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# THE EFFECTS OF HIV/AIDS ON MEDICAL SCHEMES IN SOUTH AFRICA

**By R da Silva and L Wayburne**

ABSTRACT

With the high level of the HIV epidemic in South Africa, medical schemes continue to be at risk. Risk-management strategies need to take into account that the disease is not notifiable and that there is legislated open enrolment and community rating of contributions, as well as prescribed minimum benefits for HIV/AIDS. As a result, many schemes have introduced HIV disease management and awareness programmes that are aimed at improving the health of HIV-positive beneficiaries and preventing new infections. This paper provides an analysis of current developments in the medical-scheme industry with respect to HIV/AIDS. For a sample of the medical-scheme membership, HIV prevalence estimates are presented with the associated cost effects. This sample is however not necessarily representative of the medical-scheme population. The intention is therefore to develop a methodology for producing indicative results to inform management decisions. The opportunity to lower costs related to HIV/AIDS through proactive risk management is investigated.

KEYWORDS

Medical schemes; disease management programme; human immunodeficiency virus (HIV); acquired immune deficiency syndrome (AIDS); antiretroviral therapy (ART)

CONTACT DETAILS

Roseanne da Silva, School of Statistics and Actuarial Science, University of the Witwatersrand; PO Box 70929, Bryanston, 2021; Tel: 011 884 9128; Fax: 011 884 4716;
Email: roseanne@worldonline.co.za

## 1. INTRODUCTION

1.1 Medical schemes are major stakeholders in the private healthcare sector in South Africa, alongside healthcare service providers, employers, administrators, managed-care organisations, brokers and medical-scheme members (the end-consumers of healthcare services).

1.2 Before the implementation of the Medical Schemes Act (Act 131 of 1998), medical schemes were able to restrict the number of older members entering the medical-scheme risk pool through benefit design and contribution loadings. This was done on the basis of statistical evidence that, on average, older members are higher claimers than younger members. This is because chronic illnesses are more prevalent in older individuals and these often require treatment with expensive medicines and procedures.

1.3 However, with the high level of HIV prevalence throughout most of South Africa, the age-costing of medical-scheme claims began to shift. This was because HIV/AIDS largely affects younger, sexually active individuals and the costs associated with HIV/AIDS can be as large as those for other chronic conditions. This has had the effect of reducing the implicit age cross-subsidies within a medical-scheme contribution structure.

1.4 Since 2000, opportunities for medical schemes to minimise the effects of HIV have been limited. Since the Medical Schemes Act has been in force, medical schemes have not been allowed to:

– exclude members with HIV or insist on an HIV test prior to acceptance (guaranteed acceptance);
– charge higher contributions based on increased perceived risk (community rating); or
– restrict benefits available for members with HIV that are provided as part of the prescribed minimum benefits (PMBs).

Therefore, for example, an HIV-positive principal member in an open medical scheme will be charged the same contribution as a corresponding HIV-negative member.

1.5 Opportunistic infections resulting from HIV/AIDS may not necessarily be recognisable as HIV- or AIDS-related and testing for HIV is not permitted without written consent from the person being tested. Therefore, medical schemes cannot necessarily identify which members are HIV-positive and which claims are for HIV- or AIDS-related conditions. Therefore it is difficult to separate HIV or AIDS claims from other claims. A direct result of these constraints is that data relating to the effects of HIV on medical schemes, primarily in terms of prevalence and costs, are difficult to determine. The allocation of claims to HIV-specific benefits may also not be accurate and therefore the determination of the total cost of these claims is likely to be understated.

1.6 Many medical schemes have chosen to manage the effects of HIV/AIDS by introducing HIV disease management programmes (DMPs) for their beneficiaries. One

of the challenges for these programmes and for schemes is to enrol members in the early stages of the disease. This management tool is one means by which data on HIV-positive members can be collected.

1.7 Although HIV prevalence and the ultimate costs of HIV/AIDS claims in a medical scheme are essentially unknown quantities, the estimation of HIV prevalence is an important step in recognising the extent of the epidemic among the membership of the scheme and in designing intervention and treatment programmes to promote behaviour change and the availability of treatment and support for those that require it. The estimation of the costs of HIV/AIDS claims is an important step in determining funding strategies for HIV, and for establishing the extent to which these claim costs affect overall contributions. These measures are integral parts of medical-scheme risk management and understanding the drivers of healthcare costs. This paper therefore aims to provide an estimate of HIV prevalence in a sample of medical-scheme beneficiaries and investigates the factors affecting the prevalence in order to facilitate scheme management decisions. The sample, however, is not representative of the medical-scheme population.

1.8 Johnson & Dorrington (unpublished) estimated that medical-scheme prevalence would peak at 8% in 2008, while Katz (unpublished) estimated that the prevalence curve could peak at 6,4%. Van den Heever (unpublished) noted a vast range of estimates (quoting various sources that suggest that medical-scheme HIV prevalence could reach a level as high as 20%) and the associated difficulties in quantifying the effects of HIV/AIDS on medical schemes. Although Katz (unpublished) used the ASSA600 model and information from a single medical scheme to derive prevalence estimates, the work nonetheless forms an input into this research.

1.9 In this paper a basic understanding of terminology and concepts associated with HIV/AIDS has been assumed. Some of this terminology is explained in Appendix A. A basic understanding of the health care environment in South Africa has also been assumed.

1.10 The paper aims to present a discussion of how South African medical schemes are affected by the AIDS epidemic and what steps have been taken to address this risk. It also aims to present a methodology for estimating HIV prevalence among medical-scheme beneficiaries using the Actuarial Society of South Africa (ASSA) AIDS models and quantifying the financial effects to assist budgeting and management decisions.

1.11 Section 2 of the paper presents a brief overview of the medical-schemes environment in South Africa. Section 3 addresses the effects of HIV and Section 4 discusses disease management and HIV treatment. Section 5 outlines the key risk factors associated with HIV and relates these to the medical-scheme population. In section 6 a methodology of assessing HIV prevalence in a medical-scheme population has been set out and a methodology of quantifying the financial effects has been presented. The paper concludes with a discussion on risk management strategies.

1.12 The ASSA AIDS models were chosen for the modelling presented in this paper because it was desired that a methodology be produced that is based on accessible publicly available models. This methodology together with the models could then be used for further research, as is indicated below.

## 2. MEDICAL SCHEMES IN SOUTH AFRICA

### 2.1 STRUCTURE

2.1.1 Medical schemes in South Africa are regulated under the Department of Health by the Council for Medical Schemes (CMS) and governed by the Medical Schemes Act (Act 131 of 1998) and its associated regulations. Medical schemes are mutual funds that are governed by boards of trustees who are required to act in the best interests of all members and to be independent of all contractual parties (such as the administrator and the managed-care organisation).

2.1.2 In terms of the Medical Schemes Act, only a registered medical scheme may do the business of a medical scheme, which is defined to include the indemnification of medical expenses or the provision of access to medical services on a pooled basis. A registered medical scheme may also only do this business. It cannot, for example, offer funeral cover or income-replacement benefits. The indemnification of expenses thus forms the basis of the demarcation between the medical schemes and the proprietary health insurers. The scope of this paper does not include health insurers.

2.1.3 Medical schemes are regulated on the principle of social solidarity. This arose out of concerns during the 1990s that vulnerable groups were being excluded from the medical-scheme risk pool.

2.1.4 The new Medical Schemes Act (Act 131 of 1998), which was implemented on 1 January 2000, introduced, *inter alia*, community rating, guaranteed acceptance and prescribed minimum benefits.

2.1.5 In the current environment, the community rate for each medical scheme is determined by the age and health profile of that scheme, and each benefit option within that scheme. Risk equalisation, which is yet to be implemented, is a mechanism to ensure that all medical-scheme beneficiaries pay the same industry community rate for the common package of benefits, not the rate determined by the age and health profile of the medical scheme and benefit option they have chosen to join.

2.1.6 It has been proposed that a Risk Equalisation Fund (REF) (McLeod et al., unpublished) be established to facilitate the pooling of risk in respect of the common package of benefits across all medical schemes.

2.1.7 As a result of the REF, schemes will no longer compete on the basis of risk selection (the age and health profile of the beneficiaries they attract). Instead, competition will be on the basis of cost-effective healthcare delivery. Schemes that are successful at reducing the cost of delivery will retain that benefit for their members and will thus be able to lower their contributions for the basic package. It is hoped that schemes will be more eager to contract with designated services providers such as doctors and hospitals in order to ensure that their members obtain cost-effective delivery of the basic package of benefits.

## 2.2 POPULATION COVERED

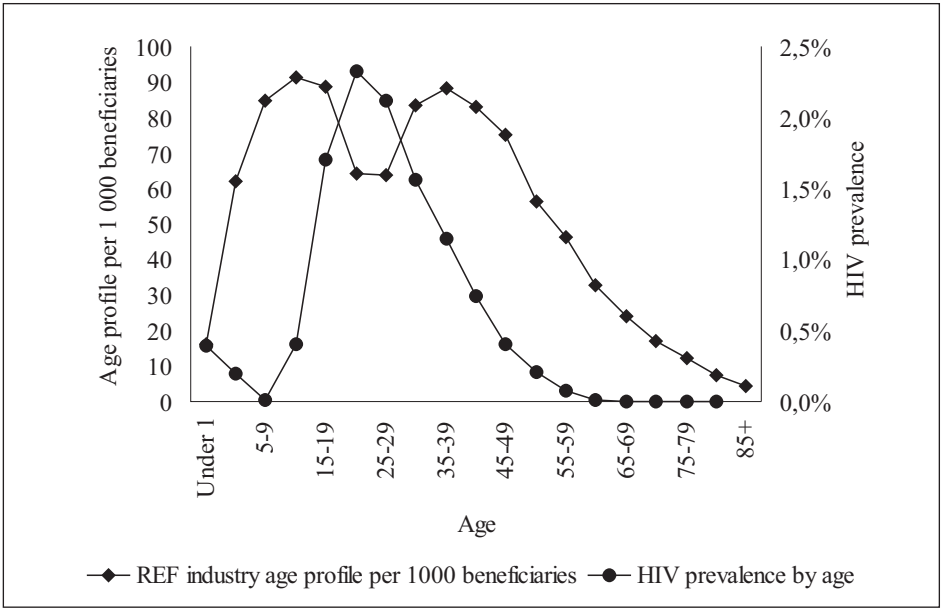
2.2.1 The total membership of all medical schemes has been about 7 million beneficiaries since 1998. This is approximately 16% of the South African population.

2.2.2 Figure 1 shows the age distribution of beneficiaries of registered medical schemes as derived from the REF grid.[1] The shape of the distribution of beneficiaries by age is often referred to as the "twin-peaks" phenomenon as the relatively low proportion of young adults causes a significant dip.

2.2.3 The beneficiary distribution has been plotted against the HIV-prevalence estimate derived from the ASSA2003 Lite model. This is a very crude comparison (as it is not adjusted for risk factors such as race and access to health services, which are discussed below); however, it aims to illustrate the distribution of beneficiaries relative to HIV risk. The research presented below aims to improve significantly on this analysis.

2.2.4 The medical-scheme population is clearly a select group from the perspective of HIV risk as the beneficiaries of medical schemes have a socio-economic status that allows them to access private medical cover. This means that the racial composition of the medical-scheme population is significantly different from the South African population and this is an important consideration when using the ASSA models to estimate HIV prevalence (see section 5.5).

Figure 1: REF industry age profile and estimated HIV prevalence




1 The REF Grid can be downloaded from www.medicalschemes.com.

## 2.3 PRESCRIBED MINIMUM BENEFITS

2.3.1 The PMBs are a legislated set of benefits that each registered medical scheme, other than bargaining-council medical schemes that may have been granted exemptions from certain provisions of the Medical Schemes Act such as the PMBs, is compelled to offer as part of each benefit option. The benefits defined in this package must be paid in full, without co-payment or deductibles. If a beneficiary chooses to use a provider who is not a 'designated service provider', then a co-payment becomes payable. Alternatively, where a beneficiary must involuntary use a provider that is not a designated service provider, no co-payment is payable. This package includes non-discriminatory cover for hospital and outpatient services. In order to ration care, medical schemes may make use of managed-care techniques such as pre-authorisation, the development of formularies, and the use of restricted networks of providers.

2.3.2 The PMBs are defined in Annexure A of the Regulations to the Medical Schemes Act. In January 2000, the regulations stipulated that schemes must provide treatment for HIV-related opportunistic infections and the costs of hospitalisation as part of the PMBs. Under code 168S (see below) the regulations also specifically covered HIV associated diseases including diagnosis and medical and surgical management of opportunistic infections and localised malignancies. From 2000, the PMBs have provided for HIV- and AIDS-related hospitalisation and a broader spectrum of treatment options such as treatment for the prevention of mother-to-child transmission, voluntary counselling and testing, and treatment for common opportunistic infections.

2.3.3 According to the annual report of the CMS for 2003/4,[2] several complaints had surfaced regarding schemes that restricted access to antiretroviral benefits. A survey commissioned by the CMS and conducted by the Centre for Actuarial Research (McLeod et al., 2003) showed that these restrictions tended to occur through financial limits as opposed to 'deliberately-formulated inappropriate clinical protocols' for the management of the disease. The Minister of Health accepted recommendations by the CMS to further expand the PMB package to contain provision for the payment by schemes of clinically appropriate treatment with antiretroviral therapy (ART).

2.3.4 Following Cabinet's commitment to the provision of ART and the publication in 2003 of an 'Operational Plan for Comprehensive HIV and AIDS Care, Management and Treatment for South Africa', ART was included as part of the PMBs from January 2005.

2.3.5 Annexure A of the regulations was amended as shown below. The treatment described in italics relates to the most recent addition to Code 168S on 1 January 2005. Code 260S and Code 111S relate to the treatment of HIV-related conditions including pain relief and treatment for tuberculosis respectively.

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2 Council for Medical Schemes (unpublished). Report of the Council for Medical Schemes, 2003/4, www.medicalschemes.com

– Prescribed Minimum Benefits for HIV/AIDS:

**"Code 168S**

Diagnosis: HIV-infection

Treatment: – HIV voluntary counseling and testing
Co-trimoxazole as preventative therapy
Screening and preventative therapy for TB
Diagnosis and treatment of sexually transmitted infections
Pain management in palliative care
Treatment of opportunistic infections
Prevention of mother to child transmission of HIV
Post-exposure prophylaxis following occupational exposure or sexual assault
*Medical management and medication, including the provision of anti-retroviral therapy, and ongoing monitoring for medicine effectiveness and safety, to the extent provided for in the national guidelines applicable in the public sector*" (Italics added)

**"Code 206S**

Diagnosis: Imminent death regardless of diagnosis

Treatment: – Comfort care, pain relief
– Hydration"

**"Code 111S**

Diagnosis: Tuberculosis

Treatment: – Diagnosis and acute medical management
– Successful transfer to maintenance therapy in accordance with DoH guidelines."

2.3.6 The regulations specify that ART be provided according to "national guidelines" that are applicable in the public healthcare sector. The Department of Health's 'National Antiretroviral Therapy guidelines'[3] set out the following selection criteria that are applied to adult patients with HIV in order to assess their readiness for receiving ART:

– medical criteria: CD4 cell count less than 200, irrespective of World Health Organisation (WHO) stage, or WHO stage IV irrespective of CD4 cell count;
– willingness and readiness on the side of the patient to adhere to their medication regimens;
– attendance at two screening visits and an ART commencement visit; and
– two drug regimens being made available for eligible patients.

2.3.7 The medical criteria for the commencement of ART are consistent with WHO guidelines (WHO, 2004) for the use of ART in resource-limited settings. However, according to Chen et al. (unpublished), in an analysis of long-term survival during

3 Department of Health (2004). National Antiretroviral Therapy Guidelines, National Department of Health, South Africa, www.doh.gov.za

first-line ART treatment in the United States, survival was significantly shorter for patients that had treatment initiated with CD4 cell counts less than 200. This is because patients are very likely to have developed life-threatening opportunistic infections by the time their CD4 cell count drops to a level of 200.

2.3.8 Figure 2 shows a fuller breakdown of the PMB package in terms of chronic-disease list (CDL) conditions, maternity benefits and HIV/AIDS. Of the total community-rated PMB price of R193–90 per beneficiary per month, the cost of the HIV/AIDS portion is R12–42 (approximately 6%).

2.3.9 The proportional share that HIV-related costs consume of the industry community rate is expected to increase as the HIV prevalence of medical-scheme beneficiaries increases, and those who are HIV-positive enter the more advanced stages of the disease.

## 3. THE EFFECTS OF HIV/AIDS

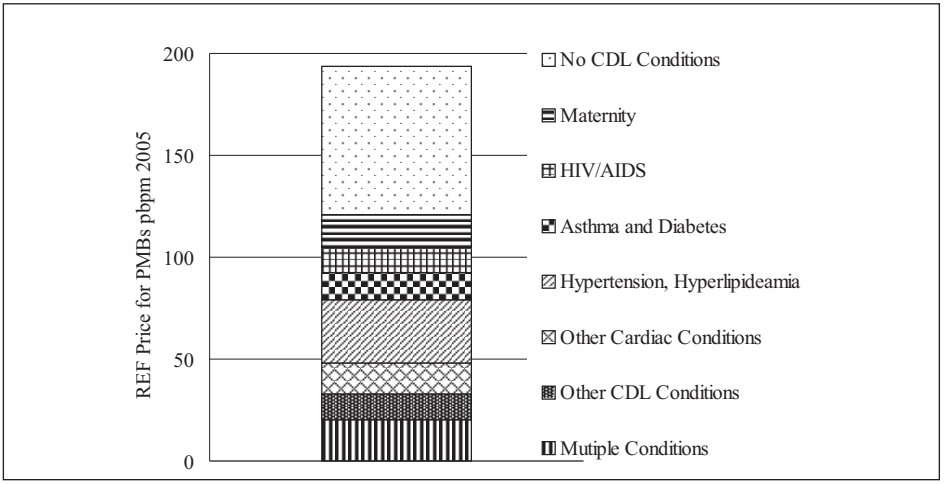
### 3.1 THE SOUTH AFRICAN EPIDEMIC

3.1.1. UNAIDS/WHO (2006) identifies sub-Saharan Africa as the worst affected region in the world. According to that report, there were 24,5 million people (64% of the global epidemic) living with HIV in sub-Saharan Africa in 2005. Relative to the global epidemic, the results for the sub-Saharan epidemic in that year are as shown in Table 1.

3.1.2 Historically, HIV was considered to be a disease associated with homosexual men. The UNAIDS report notes that 59% of people living with HIV in sub-Saharan Africa are female.

3.1.3 It also notes that one-third of global AIDS deaths (930 000) occurred in southern Africa. With respect to South Africa, the UNAIDS report summarises its findings as follows:

Figure 2: Analysis of the community-rated PMB price[4]




4 Risk Equalisation Technical Advisory Panel, REF Contribution Table 2005, implicit price

Table 1: UNAIDS Analysis of sub-Saharan epidemic[5]

| | Proportion of global epidemic in sub-Saharan Africa |
|---|---|
| People living with HIV | 64% |
| New infections | 66% |
| AIDS deaths | 71% |
| Women living with HIV | 75% |
| Children living with HIV | 90% |
| People in need of ART | 72% |

> "South Africa's epidemic is one of the worst in the world with an estimated 5.5 million people (18.8% of adults) living with HIV in 2005. Almost one in three pregnant women attending public antenatal clinics were living with HIV in 2004 and trends show a gradual increase in HIV prevalence. There has been significant scale-up on the treatment front – around 190 000 people were receiving therapy by the end of 2005 – however this still only represents less than 20% of those in need."

UNAIDS HIV prevalence estimates derived from EPP and Spectrum models describe the percentage of adult men and women in the age range 15 to 49 years living with HIV nationally. These estimates are based on a variety of HIV data including household HIV surveys and antenatal-clinic data. Since the latter reflect HIV prevalence only among those pregnant women who use public facilities, these tend to be higher than those based on household surveys.

3.1.4 The first South African study of the national burden of disease (Bradshaw et al., 2006) focused on estimates of premature mortality calculating years of life lost (YLLs) due to mortality. The top single cause of mortality burden in 2000 was HIV/AIDS, followed by homicide, tuberculosis, road traffic accidents and diarrhoea.

3.1.5 Since HIV/AIDS is the leading cause of illness and death in South Africa, HIV/AIDS presents additional burdens to the South African economy in general and the health sectors in particular—both public and private. The care needs of patients suffering from opportunistic infections and from AIDS have placed severe strains on healthcare services, often with more severe strains on some of the most disadvantaged facilities (Ntuli & Day, 2004). HIV/AIDS can also be considered to be a factor outside of the healthcare delivery system that directly impacts on the demand for healthcare goods and services. This is because it is a long-term disease, which is not notifiable and requires ongoing commitment to treatment. There is also a demand for medication and other healthcare goods and services until the death of the infected individual. These demands are often not characteristic of other diseases.

5 UNAIDS/WHO (2006)

## 3.2 MORTALITY

According to Bradshaw & Dorrington (2005), mortality rates, are 'key measures' that are widely used for international comparisons of the general state of the development and health of a nation. These authors estimated that, in South Africa:

> "40% of mortality between the ages 15 to 49 years was due to HIV/AIDS and 25% of mortality across all ages. There is much more uncertainty about the extent of HIV/AIDS on child mortality than there is for adults …"

In terms of an analysis of a sample of death certificates from 1997 to 2001, they note:

> "there was a concomitant increase in AIDS-indicator conditions such as TB (from 5% to 9%) and pneumonia (from 5% to 9%) confirming the rapid change in the cause of death profile arising from the maturing HIV epidemic."

## 3.3 MORBIDITY

Despite the limitations of death data in South Africa, various sources claim that AIDS is not only the leading cause of death but also the leading cause of morbidity and lost years of productive life for adults aged 15 to 59 years in sub-Saharan Africa (WHO, 2004; UNAIDS/WHO, 2002). This is because, as the immune system of infected persons weakens, they become significantly more susceptible to the onset of opportunistic infections.

## 3.4 LEGISLATION

3.4.1 A return to social-solidarity principles is evident through the intention of implementing social health insurance (SHI) and the reforms that constitute such a health system. One such reform is the REF. The Department of Health considers that the environment is now ready for the implementation of an REF (as cited in McLeod et al., unpublished). As explained in ¶2.1.7, risk equalisation is a mechanism to ensure that everyone pays the same industry community rate for the common package of benefits. This rate does not depend on the age and health profile of any individual medical scheme. This mechanism intends to address the apparent need for risk-related cross subsidies in the South African medical-scheme industry.

3.4.2 An REF, SHI, an expanding membership base and increased coverage of younger members could lead to changes in the structure of the medical-scheme population, which could result in increased HIV prevalence in the medical-scheme population.

3.4.3 One of the REF risk factors is the number of beneficiaries (per 5-year age band) that receive ART according to the PMB definition. Therefore, medical schemes will be compensated for the number of beneficiaries that are registered on an HIV 'disease management provider' and are administered ART, according to the PMB definition. This compensation would be for those members that are receiving ART in excess of the assumed industry profile. This feature of the REF may encourage medical schemes to promote their HIV programmes and by doing so, encourage beneficiaries to enrol on an HIV DMP and receive the requisite treatment. However, the REF provides some compensation only for those beneficiaries that are on ART and not to those

beneficiaries that are HIV-positive but do not yet require ART. Therefore, the REF recognises only a selection of the funding required to administer ART.

## 4. HIV DISEASE MANAGEMENT AND TREATMENT

### 4.1 DEFINITION OF DISEASE MANAGEMENT

4.1.1 Disease management is a relatively recent innovation in the healthcare market that aims to control healthcare costs by actively and intensely managing the prevention and care of specified chronic diseases. This innovation represents an integrated and systematic approach for delivering care. More precisely, "disease management is an integrated approach to patient care that optimises health outcomes by co-ordinating cost-effective health care throughout the life cycle of the condition and across the entire health care delivery system" (Ball, 2003). The success of such programmes hinges on excellent clinical practice and patient care and sound risk sharing processes between healthcare service providers and funders, such as medical schemes.

4.1.2 Medical schemes have implemented HIV DMPs so as to meet the definition of disease management in ¶4.1.1 for beneficiaries with HIV/AIDS. One of the biggest challenges facing medical schemes regarding HIV disease management is that members are not enrolling on HIV DMPs at an early stage of the disease (Cowlin et al., 2003). This is because beneficiaries often delay access until they are seriously ill with opportunistic infections. The challenge for medical schemes and DMPs is therefore to ensure that HIV-positive beneficiaries enrol on their DMP early enough to commence ART at the clinically optimal time. Those patients that initiate therapy at that time have much better survival prospects (Chen et al., op. cit.).

4.1.3 Cowlin et al. (op. cit.) note that there is a strong correlation between entry stage and post-enrolment treatment costs, thus ascertaining that the goal for medical schemes is to get all beneficiaries to know their status and to understand the importance of enrolling on their DMP before becoming symptomatic. In an observational prospective cohort study by Etard et al. (2006) to evaluate survival and investigate causes of death among HIV-infected adults receiving ART in Senegal, it was found that for patients starting ART, mortality rates decreased from 12,5 deaths per 100 person-years during the first year of treatment to 6,6 per 100 person-years during the second year and kept decreasing thereafter (4,5, 2,3 and 2,2 for years 3, 4 and 5 respectively). Furthermore, the cumulative probability of dying at 12 months reached 17,9%, 13,1% and 5,8% for less than 50, 50 to 199 and more than 200 CD4 cells respectively. That study underlines the effectiveness of ART in reducing mortality and the importance of commencing treatment at optimal clinical starting times.

4.1.4 According to Taylor (2004), the outcomes of successful HIV treatment programmes must at least do the following:

- reduce HIV-related morbidity and mortality;
- improve the quality of life for people with HIV and their families—to reduce the burden of care and increase the ability to be productive; and
- reduce levels of virus in the community—to reduce the incidence of new or re-infected cases)

## 4.2 ART

4.2.1 Antiretroviral medication interferes with the ability of the HIV to use specific enzymes to survive once inside a cell (Carpenter et al., 2000). Highly active antiretroviral therapy (HAART) (also referred to as 'triple therapy') combines three or more different medications. The impact of ART on survival is not yet well understood and numerous studies are in progress (King et al., 2003). The medication has been available only since the mid-1990s and so long-term data are not available. The effects have been estimated with reference to clinical trials and projections. Despite a lack of published literature in South Africa on the subject of increases in life expectancy with ART, in the authors' opinion ART has the potential to add about 10 years to the life if administered at a CD4 count of between 350 and 200 and with good levels of compliance to treatment. Advances in ART should result in longer extensions to life expectancy in future years.

4.2.2 In order to be effective, ART requires compliance with a treatment regime that includes a number of tablets being taken at the same time each day (and sometimes at different times in the day). There can also be unpleasant side effects. Individuals on ART also need to be monitored to ensure that the treatment is having the desired effect (such as reducing viral load). If this is not the case alternative (and often more expensive) treatment options may need to be explored (Losina et al., 2004).

4.2.3 Guidelines on ART, published by the WHO in 2002, are set out in Table 2.

Table 2: Treatment Guidelines[6]

| Clinical Category | CD4 Cell Count | Recommendations |
|---|---|---|
| Significant opportunistic infections or AIDS | any value | Treat |
| Asymptomatic | < 200 | Treat |
| Asymptomatic | 200–350 | Monitor CD4 count and viral load six monthly |
| Asymptomatic | > 350 | Monitor CD4 count and viral load six monthly |

## 4.3 ACCESS TO ART

4.3.1 At the time of writing, ART had been made available to HIV-positive individuals in South Africa via four main mechanisms:

– outsourced HIV disease management services;
– medical schemes;
– government ART operational plan; and
– company clinics.

These are explained in the following paragraphs.

4.3.2 In terms of outsourced HIV disease management services, medical schemes and employer groups can contract the services of a disease management

6 Source: WHO (2002)

company to supply ART and other medication to patients enrolled on an HIV DMP, as well as coordinate and manage the processes involved.

4.3.3 In medical schemes, ART is made available via the PMBs package and although each benefit option is required to provide the PMBs, the benefits of many options tend to exceed the minimum requirements (McLeod et al., 2003). The REF should provide some incentive for medical schemes to seek ways of increasing the number of HIV-positive beneficiaries on their DMP and therefore the number actually receiving treatment. However, the REF reflects only those beneficiaries that are receiving ART according to the government treatment protocol. In addition, these beneficiaries are required to meet the entry and verification criteria. Therefore, the REF returns would not reflect all beneficiaries that are HIV-positive and on treatment.

4.3.4 Under the government ART operational plan, ART is available at selected public-sector clinics. Patients presenting themselves for treatment must satisfy certain medical and attendance criteria as set out by the Department of Health's national antiretroviral treatment guidelines.[7] Although government is making antiretrovirals (ARVs) available, there are several practical constraints with this provision in the context of the private healthcare sector for individuals that require ART. Patients must present with a CD4 count of 200 or less. By this stage, it is most likely that they are infected with one or more fatal opportunistic infections. Furthermore, WHO (2002) notes that immune reconstitution is likely to happen in most patients presenting for treatment with a CD4 cell count above 350 and that ART initiation at a CD4 cell count below 200 is applicable in what are known as 'resource-limited' settings.

4.3.5 The government provides access to only two drug regimens. If patients fail both these regimens then they are effectively removed from the programme. Patients are required to attend two ART screening assessments and one ART commencement visit at designated public-sector clinics. Should they miss any of these assessments, they must commence the process from the beginning.

4.3.6 Several companies in South Africa have established company clinics to facilitate the provision of healthcare services including HIV-specific services and ARVs to employees.

4.3.7 In a survey by Connelly & Rosen (unpublished) of 52 private-sector and parastatal employers in South Africa with more than 6000 employees, it was found that, among these companies, 63% of employees had access to employer-sponsored care and treatment for HIV/AIDS. Approximately 27% of estimated HIV-positive employees were enrolled on an HIV DMP, about 3,8% of employees across the 52 companies surveyed actually receiving ART.

4.3.8 Despite increased availability and affordability of ART via these four avenues of access, the proportion of HIV-positive people in South Africa who are eligible for treatment that are actually receiving it is low. Johnson (2006) estimated that, in the middle of

7 Department of Health (2004). National Antiretroviral Therapy Guidelines, National Department of Health, South Africa, www.doh.gov.za

2005, about 60 000 people were receiving ART through medical schemes, workplace treatment programmes and community treatment programmes. This estimate does not include individuals that were paying for their own treatment and not registered on a treatment programme. It has been further estimated (in news reports) that, by February 2006, between 80 000 and 100 000 people were receiving ART at public-sector clinics. The target,[8] however, was set at 215 689 patients starting ART in 2005–2006 and cumulatively, 381 177. While the numbers on treatment are below 60% of the target, the programme is larger than any other state-sponsored programme in the world (da Silva, 2006).

## 4.4 TREATMENT

4.4.1 ART is recognised as a long-term treatment course (King et al., 2003) that is not a cure for HIV; rather it diminishes the viral load by halting viral replication, reduces the damage to immune system and therefore enables people with HIV to resist opportunistic infections. It also reduces the risk of transmitting the virus through bodily fluids (Taylor, 2004).

4.4.2 Problems arise because multi-drug treatment combinations of ARVs (PI or NNRTI) are associated with long- and short-term toxicity. Therefore it is important to weigh the relative short-term and long-term cumulative effects of benefits and harms of antiretroviral treatment (King et al., 2003) and to continue to monitor and measure these effects. Some of the problems associated with ART include, but are not limited to, the following:

– drug resistance: an ART regimen is generally only effective for a limited period of time before resistant viral types emerge and a new regimen is required; studies by Losina et al. (2004) have shown that regimen failure rates as high as 10% to 40% create the need for subsequent ART regimens;
– non-adherence and treatment failure: sustained adherence is required in order for the drugs to be effective; ART drug adherence is well recognised to be one of the key determinants of the success of therapy (Carpenter et al., 2000); and
– reduced precautions against infections: according to Barnett & Whiteside (2002), if people perceive AIDS as a chronic manageable condition, they may be less inclined to take precautions against infection; fewer precautions directly undermine efforts to curb infection and affect incidence rates.

4.4.3 According to Taylor (2004), a comprehensive HIV/AIDS programme should not only contain ART, but also include other commodities such as:

– family planning;
– prevention programmes;
– detection programmes using diagnostic agents and lab supplies for detecting HIV, sexually transmitted infections (STIs), tuberculosis (TB) and opportunistic infections;

8 Department of Health (2003). Operational Plan for Comprehensive HIV and AIDS Care, Management and Treatment for South Africa, National Department of Health, South Africa, www.doh.gov.za.

– treatment using drugs and consumable medical supplies for STIs, opportunistic infections and TB; and
– drugs, consumables and medical supplies.

These services then need to be supported by functioning laboratory infrastructure and a responsive supply chain.

4.4.4 Other medications commonly used in conjunction with ART, or before ART is administered to patients, are vitamins and other immune supplements. These medications aim to boost the immune systems of HIV-infected patients. Kaiser et al. (unpublished) shows that there may be a link between deficiencies in micronutrients (vitamins, minerals and antioxidants) in HIV-positive people and more frequent opportunistic infections and therefore even faster progression to death. In this 12-week clinical trial in the United States, patients were administered a specific micronutrient combination. The results were that the average CD4 cell counts of the group taking these supplements increased from 357 to 422 (i.e. by 18%) while the group that was being administered the placebo saw their CD4 cell counts drop by 6 cells and showed no increase in their CD4 percentages. The increases were shown to be statistically significant. At present, there are no clinical protocols on the provision of immune supplementation for patients that have not yet commenced ART.

4.4.5 For the purpose of this paper, and in discussion with various industry participants, it was assumed that immune supplements are included for patients that are pre-ART and on ART. The cost of the immune supplements can vary quite significantly depending on the type of supplement taken. For the purposes of this paper it was assumed that the cost per patient per month would be R153 for patients pre-ART and patients on ART.

## 5. DISCUSSION OF HIV RISK FACTORS

### 5.1 IDENTIFICATION OF RISK FACTORS

5.1.1 In South Africa, HIV prevalence is known to differ between various population groups and geographical regions, and also by age and sex. These and other factors are statistically significant in terms of explaining the prevalence of HIV/AIDS in a population or subpopulation in South Africa (Johnson & Budlender, 2002).

5.1.2 For the purposes of this discussion, the term ‘medical-scheme population’ refers to all individuals who are beneficiaries of medical schemes (principal members and their dependants, if any) and ‘general population’ refers to the aggregate South African population. The medical-scheme population is assumed to form what has been referred to as a ‘subpopulation’—a population that has been selected in some way from the general population.

5.1.3 Risk factors and risk grouping are commonplace tools in the insurance environment whereby (prospective) policyholders are classified according to one or more risk factors and hence into broadly homogenous risk groups. These classifications assist in assigning an accurate price to the cost of the benefit, and also help reduce anti-selection by aiming to charge a price that depends on the risks that that policyholder brings to the pool. Although medical schemes operate in an environment of social solidarity (and

hence do not charge a contribution related to the risk that the member brings), the concept of classifying members (in a medical-scheme environment) according to HIV risk factors and risk groups can facilitate the modelling of HIV in that membership group.

5.1.4 In epidemiology, the concept of 'risk' is used strictly in a statistical sense. It is the relative risk of infection assessed by comparing individuals with and without the factor. Barnett & Whiteside (2002) distinguish between a risk environment and risk behaviour, in that the riskiness of the behaviour is a characteristic of the environment rather than of the individuals or the particular practices.

5.1.5 The following factors, as detailed in Johnson & Budlender (2002), have been identified as primary and measurable risk factors with respect to HIV prevalence:

– income and employment;
– sex;
– age;
– race; and
– province.

These are discussed in more detail below. The analysis of HIV risk factors is anchored on the statistics collected for the REF work as, for the purposes of this research, it was the most comprehensive analysis of medical-scheme data at the time.

## 5.2 INCOME AND EMPLOYMENT

5.2.1 Income is considered to be one of the most significant factors affecting HIV prevalence in South Africa (Rosenberg et al., unpublished). Relatively poor people suffer from higher risk of HIV infection, in general, for the following reasons:

– Poor women may be forced into sexual relationships for monetary reasons so as to ensure the survival of themselves and their children (Whiteside & Sunter, 2000).
– The poor are less likely to be educated about HIV/AIDS, and how it is transmitted (Johnson & Budlender, 2002).
– Many of the poor do not have access to treatment for sexually transmitted diseases or cannot afford treatment (Rosenberg et al., op. cit.). Sexually transmitted diseases enhance HIV transmission by increasing both the susceptibility of HIV-negative individuals and the infectiousness of HIV-positive individuals (Barnett & Whiteside, 2002).
– Separation from families for long periods of time has established a pattern of irregular sexual relationships among migrant labourers. As a result of this, migrants and migrant labourers are at a higher risk of HIV infection (Johnson & Budlender, 2002). This affects a large proportion of the unskilled and semi-skilled workforce who are more likely to be migrant workers. Examples of migrant labourers are miners and long-distance truck drivers.

5.2.2 Although the poorer members of society are worst affected by the HIV epidemic in South Africa, HIV prevalence among semi-skilled and skilled members of society can be high. The ability of higher income earners to attract more sexual partners (Rosenberg et al., op. cit.), different perceptions of the risk of contracting HIV, and ignorance relating to the disease have been cited as reasons.

5.2.3 The employed population is of particular interest in the medical-scheme context. Because of the socio-economic implications of medical-scheme membership (i.e. affordability), HIV prevalence levels in medical schemes are expected to be lower than in the general population. Also, it has been shown that the labour force experiences prevalence rates that are slightly lower than the general population of adults of working age (e.g. da Silva, unpublished).

5.2.4 Higher income earners also tend to choose a medical-scheme benefit option that best meets their needs and they may be risk-averse, thus selecting more comprehensive cover. Middle- and lower-income people tend to choose an option that they can afford and aim to optimise the affordability of medical-scheme cover and the benefits that they require.[9]

5.2.5 Some medical-scheme contribution tables are income-based in that the higher-income earners pay more contributions. This is usually the case only in restricted schemes, as open medical schemes do not tend to rate contributions according to income, except to promote affordability at the lower levels.

5.2.6 As the structure of a family changes, the benefit options selected by members would change depending on need and affordability. Medical-scheme members tend to migrate to more comprehensive benefit options as they get older and their healthcare needs increase.

5.2.7 Sick people may be more likely to want medical-scheme cover, and are perhaps willing to pay more for this cover as they perceive value for money in that their contributions are less than the expected medical costs. Healthy individuals are more likely to look for more affordable options, while chronic sufferers look for the best benefit option to cover the costs of chronic conditions for the most reasonable contributions. Increasing medical-scheme contributions in the industry may have influenced members' choice of benefit options in that they may prefer to purchase cheaper benefit options rather than options that may have been selected on a needs-only basis.

5.2.8 Contribution level has been used as a proxy factor for income in determining the relative risk of individuals to contracting HIV. This is done by allocating members to the skill levels defined in the select model according to their benefit option (or salary band where this was available). This is an approximation for stratifying risk groups and as such is not expected to be the only way of incorporating income information for differential purposes. This proxy may not be sustainable in the future because HIV-positive medical-scheme members are more likely to move to more comprehensive benefit options when they become aware of their HIV status. A summary of beneficiaries by contribution band is shown in Figure B5 of Appendix B. Overall, about 35% of beneficiaries are covered by comprehensive-type benefit options, while about 40% have low-cost benefit options. The proportions with lower-cost options are expected to increase as medical schemes introduce more lower-cost options.

9 These statements are based on observed experience from medical-scheme consulting work.

5.2.9 At present, medical-scheme membership is not mandatory, unless it is provided through the employer. Under the proposed SHI system (see McLeod et al., unpublished), membership will be mandatory for middle- and higher-income groups. Lower-income groups will remain in a voluntary environment for the foreseeable future. It is expected by the Department of Health that a further 3 or 4 million people could become members of medical schemes under the initial phase of SHI.

5.2.10 If appropriate lower-cost products are developed and the tax expenditure subsidy reforms encourage lower-income workers in the system, then a further 4,9 million members could become beneficiaries of medical schemes, bringing the total number of South Africans covered by SHI to a potential 15,2 million people. This would represent 35% of the total population. The introduction of the SHI system could therefore increase the proportion of lower-income earners in the medical-scheme risk pool above current levels, thereby increasing the impact of HIV/AIDS on medical schemes. The lowest-income groups and those without income are expected to remain in the publicly funded system.

## 5.3 GENDER

5.3.1 According to estimates of the Department of Health (2006), female HIV-infection is higher than male HIV-infection. For adults aged 15 years and over, the number of HIV-infected females and males are estimated to be 3,12 million and 2,19 million respectively, giving a ratio of female to male HIV-infection of 1,425.

5.3.2 Some reasons for the higher HIV infection among females than among males are:

– According to World Bank (1997: 59), the probability of HIV-1 infection by exposure is 1,2 infections per 1000 exposures for male-to-female unprotected sex and 0,33 to 1 per 1000 exposures for female-to-male unprotected sex. This is because females are biologically more susceptible to HIV-infection per sexual exposure.
– The income share of women being only 30,5% of national income (Department of Health and Population Development, unpublished), women are also more susceptible because of their lower socio-economic status (this is particularly so in developing and least developed countries).

## 5.4 AGE

5.4.1 Gender not only affects the general level of HIV prevalence, but also the shape of the prevalence curve as a function of age (Dorrington & Johnson, 2002). Therefore, the effect of age in HIV prevalence needs to be analysed separately for each sex.

5.4.2 Infants (0 to 4 years) tend to experience high levels of HIV prevalence as a result of mother-to-child transmission. In this age group there is very little difference between prevalence in boys and girls. Prevalence among children (5 to 14 years) and pensioners (older than 65 years) is very low. For the purposes of this work, medical-scheme beneficiaries who are pensioners are excluded. The most severe concentration of HIV is in the adult population (15 to 64 years) who form the bulk of the population (Whiteside & Sunter, 2000). This is consistent with the fact that HIV is a sexually transmitted disease.

5.4.3 In the medical-scheme population, age distributions differ markedly according to the type of medical scheme. Open medical schemes have historically had more young members than restricted medical schemes. In Figure 3 the age distributions of the four largest open medical schemes in South African in 2002 are shown; the schemes are labelled a, b, c and d. The age distributions are generally bimodal in shape, with a significant concentration of members (and dependants) in the younger age bands.

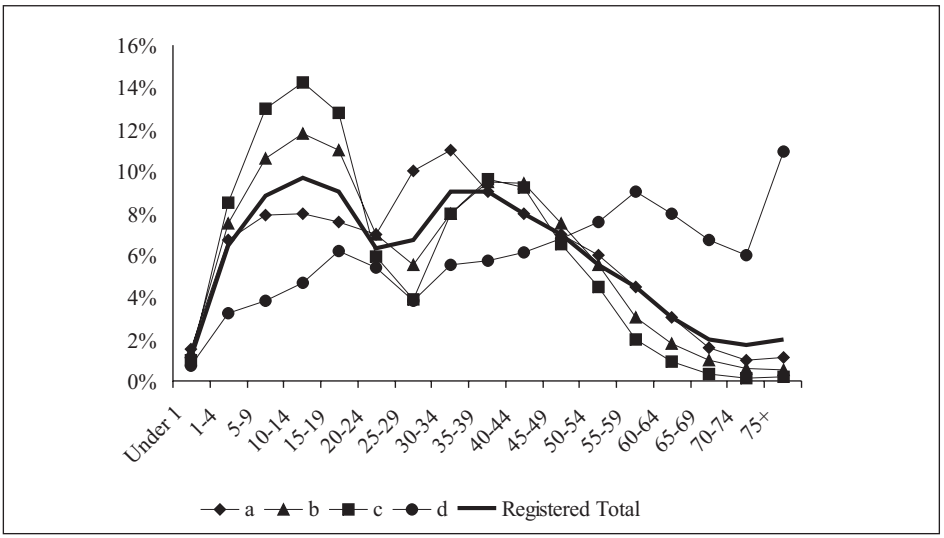
## 5.5 RACIAL DIFFERENTIALS

5.5.1 The AIDS epidemic is most severe in the black African population (Dorrington & Johnson, 2002). The low income levels in that population have been put forward as a reason but the social effects of the migrant labour system and the gradual breakdown of traditional society are also responsible.

5.5.2 The epidemic in the South African 'coloured' population (not black African) is less severe than that in the black African population. It is unlikely, given the higher socio-economic status of the coloured population (in particular greater access to healthcare, as well as other cultural differences), that the epidemic will peak at as high a level as it will in the black African population (Dorrington & Johnson, 2002). The epidemic is the least severe in the Asian and white population groups.

5.5.3 Data on race are not available from medical schemes because they are not permitted to underwrite new applicants on the basis of this risk factor and thus do not maintain accurate records. Race, however, does serve as a proxy for other socio-economic factors influencing HIV transmission in South Africa (Johnson & Dorrington,

Figure 3: Age profiles of the largest open schemes (2002 data)[10]




10 Source: McLeod et al. (unpublished: 18)

unpublished). Sexually transmitted diseases, migration, urbanisation, education, occupation and industry, skill level and culture group each contribute to the risk of transmission of the virus but data are not available from medical schemes on many of these factors.

5.5.4 Figure 4 provides some indication of the racial composition of the medical-scheme population. Historically, the proportion of medical-scheme members that are white has been high and this is projected to decrease as a proportion of total membership under proposed SHI reforms. McLeod et al. (unpublished) have estimated that in the first phase of SHI about 43,2% of the medical-scheme membership could be black African and that this figure could increase to 54,7% under the fullest extent of SHI.

5.5.5 Therefore, all other things such as age and sex being equal, the racial proportions given in Figure 4 suggest a lower HIV prevalence level in the medical-scheme population than that of the general population.

## 5.6 PROVINCE OR REGION OF RESIDENCE

5.6.1 The differences in the spread of HIV across provinces are partly as a result of differences in the stage of the epidemic reached and partly as a result of different patterns of the epidemic across provinces and the heterogeneity of racial mixes in the different provinces of South Africa (Dorrington & Johnson, 2002). Figure 5 shows antenatal HIV prevalence rates by province in South Africa in 2003 and 2005.

5.6.2 According to the Department of Health (2006), the antenatal-clinic data for 2005 reveal that the epidemic has historically differed, and continues to differ, between the provinces. The provinces differ in terms of ultimate plateaux, ranging from 15,7% for the Western Cape to a high of 39,1% for KwaZulu-Natal (KZN) (this is lower than the 2005 estimate of 40,7% HIV prevalence in KZN). KZN appears to have started earliest and is expected to peak at the highest level, while four of the nine provinces appear to be following similar epidemics. The epidemics are similar in terms of the shape of the curve but not the level of the curve.

5.6.3 According to Van den Heever (unpublished), there is a correlation between area of residence, by socio-economic status, and HIV risk. Areas with low socio-economic status are assumed to correlate with higher HIV risk. The areas assumed to have lower socio-economic status are those with largely informal dwellings.

5.6.4 Differences in prevalence and incidence between provinces mean that a medical scheme with large coverage in, say, KZN should be expected to have a higher HIV prevalence rate than a scheme in, say, the Western Cape, all other things being equal.

## 5.7 BEHAVIOUR

5.7.1 The risk factors discussed above are not the only statistical risk factors for HIV/AIDS but provide some statistical explanation of the spread of HIV in different population groups and in different areas.

5.7.2 The above risk factors and risk groups take limited account of the effect that behavioural factors can have on HIV prevalence. Individuals who are at high risk of HIV infection and are less inclined to modify their behaviour are classified as a high-risk group. Conversely, low-risk groups can be expected to modify behaviour.

Figure 4: Ethnicity by target group[11]

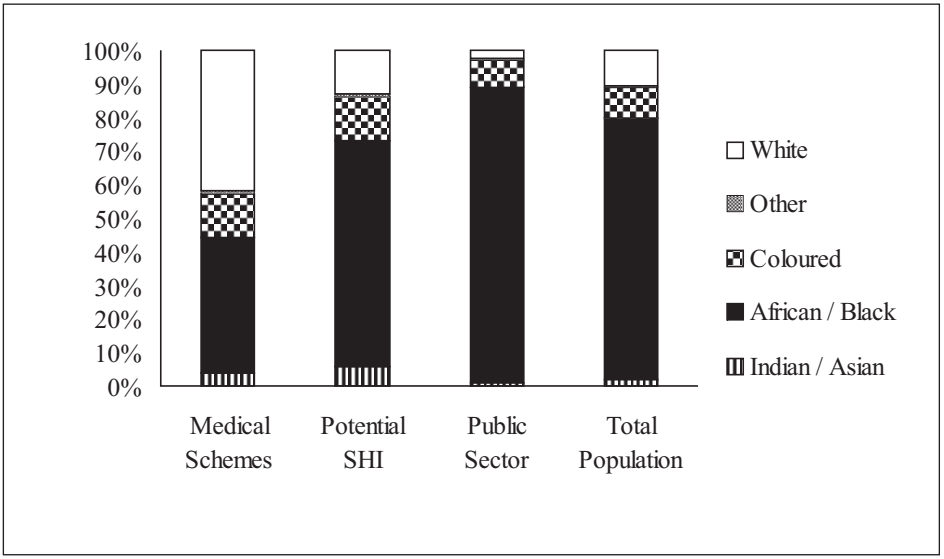
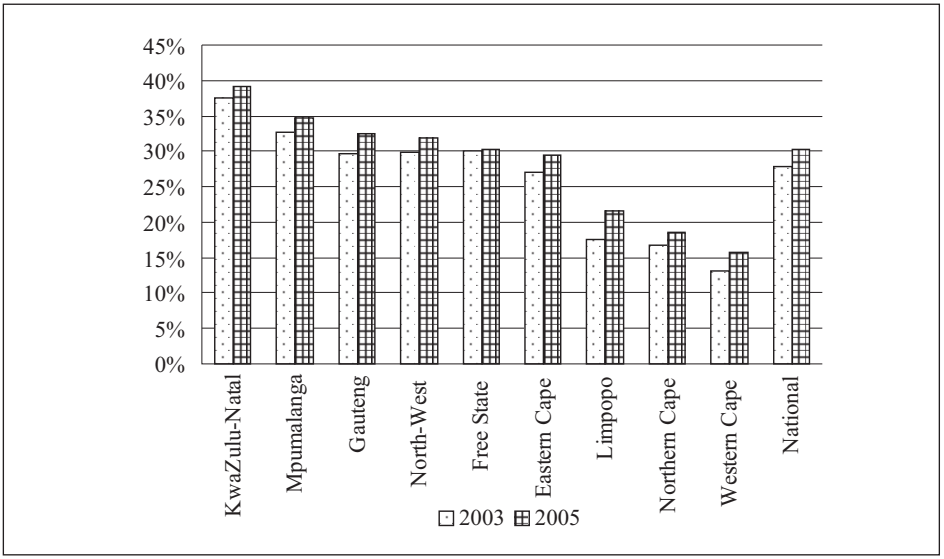



Figure 5: Antenatal HIV prevalence rates by province in South Africa, 2003, 2005[12]




11 Source: October Household Survey, 1999, cited in McLeod et al. (unpublished: 56)
12 Source: Department of Health (2006)

5.7.3 To reduce HIV prevalence, persons classified as a 'high-risk'—especially women—would need to take preventative action. In particular, the use of condoms and other barrier items is important. Further preventative action involves detecting the disease in its early stages when symptoms begin to occur so that the infected person can enrol on an HIV programme and address his/her health needs accordingly. This action can increase mean survival time. Furthermore, the modification of sexual behaviour after discovering HIV status is very important to ensure that more people are not infected with the virus (Van den Heever, unpublished).

5.7.4 Lower-risk groups are likely to take the aforementioned initiatives and so have lower HIV incidence. The extent to which behavioural interventions and initiatives occur will affect the incidence rates and hence the prevalence rates in the group concerned. More specific identification of risk groups would facilitate the assessment of behavioural responses within each group and over time. On this basis, it is presumed that prevalence rates are expected to be mildly overstated, particularly in the medical-scheme population, as this group is more likely to modify their behaviour to reduce HIV prevalence.

5.7.5 Amongst social factors that implicitly affect group behaviour, it has been found that higher levels of social cohesion, as defined in Barnett & Whiteside (2002), may be witnessed among people with higher levels of wealth. By implication, those with higher levels of wealth are more likely to purchase medical-scheme cover than the general population and this may also explain or imply a lower prevalence rate than that of the general population, which exhibits low social cohesion and lower levels of wealth.

5.7.6 HIV prevalence has been shown to differ significantly by income and the type of employment. Therefore, by implication, different medical schemes will have different prevalence rates because of the nature of the underlying membership. In the case of employment, a scheme that provides coverage for mine workers will have a higher HIV prevalence than a similar medical scheme for accountants and other clerical professionals. The latter have historically displayed lower HIV incidence rates, partly because of the different living conditions and migratory patterns.

5.7.7 While it is possible to attribute the severity of HIV/AIDS in various population groups to demographic factors such as age, sex and income, it must be remembered that these factors represent statistical predictors and are subject to much variability or noise. This could be why the HIV/AIDS epidemic is so rife in South Africa—the heterogeneity of the disease in both its clinical properties and social determinants confounds the ease with which it is spread.

## 6. MODELLING

### 6.1 INTRODUCTION

6.1.1 This section of the paper aims to establish a rationale and then a methodology for measuring HIV prevalence within a medical-scheme population. Projection models of the Actuarial Society of South Africa are utilised to assess an estimated prevalence rate: the ASSA2003 AIDS and Demographic Model and the ASSA 2003 DemSelect Model. In this paper, these models are referred to as the 'national model'

and the 'select model', respectively.[13] The former is a population model that describes the spread of HIV/AIDS at a national or provincial level, while the latter describes the spread of HIV/AIDS in a sub-population that has been selected in some way, such as members of an employer group.

6.1.2 The select model is underpinned by the following staging system (Rosenberg et al., unpublished):

- HIV Stage 1: acute HIV infection;
- HIV Stage 2: minor respiratory infections;
- HIV Stage 3: oral infections, weight loss, diarrhoea;
- HIV Stage 4: AIDS;
- ART Stage 1: first line treatment, early starters;
- ART Stage 2: first line treatment, late starters;
- ART Stage 3: second line treatment; and
- ART Stage 4: ART failure.

6.1.3 At any one time, a medical scheme will not know the exact rate of HIV prevalence among its beneficiaries as some may not be registered on its HIV DMP and it would therefore not necessarily be possible to identify those members that are claiming for HIV-related benefits. Even where a scheme does have an HIV DMP, it may be outsourced to a third party, and the medical scheme would not be able to identify those beneficiaries that are managed on the programme. Nor would it be entirely possible to separate claims for HIV- and AIDS-related conditions and treatments from other claims. Therefore, a mathematical model of HIV in a medical-scheme population could provide a useful estimate of HIV prevalence and the cost implications of HIV.

6.1.4 The modelling of HIV prevalence in a medical-scheme context can provide an analysis of the proportion of beneficiaries infected with HIV and the distribution of HIV within this subpopulation. The accuracy of the analysis will very much depend on the structure of the model and on the underlying assumptions.

6.1.5 Further uses of a mathematical model for HIV prevalence are as follows:

- The model may be used to determine a baseline HIV prevalence rate against which future HIV prevalence rates can be measured.
- The model can incorporate parameters that allow for the effects of interventions, treatment and other management efforts. In this way, trends in HIV prevalence can be calculated according to the initiatives undertaken to reduce the spread or negative health implication of HIV/AIDS. This will provide necessary information for current and future planning purposes.

6.1.6 For the purposes of this research, medical-scheme risk exposure is measured through HIV prevalence only. Out of all lives covered by medical schemes, there are four distinct groups of beneficiaries with respect to HIV/AIDS:

13 Both models and the respective user guides can be downloaded from www.assa.org.za/aidsmodel.asp

– those who are HIV negative;
– those who are HIV positive (pre-AIDS) and are not aware of their status;
– those who are HIV positive (pre-AIDS) and are aware of their status; and
– those who have reached the AIDS-sick stage of the disease.

Those who are HIV-positive and AIDS-sick should ideally be registered on and participating in HIV DMPs.

## 6.2 DATA

6.2.1 Demographic data per beneficiary were obtained by three large medical schemes in South Africa during 2004. The data were provided at beneficiary level and comprised only member number, date of birth, sex, contributions per beneficiary, benefit-option selection and province. The data covered some 2 202 940 beneficiaries. This represented about 31,8% of medical-scheme beneficiaries during 2004, the estimated number of beneficiaries in that year being 6,915 million.[14] It is not suggested that the sample population is representative of the medical-scheme population as a whole. The aim of this paper is however to present a methodology rather than to present results that apply to the medical-scheme population as a whole.

6.2.2 Information on race was not available as, in the authors' experience, schemes generally do not collect this information. Also, no information relating to estimated HIV prevalence or numbers enrolled on HIV DMPs was provided. Even if the medical schemes that provided data were willing to share information about their HIV DMPs, some of the schemes may have outsourced treatment programmes and thus do not necessarily know which specific beneficiaries are participating in the programme. As a result, the ASSA models cannot be calibrated to replicate any observed statistics. The methodology presented in this paper is intended to provide for demographic estimation of HIV prevalence that can be compared with enrolments on an HIV DMP.

6.2.3 Discussions with industry players indicate that an accurate count of HIV-positive beneficiaries is very difficult for medical schemes to obtain. Therefore medical schemes are reliant on modelling to estimate HIV prevalence and the financial consequences of HIV. A consequence of this lack of data is that any results presented in this paper are merely illustrative.

6.2.4 As indicated above, the data from these participating medical schemes are not necessarily representative of the entire South African medical-scheme population and the results derived from this research can therefore not necessarily be extrapolated to the medical-scheme population. However, a comparison is made between each demographic factor for which data have been received and the data submissions for the REF, as set out in McLeod et al. (unpublished).

6.2.5 A summary of the data is provided in Appendix B.

6.2.6 Clinical costing data were obtained directly from a managed-care organisation that specialises in HIV disease management for medical schemes. The data

14 Council for Medical Schemes (2005). Annual Report 2004–5, www.medicalschemes.com

are therefore expected to fairly represent the cost of HIV disease management for medical schemes. Such clinical costing data includes prices of ART (for each ART stage), immune boosters (for each HIV and ART stage) and pathology (for each HIV and ART stage).

## 6.3 HIV-PREVALENCE MODELLING METHODOLOGY

6.3.1 This section briefly sets out the methodology for the estimation of HIV prevalence in a sample of the medical-scheme population.

6.3.2 Since data on the racial profile of beneficiaries were not available for this analysis, and the racial split of the total medical-scheme population is different from that of the total population (see section 5.5 above), an adjustment for race as represented in Table 3 was made. This was calculated by adjusting the national model's initial population in 1985 so that the projected racial split in 2004 reflects the racial split of the medical-scheme population. In order to account for this change in the select model, the corresponding incidence rates by age and sex from the national model were calculated and imported into the select model. In doing this, it was assumed that the racial profile differentials remain would remain constant.

Table 3: Adjustment of ASSA national model's initial population to reflect medical-scheme racial split

| | White | Coloured | Black | Asian | Combined |
|---|---|---|---|---|---|
| Actual initial total SA population (1985) | 4 530 280 (14%) | 3 059 659 (9%) | 23 793 910 (74%) | 922 486 (3%) | 32 306 335 (100%) |
| Initial total SA population according to current medical-scheme racial split | 14 214 787 (44%) | 3 876 760 (12%) | 12 922 534 (40%) | 1 292 253 (4%) | 32 306 335 (100%) |
| Initial adjusted total SA population to reproduce current medical-scheme racial split | 17 122 357 (53%) | 3 876 760 (12%) | 10 014 964 (31%) | 1 292 253 (4%) | 32 306 335 (100%) |
| Projected adjusted total SA population to 2004 | 19 168 719 (44%) | 5 309 186 (12%) | 17 152 435 (40%) | 1 664 229 (4%) | 43 294 569 (100%) |
| Divergence between assumed and projected | –0,3% | –0,3% | 0,4% | 0,2% | 0,0% |

For simplicity, the racial splits have been applied uniformly across age groups. This could be improved upon by applying an age distribution for each racial group.

6.3.3 The effects of the change in racial profile on the estimated HIV prevalence and incidence rates as produced by the national model are to reduce the prevalence and incidence levels both in the total population and more particularly in the adult population. Given that incidence rates refer to the mathematical rate of change of the

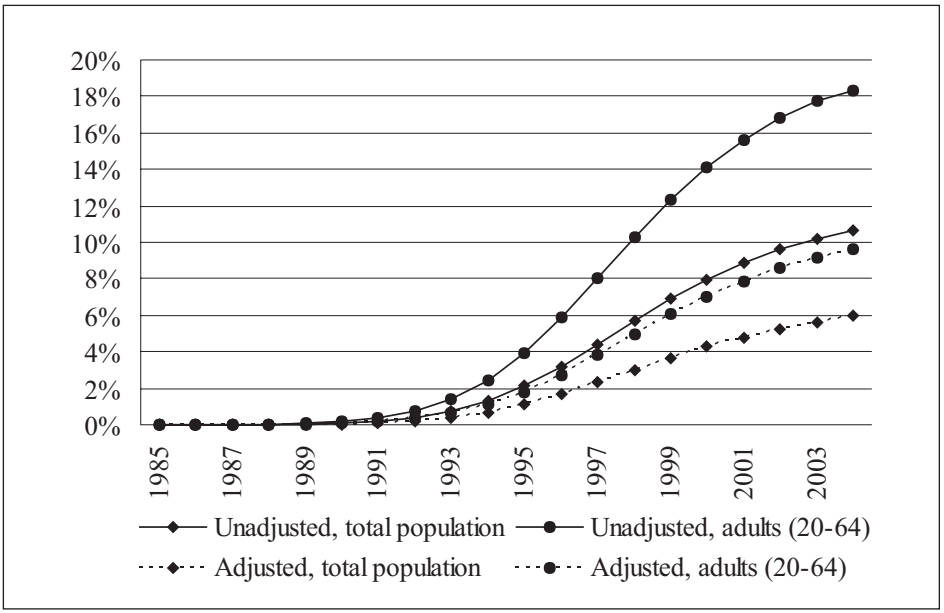
prevalence rates, it can be expected that a fall in incidence rates will result in a corresponding fall in prevalence rates. Figures 6 and 7 summarise the HIV prevalence and HIV incidence rates based on the above adjustments.

6.3.4 Increased interventions and access to treatment must be allowed for within the model in order to more accurately reflect the benefits available to HIV-positive medical-scheme beneficiaries. Given this requirement, the ASSA 2003 Lite model makes allowances for the following interventions, which are used as the basis of developing scenarios depicting medical-scheme benefits:

– information and education campaigns and social marketing;
– treatment for sexually transmitted infections;
– voluntary counselling and testing;
– prevention of mother-to-child transmission; and
– ART.

6.3.5 In order to account for increased interventions accessible to the medical-scheme population relative to the total population, an adjustment was made to calibration factors for the HIV prevalence rate of new entrants to the sub-population and to the incidence rates that were calculated as above in the select model. Since it was not possible to calibrate the model to observed estimates of incidence or prevalence, subjective factors

Figure 6: Estimated national HIV prevalence, adjusted for racial composition[15]




15 Source: calculated from ASSA 2003 AIDS and Demographic model

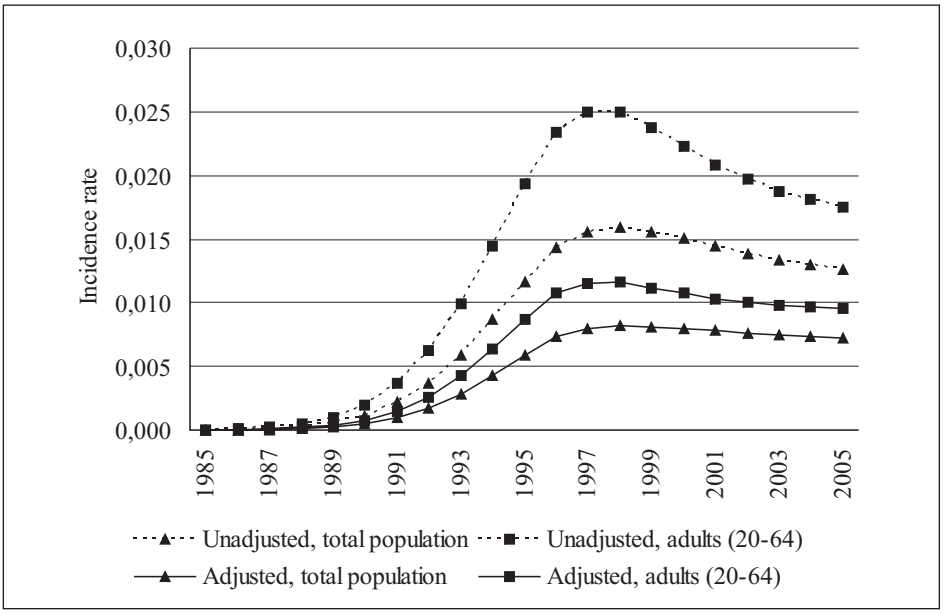
that reflect increased access to and utilisation of interventions were applied in the model. To ascertain the appropriateness of these assumptions, one would require data against which to check the sensitivities.

6.3.6 The assumptions for the calibration factors to be applied to the prevalence rates for new entrants and the incidence rates from the national model are set out in four illustrative scenarios per skill level or job grade (allowing for income differentials), as follows:

– scenario 1: no adjustments are made to HIV prevalence rates for new entrants and incidence rates;
– scenario 2: the select-model default assumptions are used for calibration factors;
– scenario 3: awareness programmes and an HIV DMP are available to beneficiaries and the existence of these programmes reduces the incidence rates of existing scheme beneficiaries, but prevalence rates of new entrants are unchanged;
– scenario 4: this scenario is intended to reflect a greater degree of intervention and treatment than under scenarios 2 and 3.

Scenario 2 should reflect having 'reasonably good HIV prevention programmes' and reflect a 'degree of intervention'.[16] Scenario 4 is intended as the scenario most appropriate for the current medical-scheme population while the other scenarios are

Figure 7: Estimated national HIV incidence, adjusted for racial composition[17]




16 Personal communication via e-mail with L Johnson, 7 August 2006.
17 Source: calculated from ASSA 2003 AIDS and Demographic model

intended to illustrate the sensitivity surrounding the effect of changes in the current medical-scheme population. The calibration factors to HIV prevalence rates of new entrants and HIV incidence rates for the respective scenarios are shown in Table 4.

Table 4: Calibration factors to HIV prevalence rates of new entrants and HIV incidence rates

| Calibration factors | to HIV prevalence rates for new entrants | | | | | to HIV incidence rates | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Skill level | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| | % | % | % | % | % | % | % | % | % | % |
| Scenario 1 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Scenario 2 | 124 | 90 | 30 | 18 | 18 | 124 | 90 | 30 | 18 | 18 |
| Scenario 3 | 100 | 100 | 100 | 100 | 100 | 50 | 50 | 50 | 50 | 50 |
| Scenario 4 | 100 | 80 | 20 | 10 | 10 | 100 | 80 | 20 | 10 | 10 |

6.3.7 At present, models in the public domain do not take into account the family-unit structure that is inherent in a medical-scheme population. In general, a medical-scheme population comprises family units and not only individual beneficiaries. The methodology presented below is intended to account for some of this non-independence. The family unit can comprise the following individuals, as defined in the Medical Schemes Act:

– principal member; and
– dependants—adult and child.

The spouse of a member is included as an adult dependant.

6.3.8 The records in respect of a family unit comprising the principal member and his/her dependants are linked through a unique medical-scheme membership number. The HIV infection of a principal member is not independent of the HIV infection of a corresponding spouse. Therefore, these beneficiary groups are not modelled separately. Instead, some account of the transmission dynamics between the above-listed beneficiary groups is required.

6.3.9 For a principal member without a spouse, and for adult dependants, the risk of HIV infection is assumed to be independent of the family structure. Child dependants are assumed to become infected through mother-to-child transmission (for child dependants under 14 years old). For child dependants over 14 years old, HIV infection is assumed to be independent of the family unit. The HIV prevalence of child dependants is modelled in the national model, with the adjustment for the medical-scheme racial composition and on the assumption of no other adjustments to incidence or prevalence rates as per Table 3.

6.3.10 Quinn (2000) tracked the HIV serostatus of 415 HIV serodiscordant couples. The findings were that 22% of the HIV-negative partners seroconverted during the course of the study. The study also found that the rate of transmission from male to

female was the same as female-to-male transmission. In Carpenter et al. (1999) and Hugonnet et al. (2003) it was found that the risk of HIV transmission from female to male was double that of transmission from male to female in HIV serodiscordant couples.

6.3.11 From the data provided by the three medical schemes for this research, it is not possible to determine which principal members and spouses (in couples according to member number) are serodiscordant and which are seroconcordant, and for the former couples it is not possible to ascertain how many couples have a principal member that is HIV-positive or a spouse that is HIV-positive. A modelling approach was therefore used to simulate the development of infection in the couples over a four-year period. This was applied to the principal members that are estimated to be HIV-positive incorporating the transmission dynamics between principal members and spouses as follows:

– If a male principal member has a female spouse, then there is a 44% probability of the male infecting the female (Quinn, op. cit.). This is because Carpenter (op. cit.) finds that a woman is twice as likely to contract HIV from her HIV-positive male partner.
– If a female principal member has a male spouse, then there is a 22% probability of the female infecting the male (Quinn, op. cit.).

These transmission probabilities relate to a four-year period and so they have been implemented uniformly over four-year periods both retrospectively and prospectively (commencing in 1990) to simulate a mix of serodiscordant and seroconcordant couples at any time.

6.3.12 A shortcoming of this method is that it ignores the infection of a spouse other than from the principal member.

6.3.13 For a principal member without a spouse, the member is assumed to become infected independently of the family structure. Therefore, the HIV prevalence of these beneficiaries is modelled using the select model, without any allowance for family-unit interactions.

6.3.14 For adult dependants other than spouses, the risk of HIV infection is also assumed to be independent of the family structure. For this reason, this group of beneficiaries is modelled separately from the other beneficiary groups.

6.3.15 Child dependants under 14 are assumed to become infected through mother-to-child transmission. For child dependants over the age of 14, transmission is assumed to occur independently of the family unit structure.

6.3.16 The ASSA select model does not model the prevalence for the age group 0 to 14 as it considers a subpopulation that is aged 15 to 64. Hence, in order to overcome this, the national model is used to calculate an estimate of HIV prevalence among child dependants. The HIV prevalence of child dependants under the age of 14 is modelled in the national model, with the adjustment for the medical-scheme racial composition, as described above.

6.3.17 Given that the national model is used to calculate these results, it is noted that the model results will not necessarily represent the HIV prevalence of child dependants in a medical-scheme population. However, the extent of accuracy underlying this approximation cannot be directly determined from data made available for this research and there are no publicly available estimates of HIV prevalence among medical-scheme child dependants with which to calibrate the ASSA model. Hence, without

further information, the national-model estimates of HIV prevalence in child dependants, adjusted for racial composition, is used as a reasonable estimate for prevalence.

6.3.18 Newborn children that are infected with HIV are assumed to have become infected through mother-to-child transmission. The methodology for incorporating vertical transmission is as follows:

– If a principal member or spouse is a woman infected with HIV, then there is a 2% probability that she will transmit HIV to the child. This is based on the assumptions that ART is administered to an HIV-positive woman during pregnancy, labour, and delivery, that elective caesarean section is available for a woman with a high viral load (more than 1 000 copies per ml) and that ART is also administered to the newborn child (Centers for Disease Control and Prevention, CDC, 2006).
– CDC (op. cit.) states that approximately 25% of pregnant women who are not aware of their HIV serostatus will transmit the virus to their children because they will not undergo procedures as described in the point above. It finds that about 25% of HIV-infected persons are not aware of their HIV status. These findings have been used to develop the methodology for estimating mother-to-child transmission in the South African medical-scheme population because these women are likely to be tested prior to delivery. This means that more women will be aware of their HIV status before giving birth. The authors assumed that all pregnant women be tested and therefore know their status.

6.3.19 The calculation steps are summarised as follows:

Using the select model:

– generate a demographic profile of principal members;
– generate a demographic profile of spouses;
– generate a demographic profile of other adult dependants;
– run a separate projection of HIV prevalence of the principal members;
– run a separate projection of HIV prevalence of the spouses; and
– run a separate projection of HIV prevalence of the other adult dependants.

Using the national model:

– run a projection of the child dependants under 14 years of age.

The select and national models are then used to derive the HIV prevalence rates per beneficiary group as described above, which are then aggregated over each of the beneficiary groups to arrive at a total estimate of HIV prevalence per year and per medical scheme.

6.3.20 The interdependence of the HIV prevalence of principal members and spouse dependants means that care must be taken in combining the prevalence rates. If one combines the HIV prevalence rate of adult dependants and child dependants (not new-borns) with those of principal members and spouses, one can determine an overall estimate of HIV prevalence within a medical-scheme population. This overall estimate is based on weighted averages of the respective HIV prevalence rates within each medical-scheme population group.

## 6.4 HIV INFECTION BY DISEASE STAGE

6.4.1 In order to model the proportion of beneficiaries by HIV stages 1 to 4 and ART stages 1 to 4, it is necessary to calculate the proportion of beneficiaries in each stage separately for males and females. This is done on the select model by splitting the proportions in each stage into males and females on the 'Start Pop' worksheet. This facilitates the modelling of the family-unit structure, in that transmission between principal members and spouses can now be taken account of separately by sex.

6.4.2 HIV infection in children by stage is modelled according to the national model. In this model, the HIV infection in children is split between pre-AIDS and AIDS. This proportion is applied to the estimated number of HIV-infected children in the medical-scheme population. In terms of ART stages, the number of children on ART as produced by the national model is used as an estimate of the number of children in the HAART stage. This is likely to be an underestimate of the proportion of children that are clinically eligible for ART compared with the medical-scheme environment.

## 6.5 OTHER ASSUMPTIONS

### 6.5.1 Promotion Rates

Promotion rates from one skill level or job grade to the next higher skill level in the select model were set to zero. Since benefit option and contributions have been used as a proxy for skill level, it is assumed that there is no movement of members between benefit options from year to year. This assumption, however, is not sustainable for the following reasons:

- members may buy down to cheaper options as affordability and the cost of medical-scheme cover dictate; and
- members may also buy up to more expensive (and comprehensive) benefit options as the range of benefits covered expands, particularly for those that are HIV-positive.

### 6.5.2 Time Lead

The select model has an assumption relating to the pace of the progression of the epidemic in each province, which explains the differentials in the levels of HIV prevalence by province. This assumption is referred to as the 'time lead' or 'time lag'. The time lag applies to provinces such as the Western Cape where the HIV epidemic is progressing at a slower rate than in other provinces such as Gauteng and KZN. The assumption for time lead in the select model has been set to zero. This is because almost half (44%) of beneficiaries modelled are resident in Gauteng, which has a time lead of 0.

### 6.5.3 Starting Population

The composition of the medical-scheme population at the start of the projection period (1985) in the select model is not available. It was assumed that the profile and size of the population at the time that the data were provided, 2004, have remained stable between 1985 and 2004. It may prove to be unrealistic to make a similar assumption for the future in terms of racial and age profile, because the forthcoming SHI reforms intend to increase the number of persons, who were previously uncovered, entering the system.

It is expected that these new entrants could be younger on average, and therefore one would expect a corresponding increase in HIV prevalence. Should the new entrants be older, the opposite result would materialise. Explicit allowance for the changing profile of new entrants, such as under SHI, can be incorporated into the select model on the assumptions sheet.

### 6.5.4 Demographic and Behavioural Profiles

As discussed above, schemes may differ significantly in terms of demographic composition, thus directly influencing the prevalence level within the scheme, and its evolution over time. For example, a scheme with younger members would be expected to have a higher HIV prevalence rate than a similar scheme with older members. When modelling the prevalence of HIV, each scheme must take into account how and when its demographic and behavioural profiles differ from those assumed in the ASSA models.

### 6.5.5 ART Initiation Rates

The default assumptions for ART initiation rates in HIV stages 3 and 4 were increased from 0,1 to 0,2 and from 0,5 to 0,8 respectively. These adjustments are to reflect increased access to ART and increased uptake of ART, particularly for those beneficiaries in the pre-ART stages that require ART.

### 6.5.6 Length of Projection

Projections are made to the year 2010. The effects and extent of various prevention and treatment efforts, as well as their costs, are expected to vary considerably over the next few years as treatment becomes more available and cheaper and as the management of the disease evolves. Also, the potential shift of the demographic profile of the medical-scheme population as a result of SHI reforms such as the introduction of the low-income medical scheme and mandatory membership, means that projections of the current demographic profile are unlikely to be representative of the medical-scheme population in several years time.

### 6.5.7 Other Assumptions

Other assumptions in the national and select models that are not referred to above have remained as in the original models. Examples are the median terms spent in each HIV or ART stage, multiplicative adjustments to median terms in each stage, independent rates of decrements, and survival distribution parameters for new entrants. The default withdrawal assumptions have been used even though it could be argued that the beneficiaries receiving treatment are less likely to exit as the affordability of treatment may be exacerbated by loss of employment.

### 6.5.8 New Entrants

New entrants to the medical-scheme population are assumed to come from the general South African population and not necessarily from a distinct subgroup. This assumption is expected to be more applicable as medical-scheme cover expands and more

people enter the risk pool. The medical-scheme population has been relatively stable in terms of size and risk profile during the period 1999 to 2006,[18] but changes in the mix of lives entering the risk pool could change its risk profile. For example, the development of explicit allowance for new members on the Government Employees' Medical Scheme that were previously uncovered and for the skills profile of new entrants constitutes areas for further work.

### 6.5.9 Data Calibration

The select model was not calibrated to reproduce observed HIV prevalence rates. This was because no HIV prevalence data were provided by the schemes that submitted data. The purpose of this work is to develop a technique for estimating prevalence when such information is not available. The participating schemes did not submit information about the numbers of beneficiaries that are registered on their HIV DMPs. It was therefore not possible to calibrate the select model and, except where otherwise specified, default assumptions in the model were used. It may be very useful to calibrate the model in light of data on HIV prevalence and HIV disease management from other medical schemes so that the validity of the assumptions used in the particular case of modelling HIV prevalence in a medical-scheme population can be ascertained. It would also be useful to test the sensitivity of these parameters so that the actuary and the client can have a better understanding as to how variations associated with particular variables can affect the overall results.

## 6.6 HIV PREVALENCE MODELLING RESULTS

6.6.1 This section details the results of the HIV prevalence modelling exercise described above. It should be noted that the results in this section are derived from the aggregate beneficiary profiles of three large medical schemes in South Africa in 2004. For confidentiality reasons, the results of each separate scheme are presented in this paper as scheme 1, scheme 2 and scheme 3. In order to assess overall HIV prevalence, the beneficiaries of all three schemes are treated as belonging to one large scheme and the results derived in aggregate accordingly. Approximately 2 202 940 medical-scheme beneficiaries are accounted for in this research out of a total of 7,025 million medical-scheme beneficiaries as at December 2004. This represents about 31,3% of the total South African medical-scheme population in 2004. It is not the intention of this paper to suggest that the results derived from the sample medical-scheme population are representative of the medical-scheme population as a whole.

6.6.2 The estimates of overall HIV prevalence rates for the medical-scheme sample range between 9% in scenario 1 and 5% in scenario 4 in 2005. This means that between approximately 110 147 and 198 265 beneficiaries are estimated to be infected with HIV in 2005.

6.6.3 Results by scenario are shown in Figure 8 and Table 5. Scenario 4 consistently results in the lowest HIV prevalence of all the scenarios. This is to be

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expected since the calibration factors to HIV prevalence of new entrants and the HIV incidence rates were the lowest of the scenarios. Scenario 2, the select-model default scenario, results in the second lowest overall estimate for HIV prevalence. Scenario 1, with no adjustment to the incidence and prevalence rates, results in the highest HIV prevalence. This indicates the need to allow for the effect of interventions on the prevalence and incidence rates.

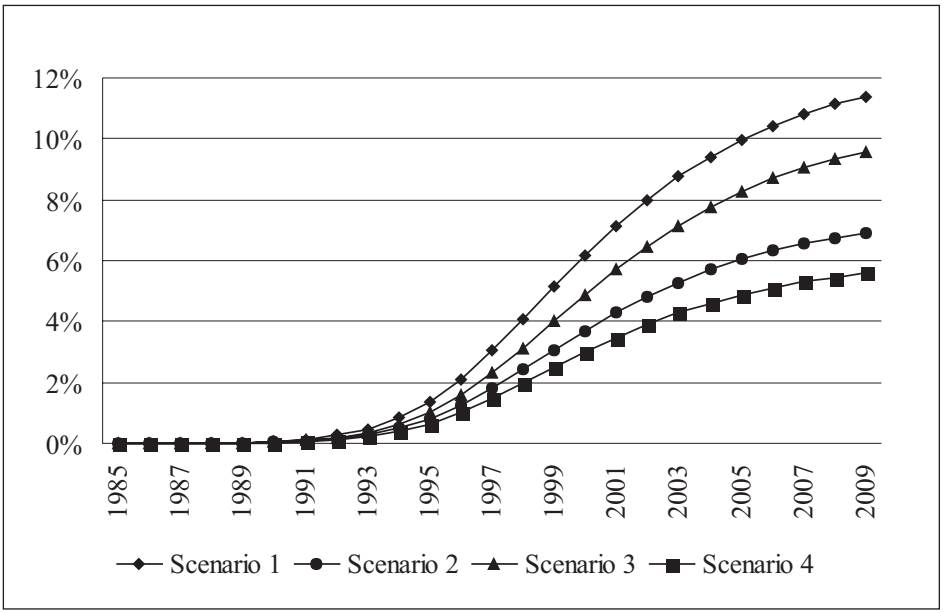
6.6.4 The authors suggest that the HIV prevalence under scenario 4 is most indicative of HIV prevalence in the medical-scheme population in South Africa. This can be explained by the higher degrees of intervention and treatment (as reflected through the lower calibration factors to HIV prevalence of new entrants and HIV incidence rates) under that scenario than under the other scenarios constructed.

6.6.5 HIV infections among principal members and spouses were derived as

Table 5: Overall HIV prevalence by scenario (2005–2010)

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Scenario 1 | 9,2% | 9,7% | 10,1% | 10,4% | 10,7% | 10,8% |
| Scenario 2 | 5,5% | 5,8% | 6,1% | 6,3% | 6,4% | 6,5% |
| Scenario 3 | 7,5% | 8,0% | 8,4% | 8,7% | 9,0% | 9,2% |
| Scenario 4 | 4,5% | 4,7% | 4,9% | 5,1% | 5,2% | 5,3% |

Figure 8: Overall HIV prevalence by scenario



described in ¶6.3.11. The results are shown in Figure 9. The number of HIV-infected principal members and spouses was highest under scenario 3 (with a calibration factor of 50% to incidence rates) and not scenario 1. HIV infections among other adult dependants are shown in Figure 10. The highest number of infected was in scenario 1 (with no adjustment to incidence rates). This reflects the importance of the adjustment to the incidence rates since incidence rates are highest in the younger adult ages and a smaller adjustment to these rates means a higher number of infections among young adults.

6.6.6 Total HIV infection among children was modelled separately. The aggregate results are shown in Figure 11; the analysis by disease stage is dealt with in ¶6.6.11 below. The total estimated number of HIV infections among child dependants has not yet reached a peak. This is because the incidence rates in children younger than 14 years are still increasing. Also, the number of HIV infections among child dependants is expected to be overstated since the results are derived from the national model, even though an adjustment has been made for racial composition.

6.6.7 For child dependants, HIV prevalence was modelled separately by disease stage. This is because this beneficiary group is modelled only by pre-AIDS, AIDS, pre-ART and ART stages, and not according to the HIV and ART stages used for modelling HIV prevalence for adults.

6.6.8 HIV infection by disease stage is shown in Figure 12. HIV infection in HIV stage 1 reaches its peak in 2002 and then starts to fall as beneficiaries progress to HIV stages 2 and 3. HIV infection in HIV stage 3 begins to peak only about 2009 as the

Figure 9: Total infections: principal members and spouses

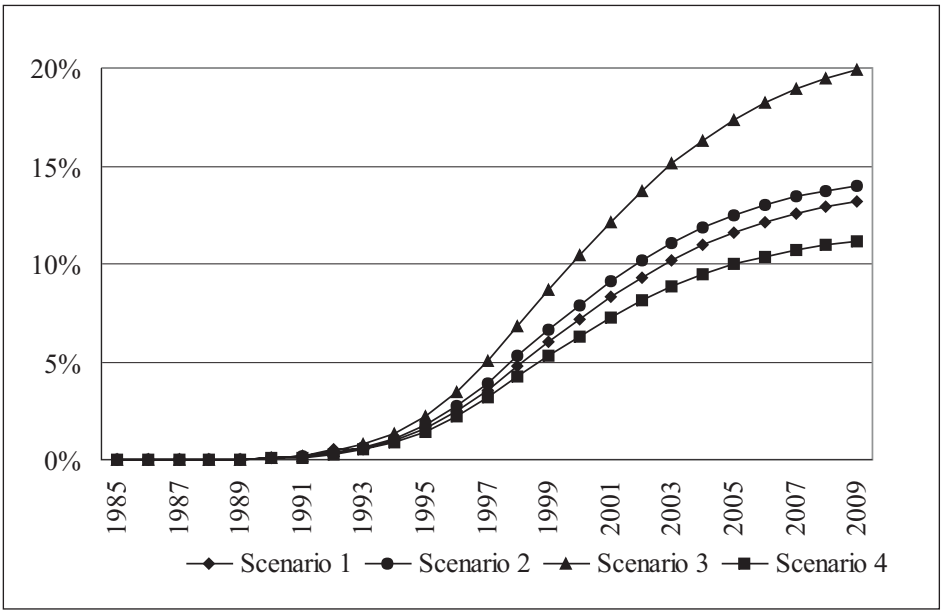


Figure 10: Total infections: adult dependants other than spouses

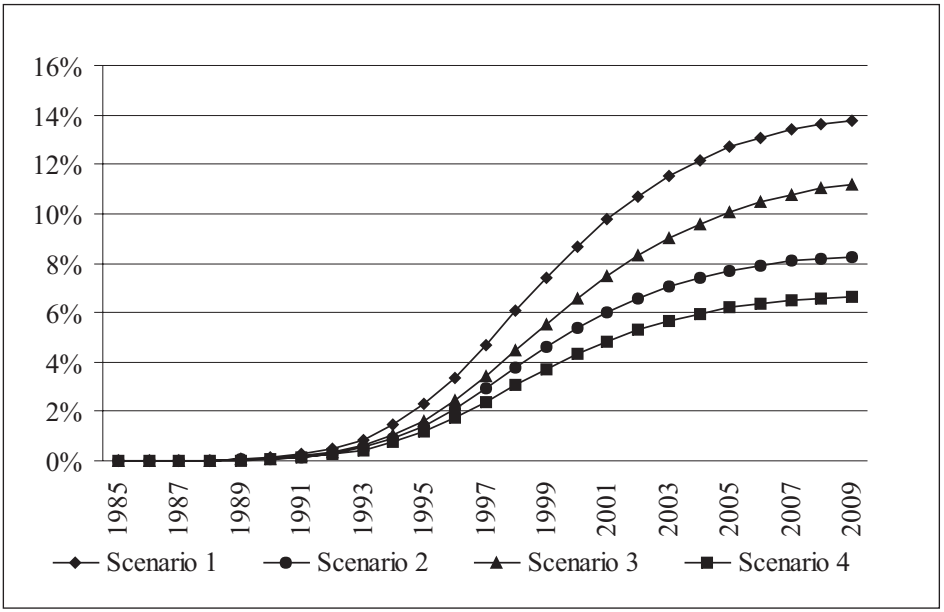
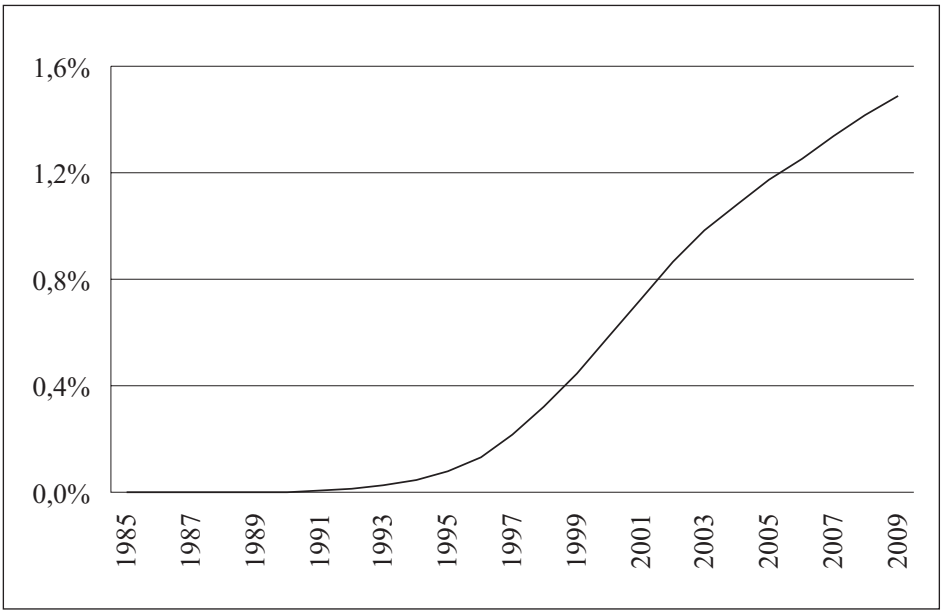



Figure 11: Total infections: child dependants



proportions in HIV stages 2 and 3 start to decrease. HIV infection in HIV stage 4 is very low (0,64% by the year 2010), which indicates that a significant number of beneficiaries from HIV stage 3 are moving to the ART stages rather than deteriorating to HIV stage 4. High numbers of HIV-positive beneficiaries are moving to ART stage 1 since it was assumed that this population exhibits higher levels of uptake on ART than in the select model, because of increased accessibility to and affordability of the drugs. The percentages in ART stages 2, 3 and 4 are increasing as beneficiaries commence ART and pass through these stages.

6.6.9 HIV infection by HIV stage is highest under scenario 1 and lowest under scenario 4. These results are consistent with those for the overall HIV prevalence by scenario. Similar results are evident for HIV infection by ART stage.

6.6.10 Earlier initiation of ART is associated with increased longevity on treatment (see ¶4.2.1). The effect of increasing the ART take-up in stage 3 from 20% to 60% is shown in Figure 13. This is more consistent with treatment protocols adopted by medical schemes (McLeod et al., 2003). The graph shows increased prevalence in the ART stages as patients on treatment survive for longer.

6.6.11 HIV infection by disease stage in children was separated into pre-AIDS and AIDS stages, as defined in and calculated using the national model. The proportion of children in each of these stages was then applied to the medical-scheme population of child dependants as an estimate of HIV prevalence among child dependants. The HIV prevalence overall and by disease stage for child dependants is therefore the same across

Figure 12: HIV infection by disease stages: scenario 4 (excluding child dependants)

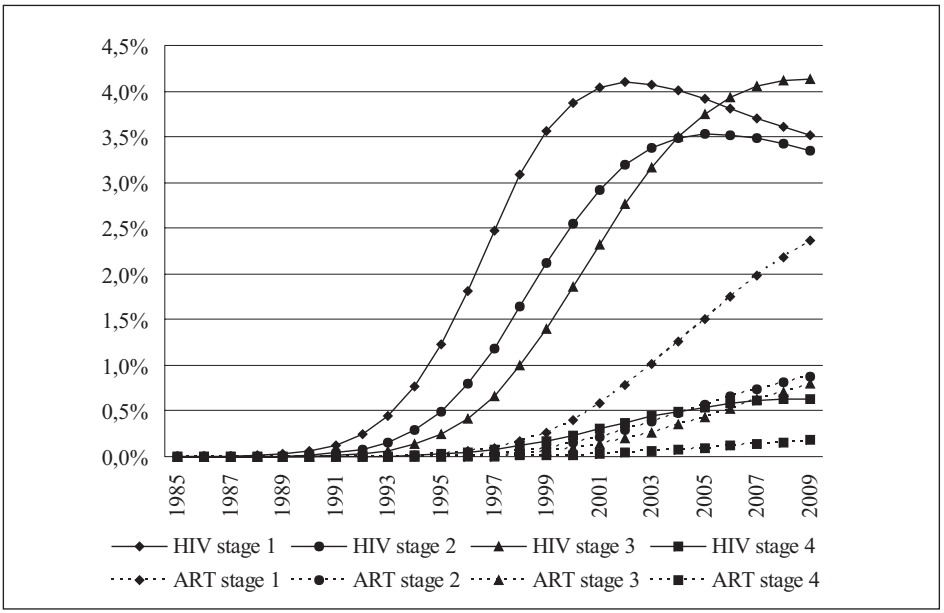


Figure 13: HIV scenario 4: HIV infection by disease stage
(60% ART take-up in HIV stage 3; 80% in HIV stage 4)

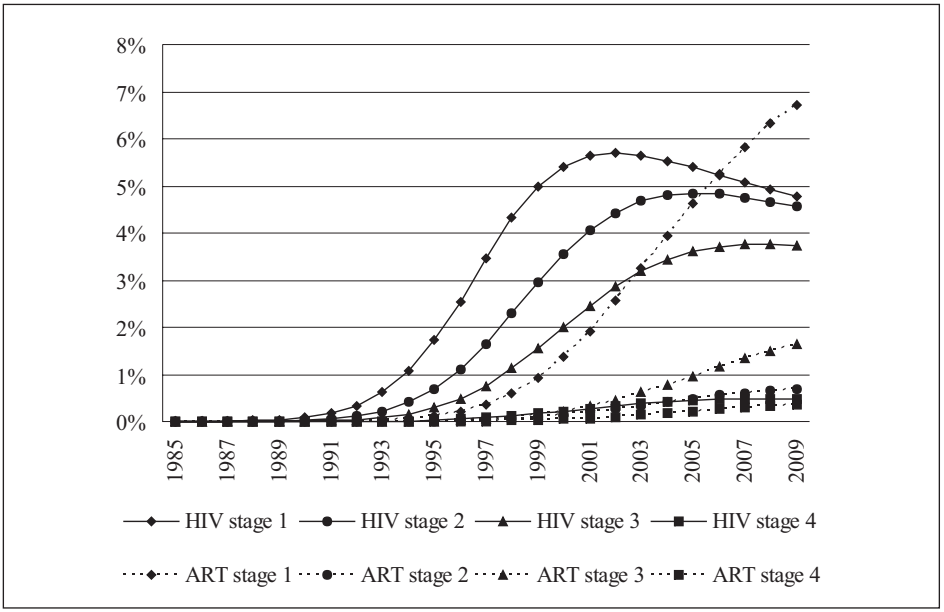
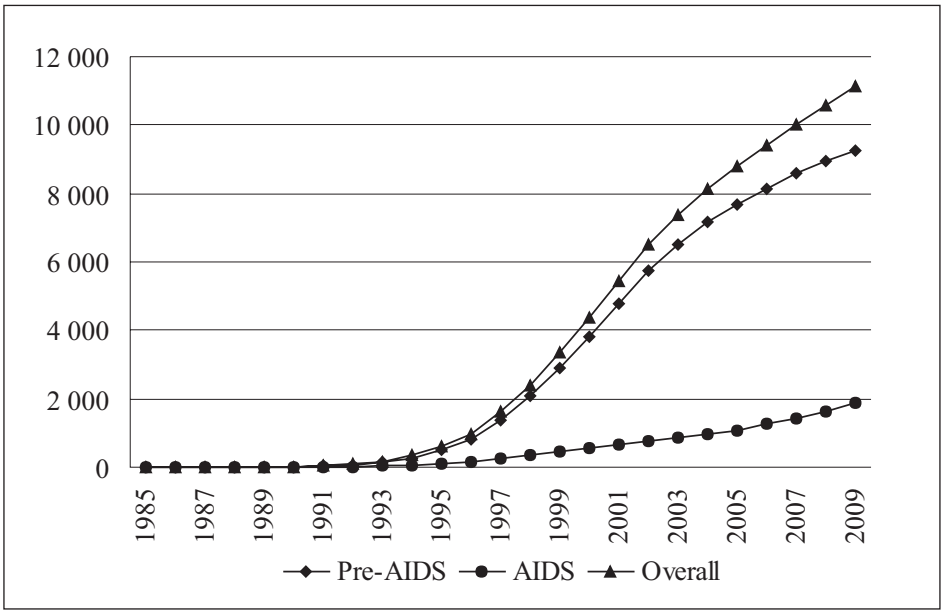



Figure 14: HIV infections by disease stage: child dependants



the modelled scenarios. The results are shown in Figure 14. The estimated number of child dependants in the AIDS stage reaches approximately 2000 by the year 2010.

## 6.7 COMPARISON WITH JOHNSON & DORRINGTON (UNPUBLISHED)

6.7.1 The results from this report can be compared with other independent estimates that rely on the ASSA models. In the case of Johnson & Dorrington (unpublished), an appendix to the paper details an estimation of HIV prevalence levels in the South African medical-scheme population under three different scenarios:

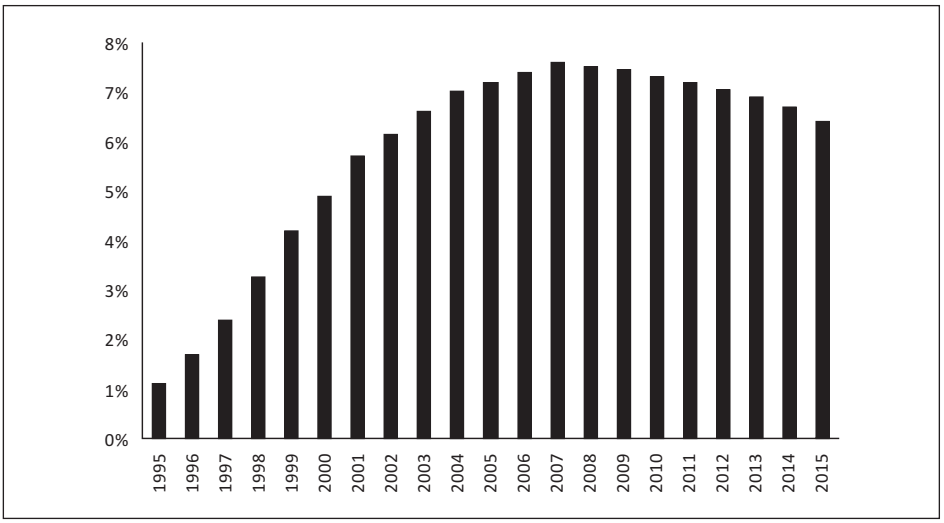
– A: no change in profile by age, sex, skill level or race;
– B: change in skill profile; and
– C: change in race profile.

As shown in Figure 15, Johnson & Dorrington (op. cit.) find that, under scenario A:

> "… it is estimated that in 2002, 6.1% of all medical scheme beneficiaries are HIV positive. The prevalence of HIV infection in the medical scheme population is expected to rise to a peak of roughly 7.5% in 2008."

6.7.2 The projections of HIV prevalence under scenarios B and C were found not to differ substantially from scenario A. All three are shown in Figure 16. In scenario B, prevalence per cent peaks 0,5 higher and one year later than scenario A, at 8,0 in 2009. In scenario C, prevalence peaks in 2009 at 8,5%. In scenarios B and C, the estimated HIV prevalence is never more than 1% above that expected for scenario A. Johnson & Dorrington (op. cit.) note:

Figure 15: HIV prevalence levels in medical schemes (scenario A)[19]




19 Johnson and Dorrington (2003)

> "…although scenario C represents the effect of a change in race profile, there is implicit within this a substantial change in the skill profile of the population as well, as black medical scheme members are – as a result of historical disadvantage – more likely to be employed in low-skill jobs. The socio-economic profile of the medical scheme population remains high even when allowance is made for greater inclusion of lower income groups. This accounts for the closeness of the prevalence levels projected for the three scenarios."

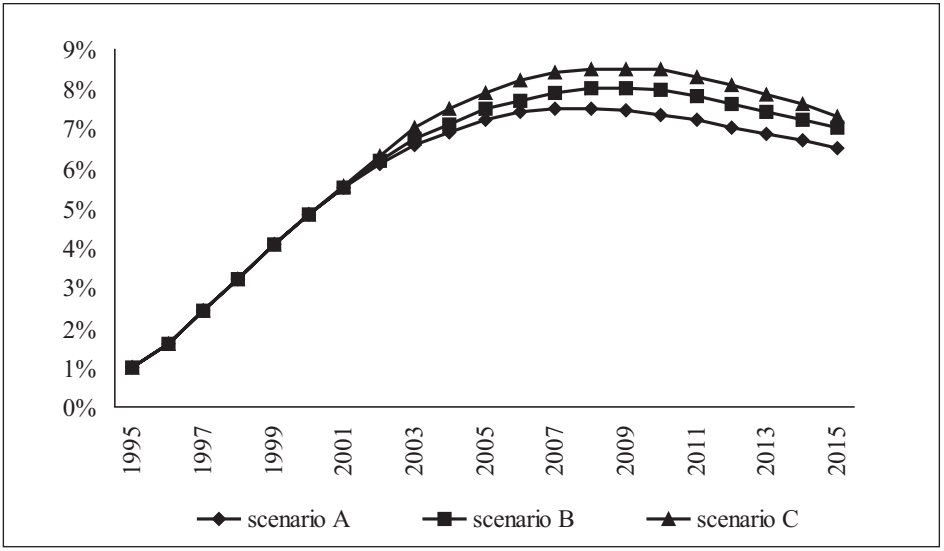
6.7.3 One of the major differences in the methodology and underlying assumptions between the research by Johnson & Dorrington (op. cit.) and the results presented in this paper are that the former utilise the ASSA 2002 national model and the latter utilises the ASSA 2003 national model.

6.7.4 The primary drawback of the estimates presented in this paper is that the models used have not been calibrated to any estimates of medical-scheme prevalence. This is because there are insufficient publicly available data to calibrate the models. The potential concentration of risk in restricted-membership medical schemes has not been modelled explicitly.

## 6.8 MODELLING THE FINANCIAL EFFECTS OF HIV

6.8.1 Using the estimates of HIV prevalence rates in a sample of the medical-scheme population, a set of cost assumptions has been applied to determine the cost that can be expected for a medical scheme with similar demographic structures and

Figure 16: Projected prevalence levels for scenarios A, B and C[20]




20 Johnson & Dorrington (unpublished)

cost profiles. The demographic structure is an aggregate of the participating medical schemes' structures and the cost structure is based on prices in the private healthcare sector during 2005. These cost components, costs and frequency of utilisation by HIV and ART stage are shown in Appendix C. The broad elements costed are:

– ART (assumed to be HAART);
– other medication (such as immune boosters that could typically be used pre-ART and with ART);
– pathology testing;
– prevention of mother-to-child transmission at birth to an HIV-positive female beneficiary;
– outpatient costs such as doctor or specialist consultations; and
– hospitalisation costs (in-patient and out-patient costs).

6.8.2 These costs are applied to the four HIV and four ART stages for adults in the select model and for the pre-AIDS and AIDS stages for children in the national model. These costs represent a managed scenario in which HIV-positive beneficiaries are enrolled on an HIV DMP. Costs relating to unmanaged beneficiaries are not accounted for. This is an area for further research.

6.8.3 Mother-to-child transmission costs are applied to the number of births in any given year. Since the select model does not supply statistics for the number of births from females in a subpopulation, the proportion of births in each age band is derived from the national model. The proportion of HIV-positive births in the general South African population (adjusted for racial composition) is applied to the medical-scheme population. Since the medical-scheme population is socio-economically select, and can therefore be expected to have lower fertility levels, this may result in overestimation of HIV-positive births in the medical-scheme sample population.

6.8.4 For estimating the cost of HIV treatment, the price of brand-name drugs will be considered. This applies to ART and to medication for the prevention of mother-to-child transmission. It is further assumed that patients routinely presenting for pathology tests have the full set of blood tests done, as set out in Appendix C.

6.8.5 All costs are shown separately by cost per claim and claim frequency in Appendix C. The cost assumptions shown in Table 6 and Figure 17 are applied for HIV stages 1 to 4 and ART stages 1 to 4 in adults and for pre-AIDS and AIDS stages in children.

6.8.6 ART stage 4 represents the highest cost per patient per annum because of the very expensive hospitalisation and medications required. The next highest cost per stage is for children with AIDS—the high cost of medications and hospitalisation are reasons for this. The next most expensive stage is HIV stage 4. The costs of HIV stages 1 and 2 and ART stage 1 are the lowest costs for HIV-positive adults, thus if these beneficiaries stay in these stages for as long as possible, the scheme can avoid, or at least delay, the high costs of HIV stage 4 and ART stage 4. The same can be said for children pre-AIDS and in the AIDS stage.

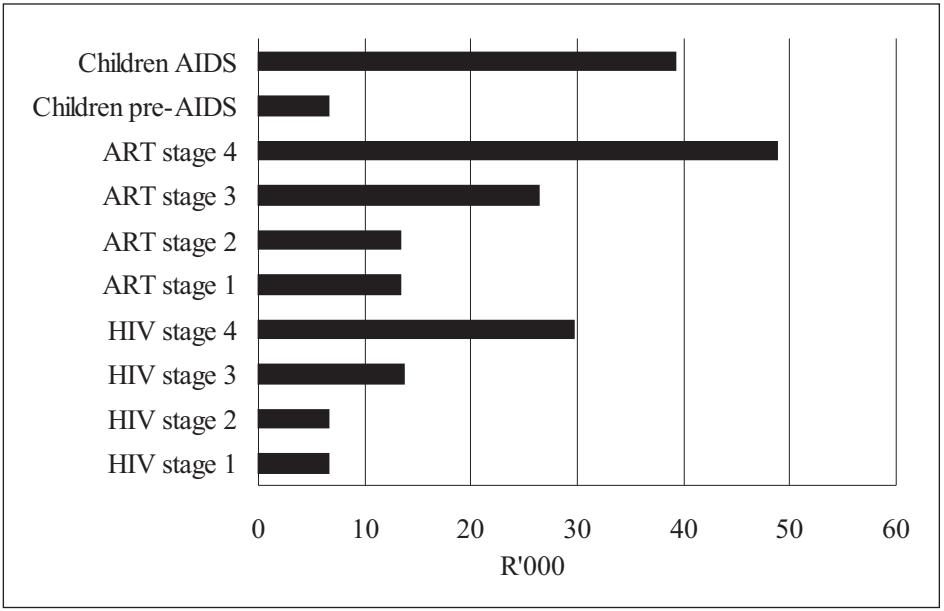
6.8.7 Prevention of mother-to-child transmission is included as a PMB. When calculating the number of HIV-infected child dependants in the medical-scheme sample population, it was assumed that for mothers that are HIV positive, ART is administered

during pregnancy, labour and delivery and then to the new born child. Under a caesarean section, the risk of HIV transmission to the child is reduced to 2%. It was also assumed that 75% of women are aware of their status at the time of childbirth. Therefore, the costs of prevention of mother-to-child transmission have been extended to include the cost of a caesarean section delivery for those 75% of women that are aware of their status and have the benefit available to them through the PMBs. The cost of a caesarean section delivery has been taken as R18 969–98, as estimated by Risk Equalisation Technical Advisory Panel (2005).

6.8.8 The total costs per beneficiary per month (pbpm) for services and treatments described above, including the cost of prevention of mother-to-child transmission, per HIV-prevalence and utilisation scenario, are shown in Tables 7 and 8. Two scenarios for ART take-up have been used. Under the first scenario, shown in Table 7, it is assumed that 20% of beneficiaries in HIV stage 3 and 80% of beneficiaries in HIV stage 4 take up ART. This is consistent with the government's protocol of ART for patients with a CD4 count of 200 and below. Most schemes (McLeod et al., 2003) seem to be operating on a protocol of ART for patients with a CD4 count of 350 and below who exhibit specified symptoms. The second scenario is thus based on the assumption that 60% of beneficiaries in HIV stage 3 and 80% of beneficiaries in HIV stage 4 take up ART.

6.8.9 The effects of the assumptions about ART initiation are shown in Figure 18. The average increase in the cost from the 20%–80% ART-initiation scenario to the 60%–80% ART-initiation scenario results in an increase of the order of 36% across

Figure 17: Cost by HIV and ART stage per annum



the HIV-prevalence scenarios and 136% from 2005 to 2010. The higher costs associated with the earlier provision of ART are associated with reduced mortality rates and greater longevity for HIV-positive beneficiaries (see ¶4.2.1). The quantification of the economic benefits of early treatment is outside of the scope of this paper but is an area for further research.

Table 6: Cost per beneficiary per annum

| Stage | Total cost (R) |
|---|---|
| HIV stage 1 | 6 512 |
| HIV stage 2 | 6 512 |
| HIV stage 3 | 13 720 |
| HIV stage 4 | 29 606 |
| ART stage 1 | 13 340 |
| ART stage 2 | 13 338 |
| ART stage 3 | 26 430 |
| ART stage 4 | 48 846 |
| Children pre-AIDS | 6 512 |
| Children AIDS | 39 196 |

Table 7: Estimated costs pbpm: 20% ART take-up in HIV stage 3; 80% in HIV stage 4.

| Prevalence scenario | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Scenario 1 | R31–12 | R35–50 | R39–41 | R42–81 | R45–64 | R47–90 |
| Scenario 2 | R11–06 | R12–60 | R13–96 | R15–14 | R16–11 | R16–89 |
| Scenario 3 | R21–06 | R24–34 | R27–33 | R29–97 | R32–24 | R34–10 |
| Scenario 4 | R7–05 | R8–06 | R8–96 | R9–73 | R10–38 | R10–89 |

Table 8: Estimated costs pbpm: 60% ART take-up in HIV stage 3; 80% in HIV stage 4

| Prevalence scenario | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Scenario 1 | R42–13 | R48–27 | R53–81 | R58–65 | R62–73 | R66–00 |
| Scenario 2 | R14–92 | R17–09 | R19–03 | R20–73 | R22–16 | R23–30 |
| Scenario 3 | R28–36 | R32–93 | R37–14 | R40–90 | R44–14 | R46–84 |
| Scenario 4 | R9–54 | R10–95 | R12–23 | R13–34 | R14–28 | R15–04 |

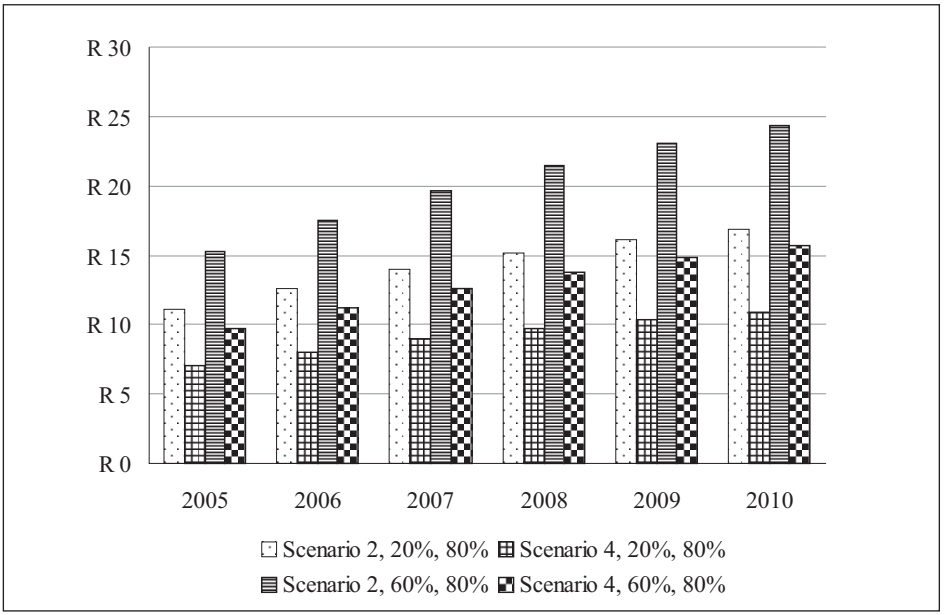
6.8.10 According to the Registrar of Medical Schemes,[21] the combined gross contributions received by the three medical schemes during 2004 was R19,5bn, average contributions pbpm being R704. Contributions increased by 7,4% across all registered medical schemes during 2004. This estimate is used as an estimate of the increase in contributions for the three medical schemes. Costs of HIV/AIDS as a percentage of contributions range from under 1% to 6,3% over the period to 2010 depending on the prevalence and ART take-up scenarios.

6.8.11 The methodology above can be strengthened by considering separately the costs of managed (enrolled on a DMP) and unmanaged HIV-positive beneficiaries.

## 7. DISCUSSION AND CONCLUSION

7.1 The effects of HIV/AIDS are being felt on all sectors of society (including the government, employers, individuals and medical schemes) and there is increased pressure for treatment to be made available to HIV-positive people that qualify for such treatment and for the HIV incidence and mortality to be reduced as far as possible. These are particular challenges for the public and private health sectors. While surveys (such as by Shisana et al., 2002) show that the public health sector is struggling to cope with the overloading of HIV-positive patients and negatively affected healthcare workers, the

Figure 18: Effects of ART-initiation assumptions




21 Registrar of Medical Schemes: Annual Report, 2005

private health sector has a pivotal role to play in combating HIV/AIDS. This is already being seen through the aforementioned SHI reforms, expansion of the PMB package to include ART, and a strengthening of social solidarity within the industry. Through these various policy mechanisms, the rights of HIV-positive people are being strengthened, as is their access to much-needed quality healthcare. Since many of the people living with HIV/AIDS have low incomes, access to private healthcare facilities and services is problematic and initiatives in this regard are currently being investigated by the CMS (through LIMS). Even though the aforementioned health reforms are yet to be completed, such reforms represent a positive move forward for South Africa's healthcare industry.

7.2 The expansion of access to private health cover is likely to result in an increase in HIV prevalence in the medical-scheme population as a result of the enrolment of lower-income lives. Techniques such as those presented in this paper need to be used to assess the financial effects of the reforms noted above with regard to HIV-related costs.

7.3 CMS (unpublished) reveals the importance of fairness in medical-scheme benefits to consumer protection and gives examples of alleged unfairness in this regard. Alleged unfairness has been found to include discrimination against HIV/AIDS sufferers, restrictions of access to benefits through managed-care interventions, non-discretionary benefits paid out of medical savings accounts and overly generous benefits for HIV/AIDS at the expense of other (chronic) conditions.

7.4 Since medical schemes are not permitted to exclude prospective members, or to apply risk rating to contributions, they cannot charge HIV-positive members a higher contribution than other members (all else equal) nor deny cover. Therefore, in response to the HIV/AIDS epidemic, medical schemes should aim to identify, measure and monitor the risks associated with HIV/AIDS and the changing legislative environment in which medical schemes operate. This should form a part of each medical scheme's wider risk-management process.

7.5 These responses should be achieved through the nature of the benefits offered by the scheme, particularly the PMBs package, and through the promotion of prevention initiatives. Through these initiatives, a medical scheme may be able to lower its incidence rate and maintain a stable prevalence rate in its existing membership. Schemes should promote early enrolment on an HIV DMP so that HIV-positive beneficiaries can start to be managed during the early stages of the disease.

7.6 There is some concern that, by linking the REF definition of HIV to the government protocol of CD4 less than 200, individual medical schemes with higher proportions of HIV-positive beneficiaries, particularly in the earlier stages of the epidemic, will not be adequately compensated for the risk of, nor incentivised to promote early registration on, an HIV DMP.

7.7 Medical-scheme contributions are currently underpinned by the principles of cross-subsidy and equity. This is expected to be furthered under impending SHI reforms in terms of which contributions will be structured for risk and income cross-subsidies, and membership will be mandatory for those earning above a minimum threshold. In this context, it is important that cross-subsidies across different classes of beneficiaries should not jeopardise the security of benefits. These cross-subsidies can be assessed by means of the methodology presented in this paper.

7.8 The data used in this paper are not intended to be representative of the medical-scheme population as a whole in terms of demographic risk factors for HIV. In order to increase the usefulness of the results, there would need to be an increase in the number of schemes included and a greater spread in terms of the sizes of schemes, and the mix of open and restricted schemes. In addition, data relating to HIV DMP enrolments and experience could be used for calibration purposes.

7.9 The methodology used above is a broad-brush approach to the measurement of HIV prevalence in a medical-scheme population by taking some account of transmission dynamics between the various beneficiary groups. The allocation of members to contribution bands or benefit options is an approximation since salary information was not available for all members.

7.10 The choice of a model and the underlying parameters have a significant influence on the results. This paper does not attempt to provide a critique of the ASSA models and therefore assumes that both the models and the parameters are appropriate for this exercise, except where otherwise mentioned (particularly the fact that the models were not calibrated).

7.11 There is considerable scope for further research on the financial effects of HIV on medical schemes so as to extend the methodology presented in this paper by analysing the costs of managed versus unmanaged patients and assessing the economic benefits of HIV treatment strategies. In addition to this, further work is needed on the analysis of possible changes in the risk profile of the medical-scheme population in future years to determine the longer-term effects of HIV/AIDS.

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# APPENDIX A
# BASIC CONCEPTS

**A.1** Origins and spread of HIV globally

The human immunodeficiency virus (HIV) is defined as the "infection caused by one of several related retroviruses that become incorporated into host cell DNA and result in a wide range of clinical presentations varying from asymptomatic carrier states to severely debilitating and fatal disorders". The acquired immune deficiency syndrome (AIDS) is not a universal disease but an acquired syndrome, as its name suggests, and represents the most severe manifestation of a spectrum of HIV-related conditions. It is defined as "a secondary immunodeficiency syndrome resulting from HIV infection and characterised by opportunistic infections, malignancies, neurologic dysfunction, and a variety of other syndromes". (Beers, 1992)

**A.2** Transmission of HIV

Transmission of HIV requires contact with body fluids containing infected cells or plasma. These infected cells can reach target cells in a new host via blood transfusion or accidental injection, or after membrane exposure. Epidemiological studies suggest that sexual transmission of HIV is more likely in the presence of herpes, syphilis, and other sexually transmitted infections (STIs). The vast majority of HIV infections are the result of sexual transmission. Where this is the case, the presence of STIs will greatly increase the probability of HIV infection, by up to 70% (Barnett & Whiteside, 2002). Apart from sexual transmission, the most common cause of HIV infection is through MTCT. The use of contaminated blood or blood products represents the greatest risk of HIV infection per exposure. This is because it introduces the virus directly into the bloodstream (Barnett & Whiteside, 2002).

**A.3** Measuring HIV infection

The primary indicators of HIV infection are the CD4 cell count and the viral load. The CD4 lymphocyte count is a measure of the current extent of HIV damage to the immune system. It is the best predictor of the risk of developing an HIV-related disease. The volume of HIV in a person's blood is measured by the viral load, which indicates the amount of virus in the bloodstream. It affects the rate of decline in the CD4 cell count and is thus a measure of how rapidly an HIV-positive individual is progressing towards death. It is the strongest predictor of the rate of disease development. The viral load is the most useful marker of response to antiretroviral therapy. The generalised distributions by disease stage are shown in Table A1.

Table A1: Generalised disease stages

| | Average duration | Clinical indicator | Symptom |
|---|---|---|---|
| Stage 1 | 4 to 6 years | CD4 > 500 | asymptomatic |
| Stage 2 | 2 to 3 years | CD4 between 350 and 500 | some opportunistic infections |
| Stage 3 | 2 to 3 years | CD4 between 200 and 350 | opportunistic infections |
| Stage 4 | 6 months to 1 year | CD4 < 200 | AIDS |

# APPENDIX B
# SUMMARY OF DATA

**B.1** A summary of the data from the three participating medical schemes is presented in Figures B1 to B5.

Figure B1: Proportion of each beneficiary type per medical scheme

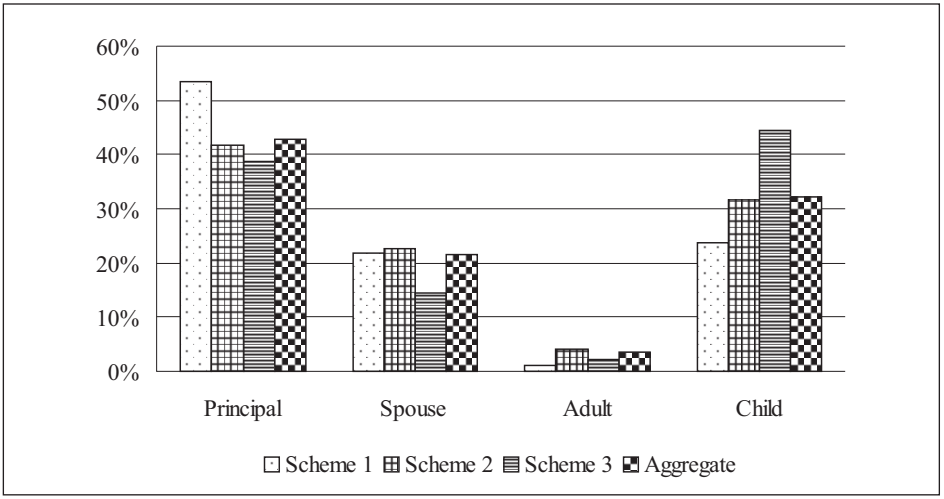



Figure B2: Age distribution for each medical scheme

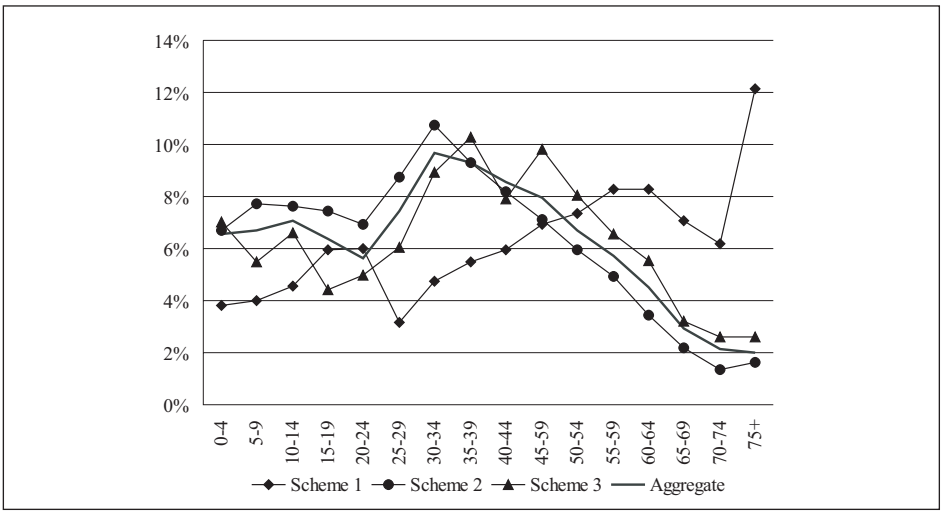


Figure B3: Total provincial distribution (aggregate membership)

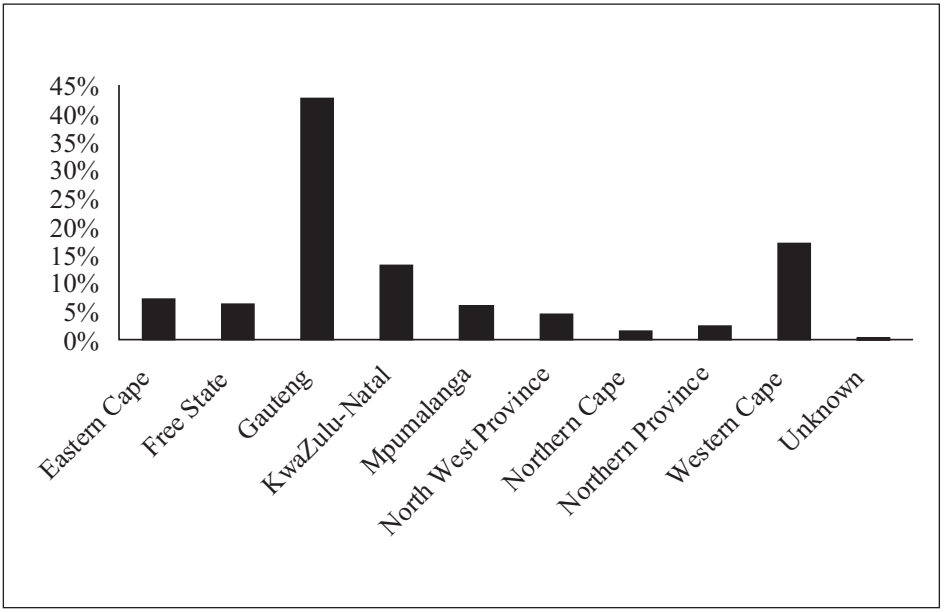



Figure B4: Gender split per beneficiary type (aggregate membership)

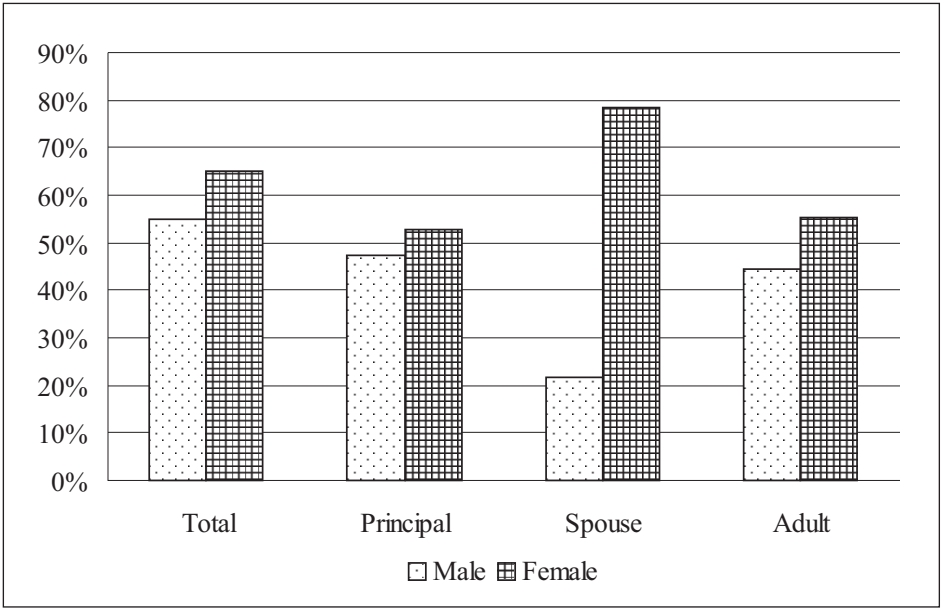
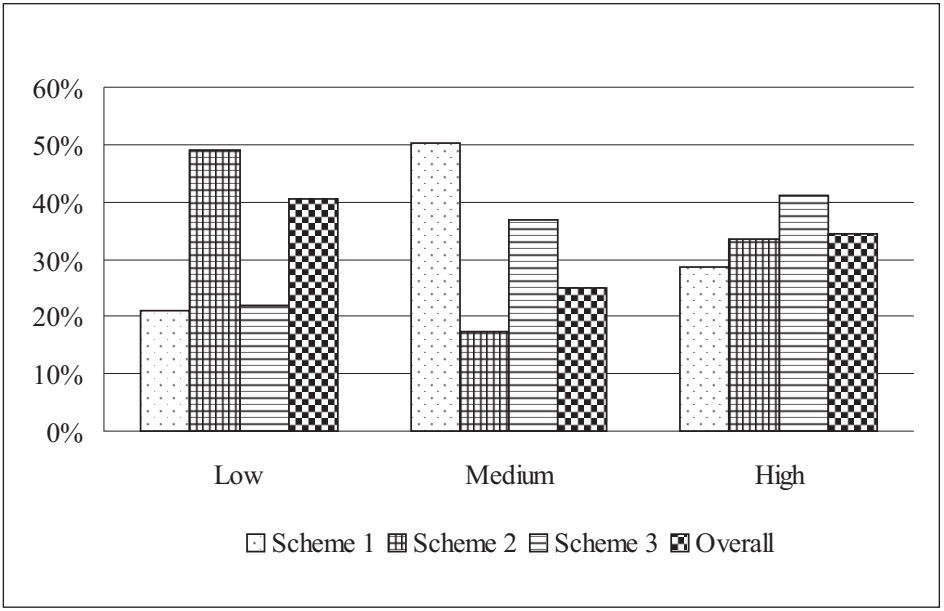


Figure B5: Membership by contribution band



# APPENDIX C
# COSTS AND UTILISATION OF TREATMENT

The costs specified in this appendix have been assumed to apply to each of the HIV and ART stages in the select model, as described in section 6.1. All costs are presented in 2005 rands.

**C.1** Antiretroviral therapy[22] – ART stages only

C.1.1 Except where otherwise stated, all medication costs listed in this section are per month.

Table C1: ART by ART stage

| ART stage | ART | Total cost |
|---|---|---|
| 1 | Staduvine, Lamivudine, Efavirenz | R360–42 |
| 2 | Staduvine, Lamivudine, Efavirenz | R360–42 |
| 3 | Zidovudine, Didanosine, Ritonavir & Lopinovir (Kaletra) | R952–07 |
| 4 | Invirase, Lamivudine, Ritonavir & Lopinovir (Kaletra) | R1373–12 |

C.1.2 Other non-antiretroviral medications to be taken in conjunction with the ART in ART stage 2 are Purbac (R25–25 per month) and Rifafour (R108–30 per month for six months—TB treatment).

C.1.3 Patients moving from ART stages 1 and 2 do so because of non-adherence or natural resistance to the drugs from having taken them for several years. In the case of non-adherence, the patient is more likely to move to ART stage 4. The treatment regimen for ART stage 4 is evolving and drugs such as Truvada and Reyataz have been registered in the United States but not yet in South Africa. The monthly cost of these drugs as well as the daily pill burden is likely to be less than for the current medications under ART stage 4.[23]

C.1.4 For this cost analysis, prices are assumed to follow a 'medium' scenario in that the scenario depicts the utilisation of brand drugs and no major complications in the disease management process. In practice it is likely that costs will be reduced through the utilisation of generic ART medications.

**C.2** Immune supplementation

Immune supplements are administered to patients during each of the four ART stages. The cost per patient per month is assumed to be R153–00.

22 The ART treatment protocols have been provided by Calibre Clinical Consultants, April 2006.

23 Personal communication with Dr Leon Odendaal, Calibre Clinical Consultants, 11 August 2006.

**C.3** Pathology testing

Pathology testing includes CD4, viral load and full blood count. The combined cost of these tests is R1210–00. Other tests such as liver function, cholesterol and glucose are not included. The frequency by stage is assumed to correspond to that of doctor consultations (see below).

**C.4** Doctor consultations

The NHRPL cost per doctor consultation (general practitioner) is R172–60.[24]

**C.5** Hospitalisation

C.5.1 In- and out-patient costs per claim for hospitalisation for patients in each HIV and ART stage are shown in Table C2. The hospitalisation costs shown in Geffen et al. (2003) reflect 2003 rand costs. These costs were therefore inflated by 17,8% for two years so that the costs of hospitalisation reflect 2005 rand amounts. This inflation assumption was derived from the annual report of the CMS for 2004/5[25] and reflects the annual increase between 2003 and 2004 in average total hospitalisation benefits (private and provincial) per beneficiary.

Table C2: Cost per claim

| Price per item | ART | Immune modulators | Pathology | Doctor Consultations | Hospitalisation |
|---|---|---|---|---|---|
| HIV stage 1 | | R153 | R1 210 | R172 | R1 912 |
| HIV stage 2 | | R153 | R1 210 | R172 | R1 912 |
| HIV stage 3 | | R153 | R1 210 | R172 | R9 120 |
| HIV stage 4 | | R153 | R1 210 | R172 | R25 006 |
| ART stage 1 | R569 | R153 | R1 210 | R172 | R1 912 |
| ART stage 2 | R569 | R153 | R1 210 | R172 | R1 912 |
| ART stage 3 | R829 | R153 | R1 210 | R172 | R9 120 |
| ART stage 4 | R1 373 | R153 | R1 210 | R172 | R25 006 |
| Children pre-AIDS | | R153 | R1 210 | R172 | R1 912 |
| Children AIDS | R569 | R153 | R1 210 | R172 | R25 006 |

C.5.2 The annual frequencies of claims for hospitalisation for patients in each HIV and ART stage are shown in Table C3.

24 www.medicalschemes.com, accessed June 2006

25 Council for Medical Schemes (unpublished). Report of the Council for Medical Schemes, 2003/4, www.medicalschemes.com

Table C3: Claim frequency

| Frequency per annum | ART | Immune modulators | Pathology | Doctor Consultations | Hospitalisation |
|---|---|---|---|---|---|
| HIV stage 1 | 0 | 12 | 2 | 2 | 1 |
| HIV stage 2 | 0 | 12 | 2 | 2 | 1 |
| HIV stage 3 | 0 | 12 | 2 | 2 | 1 |
| HIV stage 4 | 0 | 12 | 2 | 2 | 1 |
| ART stage 1 | 12 | 12 | 2 | 2 | 1 |
| ART stage 2 | 12 | 12 | 2 | 2 | 1 |
| ART stage 3 | 12 | 12 | 4 | 4 | 1 |
| ART stage 4 | 12 | 12 | 4 | 4 | 1 |
| Children pre-AIDS | 0 | 12 | 2 | 2 | 1 |
| Children AIDS | 12 | 12 | 4 | 4 | 1 |

C.5.3 The total annual cost of claims for hospitalisation for patients in each HIV and ART stage are shown in Table C3.

Table C4: Cost per annum per stage

| Cost per annum | ART | Immune modulators | Pathology | Doctor Consultations | Hospitalisation |
|---|---|---|---|---|---|
| HIV stage 1 | | R1 836 | R2 420 | R344 | R1 912 |
| HIV stage 2 | | R1 836 | R2 420 | R344 | R1 912 |
| HIV stage 3 | | R1 836 | R2 420 | R344 | R9 120 |
| HIV stage 4 | | R1 836 | R2 420 | R344 | R25 006 |
| ART stage 1 | R6 825 | R1 836 | R2 420 | R344 | R1 912 |
| ART stage 2 | R6 825 | R1 836 | R2 420 | R344 | R1 912 |
| ART stage 3 | R9 946 | R1 836 | R4 840 | R688 | R9 120 |
| ART stage 4 | R16 476 | R1 836 | R4 840 | R688 | R25 006 |
| Children pre-AIDS | | R1 836 | R2 420 | R344 | R1 912 |
| Children AIDS | R6 825 | R1 836 | R4 840 | R688 | R25 006 |