An Economic Evaluation of the Impact of Widespread Antiretroviral Treatment on Secondary Hospitals in South Africa:

Case Study of the GF Jooste Hospital Antiretroviral Referral Unit

Sebastian Kevany

University of Cape Town

September 2005

Submitted to the Health Economics Unit, Department of Public Health, University of Cape Town, in partial fulfilment of the requirements for the Master of Public Health (Health Economics Specialisation) Degree.

DECLARATION

I, SEBASTIAN KEVANY, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise), and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the University of Cape Town to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature Signed by candidate

Date 25 / 10 / 2005

Acknowledgements

I am grateful to a wide range of individuals for donating their time and effort towards this research. In particular, I am indebted to the staff at GF Jooste Hospital and the Department of Public Health, University of Cape Town. I am also grateful to the Health Systems Trust for their funding and support, and to my family in Ireland. The following individuals were instrumental to the success of this study (in alphabetical order):

Dr. Andrew Boulle	*Infectious Disease Epidemiology Unit*
Ms. Susan Cleary	*Health Economics Unit*
Dr. Nontobeko Dyakopu	*GF Jooste Antiretroviral Referral Unit*
Ms. Cordelia Falen	*GF Jooste Antiretroviral Referral Unit*
Dr. Jane Kawadza	*GF Jooste Antiretroviral Referral Unit*
Dr. Gary Maartens	*University of Cape Town*
Dr. Graeme Meintjes	*GF Jooste Antiretroviral Referral Unit*
Dr. Dave Stead	*GF Jooste Antiretroviral Referral Unit*
Mr. Rob Stewart	*Health Systems Trust*

Table of Contents

1. Introduction

1.1 Background to Research

The AIDS epidemic has been identified as the primary public health concern of many developing countries. The social, economic and public health impacts of HIV/AIDS continue to rise, and the links between the incidence of infection and the level of human and economic development are increasingly evident (Bourne: 2003). In order to attempt to limit the current and future economic and public health costs imposed by HIV/AIDS, a number of severely-affected developing countries are in the process of introducing treatment programmes based on the use of antiretroviral drugs.

South Africa is amongst the first of these severely-affected countries to implement a comprehensive antiretroviral-based treatment programme for persons infected with HIV. This treatment programme was officially introduced in April 2004 and aims to provide Highly Active Antiretroviral Therapy (HAART) to infected persons through the public health system and via non-governmental aid organisations. Antiretroviral treatment does not provide a cure for HIV/AIDS, but frequently results in a dramatic reduction in morbidity and mortality in infected individuals (Forsythe *et al:* 1999; Casseb *et al:* 2003).

It is hoped that the widespread use of HAART will limit the negative economic and public health impacts of the AIDS epidemic. Whilst anticipated to reduce overall levels of HIV-related hospital admissions, the widespread provision and use of antiretroviral drugs has the potential to create specific added burdens on the health system, and on secondary (or referral) hospitals in particular, as a result of high levels of morbidity and associated treatment costs in patients with advanced HIV infection in the early stages of HAART, and in patients preparing to initiate HAART (Arens *et al:* 2004). Current public sectorguidelines on antiretro viral therapy focus on provision for patients at an advanced stage of infection[1] (National

[1] HIV-positive patients presenting with CD4 counts below 200 cells/μl and/or WHO Clinical Stage 4 diagnosis.

Department of Health: 2004a), with a median CD4 count of 43 (n = 287) recorded at HAART initiation in Khayelitsha (Coetzee *et al:* 2004).

Secondary hospitals face significant resource requirements for identifying the causes of morbidity in patients receiving HAART, including new opportunistic infections, paradoxical deterioration of pre-existing opportunistic infections, and drug side effects, and for pre-HAART morbidity assessment (Meintjes: 2004b). In addition, the increased survival time of HAART patients has the potential to result in higher levels of demand for secondary hospital treatment over the life span. The incidence of these various treatment requirements can be expected to increase in proportion to the level and scale of the national HAART roll-out. In order to ensure that the health system is not overburdened in caring for patients on or preparing for HAART, the need for a specific service arm devoted to their treatment has been proposed.

1.2 Problem Statement

The widespread use of HAART has the potential to create an increased demand for certain specific treatment requirements provided by secondary hospitals. Most patients commencing HAART in disadvantaged areas are at a stage of advanced immunosuppression (Coetzee *et al:* 2004). These patients remain immunosuppressed while preparing for (or during the initial period of) HAART treatment, and may continue to develop opportunistic infections or Immune Reconstitution Syndrome during this time. The development of specific treatment services will improve secondary level care for patients on or preparing for HAART and ensure earlier treatment upon development of medical problems. 'This in turn will prevent the deterioration and ultimately prolonged hospitalisation that many of these patients require' (Meintjes: 2004b, p 4).

The development of Antiretroviral Referral Units, specifically designed for the assessment and treatment of patients on or preparing for HAART, as well as the expansion of associated secondary hospital services, should be included as a key element of the planning of the

national antiretroviral roll-out in order to avoid excessive strain on the South African health system. Using a combination of current and retrospective data from GF Jooste Secondary Hospital, this study provides a comprehensive cost analysis, a cost-outcome description and a prospective costing model for the implementation of a proposed Antiretroviral Referral Unit, which may be used as a template for similar units in other secondary hospitals in South Africa. A range of descriptive and epidemiological data sets are also presented in order to provide a detailed assessment of the characteristics and treatment needs of HAART patients at the secondary level.

1.3 Study Area and Setting

1.3.1 GF Jooste Hospital

All research for this study was conducted at GF Jooste Hospital, located in Manenberg, Cape Town, in the Western Cape Province of South Africa. GF Jooste Hospital is a public sector secondary hospital serving the Klipfontein Health District and is administered by the Provincial Government of the Western Cape. The hospital was established in 1975 as an inpatient convalescent care centre. Trauma and emergency services have been provided since 1996 and an outpatient department was opened in 2001. An infectious disease clinic and an antiretroviral clinic were established in the hospital in 2003. In addition, GF Jooste Hospital provides secondary treatment and referral facilities for the antiretroviral clinics located within its Catchment Area at Mitchell's Plain, Guguletu, Crossroads, Site B and Site C (Nolungile Clinic)[2].

[2] Patients resident in the GF Jooste Catchment Area and attending the Red Cross (for parents of infected children) or Groote Schuur Antiretroviral Clinics are also occasionally referred to the Antiretroviral Referral Unit.

1.3.2 Catchment Area

GF Jooste Hospital serves a population of approximately 1.2 million people (Meintjes: 2004a). The GF Jooste Catchment Area includes the areas of North Khayelitsha, Nyanga, Guguletu, Mitchells Plain, Heideveld, Crossroads, Manenberg, Strandfontein and Phillipi. These areas include some of the most socially and economically disadvantaged communities in the Western Cape Province. The broad unemployment rate in the Khayelitsha and Mitchells Plain areas has been estimated at 46.3%[3] (Nattrass: 2003). The area of Manenberg has been described as 'an established African working class township' (Govender *et al:* 2000, p 11). Housing is composed of a combination of informal shacks, council houses, and private houses. HIV prevalence in the Catchment Area is estimated at 10.7% (Human Sciences Research Council: 2004) or 120,000 persons (Meintjes: 2004a). Access to private health care is limited.

1.4 The GF Jooste Antiretroviral Referral Unit

1.4.1 Background to the Antiretroviral Referral Unit

The GF Jooste Antiretroviral Referral Unit was established in August 2004. In response to a high level of casualty admissions for persons on HAART, the unit was initially designed to relieve demand on the Trauma and Emergency Department at GF Jooste Hospital. Significant and sustained levels of demand for secondary treatment by HIV/AIDS patients on or preparing for HAART prompted the expansion of the Antiretroviral Referral Unit into an independent clinical service, providing specialised medical treatment and expert medical opinion. The unit manages a wide range of HAART-related illnesses, including immune reconstitution syndrome, smear-negative tuberculosis treatment, hyperlactataemia, lactic acidosis, and other side-effects of antiretroviral drug use.

[3] The broad unemployment rate = (active-searching unemployed + network-searching unemployed + marginalized unemployed) / broad labour force.

The Antiretroviral Referral Unit provides inpatient and outpatient care for HAART patients. Outpatient care is currently provided through the GF Jooste Outpatient Department and Infectious Disease Clinic. Clinic hours are 8.00 am to 5.00 pm Monday to Friday, with a range of 5 to 15 patients seen on a daily basis. Consultations take place in outpatient department facilities and require the *ad hoc* use of consultation rooms in the absence of any designated physical infrastructure. Spatial limitations have been noted to severely hamper service provision (Meintjes: 2004a).

Antiretroviral Referral Unit inpatient care is provided *via* the GF Jooste Inpatient Medical Ward. Inpatients are primarily managed by medical ward clinical staff, with additional specialist medical input supplied by Antiretroviral Referral Unit clinicians. Approximately 40% of Antiretroviral Referral Unit outpatients subsequently require inpatient care (Meintjes: 2004a). A telephone consultation service for local antiretroviral clinics is also provided by the unit, which is currently staffed by two (part-time) consultant HIV / AIDS specialists, two medical officers, one (part-time) registered nurse, and an admissions clerk.

1.4.2 Admission Procedure and Referral Chain

Prospective Antiretroviral Referral Unit patients are discussed by telephone consultation with the attending primary antiretroviral clinic. Patients are then triaged to (1) immediate inpatient admission through GF Jooste Casualty, (2) an outpatient appointment at the Antiretroviral Referral Unit, or (3) continued primary care with specialist telephone assistance. Patients requiring an outpatient appointment are generally seen by clinicians within 48 hours of the initial telephone consultation (Meintjes: 2004a). These patients report to the GF Jooste Outpatient Department Reception and a patient file is opened. Patients are then evaluated by the attending Antiretroviral Referral Unit clinician(s), and an investigation and management plan is developed.

1.5 Proposed Antiretroviral Referral Unit

Based on the consistent levels of prior demand for specialised secondary level services, and in anticipation of increasing demand for secondary hospital treatment of HAART patients with expansion of the antiretroviral roll-out, the establishment of an independent Antiretroviral Referral Unit at GF Jooste Hospital has been proposed. This initiative requires an independent building and specialist equipment in addition to existing resources. The proposed Antiretroviral Referral Unit will operate independently from the GF Jooste Outpatient Department and Infectious Disease Clinic.

The proposed Antiretroviral Referral Unit will contain outpatient consulting rooms, a procedure room, a sluice room, staff offices and ablution facilities, and will be located within the grounds of GF Jooste Hospital. Key investigational equipment includes a CT scanner, gastro-intestinal scope facilities, bronchoscopy facilities and liver biopsy equipment. The proposed unit will employ existing clinical and non-clinical staff. The facility will also act as a training site for medical professionals in HIV medicine, and as a centre for local clinical research on key issues related to the antiretroviral roll-out.

The proposed Antiretroviral Referral Unit will function primarily as an outpatient service. Inpatient care will continue to be provided by clinical staff at the GF Jooste Inpatient Medical Ward, supplemented by input from Antiretroviral Referral Unit clinicians. A range of medical and surgical procedures, examinations, imaging and radiology scanning, and laboratory testing for both inpatients and outpatients will be conducted at the Antiretroviral Referral Unit.

2. Literature Review

2.1 Literature Sources

This literature review was primarily conducted through a series of manual and electronic searches for relevant articles. The core electronic databases used to conduct this review were MedLine and PubMed. The words and phrases 'HIV/AIDS', 'Antiretrovirals', 'Cost Analysis', 'Complications', 'South Africa', 'Hospital' and 'Referrals', amongst other terms, were used in various combinations to search these databases. A similar literature search was conducted through the ALEPH database of the University of Cape Town.

A number of reviewed articles were provided by members of staff at the Health Economics Unit in the Department of Public Health, University of Cape Town. Consultation with academics and professionals working in the fields of public health and health economics in other institutions *via* e-mail also rendered a number of relevant documents. Literature searches were also conducted through the internet. Relevant references in articles found through all of these sources were used as an *ad hoc* literature source.

All literature available from GF Jooste Hospital relating to the proposed Antiretroviral Referral Unit was reviewed for this proposal. This included a comprehensive business plan (Meintjes: 2004a), internal correspondence outlining the rationale for Antiretroviral Referral Unit construction (Meintjes: 2004b), and a presentation describing the key elements of service provision required to treat patients on HAART at the secondary level (Meintjes: 2004c). These documents provided a key source of background information on the structure, requirements and demand for the Antiretroviral Referral Unit.

2.2 Economic Evaluation in the Health Care Setting

A review of economic evaluation studies in health care was conducted to provide a general framework for this research. An assessment of the demand for economic evaluation studies in

health care provided a key motivation for this study. In addition, a selected review of the application of economic evaluation in specific health care scenarios provided valuable insights into key techniques and procedures.

2.2.1 Demand for Economic Evaluation in Health Care

In his study of the cost-effectiveness of HIV/AIDS prevention strategies, Walker (2003) states that there is 'an urgent need for the generation of this knowledge for planning and decision-making' (p 4). A wide range of HIV/AIDS interventions in developing countries are shown to lack an evaluative basis, raising questions about their appropriateness. For those interventions that have been evaluated, the frequent incomparability of methods and results is compounded by the lack of a common outcome measure. The analysis of epidemics in developing countries requires 'better definition and cost analysis of the new interventions or strategies needed to facilitate improved levels of control' (Floyd *et al:* 2003, p 5).

2.2.2 Application of Economic Evaluation in Health Care

In their study of hospital efficiency, Kirigia *et al* (1998) undertake a comparative cost-effectiveness analysis between two Kenyan hospitals for a malaria-related intervention. This study presents a detailed description of data sourcing and record review procedures in a developing country hospital, which informed data collection methodology. These procedures include the timeframe for data collection at the hospital level, the cross-checking of medical records with other data sources, and key sources of data within the hospital system.

In their costing study of tuberculosis care in Cape Town, Sinanovic *et al* (2003) provide a detailed description of the procedures involved in community-based research, and present a comprehensive listing of provider costing centres. Key research issues include the identification of information sources within and outside the hospital, as well as the development of outcome measures appropriate to available data. Similarly, Chrischilles and Scholz (1999) describe the necessary techniques for the application of cost analysis to

hospital-based interventions, and outline alternative approaches for data collection. These include the categorisation of patient costs, the identification of hidden costs, and the establishment of costing boundaries.

2.3 Economic Evaluation of Antiretroviral Programmes

A wide range of recent studies attempt to assess the costs and effectiveness of HAART in developing countries. These studies emphasise the importance of the use of economic evaluation in antiretroviral-related interventions, provide detailed information on appropriate costing techniques, and illustrate gaps in the assessment of the health system impact of antiretroviral therapy. This research provided a basis for the economic evaluation of secondary level care for HAART patients.

2.3.1 Cost Analysis of Antiretroviral Programmes

The Health Systems Trust (2003) provides a comprehensive discussion of costing techniques for antiretroviral treatment programmes. An evaluation framework for assessing the investment required for construction and maintenance of an antiretroviral clinic is outlined, and all key primary level costs are identified. The roles of eligibility criteria, clinical guidelines and patient registration in providing efficient and effective treatment are discussed. The need for close co-ordination between all health service levels is observed as being critical to the effectiveness of widespread antiretroviral provision.

Bekker *et al* (2003) provide a comprehensive retrospective financial analysis of a community-based antiretroviral therapy clinic in South Africa based on pilot data from the Guguletu Community Health Centre. Data on service utilisation and resource consumption reflect a high potential demand for antiretroviral therapy, and indicate advanced immunosuppression in a high proportion of patients. In common with research on the costs of an Antiretroviral Referral Unit, the study focused on 'an easily replicable service delivery model' (p 459) with

the aim of 'facilitating expansion of this or similar service delivery models for antiretroviral therapy elsewhere in South Africa' (*ibid*).

Beck *et al* (2001) present a comprehensive global systematic review of studies on the cost of HIV treatment and care, including antiretroviral therapy. The costs of adult hospital care for AIDS patients are estimated for the time periods pre-1987, 1987-1995, and post-1996. These costs are seen to stabilise after initial increases, in the context of rising costs for the treatment of asymptomatic patients. The authors note that inaccessibility of data is a key limitation to the generation of accurate treatment cost estimates. The need for improved relevant costing information, especially in non-industrialised countries, is again emphasised.

2.3.2 Cost-Effectiveness Analyses of Antiretroviral Programmes

Creese *et al* (2002) provide a detailed systematic review of evidence on the cost-effectiveness of HIV/AIDS interventions in Africa. 24 studies were reviewed to calculate standardised estimates of the cost per HIV infection prevented and per disability-adjusted life year (DALY) gained for 31 different treatment interventions. Cost-outcome ratios were observed to vary widely across interventions, with preventive measures and tuberculosis treatment amongst the most cost-effective interventions. The role of antiretroviral drugs was recognised as critical to attaining the correct balance of prevention, treatment and care interventions.

Moore and Bartlett's (1996) economic analysis of the use of combination antiretroviral therapy in HIV infection models the costs of care for HIV/AIDS patients in the United States. Projections of the estimated cumulative cost of care are presented along with morbidity and mortality estimates for intervention and non-intervention scenarios, the results supporting the use of HAART under appropriate circumstances. The study 'did not take into account the indirect costs associated with the increased duration of asymptomatic disease and improved life expectancy' (p 111) for patients on HAART.

Anis *et al* (2000) calculate the incremental costs of a range of alternative antiretroviral regimens in a Canadian hospital *via* a patient perspective. Data on patient-specific costs and outcomes was gathered from a longitudinal cohort of HIV-positive males over a period of 30 months. The cost-effectiveness of antiretroviral use is shown to be within the range of therapy costs for comparable chronic diseases.

In their cost-effectiveness study of antiretroviral treatment in a South African township, Cleary *et al* (2004a) outline the key overhead and patient-specific cost categories associated with antiretroviral treatment in South Africa. These include laboratory testing, primary and secondary prophylaxis, and pharmaceutical expenditure. Examples of the categorisation of staffing and capital requirements are also provided. Bavry and Maudlin (1996) supplement these categories by providing a breakdown of costs associated with an outpatient AIDS clinic in the United States.

2.4 Macroeconomic Costs of Antiretroviral Provision

A number of macroeconomic costing and resource requirements studies for comprehensive HIV/AIDS treatment programmes in developing countries were reviewed. These studies are designed to provide a basis for healthcare resource planning (Beck *et al:* 2001), although estimates of programme costs were frequently observed to focus on the direct costs of antiretroviral medication, excluding or overlooking the required secondary and support costs (Hogg *et al:* 1998). Beck *et al* (2001) note that 'adequate research effort should be directed to improving the scope and quality of information on costs of HIV service provision around the world' (p 14). Similarly, Forsythe and Gilks (1999) note that resources required for provision of ARV therapy beyond pharmaceutical costs are significant and that 'it remains imperative to assess the full economic implications of offering antiretrovirals' (p 2).

2.4.1 World Health Organisation Estimates

In their seminal discussion of antiretroviral provision costs, the WHO provides projected expenditure estimates for the '3 by 5' treatment goal, which aims to provide 3 million people in low and middle income countries with HAART by the end of 2005 (WHO: 2003). Data on HIV/AIDS incidence and treatment needs from the 34 countries which make up 90% of global demand for antiretroviral therapy were used to estimate the financial costs of a comprehensive multinational treatment and care programme. The report emphasises the importance of support cost inclusion (Gutierrez *et al*: 2004), and the cost of support activities is estimated at 12.2% of total projected expenditure.

2.4.2 United Nations Estimates

Schwartlander *et al* (2001) support these findings in their assessment of the resources required for HIV/AIDS treatment, prevention and care required to meet the UN Millennium Summit Goals. The costs of key interventions are estimated for 135 low and middle income countries, on the basis of projected HAART coverage across six global regions. Resource requirements are divided into expenditure on (1) prevention interventions and (2) care and support interventions. Programme costs of US$9.2 billion are projected for end-2005, with the share required for HAART increasing from 12.5% in 2002 to 26.0% in 2005, illustrating the increasing importance of antiretroviral therapy in planning estimates.

Bertozzi *et al* (2004) present updated United Nations estimates of the resource needs for HIV/AIDS health care services in low and middle income countries. Prospective costs were estimated based on existing annual expenditure for HIV/AIDS health care activities in countries with a per capita gross national income level below US$9265. Total resource needs are estimated by multiplying the projected total number of persons utilising specific health services by the unit cost of providing that service. The authors note that 'a number of interventions identified as key elements in HIV care were not included in the model' (p 192), given the very limited cost data available for these programmes.

2.4.3 Commission on Macroeconomics and Health Estimates

In their study of the costs required for expanding Tuberculosis, Malaria and HIV/AIDS treatment and care in Sub-Saharan Africa for the Commission on Macroeconomics and Health, Kumaranayake *et al* (2001) attempt to 'estimate the volume of additional resources that would be required for a large-scale expansion of activities' (p 1) and provide incremental HAART coverage costs for 2007 and 2015. Future expenditure levels are categorised according to implementation, investment, and management and administration of treatment programmes. By 2007, HAART costs are expected to range from US$3.0 billion to US$4.9 billion, based on a target coverage level of 62.0%. Total expenditure on HIV/AIDS care, including the clinical management and prevention of opportunistic illnesses, is expected to require US$6.9 billion to US$12.0 billion at the same date.

2.5 Guidelines for Large-Scale Antiretroviral Provision

A review of key domestic and international guidelines for large-scale antiretroviral provision was conducted to determine the planning provisions for the secondary level treatment of HAART patients. The identification of key directives provides a framework for the development of specialised secondary level services.

2.5.1 South African Guidelines

The framework provided by the South African National Department of Health (2003) on AIDS treatment mechanisms outlines the key organisational and logistical elements of the national antiretroviral roll-out. These include prospective treatment and coverage levels, as well as a detailed assessment of the facilities and infrastructure required for HAART provision. The complications associated with the use of antiretroviral drugs are identified as requiring both a supportive environment and close ongoing monitoring (National Department of Health: 2003).

2.5.2 World Health Organisation Guidelines

The World Health Organisation (2003) provides a broad description of the essential technical and operational aspects of a large-scale antiretroviral treatment programme in resource-poor settings. Guidelines on the extent of infrastructural and secondary health system support required for the successful widespread utilisation of HAART are included. Recommendation 2.4 calls for the development of chronic care capacity in health facilities concurrent with the introduction of antiretroviral therapy, and states that district level hospitals must prepare for 'the management of severe conditions of referred patients, including hospital admission where necessary' (p 23).

2.5.3 Health Systems Trust Guidelines

The Health Systems Trust (2004) provides a broad description of the resources required for large-scale antiretroviral provision and notes that adequate financial allocations are fundamental to programme success. The importance of a comprehensive approach to service delivery is emphasised, and potential key determinants of the success of the roll-out are identified. These include adequate staffing, strong programme management, ongoing evaluation of the HAART roll-out at all levels of delivery, and provision of HAART beyond well-resourced demographic centres. The need to monitor budgetary allocations to ensure that funding is spent effectively underlines the importance of utilising economic and cost analyses throughout the roll-out process, and at all levels of care.

Barron (2003) describes the primary obstacles to the widespread provision of antiretrovirals, and notes that the improvement of the health service infrastructure to ensure adequate delivery of HAART is a key limiting constraint. The prioritisation of key support services highlights the importance of adequate preparation at the secondary hospital level for the successful nationwide introduction of antiretroviral treatment. Similarly, in their overview of the essential principles of widespread antiretroviral use, Schneider and Coetzee note that

'universal access to ART will require a new level of performance of our health system, necessitating an innovative approach to implementation' (p 772).

2.5.4 Other Guidelines

Guidelines for antiretroviral programmes in developing countries were supplemented by a review of the process of building comprehensive HIV/AIDS care services in the USA (Meredith *et al:* 1998). The study compares three major HIV service delivery models and describes their implementation and operation within different target populations. The provision of comprehensive integrated services for persons receiving HAART, including medical care case management and social support, is identified as key to successful treatment provision across all models[4].

2.6 Medical Treatment for HAART Patients

A number of articles focusing on medical treatment for HAART patients and the clinical complications of antiretroviral drugs were reviewed. These articles helped inform the design of, and resource requirements for, appropriate secondary hospital services.

2.6.1 Clinical Complications of Antiretroviral Therapy

Stenzel and Carpenter (2000) provide a detailed scientific description of the management of the clinical complications of antiretroviral therapy based on their observation of adverse drug reactions and drug-related toxicities. Diagnosis of the most frequent and severe forms of complications is outlined. Havlir and Currier (2003) present a comprehensive list of the various major and minor metabolic complications that may arise as a result of HAART and provide guidelines on their frequency and incidence. These include cardiovascular risk, lipid disorders and lipoatrophy, renal complications, hepatic complications, tuberculosis, and other bacterial infections.

Edelstein and Wilson (2001) describe a strong correlation between errors in antiretroviral medication provision during secondary level hospitalisation based on a retrospective review of HIV-seropositive patients from 1998 to 2000. A review of inaccuracies in initial orders for medication, including errors in dosing intervals (100.0%) and dosing amounts (41.0%), indicates the importance of a coherent, efficient and specialist-based secondary level treatment system for HAART patients.

2.6.2 Treatment of Clinical Complications

Meintjes (2004b) provides a broad categorisation of the most common forms of medical treatment provided to patients on or preparing for HAART at GF Jooste Hospital. Information on the associated medical equipment and infrastructural requirements is also provided. The National Department of Health (2004b) presents a guide to the clinical treatment of side effects and drug interactions associated with HAART use as part of the Pharmacovigilance Programme.

2.7 The Impact of HAART on Secondary Hospitals

Studies on the effects of widespread HAART provision on secondary hospitals were reviewed to inform prospective demand for secondary level services in South Africa. In the absence of appropriate data from non-industrialised countries, empirical findings from developed countries with established large-scale antiretroviral programmes were considered in this review.

2.7.1 Hospital Admission and Expenditure Patterns

A review of the impact of widespread HAART treatment on hospital services tended to describe a decline in the overall burden of care at the secondary level. Le Pen *et al* (2001)

[4] Resource constraints may limit the applicability of these findings in developing countries.

utilised a Markov Modelling procedure for data from 500 HAART patients in France to compute overall health system expenditure. The authors state that 'important savings in hospital charges can compensate for the extra cost associated with the initiation of HAART' (p 136). Similarly, a study of the general mortality and morbidity spectrum in Spain concluded that 'in the HAART era, hospital admissions and mortality due to AIDS-defining illnesses continue to decrease' (Escolano Hortelano *et al:* 2004, p 5).

2.7.2 Immunosuppression and Hospital Utilisation Levels

Demand for secondary hospital services by patients on HAART was frequently observed to increase in proportion to the level of clinical advancement of HIV/AIDS. In their study of the utilisation of hospital services by HIV-infected children on HAART, Mandalia *et al* (1999) observed that 'when the data were analysed by the stage of HIV infection, we found that the use of hospital services increased with disease severity' (p 2591). In the South African context, a high proportion of HAART patients are expected to initiate treatment with low CD4 levels (Coetzee *et al:* 2004; Meintjes: 2004a), imposing significant prospective demand on secondary hospital services.

The cost of treatment of HAART patients at the secondary level has also been observed to increase with disease advancement. In France, Yazdanpanah *et al* (2002) stratified the lifetime cost of HAART patients by CD4 count and concluded that 'the cost of HIV disease varies widely depending on the stage of illness' (p 266). In Japan, the cost of inpatient treatment of HAART patients with low CD4 counts (<50 cells/μl) was 4.59 times higher than for patients with high CD4 counts (200 – 499 cells/μl) (Kimura: 2002). In the United States, patients with a CD4 count of less that 200 cells/μl recorded more than double the monthly hospital costs of patients with CD4 counts above this level (Moore and Bartlett: 1996).

2.8 Supplementary and Contextual Articles

A number of supplementary and contextual articles relating to the AIDS epidemic in Africa were reviewed to provide background information for this research. An understanding of the progress and broader effects of the AIDS epidemic in developing countries may assist in the creation of appropriate and cost-effective health system interventions.

2.8.1 Progress of the AIDS Epidemic

Bourne (2003) provides a detailed description of the retrospective and prospective progress of the AIDS epidemic in South Africa. Levels of HIV prevalence are expected to decline independent of planned interventions, although at a decreased rate. HIV/AIDS-related mortality in South Africa is not expected to peak until 2009. In addition, the widespread use of antiretroviral therapy is expected to produce a paradoxical rise in the HIV-positive population due to delay of death. The quality and scope of existing datasets on HIV/AIDS prevalence and other key demographic indicators are identified as limiting the development of appropriate health system responses.

2.8.2 Microeconomic Effects of HIV/AIDS

Analysis of the direct costs of HIV/AIDS to South African industry is may be based on an aggregation of meso-level results. Morris and Cheevers' (2000) study of the effects of HIV/AIDS on a sugar mill and 'confirms the significant amount of lost economic activity due to HIV infection' (p 8), while presenting a compelling illustration of the microeconomic impact of HIV/AIDS. Costs to small industry are divided between replacement worker costs, productivity losses and absenteeism. The ability to defer or avoid these costs through antiretroviral provision is considered a cost-effective response in this context.

3. Conceptual Framework

This study calculates the economic fixed and variable costs and a cost-outcome description of the GF Jooste Antiretroviral Referral Unit from the provider perspective, using a combination of gross and micro full costing techniques. The following review of the accepted (and alternative) theoretical and applied economic evaluation procedures for the assessment of health care interventions provides a framework for this research methodology.

3.1 Key Theoretical Concepts

3.1.1 Study Design

A partial economic evaluation occurs when 'both outcomes and costs of a single service or programme are described' (Drummond *et al:* 1988, p 8). In contrast, a full economic evaluation considers situations in which two or more alternatives are compared (*ibid*). In the absence of any identifiable parallel initiatives in this area of research, this study undertakes a partial economic evaluation through cost analysis, cost-outcome and cost projection components.

Cost analysis involves 'the identification, measurement and valuation of all resource changes that occur as a specific health care intervention is implemented' (Drummond *et al:* 2001, p 68) and 'seeks to improve efficiency by guiding policy makers in how scarce resources can be used' (Hutubessy: 2002, p 89). A cost-outcome description is designed to attribute relevant costs to relevant effects by using health outcomes as the measure of effect (Drummond *et al:* 2001). Cost projections are used to identify future needs, establish priorities, and set appropriate productivity and expenditure targets (Creese and Parker: 1994).

3.1.2 Costing Perspective

A provider perspective is utilised in this study. This estimates all costs associated with the provision of an Antiretroviral Referral Unit as accounted for by the service provider (Drummond *et al:* 2001). The alternative societal or patient perspective study designs enumerate a wider range of productivity, time, indirect and intangible costs (*ibid*). Few studies calculate the costs associated with the latter perspectives because of difficulties in data collection (Beck *et al:* 2001; Sinanovic *et al:* 2003). Similarly, the use of a patient perspective poses difficulties in the measurement of intangible costs, such as the value of patient time.

3.1.3 Financial and Economic Costs

The results of this study are presented in the form of economic costs. While financial costs are limited to recorded monetary expenditure by providers, economic costs includes 'the cost of resources that were not regarded as costs to the health facility' (Govender *et al:* 2000, p 9) including external funding, the use of external facilities, and resource donations. Economic costs include a range of opportunity costs, which reflect the true societal valuation of the sacrificed resources (Drummond *et al:* 2001). All possible opportunity costs are not considered in this study as the 'accurate estimation of [such] costs is likely to be, in practice, an unrealistic objective' (Govender *et al:* 2000, p 16).

3.1.4 Capital and Recurrent Costs

Capital costs include all cost items with a lifespan of greater than one year (Creese and Parker: 1994). Recurrent costs include all cost items which require recurrent or ongoing expenditure, including personnel and overhead costs (*ibid*).

3.1.5 Fixed and Variable Costs

Fixed costs are defined as all costs which 'do not change when the quantity of patient care changes' (Shepard *et al:* 2000, p 32). Fixed costs generally include a range of capital and other costs. Variable costs are defined as all costs which vary according to the quantity of outpatient visits or inpatient days (*ibid*).

3.1.6 Full and Incremental Cost Analyses

This study employs a full cost analysis technique. A full cost analysis quantifies all existing resources utilised to provide a service or intervention and is based on average prices. 'Average prices include fixed costs, such as costs of hospital buildings and costs of overheads, as well as variable costs' (Drummond *et al:* 2001, p 71). An incremental cost analysis is limited to the additional or incremental resources used in the expansion of a service or intervention (*ibid*).

3.2 Key Applied Concepts

3.2.1 Gross and Micro Costing Techniques

This research employs a combination of gross (step-down) and micro (ingredients-based) costing methods for the valuation of resource use. Gross costing occurs when 'total expenditure on a service is divided by the number of persons served over a particular time period to arrive at a per-person cost estimate for treatment over that period' (Beck *et al:* 2001, p 16). Conversely, micro costing focuses on the collection and analysis of resource inputs at the individual level and relates use of services to patient characteristics for the calculation of patient-specific costs (*ibid*).

3.2.2 Allocation Procedures

This study employs a range of allocation procedures for the assignment of shared costs across inpatient and outpatient care. Allocation procedures are designed to ensure the appropriate distribution of costs across cost centres (Drummond *et al:* 2001) whereby 'all costs incurred in the provision of services are allocated to relevant services based on methods suitable for each category' (Matsheke: 2004, p 30). The allocation of shared personnel costs, hospital-wide recurrent costs, and capital costs was conducted based on accepted economic evaluation allocation procedures (Shepard *et al:* 1998; Creese and Parker: 1994). Matsheke notes that these criteria are designed as guidelines and that 'the basis of cost allocation may vary subject to evaluator's choice and availability of information' (*ibid*).

3.2.3 Timeframe for Data Collection

The timeframe for costing data collection was designed to capture all possible costs associated with the Antiretroviral Referral Unit. 'Choosing an appropriate time horizon for the evaluation is important, since shifting the time horizon of the evaluation may have a substantial impact on the results of the study' (Drummond *et al:* 2001, p 71). The timeframe for data collection was designed to capture all occasional costs which may not be recorded during shorter time periods (Creese and Parker: 1994).

3.2.4 Real and Nominal Prices

Nominal prices are defined as prices in current money terms (www.encyclopedia.laborlawtalk.com). Real prices reflect actual purchasing power, and are corrected for the effects of inflation (*ibid*). All monetary values used in this analysis are presented in real March 2005 prices.

4. Methodology

This chapter describes the methods employed in this economic evaluation. Section 4.1 describes the background to the data collection stage. The data identification and collection processes for all Antiretroviral Referral Unit epidemiological and economic data are outlined in Section 4.2. Section 4.3 summarises data analysis techniques. The determination of costs per inpatient day and admission and per outpatient visit is presented in Section 4.4. Finally, procedures for the projection of Antiretroviral Referral unit costs are described in Section 4.5.

4.1 Background to Data Collection

4.1.1 Case Definition

All new and existing patients treated by the GF Jooste Antiretroviral Referral Unit during the study period were considered eligible for inclusion in this research. All patients treated by the Antiretroviral Referral Unit are required by the hospital to be resident in the GF Jooste Catchment Area, HIV-positive and above 13 years of age. In addition to these criteria, all such patients are required by the Antiretroviral Referral Unit to be on or preparing for HAART treatment and currently attending a designated antiretroviral clinic.

4.1.2 Data Collection Timeframe

Data was collected on all patient-specific provider costs associated with the GF Jooste Antiretroviral Referral Unit from 1st to 31st March 2005 inclusive. Information on inpatient length of stay in advance and after termination of the study period was collected during April 2005. All other costing data was collected between March and May 2005.

4.1.3 Retrospective Data Sets

In order to analyse the costs associated with the proposed GF Jooste Antiretroviral Referral Unit, this study utilised a combination of current and retrospective expenditure data sets. Overhead costs, inpatient personnel costs, and capital costs were based on data from the 2003 - 2004 Financial Year. All retrospective data sets were harmonised to March 2005 prices using STATSSA CPIX inflation data (www.statssa.gov.za/keyindicators/cpix.asp) to allow for differential timing (Drummond *et al:* 1987).

4.2 Data Collection

4.2.1 HAART Coverage and Antiretroviral Referral Unit Utilisation

Empirical information on the total numbers of patients on or preparing for HAART within the GF Jooste Catchment Area was sourced from the Provincial Administration of the Western Cape (PAWC: 2005). Historical data on monthly Antiretroviral Referral Unit utilisation levels was sourced from Ms. Cordelia Falen, GF Jooste Hospital Administration.

4.2.2 Descriptive Patient Characteristics

Information on descriptive patient characteristics was collected on a daily basis throughout the study period *via* patient data capture forms (see Appendix A). Attending clinicians were interviewed at the termination of their work shift with the assistance of patient record folders. Information on patient age and gender, key diagnoses of patients, HAART status, and all other required patient characteristics was captured through this procedure. Separate data capture forms were utilised for inpatients and outpatients.

4.2.3 Patient-Specific Resource Requirements and Associated Costs

4.2.3.1 Patient-Specific Resource Requirements

Data on patient-specific resource consumption was collected on a daily basis throughout the study period using the patient data capture forms. For the purposes of this study, patient-specific resource requirements were recorded and classified according to the following categories:

Laboratory Testing: All laboratory tests performed on patients, including blood tests, cerebro-spinal fluid tests, aspirations, and all other tests.

Imaging and Radiology: All imaging and radiology procedures ordered for patients, including X-rays, ultrasounds, and CT Scans. Electrocardiograms were also included in this category.

Medical and Surgical Procedures: All medical and surgical procedures performed on patients, including lumbar punctures, gastroscopies, and fine needle aspiration biopsies[5].

Medication: All medication prescribed for patients, including all antiretroviral drugs prescribed by the Antiretroviral Referral Unit[6]. Discharge medication prescribed for inpatients was also recorded and included in this category.

Intravenous Fluids: All intravenous fluids prescribed for inpatients, including saline fluids, dextrose, and rehydration fluids.

[5] Associated laboratory investigations were included under laboratory testing costs.

[6] Antiretroviral drugs dispensed at the primary level were excluded from medication costs.

Medical Consumables: All inpatient-specific medical consumable goods, including intravenous lines. All other medical and non-medical consumable goods utilised by the Antiretroviral Referral Unit were recorded as recurrent costs.

Counselling Services: All counselling services provided for Antiretroviral Referral Unit inpatients, including HAART counselling, pre-test counselling and post-test counselling.

4.2.3.2 Patient-Specific Costs

Patient-specific costs were determined through a variety of sources. Laboratory test costs were sourced from Mr. Anthony Williams, Senior Laboratory Supervisor, GF Jooste Hospital Laboratory and were based on National Health Laboratory Services (NHLS) estimates. Pharmaceutical and intravenous fluid costs, including all antiretroviral drugs prescribed by the Antiretroviral Referral Unit, were sourced from Mr. Mohammed Sonday, Senior Pharmacist, GF Jooste Hospital Pharmacy, and from the Community Health Services Organisation Drug Price Listings 2004. The costs of donated drugs, such as fluconazole, were sourced directly from drug manufacturers. All drug and pharmaceutical costs were calculated exclusive of dispensing costs.

Imaging, radiology and medical and surgical procedure costs were sourced from the South African Uniform Patient Fee Schedule (UPFS) 2005 and from Mr. Shawn Van Schoor, Finance Department, GF Jooste Hospital. All imaging and procedures unavailable at GF Jooste Hospital and conducted at Groote Schuur Tertiary Hospital on behalf of the Antiretroviral Referral Unit were included in these calculations. Medical and non-medical consumable costs were sourced from Mr. Robertson and Mr. Mdayi, Supplies Department, GF Jooste Hospital. Counselling costs were provided by the Lifeline Counselling Service, Cape Town. All costs were measured in 2005 South African Rands.

4.2.4 Capital Resource Requirements and Associated Costs

4.2.4.1 Antiretroviral Referral Unit Building

Antiretroviral Referral Unit building resource requirements were provided by Dr. Graeme Meintjes, Medical Consultant, GF Jooste Infectious Disease Clinic (Meintjes: 2004a). A full list of these requirements is provided in Appendix B. The corresponding costs associated with these requirements were collected from Mr. Hein Hanakom, Senekal Allen Quantity Surveyors, Cape Town.

4.2.4.2 Antiretroviral Referral Unit Equipment

Medical and non-medical equipment requirements were sourced from Dr. Graeme Meintjes. This included all medical and non-medical equipment required for the full operation of an Antiretroviral Referral Unit. A full list of equipment requirements is provided in Appendix B. Associated equipment costs were sourced from Ms. Lezel Adams, Inventory Department, GF Jooste Hospital, and directly from medical equipment manufacturers. Installation and maintenance fees were included for all Antiretroviral Referral Unit equipment.

4.2.4.3 Antiretroviral Referral Unit Staff Training

Training in the management of patients on antiretroviral drugs is periodically provided to Antiretroviral Referral Unit clinical staff. Training programme information and associated costs were sourced from the Medicines Information Centre, University of Cape Town.

4.2.4.4. Medical Ward Capital

Antiretroviral Referral Unit inpatients are treated in the GF Jooste Hospital Medical Ward. Capital resources required for Antiretroviral Referral Unit inpatient care, and associated costs per inpatient day, were based on prior costing data for HIV-positive inpatients at GF Jooste Hospital (Cleary *et al:* 2005).

4.2.5 Recurrent Resource Requirements and Associated Costs

4.2.5.1 Antiretroviral Referral Unit Personnel

Medical and non-medical personnel resource requirements were sourced from attending clinicians at the Antiretroviral Referral Unit. A clinician data capture form was used to inform estimates of the level and distribution of clinical staff time required for full Antiretroviral Referral Unit operation (see Appendix A). Associated costs were provided by Mr. George Julius, Finance Department, GF Jooste Hospital. Personnel costs include all benefits, scarce skills bonuses, committed overtime, pension funds and medical aid contributions.

4.2.5.2 Medical Ward Clinical Personnel

In addition to Antiretroviral Referral Unit clinical personnel, Antiretroviral Referral Unit inpatients receive treatment from GF Jooste Medical Ward clinical staff. Clinical personnel resource requirements for Antiretroviral Referral Unit inpatient care, and associated costs per inpatient day, were based on prior data for HIV-positive inpatients at GF Jooste Hospital[7] (Cleary *et al:* 2005).

[7] Antiretroviral Referral Unit clinical staff costs were deducted from medical ward clinical personnel costs where double counting occurred.

4.2.5.3 Overhead Costs

Monthly medical and surgical supplies requirements were sourced from attending clinicians at the Antiretroviral Referral Unit. A full list of these resource requirements is provided in Appendix B. Associated costs were sourced from Mr. Mdayi, Supplies Department, GF Jooste Hospital. Antiretroviral Referral Unit administrative requirements were sourced from Dr. Graeme Meintjes, while associated costs were provided by Mr. George Julius. All other general overhead costs for the Antiretroviral Referral Unit and the GF Jooste Medical Ward, as well as associated costs per outpatient visit and per inpatient day, were based on prior overhead cost data for HIV-positive inpatients and outpatients at GF Jooste Hospital (Cleary *et al:* 2005) and include utility, administrative[8], cleaning and security personnel costs.

4.3 Data Analysis

The data for this study was entered into the Microsoft EXCEL Version 9.0 software package (Seattle, Washington: 2000). Data sorting, data cleaning, data analysis and the generation of associated graphs, tables and charts were performed using EXCEL. Extrapolation of prospective HAART coverage and Associated Antiretroviral Referral Unit demand levels was also performed using EXCEL. Manual calculations using a hand calculator were performed where necessary.

[8] Antiretroviral Referral Unit administrative costs are supplementary to the administrative costs recorded under general overhead costs.

4.4 Cost per Outpatient Visit, per Inpatient Day and per Inpatient Admission

Cost per outpatient visit includes total patient-specific costs as well as Antiretroviral Referral Unit capital and recurrent costs. Cost per inpatient day and cost per inpatient admission includes total patient-specific costs as well as Antiretroviral Referral Unit and Medical Ward capital and recurrent costs. Allocation procedures for determining the distribution of shared capital and recurrent costs across inpatients and outpatients were developed in accordance with accepted economic evaluation criteria (Shepard *et al:* 1998), or based on prospective utilisation estimates from Dr. Graeme Meintjes. The following formulae were utilised in these calculations:

Formula 4.1: Cost per Outpatient Visit

Cost per Outpatient Visit = Antiretroviral Referral Unit Capital Costs per Outpatient Visit +
Antiretroviral Referral Unit Recurrent Costs per Outpatient Visit +
Outpatient-Specific Costs per Outpatient Visit

Formula 4.2: Cost per Inpatient Day

Cost per Inpatient Day = Antiretroviral Referral Unit Capital Costs per Inpatient Day +
Antiretroviral Referral Unit Recurrent Costs per Inpatient Day +
Inpatient-Specific Costs per Inpatient Day +
Medical Ward Capital Costs per Inpatient Day +
Medical Ward Personnel Costs per Inpatient Day

Formula 4.3: Cost per Inpatient Admission

Cost per Inpatient Admission = Total Cost per Inpatient Day x
Average Length of Stay

4.4.1 Patient-Specific Costs

4.4.1.1 Outpatient-Specific Costs

A micro costing procedure was employed for all patient-specific costing categories. The total cost of each patient-specific costing category was calculated for each outpatient visit, based on study period data. Total outpatient-specific costs per outpatient visit were then calculated. Total outpatient-specific costs were then divided by total outpatient visits to determine the average outpatient-specific cost per outpatient visit.

4.4.1.2 Inpatient-Specific Costs

A micro costing procedure was employed for all inpatient-specific costs. The total cost of each patient-specific costing category was calculated for each inpatient admission, based on study period data. Total inpatient-specific costs were then divided by total inpatient days to determine the average inpatient-specific cost per inpatient day.

4.4.2 Capital Costs

4.4.2.1 Antiretroviral Referral Unit Capital Costs

A step-down costing procedure was employed for all Antiretroviral Referral Unit capital costs. Equivalent annual costs for 2005 were calculated for all capital items based on their replacement costs[9]. Capital costs were annuitised assuming an average life span of 30 years for buildings, 10 years for equipment and 2 years for staff training (Shepard *et al:* 1998) to produce annual capital costs. A discount rate of 8.0% per annum was employed to allow for depreciation and the opportunity cost of capital investment. This discount rate is equivalent

[9] For CT Scanner equipment costs, prospective Antiretroviral Referral Unit utilisation was estimated at 5.0% of total hospital utilisation, based on consultation with Dr. Graeme Meintjes. Utilisation-based CT Scanner costs were then annuitised as for other Antiretroviral Referral Unit equipment.

to the return on long term government bonds in South Africa, in accordance with methodological recommendations (Drummond *et al:* 2001).

Annuitised Antiretroviral Referral Unit building and equipment costs were allocated to inpatients and outpatients according to relative utilisation estimates sourced from Dr. Graeme Meintjes. Staff training costs were allocated according to staff time distribution data for the study period. Total monthly inpatient and outpatient Antiretroviral Referral Unit capital costs were then divided by total monthly outpatient visits and total monthly inpatient days respectively to produce capital costs per outpatient visit and per inpatient day.

4.4.3 Recurrent Costs

4.4.3.1 Antiretroviral Referral Unit Clinical Personnel Costs

Total monthly clinical personnel costs were calculated by combining data on clinical staff time distribution with associated monthly salary information. Clinical personnel costs were allocated to inpatients and outpatients according to data on inpatient and outpatient contact time sourced from the clinician data capture forms (see Appendix D). Inpatient and outpatient clinical personnel costs for the Antiretroviral Referral Unit were then divided by total inpatient days and total outpatient visits respectively to produce the clinical personnel cost per outpatient visit and per inpatient day.

4.4.3.2 Antiretroviral Referral Unit Overhead Costs

Antiretroviral Referral Unit administration and medical and surgical supplies costs were allocated to outpatients and inpatients according to relative facility utilisation estimates sourced from Dr. Graeme Meintjes. These costs were then divided by total outpatient visits and total inpatient days respectively to produce the respective cost per outpatient visit and per inpatient day.

4.5 Cost-Outcome Description

The cost per successful outcome for Antiretroviral Referral Unit treatment was calculated for inpatients and outpatients. Information from the patient data capture forms on response to treatment was used to develop the outcome measure. Attending clinicians were asked to categorise inpatients and outpatients as 'improved', 'stabilised', 'no change', 'deteriorated', or 'died'[10]. Patients assessed as 'improved' or 'stabilised' were considered to have been successfully treated. The cost per successful outpatient visit, the cost per successful inpatient day and the cost per successful inpatient admission were then calculated.

4.6 Modelling of Prospective Costs

The modelling of prospective costs per outpatient visit, per inpatient day and per inpatient admission is designed to assist in determining the resource requirements associated with projected demand for secondary hospital services by patients on or preparing for HAART in the GF Jooste Catchment Area. A five-year projection period from 2006 to 2010 was utilised for the modelling of prospective year-on-year costs.

4.6.1 Prospective HAART Coverage

Projected HAART coverage levels, include all patients on or preparing for antiretroviral treatment in the GF Jooste Catchment Area, were calculated based on the linear extrapolation of coverage levels for December 2004 to March 2005. The following formula was used:

[10] Standardised outcome measures, such as viral suppression levels, were considered to be more appropriate to the measurement of the direct effects of antiretroviral therapy, rather than to measurement of the specialised services provided by the Antiretroviral Referral Unit. In many cases, the treatment provided by the Antiretroviral Referral Unit may not affect viral suppression or CD4 levels, while still resulting in an improvement or stabilisation of the patient's health condition.

Formula 4.4: Projected Monthly HAART Coverage

$$\text{Coverage}_{\text{Month A}} = \text{Coverage in Projection Month}$$

$$\text{Coverage}_{\text{Month (A-n)}} = \text{Coverage in Prior Month}$$

$$\text{Coverage}_{\text{Month A}} = \{ [(\text{Coverage}_{\text{Month (A-1)}} - \text{Coverage}_{\text{Month (A-2)}}) + (\text{Coverage}_{\text{Month (A-2)}} - \text{Coverage}_{\text{Month (A-3)}}) + (\text{Coverage}_{\text{Month (A-3)}} - \text{Coverage}_{\text{Month (A-4)}})] / (3) \} + \text{Coverage}_{\text{Month (A-1)}}$$

4.6.2 Prospective Antiretroviral Referral Unit Demand

Based on prior Antiretroviral Referral Unit utilisation data (see Appendix C), the proportion of persons on or preparing for HAART requiring Antiretroviral Referral Unit services was calculated for the projection period. The proportions of prospective patients requiring inpatient and outpatient care were then calculated based on Antiretroviral Referral Unit admission data for the study period (see Appendix C). Average monthly outpatient visit frequency and average monthly inpatient length of stay for the study period were then used to calculate prospective monthly outpatient visits and inpatient days.

4.6.3 Prospective Antiretroviral Referral Unit Costs

Prospective costs per outpatient visit, per inpatient day and per inpatient admission were estimated based on projected demand for Antiretroviral Referral Unit services in the GF Jooste Catchment Area. All patient-specific, capital and recurrent costs were recategorised as fixed and variable costs for inpatients and outpatients. The model assumes that initial Antiretroviral Referral Unit and GF Jooste Medical Ward fixed resources maintain excess capacity[11], and will not be expanded during the projection period. Based on consultation with Dr. Graeme Meintjes, specialist clinical personnel resources were considered to remain

independent of projected demand levels, and were categorised as fixed costs throughout the projection period. Total year-on-year fixed costs per outpatient visit, per inpatient day and per inpatient admission were then calculated based on prospective demand levels.

All variable costs per outpatient visit, per inpatient day and per inpatient admission were assumed to remain independent of total Antiretroviral Referral Unit utilisation levels, and were held constant throughout the projection period[12]. Total fixed costs per outpatient visit, per inpatient day and per inpatient admission were then combined with their respective variable costs to produce total projected costs per outpatient visit, per inpatient day and per inpatient admission.

[11] Excess capacity is defined as the amount by which actual output falls short of potential output at operational capacity (Lipsey *et al:* 1992), and is assumed in this case due to low levels of demand at baseline.

[12] In economic evaluation terminology, these costs are described as constant marginal variable costs (Drummond *et al:* 1988).

5. Epidemiological Results

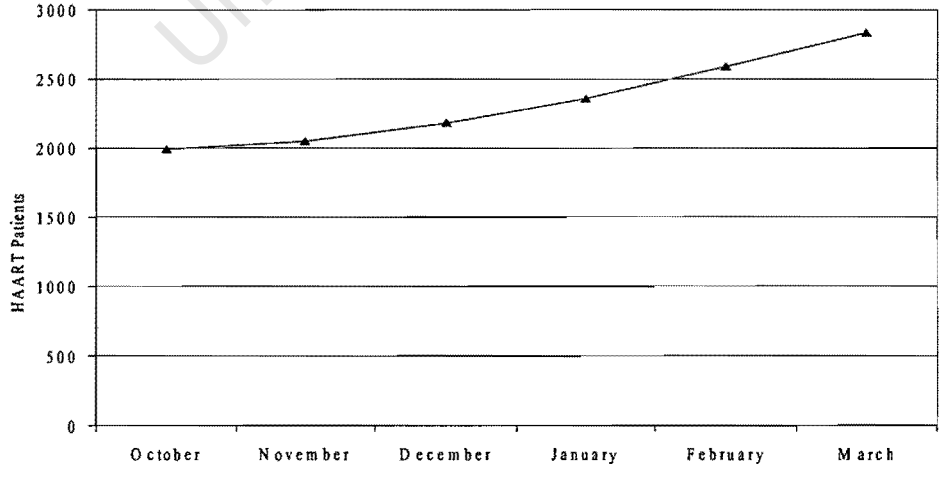
5.1 Demand for Antiretroviral Referral Unit Services

Total numbers of patients on or preparing for HAART and attending an antiretroviral clinic within the GF Jooste Catchment Area between October 2004 and March 2005 are presented in Table 5.1 and Figure 5.1[13]. HAART patients include all patients on or preparing for HAART[14].

Table 5.1: HAART Patients Attending Antiretroviral Clinics in the GF Jooste Catchment Area

	October 2004	November 2004	December 2004	January 2005	February 2005	March 2005
GF Jooste	197	218	235	248	258	271
Site B (Khayelitsha)	593	606	597	629	678	720
Site C (Nolungile)	403	422	415	431	450	465
Mitchells Plain	238	285	306	341	378	423
Guguletu	403	422	443	473	532	597
Crossroads	19	36	50	62	62	113
Total	**1,853**	**1,989**	**2,046**	**2,184**	**2,358**	**2,589**

Figure 5.1: HAART Patients Attending Antiretroviral Clinics in the GF Jooste Catchment Area, October 2004 - March 2005.



[13] Source: Provincial Administration of the Western Cape (PAWC: 2005).

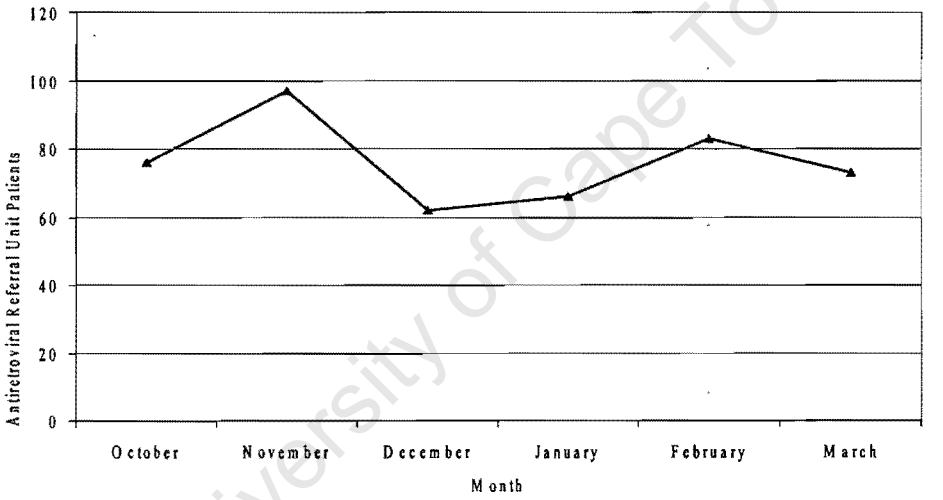
[14] Patients preparing for HAART were included by adding the total number of new starts in the succeeding month to each preceding month.

Total numbers of patients on or preparing for HAART and attending the Antiretroviral Referral Unit between October 2004 and March 2005 are presented in Table 5.2 and Figure 5.2[15]. Total patients include all Antiretroviral Referral Unit inpatients and outpatients.

Table 5.2: Patients Attending the Antiretroviral Referral Unit

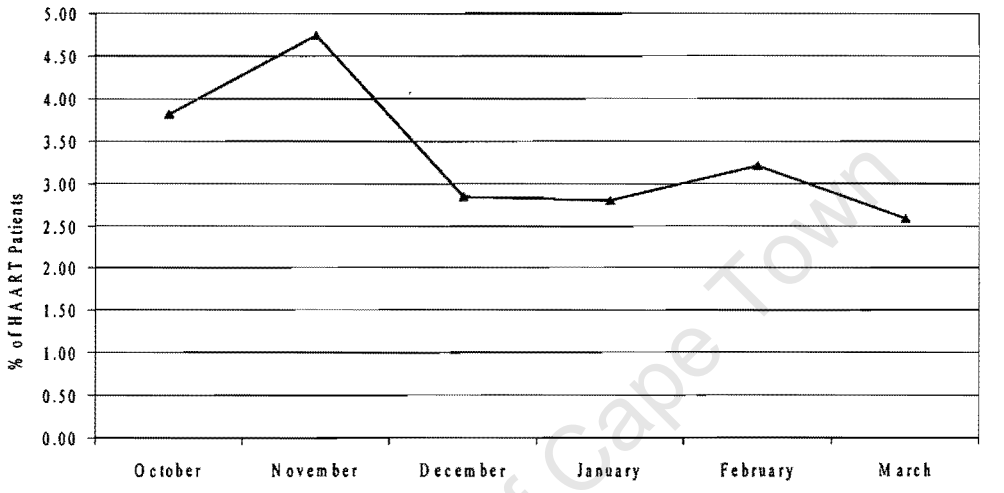
	October 2004	November 2004	December 2004	January 2005	February 2005	March 2005
Total Patients	76	97	62	66	83	73

Figure 5.2: Antiretroviral Referral Unit Treatment Levels, October 2004 - March 2005.



Total monthly Antiretroviral Referral Unit treatment levels, as a proportion of patients on or preparing for HAART and attending antiretroviral clinics within the GF Jooste Catchment Area, are presented in Figure 5.3. From October 2004 to March 2005, an average monthly level of 3.33% of HAART patients required treatment from the Antiretroviral Referral Unit[16].

Figure 5.3: HAART Patients Requiring Antiretroviral Referral Unit Treatment, October 2004 - March 2005.



5.2 Study Sample Size

All patients attending the Antiretroviral Referral Unit during the study period met inclusion criteria. During the time period 1st to 31st March 2005 inclusive, information on 48 outpatients and 25 inpatients was collected from the Antiretroviral Referral Unit. A total of 62 outpatient visits were made to the Antiretroviral Referral Unit by the 48 outpatients during this time period.

---

15 Source: GF Jooste Hospital Administration.

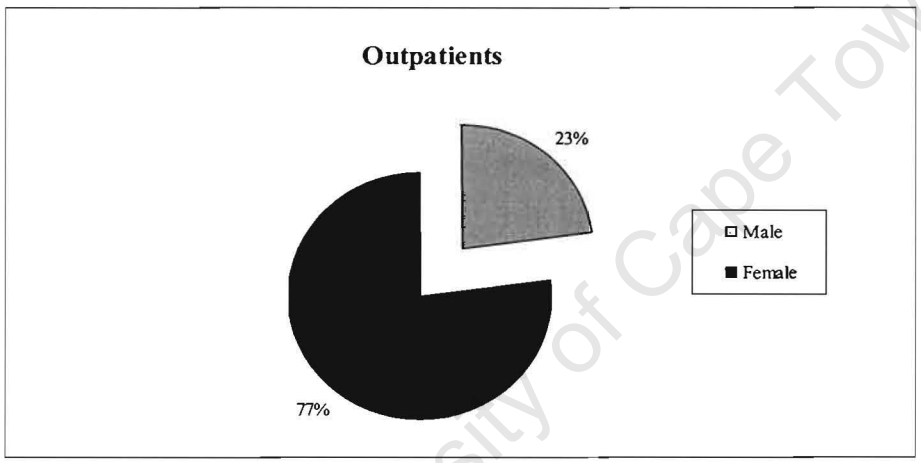
16 See Appendix C for the derivation of the average monthly level of HAART patients.

5.3 Descriptive Patient Characteristics

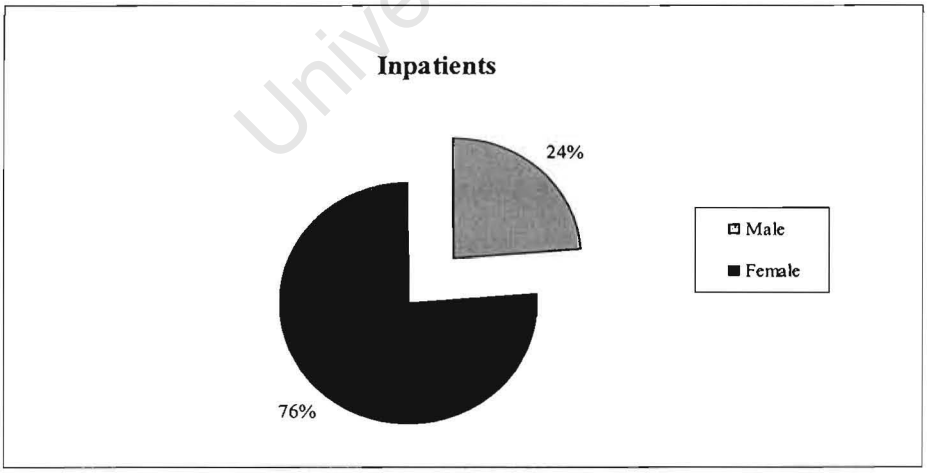
5.3.1 Patient Gender

Gender information was recorded for all 48 outpatients and all 25 inpatients in the study sample. The gender of patients was predominantly female for both outpatients (77.0%) and inpatients (76.0%). The distributions of Antiretroviral Referral Unit outpatients and inpatients by gender are illustrated in Figure 5.4.

Figure 5.4: Patient Gender Distributions



n = 48

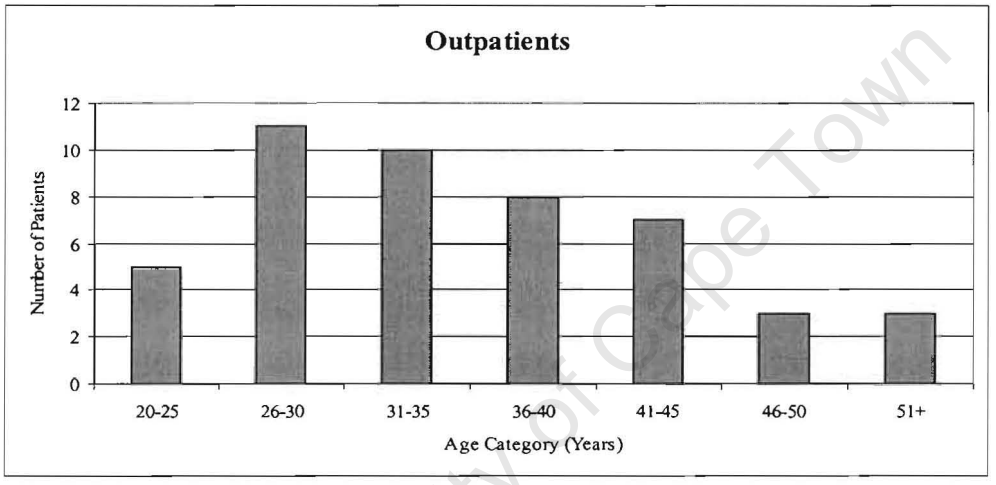


n = 25

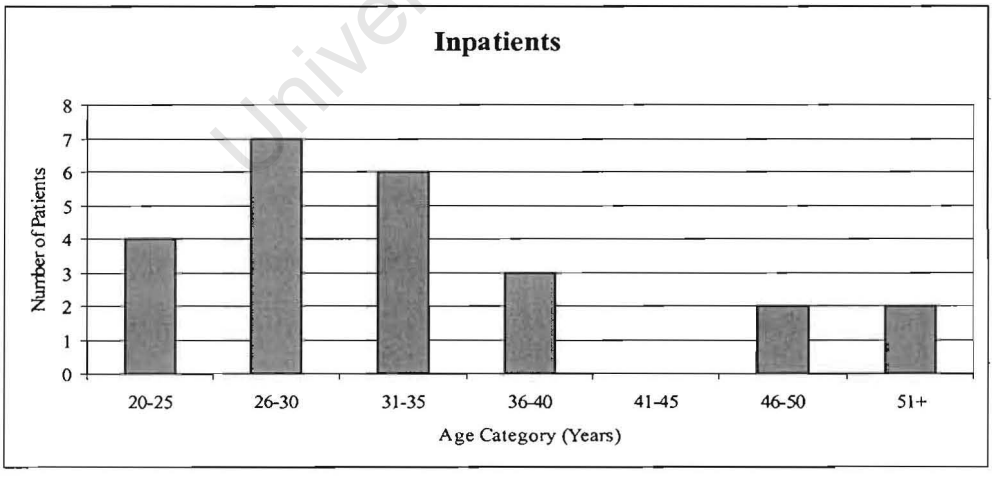
5.3.2 Patient Age

Data on patient age was recorded for 47 outpatients and 24 inpatients. Inpatient age is represented as age at date of admission. The mean age at date of visit was 35.96 years for outpatients and the mean age at date of admission was 34.0 years for inpatients. The distributions of Antiretroviral Referral Unit inpatients and outpatients across age categories are presented in Figure 5.5.

Figure 5.5: Patient Age Category Distributions



n = 47

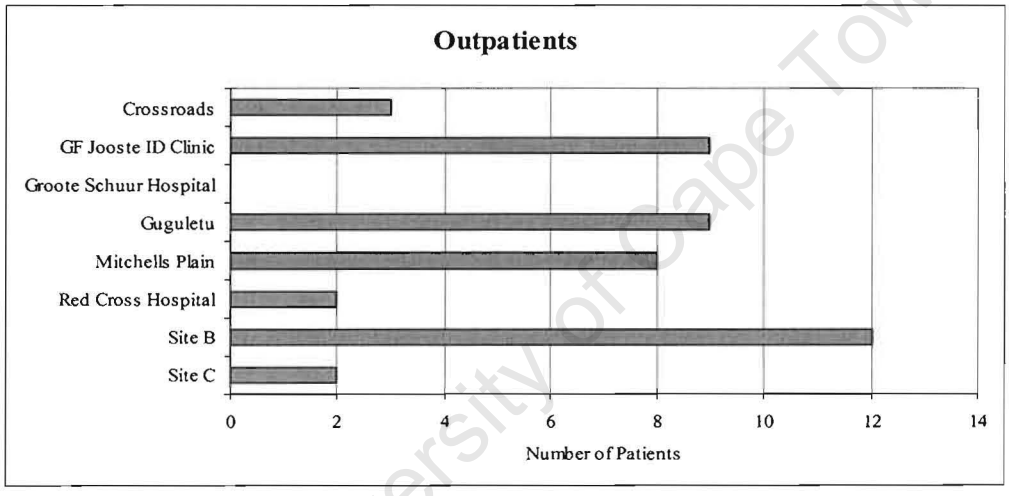


n = 24

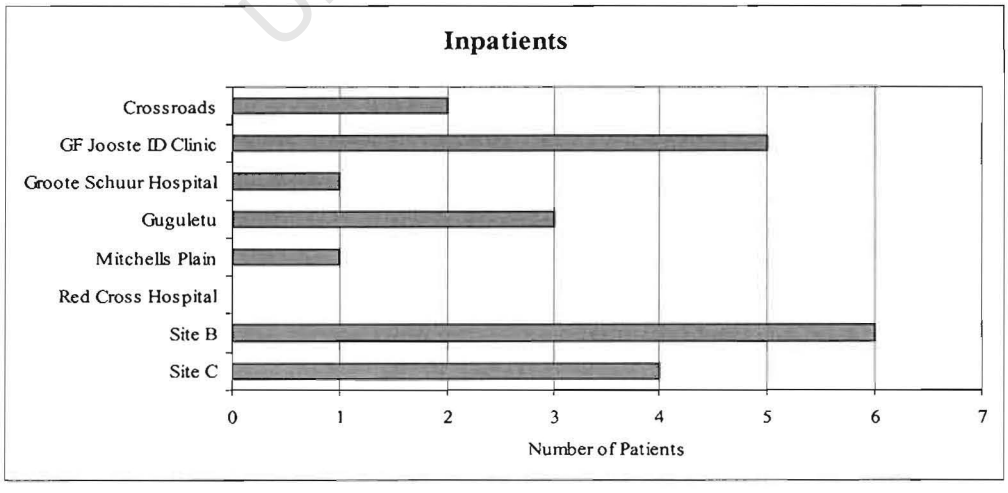
5.3.3 Attending Antiretroviral Clinic

Information on attending antiretroviral clinic was collected for 45 outpatients and 22 inpatients. For outpatients, the majority of patients attended the Site B Clinic (26.67%), the GF Jooste Infectious Disease Clinic (20.0%) and the Guguletu Clinic (20.0%). For inpatients, the majority of patients attended the Site B Clinic (27.27%) followed by the GF Jooste Infectious Disease Clinic (22.73%) and the Site C Clinic (18.18%). The distributions of outpatients and inpatients by attending antiretroviral clinic are illustrated in Figure 5.6.

Figure 5.6: Patient Antiretroviral Clinic Distributions



n = 45

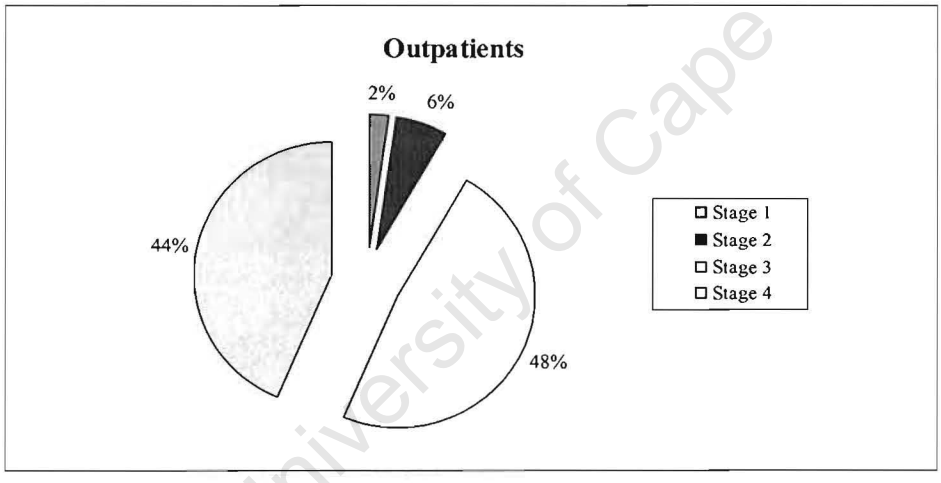


n = 22

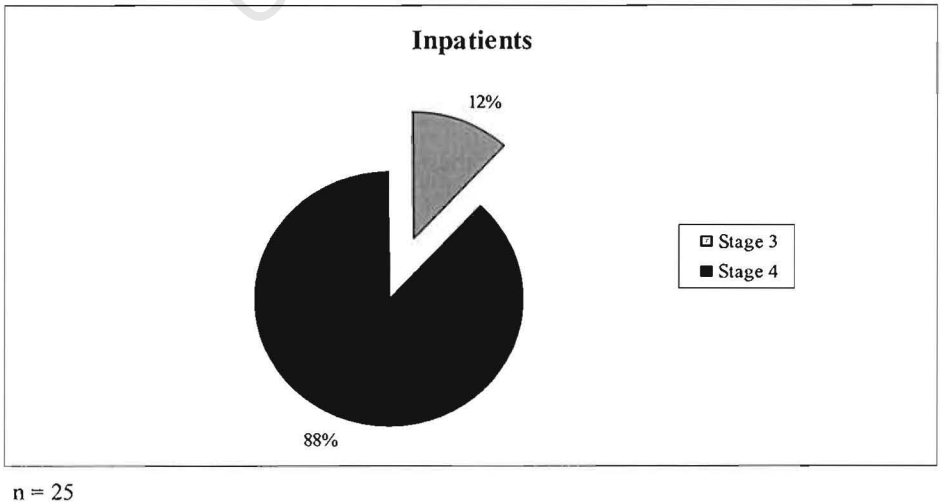
5.3.4 WHO HIV / AIDS Clinical Stage

The WHO HIV / AIDS Clinical Stage was recorded for all 48 outpatients and all 25 inpatients. Patient clinical stage was assessed based on the patient's medical record and clinician assessment. For outpatients, a total of 21 patients (43.75%) were assessed as clinical stage 4 and a further 23 patients (47.92%) as clinical stage 3. The median clinical stage for outpatients was stage 3. For inpatients, 22 of 25 patients (88.0%) were at clinical stage 4 with the remaining three patients (12.0%) at clinical stage 3. The median clinical stage for inpatients was stage 4. The distributions of outpatients and inpatients by clinical stage are presented in Figure 5.7.

Figure 5.7: Patient WHO HIV / AIDS Clinical Stage Distributions



n = 48

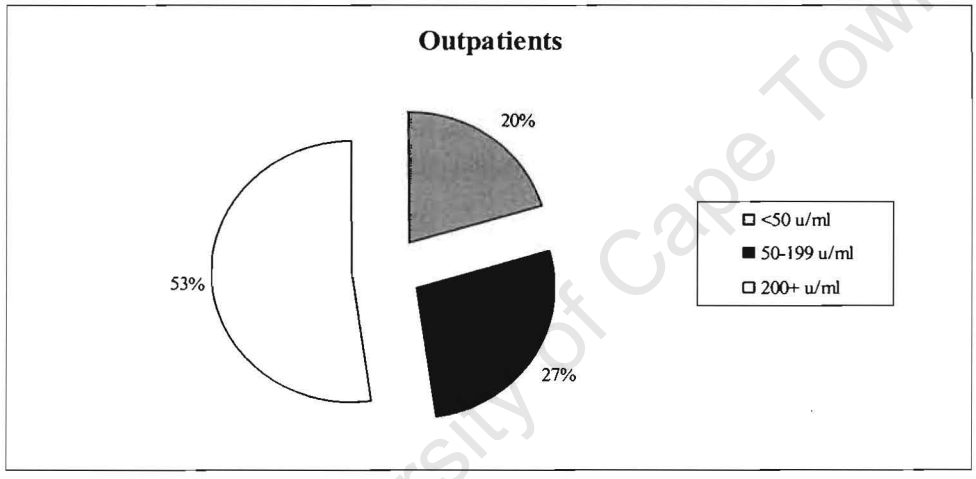


n = 25

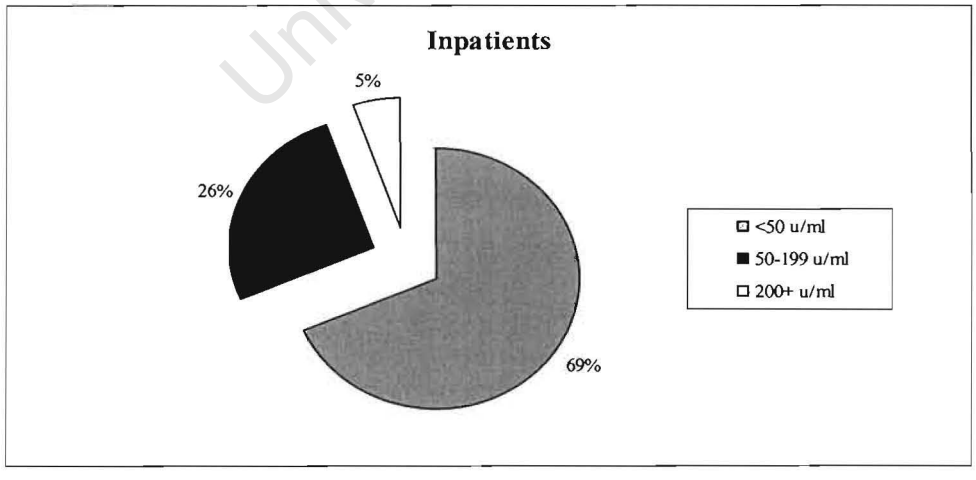
5.3.5 CD4 Count

Most recent CD4 count data was recorded for 44 outpatients and 19 inpatients. For outpatients, 20.45% presented with a CD4 count below 50 μ/ml, and a further 27.27% with a CD4 count between 51 and 200 μ/ml. The mean outpatient CD4 count was 175.07 μ/ml. For inpatients, 68.42% presented with a CD4 level below 50 μ/ml, and a further 26.32% with a CD4 count between 51 and 200 μ/ml. The mean inpatient CD4 count was 77.58 μ/ml. The distributions of outpatients and inpatients by CD4 count are illustrated in Figure 5.8.

Figure 5.8: Patient CD4 Count Distributions



n = 44



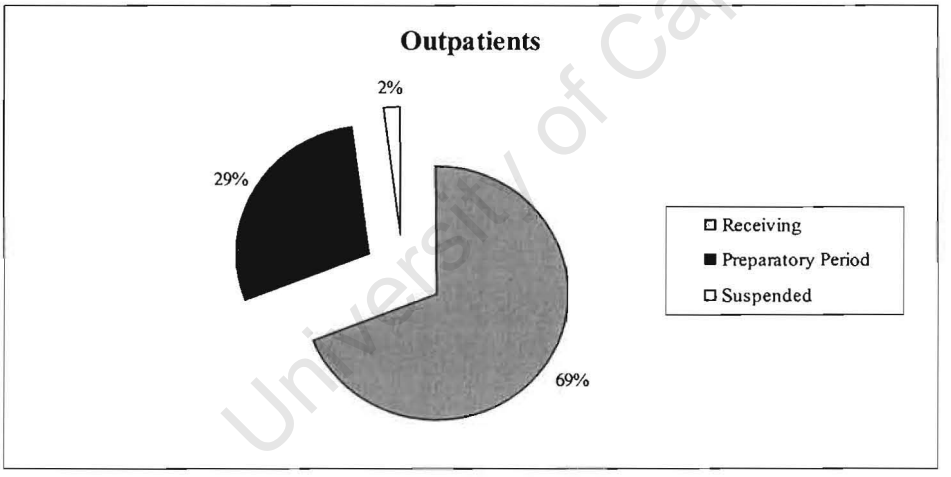
n = 19

5.4 Antiretroviral Data

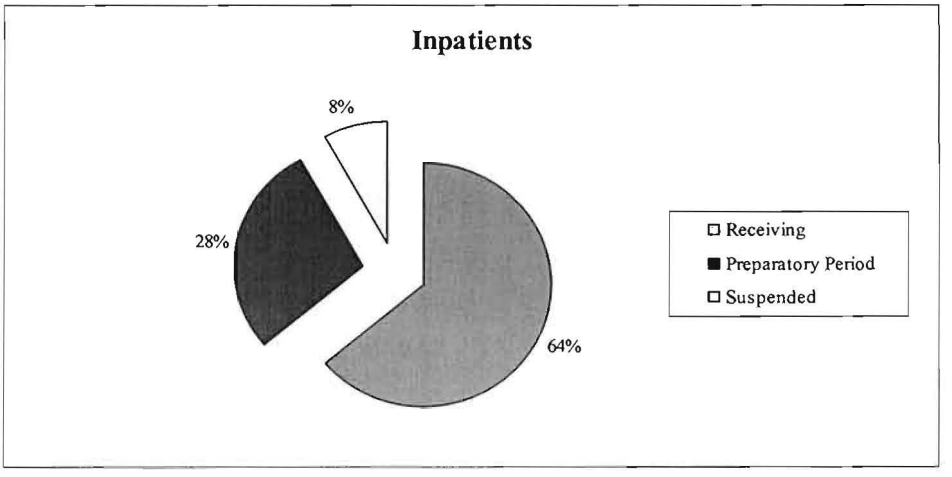
5.4.1 HAART Status

HAART status was recorded for all 48 outpatients and all 25 inpatients. 68.75% of outpatients were receiving HAART while a further 29.17% were preparing for HAART initiation at date of visit. One outpatient was suspended from HAART treatment at date of visit. 64.0% of inpatients were receiving HAART, while 28.0% were at the preparatory stage at date of admission. Two inpatients were suspended from HAART treatment at date of admission. The distributions of outpatients and inpatients by HAART status are illustrated in Figure 5.9.

Figure 5.9: Patient HAART Status Distributions



n = 48

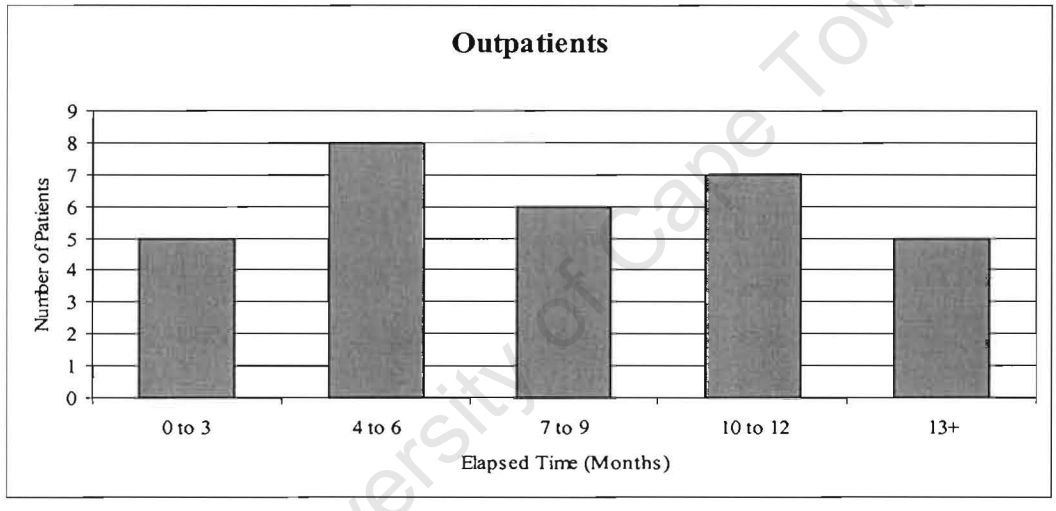


n = 25

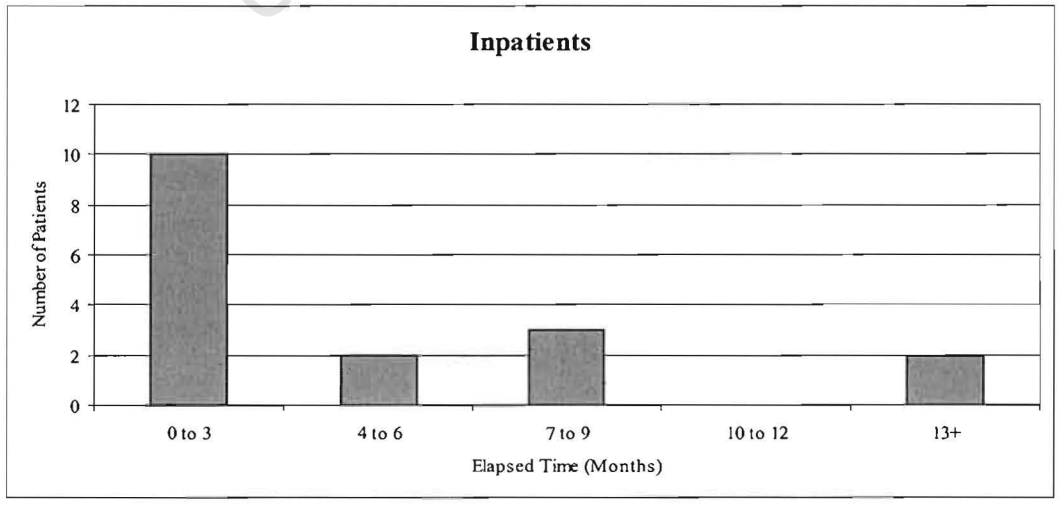
5.4.2 Time Since HAART Initiation

The date of HAART initiation was recorded for 31 of 34 outpatients on HAART and 17 of 18 inpatients on HAART. Time since HAART initiation was calculated based on date of visit for outpatients and date of admission for inpatients. For outpatients, the mean time since initiation was 10.06 months and the median time 8 months. For inpatients, corresponding mean time was 5.47 months and median time 2 months. The distributions of outpatients and inpatients by time elapsed since HAART initiation are presented in Figure 5.10.

Figure 5.10: Time Since HAART Initiation



n = 31

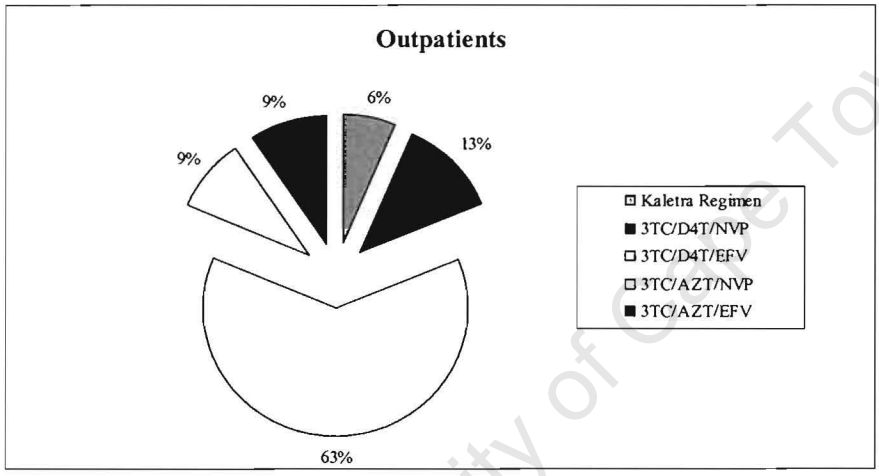


n = 17

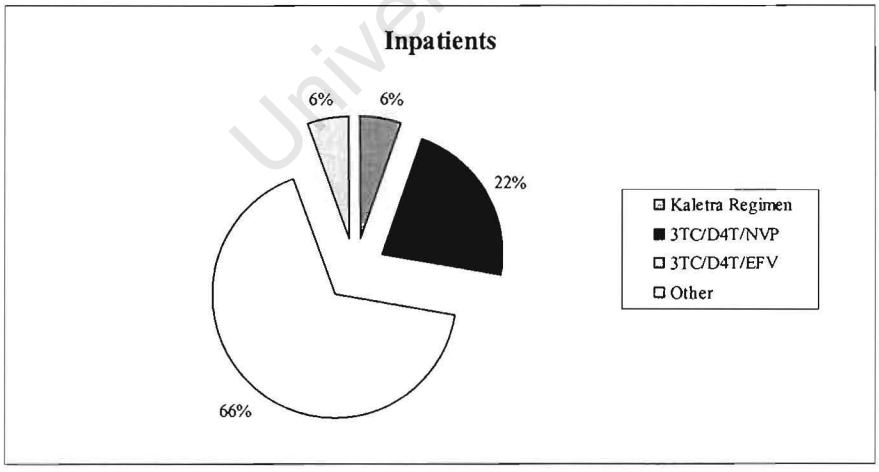
5.4.3 HAART Regimen

Information on HAART regimen was recorded for 32 of 34 outpatients on HAART and 17 of 18 inpatients on HAART. 62.5% of HAART outpatients received a combination of 3TC, D4T and Efavirenz antiretrovirals. Similarly, 66.67% of HAART inpatients received this combination. The distributions of outpatients and inpatients on HAART by HAART regimen are illustrated in Figure 5.11.

Figure 5.11: Patient HAART Regimen Distributions[17]



n = 32



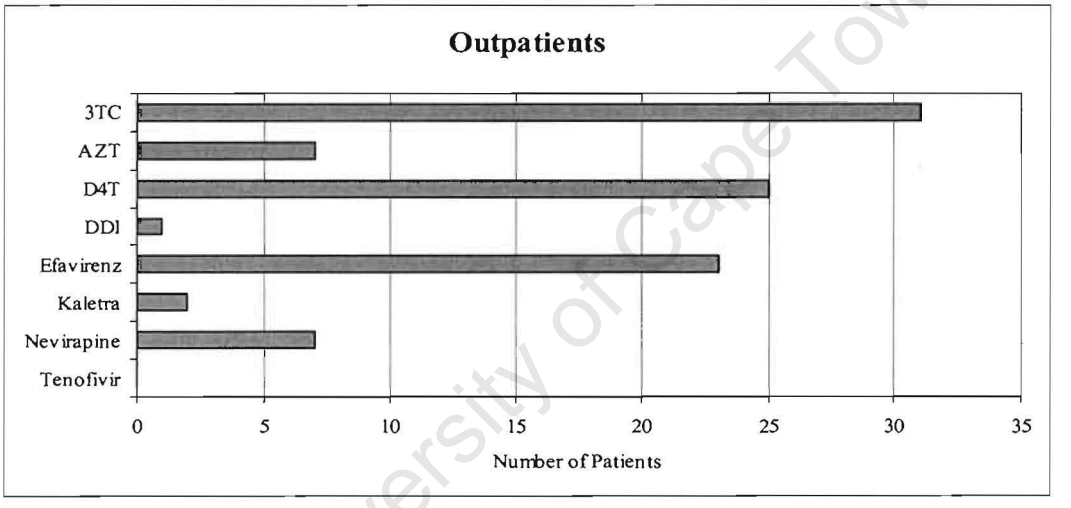
n = 17

[17] The Kaletra Regimen is composed of Kaletra and a combination of two other antiretroviral drugs, including DDI, D4T or AZT.

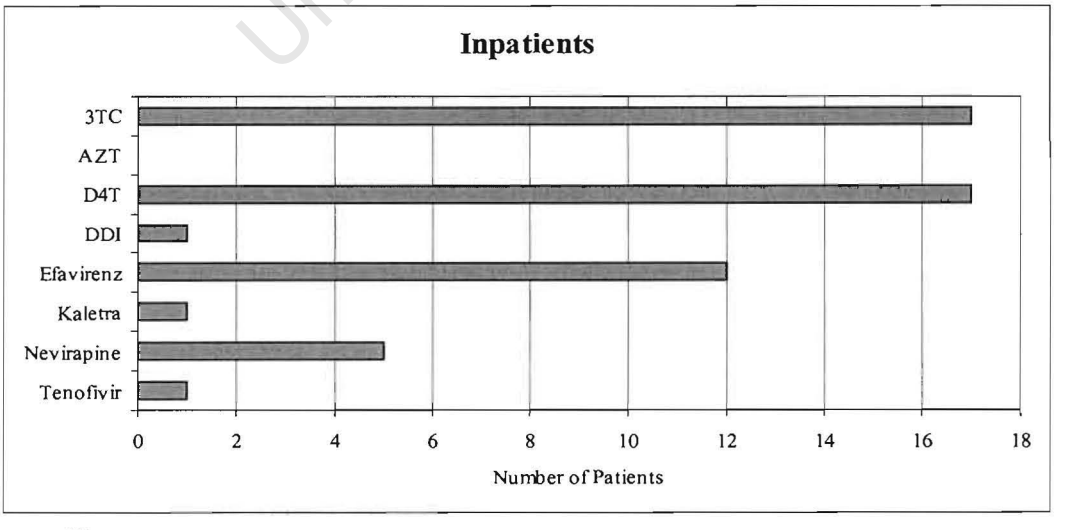
5.4.4 Antiretroviral Drug Type

Based on HAART regimen data, information on the types of individual antiretroviral drugs used by HAART outpatients and inpatients was derived. Of the 32 outpatients with HAART regimen information, 96.88% received 3TC and 78.13% received D4T. Of the 18 inpatients with HAART regimen information, 94.44% received 3TC and 94.44% received D4T. The levels of individual antiretroviral drug types across inpatients and outpatients on HAART are illustrated in Figure 5.12.

Figure 5.12: Patient Antiretroviral Drug Type Levels



n = 32



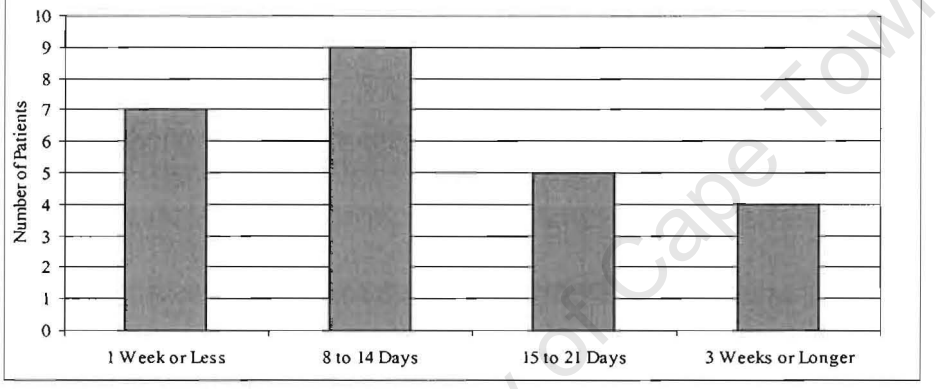
n = 18

5.5 Length of Stay and Visit Duration

5.5.1 Inpatient Length of Stay

Information on total length of stay at GF Jooste Hospital was available for all 25 inpatients. 28.0% of inpatients were hospitalised for 7 days or less, while 36.0% were hospitalised for 8 to 14 days. 20.0% (5 patients) were admitted for 14 to 21 days, and a further 16.0% (4 patients) for longer than 3 weeks. The mean length of stay was 14.60 days[18]. The distribution of inpatients according to length of stay is presented in Figure 5.13.

Figure 5.13: Inpatient Length of Stay

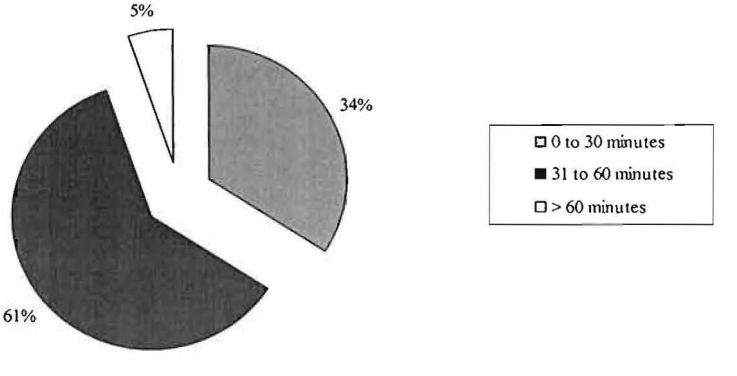


n = 25

5.5.2 Outpatient Duration of Visit

Information on duration of outpatient visit was available for 38 out of 62 outpatient visits. The average length of outpatient visit was 47.37 minutes. The distribution of outpatient visits according to duration of visit is presented in Figure 5.14.

Figure 5.14: Outpatient Duration of Visit



n = 38

[18] This figure includes all inpatient days accrued in advance and after termination of the study period (365 inpatient days). Average inpatient length of stay for the study period was 9.60 days (240 days).

5.6 Patient Diagnoses

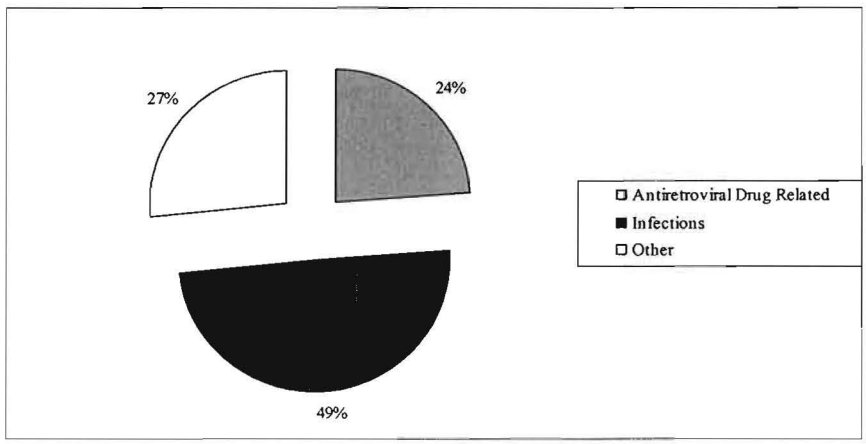
5.6.1 Outpatient Diagnoses

Diagnosis information was collected for all 62 outpatient visits. Individual outpatients frequently presented with multiple diagnoses, and a total of 75 outpatient diagnoses were recorded. Outpatient primary and secondary diagnostic groups and associated frequencies are presented in Table 5.3. Of 48 outpatients, 33.33% were diagnosed with Tuberculosis. Primary diagnostic groups are presented in Figure 5.15. 49.33% of all outpatient diagnoses were categorised as 'Infections' and 24.0% as 'Antiretroviral Drug Related'.

Table 5.3: Outpatient Primary and Secondary Diagnostic Groups

Primary Diagnostic Group	Secondary Diagnostic Group	Number of Diagnoses	% of Outpatients
Antiretroviral Drug Related	Stavudine (D4T) Related Neuropathy	2	4.17
	Drug Induced Hepatitis	5	10.42
	Drug Induced Skin Rash	1	2.08
	Lactic Acidosis	3	6.25
	Lipodystrophy	1	2.08
	Hyperlactataemia	5	10.42
	Suspected Hyperlactataemia (Disproven)	1	2.08
Infections	Chronic Diarrhoea	1	2.08
	Cryptococcal Meningitis	3	6.25
	Oesophageal Candidiasis	1	2.08
	Other: Infection	8	16.67
	Pneumocystis Carinii Pneumonia	1	2.08
	Pneumonia	5	10.42
	Toxoplasmosis	1	2.08
	Tuberculosis	16	33.33
	Viral Hepatitis	1	2.08
Other	Other: HIV Related	6	12.50
	Other: HIV Unrelated	6	12.50
	HIV Encephalopathy	4	8.33
	HIV Nephropathy	4	8.33
Total	--	**75**	--

Figure 5.15: Outpatient Primary Diagnostic Groups



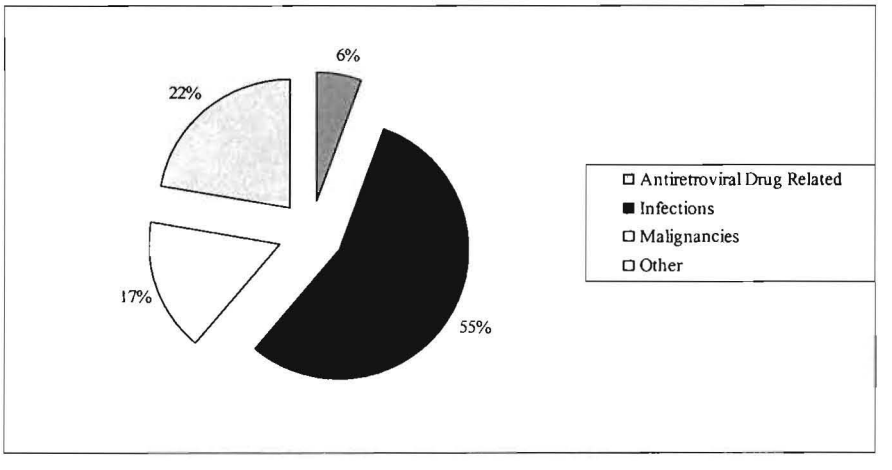
5.6.2 Inpatient Diagnoses

Diagnosis information was collected for all 25 inpatient admissions. Individual inpatients frequently presented with multiple diagnoses, and a total of 36 inpatient diagnoses were recorded. Inpatient primary and secondary diagnostic groups and associated frequencies are presented in Table 5.4. Of 25 inpatients, 40.0% were diagnosed with Tuberculosis and 24.0% with Cryptococcal Meningitis. Primary diagnostic groups are presented in Figure 5.14. 55.56% of inpatient diagnoses were classified as 'Infections' and a further 16.67% as 'Malignancies'.

Table 5.4: Inpatient Primary and Secondary Diagnostic Groups

Primary Diagnostic Group	Secondary Diagnostic Group	Number of Cases	% of Inpatients
Antiretroviral Drug Related	Drug Induced Hepatitis	1	4.00
	Lactic Acidosis	1	4.00
Infections	Chronic Diarrhoea	2	8.00
	Cryptococcal Meningitis	6	24.00
	Other: Infection	2	8.00
	Tuberculosis	10	40.00
Malignancies	Kaposi's Sarcoma	5	20.00
	Lymphoma	1	4.00
Other	Deep Vein Thrombosis	1	4.00
	Acute Renal Failure	3	12.00
	HIV Nephropathy	1	4.00
	Other: HIV Related	2	8.00
	Other: HIV Unrelated	1	4.00
Total	--	**36**	--

Figure 5.16: Inpatient Primary Diagnostic Groups

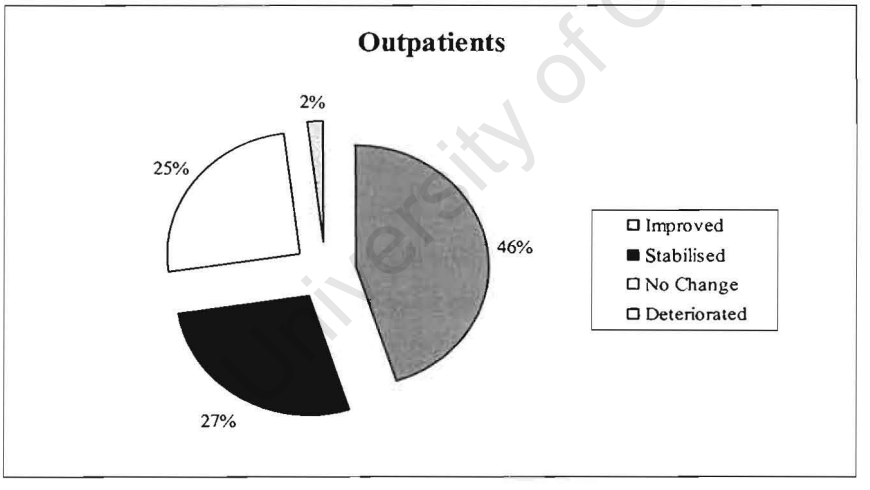


5.7 Patient Outcomes

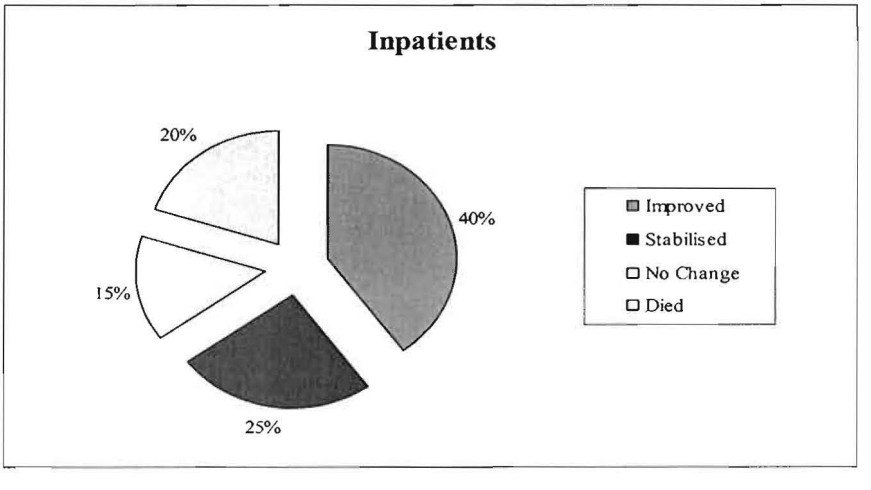
5.7.1 Response to Treatment

Patient response to treatment was assessed by the attending clinician for 51 of 62 outpatient visits and 20 of 25 inpatient admissions. For outpatient visits, 45.1% of patients improved with treatment and a further 27.45% were stabilised. 25.49% of visits were recorded as producing no change in health status. For inpatient admissions, 40.0% were recorded as improving with treatment while 25.0% recorded stabilisation. 15.0% of inpatient admissions were recorded as showing no change in health status. Four deaths (20.0% of known inpatient outcomes) occurred amongst inpatients. The distributions of outpatient visits and inpatient admissions by response to treatment outcome category are presented in Figure 5.17.

Figure 5.17: Patient Response to Treatment



n = 51

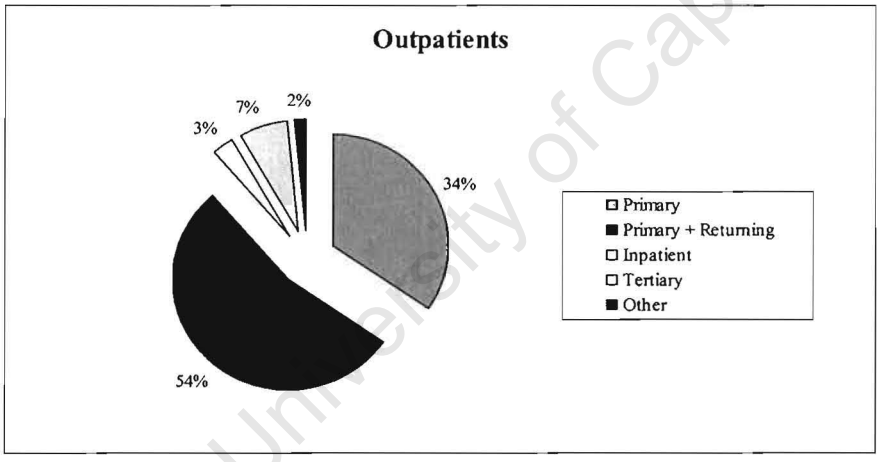


n = 20

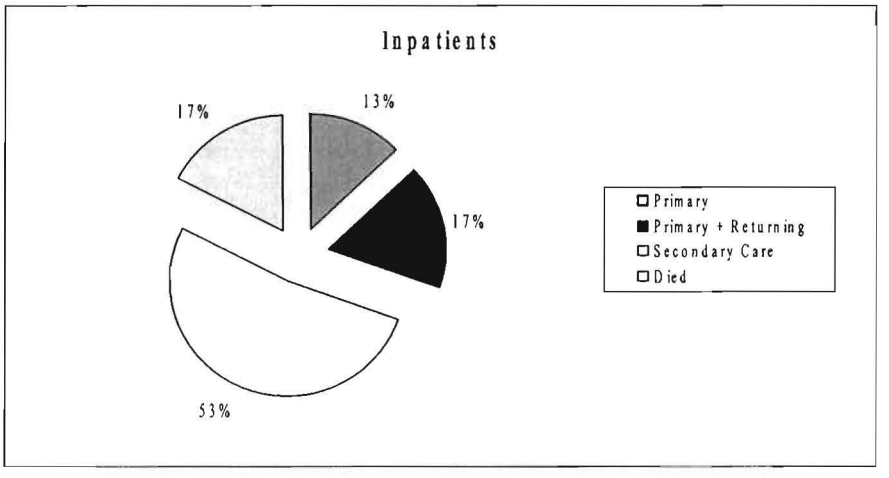
5.7.2 Destination of Patient

Post-treatment patient destination was recorded for 61 of 62 outpatient visits and 23 of 25 inpatient admissions. For outpatient visits, 88.53% returned to primary care of which 61.11% were scheduled for return appointments at the Antiretroviral Referral Unit. A further 3.28% were admitted to inpatient care and 6.56% to tertiary care. For inpatients, 30.43% were returned to primary care, of which figure 57.15% were scheduled to return for outpatient Antiretroviral Referral Unit treatment. 52.17% of inpatients were transferred to other secondary hospital care, including St. Luke's Hospice, Lentegeur Hospital[19], and Tuberculosis hospitals. The distributions of patient destinations for inpatients and outpatients are shown in Figure 5.18.

Figure 5.18: Patient Destinations



n = 61



n = 23

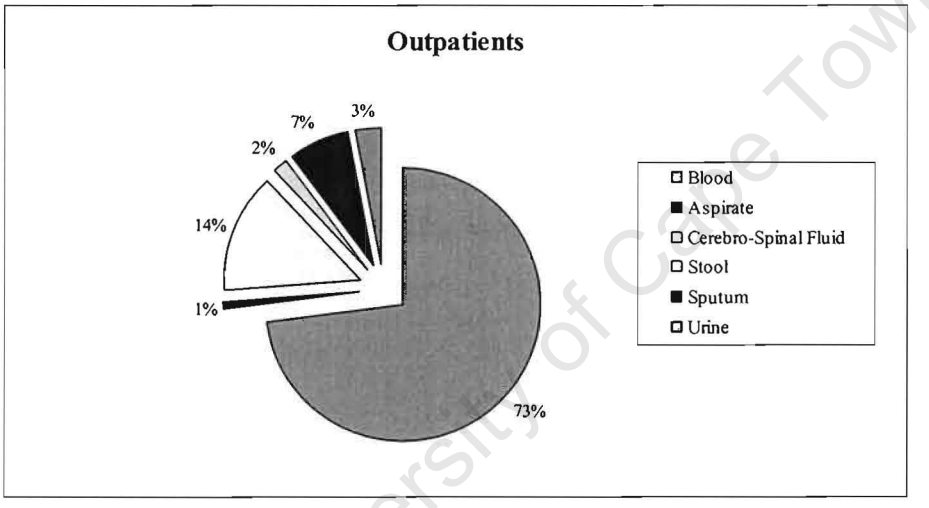
[19] The Lentegeur Hospital Carnation Ward is a secondary level step-down care facility. The Carnation Ward is administered as part of GF Jooste Hospital.

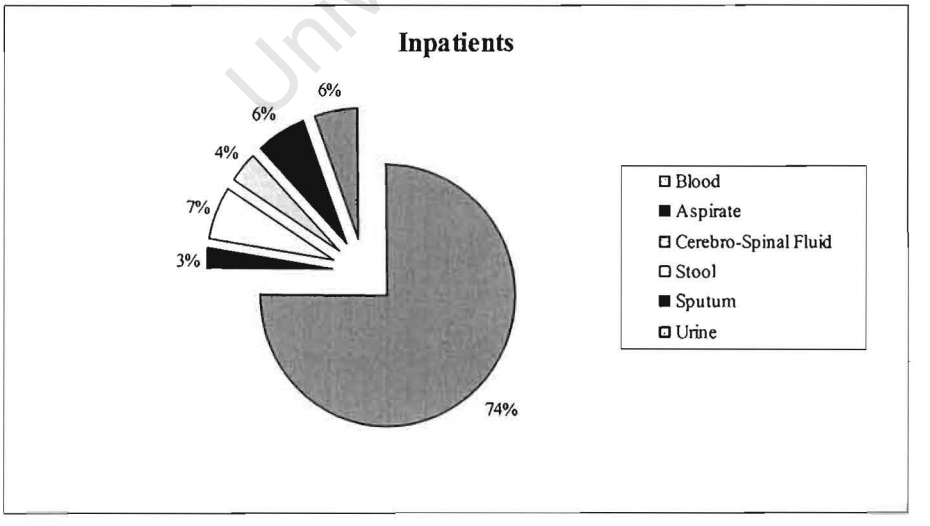
6. Patient-Specific Costing Results

6.1 Laboratory Testing Costs

Laboratory testing costs may be divided by laboratory test type. 73.0% of outpatient laboratory testing costs were generated by blood tests. Similarly, 74.98% of inpatient laboratory testing costs were generated by blood tests. The distributions of laboratory testing costs by laboratory test type for inpatients and outpatients are presented in Figure 6.1.

Figure 6.1: Laboratory Testing Cost Distributions

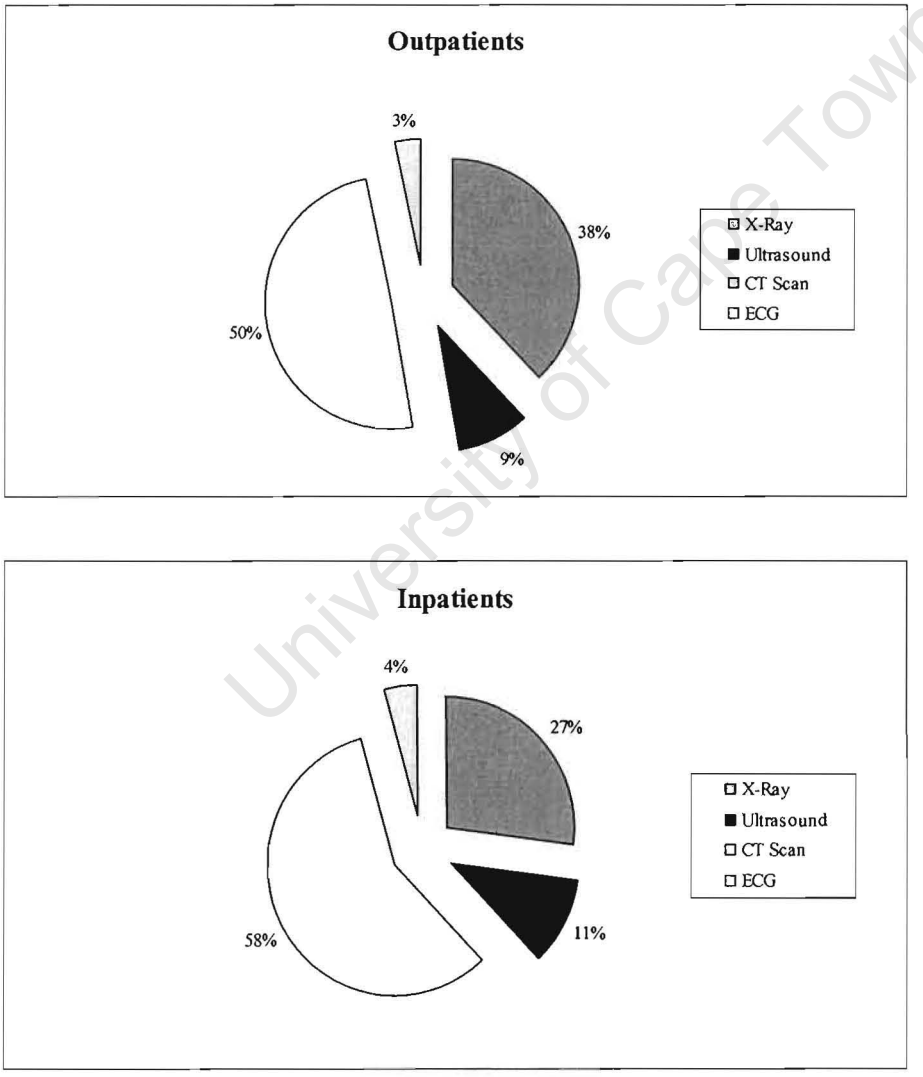




6.2 Imaging and Radiology Costs

Imaging and radiology costs may be divided by type of imaging or radiology test. 49.27% of outpatient imaging and radiology costs were generated by CT scans, while a further 38.02% were accrued by X-Rays. 57.88% of inpatient imaging and radiology costs were generated by CT scans and a further 27.19% by X-Rays. The distributions of imaging and radiology costs by test type for inpatients and outpatients are presented in Figure 6.2.

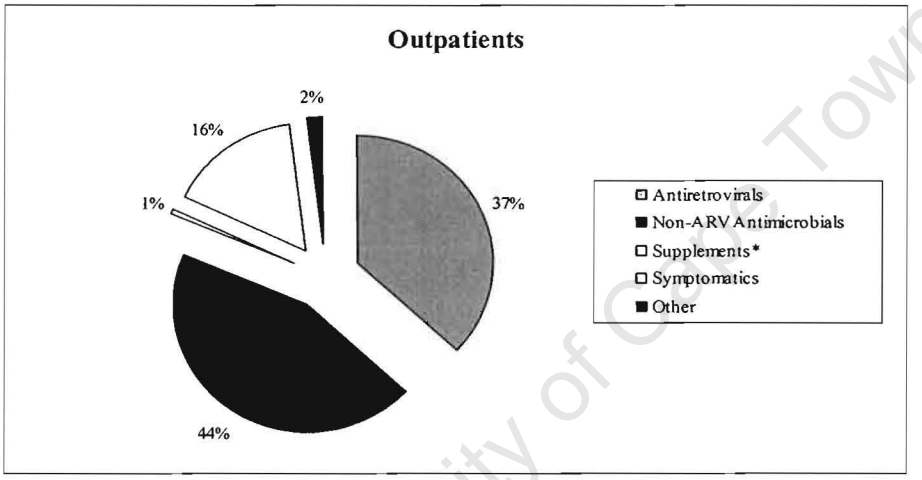
Figure 6.2: Imaging and Radiology Cost Distributions



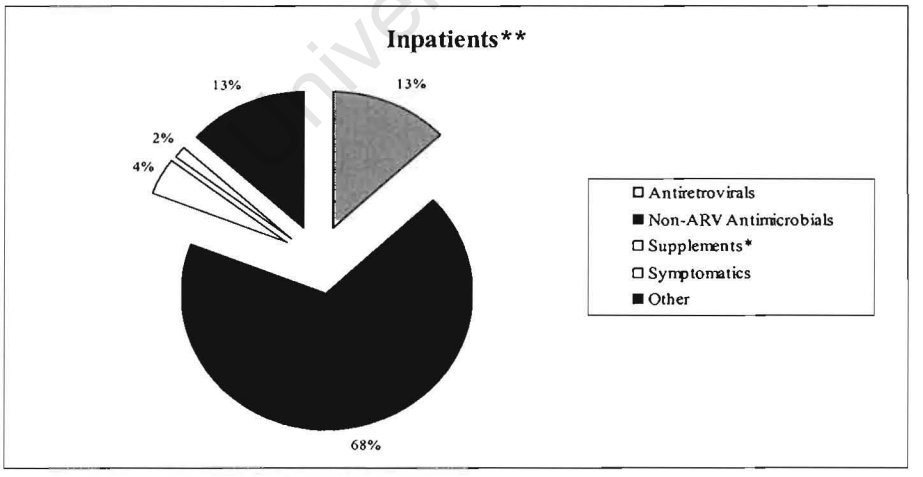
6.3 Medication Costs

Medication costs may be divided according to a number of broad medication categories. 44.33% of outpatient medication costs were accrued by non-antiretroviral antimicrobial medication, while a further 37.01% were caused by antiretroviral drugs. 67.8% of inpatient medication costs were assigned to non-antiretroviral antimicrobials. The distributions of medication costs for inpatients and outpatients by medication type are presented in Figure 6.3.

Figure 6.3: Medication Cost Distributions



* Includes vitamin, nutritional and electrolyte replacement supplements.

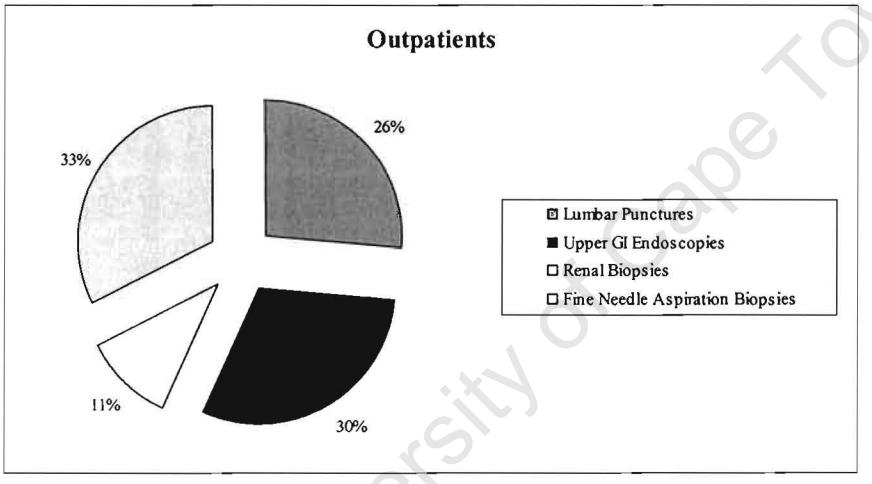


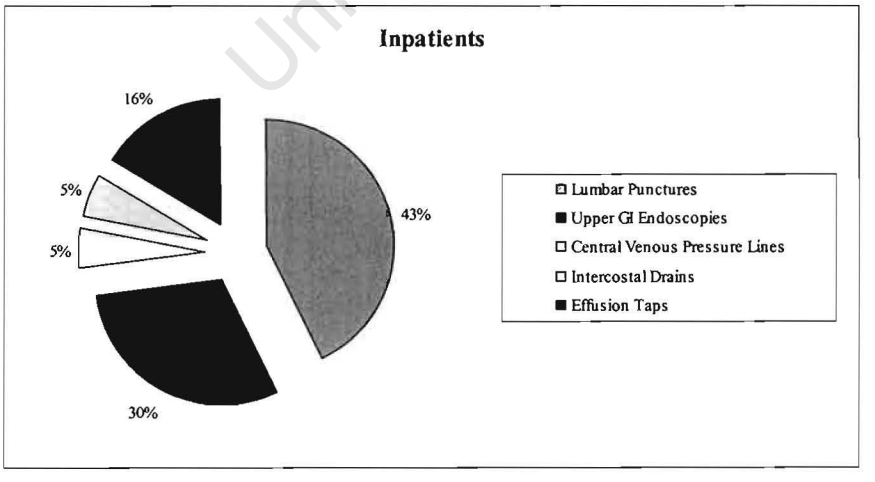
* Includes vitamin, nutritional and electrolyte replacement supplements.
** Includes all discharge medication.

6.4 Medical and Surgical Procedures Costs

Medical and surgical procedures costs may be classified according to procedure type. 32.42% of outpatient procedures costs were caused by fine needle aspiration biopsies, and 30.31% by upper gastro-intestinal endoscopies. For inpatients, 42.65% of procedure costs were caused by lumbar punctures, and a further 30.05% by upper gastro-intestinal endoscopies. The distributions of medical and surgical procedure costs by procedure type for inpatients and outpatients are presented in Figure 6.4.

Figure 6.4: Medical and Surgical Procedures Cost Distributions

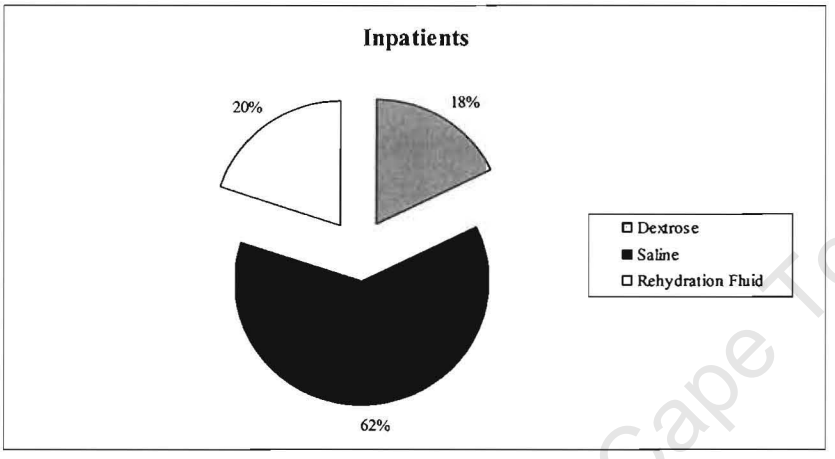




6.5 Intravenous Fluids Costs

Inpatient intravenous fluid costs may be divided by fluid type. 62.03% of intravenous fluid costs were accrued by saline fluids. The distribution of intravenous fluid costs by fluid type is presented in Figure 6.5.

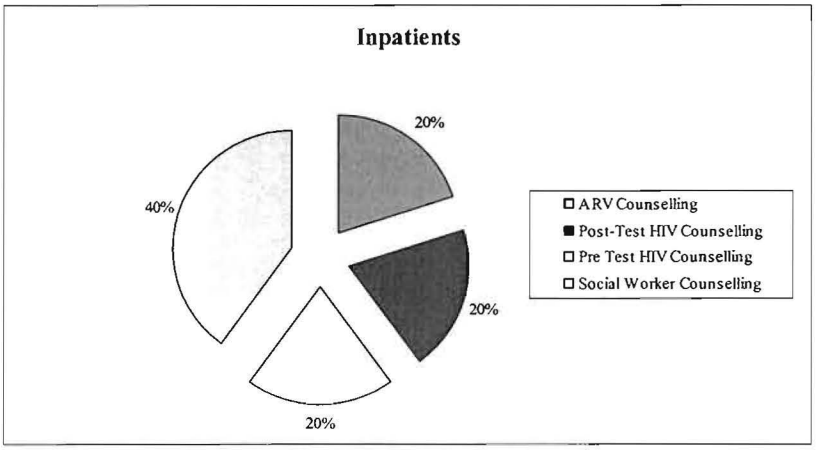
Figure 6.5: Intravenous Fluid Cost Distribution



6.6 Counselling Costs

Inpatient counselling costs can be divided according to counselling type. 40.0% of counselling costs were caused by Social Worker Counselling. The distribution of counselling costs by counselling type is illustrated in Figure 6.6.

Figure 6.6: Counselling Cost Distribution



7. Costing and Cost-Outcome Results

7.1 Cost per Outpatient Visit

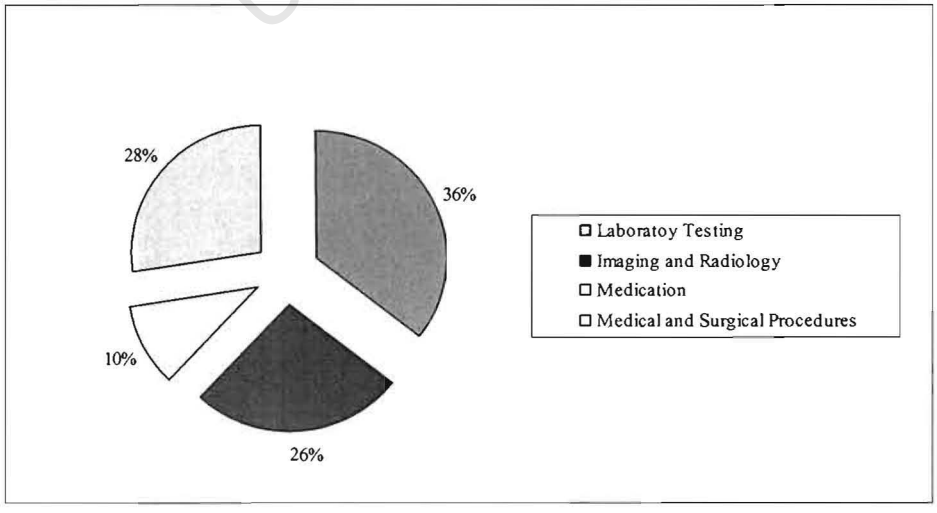
7.1.1 Outpatient-Specific Costs

Outpatient-specific costs per outpatient visit to the Antiretroviral Referral Unit are presented in Table 7.1. Total monthly costs, cost allocation procedures and associated allocation factors are also presented. The distribution of outpatient-specific costs by costing category is presented in Figure 7.1.

Table 7.1: Outpatient-Specific Costs per Outpatient Visit

Category	Total Monthly Cost	Allocation Procedure	Allocation Factor	Monthly Outpatient Cost	Total Outpatient Visits	Cost per Outpatient Visit
Laboratory Testing	8,646.00	Direct	1.00	8,646.00	62	139.45
Imaging + Radiology	6,423.92	Direct	1.00	6,423.92	62	103.61
Medication	2,553.70	Direct	1.00	2,553.70	62	41.19
Medical + Surgical Procedures	6,704.76	Direct	1.00	6,704.76	62	108.14
Total	**24,328.38**			**24,328.38**		**392.39**

Figure 7.1: Distribution of Outpatient-Specific Costs



7.1.2 Recurrent Costs

7.1.2.1 Clinical Personnel Costs

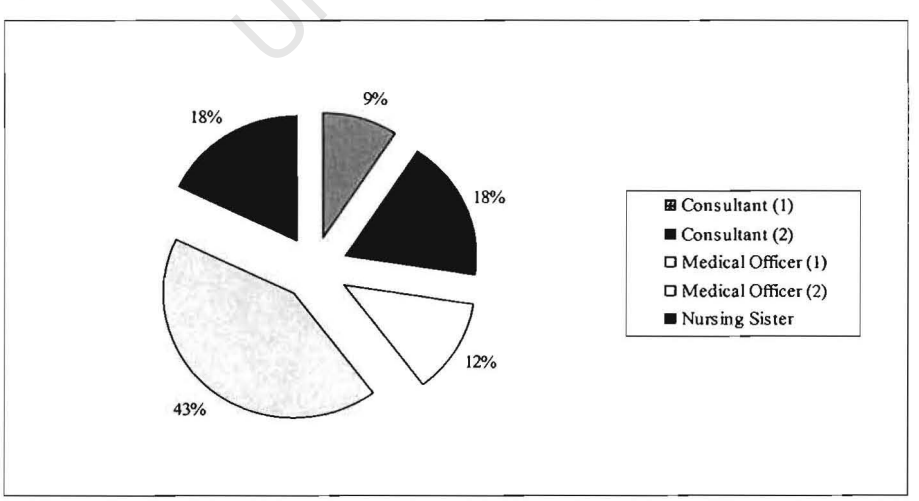
Clinical personnel costs per outpatient visit are presented in Table 7.2. Total monthly costs, cost allocation procedures and associated allocation factors[20] are also presented. The distribution of clinical personnel costs by clinical personnel category is presented in Figure 7.2.

Table 7.2: Clinical Personnel Costs per Outpatient Visit

Category	Total Monthly Cost	Allocation Procedure	Allocation Factor	Monthly Outpatient Cost	Total Outpatient Visits	Cost per Outpatient Visit
Consultant (1)	7,798.05	% Working Hours	0.40	3,119.22	62	50.31
Consultant (2)	13,467.32	% Working Hours	0.46	6,194.97	62	99.92
Medical Officer (1)	21,633.64	% Working Hours	0.19	4,110.39	62	66.30
Medical Officer (2)	20,568.20	% Working Hours	0.70	14,397.74	62	232.22
Nursing Sister	6,002.19	Direct*	1.00	6,002.19	62	96.81
Total	**69,469.40**			**33,824.51**		**545.56**

*** The Antiretroviral Referral Unit Nursing Sister provides outpatient care only.**

Figure 7.2: Distribution of Clinical Personnel Costs (Outpatients)



[20] The derivation of monthly clinical personnel costs and associated allocation factors is presented in Appendix D.

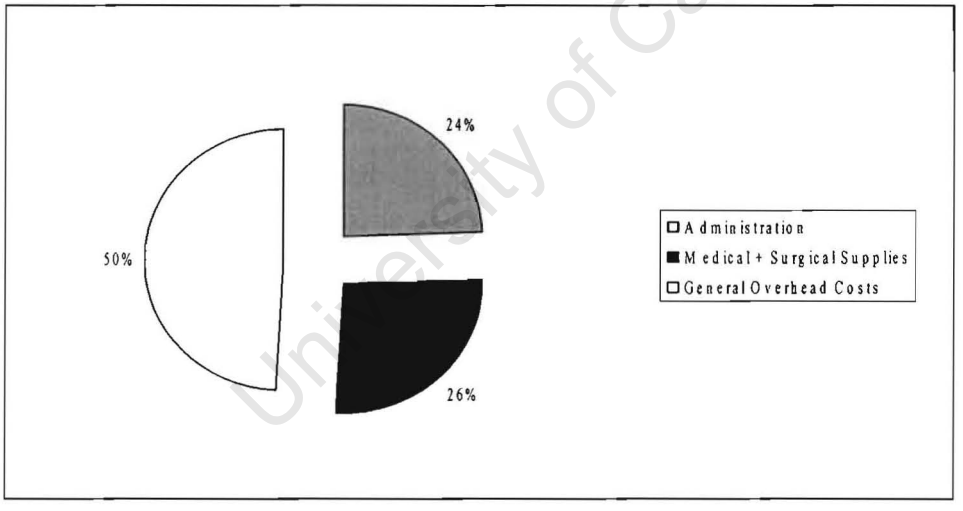
7.1.2.2 Overhead Costs

Overhead costs per outpatient visit are presented in Table 7.3. Cost allocation procedures and associated allocation factors are also presented. The distribution of overhead costs by overhead cost category is presented in Figure 7.3.

Table 7.3: Overhead Costs per Outpatient Visit

Category	Total Monthly Cost	Allocation Procedure	Allocation Factor	Monthly Outpatient Cost	Total Outpatient Visits	Cost per Outpatient Visit
Administration	3,510.12	% Administrative Staff Time	0.95	3,334.61	62	53.78
Medical + Surgical Supplies	3,997.47	% Utilisation	0.90	3,597.72	62	58.03
General Overhead Costs	6,713.98	Direct	1.00	6,713.98	62	108.29
Total	**13,646.31**			**13,646.31**		**220.10**

Figure 7.3: Distribution of Overhead Costs (Outpatients)



7.1.3 Capital Costs

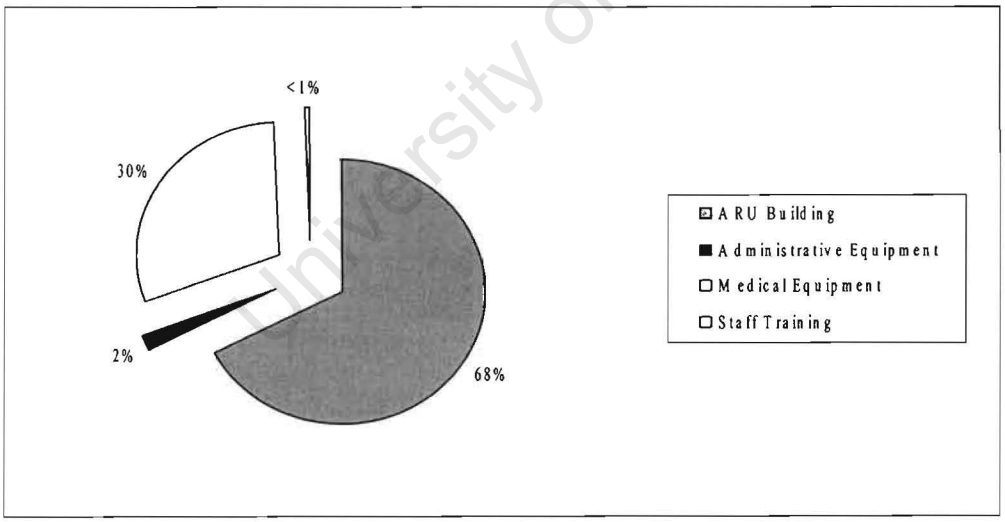
Capital costs per outpatient visit are presented in Table 7.4. Cost allocation procedures and associated allocation factors are also presented. The distribution of capital costs by costing category is presented in Figure 7.4.

Table 7.4: Capital Costs per Outpatient Visit

Category	Replacement Value	Annual Cost	Allocation Procedure	Allocation Factor	Monthly Outpatient Cost	Total Outpatient Visits	Cost per Outpatient Visit
Antiretroviral Referral Unit	2,845,995.75	252,802.12	% Utilisation	0.90	18,960.16	62	305.81
Medical Equipment	765,598.78	114,096.48	% Utilisation	0.90	40,412.20	62	138.02
Administrative Equipment	44,900.44	6,691.47	% Administration	0.95	529.74	62	8.54
Staff Training	5,400.00	3,028.09	% Working Hours*	0.47	118.60	62	1.91
Total	**3,661,894.97**	**376,618.17**			**28,165.74**		**454.29**

*** Based on average allocation factors of surveyed clinical personnel (see Table 7.2).**

Figure 7.4: Distribution of Capital Costs (Outpatients)



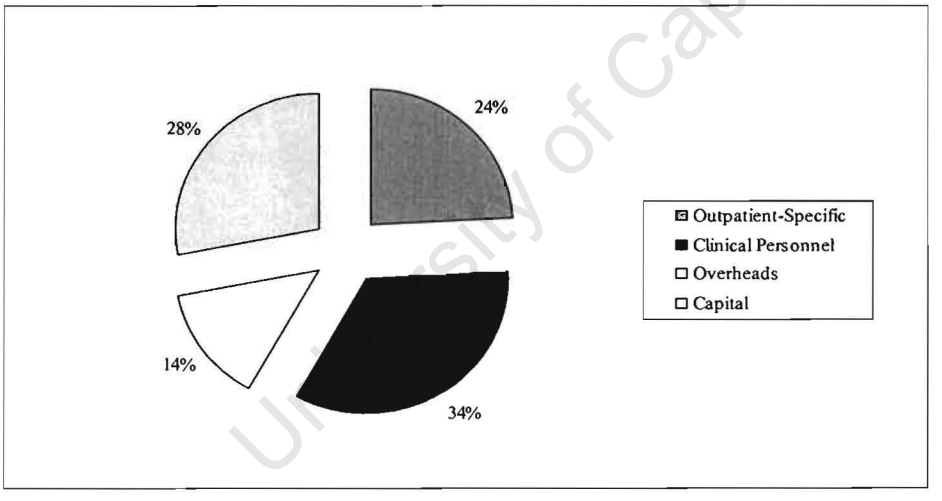
7.1.4 Total Cost per Outpatient Visit

Total costs per outpatient visit are presented in Table 7.5. The distribution of total costs per outpatient visit is presented in Figure 7.5.

Table 7.5: Cost per Outpatient Visit

Category	Cost per Outpatient Visit	% of Total Cost
Outpatient-Specific	392.39	24.34
Recurrent: Clinical Personnel	545.56	33.84
Recurrent: Overheads	220.10	13.65
Capital	454.29	28.18
Total	**1,612.34**	**100.00**

Figure 7.5: Distribution of Costs per Outpatient Visit



7.1.5 Cost-Outcome per Outpatient Visit

The cost-outcome description of Antiretroviral Referral Unit treatment per successful outpatient visit is presented in Table 7.6. Patients assessed as 'improved' or 'stabilised' by the attending clinician were classified as successfully treated[21].

Table 7.6: Cost-Outcome per Successful Outpatient Visit

Category	Monthly Cost	Successful Outpatient Visits	Cost per Successful Outpatient Visit
Outpatient-Specific	24,328.38	37	657.52
Recurrent: Clinical Personnel	33,824.51	37	914.18
Recurrent: Overheads	13,646.31	37	368.82
Capital	28,165.74	37	761.24
Total	**99,964.94**		**2,701.76**

[21] See Section 5.6.1 for a full description of patient outcome measurement and results.

7.2 Cost per Inpatient Day

7.2.1 Inpatient-Specific Costs

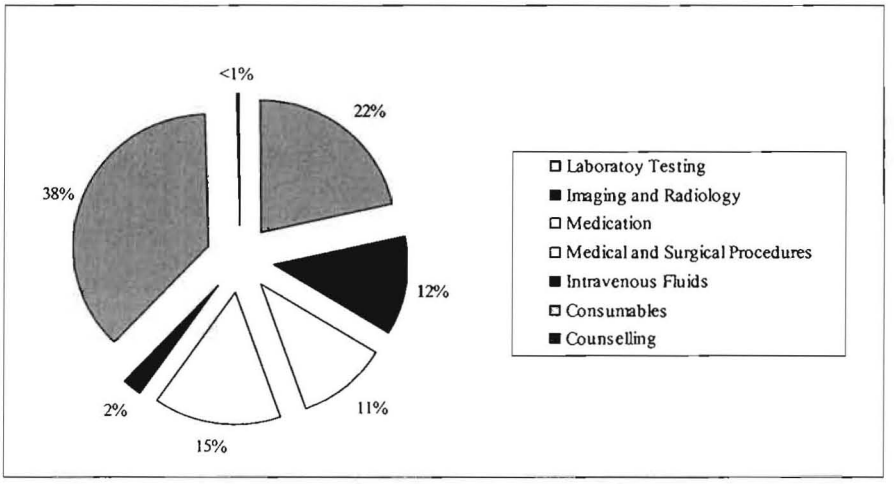
Inpatient-specific costs per inpatient day are presented in Table 7.7. Cost allocation procedures and associated allocation factors are also presented. The distribution of inpatient-specific costs by costing category is presented in Figure 7.6.

Table 7.7: Inpatient-Specific Costs

Category	Total Monthly Cost	Allocation Procedure	Allocation Factor	Monthly Inpatient Cost	Total Inpatient Days	Cost per Inpatient Day
Laboratory Testing	9,635.65	Direct	1.00	9,635.65	240	40.15
Imaging + Radiology	5,468.12	Direct	1.00	5,468.12	240	22.78
Medication*	4,841.47	Direct	1.00	4,841.47	240	20.17
Medical + Surgical Procedures	6,762.58	Direct	1.00	6,762.58	240	28.18
Intravenous Fluids	1,016.91	Direct	1.00	1,016.91	240	4.24
Consumables	16,921.24	Direct	1.00	16,921.24	240	70.51
Counselling	109.10	Direct	1.00	109.10	240	0.45
Total	**44,755.07**			**44,755.07**		**186.48**

* Including all discharge medication.

Figure 7.6: Distribution of Inpatient-Specific Costs



7.2.2 Recurrent Costs

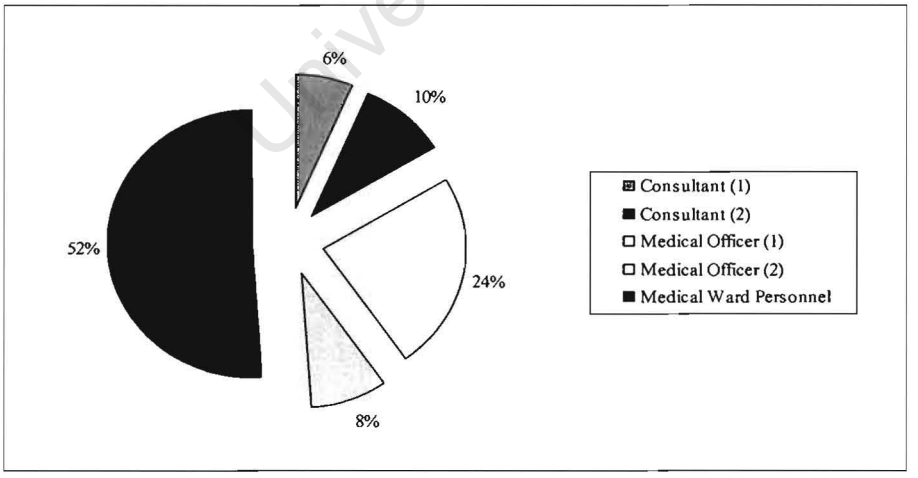
7.2.2.1 Clinical Personnel Costs

Clinical personnel costs per inpatient day are presented in Table 7.8. Total monthly costs, cost allocation procedures and associated allocation factors are also presented[22]. The distribution of clinical personnel costs by personnel category is presented in Figure 7.7.

Table 7.8: Clinical Personnel Costs per Inpatient Day

Category	Total Monthly Cost	Allocation Procedure	Allocation Factor	Monthly Inpatient Cost	Total Inpatient Days	Cost per Inpatient Day
Consultant (1)	7,798.05	% Working Hours	0.60	4,678.83	240	19.50
Consultant (2)	13,467.32	% Working Hours	0.54	7,272.35	240	30.30
Medical Officer (1)	21,633.64	% Working Hours	0.81	17,523.25	240	73.01
Medical Officer (2)	20,568.20	% Working Hours	0.30	6,170.46	240	25.71
Sub-Total	**63,467.21**			**35,644.89**		**148.52**
Medical Ward Personnel	37,380.00	Direct	1.00	37,380.00	240	155.75
Total	**100,847.21**			**73,024.89**		**304.27**

Figure 7.7: Distribution of Clinical Personnel Costs (Inpatients)



[22] The derivation of monthly clinical personnel costs and associated allocation factors is presented in Appendix D.

7.2.2.2 Overhead Costs

Overhead costs per inpatient day are presented in Table 7.9. Cost allocation procedures and associated allocation factors are also presented.

Table 7.9: Overhead Costs per Inpatient Day

Category	Total Monthly Cost	Allocation Procedure	Allocation Factor	Monthly Inpatient Cost	Total Inpatient Days	Cost per Inpatient Day
Administration	3,510.12	% Administrative Staff Time	0.05	175.51	240	0.73
Medical + Surgical Supplies	3,997.47	% Utilisation	0.10	399.75	240	1.67
General Overhead Costs	98,068.80	Direct	1.00	98,068.80	240	408.62
Total	**105,576.39**			**98,644.06**		**411.02**

7.2.3 Capital Costs

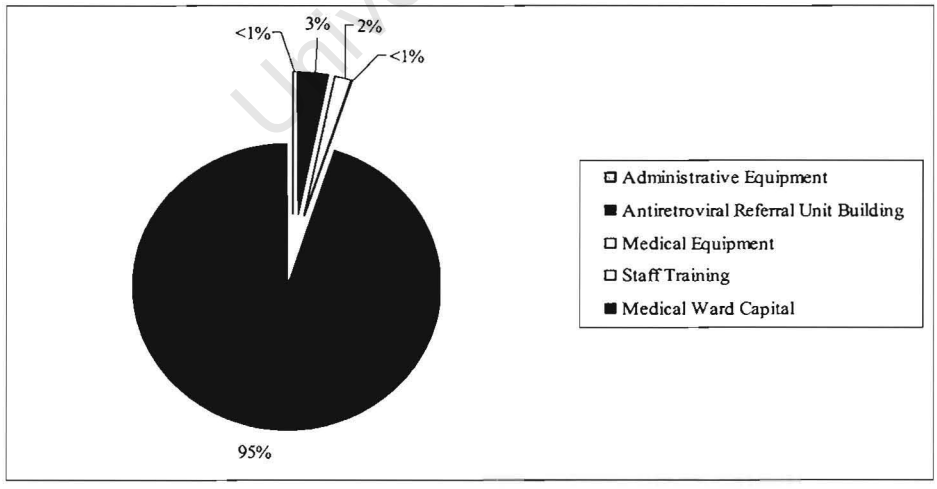
Capital costs per inpatient day are presented in Table 7.10. Cost allocation procedures and associated allocation factors are also presented. A sub-total for Antiretroviral Referral Unit capital costs per inpatient day is provided. The distribution of capital costs for inpatient care is presented in Figure 7.8.

Table 7.10: Capital Costs per Inpatient Day

Category	Replacement Value	Annual Cost	Allocation Procedure	Allocation Factor	Monthly Inpatient Cost	Total Inpatient Days	Cost per Inpatient Day
Antiretroviral Referral Unit	2,845,995.75	252,802.12	% Utilisation	0.10	2,106.68	240	8.78
Medical Equipment	765,598.78	114,096.48	% Utilisation	0.10	950.80	240	3.96
Administrative Equipment	44,900.44	6,691.47	% Administration	0.05	27.88	240	0.12
Staff Training	5,400.00	3,028.09	% Working Hours*	0.53	133.74	240	0.56
Sub-Total	**3,661,894.97**	**376,618.17**			**3,219.11**		**13.41**
Medical Ward Capital Costs	8,054,712.86	715,478.40	Direct	1.00	59,623.20	240	248.43
Total	**11,716,607.82**	**1,092,096.57**			**62,842.31**		**261.84**

*** Based on average allocation factors of surveyed clinical personnel (see Table 7.8).**

Figure 7.8: Distribution of Capital Costs (Inpatients)



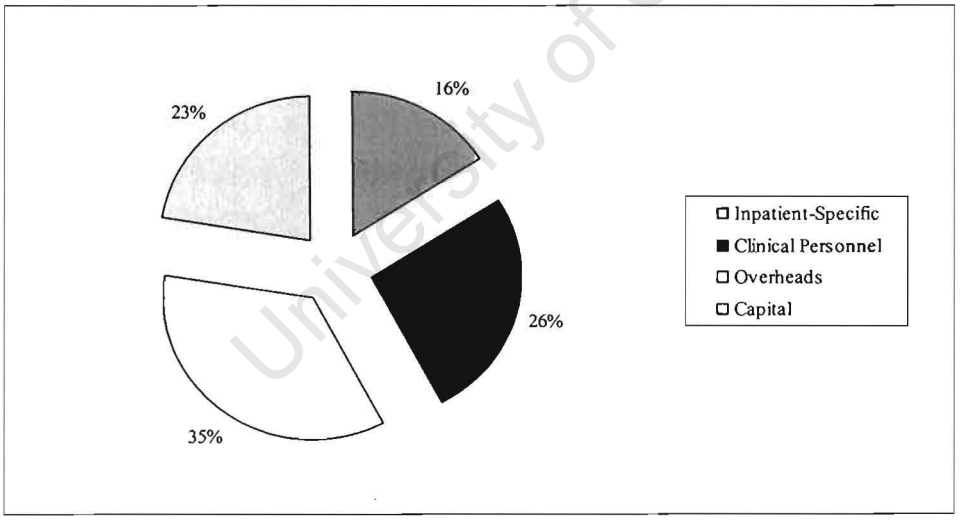
7.2.4 Total Cost per Inpatient Day and per Inpatient Admission

Total costs per inpatient day and per inpatient admission are presented in Table 7.11. The distribution of total costs per inpatient day and per inpatient admission is presented in Figure 7.9.

Table 7.11: Cost per Inpatient Day and per Inpatient Admission

Category	Cost per Inpatient Day	Average Length of Stay	Cost per Inpatient Admission	% of Total Cost
Inpatient-Specific	186.48	14.60	2,722.61	16.03
Recurrent: Clinical Personnel	304.27	14.60	4,442.34	26.15
Recurrent: Overheads	411.02	14.60	6,000.89	35.32
Capital	261.84	14.60	3,822.86	22.50
Total	**1,163.61**		**16,988.71**	**100.00**

Figure 7.9: Distribution of Costs per Inpatient Day and per Inpatient Admission



7.2.5 Cost-Outcome per Inpatient Day and per Inpatient Admission

The cost-outcome of Antiretroviral Referral Unit treatment per successful inpatient day and per successful inpatient admission are presented in Table 7.12 and Table 7.13. Patients assessed as 'improved' or 'stabilised' by the attending clinician were classified as successfully treated[23].

Table 7.12: Cost-Outcome per Inpatient Day

Category	Monthly Cost	Successful Inpatient Days	Cost per Successful Inpatient Day
Inpatient-Specific	44,755.07	125	358.04
Recurrent: Clinical Personnel	73,024.89	125	584.20
Recurrent: Overheads	98,644.06	125	789.15
Capital	62,842.31	125	502.74
Total	**279,266.33**		**2,234.13**

Table 7.13: Cost-Outcome per Inpatient Admission

Category	Monthly Cost	Successful Inpatient Admissions	Cost per Successful Inpatient Admission
Inpatient-Specific	44,755.07	13	3,442.70
Recurrent: Clinical Personnel	73,024.89	13	5,617.30
Recurrent: Overheads	98,644.06	13	7,588.00
Capital	62,842.31	13	4,834.02
Total	**279,266.33**		**21,482.03**

[23] See Section 5.6.1 for a full description of patient outcome measurement and results.

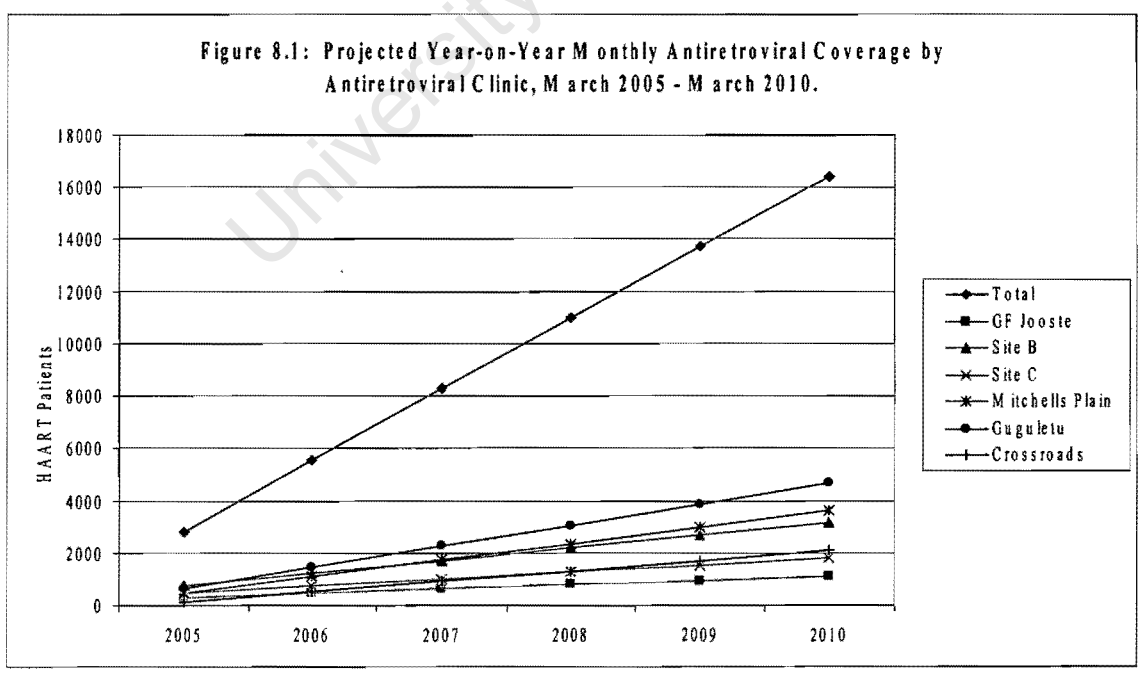
8. Costing Projection Results

8.1 Projected HAART Coverage

Projected year-on-year monthly antiretroviral coverage levels for the GF Jooste Catchment Area are presented by antiretroviral clinic in Table 8.1 and in Figure 8.1. Coverage levels include all patients on or preparing for antiretroviral treatment.

Table 8.1: Projected Antiretroviral Coverage by Antiretroviral Clinic, 2005 – 2010

	March 2005	March 2006	March 2007	March 2008	March 2009	March 2010
GF Jooste	287	454	622	790	958	1,126
Site B (Khayelitsha)	756	1,240	1,722	2,204	2,686	3,168
Site C (Nolungile)	492	750	1,010	1,270	1,530	1,790
Mitchells Plain	485	1,107	1,733	2,359	2,985	3,611
Guguletu	667	1,464	2,261	3,059	3,857	4,655
Crossroads	144	532	922	1,312	1,702	2,092
Total	**2,831**	**5,547**	**8,271**	**10,995**	**13,719**	**16,443**



8.2 Projected Antiretroviral Referral Unit Demand

Projected year-on-year monthly Antiretroviral Referral Unit demand levels for the GF Jooste Catchment Area are presented in Table 8.2 and Figure 8.2. Based on prior Antiretroviral Referral Unit utilisation levels (see Appendix C), a constant level of 3.33% of persons on or preparing for HAART requiring Antiretroviral Referral Unit care was assumed for the projection period[24].

A constant ratio of 66:34 was employed to determine the distribution of patients requiring outpatient and inpatient care (see Appendix C), while each outpatient was assumed to require 1.29 visits per month based on study period data[25]. Each patient requiring inpatient care was assumed to require a length of stay of 14.60 days[26]. Total outpatient visits and total inpatient days were then calculated for the projection period.

[24] This excludes the March 2005 level of 2.58%, which was based on study period utilisation data.

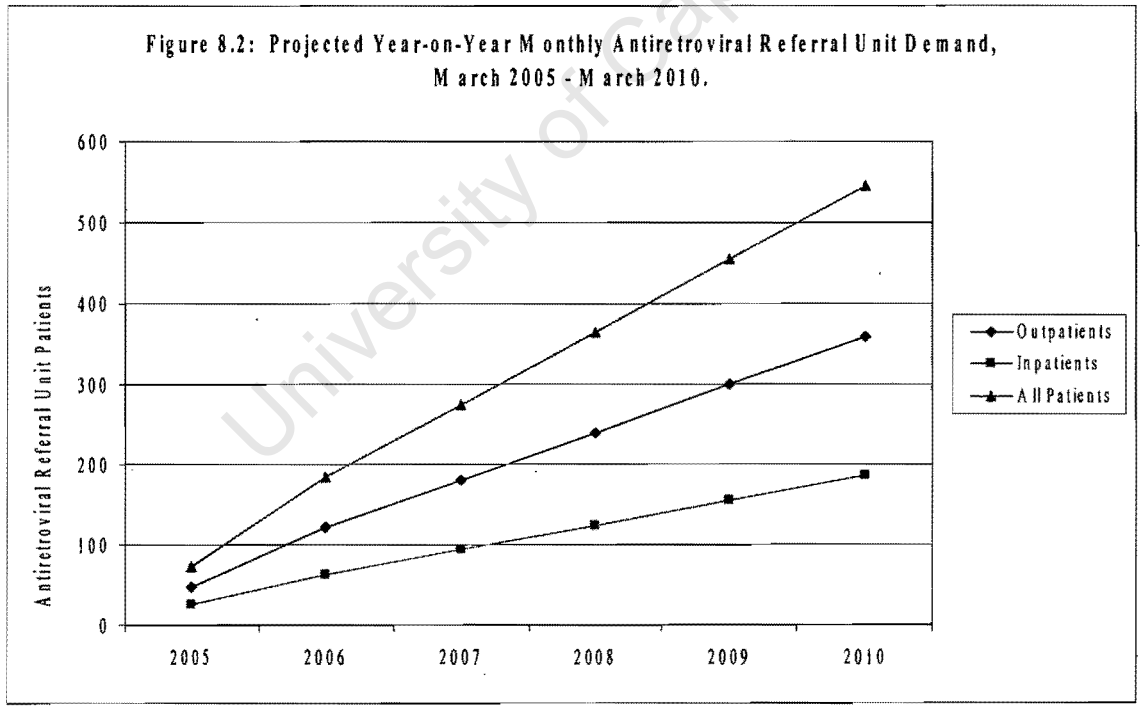
[25] A total of 62 visits were made by 48 different outpatients during the study period. This produces an average outpatient visit frequency of 1.29 visits per month.

[26] See Section 5.4.1 for a full discussion of inpatient length of stay measurement and results.

Table 8.2: Projected Antiretroviral Referral Unit Demand, 2005 – 2010

	March 2005	March 2006	March 2007	March 2008	March 2009	March 2010
HAART Patients	2,831	5,547	8,271	10,995	13,719	16,443
% Requiring ARU Treatment	2.58	3.33	3.33	3.33	3.33	3.33
Total ARU Patients	**73**	**185**	**275**	**366**	**457**	**548**
% Outpatient Treatment	0.66	0.66	0.66	0.66	0.66	0.66
% Inpatient Treatment	0.34	0.34	0.34	0.34	0.34	0.34
Total Outpatients	**48**	**121**	**181**	**240**	**300**	**359**
Total Inpatients	**25**	**63**	**94**	**124**	**155**	**186**
Outpatient Visit Frequency	1.29	1.29	1.29	1.29	1.29	1.29
Inpatient Length of Stay (Days)*	14.60	14.60	14.60	14.60	14.60	14.60
Total Outpatient Visits	**62**	**156**	**233**	**310**	**387**	**463**
Total Inpatient Days*	**365**	**917**	**1,367**	**1,817**	**2,268**	**2,718**

* Including all inpatient days accrued in advance and after termination of the study period.



8.3 Projected Antiretroviral Referral Unit Costs

8.3.1 Cost per Outpatient Visit

Total variable costs per outpatient visit are presented in Table 8.3. Variable costs per outpatient visit are assumed to be independent of total Antiretroviral Referral Unit utilisation levels, and remain constant throughout the projection period. Total fixed costs per outpatient visit for the projection period are presented in Table 8.4, and total fixed and variable costs are presented in Table 8.5. These results are illustrated in Figure 8.3.

Table 8.3: Variable Costs per Outpatient Visit

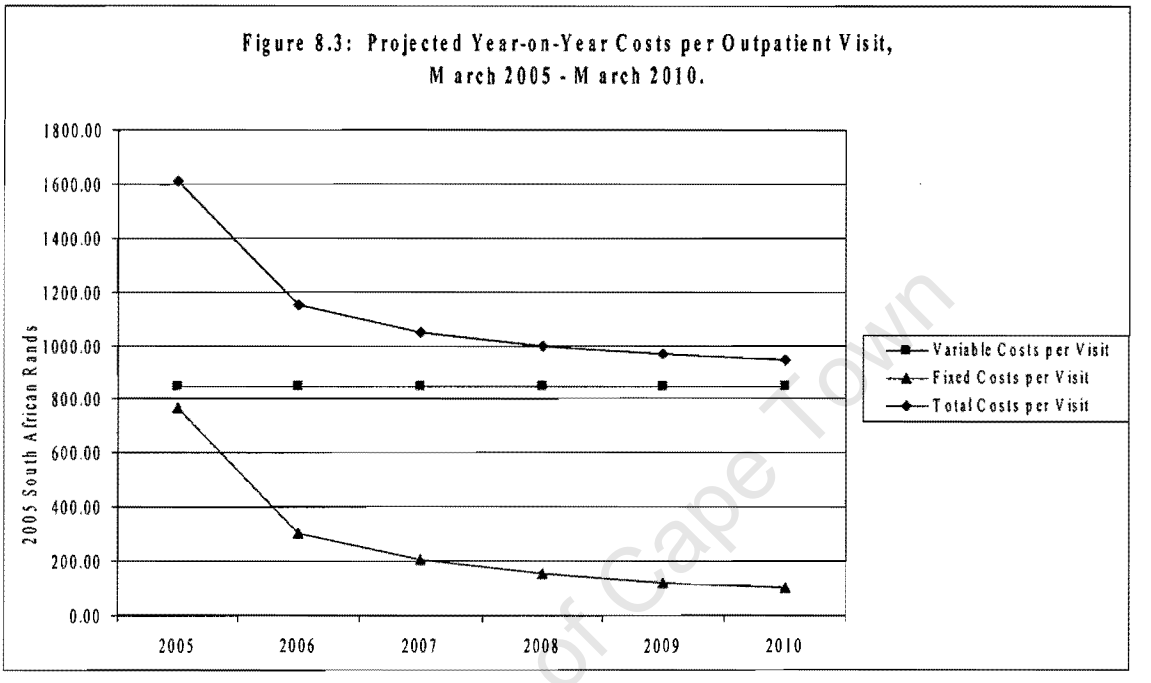
	Variable Cost per Outpatient Visit
Outpatient-Specific	392.39
Medical Officer (1)	66.30
Medical Officer (2)	232.22
Nursing Sister	96.81
Medical + Surgical Supplies	58.03
Total	**845.75**

Table 8.4: Fixed Costs per Outpatient Visit

	March 2005	**March 2006**	**March 2007**	**March 2008**	**March 2009**	**March 2010**
Consultant (1)	3,119.22	3,119.22	3,119.22	3,119.22	3,119.22	3,119.22
Consultant (2)	6,194.97	6,194.97	6,194.97	6,194.97	6,194.97	6,194.97
Administration	3,334.61	3,334.61	3,334.61	3,334.61	3,334.61	3,334.61
Capital	28,165.74	28,165.74	28,165.74	28,165.74	28,165.74	28,165.74
General Overheads	6,713.98	6,713.98	6,713.98	6,713.98	6,713.98	6,713.98
Total Fixed Costs	47,528.52	47,528.52	47,528.52	47,528.52	47,528.52	47,528.52
Total Outpatient Visits	62	156	233	310	387	463
Fixed Cost per Outpatient Visit	**766.59**	**304.67**	**203.99**	**153.32**	**122.81**	**102.65**

Table 8.5: Total Costs per Outpatient Visit

	March 2005	March 2006	March 2007	March 2008	March 2009	March 2010
Fixed Cost per Outpatient Visit	766.59	304.67	203.99	153.32	122.81	102.65
Variable Cost per Outpatient Visit	845.75	845.75	845.75	845.75	845.75	845.75
Total Cost per Outpatient Visit	**1,612.34**	**1,150.42**	**1,049.74**	**999.07**	**968.56**	**948.40**



8.3.2 Cost per Inpatient Day and per Inpatient Admission

Total variable costs per inpatient day and per inpatient admission are presented in Table 8.6. Variable costs per inpatient day and per inpatient admission are assumed to be independent of total Antiretroviral Referral Unit utilisation levels, and remain constant throughout the projection period. Total fixed costs per inpatient day and per inpatient admission for the projection period are presented in Table 8.7, and total fixed and variable costs are presented in Table 8.8. These results are illustrated in Figures 8.4 and 8.5.

Table 8.6: Variable Costs per Inpatient Day and per Inpatient Admission

	Variable Cost per Inpatient Day	Inpatient Length of Stay (Days)	Variable Cost per Inpatient Admission
Inpatient-Specific	186.48	14.60	2,722.60
Medical Officer (1)	73.01	14.60	1,065.95
Medical Officer (2)	25.71	14.60	375.37
Medical + Surgical Supplies	1.67	14.60	24.38
Total	**286.87**		**4,188.30**

Table 8.7: Fixed Costs per Inpatient Day and per Inpatient Admission

	March 2005	March 2006	March 2007	March 2008	March 2009	March 2010
Consultant (1)	4,678.83	4,678.83	4,678.83	4,678.83	4,678.83	4,678.83
Consultant (2)	7,272.35	7,272.35	7,272.35	7,272.35	7,272.35	7,272.35
Medical Ward Personnel	37,380.00	37,380.00	37,380.00	37,380.00	37,380.00	37,380.00
Administration	175.51	175.51	175.51	175.51	175.51	175.51
Capital	62,842.31	62,842.31	62,842.31	62,842.31	62,842.31	62,842.31
General Overheads	98,068.80	98,068.80	98,068.80	98,068.80	98,068.80	98,068.80
Total Fixed Costs	**210,417.80**	**210,417.80**	**210,417.80**	**210,417.80**	**210,417.80**	**210,417.80**
Total Inpatient Days*	240	603	899	1,195	1,491	1,787
Fixed Cost per Inpatient Day	**876.74**	**348.95**	**234.06**	**176.08**	**141.13**	**117.75**
Inpatient Length of Stay (Days)	14.60	14.60	14.60	14.60	14.60	14.60
Fixed Cost per Inpatient Admission	**12,800.42**	**5,094.69**	**3,417.24**	**2,570.79**	**2,060.43**	**1,719.14**

* Total inpatient days for March 2005.

Table 8.8: Total Costs per Inpatient Day and per Inpatient Admission

	March 2005	March 2006	March 2007	March 2008	March 2009	March 2010
Fixed Cost per Inpatient Day	876.74	348.95	234.06	176.08	141.13	117.75
Variable Cost per Inpatient Day	286.87	286.87	286.87	286.87	286.87	286.87
Total Cost per Inpatient Day	**1,163.61**	**635.79**	**520.92**	**462.96**	**428.01**	**404.64**
Fixed Cost per Inpatient Admission	12,800.42	5,094.69	3,417.24	2,570.79	2,060.43	1,719.14
Variable Cost per Inpatient Admission	4,188.30	4,188.30	4,188.30	4,188.30	4,188.30	4,188.30
Total Cost per Inpatient Admission	**16,988.72**	**9,282.51**	**7,605.44**	**6,759.19**	**6,248.94**	**5,907.73**

Figure 8.4: Projected Year-on-Year Costs per Inpatient Day, March 2005 - March 2010.

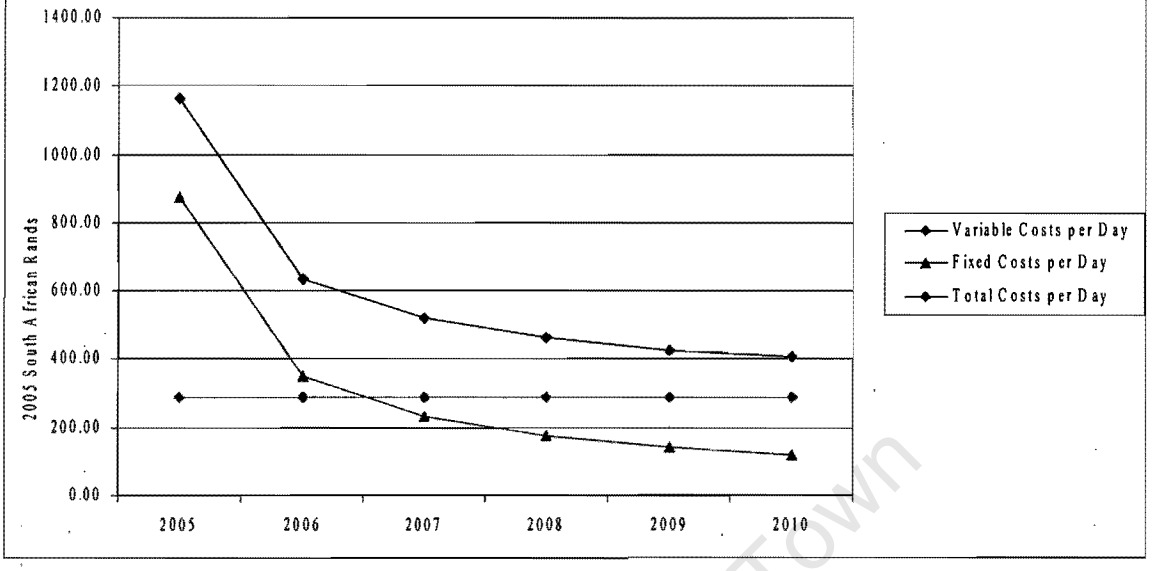
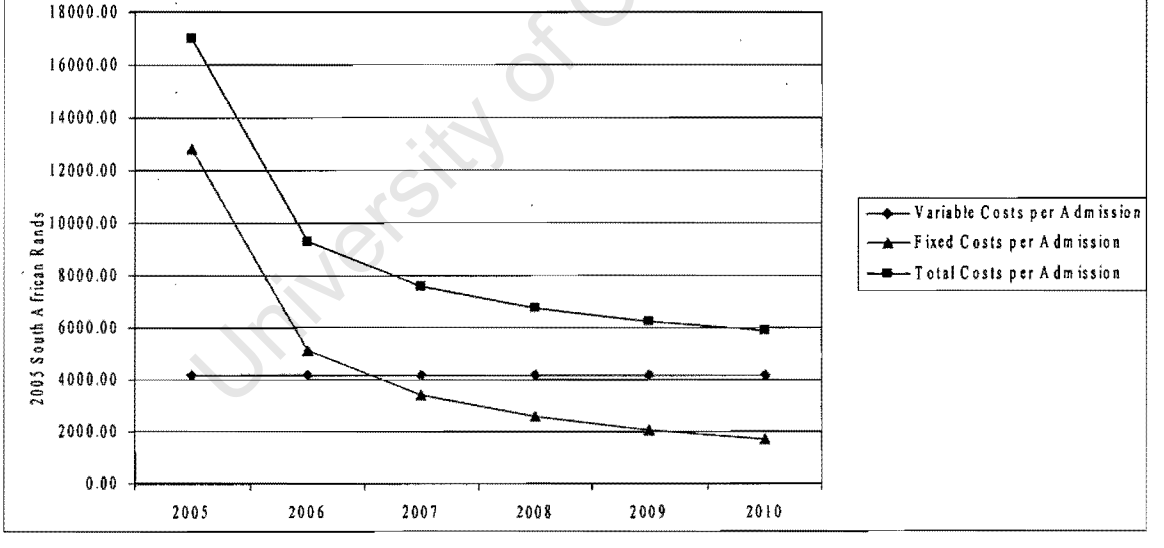


Figure 8.5: Projected Year-on-Year Costs per Inpatient Admission, March 2005 - March 2010.



8.4 Sensitivity Analysis

The projection of costs per outpatient visit, per inpatient day and per inpatient admission assumed that all general overhead costs were fixed costs. Under certain circumstances, such costs may behave as variable costs, and expand according to demand levels. As an example of this phenomenon, this sensitivity analysis assumes that 50% of all general outpatient overhead costs are variable by nature, and examines the effects on projected costs per outpatient visit.

Sensitivity analysis results are presented in Table 8.9, Table 8.10 and Table 8.11, and in Figure 8.6. Assuming 50% variable general overhead costs, total costs per outpatient visit for March 2010 adjust from the original projection level of ZAR 948.40 to ZAR 995.30.

Table 8.9: Variable Costs per Outpatient Visit (Adjusted)

	Variable Cost per Outpatient Visit
Outpatient-Specific	392.39
Medical Officer (1)	66.30
Medical Officer (2)	232.22
Nursing Sister	96.81
Medical + Surgical Supplies	58.03
Variable General Overheads	54.15
Total	**899.90**

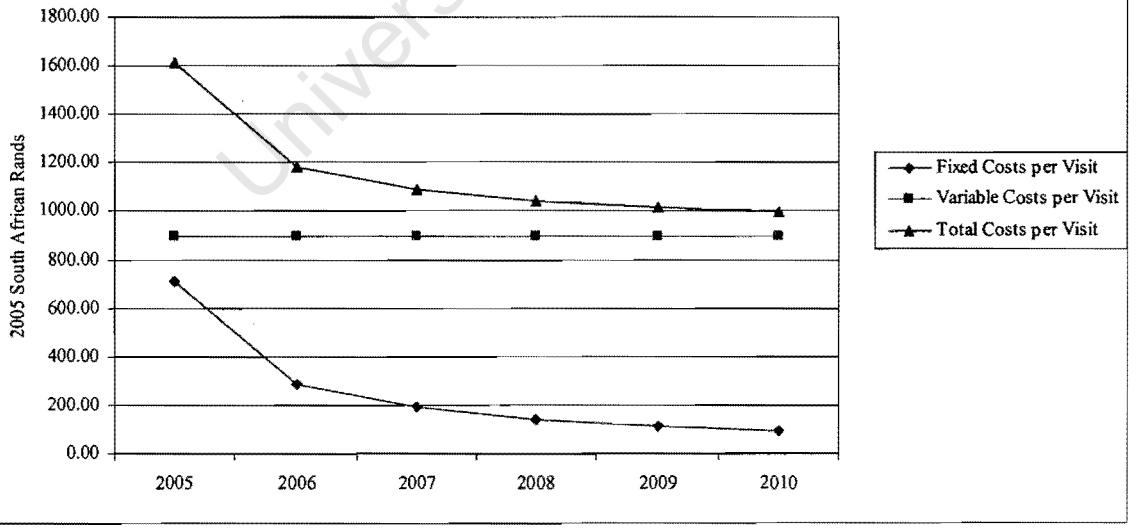
Table 8.10: Fixed Costs per Outpatient Visit (Adjusted)

	March 2005	March 2006	March 2007	March 2008	March 2009	March 2010
Consultant (1)	3,119.22	3,119.22	3,119.22	3,119.22	3,119.22	3,119.22
Consultant (2)	6,194.97	6,194.97	6,194.97	6,194.97	6,194.97	6,194.97
Administration	3,334.61	3,334.61	3,334.61	3,334.61	3,334.61	3,334.61
Capital	28,165.74	28,165.74	28,165.74	28,165.74	28,165.74	28,165.74
Fixed General Overheads	3,356.99	3,356.99	3,356.99	3,356.99	3,356.99	3,356.99
Total Fixed Costs	44,171.53	44,171.53	44,171.53	44,171.53	44,171.53	44,171.53
Total Outpatient Visits	62	156	233	310	387	463
Fixed Cost per Outpatient Visit	**712.44**	**283.15**	**189.58**	**142.49**	**114.14**	**95.40**

Table 8.11: Total Costs per Outpatient Visit (Adjusted)

	March 2005	March 2006	March 2007	March 2008	March 2009	March 2010
Fixed Cost per Outpatient Visit	712.44	283.15	189.58	142.49	114.14	95.40
Variable Cost per Outpatient Visit	899.90	899.90	899.90	899.90	899.90	899.90
Total Cost per Outpatient Visit	**1,612.34**	**1,183.05**	**1,089.48**	**1,042.39**	**1,014.04**	**995.30**

Figure 8.6: Sensitivity Analysis of Adjusted Year-on-Year Costs per Outpatient Visit, March 2005 - March 2010.



9. Discussion

9.1 Epidemiological Results

9.1.1 Demand for Antiretroviral Referral Unit Services

The total number of patients on or preparing for HAART in the GF Jooste Catchment Area increased by 39.72% between October 2004 (1,853 patients) and March 2005 (2,589 patients). Antiretroviral Referral Unit monthly treatment levels varied between 97 patients (November 2004) and 73 patients (March 2005). Monthly demand for secondary level services, as a proportion of patients on or preparing for HAART and attending an antiretroviral clinic within the GF Jooste Catchment Area, was observed to range from 4.74% in November 2004 to 2.58% in March 2005. These results suggest a consistent level of demand for secondary level treatment in the early stages of the antiretroviral roll-out.

9.1.2 Descriptive Patient Characteristics

A high proportion of patients attending the Antiretroviral Referral Unit during the study period were female (77.0% of outpatients; 76.0% of inpatients) and between 26 and 35 years of age (44.68%; 54.17%). A high proportion of patients were observed to originate from the Site B (26.67%; 27.27%), Guguletu (20.0%; 13.64%), and GF Jooste Hospital (20.0%; 22.73%) antiretroviral clinics. These results suggest that the need for secondary level treatment for patients on or preparing for HAART may be associated with gender, age demographic and treatment location.

Advanced HIV/AIDS infection (WHO Clinical Stage 3 or 4) was recorded for all Antiretroviral Referral Unit inpatients. 88.0% of inpatients were classified as Clinical Stage 4, as opposed to 43.75% of outpatients. In addition, 94.74% of inpatients presented with a CD4 count below 200 μ/ml as compared to 47.73% of outpatients. These results suggest that

the need for hospitalisation of patients on or preparing for HAART is related to stage of disease advancement and CD4 count.

9.1.3 Antiretroviral Data

A high proportion of inpatients (64.0%) and outpatients (68.75%) were receiving antiretroviral medication. Outpatients on HAART had generally been receiving antiretroviral therapy for longer periods than inpatients on HAART, as indicated by the respective mean and median times since HAART initiation. These results suggest that the length of time on antiretroviral treatment may be associated with the need for hospitalisation of HAART patients, and that secondary outpatient care is frequently required for extended periods after HAART initiation.

A high proportion of inpatients and outpatients on HAART received a combination of 3TC, D4T and Efavirenz antiretrovirals (66.67%; 62.5%). 3TC and D4T were the most frequently-used drugs amongst Antiretroviral Referral Unit patients. As the 3TC, D4T and Efavirenz regimen is the primary first-line HAART regimen in the GF Jooste Catchment Area (National Department of Health: 2004a), no relationship between specific drug use and the need for secondary level treatment can be inferred.

9.1.4 Length of Stay and Visit Duration

The mean length of stay for inpatients was 14.60 days. This is higher than prior length of stay findings for HIV-positive patients at GF Jooste Hospital (Haile: 2000), suggesting advanced morbidity and associated treatment requirements amongst inpatients receiving HAART. The average outpatient visit duration was 47.37 minutes. This is higher than recorded primary-level consultation times for both HAART and non-HAART patients (Cleary *et al:* 2004a), suggesting greater diagnostic complexity at the secondary level. This result also provides supporting evidence for potential efficiency gains associated with the introduction of

secondary level outpatient care for patients on or preparing for HAART, assuming that such treatment may reduce the need for subsequent inpatient admissions.

9.1.5 Patient Diagnoses

Inpatient and outpatient diagnoses were dominated by infections (55.56%; 49.33%). Tuberculosis formed a high proportion of both inpatient (50.0%) and outpatient (43.24%) infections diagnoses, suggesting a need for attention to the clinical and health system issues raised by (i) the high incidence of tuberculosis in patients on or preparing for HAART and (ii) the combined effects of tuberculosis infection and HAART treatment. While antiretroviral drug related diagnoses accounted for 24.0% of all outpatient diagnoses, these diagnoses were relatively infrequent for inpatients (5.56%), supporting the suggestion that the need for secondary treatment of patients on or preparing for HAART is often unrelated to antiretroviral drug complications (Meintjes: 2004b).

9.1.6 Patient Outcomes

Antiretroviral Referral Unit patient outcomes suggest high levels of improvement or stabilisation as a result of secondary level treatment. The proportions of patient improvements and stabilisations are similar for inpatients and outpatients (65.0%; 72.55%), suggestive of an efficient inpatient admission triage system. The relatively low share of the 'no change' outcome for inpatients (15.0%) suggests that most patients may be either effectively treated at the secondary level, or are in terminal health decline.

Patient destinations also suggest a high level of successful treatment for outpatients, with 88.52% returning to primary care. However, the high proportion of outpatients returning for follow-up visits (54.1%) suggests the need for ongoing outpatient monitoring and treatment. For inpatients, the high proportion of patients referred for continued secondary care (52.17%) suggests limited capacity at GF Jooste Hospital, and illustrates the frequent need for extended inpatient hospitalisation.

9.2 Patient-Specific Cost Results

9.2.1 Laboratory Testing Costs

Laboratory testing costs for inpatients and outpatients were dominated by blood testing costs (74.98%; 73.0%). These results suggest that blood testing forms a key element of secondary level patient treatment, and that the possibility of more efficient methods of blood testing, including greater internalisation of blood testing procedures and analysis, should be explored[27].

9.2.2 Imaging and Radiology Costs

Imaging and radiology costs were primarily accrued by CT Scanning procedures for inpatients and outpatients (57.88%; 49.27%). These results support the inclusion of a CT Scanner in the proposed Antiretroviral Referral Unit equipment requirements (see Appendix B).

9.2.3 Medication Costs

Medication costs for inpatients and outpatients were dominated by non-antiretroviral antimicrobials (67.8%; 44.33%) and antiretroviral drugs (12.94%; 37.01%). These results suggest that the use of non-antiretroviral antimicrobials forms a key element of patient care at the secondary level. In addition, these results are compatible with the high levels of infection diagnoses amongst inpatients and outpatients. Conversely, the provision of antiretroviral drugs was observed to be largely dependent on the availability of patients' primary care supplies.

[27] The GF Jooste Laboratory is currently limited to conducting basic laboratory tests, and outsources more complex procedures.

9.2.4 Medical and Surgical Procedures Costs

Medical and surgical procedures costs were dominated by ambulatory rather than theatre-based procedures. Lumbar punctures (42.65%; 26.47%) and upper gastro-intestinal endoscopies (30.05%; 30.31%) formed a high proportion of medical and surgical procedures costs for inpatients and outpatients. The high proportion of lumbar puncture costs suggests that investment in associated equipment (*e.g.* manometers) or procedure facilities should be explored. The share of upper gastro-intestinal endoscopy costs supports the inclusion of associated equipment in prospective Antiretroviral Referral Unit equipment costs (see Appendix B).

9.2.5 Intravenous Fluids

Intravenous fluids costs were primarily accrued by saline fluids (62.03%). All medication provided through intravenous fluids was classified under medication, thereby limiting the range of the intravenous fluids category.

9.2.6 Counselling Costs

Counselling costs were distributed across a number of different counselling types. The need for a range of different counselling services for Antiretroviral Referral Unit inpatients suggests the ongoing need for both adaptability and comprehensive training in counselling staff at the secondary level.

9.3 Costing and Cost-Outcome Results

9.3.1 Patient-Specific Costs

Patient-specific costs for Antiretroviral Referral Unit inpatients and outpatients were dominated by laboratory testing (21.53%; 35.54%), medical and surgical procedures (15.11%; 27.56%), and imaging and radiology costs (12.22%, 26.41%). Medication costs formed a relatively low proportion of total patient-specific costs for inpatients and outpatients (10.82%; 10.5%), suggesting that the treatment of patients on or preparing for HAART is primarily dependent on a range of secondary-level infrastructural, equipment and support facilities. The high proportion of inpatient-specific consumables costs (37.81%) may be attributed to the high cost of intravenous lines (ZAR 101.89 per set).

9.3.2 Clinical Personnel Costs

Clinical personnel costs for Antiretroviral Referral Unit inpatients and outpatients were dominated by clinician costs. Medical officer costs accounted for a high level of total clinical personnel costs for Antiretroviral Referral Unit outpatients (54.72%), while the cost of inpatient medical ward clinical personnel formed a high proportion of total inpatient clinical personnel costs (51.19%). The relatively low share of nursing costs for outpatients (17.75%) suggests that the increased delegation of duties and responsibilities to relatively low-cost nursing staff should be explored as a cost-effective treatment option, as staff expansion occurs.

9.3.3 Overhead Costs

Outpatient overhead costs are primarily composed of general overhead costs (49.20%), followed by medical and surgical supplies (26.37%). Inpatient overhead costs are dominated by general overhead costs. Overhead costs per inpatient day are nearly double (1.87) the level of overhead costs per outpatient visit, reflecting the higher utilisation of overhead resources by inpatients.

9.3.4 Capital Costs

Antiretroviral Referral Unit outpatient capital costs are primarily accrued by building and medical equipment costs (67.32%; 30.38%). Administrative equipment and staff training costs form a relatively low proportion of outpatient capital costs (1.88%; 0.42%). These results emphasise the high cost of medical equipment relative to building space, and therefore encourage the expansion of building space to house key medical equipment. Antiretroviral Referral Unit inpatient capital costs are primarily composed of inpatient medical ward capital costs (94.87%), reflecting the low anticipated utilisation of Antiretroviral Referral Unit facilities by inpatients.

9.3.5 Total Cost per Outpatient Visit

Total costs per outpatient visit are primarily composed of clinical personnel and capital costs (33.84%; 28.18%). Overhead costs make up a relatively small proportion of total costs (13.65%). These results are in line with prior studies (Cleary *et al:* 2005), and are indicative of the relative importance of these categories to planning, resource allocation and budgeting decisions. Total costs per outpatient visit are significantly higher than equivalent findings in prior related studies (*ibid*). This differential may be explained by the existence of excess capacity in fixed costs at baseline.

9.3.6 Total Cost per Inpatient Day and per Inpatient Admission

Total costs per inpatient day and per inpatient admission are primarily generated by clinical personnel (26.15%), capital (22.5%) and overhead (35.32%) costs. The relatively low share of capital costs per inpatient day and per inpatient admission, when compared with capital costs per outpatient visit, reflects the use of inpatient medical ward capital facilities as opposed to Antiretroviral Referral Unit building and equipment. Total costs per inpatient day are in line with findings from previous studies (Haile: 2000).

While the cost per outpatient visit is therefore currently greater that the cost per inpatient day, it should be noted that the total cost per inpatient admission is 10.54 times higher than the total cost per outpatient visit, supporting the suggestion that outpatient care represents a more efficient use of resources, where it is medically and ethically possible.

9.3.7 Cost-Outcome Results

The cost-outcome per successfully-treated outpatient visit is ZAR 2,701.76 as compared to a cost per standard outpatient visit of ZAR 1,612.34, representing an increase in costs of 67.57%. The cost-outcome per successfully treated inpatient day (inpatient admission) is ZAR 2,234.13 (ZAR 21,482.03) as compared to a cost per standard inpatient day (inpatient admission) of ZAR 1,163.61 (ZAR 16,988.71), representing an increase in costs of 91.99%.

9.4 Costing Projection Results

9.4.1 Projected HAART Coverage

Projected numbers of patients on or preparing for HAART show a month-on-month increase from 2,831 patients in March 2005 to 16,443 patients in March 2010 in the GF Jooste Catchment Area. This represents an increase of 13,612 patients or a 580.81% increase in treatment levels over the projection period. These results suggest that provisional long-term antiretroviral coverage targets (National Department of Health: 2003) may have been overestimated if treatment expansion occurs at the projected linear rate.

9.4.2 Projected Antiretroviral Referral Unit Demand

Assuming a constant level of 3.33% of patients on or preparing for HAART requiring Antiretroviral Referral Unit treatment, the total number of Antiretroviral Referral Unit patients is expected to increase from 73 in March 2005 to 548 in March 2010. This represents an increase of 475 patients, or a 750.68% increase in Antiretroviral Referral Unit treatment levels over the projection period. These results suggest that the secondary level treatment of patients on or preparing for HAART is likely to become a key issue for the South African health system as the use of antiretroviral drugs increases. Projected levels of Antiretroviral Referral Unit patients suggests the need for ongoing expansion of facilities and personnel for associated secondary level treatment and care.

9.4.3 Prospective Antiretroviral Referral Unit Costs

Total costs per outpatient visit decline from ZAR 1,612.34 in March 2005 to ZAR 948.40 in March 2010. This represents a decrease in costs per outpatient visit of ZAR 663.94 or 41.17%. Similarly, total costs per inpatient day (inpatient admission) decline from ZAR 1,163.61 (ZAR 16,988.72) in March 2005 to ZAR 404.64 (ZAR 5,907.73) in March 2010, representing a decrease in costs of 65.22%. These declines in costs are explained by the

economies of scale of Antiretroviral Referral Unit expansion, whereby initial fixed costs are spread over an increasing number of inpatients and outpatients[28]. These results suggest that high initial costs of treatment for both inpatients and outpatients will decrease dramatically over the projection period, in line with expectations for programmes with high development costs (Johns and Tan Torres: 2005).

9.4.4 Sensitivity Analysis

The sensitivity analysis produced a 4.95% increase in the cost per outpatient visit from ZAR 948.40 to ZAR 995.30. This result suggests that the categorisation of certain overhead costs as variable costs does not produce a significant alteration in total costs.

9.5 Limitations

9.5.1 General Limitations

Cost analyses require a significant temporal commitment for successful execution. Data collection is frequently dependent on the availability of third parties, while the selection and categorisation of key costs requires ongoing assessment and adjustments. In the case of a new project, these costs must be determined without the assistance of a costing template or associated studies. Such costing studies have been described as 'complex, difficult and time consuming to perform' (Beck *et al:* 2001, p 16). In addition, the resources required to perform economic evaluations are themselves scarce, and must therefore be rationed appropriately (Drummond *et al:* 1987).

[28] Amongst other circumstances, economies of scale arise in health care when fixed costs are spread over a larger number of units of output, or more efficient use is made of expensive diagnostic equipment (Clewer and Perkins: 1998).

9.5.2 Demand for Antiretroviral Referral Unit Services

Total monthly Antiretroviral Referral Unit treatment levels are presented as a proportion of patients attending antiretroviral clinics within the GF Jooste Catchment Area. As illustrated in Section 5.3.3, patients are occasionally referred to the Antiretroviral Referral Unit from clinics outside the GF Jooste Catchment Area, such as the Red Cross Hospital and Groote Schuur Hospital. The total proportion of HAART patients in the GF Jooste Catchment Area requiring secondary level treatment may therefore have been overestimated.

9.5.3 Antiretroviral Referral Unit Costs

9.5.3.1 Data Collection

Limitations on the availability of appropriate datasets frequently diminish the accuracy of cost analysis results. 'Two obstacles that frequently exist include scarcity of resources to perform the costing exercise, and the lack or inaccessibility of data' (Beck *et al:* 2001, p 16). Where possible, key primary datasets for this research were sourced directly from GF Jooste Hospital. Where this data was unavailable, equivalent prices were sourced from alternative costing sources (*e.g.* the South African Uniform Patient Fee Schedule) or secondary data sets (*e.g.* Cleary *et al:* 2005).

9.5.3.2 Translator Costs

No translator position was included in the Antiretroviral Referral Unit personnel resource requirements. Antiretroviral Referral Unit patients were predominantly English-speaking. In addition, a number of Antiretroviral Referral Unit clinical and non-clinical personnel were multilingual, communicating with patients in English, Afrikaans and Xhosa. These circumstances may not apply in other cultural contexts and geographical settings, representing a limitation on the replicability of Antiretroviral Referral Unit personnel cost results.

9.5.3.3 Medical Ward Costs

Capital, clinical personnel, and overhead costs for the GF Jooste Medical Ward were included in the assessment of Antiretroviral Referral Unit inpatient costs. These costs were included to provide a complete representation of all costs associated with the Antiretroviral Referral Unit. In practice, these costs are the responsibility of GF Jooste Hospital, and are not directly borne by the Antiretroviral Referral Unit.

9.5.4 Costing Projection Results

9.5.4.1 Projected HAART Coverage

The calculation of projected HAART coverage levels for the GF Jooste Catchment Area was dependent on a number of assumptions. The extrapolation of HAART coverage levels employed a linear projection model, based on prior monthly increases in antiretroviral treatment in local antiretroviral clinics. This model assumes that increases in HAART treatment levels will continue at the same rate until 2010. HAART coverage levels for 2010 will have been underestimated if treatment levels increase at an accelerated rate in the future.

9.5.4.2 Projected Antiretroviral Referral Unit Demand

The proportion of patients on or preparing for HAART requiring secondary level care for the projection period was based on empirical attendance data for the Antiretroviral Referral Unit and was assumed to remain constant. Owing to the scale and scope of the AIDS epidemic, and the associated challenges to primary level care in diagnosing HIV/AIDS at an early stage of the disease, it was assumed that a constant proportion of patients on or preparing for HAART during the projection period will initiate treatment in a state of advanced immunosuppression and require secondary level care. Should a higher proportion of patients commence HAART prior to advanced immunosuppression, or the efficacy (or side-effect

profile) and effectiveness of antiretroviral treatment improve, Antiretroviral Referral Unit demand levels for 2010 may have been overestimated.

In addition, outpatient visit frequency and the average inpatient length of stay were held constant for the projection period. Should efficiency improvements in the secondary level treatment of patients on or preparing for HAART occur during the projection period, Antiretroviral Referral Unit demand levels for 2010 will have been overestimated. Finally, the proportions of patients on or preparing for HAART requiring inpatient and outpatient care were held constant for the projection period. This ratio may alter during the projection period due to any combination of the above considerations, with associated cost effects.

9.5.4.3 Prospective Antiretroviral Referral Unit Costs

The decline in costs per outpatient visit, per inpatient day and per inpatient admission over the projection period is dependent on the categorisation of fixed and variable costs. Should any fixed costs categories require additional resources over time, or should they prove to be variable costs in practice, this decline will have been overestimated. The effect of fixed and variable cost categorisation on total costs is described in Section 8.3.3.

10. Conclusion

10.1 Use of Results

10.1.1 Policy Utilisation

This research has attempted to determine the costs of secondary level treatment and care of patients on or preparing to initiate HAART. The measurement of these costs is designed to provide policymakers with information on the hidden or downstream costs of widespread antiretroviral treatment. This study therefore aims to assist in the determination of the scope, scale, pace and spatial distribution of the national antiretroviral roll-out. Walker notes that in the context of HIV/AIDS treatment, 'cost information, both measures of cost and cost-effectiveness, serves as a critical input into the processes of setting priorities and allocating resources efficiently' (2003, p 4). In South Africa, Cleary *et al* note that 'there is very limited data on the expenditure required by the public health system to meet the needs of HIV-positive people across the continuum of care' (2004b, p 1).

10.1.2 GF Jooste Hospital Utilisation

The assessment of the current and prospective costs of the Antiretroviral Referral Unit is designed to contribute to the budgeting and planning processes at GF Jooste Hospital, in preparation for an era of widespread HAART utilisation in the GF Jooste Catchment Area. Data on the resource requirements for full Antiretroviral Referral Unit operation, as well as current and prospective data on the total costs of treating patients on or preparing for HAART at the secondary level, may be utilised by hospital administrators and clinicians in resource allocation decisions.

10.1.3 Further Utilisation

The determination of the key costs required for the secondary level treatment of patients on or preparing for HAART is designed to provide support to academic research into technical and allocative efficiency in the South African health system. In addition, this research may be utilised by other secondary hospitals in South Africa in order to assess the resources required for the introduction of an Antiretroviral Referral Unit. While local infrastructural considerations may require variations on the GF Jooste model, this evaluation may nonetheless serve as a template for the delivery of specialised secondary care.

More broadly, estimates of the costs of secondary level treatment of patients on or preparing for HAART may provide a useful input into the assessment of the health system and macroeconomic effects of HIV/AIDS in South Africa. Finally, the results of this research may be used as a guideline for other countries intending to introduce HAART through their public health systems.

10.2 Research Recommendations

10.2.1 Immunosuppression Levels

Advanced research into the current and prospective levels of patients on or preparing for HAART and in a state of advanced immunosuppression is required to gain further insights into the potential future demands on secondary level hospitals. A full assessment of the morbidity status of new HAART patients will assist in the planning and development of related services.

10.2.2 Voluntary Counselling and Testing

The increased costs of improved and expanded Voluntary Counselling and Testing (VCT) services for earlier detection of HIV/AIDS may be offset by savings in treatment and care costs at the secondary level. Ongoing research into the affordability and development of widespread VCT services is may assist in generating improvements in patient response to antiretroviral treatment, thus reducing both morbidity levels and associated downstream costs.

10.2.3 Antiretroviral Drugs

The increased costs associated with the manufacture and distribution of 'safer' antiretroviral drugs (*e.g.* drugs less likely to cause hyperlactataemia or lactic acidosis) may be offset by savings in treatment and care costs at the secondary level. Research into the additional costs and potential savings of the use of improved first-line antiretroviral regimens is required for the successful advancement of the antiretroviral roll-out.

10.2.4 HAART Treatment and Opportunistic Infections

The high level of diagnosis and treatment of patients on or preparing for HAART for infections such as tuberculosis suggests the need for further research into the appropriate primary-level investigation and treatment of such patients. In particular, research on interventions designed to expedite the diagnosis of tuberculosis at the primary level may assist in reducing associated morbidity and the need for secondary level referral.

10.3 Policy Recommendations

10.3.1 Provision of Secondary Level Facilities and Associated Funding

The provision of appropriate funding for the development of key facilities at the secondary level to support the HAART roll-out should be included as an integral part of the health care budgeting and planning process at the meso, provincial, and national levels. The provision of adequate secondary-level support for widespread antiretroviral therapy is essential to the success of both individual HAART treatment and the roll-out process as a whole.

10.3.2 Sustainability and Durability of HIV/AIDS Expenditure

Health system interventions, including the antiretroviral roll-out, may frequently concentrate resources on the provision of short-term consumable items. The importance of sustainable and durable investments in the health system is supported by the findings of this study. Only through parallel and complementary investment in clinical personnel, buildings and medical equipment can the South African health system hope to advance and progress through the challenges posed by the AIDS epidemic.

10.3.3 Distributive Equity Opportunities

The allocation of funds based on vertical interventions, such as the antiretroviral roll-out, should aim to achieve distributive equity where possible. In this way, the historical under-funding of specific facilities, services and geographical areas, such as those represented by GF Jooste Hospital, may be redressed whilst simultaneously responding to immediate treatment requirements. Increased expenditure on disadvantaged facilities may be combined with a focus on long-term capital investment to produce significant improvements in the quality of services offered to disadvantaged areas.

10.3.4 System-Wide Approach

The implementation of vertical interventions such as the antiretroviral roll-out should consider the future of the health system as a whole. Only through an integrated approach to health care interventions can future economic and burden of care shocks be avoided. The need for a system-wide approach to the treatment and care of HIV/AIDS, rather than a limited and potentially blinkered focus on primary level initiatives, is recommended. 'The successful implementation of the ARV treatment programme depends on a broadly strengthened health system' (Guthrie and Hickey: 2004, p 159).

10.4 Concluding Remarks

This study has provided a detailed economic analysis of the secondary level treatment of patients on or preparing for HAART through a case study of the proposed GF Jooste Antiretroviral Referral Unit. A full cost analysis, a cost-outcome description and a projection of prospective costs per outpatient visit, per inpatient day and per admission were produced. It is to be hoped that a detailed picture of the demands placed on secondary hospitals through the treatment of patients on or preparing for HAART has been created.

This study does not seek to undermine or question the affordability and viability of the antiretroviral roll-out. Rather, it attempts to provide additional information on the true costs to the South African health system of this ambitious project. In this way, the findings of this study are designed to assist in the successful implementation of widespread antiretroviral use.

This study seeks to provide evidence that widespread vertical or primary-level interventions, such as the roll-out of antiretroviral therapy, have the potential to create a wide range of hidden and downstream costs. In assessing the viability of specific health interventions, it is of paramount importance that policymakers consider their impact at all levels of the health system. This conclusion should be borne in mind by pressure groups, lobbying campaigns and other stakeholders in the antiretroviral roll-out. Only through the comprehensive

assessment of resource requirements across the health system can vertical interventions be fully audited and resources distributed appropriately.

The ongoing applicability of the results of this research are dependent on a wide range of variables, many of them both unpredictable and beyond the scope of this study. The ultimate scale of the AIDS epidemic, the success of the antiretroviral roll-out and the ongoing use of antiretrovirals in HIV / AIDS treatment, and the ongoing need for secondary level treatment of patients on or preparing for HAART are contingent on a range of secondary and currently indefinite factors. However, based on the *status quo* and assuming *ceteris paribus*, the resources required for the treatment of patients on or preparing for HAART may be expected to grow in proportion to the scale and scope of the antiretroviral roll-out.

Ultimately, the aim of this study is to inform the resource allocation decisions of the South African health system, both within and beyond the context of the AIDS epidemic and antiretroviral treatment, and to illustrate the key role of economics in the assessment of health care interventions. Only through the appropriate use of the tools of economic evaluation can a socially and individually just and fair distribution of scarce resources be achieved.

11. References

Anis, A; Guh, D; Hogg, RS *et al* (2000). The Cost-Effectiveness of Antiretroviral Regimens for the Treatment of HIV / AIDS. *Pharmacoeconomics* 18 (4): 393 – 404.

Arens, FJ and Maartens, G (2004). *Treatment Costs for HIV / AIDS in a Managed Care Setting in South Africa.* Presentation to the 38th Annual Congress of the South African Pharmacology Society, Bloemfontein, 24th to 27th October 2004.

Barron, P (2003). *The Challenge of Rolling Out Antiretrovirals.* Health Systems Trust Document. Accessed through www.news.hst.org.za/view.php3?id=20030808 in September 2004.

Barvy, A and Mauldin, PD (1996). Resource Utilisation and Stage of Illness: A Study of an Outpatient AIDS Clinic. *AIDS Patient Care and STDs* 10 (5): 288 – 291.

Bateman, C (2004). SAMA leads the way with ARV roll-out. News Item. *South African Medical Journal* 94 (1): 17 – 18.

Beck, EJ; Miners, AH; Tolley, K (2001). The Cost of HIV Treatment and Care: A Global Review. *Pharmacoeconomics* 19 (1): 13 – 39.

Bekker, LG; Orrell, C; Reader, L *et al* (2003). Antiretroviral Therapy in a Community Clinic – Early Lessons from a Pilot Project. *South African Medical Journal* 93 (6): 458 – 462.

Bertozzi, S; Gutierrez, JP; Opuni, M *et al* (2004). Estimating Resource Needs for HIV / AIDS Health Care Services in Low-Income and Middle-Income Countries. *Health Policy* 69: 189 – 200.

Boulle, A; Johnson, L; Cleary, S *et al* (2004). *The Cape Town Antiretroviral Costing Model.* Version 2.0 (2004). University of Cape Town.

Bourne, D (2003). Whither the AIDS Epidemic – Or Lies, Damned Lies and Statistics? *South African Medical Journal* 93 (12): 916.

Casseb, J; Fonseca, LA; Veiga, AP *et al* (2003). AIDS Incidence and Mortality in a Hospital-based Cohort of HIV-1-Seropositive Patients receiving Highly Active Antiretroviral Therapy in Sao Paulo, Brazil. *AIDS Patient Care and Sexually Transmitted Diseases* 17 (9): 447 – 452.

Chimfwembe, DM (1997). *Distribution of 1996/7 Recurrent Expenditure to Service Levels: A Case Study of Mount Frere Health District.* Master's Degree Thesis, University of York.

Chrischelles, EA and Scholz, DA (1999). Dollars and Sense: A Practical Guide to Cost Analysis for Hospital Epidemiology and Infection Control. *Clinical Performance and Quality Health Care* 7 (2): 107 – 111.

Cleary, S; Boulle, A; McIntyre, D *et al* (2004a). *Cost-effectiveness of Antiretroviral Treatment for HIV-Positive Adults in a South African Township.* Health Systems Trust Report.

Cleary, S; McIntyre, D; Boulle, A *et al* (2004b). *Health Service Burden of HIV in Two Districts in the Public Health System: Methodology Report.* Health Economics Unit Report, University of Cape Town.

Cleary, S; Boulle, A; Johnson, L (2004c). *Scaling up Treatment in South Africa 2004 – 2008: Changes in Expenditure and Service Utilisation Comparing ART to the Status Quo.* Presentation to the International AIDS Economics Network Symposium, Bangkok, 9th to 10th July 2004.

Cleary, S *et al* (2005). *Health System Burden of HIV / AIDS in the Western Cape: Based on Facilities and Patients in Guguletu, Nyanga and Paarl.* Joint Economics AIDS and Poverty Programme (JEAPP) Document. Accessed through http://www.jeapp.org.za/attachment.php?attachmentid=53 .

Clewer, A and Perkins, D (1998). *Economics for Health Care Management.* New York: Prentice Hall.

Coetzee, D; Hildebrand, K; Boulle, A *et al* (2004). Outcomes after Two Years of Providing Antiretroviral Treatment in Khayelitsha, South Africa. *AIDS* (18): 887 – 895.

Community Health Services Organisation. *South African Drug Price Listings 2004.* EXCEL Spreadsheet.

Creese, A and Parker, D (1994). *Cost Analysis in Primary Health Care: A Training Manual for Programme Managers.* World Health Organisation: Geneva.

Creese, A; Floyd, K; Alban, A (2002). Cost-Effectiveness of HIV / AIDS Interventions in Africa: A Systematic Review of the Evidence. *Lancet* 359 (9318): 1635 – 43.

Drummond, M (ed.) *et al* (1987). *Methods for the Economic Evaluation of Health Care Programmes.* Oxford University Press: Oxford.

Drummond, M and McGuire, A (eds) (2001). *Economic Evaluation in Health Care: Merging Theory with Practice.* Oxford University Press: Oxford.

Edelstein, H and Wilson, M (2001). Antiretroviral Medication Errors were Universal in Hospitalised HIV-Seropositive Patients at a Teaching Hospital. *Journal of Acquired Immune Deficiency Syndrome* 28 (5): 496.

Escolano Hortelano, CM; Ramos Rincon, JM; Gutierrez Rodero, F *et al* (2004). Changes in the Spectrum of Morbidity and Mortality in Hospital Admissions of HIV-Infected Patients During the HAART Era. *Medicina Clinicia (Barcelona)* 122 (1): 21 – 23.

Farlex Corporation. *The Free Dictionary Online. Financial Dictionary Section.* http://financial-dictionary.thefreedictionary.com/Economies+of+scale. Accessed July 2005.

Floyd, K; Blanc, L; Raviglione, M *et al* (2003). Resources Required for Global Tuberculosis Control. *Science* 295 (5662): 2040 – 2046.

Forsythe, S and Gilks, C (1999). Economic Issues and Antiretroviral Therapy in Developing Countries. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 93 (1): 1 – 3.

Govender, V *et al* (2000). *The Costs and Perceived Quality of Care for People Living with HIV / AIDS in the Western Cape Province in South Africa.* Partnerships for Health Reform Small Applied Research Paper (14).

Guthrie, T and Hickey, A (2004). *Funding the Fight: Budgeting for HIV / AIDS in Developing Countries.* IDASA: Cape Town.

Gutierrez, JP; Johns, B; Adam, T *et al* (2004). Achieving the WHO / UNAIDS Antiretroviral Treatment 3 by 5 Goal: What will it Cost? *The Lancet* 364: 63 – 64.

Haile, B (2000). *Costs of Adult Inpatient Care for HIV Disease at GF Jooste Hospital.* Master's Degree Thesis, University of Cape Town.

Havlir, DV and Currier, JS (2003). Complications of HIV Infection and Antiretroviral Therapy. *Topics in HIV Medicine* 11 (3): 86 – 91.

Human Sciences Research Council (2004). *Nelson Mandela/HSRC Study of HIV/AIDS: South African National HIV Prevalence, Behavioural Risks and Mass Media Household Survey (SABSSM II Main Study).* Human Sciences Research Council: Pretoria.

Health Systems Trust (2003). *Introducing Antiretroviral Therapy on a Large Scale: Hope and Caution.* Accessed through www.hst.org.za/publications/596 in September 2004.

Hogg, RS; Weber, AE; Craib, KJ *et al* (1998). One World, One Hope: The Cost of Providing Antiretroviral Therapy to All Nations. *AIDS* 12 (16): 2203 – 2209.

Hutubessy RC; Baltussen, RM; Torres-Edejer, TT *et al* (2002). Generalised Cost-Effectiveness Analysis: An Aid to Decision-Making in Health. *Journal of Applied Health Economics and Health Policy* 1(2): 89 – 95.

Johns, B and Tan Torres, T (2005). Costs of Scaling Up Health Interventions: A Systematic Review. *Health Policy and Planning* 20 (1): 1 – 13.

Kimura, H (2002). Cost of HIV Treatment in Highly Active Antiretroviral Therapy in Japan. *Nippon Rinsho* 60 (4): 813 – 816.

Kirigia, JM; Snow, RW; Fox-Rushby, J *et al* (1998). The Cost of Treating Paediatric Malaria Admissions and the Potential Impact of Insecticide-Treated Mosquito Nets on Hospital Expenditure. *Tropical Medicine and International Health* 3 (2): 145 – 150.

Kumaranayake, L; Conteh, L; Kurowski, C *et al* (2001). *Preliminary Estimates of the Cost of Expanding TB, Malaria and HIV / AIDS Activities for Sub-Saharan Africa.* Prepared for Working Group 5: Commission on Macroeconomics and Health Improving Health Outcomes of the Poor, May 2001.

Lipsey, RG *et al* (1992). *Economics*. 10th Edition. Harper Collins: New York.

Le Pen, C; Rosenbaum, W; Downs, A *et al* (2001). Effect of HAART on Health Status and Hospital Costs of Severe HIV-Infected Patients: A Modeling Approach. *HIV Clinical Trials* 2 (2): 136 – 145.

Mandalia, SA; Beck, EJ; Beecham, J *et al* (1999). Use and Cost of Hospital Services by HIV-Infected Children During the Era of Antiretroviral Monotherapy. *AIDS* 13 (18): 2591 – 2609.

Matsheke, T (2004). *A Cost Analysis of Rural Primary Health Care Services in KwaZulu-Natal.* Master's Degree Thesis, University of Cape Town.

Meintjes, G (2004a). *Proposed Development of Physical Infrastructure for Integrated HIV Service at GF Jooste Hospital.* Unpublished Draft.

Meintjes, G (2004b). *Secondary Level Back-Up for Antiretroviral Programme.* Unpublished Letter.

Meintjes, G (2004c). *The GF Jooste Hospital Antiretroviral Referral Unit.* Unpublished Presentation.

Meredith, KL; Larson, TA; Soons, KR *et al* (1998). Building Comprehensive HIV / AIDS Services. *AIDS Patient Care and Sexually Transmitted Diseases* 12 (5): 379 – 393.

Moore, RD and Bartlett, JG (1996). Combination Antiretroviral Therapy in HIV Infection: An Economic Perspective. *Pharmacoeconomics* 10 (2): 109 – 113.

Morris, CN and Cheevers, EJ (2000). The Direct Costs of HIV / AIDS in a South African Sugar Mill. *AIDS Analysis Africa* 10 (5): 7 – 8.

National Department of Health (2003). *Operational Plan for Comprehensive HIV and AIDS Care, Management and Treatment for South Africa.* National Department of Health Report.

National Department of Health (2004a). *National Antiretroviral Treatment Guidelines.* National Department of Health Report.

National Department of Health (2004b). *Antiretroviral Therapy in South Africa: A Pocket Guide to the Prevention and Management of Side Effects and Drug Interactions.* National Department of Health Report.

Nattrass, N; Leibbrant, M; Seekings, J *et al* (2003). *Khayelitsha / Mitchell's Plain Survey 2000: Survey Report and Baseline Information.* Centre for Social Science Research, University of Cape Town and the Population Studies Center, University of Michigan.

Okello, DO (1994). Resource Utilisation Patterns in Patients with Acquired Immunodeficiency Syndrome (AIDS). *East African Medical Journal* 71 (12): 816 – 817.

Phiri, B (2000). *An Economic Evaluation of Reproductive Health Service Delivery in Central Lusaka.* Master's Degree Thesis, University of Cape Town.

Provincial Administration of the Western Cape (2005). *Total Numbers of Patients on HAART and Attending Antiretroviral Clinics in the GF Jooste Catchment Area, October 2004 to March 2005.* Personal Communication.

Schneider, H and Coetzee, D (2003). Strengthening the Health System and Ensuring Equity in the Widescale Implementation of an Antiretroviral Therapy Programme in South Africa. *South African Medical Journal* 93 (10): 772 – 773.

Schopper, D and Walley, J (1992). Care for AIDS Patients in Developing Countries: A Review. *AIDS Care* 4 (1): 89 – 102.

Schwartlander, B; Stover, J; Walker, N *et al* (2001). Resource Needs for HIV / AIDS. *Science* 292: 2434 – 2436.

Shepard, S *et al* (2000). *Analysis of Hospital Costs: A Manual for Managers.* World Health Organisation: Geneva.

Sinanovic, E; Floyd, K; Dudley, L *et al* (2003). Cost and Cost-Effectiveness of Community-Based Care for Tuberculosis in Cape Town, South Africa. *International Journal of Tuberculosis and Lung Disease* 7 (9): S56 – S62.

Stenzel, MS and Carpenter, CC (2000). The Management of the Clinical Complications of Antiretroviral Therapy. *Journal of Infectious Disease Clinicians of North America* 14 (4): 851 – 878.

Stewart, R (2004). *Scaling-Up Treatment for HIV in South Africa – A Way Forward.* Health Systems Trust Document. Accessed through www.hst.org.za/news/ easyprint.php?nws_id=20040394 in September 2004.

Walker, D (2003). Cost and Cost-Effectiveness of HIV / AIDS Prevention Strategies in Developing Countries: Is There an Evidence Base? *Health Policy and Planning* 18 (1): 4 – 17.

World Health Organisation (2003). *Emergency Scale-Up of Antiretroviral Therapy in Resource-Limited Settings: Technical and Operational Recommendations to Achieve 3 by 5.* WHO / UNAIDS International Consensus Meeting Report.

Yazdanpanah, Y; Goldie, SJ; Losina, E *et al* (2002). Lifetime Cost of HIV Care in France During the Era of Highly Active Antiretroviral Therapy. *Anti-Viral Therapy* 7 (4): 257 – 266.

12. Abstracts and Presentations

1. *An Economic Analysis of the Secondary Hospital Treatment of Patients Receiving Highly Active Antiretroviral Therapy (HAART) in South Africa.* Abstract and presentation to the International AIDS Impact Conference, Cape Town, 11th – 15th April 2005.

2. *An Economic Analysis of the Secondary Hospital Treatment of HAART Patients: The GF Jooste Antiretroviral Referral Unit.* Presentation to clinical staff and guests at GF Jooste Hospital, 21st June 2005.

3. *An Economic Evaluation of the Impact of Widespread Antiretroviral Treatment on Secondary Hospitals in South Africa: Case Study of the GF Jooste Hospital Antiretroviral Referral Unit.* Presentation to the Department of Public Health, University of Cape Town, 4th August 2005.

List of Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ARU	Antiretroviral Referral Unit
ARV	Antiretroviral Drug
AZT	Zidovudine
DDI	Didanosine
D4T	Stavudine
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
HST	Health Systems Trust
PAWC	Provincial Administration of the Western Cape
TB	Tuberculosis
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
VCT	Voluntary Counselling and Testing
WHO	World Health Organisation
3TC	Lamivudine

List of Tables

List of Figures

List of Figures (Continued)

Abstract

This research presents a partial economic evaluation of the current and anticipated impact of widespread antiretroviral treatment on the secondary hospital system in South Africa. The evaluation encompasses the treatment and care of HIV-positive inpatients and outpatients on or preparing for highly active antiretroviral therapy (HAART) at the secondary level. This study was conducted based on analysis of the Antiretroviral Referral Unit at GF Jooste Hospital during March 2005, and utilises a combination of current and retrospective data sets. Current and projected fixed and recurrent costs per outpatient visit, inpatient day and inpatient admission are presented. A range of epidemiological results are also analysed.

Epidemiological results suggest that most patients requiring Antiretroviral Referral Unit care are women (77.0% of outpatients; 76.0% of inpatients) with a mean age of 35.9 years for outpatients and 34.0 years for inpatients. The most commonly used antiretroviral regimen was 3TC+D4T+Efavirenz for both inpatients (66.67%) and outpatients (62.5%) currently receiving HAART. Diagnoses were dominated by infections (49.33% of outpatient diagnoses; 55.56% of inpatient diagnoses) rather than antiretroviral drug-related complaints (24.0%; 5.56%). Successful treatment outcomes were recorded for a high share of patients.

Costing results describe the share and composition of capital, overhead, clinical personnel and patient-specific costs per outpatient visit, per inpatient day and per inpatient admission. Capital and clinical personnel costs accounted for high shares of total costs for both inpatients (22.50%; 26.15%) and outpatients (28.18%; 33.84%). Detailed analysis of patient-specific costs revealed laboratory testing and medical and surgical procedures as key cost drivers. Cost projections indicate a decline in costs per outpatient visit and per inpatient day (and admission) over time due to economies of scale, *ceteris paribus*. Cost-outcome results indicate that treatment costs rise considerably when effectiveness of treatment is considered. A range of research and policy recommendations based on these findings are presented.

13. Appendices

Table of Contents

Instructions to Attending Clinicians: Please provide all details for (current and new) HAART outpatients attending the GF Jooste Antiretroviral Referral Unit during the study period 1 – 31 March 2005. Please be as comprehensive as possible in stating all patient costs. Space has been provided for explanatory comments where necessary. Please print clearly and legibly. Thank you for your time.

Section 1: Patient Details

Patient Folder Number: _____

Date of Birth: _____

Patient Gender: ☐ Male ☐ Female

Patient Type: ☐ New ☐ Existing

Referred From: _____

WHO HIV / AIDS Clinical Stage[1]: ☐ 1 ☐ 2 ☐ 3 ☐ 4

Most Recent CD4 Count: _____

Date of Most Recent CD4 Count: _____

HAART Status: ☐ Receiving HAART ☐ Preparatory Period

Date of HAART Initiation: _____

HAART Regimen Type: ☐ Regimen 1 ☐ Regimen 2 ☐ Other

Drug Content of HAART Regimen: _____

Name of Attending Antiretroviral Clinic: _____

Section 2: Treatment Outcome

Was a Definitive Diagnosis Made? ☐ Yes ☐ No ☐ Unknown

Patient Response to Treatment: ☐ Improved ☐ Deteriorated ☐ Stabilised ☐ No Change ☐ Unknown ☐ Died

Destination of Patient: ☐ Hospice ☐ Tertiary ☐ Primary ☐ Inpatient ☐ Other

If Other, Please State: _____

[1] See attached document for a description of the WHO Clinical Staging System.

Section 3: Patient Visit Record

Date of Visit: _____

Duration of Visit: _____

Other Attending Clinician(s): _____

Diagnosis	Key Features	Comments
	1.	
	2.	
	3.	
	4.	
	1.	
	2.	
	3.	
	4.	
	1.	
	2.	
	3.	
	4.	
	1.	
	2.	
	3.	
	4.	

Section 4: Laboratory Tests

Test Type	Location*	Comments

* If other than GF Jooste Hospital.

Section 5: Imaging and Radiology

Imaging Type	Location*	Comments

Section 6: Medication

Medicine Type	Quantity	Duration	Comments

Section 7: Medical and Surgical Procedures

Procedure Type	Location*	Comments

* If other than GF Jooste Hospital.

Section 8: Medical and Non-Medical Consumables and Other Costs

Type	Comments

Section 9: Other Illnesses or Medical Conditions and Associated Medication (i.e. Tuberculosis)

Illness or Medical Condition	Medication	Comments

Section 10: Additional Information

_____

_____

_____

_____

Section 11: Attending Clinician Details

Name: _____

Position (MO, PMO): _____

Signature: _____

Date: _____

Data Capture Form for the Costing of HAART-Related Treatment and Care for Inpatients.

GF Jooste Antiretroviral Referral Unit, March 2005.

Instructions to Attending Clinicians: Please fill in all details of (current and new) HAART inpatients treated by the GF Jooste Antiretroviral Referral Unit during the study period 1 – 31 March 2005. Please be as comprehensive as possible in recording all patient costs. Space has been provided for explanatory comments where necessary. Please print clearly and legibly. Thank you for your time.

Section 1: Patient Details

Patient Folder Number: _____

Date of Birth: _____

Patient Gender: ☐ Male ☐ Female

Patient Type: ☐ New ☐ Existing

Referred From: _____

Admission Date: _____

Discharge Date (Estimate if Unknown): _____

Diagnoses / Reasons for Attendance:

1. _____
2. _____
3. _____
4. _____
5. _____

WHO HIV / AIDS Clinical Stage[2]: ☐ 1 ☐ 2 ☐ 3 ☐ 4

Most Recent CD4 Count: _____

Date of Most Recent CD4 Count: _____

HAART Status: ☐ Receiving HAART ☐ Preparatory Period

Date of HAART Initiation: _____

HAART Regimen Type: ☐ Regimen 1 ☐ Regimen 2 ☐ Other

Drug Content of HAART Regimen: _____

Name of Attending Antiretroviral Clinic: _____

[2] See attached document for a description of the WHO Clinical Staging System.

Section 2: Laboratory Tests

Test Type	Date	Location*	Comments

Section 3: Imaging and Radiology

Imaging Type	Date	Location*	Comments

* If other than GF Jooste Hospital.

Section 4: Medication (Including Locally-Provided HAART and Other Medication)

Medicine Type	Daily Dosage	Start Date	End Date

Section 5: Medical and Surgical Procedures

Procedure Type	Date	Location*	Comments

* If other than GF Jooste Hospital.

Section 6: Physiotherapy

Reason for Physiotherapy	Date	Location*	Comments

Section 7: Social Worker Counselling or HIV / AIDS Counselling

Reason for Counselling	Date	Location*	Comments

Section 8: Discharge Medication

Medicine Type	Date	Quantity	Comments

* If other than GF Jooste Hospital.

Section 9: Medical and Non-Medical Consumables and Other Costs

Type	Date	Comments

Section 10: Other Illnesses or Medical Conditions and Associated Medication (i.e. Tuberculosis)

Illness or Medical Condition	Medication	Comments

Section 11: Treatment Outcome

Was a Definitive Diagnosis Made? ☐ Yes ☐ No ☐ Unknown

Patient Response to Treatment: ☐ Improved ☐ Deteriorated ☐ Stabilised ☐ No Change ☐ Unknown ☐ Died

Destination of Patient: ☐ Hospice ☐ Tertiary ☐ Primary ☐ Outpatient ☐ Other

If Other, Please State: _____

Section 12: Additional Information

_____

_____

Data Capture Form for the Costing of HAART-Related Treatment and Care.

GF Jooste Antiretroviral Referral Unit, March 2005.

Instructions to Staff: Please fill out this time diary based on your work and experience in the Antiretroviral Referral Unit (ARU) at GF Jooste Hospital during the period 14 – 18 March 2005. **This form relates to the treatment and care of ARU patients only.** Full confidentiality will be preserved in the analysis and use of this information. Thank you for your participation.

Section 1: Daily Time Allocation

Date	Outpatients	# Seen	Inpatients	# Seen	TCS*	# Calls
14/3						
15/3						
16/3						
17/3						
18/3						

Date	Research	Analysis	Meetings	Clerical	Other	TOTAL
14/3						
15/3						
16/3						
17/3						
18/3						

* Telephone Consultation Service.

Section 2: Additional Information

_____

_____

Section 3: Staff Member Details

Position: ☐ Consultant ☐ CMO ☐ MO

☐ Nurse ☐ Clerk ☐ Other

If Other, Please State: _____

Signature: _____

Date: _____

B.1 Proposed GF Jooste Antiretroviral Referral Unit Building

Admissions Area: Space for a clerk's desk and a storage and filing area. Telephone line for admissions clerk.

Waiting Area: Space for soft furnishings for patients. Wheelchair access and general access to ablution facilities.

Offices: Five clinician offices. Capacity for conversion into consultation rooms if required. Telephone line in each office.

Consulting Rooms: Five consulting rooms. Space for desk and examination couch in each consulting room. Consulting rooms may serve multiple roles for consultations, minor procedures, and counselling. Each room equipped with capacity for one blood pressure cuff and one diagnostic set (opthalmoscope and otoscope) anchored to the wall.

Procedure Room: One procedure room. Large enough to allow for bronchoscopy, gastroscopy and colonoscopy equipment. Requires scope fittings, resuscitation facilities and washing facilities.

Ablution Facilities: Three ablution facilities. Male patient toilet and washing facilities. Female patient toilet and washing facilities. Staff toilet.

Sluice Room: One sluice room.

B.2 Proposed GF Jooste Antiretroviral Referral Unit Equipment

Table B.1: Antiretroviral Referral Unit Medical Equipment

Medical Equipment	Unit Price	Quantity	Total Price
Automated Observation Machine with BP Cuff and Pulse Oximeter	21,000.00	1	21,000.00
Blood Pressure Cuff	340.00	5	1,700.00
Bronchoscopy Unit	450,000.00	1	450,000.00
CT Scanner[3]	3,000,000.00	1	150,000.00
Diagnostic Sets (Opthalmoscope and Otoscope)	456.00	5	2,280.00
Gastro-Intestinal Endoscopy Unit	130,000.00	1	130,000.00
Reflex Hammer	89.00	10	890.00
Resuscitation Trolley	850.00	1	850.00
Scale	2,500.00	1	2,500.00
Stethoscope	54.00	10	540.00
Trucut Biopsy Gun	300.00	1	300.00
Ultrasonic Nebuliser for Sputum Induction	2,244.78	1	2,244.78
X-Ray Board	549.00	6	3,294.00
Total	--	--	**765,598.78**

Table B.2: Antiretroviral Referral Unit Non-Medical Equipment

Non-Medical Equipment	Unit Price	Quantity	Total Price
Cable to Link Computer to NHLS Laboratory	456.61	4	1,826.44
Cell Phone	3600.00	1	3,600.00
Chair	650.00	20	13,000.00
Computer	5500.00	3	16,500.00
Computer	5500.00	3	16,500.00
Desk	784.00	11	8,624.00
Printer	450.00	3	1,350.00
Total	--	--	**44,900.44**

[3] For CT Scanner equipment costs, prospective Antiretroviral Referral Unit utilisation was estimated at 5.0% of total hospital utilisation, based on consultation with Dr. Graeme Meintjes.

B.3 Antiretroviral Referral Unit Medical and Surgical Supplies, March 2005

Table B.3: Antiretroviral Referral Unit Medical and Surgical Supplies, March 2005

Medical and Surgical Supplies	Amount	Unit Price	Total Price
Alcohol Medical Swabs	250.00	0.08	20.00
Blood Culture Bottles	15.00	2.05	30.72
Dressing Packs	30.00	6.04	181.09
Elastoform Bandages	4.00	28.37	113.48
Gauze Swabs	40.00	0.27	10.96
General Purpose Hypodermic Promex Needles	120.00	0.31	36.90
Glass Slides	30.00	20.50	615.00
Iodine	1.00	90.00	90.00
Lavender Blood Collecting Vacutainer Tubes	250.00	1.80	450.40
Linen Savers	30.00	1.60	47.95
Non-Sterile Examination Gloves	20.00	0.68	13.65
Non-Sterile Latex Gloves	150.00	0.74	111.18
Sputum Jars	100.00	7.00	700.00
Sterile Single Use Stitch Cutter Blade	10.00	72.90	729.00
Surgeons Latex Gloves	60.00	0.74	44.47
Tegaderm/Opsite (small)	60.00	1.05	63.00
Winged Infusion Set	25.00	3.12	78.00
Total	--	--	**3,997.47**

C.1 Prior Antiretroviral Referral Unit Utilisation Levels

Prior Antiretroviral Referral Unit utilisation levels were based on the time period October 2004 to March 2005 inclusive. Total Antiretroviral Referral Unit patients include all inpatients and outpatients treated by the Antiretroviral Referral Unit. The average monthly percentage of patients on or preparing for HAART requiring Antiretroviral Referral Unit treatment was used for the projection period, and is presented in Table C.1.

Table C.1: Prior Antiretroviral Referral Unit Utilisation Levels

Month	Antiretroviral Referral Unit Patients	Patients on or Preparing for HAART*	% Antiretroviral Referral Unit Patients
October	76	1989	3.82
November	97	2046	4.74
December	62	2184	2.84
January	66	2358	2.80
February	83	2589	3.21
March	73	2831	2.58
Average	--	--	**3.33**

* Patients preparing for HAART were included by adding the total number of new starts in each succeeding month to each preceding month.

C.2 Ratio of Inpatients to Outpatients

The ratio of inpatients to outpatients for the projection period was based on the corresponding ratio for the study period. Derivation of this ratio is presented in Table C.2.

Table C.2: Ratio of Inpatients to Outpatients

	March 2005 (Total)	March 2005 (%)
Outpatients	48	65.75
Inpatients	25	34.24
Total	73	**100.00**

D.1 Determination of Clinical Personnel Costs and Allocation Factors

Antiretroviral Referral Unit clinical personnel costs per outpatient visit, per inpatient day and per inpatient admission were determined based on data from the clinician data capture forms (see Appendix B). Data on the weekly level and distribution of clinical personnel time is presented in Table D.1.

Table D.1: Antiretroviral Referral Unit Clinical Personnel Weekly Time Distribution (Minutes)

	Consultant (1)	Consultant (2)	Medical Officer (1)	Medical Officer (2)
Outpatient Contact	120	155	750	180
Inpatient Contact	180	180	330	780
TCS*	75	80	110	45
Research	0	0	0	195
Analysis	0	0	0	0
Meetings	210	90	330	330
Clerical	0	90	0	225
Other	0	30	0	0
Total	**585**	**625**	**1520**	**1755**

* Telephone Consultation Service.

Data on the level and distribution of Antiretroviral Referral Unit clinical staff time was combined with monthly salary data to produce total Antiretroviral Referral Unit clinical staff costs[4]. This figure was then allocated to inpatient and outpatient care according to the distribution of inpatient and outpatient contact time (see Table D.1). The derivation of total monthly clinical personnel costs for outpatients and inpatients is presented in Table D.2.

[4] Time spent on TCS was excluded from the determination of cost per outpatient visit, cost per inpatient day and cost per inpatient admission, on the assumption that TCS patients were not treated at the Antiretroviral Referral Unit during the study period.

Table D.2: Derivation of Antiretroviral Referral Unit Monthly Clinical Personnel Costs

	Consultant (1)	Consultant (2)	Medical Officer (1)	Medical Officer (2)	Nursing Sister
Monthly Salary	32,109.61	51,892.42	26,567.63	30,633.49	8,079.87
Daily Salary*	1,605.48	2,594.62	1,328.38	1,531.67	403.99
Hourly Salary**	229.35	370.66	189.77	218.81	57.71
Salary per Minute	3.82	6.18	3.16	3.65	0.96
Total Weekly Minutes	510	545	1,710	1,410	1,560***
Total Weekly Cost	1,949.51	3,366.83	5,408.41	5,142.05	1,500.55
Total Monthly Cost**	**7,798.05**	**13,467.32**	**21,633.64**	**20,568.20**	**6,002.19**
% Outpatient Time	40.0	46.0	19.0	70.0	100.0
Total Outpatient Monthly Cost	**3,119.92**	**6,194.97**	**4,110.39**	**14,397.74**	**6,002.19**
% Inpatient Time	60.0	54.0	81.0	30.0	0.0
Total Inpatient Monthly Cost	**4,678.83**	**7,272.35**	**17,523.25**	**6,170.46**	**0.00**

* Assumes 20 working days per month.

** Assumes 7 working hours per day.

*** Based on average medical officer weekly minutes.