmes need to set up transfer mechanisms for ARV users to allow them to attend newly established facilities closer to home.

Pharmacists and nurses can play an important role in this follow-up care. Their involvement can also reduce the workload of doctors. To provide good quality care, all auxiliary health workers should be trained to recognize clinical signs of treatment failure, such as emergent opportunistic infections, and to provide adequate adherence support. When treatment failure occurs, intensified adherence monitoring by means of electronic monitoring devices or self-report could be used more systematically to investigate whether sub-optimal adherence is causing the treatment failure. This would help prevent unnecessary recourse to second-line ARVs.

Adequate counseling services are needed at health facilities or in communities in both the initiation and continuation phases of ART to help patients cope with the side-effects of ART, identify and confront the social constraints to adherence, and address the financial problems that ARV users face. The country reports highlighted the lack of designated rooms for counseling in some facilities and, in one glaring example, a room being used by three counselors and ARV users at the same time. These kinds of conditions are likely to inhibit patients from discussing personal issues. Adequate space and privacy is needed to ensure the confidentiality and trust needed for effective adherence counseling. (Anita Hardon ... [et al.]. 2006)

## **2.5 Adherence Study in Ethiopia**

The problem of non adherence to ARV drug treatment is a recent issue of ART program in Ethiopia. It has become a major worry of the ART service providers. Because of the recentness of the program a little has been done in the area of adherence. After the introduction of free ARV drug in some selected hospital in 2005 the problem of non adherence emerges as some patients who started the treatment be lost to follow up because of some reasons like death, discontinued their medication and others started other traditional medications. So the area has not been studied well and the only literature in the case of Ethiopia especially Addis Ababa concludes that self reported adherence is higher than that seen in developed countries further regular follow up of patients, depression, side effects of the drug regimen and adopting a treatment program that fits to their daily routine (Yonas et al, 2006) are the factors to be considered to enhance adherence of the patient to ART treatment.

## **2.6 Statistical methodologies in the literatures**

In univariate analyses, means were compared using student's t-test and ANOVA. Categorical variables were compared using Chi-squared and Fisher's exact tests, as applicable. Odds ratios (with 95% confidence intervals, CI) were calculated. Univariate and multivariate logistic regression were done using adherent vs. non-adherent status as the outcome variable, while various study variables were used as independent variables. Associations of study variables with the adherence score were checked with the help of linear regression using adherence score as the dependant variable and study variables as independent variables. A p-value of less than 0.05 was considered to be statistically significant for most of the analyses.

## **Chapter Three**

### **METHODOLOGY**

#### **3.1 Introduction**

The methodology employed and the statistical packages used are discussed in this chapter, starting with data, sample selection procedure and the description of the study variables. The chapter concludes discussing different statistical techniques used in the data analysis such as Principal component analysis, factor analysis and discriminant analysis.

#### **3.2 Data**

The data used in this study are mainly primary and cross sectional. Secondary data are also used to retrieve data on type of regimen, disease stage, CD4 count and duration of therapy. The hospitals ART register was the sole sampling frame for this study because ART register is exhaustive, non-repetitive, traceable list of patients on ART. This study covers all HIV/AIDS patients attending ART medication program in Shashemene General Hospital who came to the hospital for their regular drug refill and some of them for medical follow up during the month of May (from May 1, 2007 to May 30, 2007). A structured questionnaire was designed to gather information on demographic, social support, treatment characteristics, patient characteristic and service provision variables. Patients voluntarily completed a questionnaire provided by the data collector.

Adherence was also measured using the self report adherence measure included in the questionnaire. Medical records were inspected in order to collect additional clinical information about the patient. Adherence was measured over two days, four days, one week and two weeks recall of medication intake. The level of adherence required for effective HIV therapy is high. Levels below 95% are consistently associated with a poor viral load or CD4 response, and with faster disease progression (Patterson, 2000). Therefore a patient is considered, in this study, non adherent if he missed at least one dose from his daily medication and missed dose timing (Liu H et al., 2006) in two hours delay.

### 3.3 Study Sample

Simple random sampling (SRS) is a basic probability selection scheme in which a predetermined number of units from a population list are selected, so that each unit on that list has an equal chance of being included in the sample. A random method of selection is one which gives each of the N (Total number of the population) units in the population to be covered a calculable probability of being selected. In some cases the nature of the survey may require recording of the attributes, which can be expressed qualitatively. The qualitative information can be quantified by counting the attribute characteristics. For instance, being male or female, married or unmarried. These attributes can be changed into quantifiable information by allocating the score “1” or “0” (Cochran 1977).

In this study, from the sampling frame those who started the medication in Shashemene General Hospital and those who had been transferred from other facilities were given sequential order number. A simple random sampling procedure was then applied on this list. During the sampling process the hospital’s appointment record logbook was also used in order to select the patients who are going to come on that data collection day. During the random sampling process patients who didn’t come at the time of the study were substituted by the next random number. The patients who were selected by simple random sampling procedure were contacted during their visit to the hospital.

We define our observation ( $Y_i$ ) as follows

$$Y_i = \begin{cases} 1, & \text{if the patient is non adherent} \\ 0, & \text{if the patient is adherent} \end{cases}$$

For population, 
$$Y = \sum_{i=1}^N Y_i = A, \quad \bar{Y} = \frac{\sum Y_i}{N} = \frac{A}{N} = P$$

where P is proportion of non adherent patients and A denote the total number of non adherent patients. Using the defaulter rate as an estimator of non - adherence rate of Shashemene General Hospital we estimated P to be 9.1%, that is  $p=0.091$ .

Assume that the proportion estimate, p, is normally distributed with absolute margin of error  $d = p-P$ , then sample size n can be calculated by

$$n = \frac{Z^2 PQ}{d^2} \Bigg/ \left( 1 - \frac{1}{N} + \frac{Z^2 PQ}{Nd} \right)$$

If we put  $n_0 = \frac{Z^2 PQ}{d^2}$ , then we get  $n = \frac{n_0}{1 - \frac{1}{N} + \frac{n_0}{N}}$

Where Q = 1-P and Z is the upper bound of two tailed (1- $\alpha$ ) 100% Confidence interval of standard normal distribution. In practice the population parameters P must be estimated while the other factors Z and d usually is set by the investigator. Since population parameter (P) is unknown, calculate  $n_0$  by using the estimate of the non adherence. That is, p=0.091, Z= 1.96 for 95% confidence interval estimation and d to be 0.04, then

$$n_0 = \frac{Z^2 p(1-p)}{d^2} = \frac{(1.96)^2(0.091)(.909)}{(0.04)^2} = 198.6 \cong 199$$

To calculate n, the total sample size of the study. The total population of patients on ARV drug at the time of investigation was 540.

$$n = \frac{n_0}{1 + \frac{n_0}{N}} = \frac{199}{1 + \frac{199}{540}} = 145.36 \cong 145 \text{ patients (26.9\% of N)}$$

### 3.4 The study variables

#### 3.4.1 Dependent variable

Missing at least one dose of medication or missing dosing time in two hours delay in the last fifteen days is the dependent variable. The response variable, which is a measure of adherence, is a Likert scale from 1 to 5. The data was divided into two, that is, those who did not adhere the treatment in the past two weeks prior to the assessment and those of who adhere to the treatment. For those who totally missed the medication are considered as being adhering to the treatment” None of the time”. Similarly, if the person at least missed one dose of medication or dosing time in the study period then we consider him being adherent “A little of the time” . These are the two groups of non adherent patients. Where as for those who where considered as being adhering to the treatment “Some of the time” if the person missed medication but not in the two weeks prior to the assessment. If the person responded that he sometimes missed dosing time

then he is considered to be adhering the treatment “Most of the time “and if he did not miss at least one dose or dosing time in the entire medication life then he said to adhere the treatment “All of the time “

### 3.4.2 Independent variables

The independent variables are classified into demographic, social support, patient characteristics, treatment characteristics and service provision. These variables are chosen because in many studies they had been used to investigate non adherence to ART. The lists of the independent variables as well as the coding format are presented in the Tables below:

**Table 3.1 Demographic variables**

<b>Variables</b>	<b>Description</b>	<b>Alternative choices</b>
X <sub>1</sub>	Gender	1.Male 2.Female
X <sub>2</sub>	Age	1.Less than 15years
		2.15 years to 30 years
		3.31 years to 49 years
		4.More than 49 years
X <sub>3</sub>	Marital status	1.Never married
		2.Married
		3.Separated
		4.Divorced
		5.Widowed
X <sub>4</sub>	Ethnicity	1.SNNP
		2.Amhara
		3.Oromo
		4.Tigray
		5.Other
X <sub>5</sub>	Religion affiliation	1.Islam
		2.Orthodox
		3.Protestant
		4.Other

**Table 3.2 Socio economic status variables**

<b>Variables</b>	<b>Description</b>	<b>Alternative choices</b>
X <sub>6</sub>	Employment status	1. Employed
		2. Own business
		3. Jobless
		4. Own farm
X <sub>7</sub>	Income per month	1. No income
		2. NGO ration
		3. Below 100 birr
		4. From 101 birr to 500 birr
		5. Above 500 birr
X <sub>8</sub>	Education level	1. Illiterate
		2. Basic education
		3. Elementary and secondary
		4. Certificate or Diploma
		5. Degree
X <sub>9</sub>	Housing status	1. Owned house
		2. NGO shelter
		3. Rent
		4. Debal
		5. Homeless

**Table 3.4 HIV serostatus Disclosure, Social support status, ART attitude and knowledge and Adherence knowledge variables**

<b>Variables</b>	<b>Description</b>	<b>Alternative choices</b>
X <sub>10</sub>	Participate in the community	Five point Likert scale*
X <sub>11</sub>	Disclosure HIV status to family	Five point Likert scale*
X <sub>12</sub>	Disclosure HIV status to community	Five point Likert scale*
X <sub>13</sub>	Depression	Five point Likert scale*
X <sub>14</sub>	Help when confined to bed( DirectSupport_1)	Five point Likert scale*
X <sub>15</sub>	Take you to the doctor (DirectSupport_2	Five point Likert scale*
X <sub>16</sub>	Prepare your meal (DirectSupport_3)	Five point Likert scale*
X <sub>17</sub>	Do your daily chores (DirectSupport_4)	Five point Likert scale*
X <sub>18</sub>	Listen when need talk (EmotionalSupport_1)	Five point Likert scale*
X <sub>19</sub>	Shows you love and affection( EmotionalSupport_2)	Five point Likert scale*
X <sub>20</sub>	Have good time with ( EmotionalSupport_3)	Five point Likert scale*
X <sub>21</sub>	Give advise about a crisis (InformationalSupport_1)	Five point Likert scale*
X <sub>22</sub>	Give you information (InformationalSupport_2)	Five point Likert scale*
X <sub>23</sub>	MHM get better( ART attitude_1)	Five point Likert scale(1)
X <sub>24</sub>	MHM have fewer symptoms (ART attitude_2)	Five point Likert scale(1)
X <sub>25</sub>	medication keep me alive longer( ART knowledge)	Five point Likert scale(1)
X <sub>26</sub>	get sick if I don't take my medication( Adherence knowledge)	Five point Likert scale(1)
X <sub>27</sub>	Drug Side effect	Five point Likert scale*

**Five point Likert scale\***

1. None of the time
2. A little of the time
3. Some of the time
4. Most of the time
5. All of the time

**Five point Likert scale (1)**

1. Strongly agree
2. Agree
3. Uncertain
4. Disagree
5. Strongly disagree

MHM: Medication Help Me

**Table 3.5 Service provision variables**

<b>Variables</b>	<b>Description</b>	<b>Alternative choices</b>
X <sub>30</sub>	Confidentiality	Five point Likert scale*
X <sub>31</sub>	Service hour	Five point Likert scale*
X <sub>32</sub>	Reception	Five point Likert scale*
X <sub>33</sub>	Transportation problem	Five point Likert scale*

**\*Five point Likert scale**

- |                     |                         |                     |
|---------------------|-------------------------|---------------------|
| 1. None of the time | 2. A little of the time | 3. Some of the time |
| 4. Most of the time | 5. All of the time      |                     |

**Table 3.6 Treatment characteristic variables**

<b>Variables</b>	<b>Description</b>	<b>Alternative choices</b>
X <sub>34</sub>	Medication disclosure	1. Very comfortable
		2. Comfortable
		3. Neither comfortable or uncomfortable
		4. Uncomfortable
		5. Very uncomfortable
X <sub>35</sub>	Current CD4	1. less than 100
		2. 101-200
		3. 201-300
		4. Above 300
X <sub>36</sub>	Disease stage	0. None
		1. WHO I
		2. WHO II
		3. WHO III
		4. WHO IV
X <sub>37</sub>	Duration of therapy	1. Less than two months
		2. Two months to six month
		3. Six months to twelve month
		4. Twelve month to 36 months
		5. More than 36 months

### 3.5 Principal Component Analysis (PCA)

Principal Components (PCs) analysis is a technique used to obtain new variables which are linear combinations of the original variables. The maximum number of new variables that can be formed is equal to the number of original variables, and the new variables are uncorrelated among themselves. PCs analysis is done either using the theoretical covariance matrix  $\Sigma$  or theoretical correlation matrix  $\mathbf{U}$  of  $X$ , where  $X$  is a random vector with  $p$  dimensions. Thus, the  $i^{\text{th}}$  PC of the standardized variables is

$$Y_i = e_i^T Z \quad 3.5.1$$

where,  $Z^T = (Z_1, Z_2, \dots, Z_p)$  of the original variable  $X$  with  $E(Z_i) = 0$  and  $E(ZZ^T) = \mathbf{U}$  and

$$e_i^T = (e_1, e_2, \dots, e_p) \quad 3.5.2$$

Since  $E(Y) = E(e^T Z) = e^T E(Z) = 0$ , The variance of the new variable ( $Y$ ) is given by

$$E(Y Y^T) = E(e^T Z Z^T e) = e^T E(Z Z^T) e = e^T \mathbf{U} e \quad 3.5.3$$

The problem now reduces to find the weight vector,  $e^T$ , such that the variance,  $e^T \mathbf{U} e$ , of the new variable is maximum over the class of linear combinations that can be formed subject to the constraint  $e^T e = 1$ .

The solution to the maximization problem can be obtained as follows: Let

$$\Phi = e^T \mathbf{U} e - \lambda (e^T e - 1) \quad 3.5.4$$

where,  $\lambda$  is the Lagrange multiplier. The  $p$ -component vector of the partial derivative is given by

$$\partial \Phi / \partial e = 2e (\mathbf{U} - \lambda I) \quad 3.5.5$$

Setting the above vector of partial derivative to zero results in the final solution of

$$(\mathbf{U} - \lambda I) e = 0 \quad 3.5.6$$

For such system of homogeneous equations to have a trivial solution, the determinant of  $(\mathbf{U} - \lambda I)$  should be zero, that is

$$|\mathbf{U} - \lambda I| = 0 \quad 3.5.7$$

Equation (3.5.7) is a polynomial in  $\lambda$  of order  $p$ , and therefore, has at most  $p$  roots.

Let  $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_p > 0$  be the roots, that is equation (3.5.7) results in  $p$  values for  $\lambda$ , and each value is called the eigen value or root of the  $p$  matrix. Each value of  $\lambda$  results in a set of weights given by the  $p$ -component vector  $e$  by solving the equation  $(\mathbf{U} - \lambda I)e = 0$  and

$$e^T e = 1 \quad 3.5.8$$

Therefore, the first eigenvector,  $e_1$ , corresponding to the first eigen value  $\lambda_1$ , is obtained by solving equations:

$$(U-\lambda_1 I)e_1= 0 \tag{3.5.9}$$

subjected to  $e_1^T e_1= 1$

Pre-multiplying equation (3.5.9) by  $e_1^T$  gives  $e_1^T (U-\lambda_1 I)e_1=0$

$$e_1^T U e_1 =\lambda_1 \tag{3.5.10}$$

As  $e_1^T e_1=1$ , the left hand side of equation (3.5.10) is the variance of the new variable,  $Y_1$ , which is equal to the eigen value,  $\lambda_1$ . The first PC is given by  $Y_1=e_1^T Z$  corresponding to the largest eigen value  $\lambda_1$ .

Let  $e_2$  be the second p-component vector of weights to form another linear combination , then the linear combination can be found. i.e., the variance of  $e_2^T Z$  is the maximum subject to the constraints  $e_1^T e_2= 0$  and  $e_2^T e_2= 1$ . Then the second PC is given by  $Y_2=e_2^T Z$  corresponding to the 2<sup>nd</sup> largest eigen value  $\lambda_2$ . Similarly it can be shown that the remaining PCs  $Y_i=e_i^T Z$ , where  $i=3, \dots, p$  corresponding to eigen values  $\lambda_3, \lambda_4, \dots, \lambda_p$  of the correlation matrix.

### 3.5.1 The number of principal components

As a rule of thumb suggests, retaining only those components whose variance  $\hat{\lambda}$  are greater than unity or equivalently only those components which individually explain at least a proportion  $1/p$  of the total variance is recommended. And another useful visual aid determining an appropriate number of PCs is the scree plot. It is a plot of  $\lambda_i$  versus  $i$ , with eigen values ordered from largest to smallest (the magnitude of eigen values versus its number). Then, to determine the appropriate number of components, we look for elbows (bends) in the scree plot. The number of components is taken to be the point at which the remaining eigenvalues are relatively small and all are about the same size.

## 3.6 Factor Analysis

This analysis describes the covariance relationships among many variables in terms of a few underlying and unobservable random quantities. It is like tuning a microscope adjustment knob to see unobservable factors in the problem area a kind of psychometric analysis.

### 3.6.1 The Orthogonal factor model

The observable random vector  $X$  with  $P$  components has mean  $\mu$  and covariance  $\Sigma$ . The factor model postulates that  $X$  is linearly dependent upon a few unobservable random variables  $F_1, F_2, \dots, F_m$  called common factors and  $p$  additional source of variation  $\varepsilon_1, \varepsilon_2, \varepsilon_3, \dots, \varepsilon_p$  of specific factors. The common factors are unobservable random variables of  $m$  dimension that replace the position of independent variables in multivariate regression model, while the specific errors are  $p$  dimensional source of variation or errors. The dimension of common factor of unobservable random variables is less than that of the dimension of specific, i.e.,  $m < p$ .

The factor analysis model is given by

$$X = LF' + \varepsilon \tag{3.6.1}$$

where,  $L_{p \times m} =$

$$\begin{pmatrix} l_{11} & l_{12} & \dots & l_{1m} \\ l_{21} & l_{22} & \dots & l_{2m} \\ \dots & \dots & \dots & \dots \\ l_{p1} & l_{p2} & \dots & l_{pm} \end{pmatrix}$$

$F = [F_1, \dots, F_m]^T$  and  $\varepsilon = [\varepsilon_1, \dots, \varepsilon_p]$

The coefficient  $l_{ij}$  is the loading of the  $i^{\text{th}}$  variable on the  $j^{\text{th}}$  factor.

#### 3.6.1.1 Assumptions of factor model:

1.  $E(F) = 0$
2.  $\text{cov}(F) = E(FF^T) = I_m$
3.  $E(\varepsilon) = 0$
4.  $\text{Cov}(\varepsilon) = E(\varepsilon\varepsilon^T) = \Psi_{p \times p}$  is a diagonal matrix
5.  $\text{Cov}(\varepsilon, F) = E(\varepsilon, F) = 0$

#### 3.6.1.2 Covariance structure for orthogonal Factor model

1.  $\text{Cov}(X) = LL^T + \Psi$
2.  $\text{Var}(X_i) = l_{i1}^2 + l_{i2}^2 + \dots + l_{im}^2 + \Psi_i$ , where  $\Psi_i$  is the  $i^{\text{th}}$  specific factor.
3.  $E(X_i, X_k) = l_{i1}l_{k1} + l_{i2}l_{k2} + \dots + l_{im}l_{km}$
4.  $\text{Cov}(X_i, F_j) = l_{ij}$
5.  $\text{Cov}(X, F) = L$ , loading matrix.

The portion of variance of  $i^{\text{th}}$  variable contributed by the  $m$  common factor is called the  $i^{\text{th}}$  communality and that portion of  $\text{var}(\mathbf{X}_i)$  due to the specific factor is called specific error. Communality is defined by

$$h_i^2 = \ell_{i1}^2 + \ell_{i2}^2 + \dots + \ell_{im}^2 \quad 3.6.2$$

The factor model assumes that  $p + \frac{p(p-1)}{2} = \frac{p(p+1)}{2}$  variables and covariance for X can be reproduced from  $pm$  factor loading  $l_{ij}$  and  $p$  specific variables  $\varepsilon_i$ .

The factor model provides a simple explanation of the co variation in X with fewer parameters ( $p+pm$ ) which are fewer than  $p(p+1)/2$  parameters in  $\Sigma$ .

### 3.6.2 Estimation of loading

If the off diagonal elements of sample covariance S are small or those of the sample correlation matrix R essentially zero, the variables are not related. This implies that a factor analysis will not prove useful and in these circumstances, the specific factor plays a dominant role. If covariance matrix appear to deviate significantly from a diagonal matrix, then a factor model can be entertained and the initial problem is one of estimating the factor loading  $l_{ij}$  and specific variance  $\psi_i$ .

There are two popular methods of parameter estimation. However, for this study, we consider the principal component method.

#### 3.6.2.1 The Principal Component Method

The spectral decomposition of covariance  $\Sigma$  having eigen value-eigenvector pairs  $(\lambda_i, e_i)$  with  $\lambda_1 > \dots > \lambda_m > 0$  is given as

$$\Sigma = \lambda_1 e_1 e_1^T + \lambda_2 e_2 e_2^T + \dots + \lambda_p e_p e_p^T \quad 3.6.3$$

From above the equation, we can obtain the loading as ,  $L = [\sqrt{\lambda_1} e_1, \sqrt{\lambda_2} e_2, \dots, \sqrt{\lambda_p} e_p]$

#### The Contribution to the Total Sample Variances

In applying the principal component to perform factor analysis, we have used, the sample covariance matrix S. Observe that  $S_{11} + S_{22} + \dots + S_{pp} = \text{tr}(S) = \text{trace of sample covariance matrix and}$

$\hat{\lambda}_1 + \hat{\lambda}_2 + \dots + \hat{\lambda}_p = p = \text{trace of sample correlation matrix}$ , where,  $\hat{\lambda}_i$ 's,  $i=1, \dots, p$  are the estimated eigen values of S.

$$\left[ \begin{array}{l} \text{The proportion of total sample} \\ \text{Variance due to } j^{\text{th}} \text{ factor} \end{array} \right] = \frac{\hat{\lambda}_j}{\text{tr}(S)} \text{ for factor analysis of sample covariance}$$

$$\left[ \begin{array}{l} \text{The proportion of total sample} \\ \text{Variance due to } j^{\text{th}} \text{ factor} \end{array} \right] = \frac{\hat{\lambda}_j}{P} \text{ for factor analysis of correlation}$$

### Rule of Thumb (Convention)

1. Choose positive eigen values of sample covariance matrix S,  $\hat{\lambda}_1 \geq \hat{\lambda}_2 \geq \dots \geq \hat{\lambda}_m \geq 0$
2. Choose Eigen values of sample correlation matrix R which are larger than 1.

### 3.6.2.2 Factor rotation

Factor rotations are an orthogonal transformation of the factor loadings, as well as the implied orthogonal transformations of the factors. If  $\hat{L}$  is the  $p \times m$  matrix of estimated factor loadings obtained by any method, then  $\hat{L}^* = \hat{L}T$ , where  $TT^T = T^T T = I$ , is a  $p \times m$  matrix of 'rotated' loadings, where I is the identity matrix. This shows that the estimated covariance (correlation) matrix remains unchanged since  $\hat{L} \hat{L}^T + \hat{\Psi} = \hat{L} TT^T \hat{L}^T + \hat{\Psi} = \hat{L}^* \hat{L}^{*T} + \hat{\Psi}$

## 3.7 Discriminant Analysis

Discrimination and classification are multivariate techniques concerned with separating distinct sets of objects or observations and allocating new objects (observations) to previously defined groups. There are two goals of discrimination and classification, the first one is to describe graphically or algebraically the differential features of objects(observations) from several known collections (populations).The second goal is to sort objects (observations) into two or more labeled classes ,that is ,deriving a rule that can be used to optimally assign new objects to the labeled classes.

## Assumptions

**Normal distribution.** It is assumed that the data (for the variables) represent a sample from a multivariate normal distribution. Note that violations of the normality assumption are not "fatal."

**Homogeneity of variances/covariances.** It is assumed that the variance/covariance matrices of variables are homogeneous across groups. Again, minor deviations are not that important.

**Correlations between means and variances.** The major "real" threat to the validity of significance tests occur when the means for variables across groups are correlated with the variances (or standard deviations).

### 3.7.1 Separation and Classification for Two populations

Let us label the two populations (classes)  $\pi_1$  and  $\pi_2$ . The observations are ordinarily separated or classified on the basis of measurements on, for instance,  $p$  associated random variables.

$\mathbf{X}'=[X_1, X_2, \dots, X_p]$ . The observed values of  $\mathbf{X}$  differ to some extent from one class to the other. We can think of the totality of values from the first class as being the population of  $\mathbf{x}$  values for  $\pi_1$  and those from the second class as the population of  $\mathbf{x}$  values for  $\pi_2$ . These two populations can then be described by probability density functions  $f_1(\mathbf{x})$  and  $f_2(\mathbf{x})$ , and consequently, we can talk of assigning observations to populations or objects to classes interchangeably.

Let  $f_1(\mathbf{x})$  and  $f_2(\mathbf{x})$  be the probability density functions associated with  $\mathbf{X}$  for the populations  $\pi_1$  and  $\pi_2$ , respectively. An object with associated measurements  $\mathbf{x}$  must be assigned to either  $\pi_1$  or  $\pi_2$ . Let  $\Omega$  be the sample space, i.e., the collection of all possible observations  $\mathbf{x}$ . Let  $R_1$  be that set of  $\mathbf{x}$  values for which we classify objects as  $\pi_1$  and  $R_2 = \Omega - R_1$  be the remaining  $\mathbf{x}$  values for which we classify objects as  $\pi_2$ . Since every object must be assigned to one and only one of the two populations, the sets  $R_1$  and  $R_2$  are mutually exclusive and exhaustive.

Let  $p_1$  be the prior probability of  $\pi_1$  and  $p_2$  be the prior probability of  $\pi_2$  where  $p_1 + p_2 = 1$ . Then the overall probabilities of correctly or incorrectly classifying objects can be derived as the product of the prior and conditional classification probabilities.

P (observation is correctly classified as  $\pi_1$ )

$$=P(\text{observation comes from } \pi_1 \text{ and correctly classified as } \pi_1)$$

$$=P(\mathbf{X} \in R_1 / \pi_1) P(\pi_1) = P(1/1)p_1 \quad 3.7.1$$

P(observation is incorrectly classified as  $\pi_1$ )

$$= P(\text{observation comes from } \pi_2 \text{ and misclassified as } \pi_1)$$

$$= P(\mathbf{X} \in R_1 / \pi_2) P(\pi_2) = P(1/2)p_2 \quad 3.7.2$$

P (observation is correctly classified as  $\pi_2$ )

$$=P(\text{observation comes from } \pi_2 \text{ and correctly classified as } \pi_2)$$

$$=P(\mathbf{X} \in R_2 / \pi_2) P(\pi_2) = P(2/2)p_2 \quad 3.7.3$$

P (observation is misclassified as  $\pi_2$ )

$$=P(\text{observation comes from } \pi_1 \text{ and misclassified as } \pi_2)$$

$$=P(\mathbf{X} \in R_2 / \pi_1) P(\pi_1) = P(2/1)p_1 \quad 3.7.4$$

Classification schemes are often evaluated in terms of their misclassification probabilities, but this ignores misclassification cost. A rule that ignores costs may cause problems. The costs of misclassification can be defined by a cost matrix.

		Classify as	
		$\pi_1$	$\pi_2$
True population	$\pi_1$	0	$c(2/1)$
	$\pi_2$	$c(1/2)$	0

The costs are

1. 0 for correct classification.
2.  $c(1/2)$  when an observation from  $\pi_2$  is incorrectly classified as  $\pi_1$ .
3.  $c(2/1)$  when an observation from  $\pi_1$  is incorrectly classified as  $\pi_2$ .

Then the average or expected cost of misclassification (ECM) is provided by

$$ECM = c(2/1) P(2/1) p_1 + c(1/2) P(1/2) p_2 \quad 3.7.5$$

A reasonable classification rule should have an ECM as small as possible.

The regions  $R_1$  and  $R_2$  that minimize the ECM are defined by the values  $\mathbf{x}$  for which the following inequalities hold:

$$R_1 : f_1(\mathbf{x})/f_2(\mathbf{x}) \geq [c(1/2)/c(2/1)] (p_2/p_1) \quad 3.7.6$$

: (Density ratio)  $\geq$  (cost ratio) (prior probability ratio)

$$R_2 : f_1(\mathbf{x})/f_2(\mathbf{x}) < [c(1/2)/c(2/1)] (p_2/p_1) \quad 3.7.7$$

: (Density ratio)  $<$  (cost ratio) (prior probability ratio)

When the prior probabilities are unknown, they are often taken to be equal and the minimum ECM rule involves comparing the ratio of the population densities to the ratio of the appropriate misclassification costs. If the misclassification cost ratio is indeterminate, it is usually taken to be unity. When both the prior probability and misclassification cost ratios are unity, then the optimal classification regions are determined simply by comparing the values of the density functions. In this case, if  $\mathbf{x}_0$  is a new observation and  $f_1(\mathbf{x}_0)/f_2(\mathbf{x}_0) \geq 1$ , i.e.,  $f_1(\mathbf{x}_0) \geq f_2(\mathbf{x}_0)$  we assign  $\mathbf{x}_0$  to  $\pi_1$  otherwise assign  $\mathbf{x}_0$  to  $\pi_2$ .

### 3.7.3 Classification with Two Multivariate Normal Populations

Classification procedures based on normal population predominate in statistical practice because of their simplicity and reasonably high efficiency across a wide variety of population models. We now assume that  $f_1(\mathbf{x})$  and  $f_2(\mathbf{x})$  are multivariate normal densities, the first with mean vector  $\mu_1$  and covariance matrix  $\Sigma_1$  and the second with mean vector  $\mu_2$  and covariance matrix  $\Sigma_2$ .

➤ **Classification of Normal population when  $\Sigma_1=\Sigma_2=\Sigma$**

Suppose that the joint densities of  $X' = [X_1 \ X_2 \ \dots \ X_p]$  for populations  $\pi_1$  and  $\pi_2$  are given by

$$f_i(X) = \frac{1}{(2\pi)^{p/2} |\Sigma|^{1/2}} \exp\left[-\frac{1}{2}(X - \mu_i)' \Sigma^{-1}(X - \mu_i)\right] \quad \text{for } i = 1, 2 \quad 3.7.8$$

Suppose also that the population parameters  $\mu_1$ ,  $\mu_2$ , and  $\Sigma$  are known. Then, after cancellation of

the terms  $\frac{1}{(2\pi)^{p/2} |\Sigma|^{1/2}}$  the Minimum ECM regions become

$$R1: \exp\left[-\frac{1}{2}(X - \mu_1)' \Sigma^{-1}(X - \mu_1) + \frac{1}{2}(X - \mu_2)' \Sigma^{-1}(X - \mu_2)\right] \geq \left[\frac{c(1/2)}{c(2/1)}\right] \left(\frac{p_2}{p_1}\right) \quad 3.7.9$$

$$R2: \exp\left[-\frac{1}{2}(X - \mu_1)' \Sigma^{-1}(X - \mu_1) + \frac{1}{2}(X - \mu_2)' \Sigma^{-1}(X - \mu_2)\right] \leq \left[\frac{c(1/2)}{c(2/1)}\right] \left(\frac{p_2}{p_1}\right) \quad 3.7.10$$

Given the classification regions  $R_1$  and  $R_2$  and assuming the two populations can be described by the above multivariate densities, and then the allocation rule that minimizes the ECM is as follows:

Allocate  $\mathbf{x}_0$  to  $\pi_1$  if

$$(\mu_1 - \mu_2)' \Sigma^{-1} X_0 - \frac{1}{2}(\mu_1 - \mu_2)' \Sigma^{-1}(\mu_1 - \mu_2) \geq \text{natural log} \left[ \frac{c(1/2)}{c(2/1)} \left(\frac{p_2}{p_1}\right) \right] \quad 3.7.11$$

Otherwise allocate  $\mathbf{x}_0$  to  $\pi_2$ .

Since in most practical situations, the population quantities  $\mu_1$ ,  $\mu_2$ , and  $\Sigma$  are unknown. Wald(1944) and Anderson (1984) have suggested replacing the population parameters by their sample estimates.

Suppose that we have  $n_1$  observations of the multivariate random variable  $X' = [X_1 \ X_2 \ \dots \ X_p]$  from  $\pi_1$  and  $n_2$  measurements of this quantity from  $\pi_2$ ,  $n_1 + n_2 - 2 \geq p$ . Then their respective data matrices are

$$X_{1(n_1 \times p)} = [X'_{11} \ X'_{12} \ \dots \ X'_{1n_1}] \text{ and } X_{2(n_2 \times p)} = [X'_{21} \ X'_{22} \ \dots \ X'_{2n_2}] \quad 3.7.12$$

From these data matrices, the sample mean vectors and covariance matrices are determined by

$$\bar{X}_{1(p \times 1)} = \frac{1}{n_1} \left( \sum_{j=1}^{n_1} X_{1j} \right) \quad S_{1(p \times p)} = \frac{1}{n_1 - 1} \sum_{j=1}^{n_1} (X_{1j} - \bar{X}_1)(X_{1j} - \bar{X}_1)' \quad 3.7.13$$

$$\bar{X}_{2(p \times 1)} = \frac{1}{n_2} \left( \sum_{j=1}^{n_2} X_{2j} \right) \quad S_{2(p \times p)} = \frac{1}{n_2 - 1} \sum_{j=1}^{n_2} (X_{2j} - \bar{X}_2)(X_{2j} - \bar{X}_2)' \quad 3.7.14$$

Since it is assumed that the parent population has the same covariance matrix  $\Sigma$ , the sample covariance matrices  $S_1$  and  $S_2$  are combined (pooled) to derive a single unbiased estimator of  $\Sigma$ , that is

$$S_{pooled} = \frac{(n_1 - 1)S_1 + (n_2 - 1)S_2}{n_1 + n_2 - 1} \quad 3.7.15$$

is unbiased estimator of  $\Sigma$  if the data matrices  $X_1$  and  $X_2$  contain random samples from the populations  $\pi_1$  and  $\pi_2$ , respectively.

Then the estimated minimum ECM rule for two normal populations is given by equation 3.7.11

where in we substitute  $\bar{x}_1$  for  $\mu_1$ ,  $\bar{x}_2$  for  $\mu_2$ , and  $S_{pooled}$  for  $\Sigma$  .i.e.

allocate  $\mathbf{x}_0$  to  $\pi_1$  if

$$(\bar{x}_1 - \bar{x}_2)' S^{-1}_{pooled} \mathbf{x}_0 - (\bar{x}_1 - \bar{x}_2)' S^{-1}_{pooled} (\bar{x}_1 - \bar{x}_2) \geq \text{natural log} \left[ \frac{c(1/2)}{c(2/1)} \left( \frac{p_2}{p_1} \right) \right] \quad 3.7.16$$

Otherwise allocate  $\mathbf{x}_0$  to  $\pi_2$  .

If  $[c(1/2)/c(2/1)](p_2/p_1) = 1$ , then  $\ln(1)=0$  ,and the estimated minimum ECM rule for two normal populations amounts to comparing the scalar variable

$$\hat{y} = (\bar{x}_1 - \bar{x}_2)' S^{-1}_{pooled} \mathbf{x} = \hat{a}'x \quad 3.7.17$$

evaluated at  $\mathbf{x}_0$  ,with the number

$$\hat{m} = (\bar{x}_1 - \bar{x}_2)' S^{-1}_{pooled} (\bar{x}_1 - \bar{x}_2) = \frac{1}{2}(\bar{y}_1 + \bar{y}_2) \quad 3.7.18$$

where  $\bar{y}_1 = (\bar{x}_1 - \bar{x}_2)' S^{-1}_{pooled} \bar{x}_1 = \hat{a}'\bar{x}_1$  and  $\bar{y}_2 = (\bar{x}_1 - \bar{x}_2)' S^{-1}_{pooled} \bar{x}_2 = \hat{a}'\bar{x}_2$

And the estimated minimum ECM rule for two normal populations is tantamount to creating two univariate populations for the y values by taking appropriate linear combination of the observations from population  $\pi_1$  and  $\pi_2$  and then assigning a new observation  $\mathbf{x}_0$  to  $\pi_1$  or  $\pi_2$ , depending upon whether  $\hat{y}_0 = \hat{a}'x_0$  falls to the right or left of the mid point  $\hat{m}$  of the two univariate means  $\bar{y}_1$  and  $\bar{y}_2$  .

### 3.7.4 Fisher's Discriminant Function

Fisher (1936) taking linear combinations of x to create y's. Fisher does not assume the population as normal; however it assumes that the population covariance matrices are equal.

A fixed linear combination of the x's takes the values  $y_{11}, y_{12}, \dots, y_{1n_1}$  for the observations from the first and the values  $y_{21}, y_{22}, \dots, y_{2n_2}$  for the observation from the second population . The

separation of these two sets of univariate  $y$ 's is assessed in terms of the difference between  $y_1$  and  $y_2$  expressed in standard deviation units. That is

$$\text{Separation} = \frac{|\bar{y}_1 - \bar{y}_2|}{s_y}, \text{ where } s_y^2 = \frac{\sum_{j=1}^{n_1} (y_{1j} - \bar{y}_1)^2 + \sum_{j=1}^{n_2} (y_{2j} - \bar{y}_2)^2}{n_1 + n_2 - 2}$$

is the pooled estimate of the variance.

The linear combination  $\hat{y} = \hat{a}'x = (\bar{x}_1 - \bar{x}_2)'S_{pooled}^{-1}x$ , which is Fisher's Discriminant function, maximizes the ratio

$$\begin{aligned} \frac{(\bar{y}_1 - \bar{y}_2)^2}{s_y^2} &= \frac{(\hat{a}'\bar{x}_1 - \hat{a}'\bar{x}_2)^2}{\hat{a}'S_{pooled}\hat{a}} \\ &= \frac{(\hat{a}'d)^2}{\hat{a}'S_{pooled}\hat{a}} \end{aligned} \quad 3.7.20$$

Overall possible coefficient vectors  $\hat{a}$  where  $d = (\bar{x}_1 - \bar{x}_2)$ . The maximum of the above ratio is  $D^2 = (\bar{x}_1 - \bar{x}_2)'S_{pooled}^{-1}(\bar{x}_1 - \bar{x}_2)$  3.7.21

Suppose the populations  $\pi_1$  and  $\pi_2$  are multivariate normal with a common covariance matrix  $\Sigma$ . Then, a test of  $H_0: \mu_1 = \mu_2$  versus  $H_1: \text{not } H_0$  is accomplished by comparing the value:

$$\frac{(n_1 + n_2 - p - 1)(n_1 n_2)}{(n_1 + n_2 - 2)p(n_1 + n_2)} D^2$$

With the tabulated F-distribution with  $v_1 = p$  and  $v_2 = n_1 + n_2 - p - 1$  degrees of freedom.

If  $H_0$  is rejected, we can conclude that the separation between the two populations is significant.

One can test the number of roots that add *significantly* to the discrimination between group. Only those found to be statistically significant should be used for interpretation; non-significant functions (roots) should be ignored. (Johnson 2002)

## **Chapter Four**

### **Study Results**

#### **4.1 Introduction**

The study results are discussed in this chapter, starting with sample profile of the demographic and social back ground of the study participants followed by a description of their treatment status, their opinions on the social support, their knowledge about the ART and service provision qualities. The results of bivariate relationships between study variables and adherence to treatment was discussed. The chapter concludes with the analysis of the study hypothesis, which where assessed using multivariate techniques of data analysis.

#### **4.2 Description of the study variables**

##### **4.2.1 Demographic and socio economic variables**

The study sample was comprised of 147 adults of women (61.9%) and men (38.8%).Table A1.1 (Annex 1). The majority of the participants (48.1%), either separated or widowed, and the rest are still married (42.9%) or never married (19%).The participants' ethnicity comprises the major ethnic groups in the country, Oromo (34.4%), Amhara (36.7%), South nations and nationalities people (or SNNP) (22.4%) ,and Tigray(6.1%) . Orthodox (54.4%), the protestant (29.3%) and Muslim(16.3%). The majority of the respondents were unemployed (about 75.5%).

As can be seen from Table A1.2 (Annex 1) approximately 89% of the participants reported their monthly income as No income (32%) or below 100 birr (57.1%). Some of the respondents who reported below 100 birr said they do not have income but they were using informal income earning mechanisms like baking traditional “ambasha” and selling. As for education the majority of the respondents (72.8%) were either elementary or high school drop outs and 21.1% reported either no education (illiterate) or basic education. More than one half of the respondents (56.5%) live in a rented house. The rest 32% owned a house, 9.5% were homeless (that is, they were living with their family and friends) and 2% live in NGO shelter.

##### **4.2.2 Treatment characteristic**

The health status of the respondents at the time of the study was assessed using treatment characteristic variables such as disease stage, CD4 count and duration of the Therapy.

Almost one half of the respondents were on WHO stage III (47.6%)followed by WHO stage II

(27.9%) , WHO stage VI (13.6%), WHO stage I(9.5%) and only two respondents reported not having disease stage.

Above one third of the respondents (34%) reported from 101 to 200 CD4 cell count, from 201 to 300 CD4 cell count (25.9%), above 300 CD4 cell count (23.1%) and less than 100 CD4 cell count(17%).More than one third of the respondents reported from six to twelve months of duration of therapy (42.9%) and the rest; from two to six months (28.6%), from twelve to thirty six months (25.9%) and 2.7% less than two months.(Table A1.4 Annex 1)

### **4.2.3 Patient characteristics**

The health status of the respondents can also be described using the depression status of the respondent. According to our scaling mechanism the bottom two item scales correspond to having depression and the rest not having depression in the study period. Therefore, 24.5% reported having depression and the rest do not have depression in the study period. (Table A1.4 Annex 1)

### **4.2.4 Regimen complexity**

The type of regimen and the side effect encounter due to this regimen which shows drug complexity, in many literatures is a predictive of adherence to treatment. All except one of the respondents were on first line regimen, twice daily intake and three or two doses per intake. This shows no problem with pill burden or food or fluid restriction. But one of the respondents reported that she is taking five doses. More than one half of the respondents (59.2%) were on 1a30/40(D4T/3TC/NVP), about quarter of the respondents were on 1b30/40 (D4T/3TC/EFV), 1c (AZT/ 3TC/NVP) (8.2%), and 1d (AZT/3TC/EFV) (6.8%). (Table 1.3 Annex A).

Almost half of the respondents reported no side effect (46.3%). Of those who had encountered 13.6% reported head ache, 12.9 % reported fatigue, 7.5% had nausea and vomiting and the rest other side effects mentioned in Table 1.5 (Annex 1)

#### **4.2.5 Social support**

The social support that the respondent received can be from family, friends, and community and support organizations. The variables along with their response are tabulated in Table A1.6 (Annex 1).

#### **4.2.6 Disclosure status, ART knowledge, and Service provision and accessibility**

Disclosure status of the respondent can be described using two variables such as disclosure to family (spouse, children, mother, father, and relatives) and disclosure to community (neighbors, "Edir" and public gathering). The variables and their percent of response is presented in the Table A1.7 the majority of the respondents have disclosed their HIV status both for their spouse, children, mother or father, and relatives (79.6%), and to their community (69.7%).

More than half of the respondents reported that confidentiality of the ART service is very good; while the rest fear that their status has been known as they come to the hospital. Service hour delay has been reported as a problem (64.7%) and the rest said there is no problem with service hour. The majority of the respondents reported sympathetic and good reception service provision, i.e., the sum of the lowest three ranks in the likert scale (96.6%). Transportation problem is a big problem to the hospital as the hospital is 12km from Shashemene town (83.0%) (Table A1.7 Annex 1).

#### **4.2.7 Adherence to ART**

Some of the respondents have totally discontinued the medication in the study period (2%), also they had at least missed one dose of medication and they had missed dosage timing (17%). Some of the respondents reported they had missed medication but not in the study period (54.4%). 25.5% of the respondents reported they had not missed starting from the beginning of the ART therapy. (Table A1.8 Annex 1). Non adherent respondents have pointed the reason of missed medication and are presented in (Table A1.9 Annex 1). Those of who missed some times said they didn't understand when and how to take medication during their first month of start of medication. The mean adherence rate of the Shashemene General Hospital was calculated using weighted average and was found to be 84.62 % (Table A1.10 annex 1).

## 4.3 Data analysis

We have used both bivariate and multivariate data analysis to investigate the association of the independent variables with the dependent variable. We used two different techniques to see the association of the dependent variable Vs the independent. As our data is a mixture of categorical and likert scale items; we divided the bivariate data analysis into two. We used the Pearson's Chi-square to observe the association of the categorical variables with the adherence to ART variable. Where as for likert scale or opinion variables we have used two strategies-an *ordinal* strategy and a *parametric* one. The purpose of this is to investigate the assertion that the two methods will produce approximately the same result in analyzing a likert scale data. The statistical software employed is SPSS. Moreover, statistical techniques such as multivariate factor analysis, Principal component analysis, and discriminant analysis were used in multivariate data analysis.

### 4.3.1 Bivariate association of adherence with the explanatory variables

A preliminary analysis was done to determine which of the explanatory variables appear to have a strong association with adherent to ART. For categorical independent variables a test of association was carried out using the Pearson Chi-Square. The bivariate association between adherence to ARV medication and selected demographic variables is shown in Table 4. 1

**Table 4.1 Association between adherence and socio- demographic variables**

Variables	Person Chi-Square	df	Significance( p- value)
Gender	2.079	1	0.149
Age	0.248	2	0.883
Marital status	3.108	4	0.54
Ethnic group	4.016	3	0.26
Religion	2.338	2	0.331
Occupation	20.126	3	0.000
Income	15.646	4.	0.004
Education level	11.445	3	0.010
Housing	1.437	3	0.697

We can see from Table 4.1 occupation, income and educational levels are significantly associated with adherence to ART. This is in some contradiction with the study which says “none of the following variables were found to be consistently predictive of non-adherence: age, race/ethnic group, sex, marital status, religion, socioeconomic status, level of education, or occupation (Besch 1995)”. Where as there is no sufficient information to conclude the existence of association between treatment characteristic variables and adherence to ART (Table 4. 2). This is due to the fact that the data collected on these variables was secondary data which didn’t show the characteristic of the patient’s treatment status in the study period. So a primary data on these variables has to be gathered to check the association.

**Table 4. 2 Association of treatment characteristic variables and adherence**

Variables	Pearson Chi-Square value	Degree of freedom	Significance( p- value)
CD4 count	4.473	3	0.215
WHO disease stage	1.895	4	0.755
Duration of therapy	0.294	3	0.961

From the correlation table we have discovered that only depression has strong associated with adherence to ART (Table B2.1 Annex 2). Where as the result obtained using the non parametric method (Kendall's tau-b) indicates a sort of association between service hour variable and adherence to ART. Further more, we have identified the two methods gave similar results.

**4.3.2 Principal Components (PCs) and Factor Analysis**

Before analyzing the data using Principal Component analysis and Factor analysis, we checked for sampling adequacy using Kaiser-Meyer-Olkin (KMO) and Bartlett test of sphericity ( or the significance of the correlation matrix ) and Anti-image (Table B 2.2 and 2.3 annex 2). Including all variables, the value obtained for KMO was 0.713 and the sphericity was significant but by dropping all categorical variables we increased Kaiser-Meyer-Olkin (KMO) Measure of Sampling adequacy to 0.802. Further dropping other variables increased the value to 0.842.

The composite reliability for the variables was assessed by calculating the Cronbach’s  $\alpha$  value of the variables included in the analysis. It was found to be 0.760. But further reduction in the

number of the variables has a tendency to improve the overall reliability of the Cronbach's  $\alpha$  . The final composite reliability for the social support, depression, ART attitude, Adherence knowledge, Adherence, ART service factors was calculated and the Cronbach's  $\alpha$  was found to be 0.824 (Table B2.6 annex 2).

Multivariate analysis in the form of factor (principal components) was conducted on all perceived determinant of adherence, except categorical and ART Knowledge variables. Orthogonal factors were obtained using varimax rotation. This eliminated problems of multicollinearity. Only those factors with an eigenvalue greater than one and high Cronbach  $\alpha$  coefficients are considered. Cronbach's  $\alpha$  can be interpreted as the percent of variance that the observed scale would explain in the hypothetical true scale composed of all possible items in the universe.

The composite reliabilities of the factors were checked against the Nunnally's recommended standards (Cronbach  $\alpha \geq .7$ ) mainly to ensure that they are reliable indicators of the constructs (Nunnally, 1967). Cronbach's  $\alpha$  is the most common form of internal consistency reliability coefficient based on the average inter-item correlation.

After excluding categorical variables we used multivariate techniques on the variables whose response values are measured in Likert scale using SPSS statistical software. The aim of factor analysis was whether we can reduce the factors to few manageable factors which can explain most of the variation in the dependent variable.

In varimax rotation factor solution for these variables, 65.36% of the total variance was explained by the first 4 factors with Eigen values greater than 1 (see Table 4.4). The variance between factors is more skewed towards the first factor, with the first factor accounting for 36.76%, the second, 13.34% the third, 9.32% and the fourth, 6.22%, of the variation.

The first factor that comprised nine items is the most significant (accounting for 36.76% of the variance of the original items). This is largely loaded with measure of social support items then we labeled it as **Social support**. The second factor that comprised of the four items accounting for 13.5% of the variation is largely loaded with HIV serostatus disclosure and we label this factor as **HIV serostatus status disclosure**. The third factor that comprised of four items and heavily loaded on NGO support, Transportation problem, and reception labeled as **Home based care** as NGO support and Transportation problem are highly loaded. The fourth and the final factor is

comprised of two items and heavily loaded on depression and service hour is labeled as **Psychological well being** (Table B2.5 and Fig.2 annex 2).

From this analysis, the Cronbach's  $\alpha$  value is 0.824 and this indicates that the items are adequate scale; both the inter and intra items correlation become high and, consequently, the items coefficient of determination becomes large to explain the variance of the model.

**Table 4.4: Factors extracted using varimax factor rotation**

Item	Factor <sub>1</sub>	Factor <sub>2</sub>	Factor <sub>3</sub>	Factor <sub>4</sub>
Variance accounted for	36.76%	13.34%	9.32%	6.22%
Eigenvalue	6.250	2.267	1.584	1.057
- Directsupport_1	0.819			
- Emotional support_1	0.832			
- Informational support_1	0.779			
- Directsupport_2	0.805			
- Emotional support_2	0.845			
- Emotional support_3	0.843			
- Informational support_1	0.803			
- Directsupport_3	0.794			
- Directsupport_4	0.816			
- Family disclosure		0.677		
- Community disclosure		0.898		
- NGO support			0.537	
- Reception			0.457	
-Transportation problem			0.759	
- Depression				0.878
- Service hour				0.545

**Reliability of factor (Cronbach  $\alpha$ =.824)**

### **4.3.3 Discriminant Analysis (DA)**

In order to differentiate between the barriers of adherence and facilitators of adherence we made our data analysis for adherent and non adherent patients separately. The data was divided into two those who did not adhere the treatment in the past two weeks prior to the assessment and those of who adhere to the treatment. The variables which were identified as the loaded variables on HIV serostatus status disclosure, Home based care and Psychological well being in the factor analysis were used. Socio demographic variables were analyzed but there were no significance in including these variables in the analysis as the SPSS stepwise discriminant analysis removes them finally. The cost function of the SPSS default value was used in the analysis.

### **Stepwise Discriminant Analysis**

Probably the most common application of discriminant function analysis is to include many measures in the study, in order to determine the ones that discriminate between groups. We want to build a "model" of how we can best predict to which group a case belongs. In stepwise discriminant function analysis, a model of discrimination is built step-by-step. Specifically, at each step all variables are reviewed and evaluated to determine which one will contribute most to the discrimination between groups. That variable will then be included in the model, and the process starts again.

The stepwise procedure is "guided" by the respective  $F$  to enter and  $F$  to remove values. The  $F$  value for a variable indicates its statistical significance in the discrimination between groups, that is, it is a measure of the extent to which a variable makes a unique contribution to the prediction of group membership.

#### **4.3.3.1 Case 1: Adherent patients**

Before the data analysis we have assumed that good service provision, strong social support, HIV serostatus disclosure and high CD4 count, no transportation problem and good NGO support as being facilitators of adherence. But after the data analysis the variables that have been identified to being facilitators of adherence includes good reception, strong NGO support , high CD4 count and free transportation mechanism. The model that can discriminate

significantly between the groups of adherent patients has correlation coefficient of 0.519 (Table B 2.21 to 2.25 annex 2). The model that significantly discriminates among groups of adherent patients can be given as

$$Y = -0.449X_1 + 0.796X_2 + 0.244X_3 + 0.538X_4 \quad 4.3.3.1$$

Where Y denotes adherent group,  $X_1$  is transportation problem,  $X_2$  is reception,  $X_3$  is CD4 count and  $X_4$  is NGO support.

### Classification

Fisher's linear discriminant function was used for each of the three groups of adherent patients. There are three classification models for each group. The classification power of our analysis was investigated using the classification matrix which shows 66.4% of the original group cases classified correctly (Table B 2.26 to 2.27 annex 2).

Let  $S_1$  be those adherent patients who have been considered to adhere to the treatment "Some of the time". Let  $S_2$  be those who have been considered to adhere to the treatment "Most of the time". And finally let  $S_3$  be those who have been considered to adhere to the treatment "All of the time". Then following the above argument the Fisher's linear discriminant function for each of the groups is given by

$$S_1 = -16.233 + 1.38 X_1 + 5.084 X_2 + 2.556 X_3 + 1.979 X_4 \quad 4.3.3.2$$

the second group will be

$$S_2 = -11.655 + 2.002 X_1 + 3.627 X_2 + 2.099 X_3 + 1.082 X_4 \quad 4.3.3.3$$

And the third group

$$S_3 = -13.904 + 1.406 X_1 + 3.207 X_2 + 3.076 X_3 + 2.087 X_4 \quad 4.3.3.4$$

If we had been given test data, then we would have assigned those cases to each group according to the value calculated using the variables of facilitators of adherence values on these functions.

#### **4.3.3.2 Case 2: Non adherent patients**

The variables that were identified as facilitators of adherence were a valuable information for the analysis of the non adherent patients data. Prior to the data analysis transportation problem, depression, no NGO support, and poor service quality have been assumed to be statistically significant barriers of adherence. After the data analysis the variables that qualified to be in the discriminating model and have been identified as barriers of adherence includes depression, NGO support and HIV serostatus disclosure. These variables have significantly discriminated between the two groups of non adherent patients and also we observed good canonical correlation between the variables and the dependent variable. Finally the model that can discriminate significantly between the groups of non adherent patients can be given as (Table B2. 13 to 2.15 annex 2)

$$Y = 0.935X_1 + 0.805X_2 - 0.683X_3 \quad 4.3.3.5$$

Where the dependent variable adherent to treatment: Y, and the independent variables depression, community disclosure and NGO support denoted by X<sub>1</sub>, X<sub>2</sub>, and X<sub>3</sub> respectively.

#### **Classification**

The second goal of discriminant analysis is to classify observations into groups based on their natural measurements. We classified our non adherent patients, using the two group Fisher's linear discriminant function, into two groups of non adherent patients. There are two classification models for each group. The classification power of our analysis was investigated using the classification matrix which shows 89.3% of the original group cases classified correctly (Table B 2.16 and 2.17).

Let S<sub>1</sub> be those non adherent patients who said they had taken the medication "none of the time". Similarly let S<sub>2</sub> be those who said "A little of the time". Then following the above argument the

Two group Fisher's linear discriminant function is given by

$$S_1 = -17.054 + 4.669X_1 + 3.275X_2 - 1.022X_3 \quad 4.3.3.6$$

And the second group will be

$$S_2 = -7.251 + 2.523X_1 + 1.787X_2 + 0.525X_3 \quad 4.3.3.7$$

If we had test data, we would have assigned those cases to each group according to the value calculated using the variables of adherence barriers values on these functions.

## **Chapter five**

### **Conclusion and recommendation**

#### **5.1 Conclusion**

Adherence to ARV medications is critically important for the success of therapy in patients who are on ART. The mean adherence rate of a patient in the hospital has been observed to be 84.62%. This study also found that 19% of the respondents are non adherent to antiretroviral drugs which is an indication of a need to closely monitor this problem in the area.

Using factor analysis four factors were extracted which explained 65.36% of the variation in adherence to ART and labeled them as social support, HIV serostatus disclosure, Home based care and psychological well being.

We have identified a number of socio-demographic and economic variables which were associated with adherence to ART in the univariate analysis such as occupation, income, and level of education, depression and service hour. Where as in the discriminant analysis only depression, NGO support, CD4 count, transportation problem, reception and community disclosure variables predicted satisfactory adherence to treatment.

In the discriminant analysis having depression, disclosing one's HIV serostatus and poor NGO support have been identified as barriers of adherence while high CD4 count, no transportation problem, strong NGO support, and good reception have been identified as facilitators of adherence.

#### **5.2 Recommendation**

To improve adherence of the patients the intervention areas has to focus on patient related factors like depression. Psychiatric consultations and appropriate treatment should be more systematically offered to socially vulnerable patients.

Interventions to improve ART adherence should address no transportation problem mechanism, a strong collaboration in terms of information exchange with other NGOs, and a frequent CD4 count disclosure has to be made for the HIV patients. Finally as we have seen from the analysis the service providers in the hospital was considerate and sympathetic towards the HIV patients. This trend has to continue for the success of the program.

### **5.3 Limitations of the study**

This study has several limitations some of them are the study period which is one month is not enough to trace the defaulting patients so study period more than one month has to be employed to see the full impact and factors of non adherence.

It is clear that adherence to ART is a multidimensional phenomenon comprising multiple interrelated factors and as such requires a multidisciplinary approach. Adherence (or the lack of) to treatment is an interaction between the patient, the regimen, the providers of therapy, and the environment in which this occurs. This interaction is the context in which adherence does or does not occur.

This is a self reported adherence so we don't know the accuracy of the response from the respondent as adherence is a sensitive issue among patients on ART.



## References

- Ammassari et al(2004). *Depressive symptoms, neurocognitive impairment and adherence to highly active antiretroviral therapy among HIV infected persons*,  
<http://psy.psychiatryonline.org/cgi/reprint/45/5/394.pdf>
- Anderson T.W. (1984). *An introduction to multivariate statistical methods* (2<sup>nd</sup> edition.),  
New York ,John Wiley ,
- Anita Hardon [et al.]( 2006). *From access to adherence: the challenges of antiretroviral treatment: studies from Botswana ,Tanzania and Uganda* ,WHO 2006.
- Besch, L.C. (1995). *Compliance in clinical trials*. *AIDS*, 9, 1–10.
- Broers, et al. (1994). *A Cohort study of drug users compliance with zidovudine treatment*.  
*Archives of Internal Medicine*, 154, 1121-1127.
- Buhrich, N & Judd, F.K. (1997). *HIV and psychiatric disorders*. In G. Stewart (Ed.), *Managing HIV*. Sydney: Australasian Medical Publishing Company.
- Carr, A. & Garsia, R. (1997). *How HIV leads to hypersensitivity reactions*. In G. Stewart (Ed.),  
*Managing HIV*. Sydney: Australasian Medical Publishing Company.
- Catz, S., Heckman, T. & Kochman, A. (1999). *Adherence to HAART therapy among older adults living with HIV disease*. 4th International Conference on the Biophysical Aspects of HIV Infection, Canada: Ottawa, Poster 18.
- Carrieri et al. *The dynamic of adherence to highly active antiretroviral therapy: Results from the French national APROCO cohort*. *Journal of Acquired Immune Deficiency Syndromes*. 2001;28:232–239.
- Carrieri et al. *The dynamic of adherence to highly active antiretroviral therapy: Results from the French national APROCO cohort*. *Journal of Acquired Immune Deficiency Syndromes*. 2002;28:232–239.
- Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B, Wu AW. (2000).  
*Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: AACTG adherence instruments*. Patient Care Committee & Adherence Working Group of the Outcomes Committee of the Adult AIDS Clinical Trials Group (AACTG). *AIDS Care*. Jun;12(3):255-66.
- Chesney MA (2000). *Factors affecting adherence to antiretroviral therapy*. *Clinical Infectious Diseases*, 30(Suppl 2):S171-S176.

- Condra, J.H. (1998). *Resistance testing. Annals of Internal Medicine*, 128, 951–954.
- Crespo-Fierro, M. (1997). *Compliance/adherence and care management in HIV disease. Journal of the Association of Nurses in AIDS Care*, 8, 43–54.
- Deeks, S. (1997). *Factors associated with failure to achieve viral suppression. 37th ICAAC*, Canada: Toronto, Abstract 412.
- Erlon, J.A. & Mellors, P. (1999). *Adherence to combination therapy in persons living with HIV: balancing the hardships and the blessings. Journal of the Association of Nurses in AIDS Care*, 10 (4), 75–84.
- Eraker, S.A., Kirscht, J.P. & Becker M.H. (1984). *Understanding and improving compliance. Annals of Internal Medicine*, 100, 258–268.
- Federal Ministry of Health Ethiopia/National HAPCO, 2006. *AIDS in Ethiopia 6<sup>th</sup> report* .
- Fisher R.A., *The use of multiple measurements in Taxonomic problems* ., *Annals of Eugenics* 7(1936): 179-188.
- Flexner, C. (1997). *Practical treatment issues and adherence: Challenges from the clinic. Clinical Care Options for HIV Treatment Issues*. [Available on-line: [www.healthcg.com/hiv/treatment/icacac97/adherence/print.html](http://www.healthcg.com/hiv/treatment/icacac97/adherence/print.html)].
- Furtado, M.R., Callawya, D.S., Phair, J.P., Kunstman, K.J., Stanton, J.L., Macken, C.A., Perelson, A.S. & Wolinsky, S.M. (1999). *Persistence of HIV-1 transcription in peripheral blood mononuclear cells in patients receiving potent HAART therapy. The New England Journal of Medicine*, 340 (21), 1614–1622.
- Gao X, Nau DP, Rosenbluth SA, et al. *The relationship of disease severity, health beliefs and medication adherence among HIV patients. AIDS Care*. 2000; 12:387-398.
- Golin CE, Liu, Hayes RD et al. *A prospective study of the predictors of adherence in combination anti retroviral medication. Gen. Intern. Med.* (2002); 17: 756-765.
- Grierson, J., Bartos, M., de Visser, R. & McDonald, K. (2000). *HIV futures II: the health and well being of people with HIV/AIDS in Australia. Monograph Series Number 17*, La Trobe University.
- Jae-On Kim ,Sep., 1975 *The American Journal of Sociology*, Vol. 81, No. 2. , pp. 261-298.
- Halkitis PN, Parsons JT, Wolitski R, Remien RH. *Characteristics of HIV antiretroviral treatments, access and adherence in an ethnically diverse sample of men who have sex with men. AIDS Care*. 2003;15:89–102.

- Hayman, J. & Buhrich, N. (1994). *Psychiatric aspects*. In J. Gold, R. Penny, M. Ross, S. Morey, G. Stewart, B. Donovan & S. Berenger (Eds.), *The AIDS Manual*. Sydney:
- Horne, R., Pearson, S., Leake, H., Fisher, M. & Weinman, J. (1999). *Patients beliefs about HAART influences adherence to HAART therapy*. 39th Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, Abstract 588.
- Ickovics, J.R. & Meisler, A.W. (1997). *Adherence in AIDS clinical trials: a framework for clinical research and clinical care*. *Journal of Clinical Epidemiology*, 50 (4), 385–391. IAVI Report on HIV/AIDS (2002)
- Ickovics JR., 1997. *Measures of adherence*. *Adherence to New HIV Therapies: A Research Conference*. Washington, DC. November)
- Johnson, M.O., Stallworth, T., and Neilands, T.B. (2003). *The drugs or the disease? Causal attribution of symptoms held by HIV positive adults on HAART*. *AIDS and Behavior*, 7:109-117
- Jones, J.L., Nakashima, A.K. & Kaplan, J.E. (1999). *Adherence to primary prophylaxis for pneumocystis carinii pneumonia: results from a multi-state interview project*. 39th Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, Abstract 586.
- Kamman, E., Williams, P., Chesney, M.A. & Currier, J. (1999). *Predictors of adherence to azithromycin prophylaxis for prevention of mycobacterium avium complex (MAC) disease*. 6th Conference on Retroviruses and Opportunistic Infections, Chicago, Abstract 444.
- Kaplan, A., Golin, C. Beck, K., Lui, H. & Hays, R. (1999). *Adherence to protease inhibitor therapy and viral load*. 6th Conference on Retroviruses and Opportunistic Infections, Chicago, Abstract 96, Chicago.
- Klosinski, L.E. & Brooks, R.N. (1998). *Predictors of non-adherence to HIV combination therapies*. 12th World AIDS Conference, Geneva, Abstract 32375.
- Michael J. Stirratt, (2006) *The Role of HIV Serostatus Disclosure in Antiretroviral Medication Adherence*.
- Morales, R., Figueiredo, V.M., Sinkoc, M.C.B., Gallani, C. & Tomazin, S.L. (1998). *Adherence of patients with AIDS to treatment with HAART medications: difficulties related*

*and proposition of attenuating measures. 12th World AIDS Conference, Geneva, Abstract 42442.*

Mugenyi, P. (2002). *HIV/AIDS Situation in Africa. Statement By Dr. Peter Mugenyi Joint Clinical Research Center Kampala Uganda*

Nunnally, J. (1967). *Psychometric Theory*, McGraw Hill, New York.

Paterson DL et al. (2000). *Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. Annals of Internal Medicine, 133:21–30.*

Pratt RJ, Robinson N, Loveday HP, Pellowe CM, Franks PJ, et al. (2001). *Adherence to Antiretroviral Therapy: Appropriate use of self-reporting in clinical practice, HIV Clin Trials 2: 146–159.*

Richard A. Johnson and Dean W. Wichern(2002) *Applied Multivariate statistical analysis (5<sup>th</sup> edition)* Pearson Education, Inc.

Stone, V.E., Adelson-Mitty, J., Duefield, C.A., Steger, K.A., Stein, M.D. & Mayer, K.H. (1998). *Adherence to protease inhibitor therapy in clinical practice: Usefulness of demographics, attitudes, and knowledge as predictors. 12th World AIDS Conference, Geneva, Abstract 32337.*

Singh, N., Squier, C., Sivek, C., Wagener, M., Hong Nguyen, M. & Yu, V.L. (1996). *Determinants of adherence with antiretroviral therapy in patients with human immunodeficiency virus: Prospective assessment with implications for enhancing adherence. AIDS Care, 8(3): 261-269.*

Shuter J. Treatment Adherence Network Meeting (2001). *Measuring adherence. NYS Dept. of Health AIDS Institute. (PDF-Powerpoint Presentation) Available at: [http://www.hivguidelines.org/public\\_html/center/clinical-education/education-slide-presentations/measuring\\_adherence/measuring\\_adherence.pdf](http://www.hivguidelines.org/public_html/center/clinical-education/education-slide-presentations/measuring_adherence/measuring_adherence.pdf)*

Torpey K, Drah B, Enniful H, Tetteh T, Benefour S. (2004) *Improving Adherence: The role of disclosure and adherence monitors International Conference AIDS. 2004 Jul 11-16; 15: abstract no. WePeB5781.*

UNAIDS. *2006 Report on the global AIDS epidemic.* Geneva, United Nations Joint Programme on AIDS, 2006.

WHO/UNAIDS. *Progress on global access to HIV antiretroviral therapy: a report on “3 by 5” and beyond.* Geneva, World Health Organization/United Nations Joint Programme on AIDS, 2006.

- Wald ,A., *On a statistical problem arising in the classification of an individual into one of two groups* . Annals of Mathematical Statistics,15(1944):145-162.
- Wenger, N., Gifford, A., Liu, H., Chesney, M. & Golin, C. (1999). *Patient characteristics and attitudes associated with HAART adherence*. 6th Conference on Retroviruses and Opportunistic Infections, Chicago, Abstract 981
- Williams, A. & Friedland, G. (1997). *Adherence, adherence, and HAART*. *AIDS Clinical Care*, 9: 51-55.
- William G. Cochran(1977).*Sampling techniques* (3<sup>rd</sup> edition). New York ,John Wiley.
- Yonas Tadios Gail Davey ,2006.*Antiretroviral treatment adherence and its correlates in Addis Ababa, Ethiopia* . *Ethiopia med J* Vol 44 No3.

## Annex 1: Data output collected from patients on ART program.

Table A1.1 Description of demographic variables

Variable	Category	Frequency	Percent
Gender	Female	91	61.9
	Male	56	38.1
Age	From 15 to 30 years	64	43.5
	From 31 to 49 years	79	57.7
	From 50 to 60 years	4	2.7
Marital status	Never married	28	19.0
	Still married	63	42.9
	Separated/divorced	22	15.0
	Widow	34	23.1
Ethnicity	SNNP	33	22.4
	Amhara	54	36.7
	Oromo	51	34.7
	Tigray	9	6.1
Religion	Muslim	24	16.3
	Orthodox	80	54.4
	Protestant	43	29.3

**Table A1.2 Description of socio- Economic variables**

<b>Variable</b>	<b>Category</b>	<b>Frequency</b>	<b>Percent</b>
<b>Occupation</b>	<b>Employed</b>	<b>15</b>	<b>10.2</b>
	<b>Owen business</b>	<b>10</b>	<b>6.8</b>
	<b>Jobless</b>	<b>111</b>	<b>75.5</b>
	<b>Own farm</b>	<b>11</b>	<b>7.5</b>
<b>income</b>	<b>No income</b>	<b>47</b>	<b>32.0</b>
	<b>Below 100 birr</b>	<b>84</b>	<b>57.1</b>
	<b>From 101 to 500 birr</b>	<b>9</b>	<b>6.1</b>
	<b>More than 500 birr</b>	<b>7</b>	<b>4.8</b>
<b>Educational level</b>	<b>No education</b>	<b>27</b>	<b>18.4</b>
	<b>Basic education</b>	<b>4</b>	<b>2.7</b>
	<b>Elementary or high school</b>	<b>107</b>	<b>72.8</b>
	<b>Certificate or diploma</b>	<b>8</b>	<b>5.4</b>
	<b>Degree</b>	<b>1</b>	<b>0.7</b>
<b>Housing status</b>	<b>Owned a house</b>	<b>47</b>	<b>32.0</b>
	<b>NGO shelter</b>	<b>3</b>	<b>2.0</b>
	<b>Rent</b>	<b>83</b>	<b>56.5</b>
	<b>Homeless</b>	<b>14</b>	<b>9.5</b>

**Table A1.3 Description of drug regimen**

<b>Drug regime</b>	<b>Frequency</b>	<b>Percent</b>
<b>1a30</b>	<b>67</b>	<b>45.6</b>
<b>1a40</b>	<b>20</b>	<b>13.6</b>
<b>1b30</b>	<b>27</b>	<b>18.4</b>
<b>1b40</b>	<b>10</b>	<b>6.8</b>
<b>1c</b>	<b>12</b>	<b>8.2</b>
<b>1d</b>	<b>10</b>	<b>6.8</b>
<b>D4T/3TC kaletra</b>	<b>1</b>	<b>0.7</b>
<b>Total</b>	<b>147</b>	<b>100</b>

**Table A1.4 Description of treatment and patient related variables**

<b>Variable</b>	<b>Category</b>	<b>Frequency</b>	<b>Percent</b>
<b>Disease stage</b>	<b>None</b>	<b>2</b>	<b>1.4</b>
	<b>WHO I</b>	<b>14</b>	<b>9.5</b>
	<b>WHO II</b>	<b>41</b>	<b>27.9</b>
	<b>WHO III</b>	<b>70</b>	<b>47.6</b>
	<b>WHO VI</b>	<b>20</b>	<b>13.6</b>
<b>CD4 cell count</b>	<b>Less than 100</b>	<b>25</b>	<b>17</b>
	<b>From 101 to 200</b>	<b>50</b>	<b>34</b>
	<b>From 201 to 300</b>	<b>38</b>	<b>25.9</b>
	<b>Above 300</b>	<b>34</b>	<b>23.1</b>
<b>Duration of Therapy</b>	<b>Less than two month</b>	<b>4</b>	<b>2.7</b>
	<b>2 months to 6 months</b>	<b>42</b>	<b>28.6</b>
	<b>6 months to 12 months</b>	<b>63</b>	<b>42.9</b>
	<b>12 months to 36 months</b>	<b>38</b>	<b>25.9</b>
<b>Depression</b>	<b>None of the time</b>	<b>32</b>	<b>21.8</b>
	<b>A little of the time</b>	<b>40</b>	<b>27.2</b>
	<b>Some of the time</b>	<b>39</b>	<b>26.5</b>
	<b>Most of the time</b>	<b>20</b>	<b>13.6</b>
	<b>All of the time</b>	<b>16</b>	<b>10.9</b>

**Table A1.5 Description of side effect**

<b>Side effect</b>	<b>Frequency</b>	<b>Percent</b>
<b>No side effect</b>	<b>79</b>	<b>53.7</b>
<b>Diarrhea</b>	<b>4</b>	<b>2.7</b>
<b>Stomach upset</b>	<b>4</b>	<b>2.7</b>
<b>Nausea and vomiting</b>	<b>11</b>	<b>7.5</b>
<b>Headache</b>	<b>20</b>	<b>13.6</b>
<b>Fatigue</b>	<b>19</b>	<b>12.9</b>
<b>Fatigue, nausea and vomiting</b>	<b>2</b>	<b>1.4</b>
<b>Headache and Fatigue</b>	<b>4</b>	<b>2.7</b>
<b>Permanent side effect</b>	<b>1</b>	<b>0.7</b>
<b>Headache ,Fatigue and Stomach upset</b>	<b>1</b>	<b>0.7</b>
<b>Headache , nausea and vomiting</b>	<b>1</b>	<b>0.7</b>
<b>Diarrhea and Stomach upset</b>	<b>1</b>	<b>0.7</b>
<b>Total</b>	<b>147</b>	<b>100</b>

**Table A1.6 Description of social Support (percent)**

<b>Variable</b>	<b>None of the time</b>	<b>A little of the time</b>	<b>Some of the time</b>	<b>Most of the time</b>	<b>All of the time</b>
<b>NGO support</b>	<b>21.8</b>	<b>21.8</b>	<b>46.9</b>	<b>6.1</b>	<b>3.4</b>
<b>Direct support_1</b>	<b>8.8</b>	<b>8.8</b>	<b>38.8</b>	<b>8.2</b>	<b>35.4</b>
<b>Emotional support_1</b>	<b>9.5</b>	<b>8.2</b>	<b>50.3</b>	<b>6.8</b>	<b>25.2</b>
<b>Informational support_1</b>	<b>8.2</b>	<b>13.6</b>	<b>51.0</b>	<b>8.2</b>	<b>19.0</b>
<b>Direct support_2</b>	<b>9.5</b>	<b>6.8</b>	<b>44.2</b>	<b>7.5</b>	<b>32.0</b>
<b>Emotional support_2</b>	<b>16.3</b>	<b>7.5</b>	<b>40.8</b>	<b>6.8</b>	<b>28.6</b>
<b>Emotional support_3</b>	<b>15.0</b>	<b>11.6</b>	<b>42.2</b>	<b>4.8</b>	<b>26.5</b>
<b>Informational support_2</b>	<b>14.3</b>	<b>12.9</b>	<b>45.6</b>	<b>8.2</b>	<b>19.0</b>
<b>Direct support_3</b>	<b>12.9</b>	<b>6.1</b>	<b>42.2</b>	<b>6.8</b>	<b>32.0</b>
<b>Direct support_4</b>	<b>14.3</b>	<b>6.8</b>	<b>43.5</b>	<b>8.2</b>	<b>27.2</b>

**Table A1.7 Description of HIV serostatus Disclosure, ART attitude and Knowledge and service provision**

<b>Variable</b>	<b>None of the time</b>	<b>A little of the time</b>	<b>Some of the time</b>	<b>Most of the time</b>	<b>All of the time</b>
<b>Family disclosure</b>	<b>15.6</b>	<b>4.8</b>	<b>34.7</b>	<b>27.2</b>	<b>17.7</b>
<b>Community disclosure</b>	<b>15.0</b>	<b>14.3</b>	<b>34.7</b>	<b>24.5</b>	<b>11.6</b>
<b>Confidentiality of ART service</b>	<b>20.4</b>	<b>34.0</b>	<b>39.5</b>	<b>2.7</b>	<b>3.4</b>
<b>Service hour</b>	<b>12.9</b>	<b>22.4</b>	<b>40.1</b>	<b>15.6</b>	<b>8.8</b>
<b>Reception</b>	<b>17</b>	<b>30.6</b>	<b>49.0</b>	<b>1.4</b>	<b>2.0</b>
<b>Transportation problem</b>	<b>10.2</b>	<b>6.8</b>	<b>39.5</b>	<b>25.9</b>	<b>17.7</b>
	<b>Strongly agree</b>	<b>Agree</b>	<b>Uncertain</b>	<b>Disagree</b>	<b>Strongly disagree</b>
<b>ART attitude_1</b>	<b>42.2</b>	<b>51.7</b>	<b>5.4</b>	<b>0</b>	<b>0.7</b>
<b>ART attitude_2</b>	<b>38.8</b>	<b>55.8</b>	<b>4.8</b>	<b>0.7</b>	<b>0</b>
<b>ART knowledge_1</b>	<b>25.2</b>	<b>57.1</b>	<b>17.7</b>	<b>0</b>	<b>0</b>
<b>Adherence knowledge</b>	<b>32.7</b>	<b>57.1</b>	<b>9.5</b>	<b>0.7</b>	<b>0</b>

**Table A1.8 Description of Adherence to ART**

<b>Variable</b>	<b>None of the time</b>	<b>A little of the time</b>	<b>Some of the time</b>	<b>Most of the time</b>	<b>All of the time</b>
<b>Adherence to ART</b>	<b>2.0</b>	<b>17.0</b>	<b>54.4</b>	<b>19.7</b>	<b>6.8</b>

**Table A1.9 Description of Reason of non adherent**

<b>Reason</b>	<b>Frequency</b>	<b>Percent</b>
<b>Forget to take</b>	<b>8</b>	<b>28.6</b>
<b>Confused how and when to take</b>	<b>5</b>	<b>17.9</b>
<b>Feel depressed</b>	<b>4</b>	<b>14.2</b>
<b>Busy</b>	<b>3</b>	<b>10.7</b>
<b>Away from home</b>	<b>3</b>	<b>10.7</b>
<b>Run out of medicine</b>	<b>2</b>	<b>7.1</b>
<b>Medicine don't help me much</b>	<b>1</b>	<b>3.6</b>
<b>Side effect</b>	<b>1</b>	<b>3.6</b>
<b>Missed appointment</b>	<b>1</b>	<b>3.6</b>
<b>Total</b>	<b>28</b>	<b>100</b>

**Table A1.10 The adherence rate**

<b>Adherence rate(%)</b>	<b>Frequency</b>	<b>Percent</b>
<b>0</b>	<b>2</b>	<b>1.4</b>
<b>50</b>	<b>1</b>	<b>0.7</b>
<b>71</b>	<b>1</b>	<b>0.7</b>
<b>75</b>	<b>1</b>	<b>0.7</b>
<b>80</b>	<b>1</b>	<b>0.7</b>
<b>86</b>	<b>1</b>	<b>0.7</b>
<b>87</b>	<b>3</b>	<b>2.0</b>
<b>90</b>	<b>4</b>	<b>2.7</b>
<b>93</b>	<b>14</b>	<b>9.6</b>
<b>100</b>	<b>119</b>	<b>81.0</b>

## Annex 2 : Tables of Bivariate and multivariate analysis

Table B2.1 Test of association of adherence to ART Vs opinion variables

Variables	Kendall's tau-b		Spearman's rho		Pearson's r	
	r	Signf.	r	Signf.	r	Signf.
Depression	-0.183	0.009	-0.218	0.008	-0.235	0.004
Family disclosure	0.104	0.139	0.117	0.159	0.066	0.428
Community disclosure	0.040	0.565	0.045	0.590	0.030	0.723
NGO support	-0.062	0.389	-0.067	0.422	-0.013	0.879
Direct support_1	-0.023	0.742	-0.026	0.759	-0.028	0.738
Emotional support_1	0.076	0.291	0.087	0.295	0.098	0.236
Informational support_1	0.134	0.061	0.151	0.067	0.144	0.083
Direct support_2	0.026	0.717	0.030	0.715	0.024	0.770
Emotional support_2	0.028	0.691	0.033	0.694	0.022	0.792
Emotional support_3	0.082	0.246	0.094	0.242	0.109	0.188
Informational support_2	-0.006	0.932	-0.006	0.947	-0.012	0.884
Direct support_3	0.011	0.879	0.012	0.886	-0.006	0.943
Direct support_4	0.078	0.274	0.088	0.289	0.081	0.332
Service hour	-0.143	0.050	-0.148	0.073	-0.145	0.079
Reception	0.025	0.727	0.024	0.772	0.012	0.882
Transportation problem	-0.055	0.434	-0.063	0.446	-0.064	0.440

**Table B2.2 Test of sampling adequacy**

**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.842
Bartlett's Test of Sphericity	Approx. Chi-Square	1369.759
	df	136
	Sig.	.000

**Table B2.3 Anti image Matrix**

	1	2	3	4	5	6	7	8
1=Depression	0.559							
2=Family disclosure		0.784						
3=Community disclosure			0.610					
4=NGO support				0.641				
5=Direct support_1					0.917			
6=Emotional support_1						0.861		
7=Informational support_1							0.872	
8=Direct support_2								0.909

**The important figures are the diagonals so the off diagonals are not presented.**

**Anti image ....continued**

	9	10	11	12	13	14	15	16
9=Emotional support_2	0.857							
10=Emotional support_3		0.848						
11=Informational support_2			0.932					
12=Direct support_3				0.850				
13=Direct support_4					0.872			
14=Service hour						0.592		
15=Reception							0.675	
16=Transportation problem								0.441

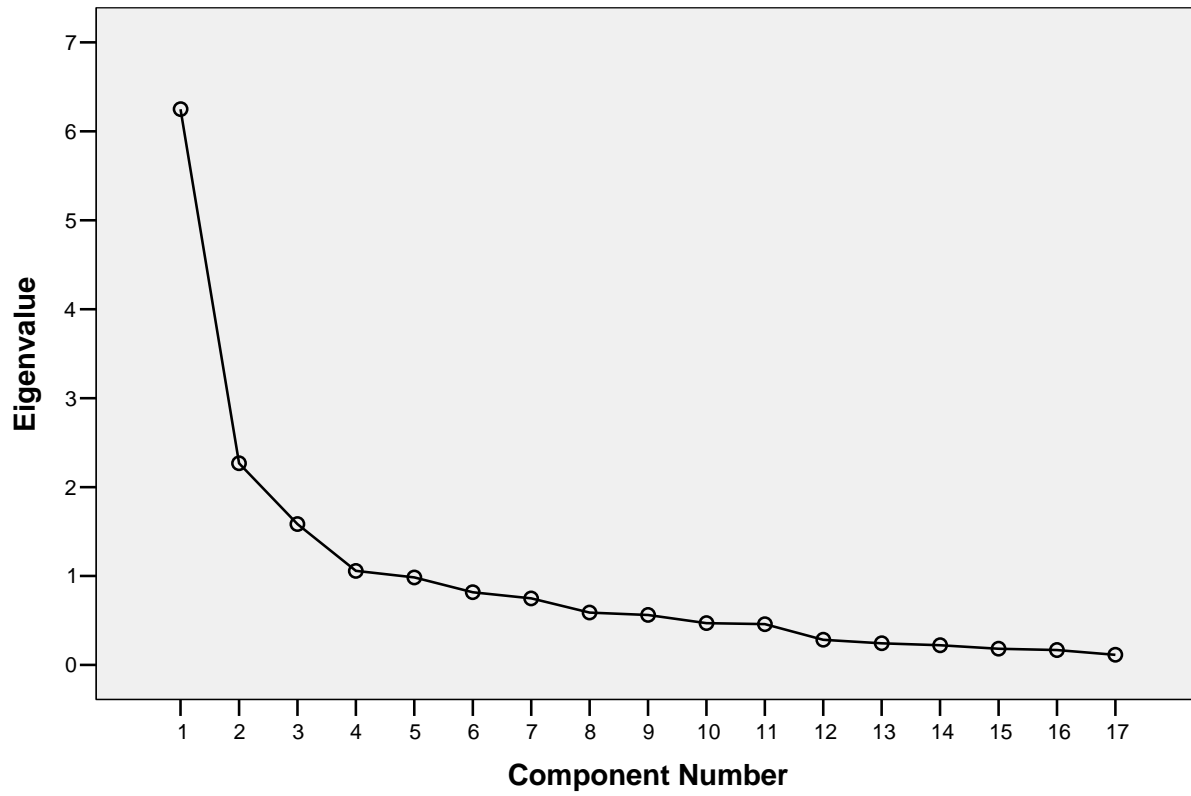
**Table B2.4 Communalities**

Variables	initial	Extraction
Depression	1.00	0.780
Family disclosure	1.00	0.586
Community disclosure	1.00	0.828
NGO support	1.00	0.532
Direct support_1	1.00	0.680
Emotional support_1	1.00	0.725
Informational support_1	1.00	0.626
Direct support_2	1.00	0.672
Emotional support_2	1.00	0.742
Emotional support_3	1.00	0.715
Informational support_2	1.00	0.683
Direct support_3	1.00	0.698
Direct support_4	1.00	0.703
Service hour	1.00	0.499
Reception	1.00	0.397
Transportation problem	1.00	0.593

**Table B2.5 Total Variance Explained**

Component	Initial eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.250	36.764	36.764	6.250	36.764	36.764	6.129	36.052	36.052
2	2.267	13.337	50.101	2.267	13.337	50.101	2.346	13.801	49.853
3	1.584	9.318	59.419	1.584	9.318	59.419	1.382	8.128	57.980
4	1.057	6.217	65.636	1.057	6.217	65.636	1.301	7.656	65.636
5	.984	5.788	71.425						
6	.818	4.812	76.237						
7	.748	4.399	80.636						
8	.589	3.465	84.101						
9	.562	3.307	87.407						
10	.470	2.766	90.173						
11	.458	2.695	92.869						
12	.283	1.665	94.533						
13	.243	1.432	95.965						
14	.222	1.305	97.270						
15	.182	1.068	98.338						
16	.168	1.662	100.000						

### Scree Plot



**Fig 2 Scree plot of factors of adherence to ART**

**Table B2.6 : Reliability Statistics for adherence to ART**

Cronbach's $\alpha$	Cronbach's $\alpha$ Based on Standardized Items	N of Items
.824	.807	16

## Case1: Discriminant analysis tables(non adherent cases)

**Table B2.11 Test of equality of group means**

Variables	Wilks' lambda	Significance
Depression	0.834	0.031
Participation in the community	0.945	0.231
Family disclosure	0.859	0.049
Community disclosure	0.885	0.078
NGO support	0.968	0.359
Direct support_1	0.966	0.345
Emotional support_1	0.991	0.628
Informational support_1	0.999	0.887
Direct support_2	0.966	0.736
Emotional support_2	0.966	0.736
Emotional support_3	0.999	0.870
Informational support_2	1.000	0.950
Direct support_3	0.998	0.843
Direct support_4	0.993	0.668
ART attitude_1	0.937	0.197
ART attitude_2	1.000	0.931
ART knowledge_1	0.996	0.761
Adherence knowledge	0.963	0.325
Side effect	0.989	0.602
Confidentiality of ART service	0.961	0.321
Service hour	0.966	0.346
Reception	0.997	0.783
Transportation problem	0.995	0.731

**Table B2.12 Eigen value**

Function	Eigen value	% of variance	Canonical correlation
1	0.693	100	0.64

**Table B2.13 Test of significance of the function**

Test of Function	Wilks' Lambda	Chi-square	Degrees of freedom	Significance
1	0.591	12.899	3	0.005

**Table B2.14 Standardized Discriminant Function Coefficients**

Discriminating variables	Function
Depression	0.935
Community disclosure	0.805
NGO support	-0.683

**Table B2.15 Structure matrix**

Variables	Function
Depression	0.537
Community disclosure	0.432
Emotional support_2	-0.358
Service hour	0.324
Direct support_1	-0.322
Adherence knowledge	-0.320
Reception	-0.305
Direct support_2	-0.275
NGO support	-0.220
ART attitude_2	-0.195
ART attitude_1	-0.183
Emotional support_1	-0.183
Confidentiality of ART service	-0.181
Participation in the community	0.170
Direct support_4	-0.167
Family disclosure	0.135
ART knowledge_1	-0.115
Emotional support_3	-0.107
Informational support_2	0.104
Side effect	0.103
Transportation problem	-0.082
Direct support_3	-0.068
Informational support_1	0.014

**Table B2.16 Classification Function Coefficients**

Classification variables	Function
Depression	0.827
Community disclosure	0.573
NGO support	-0.596
Constant	-2.761

**Table B2.17 Classification matrix**

**Classification Results<sup>a,b</sup>**

				Predicted Group Membership		Total
				None of the time	A little of the time	
Cases Selected	Original	Count	How often do you adhere			
			None of the time	3	0	3
	A little of the time	3	22	25		
	%	100.0	.0	100.0		
Cases Not Selected	Original	Count	None of the time	0	0	0
			A little of the time	0	1	1
	%	.0	.0	100.0		
	A little of the time	.0	100.0	100.0		

a. 89.3% of selected original grouped cases correctly classified.

b. .8% of unselected original grouped cases correctly classified.

## Case 2: Discriminant analysis tables (Adherent cases)

Table B2.21 Test of equality of group means

Variables	Wilks' lambda	Significance
Depression	0.955	0.070
Participation in the community	0.969	0.158
Family disclosure	0.994	0.720
Community disclosure	0.982	0.358
NGO support	0.891	0.001
Direct support_1	0.983	0.379
Emotional support_1	0.960	0.093
Informational support_1	0.955	0.070
Direct support_2	0.969	0.161
Emotional support_2	0.989	0.514
Emotional support_3	0.971	0.181
Informational support_2	0.982	0.342
Direct support_3	0.998	0.896
Direct support_4	0.976	0.240
ART attitude_1	0.985	0.411
ART attitude_2	0.965	0.126
ART knowledge_1	1.000	0.980
Adherence knowledge	0.981	0.321
Side effect	0.985	0.423
Confidentiality of ART service	0.948	0.044
Service hour	0.996	0.799
Reception	0.796	0.000
Transportation problem	0.991	0.580
CD4 count	0.938	0.025

**Table B2.22 Eigen value**

Function	Eigen value	% of variance	Canonical correlation
1	0.369	76.4	0.519
2	0.114	23.6	0.320

**Table B2.23 Test of significance of the function**

Test of Functions	Wilks' Lambda	Chi-square	Degrees of freedom	Significance
1through2	0.655	48.372	8	0.000
2	0.898	12.373	3	0.006

**Table B2.24 Standardized Discriminant Function Coefficients**

Discriminating variables	Function 1	Function 2
NGO support	0.538	0.493
CD4 count	0.244	0.636
Reception	0.796	-0.553
Transportation problem	-0.449	-0.311

**Table B2.25 Structure matrix**

<b>Variables</b>	<b>Function1</b>	<b>Function2</b>
Depression	0.180	0.076
Community disclosure	0.043	0.348
Emotional support_2	0.039	0.067
Service hour	0.232	-0.270
Direct support_1	-0.049	0.075
Adherence knowledge	0.150	0.021
Reception	0.769	-0.580
Direct support_2	-0.052	0.046
NGO support	0.534	0.389
ART attitude_2	0.098	0.037
ART attitude_1	0.070	0.050
Emotional support_1	-0.057	0.006
Confidentiality of ART service	0.222	0.018
Participation in the community	0.105	0.194
Direct support_4	0.038	0.080
Family disclosure	-0.065	0.268
ART knowledge_1	0.087	0.044
Emotional support_3	-0.076	-0.008
Informational support_2	-0.019	0.034
Side effect	0.163	0.053
Transportation problem	-0.115	-0.119
Direct support_3	-0.044	0.048
Informational support_1	-0.034	0.101
CD4 count	0.198	0.669

**Table B2.26 Classification Function Coefficients**

<b>Classification variables</b>	<b>Some of the time</b>	<b>Most of the time</b>	<b>All of the time</b>
NGO support	1.979	1.082	2.087
CD4 count	2.556	2.099	3.076
Reception	5.084	3.627	3.207
Transportation problem	1.380	2.002	1.406
Constant	-16.233	-11.655	-13.904

**Table B2.27 Classification matrix (adherent cases)**

**Classification Results<sup>a,b</sup>**

				Predicted Group Membership			Total	
				Some of the time	Most of the time	All of the time		
Cases Selected	Original	Count	How often do you adhere					
			Some of the time	55	16	9	80	
			Most of the time	4	18	7	29	
	All of the time	2	2	6	10			
	%			Some of the time	68.8	20.0	11.3	100.0
				Most of the time	13.8	62.1	24.1	100.0
All of the time				20.0	20.0	60.0	100.0	
Cases Not Selected	Original	Count	Some of the time	0	0	0	0	
			Most of the time	0	0	0	0	
			All of the time	0	0	0	0	
	%			Some of the time	.0	.0	.0	100.0
				Most of the time	.0	.0	.0	100.0
				All of the time	.0	.0	.0	100.0

a. 66.4% of selected original grouped cases correctly classified.

b. .0% of unselected original grouped cases correctly classified.

## Annex 3: Questionnaire

### Patients on ART treatment Self report adherence Questionnaire / Shashemene General Hospital

This questionnaire asks how you are doing in taking the ART medication as the physician prescribes. The data collected will be used in the assessment of the ART program in the hospital and the barriers to taking the medication as prescribed. The recommendation from this study will help you; and at large the people living with the virus by addressing the problems of HIV medication that will be raised during the interview. Your personal response will be confidential

Please mark circle for each the respondent's choice if the respondent asks any question for further clarification please provide.

1. Gender                      1. Male                      2. Female
  
2. Age                              1. Less than 15 years  
   2. 15 years- 30 years  
   3. 31 years- 49 years  
   4. 50 years - 60 years  
   5. More than 60 years
  
3. Marital status              1. Never married  
   2. Married  
   3. Separated/Divorced  
   4. Widowed
  
4. Ethnicity                      1. South nations and nationalities people(SNNP)  
   2. Amhara  
   3. Oromo  
   4. Tigray  
   5. Other
  
5. Religion                        1. Islam  
   2. Orthodox  
   3. Protestant  
   4. Catholic  
   5. Other

6. Employment status
1. Employed
  2. Own business
  3. Jobless
  4. Own farm
7. Income per month
1. No income
  2. below 100 birr
  3. 101 birr- 500 birr
  4. More than 500 birr
8. Education level
1. Illiterate/no education
  2. Basic Education
  3. Elementary and Secondary (1- 12 grade)
  4. College certificate or Diploma
  5. Degree
9. How often do you feel depressed?
- |                         |                     |
|-------------------------|---------------------|
| 1. None of the time     | 3. Some of the time |
| 2. A little of the time | 4. Most of the time |
| 5. All of the time      |                     |
10. How often do you participate after disclosure?
- |                         |                     |
|-------------------------|---------------------|
| 1. None of the time     | 3. Some of the time |
| 2. A little of the time | 4. Most of the time |
| 5. All of the time      |                     |
11. Housing status
- |                  |                |
|------------------|----------------|
| 1. Owned a house | 2. NGO shelter |
| 3. Rent          | 4. Homeless    |
12. How often do you disclose your HIV status to your FAMILY?
- |                         |                     |
|-------------------------|---------------------|
| 1. None of the time     | 3. Some of the time |
| 2. A little of the time | 4. Most of the time |
| 5. All of the time      |                     |
13. How often do you disclose your HIV status to your (COM)?
- |                         |                     |
|-------------------------|---------------------|
| 1. None of the time     | 3. Some of the time |
| 2. A little of the time | 4. Most of the time |
| 5. All of the time      |                     |
14. How often do you get NGO support ?
- |                         |                     |
|-------------------------|---------------------|
| 1. None of the time     | 3. Some of the time |
| 2. A little of the time | 4. Most of the time |
| 5. All of the time      |                     |

15. How often is the following support available when you need it?

1. None of the time      2. A little of the time      3. Some of the time  
4. Most of the time      5. All of the time

- A. someone to help you when you are confined to bed \_\_\_\_\_  
B. someone to count on to listen when you need to talk \_\_\_\_\_  
C. Some one to give you advise about a crisis \_\_\_\_\_  
D. Someone to take you to the doctor when you need it \_\_\_\_\_  
E. Someone who shows you love and affection \_\_\_\_\_  
F. Someone to have good time with \_\_\_\_\_  
G. Someone to give you information to help you understand a situation \_\_\_\_\_  
H. Someone to prepare your meal when you are unable to do it. \_\_\_\_\_  
I. Someone who do your daily chores when you are Sick \_\_\_\_\_

16. Write treatment combinations that you currently taking?-----

17. How helpful do you think that your prescribed ART medication? I

1. Strongly agree      2. Agree      3. Uncertain  
4. Disagree      5. Strongly disagree

- A. ART medication will help me get better \_\_\_\_\_  
B. ART medication will help me have fewer symptoms \_\_\_\_\_  
C. ART medication will keep me alive longer \_\_\_\_\_  
D. I will get sick if I don't take my medication \_\_\_\_\_

18. I know it is hard to take all your medication. How often do you take? Your HIV medication as prescribed

1. None of the time      3. Some of the time  
2. A little of the time      4. Most of the time  
5. All of the time

19. What do you think are the main reasons you do not Take all your medication as prescribed?

1. Forget to take      2. Run out of medicine  
3. Side effects      4. Don't think medicine help me  
5. Miss appointment      6. Feel depressed, angry or hopeless  
7. Alcohol use      8. Confused about when and how to take  
9. Feel too sick to take it      10. Too many pills      11. Busy  
88. Other specify \_\_\_\_\_



29. How often do you subjected to long hour waiting to get the service?
- 1. None of the time
  - 2. A little of the time
  - 3. Some of the time
  - 4. Most of the time
  - 5. All of the time
30. How often do you get the staff cooperative to render the service?
- 1. None of the time
  - 2. A little of the time
  - 3. Some of the time
  - 4. Most of the time
  - 5. All of the time
31. How often do you have transportation problem to the hospital?
- 1. None of the time
  - 2. A little of the time
  - 3. Some of the time
  - 4. Most of the time
  - 5. All of the time

Thank you very much for completing this interview. The information that you provided will help with the development of better program capacity to reach and save all patients with HIV.

### **Declaration**

I, the undersigned, declare that the thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

#### **Declared by**

Name-----

Signature-----

Date-----

#### **Confirmed by the Advisor**

Name-----

Signature-----

Date-----