

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

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## ABSTRACT

With the mounting 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, community rating of contributions and 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 impacts. The opportunity to lower these costs through proactive risk management is investigated.

## 1. INTRODUCTION

- 1.1 Medical schemes are major stakeholders in the private health care sector in South Africa, alongside health insurers, health care providers, employers, administrators, managed care organisations, brokers and medical scheme members (the end-consumers of health care services).
- 1.2 Prior to the implementation of current legislation defined through 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 based on statistical evidence that older members are higher claimers than younger members, on average. 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 mounting HIV epidemic throughout South Africa, the age-costing of medical scheme claims began to shift. This was because HIV/AIDS largely impacts on 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 however, opportunities for medical schemes to exclude 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. 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 impact of HIV on medical schemes, primarily in terms of prevalence and costs, is difficult to determine.
- 1.6 Many medical schemes have chosen to manage the impact of HIV/AIDS by introducing HIV disease management programmes 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, establishing an estimate 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. Determining estimates 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 impact on overall contributions. These measures are integral parts of medical scheme risk management and understanding the drivers of health care costs.
  - 1.8 Johnson and Dorrington (2002) estimated that medical scheme prevalence would peak at 8% in 2008, while Katz (1999) estimated that the prevalence curve will peak at 6.4%. Van den Heever (1998) quotes various sources that suggested that medical scheme HIV prevalence could reach a level as high as 20%. Although Katz (1999) used the ASSA600 model and information from a single medical scheme to derive prevalence estimates, the work nonetheless forms a basis for this research and a baseline for comparison of prevalence results. This research will, however, be a progression from Katz (1999), as it will use data from three large medical schemes and employ models that reflect the current extent of the epidemic. Results derived from this research will be compared to Johnson and Dorrington (2002).
  - 1.9 We have assumed a basic understanding of terminology and concepts associated with HIV/AIDS. Some of this terminology is explained in Appendix A.
  - 1.10 This 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. The paper 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 impact to assist budgeting.
  - 1.11 Section 2 of the paper presents an overview of the medical schemes environment in South Africa. Section 3 addresses the impact 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 we have set out a methodology for assessing HIV prevalence in a medical scheme population and presented a methodology for quantifying the financial impact. 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 later in the paper.

## 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 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 or 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 The medical schemes are regulated on the principle of social solidarity. This arose out of concerns during the 1990s that vulnerable groups were being excluded. By 1999 no open scheme was permitting anyone over the age of 55 to join as an individual member. Virtually all open schemes applied life-time exclusions for pre-existing conditions, and age-rated and/or experience rated their membership without restriction. Medical costs continued to rise (due to the retention of fee-for-service reimbursement) and non-medical costs were driven up (through profit taking and hidden commission costs).
- 2.1.4 The new Medical Schemes Act (Act 131 of 1998) that was implemented on 1 January 2000 introduced the following concepts to the medical schemes:
- **Community rating:** contributions cannot be determined on factors other than income and family size. This means that medical schemes cannot rate based on risk factors such as age and health status. Members who do not enter the medical scheme environment until after the age of 35 may be subject to late joiner penalties.
  - **Guaranteed acceptance:** all members who apply to open medical schemes must be accepted, provided that they pay the required contributions. Some temporary restrictions may be placed on members based on pre-existing

conditions depending on the prior coverage status and reason for changing schemes. For restricted membership schemes, all members who meet the eligibility criteria (for example employment with the sponsoring employer) must be accepted.

- Prescribed minimum benefits: all registered medical scheme options must offer the prescribed minimum benefits. These were initially defined according to a set of acute, urgent hospital treatments (at a designated service provider) but later expanded to include HIV diagnosis and treatment and chronic medication and management (for the defined conditions).
- Statutory minimum solvency: medical schemes are required to hold 25% of their annual gross contributions as a solvency margin i.e.  $(\text{Net Assets} - \text{Liabilities}) / \text{Gross annual contributions}$ . No allowance is made for factors such as reinsurance and other risk transfer agreements or the portion of contributions relating to administration and other fees or members savings in this calculation. Schemes were given five years from the implementation of the Act (or subsequent registration) to meet this requirement. Assets are also subject to regulation in terms of the proportion that can be held in equities, offshore etc.
- Contractual arrangements: medical schemes may only contract with Administrators and Managed Care Organisations that have been accredited by the Council for Medical Schemes and may only pay commission (up to the regulated maximum) to Brokers that have been registered with the Council for Medical Schemes. The medical schemes may also only enter into reinsurance arrangements that have been approved by the Council for Medical Schemes.

2.1.5 In the current environment, despite the reforms of open enrolment, community rating and Prescribed Minimum Benefits (PMBs), 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 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, 2004) be established to facilitate the pooling of risk in respect of the common package of benefits across all medical schemes. It was proposed that the REF would be implemented from January 2007 but it now appears that this may be delayed as the legislation has yet to be published. This implementation may take place in stages.

- 2.1.7 The REF formula is published in the form of a REF Contribution Table which indicates the amount to be received by the medical scheme for each person in each risk group. The risk factors agreed by the industry for use by the REF are:
- Age last birthday on 1 January, summarised into five year age bands
  - The diagnosis and treatment of any of the 25 PMB–CDL (Chronic Disease List) conditions; Where a beneficiary has more than one CDL condition, the scheme may count the most expensive of the conditions;
  - The number of multiple CDL conditions. Allowance is made for 2, 3, and 4+ simultaneous CDL conditions;
  - The treatment of HIV/AIDS provided the beneficiary is receiving or has received anti-retroviral therapy according to the PMB definition; and
  - Maternity, defined as the delivery of a single/multiple foetus either still-born or alive.
- 2.1.8 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 doctors and hospitals in order to ensure that their members obtain cost-effective delivery of the basic package of benefits.

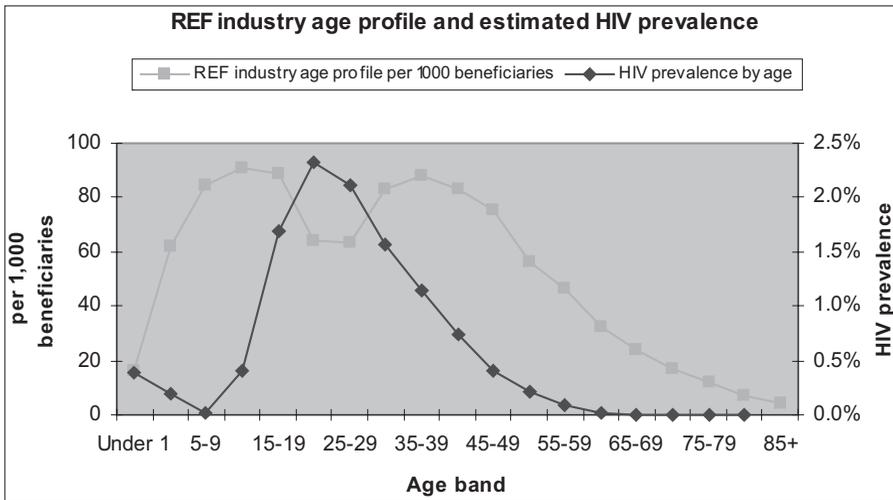
## 2.2 Population covered

- 2.2.1 The total membership of all medical schemes has been at the level of around 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.<sup>1</sup> 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 later in the paper) however it aims to illustrate the distribution of beneficiaries relative to HIV risk. The research presented later in the paper aims to improve significantly on this analysis.
- 2.2.4 The medical scheme population is clearly a select group from the perspective

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1 The REF Grid can be downloaded from [www.medicalschemes.com](http://www.medicalschemes.com)

Figure 1



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).

### 2.3 Prescribed Minimum Benefits

- 2.3.1 The Prescribed Minimum Benefits are a legislated set of benefits that each registered medical scheme<sup>2</sup> is compelled to offer as part of each benefit option. The benefits defined in this package must be paid in full, without co-payment<sup>3</sup> or deductibles. This package includes cover for hospital and outpatient services on a non-discriminatory basis. 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 minimum benefits package. Under code 168S (see

2 Bargaining Council medical schemes may have been granted exemptions from certain provisions of the Medical Schemes Act such as the PMBs.

3 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 involuntarily use a provider that is not a Designated Service Provider, no co-payment is payable.

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 mother-to-child transmission prevention treatment, voluntary counselling and testing, and treatment for common opportunistic infections.

- 2.3.3 According to the Annual Report of the Council for Medical Schemes (CMS) (2003/4), several complaints had surfaced regarding schemes that restricted access to antiretroviral benefits. A survey conducted by the CMS (Stein et al (2002)) 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 on Cabinet’s commitment to the provision of ART and the publication of the Department of Health Operational Plan for Comprehensive HIV and AIDS Care, Management and Treatment for South Africa (2003), 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. 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 health care sector. The Department of Health’s National Antiretroviral Therapy Guidelines (2004) 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 WHO stage or WHO stage IV irrespective of CD4 cell count
  - Willingness and readiness on the side of the patient to be adherent with their medication regimens
  - Attendance at two screening visits and an ART commencement visit
  - Two drug regimens are made available for eligible patients
- 2.3.7 The medical criteria for the commencement of ART are consistent with WHO (2004) guidelines for the use of ART in resource-limited settings. However, according to Chen et al (2001), in an analysis of long-term survival during 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 Before the implementation of the PMBs, Katz (1999) noted that the PMB requirement might have onerous implications on many smaller schemes in the market. In this respect, he noted that all medical schemes, not only small schemes, might be faced with enormous unmanaged costs as more current HIV positive beneficiaries developed AIDS-related conditions.
- 2.3.9 In the early part of 2003, the CMS finalised a costing study of the PMBs to measure their affordability. The study estimated the full price of the PMB package, which consists of the Inpatient package, the Outpatient package and the CDL, at R 2158 per beneficiary per annum (p.b.p.a.) or R179.73 per beneficiary per month (p.b.p.m). This is made up of an Inpatient package of R1 246,95 p.b.p.a., an Outpatient package of R232,10 p.b.p.a. and the CDL package of R677,74 p.b.p.a. in 2001 prices. The CDL package contains the

chronic medicine component together with an estimate for medical management that covers the diagnosis and management of the CDL package.

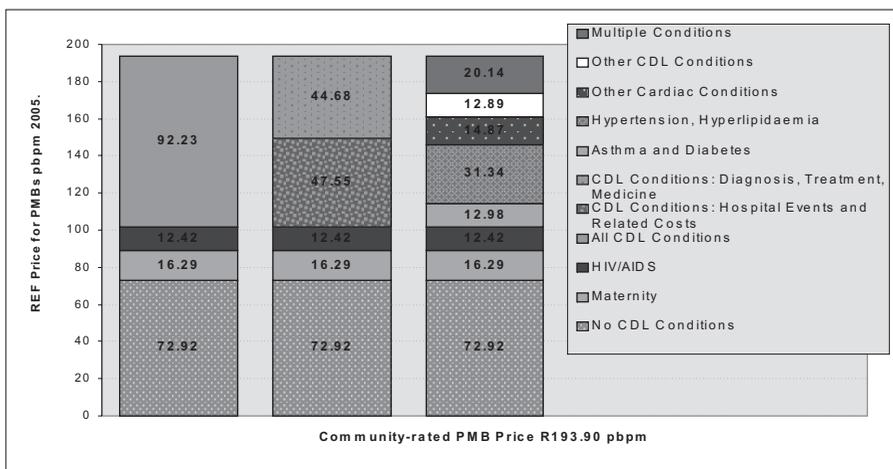
- 2.3.10 The figure below shows a fuller breakdown of the PMB package in terms of Chronic Disease List conditions, maternity benefits and HIV/AIDS. Of the total community-rated PMB price of R193.90 per beneficiary per month, the cost of the HIV/AIDS portion is R12.42 (6%).
- 2.3.11 These PMBs form the basis of the proposed REF that was proposed for implementation in January 2007 but has been delayed by the legislative process.
- 2.3.12 The proportionate 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 IMPACT OF HIV/AIDS

#### 3.1 The South African Epidemic

- 3.1.1 The UNAIDS 2005 Report on the Global AIDS Epidemic identifies sub-Saharan Africa as the worst affected region in the world. According to the UNAIDS report, there were 24.5 million people (64% of the global epidemic) living with HIV in sub-Saharan Africa in 2005. Considering the sub-Saharan epidemic relative to the global epidemic, the results for 2005 are as follows:

**Figure 2: Risk Equalisation Technical Advisory Panel, REF Contribution Table 2005, implicit price**



SOURCE: Risk Equalisation Technical Advisory Panel, March 2005. [www.medicalschemes.com](http://www.medicalschemes.com)

**Table 1: UNAIDS Analysis of sub-Saharan epidemic**

	<b>Proportion of Global Epidemic in sub-Saharan Africa</b>
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 antiretroviral therapy	72%

SOURCE: UNAIDS (2005)

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

“South Africa’s epidemic is one of the worst in the world with an estimated 5.5 million people (18.8% of adults<sup>4</sup>) 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.”

3.1.4 The first South African national burden of disease (Bradshaw et al (2006)) focussed 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 health care services, often with more severe strains placed on some of the most disadvantaged facilities (Ntuli and Day, 2004).

4 UNAIDS HIV prevalence estimates 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 antenatal clinic data reflect only HIV prevalence among pregnant women who use public facilities, these tend to be higher than those based on household surveys.

HIV/AIDS can also be considered to be a factor outside of the health care delivery system that directly impacts on the demand for health care 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 health care goods and services until death of the infected individual. These demands are often not characteristic of other diseases.

### 3.2 Mortality

Mortality rates, according to Bradshaw and Dorrington (2005), are “key measures” that are widely used for international comparisons of the general state of development and health of a nation. The authors above 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, the authors 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 15–59 years in sub-Saharan Africa (WHO, 2004, UNAIDS, 2002). This is because, as the immune system of infected persons weakens, so 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 implementation of Social Health Insurance 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 a Risk Equalisation Fund (as cited in McLeod et al, 2004). 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 REF, Social Health Insurance (SHI), expanding membership base, increased coverage of younger members could lead to changes in the structure of the medical scheme population could result in increased HIV prevalence in medical scheme population.
- 3.4.3 One of the REF risk factors is the number of beneficiaries (per 5-year age band) that receive antiretroviral therapy according to the PMB definition. Therefore, medical schemes will be compensated for the number of beneficiaries that are registered on a HIV Disease Management Provider and are administered antiretroviral therapy, according to the PMB definition. This compensation would be for those members that are receiving antiretroviral therapy in excess of the assumed industry profile. This feature of the REF may encourage medical schemes to promote their HIV programme and by doing so, encourage beneficiaries to enrol on a HIV Disease Management Programme (DMP) and receive the requisite treatment. However, the REF only provides some compensation for beneficiaries on antiretroviral therapy only and not to those beneficiaries that are HIV-positive but those do not yet require antiretroviral treatment.

## **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 health care service providers and payers, such as medical schemes.
- 4.1.2 One of the biggest challenges facing medical schemes in terms of HIV disease management is that members are not enrolling on HIV programmes at an early stage of the disease, according to 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 antiretroviral therapy at the optimal time (as defined by clinical criteria). Those patients that initiate therapy at the optimal time have much better survival prospects (Chen et al (2001)).

- 4.1.3 Cowlin et al (2003) 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/100 person-years during the first year of treatment to 6.6/100 person-years during the second year and kept decreasing thereafter (4.5, 2.3 and 2.2 for 3, 4 and 5 years respectively). Further, the cumulative probability of dying at 12 months reached 17.9%, 13.1% and 5.8% for less than 50, 50–199 and more than 200 CD4 cells respectively. This 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 the World Bank (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
  - 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 interfere 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 only been available since the mid-nineteen-nineties and so long-term data is not available. The effects have been estimated with reference to clinical trials and projections. It is generally accepted that 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.
- 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 The World Health Organisation (WHO) published guidelines on ART in 2002 as set out in Table 2.

**Table 2: Treatment Guidelines (WHO, 2002)**

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 (2006), ART had been made available to HIV-positive individuals in the South Africa via four main mechanisms:

#### 4.3.1.1 OUTSOURCED HIV DISEASE MANAGEMENT SERVICES

Medical schemes and employer groups can contract the services of a disease management company to supply antiretroviral therapy and other medication to patients enrolled on a HIV DMP, as well as to co-ordinate and manage the processes involved.

#### 4.3.1.2 MEDICAL SCHEMES

Antiretroviral therapy is made available via the Prescribed Minimum Benefits package and the benefits of many medical schemes tend to be in excess of the minimum requirements (Stein et al, 2002). The REF should provide some incentive for medical schemes to seek ways of increasing the number of HIV-positive beneficiaries on their DMP.

#### 4.3.1.3 GOVERNMENT ANTIRETROVIRAL THERAPY OPERATIONAL PLAN

ART is available at selected public sector clinics through the Operational Plan. Patients presenting themselves for treatment must satisfy certain medical and attendance criteria as set out by the Department of Health' National Antiretroviral Treatment Guidelines. Although Government is making ARVs available, there are several problems with this provision in the context of the private health care sector for individuals that require treatment with 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 (see Appendix A, Figure A2). Further, 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 antiretroviral treatment initiation at a CD4 cell count below 200 is applicable in what are known as 'resource- limited' settings (WHO, 2002).

The Government only provides access to 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.

#### 4.3.1.4 COMPANY CLINICS

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

In a survey by Connelly and Rosen (2005) of 52 private sector and parastatal employers in South Africa with more than 6,000 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 a HIV DMP, with about 3.8% of employees across the 52 companies surveyed actually receiving antiretroviral therapy.

- 4.3.2 Despite an increased availability and affordability of antiretroviral therapy via these four avenues for accessing ART, there is a low proportion of HIV-positive people in South Africa who are eligible for treatment that are actually receiving it. Johnson (2006) estimated that, in the middle of 2005, about 60,000 people were receiving antiretroviral therapy 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 antiretroviral therapy at public sector clinics. The target (Department of Health (2003)), however, was set at 215,689 patients starting ART in 2005/6 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 statistical risk of transmitting the virus through bodily fluids (World Bank, 2004).
- 4.4.2 Problems arise because multi-drug treatment combinations of antiretrovirals (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 antiretroviral treatment 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%–40% creates 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).
- Reduced precautions against infections: According to Barnett and Whiteside (2003), 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 impacts on incidence rates.

4.4.3 According to the World Bank (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
- Treatment using drugs and consumable medical supplies for STIs, opportunistic infections and TB
- 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 system of HIV-infected patients. Recent research from the XVI International AIDS Conference by Kaiser et al (2006) 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 (CD4 percentage increased 24%) 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. These increases were shown to be statistically significant. At present, there are no clinical protocols in terms of provision of immune supplementation for patients that have not yet commenced ART.

- 4.4.5 For the purpose of this research report, and in discussion with various players in the industry, 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. Since there is no generally accepted immune supplement in terms of a pre-ART and ART treatment protocol, it is assumed that the supplements provided by Calibre Clinical Consultants provide a reasonable indication of cost and frequency of administration. The cost per patient per month is 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, geographical regions and also by age and gender. 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 and Budlender, 2003).
- 5.1.2 For the purposes of this discussion, we have used the term “medical scheme population” to refer to all individuals who are beneficiaries of medical schemes (principal members and their dependants, if any) and “general population” to refer 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 and 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 and Budlender (2003), have been identified as primary and measurable risk factors with respect to HIV prevalence:
- income and employment
  - gender
  - age
  - race
  - province

These are discussed in more detail below.

## 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, 2000). Relatively poorer 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 and Sunter, 2000);
  - The poor are less likely to be educated about HIV and AIDS, and how it is transmitted (Johnson and Budlender, 2002);
  - Many of the poor do not have access to treatment for sexually transmitted diseases or cannot afford treatment (Rosenberg et al, 2000). Sexually transmitted diseases enhance HIV transmission by increasing both susceptibility of HIV negative individuals and the infectiousness of HIV positive individuals (Barnett and 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 and 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. Reasons have been cited as the ability of higher income earners to attract more sexual partners (Rosenberg et al, 2000), different perceptions of the risk of contracting HIV, and ignorance relating to the disease.
- 5.2.3 The employed population, comprising unskilled, semi-skilled and skilled people, is of particular interest in the medical scheme context. Due to the socio-economic implications of medical scheme membership (i.e. affordability), HIV prevalence levels in medical schemes are expected to be lower than 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 (for example, da Silva (2002)).
- 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 adverse 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.
- 5.2.5 Some medical scheme contribution tables are income-based in that the higher income earners pay more contributions. This is usually a case only in restricted schemes as open medical schemes do not tend to rate contributions according to income except at the lower levels to promote affordability.
- 5.2.6 As a family structure 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 chronic condition costs 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 We have used contribution level as a proxy factor for income when 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 Appendix B. Overall, about 35% of beneficiaries are covered by comprehensive-type benefit options, while about 40% have low cost medical scheme benefit options. The proportions with lower cost options are expected to increase as medical schemes introduce more lower cost options.

- 5.2.9 At present, medical scheme membership is not mandatory, unless through the employer. Under the proposed Social Health Insurance (SHI) system (see McLeod et al, 2004), 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 results of the National HIV and syphilis antenatal seroprevalence survey in South Africa in 2005, the Department of Health (2006) estimates that female HIV-infection is higher than male HIV-infection. For adults aged 15+ years, the number of HIV-infected females and males are estimated to be 3.12 million and 2.19 million respectively, with the ratio of female to male HIV-infection estimated at 1.425.
- 5.3.2 Some reasons for HIV infection being higher among females than males are:
- According to the World Bank (1997), the probability of HIV-1 infection per exposure is 1.2 infections per 1000 exposures for male-to-female unprotected sex and 0.33-1 per 1000 exposures for female-to-male unprotected sex. This is because females are biologically more susceptible to HIV-infection per sexual exposure.

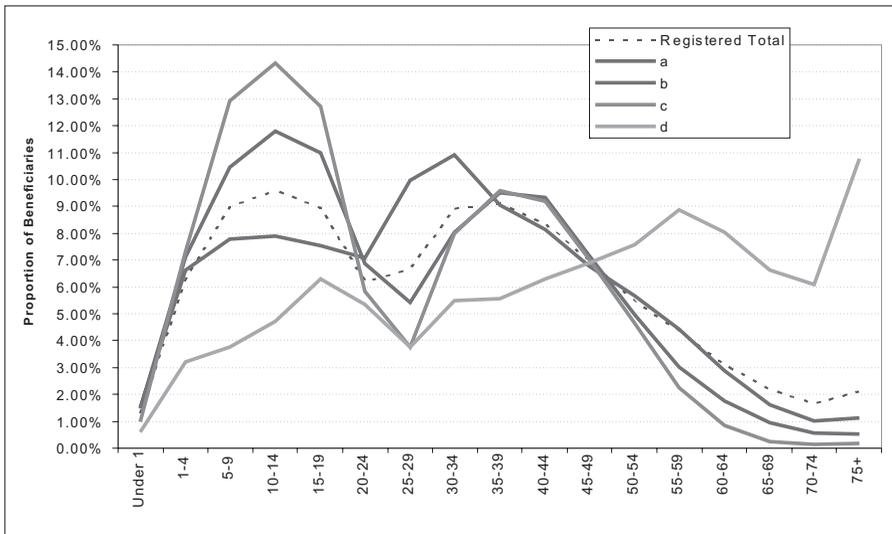
- With the income share of women being only 30.5% of national income (Department of Health and Human Development, 1998), women are also more susceptible because of their lower socio-economic status (this is particularly so in developing and least developed countries)

## 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 and Johnson, 2002). Therefore, the effect of age in HIV prevalence needs to be analysed separately for each gender.
- 5.4.2 Infants (0–4 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 (5–14 years) and pensioners (older than 65 years) is very low and the latter is assumed to be negligible for the purposes of this work. For this reason, medical scheme beneficiaries who are pensioners are excluded from this analysis. The most severe concentration of HIV is in the adult population (15–64 years) who form the bulk of the population (Whiteside and Sunter, 2002). 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 depending on the type of medical scheme. Open medical schemes have historically had more young members than restricted medical schemes. For the four largest open medical schemes in South Africa (see figure 3 below), the age distributions are generally bimodal in shape, with a significant concentration of members (and dependants) in the younger age bands.

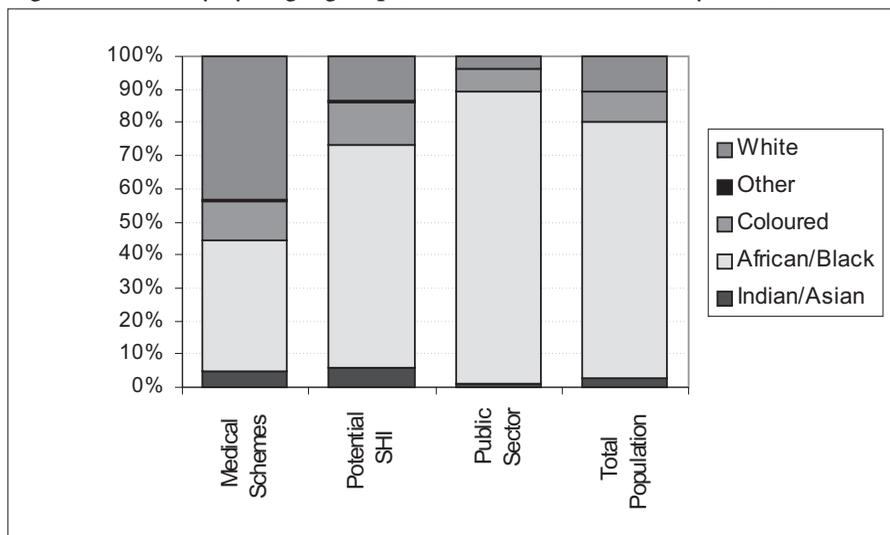
## 5.5 Racial differentials

- 5.5.1 The AIDS epidemic is most severe in the black African population (Dorrington and Johnson, 2002). The low income levels in the black African population have been put forward as a reason but the social effects of the migrant labour system and the gradual breakdown of traditional society is also responsible.
- 5.5.2 The epidemic in the South African ‘Coloured’ community (not black African) is less severe than that in the black African community. 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 population (Dorrington and Johnson, 2002). The epidemic is the least severe in the Asian and White population groups.

**Figure 3: Age profiles of the largest open schemes (2002 data)**

SOURCE: McLeod et al (2004), page 18

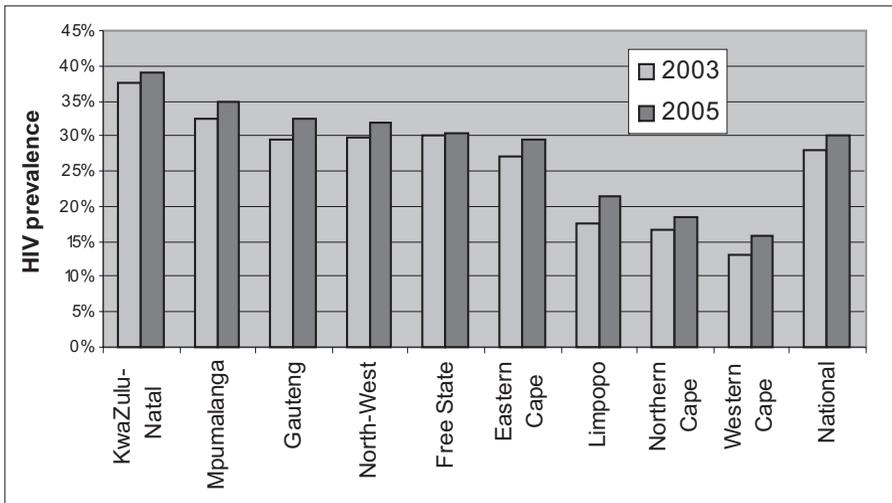
- 5.5.3 Data on race is not available from medical schemes because they are not permitted to underwrite new applicants based on this risk factor and thus do not maintain accurate records. Race, however, does serve as a proxy for other socio-economic factors influencing HIV transmission in South Africa (Johnson and Dorrington, 2002). Sexually transmitted diseases, migration, urbanisation, education, occupation and industry, skill level, culture group each contributes to the risk of transmission of the virus but data is not available from medical schemes on many of these factors.
- 5.5.4 Data from the October Household Survey in 1999 provides some indication of the racial composition of the medical scheme population. Historically, the proportion of white medical scheme members has been high and this is projected to decrease as a proportion of total membership under proposed Social Health Insurance reforms. McLeod et al (2004) have estimated that in the first phase of SHI about 43.2% of the medical scheme membership could be black and that this figure could increase to 54.7% under the fullest extent of SHI.
- 5.5.5 Therefore, all other things being equal such as age and gender, the racial proportions given in Figure 4 on race suggest a lower HIV prevalence level in the medical scheme population than that of the general population.

**Figure 4: Ethnicity by target group (October Household Survey 1999)**

SOURCE: McLeod et al (2004), page 56

## 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 in South Africa (Dorrington et al, 2002).
- 5.6.2 According to the Department of Health (2006), the antenatal clinic data for 2005 reveal that the epidemic has historically 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 (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.
- 5.6.3 According to Van den Heever (1998), there is a correlation between area of residence and socio-economic status and with HIV higher risk. Areas with low socio-economic status are assumed to correlate with higher HIV risk. The areas are assumed to comply with lower socioeconomic status are those with largely informal dwellings.
- 5.6.4 Differences in prevalence and incidence between provinces mean that medical schemes 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.

**Figure 5: Antenatal HIV prevalence rates by province in South Africa, 2003, 2005**

SOURCE: Department of Health (2006)

## 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 for 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.
- 5.7.3 To reduce HIV prevalence, the group that is classified as a 'high risk' group would need to take preventative action, with women taking initiatives in this regard. 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 a HIV programme and address his health needs accordingly. This action can increase mean survival time. Further, modifying sexual behaviour after discovering HIV status is very important to ensure that more people are not infected with the virus (Van den Heever, 1998).
- 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 If one looks at social factors that implicitly affect group behaviour, it has been found that higher levels of social cohesion, as defined in Barnett and 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 relative to the general population and this may also explain or imply a reduced prevalence rate to 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 due in part to 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, gender 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 method for measuring HIV prevalence within a medical scheme population. Projection models of the Actuarial Society of South Africa (ASSA) are utilised to assess an estimated prevalence rate: the ASSA2003 AIDS and Demographic Model and the ASSA 2003 DemSelect Model.<sup>5</sup> In this paper, these models are referred to as the ‘National model’ and the ‘Select model’, respectively. The former model 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

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5 Both models and the respective User Guides can be downloaded from [www.assa.org.za/aidsmodel.asp](http://www.assa.org.za/aidsmodel.asp)

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, 2000):
- 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
  - 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 a scheme's HIV DMP and therefore, it would not necessarily be possible to identify those members that are claiming for HIV-related benefits. Even where schemes do have a 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 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:
- The model used to determine a baseline HIV prevalence rate against which future HIV prevalence rates can be measured
  - The model can incorporate parameters that incorporate the impact of interventions, treatment and other management efforts. In this way, trends in HIV prevalence can be calculated based on the initiatives undertaken to reduce the spread and/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:

- 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.

Ideally those who are HIV positive and AIDS sick should be registered on and participating in HIV Disease Management Programmes.

## 6.2 Data

- 6.2.1 Demographic data per beneficiary was obtained by three large medical schemes in South Africa during 2004. The data was provided at beneficiary level and comprised only of member number, date of birth, gender, 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 (according to the annual report of the Council for of Medical Schemes (2005), the estimated number of beneficiaries in 2004 was 6.915 million).
- 6.2.2 Information on race was not available, as schemes do not collect this information. No information relating to estimated HIV prevalence or numbers enrolled on HIV disease management programmes was provided. Even if the medical schemes that provided data were willing to share information about their HIV treatment programmes, 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.
- 6.2.3 Based on discussions with various industry players, such data on HIV-positive beneficiaries is very difficult 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 The data from these participating medical schemes is not necessarily representative of the entire South African medical scheme population and therefore, the results derived from this research cannot necessarily be extrapolated to the medical scheme population. However, a comparison is made between each demographic factor for which data has been received and the data submissions for the Risk Equalisation Fund, as set out in McLeod et al (2004).
- 6.2.5 A summary of the data is provided in Appendix B.
- 6.2.6 Clinical costing data was obtained directly from Calibre Clinical Consultants, a Managed Care Organisation that specialises in HIV Disease Management for medical schemes. The data is therefore expected to fairly represent the cost of

HIV disease management for medical schemes. The company is accredited by the Council for Medical Schemes as a Managed Care Organisation. Such clinical costing data includes prices of the following antiretroviral therapy (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 the methodology for determining estimates of HIV prevalence in a sample of the medical scheme population.

#### 6.3.2 ADJUSTMENT OF RACIAL COMPOSITION

Since data on the racial profile of beneficiaries was not available, and the racial split of the total medical scheme population is different to 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 initial population in 1985 so that the projected racial split in 2004 reflects the current 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 gender from the National model were calculated and imported into the Select model.

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

6.3.3 The effect 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.

**Table 3: Adjustment of ASSA National model 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%

#### 6.3.4 ALLOWANCE FOR INCREASED INTERVENTIONS AND ACCESS TO TREATMENT

The ASSA 2003 Lite model makes allowances for the following interventions:

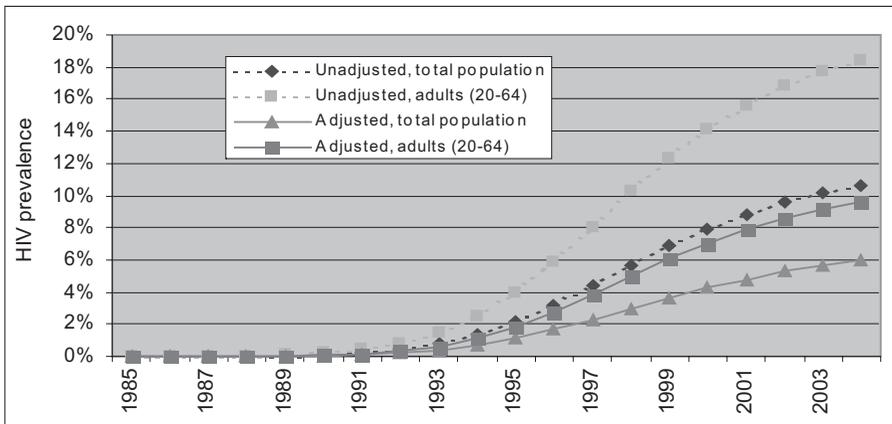
- Information and education campaigns, social marketing
- Treatment for sexually transmitted infections
- Voluntary counselling and testing
- Mother-to-child transmission prevention
- Antiretroviral therapy

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 multiplicative adjustment 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 adjustment factors that reflect increased access to and utilisation of interventions was applied. To ascertain the appropriateness of these assumptions, one would require data against which to check the sensitivities.

6.3.6 The assumptions for the multiplicative adjustments to the prevalence rates for new entrants and the incidence rates from the National model are set out in four illustrative scenarios, as follows:

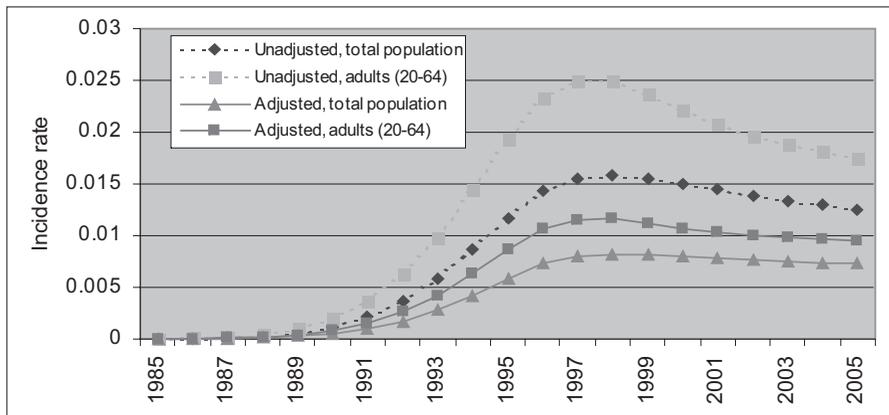
- Scenario 1: no adjustments to HIV prevalence rates for new entrants and incidence rates.

**Figure 6: Estimated national HIV prevalence, adjusted for racial composition**



SOURCE: calculated from ASSA 2003 AIDS and Demographic model

**Figure 7: Estimated national HIV incidence, adjusted for racial composition**



SOURCE: Calculated from ASSA 2003 AIDS and Demographic model

- Scenario 2: Select model default assumptions for multiplicative adjustments<sup>6</sup>
- 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 4 is intended as the scenario most appropriate for the current medical scheme population while the other scenarios are intended to illustrate the effect of changes in the current medical scheme population.

**Table 4: Multiplicative adjustments to HIV prevalence rates of new entrants and HIV incidence rates**

Multiplicative adjustments	To HIV prevalence rates for new entrants					To HIV incidence rates				
	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 This scenario should reflect having “reasonably good HIV prevention programmes” and reflect a “degree of intervention”, personal communication via e-mail with L Johnson, 7 August 2006.

### 6.3.7 ALLOWANCE FOR MODELLING OF A FAMILY UNIT STRUCTURE

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
- Spouse
- Adult dependant(s)
- Child dependant(s)

6.3.8 The linkage of these beneficiaries is through the 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 corresponding 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 dependents under 14 years old). For child dependents over 14 years old, HIV infection is assumed to be independent of the family unit. The HIV prevalence of child dependents 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 In a study by Quinn et al (2000), the authors tracked the HIV sero-status 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 other studies by Carpenter et al (1999) and Hugonnet et al (2002), it was found that the risk of HIV transmission from female to male was double that of transmission from male to female in HIV sero-discordant 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. For ease of calculation, it is initially assumed that all of the calculated HIV-positive principal members have a corresponding HIV-negative spouse and therefore the couple is HIV serodiscordant. In other words, of the principal member and spouse couple, either a principal member (male or female) is HIV-positive, or a spouse (female or male) is HIV-positive.

6.3.12 The methodology for incorporating the transmission dynamics between principal members and spouses are as follows:

- If a male principal member has a corresponding female spouse, then there is a 44% probability of the male infecting the female (Quinn et al, 2000). This is because Carpenter (1999) finds that women are twice as likely to contract HIV from their HIV-positive male partner.
- If a female principal member has a corresponding male spouse, then there is a 22% probability of the female infecting the male (Quinn et al, 2000).
- These transmission probabilities relate to a 4-year period. Therefore, the rates have been implemented uniformly over 4-year periods (retrospectively and prospectively) to derive a mix of sero-discordant and sero-concordant couples at any point in time.

6.3.13 A shortcoming of this method is that it ignores infection of spouses other than from the principal member.

6.3.14 For a principal member without a corresponding 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.

6.3.15 For adult dependants, 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 to the other beneficiary groups.

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

6.3.17 The ASSA Select model does not model the prevalence for the age group 0–14 as it considers a subpopulation that is aged between 15–64. Hence, in order to overcome this, the National model is used to calculate an estimate of HIV prevalence in 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.

6.3.18 In using the National model 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, adjusting for racial composition, is used as a reasonable estimate for prevalence.

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

- If a principal member or spouse is female infected with HIV, then there is a 2% probability that the female will transmit HIV to the child. This assumption is based on the scenario whereby ART is administered to HIV-positive females during pregnancy, labour, and delivery as well as elective caesarean section for women with high viral loads (more than 1,000 copies/ml). ART is also administered to the newborn child (CDC, 2006).
- For pregnant women that are not aware of their HIV sero-status, the CDC (2006) cites that approximately 25% of these women will transmit the virus to their child because they will not undergo procedures as described in the point above. The CDC estimates that about 25% of HIV-infected persons are not aware of their HIV status. This statistic has been used in the South African because in the medical scheme population women are likely to be tested prior to delivery.

6.3.20 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 the adult dependants
- Run a separate projection of HIV prevalence of the principal members
- Run a separate projection of HIV prevalence of the spouses
- Run a separate projection of HIV prevalence of the 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 and then aggregated over each of the beneficiary groups to arrive at a total estimate of HIV prevalence per year and per medical scheme.

6.3.21 Since the prevalence of Principal members with spouses is not independent, one cannot add the respective prevalence rates. For the prevalence of adult dependants and child dependants (not new-borns), the addition of the weighted average of prevalence rates of adult and child dependants to the

prevalence rate of principal members and spouses gives an estimate of overall HIV prevalence.

## 6.4 HIV infection by disease stage

- 6.4.1 In order to model the proportion of beneficiaries by HIV stages 1–4 and ART stages 1–4, 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 modelling of the family unit structure in that transmission between male and female principal members and spouses can now be taken account of.
- 6.4.2 HIV infection in children by stage is modelled as per 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 to the medical scheme environment.

## 6.5 Other Assumptions

### 6.5.1 PROMOTION RATES

Promotion rates from one skill level 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 therefore 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 dictates
- 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 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.

### 6.5.3 STARTING POPULATION

The population 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 composition of the population at the time that the data was provided,

2004, has remained stable in profile and size between 1985 and 2004. This assumption may prove to be unrealistic in the future in terms of racial profile and age because of the imminent social health insurance reforms that intend to increase the number of members, 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. Explicit account of the changing profile of new entrants, such as under SHI, can be incorporated into the Select model on the assumptions sheet.

6.5.4 Schemes may differ significantly in terms of demographic composition (as discussed above), 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 their 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 per 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 the costs thereof, 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, bearing in mind 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 model that were not referred to above have remained as per the original models. Examples are the median terms spent in each HIV/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, however their affordability may be affected 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 a distinct subgroup. This assumption is expected to be more applicable as medical scheme cover expands and more people enter the risk pool.

### 6.5.9 DATA CALIBRATION

The Select model was not calibrated to reproduce observed HIV prevalence rates. This was because no HIV prevalence data was provided by the schemes that submitted data. Nor did the schemes submit information about the numbers of beneficiaries that are registered on their respective HIV disease management programmes. Therefore it was not possible to calibrate the Select model and default assumptions in the model were used, unless otherwise specified. It may be very useful to calibrate the model in light of HIV prevalence and/or HIV disease management data 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 do sensitivity testing of these parameters so that the actuary and the client can have a better understanding as to how a variation associated in a particular variable(s) 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 detailed 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 under the names of Scheme 1, Scheme 2 and Scheme 3. In order to assess overall HIV prevalence, the members of all three schemes are treated as belonging to one large scheme and the results derived on aggregate accordingly. Approximately 2,202,940 medical scheme beneficiaries are accounted for in this research out of a total 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.
- 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 the figure below. Scenario 4 consistently results in the lowest HIV prevalence of all the scenarios. This is to be expected since the multiplicative adjustments 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 points to the need to allow for the effect of interventions on the prevalence and incidence rates.

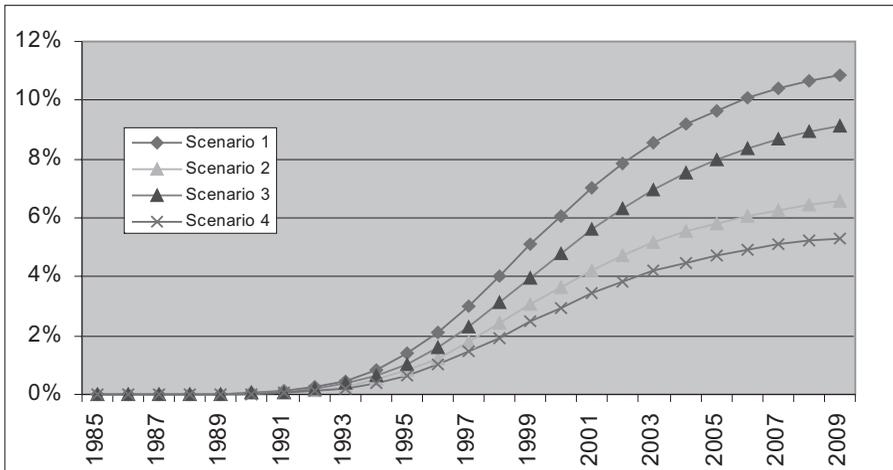
It is put forward that HIV prevalence scenario 4 is most indicative of HIV prevalence in the medical scheme population in South Africa. This can be explained by scenario 4 representing higher degrees of intervention and treatment (as reflected through the lower multiplicative adjustments to HIV prevalence of new entrants and HIV incidence rates) relative to the other scenarios that were constructed.

**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%

6.6.4 HIV infections among principal members and spouses were derived as described in section 6.3.12 on methodology. The number of HIV-infected principal members and spouses was highest under scenario 3 (multiplicative adjustment of 50% to incidence rates) and not scenario 1. For the adult dependants, the highest number of infected was in scenario 1 (no adjustment

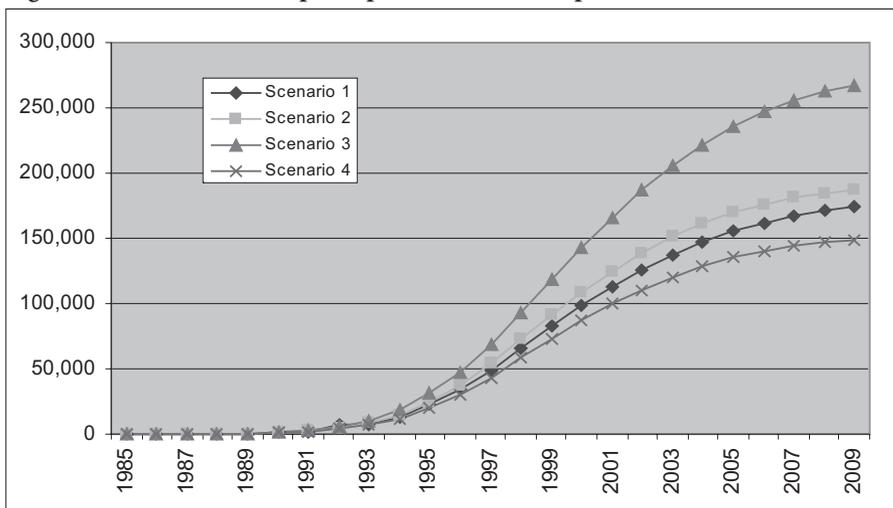
**Figure 8: Overall HIV prevalence by scenario**

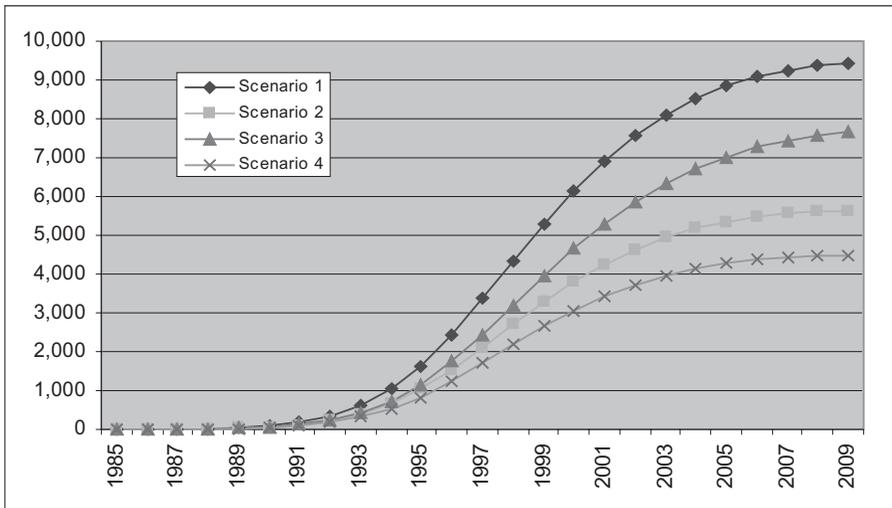


to incidence rates). This reflects the importance of the adjustment to the incidence rates since incidence rates are highest in the younger adult ages and a smaller adjustment to these rates means a higher number of infections among young adults.

- 6.6.5 Total HIV-infection among children was modelled separately. The total number of estimated 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 for racial composition has been made.
- 6.6.6 The number of HIV infections among female adult beneficiaries is highest among the principal members because these beneficiaries were assumed to be the HIV-positive partner in each HIV sero-discordant couple. This output is used further in the cost applications. The result is consistent with the modelling of HIV prevalence by scenario for the entire beneficiary group, with the main difference being that HIV prevalence among the female beneficiaries is higher in each case.
- 6.6.7 HIV prevalence modelling by disease stage is done separately for child dependants. This is because this beneficiary group is only modelled 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.

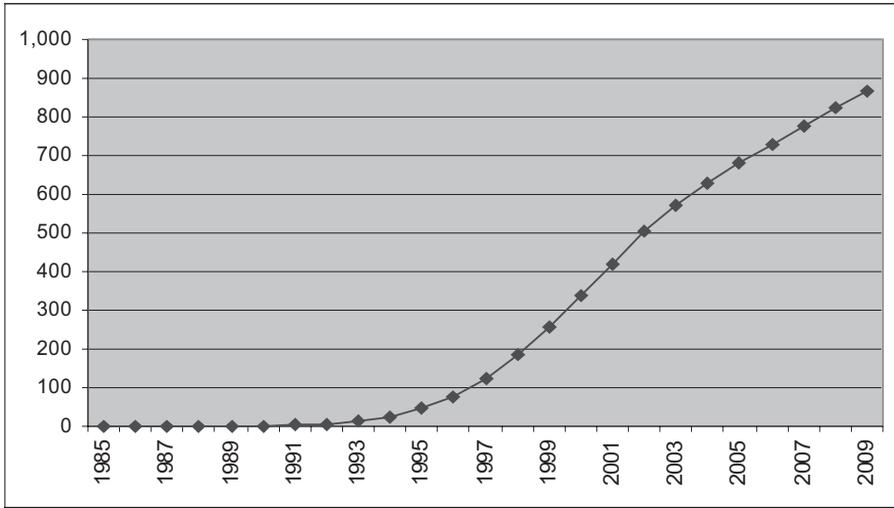
**Figure 9: Total infections: principal members and spouses**



**Figure 10: Total infections: adult dependants**

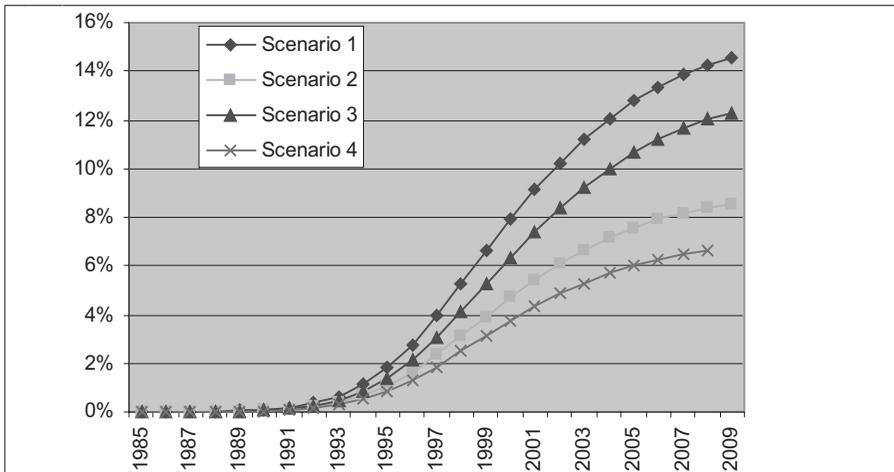
- 6.6.8 HIV infection by disease stage is shown in figure 13 below. The percentage of HIV-infections in HIV stage 1 reaches its peak in 2002 and then starts to fall as beneficiaries progress to HIV stages 2 and 3. The percentage of HIV-infected beneficiaries in HIV stage 3 only begins to peak in about 2009 as the proportions in HIV stages 2 and 3 start to decrease. The percentage of beneficiaries 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 1 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 ART stage 1.
- 6.6.10 Earlier initiation of ART is associated with increased longevity on treatment (see section 4.2.1). This impact of increasing the ART take-up in stage 3 from 20% to 60% is shown in figure 15. This is more consistent with treatment protocols adopted by medical schemes (Stein 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 is separated into pre-AIDS and AIDS stages, as defined in and calculated using the National model. The proportion of

**Figure 11: Total infections: child dependants**

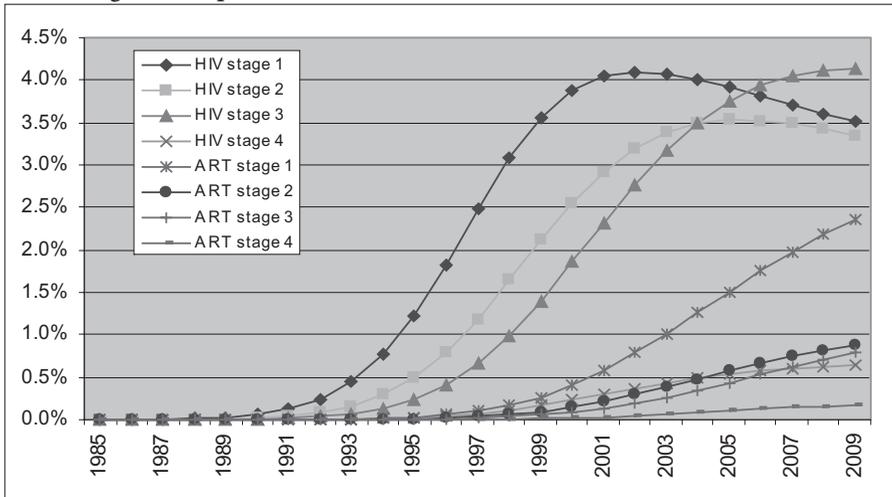


children in each of these stages was then applied to the medical scheme population of child dependants as an estimate of HIV prevalence among child dependants. Therefore, the HIV prevalence overall and by disease stage for child dependants is the same across the modelled scenarios. The estimated number of child dependants in the AIDS stage reaches approximately 2000 by the year 2010.

**Figure 12: HIV prevalence by scenario: female principal members, spouses and adult dependants**



**Figure 13: HIV infection by disease stages: scenario 4 (excluding child dependants)**



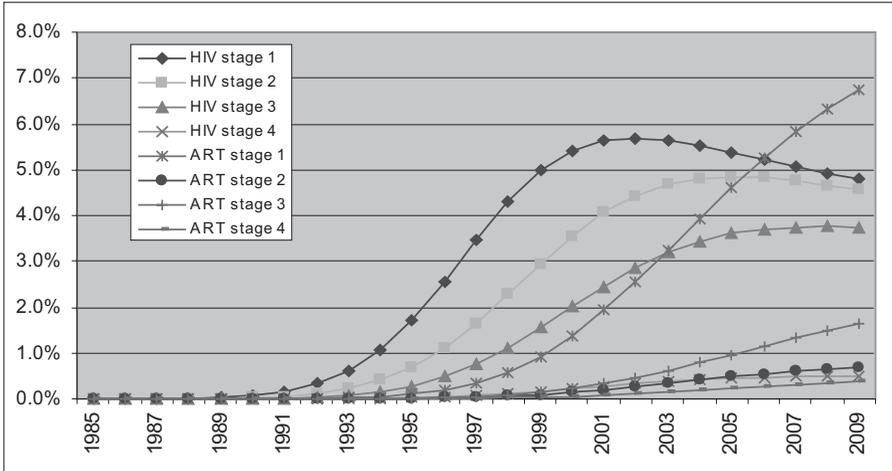
6.6.12 The results of the HIV prevalence modelling by medical scheme are that the prevalence rates for scheme 2 do not differ very much from that of scheme 3 under each of the scenarios modelled. Scheme 2 has the highest eventual HIV prevalence rate. This can be explained by the demographic nature of the beneficiaries: the highest proportion of adult dependants and the age distribution is such that this scheme has the higher proportion of beneficiaries aged between 20 and 35 years. This means that the HIV prevalence can be expected to be higher than the other schemes. Scheme 3 has a very high proportion of beneficiaries older than 55 years of age. The proportion of beneficiaries aged between 20 and 35 years is the lowest of the three schemes.

6.6.13 The results from this report can be compared to other independent estimates that rely on the ASSA models. In the case of Johnson and Dorrington (2003), 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, gender, skill level or race,
- B: change in skill profile
- C: change in race profile

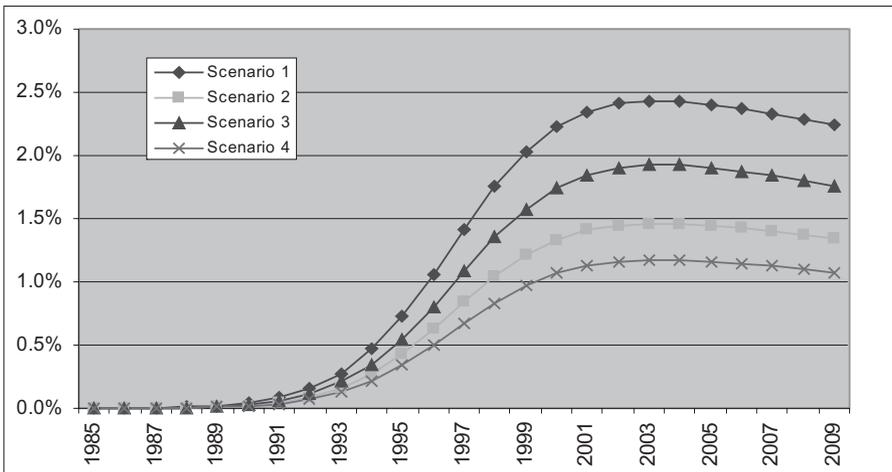
6.6.14 The results from Johnson and Dorrington (2003) are that, under scenario A, “it is estimated that in 2002, 6.1% of all medical scheme beneficiaries are HIV positive. The prevalence of HIV infection in the medical scheme population is expected to rise to a peak of roughly 7.5% in 2008.”

**Figure 14: HIV scenario 4: HIV infection by disease stage (60%, 80% ART initiation)**

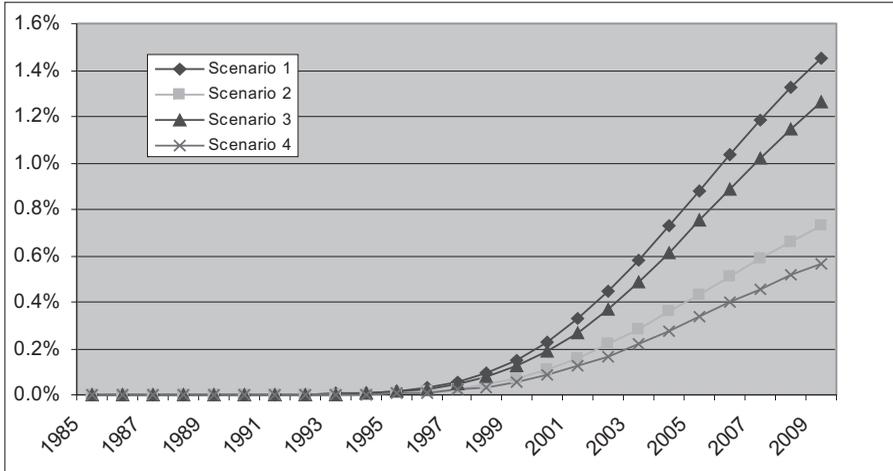


6.6.15 The projections of HIV prevalence under scenarios B and C were found not to differ substantially from scenario A. In scenario B, prevalence peaks 0.5% higher and one year later than scenario A, at 8.0% in 2009. In scenario C, prevalence peaks in 2009 at 8.5%. In scenarios B and C, the estimated HIV prevalence is never more than 1% above that expected for scenario A. Johnson and Dorrington (2003) note that “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

**Figure 15: HIV infection in HIV stage 1 (excluding child dependants)**



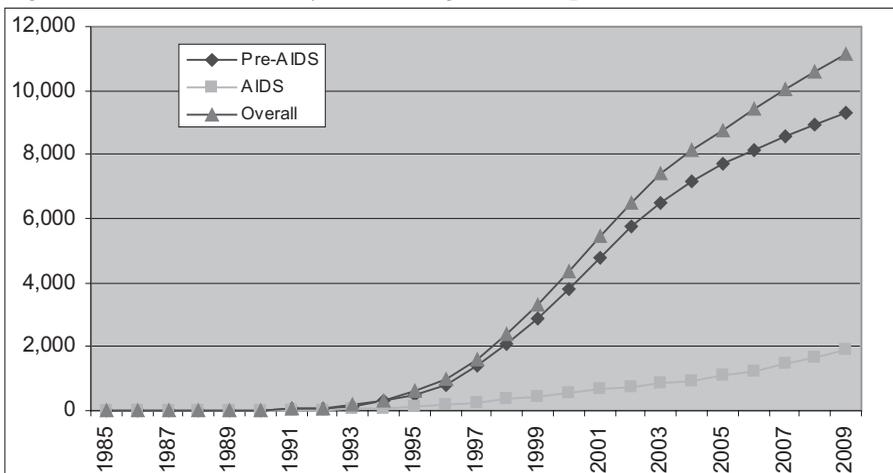
**Figure 16: Percentage of beneficiaries in ART stage 1 (excluding child dependants) HIV prevalence results by medical scheme**



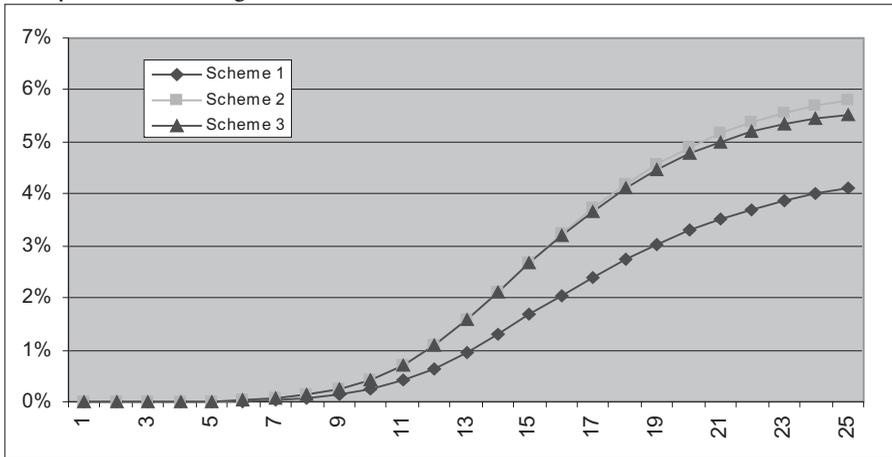
well, as black medical scheme members are – as a result of historical disadvantage – more likely to be employed in low-skill jobs. The socio-economic profile of the medical scheme population remains high even when allowance is made for greater inclusion of lower income groups. This accounts for the closeness of the prevalence levels projected for the three scenarios.”

6.6.16 One of the major differences in the methodology and underlying assumptions between the research by Johnson and Dorrington (2003) and the results

**Figure 17: HIV infections by disease stage: child dependants**



**Figure 18: Overall HIV prevalence by medical scheme: scenario 4**  
**Analysis of modelling results**



presented in this paper are that the former utilise the ASSA 2002 National model and the latter utilises the ASSA 2003 National model.

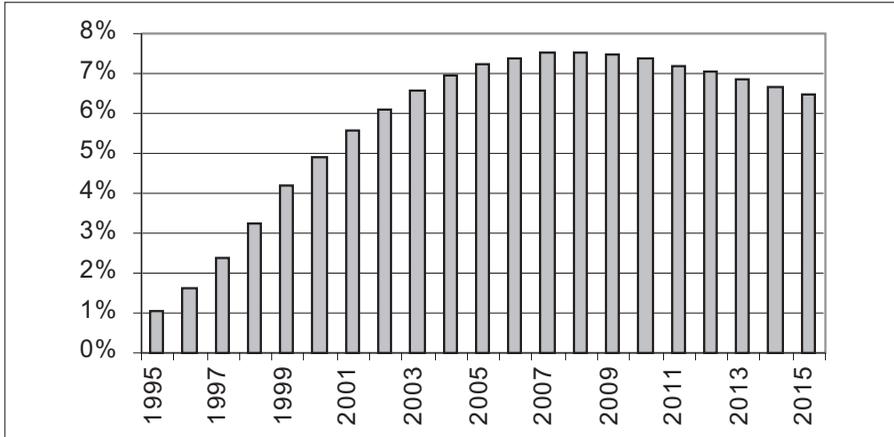
6.6.17 The primary drawback of the estimates presented in this paper is that the models used have not been calibrated to any estimates of medical scheme prevalence. This is because there is insufficient publicly available data to calibrate the models. The potential concentration of risk in restricted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

## 6.7 Modelling the financial impact of HIV

6.7.1 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 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 health care sector during 2005. These cost components, costs and frequency of utilisation per HIV and ART stage are shown in Appendix C. The broad elements costed are:

- Antiretroviral therapy (assumed to be HAART)
- Other medication (such as immune boosters that could typically be used pre-ART and with ART)
- Pathology testing
- Mother-to-child transmission prevention, per birth to an HIV-positive female beneficiary

**Figure 19: HIV prevalence levels in medical schemes (scenario A), Johnson and Dorrington (2003)**

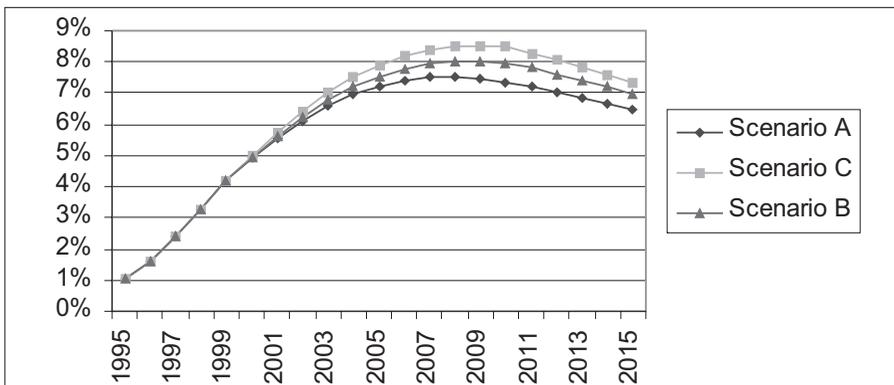


- Outpatient costs such as doctor or specialist consultations
- Hospitalisation costs (in-patient and out-patient costs)

6.7.2 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 as per the National model. These costs represent a managed scenario whereby HIV-positive beneficiaries are enrolled on a HIV disease management programme. Costs relating to unmanaged beneficiaries are not accounted for. This is an area for further research.

6.7.3 Mother-to-child transmission costs are applied to the number of births in any given year. Since the Select model does supply statistics for the number of births

**Figure 20: Projected prevalence levels for scenarios A, B and C (Johnson and Dorrington, 2003)**



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. This may lead to the number of HIV-positive births in the medical scheme sample population being over-estimated since the medical scheme population is select from a socio-economic perspective, and can therefore be expected to have lower fertility levels.

- 6.7.4 For estimating the cost of HIV treatment, the price of brand name drugs will be considered. This applies to antiretroviral therapy and medication for mother-to-child transmission prevention. It is further assumed that patients presenting for pathology tests routinely have the full set of blood tests done, as set out in Appendix C.
- 6.7.5 All costs are shown separately by cost per claim and claim frequency in Appendix C. The following cost assumptions are applied for HIV stages 1–4 and ART stages 1–4 in adults and pre-AIDS and AIDS stages in children:

**Table 6: Cost per beneficiary per annum**

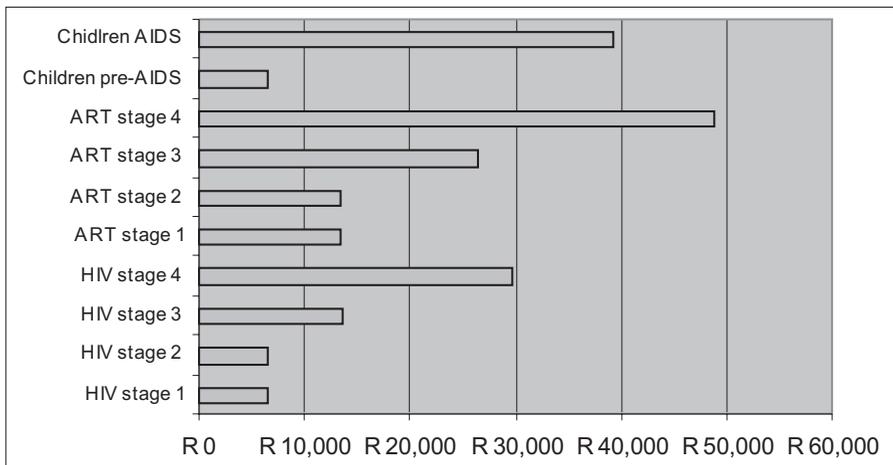
Stage	Total cost	Stage	Total cost
HIV stage 1	R 6,512	ART stage 1	R 13,340
HIV stage 2	R 6,512	ART stage 2	R 13,338
HIV stage 3	R 13,720	ART stage 3	R 26,430
HIV stage 4	R 29,606	ART stage 4	R 48,846
Children pre-AIDS	R 6,512	Children AIDS	R 39,196

- 6.7.6 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 stages 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.
- 6.7.7 Prevention of mother-to-child transmission is included as a Prescribed Minimum Benefit. 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 mother-to-child transmission prevention 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 R 18 969.98, as estimated by the Risk Equalisation Technical Advisory Panel in their report to the Council for Medical Schemes in their report of 2005.

- 6.7.8 The total costs per beneficiary per month (pbpm) for services and treatments described in the previous section, including the cost of mother-to-child transmission prevention, per HIV prevalence and utilisation scenarios are shown below. Two scenarios for ART take-up have been used. Under the first scenario 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 (Stein 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.
- 6.7.9 The average increase in the cost from the 20%, 80% ART initiation scenario to the 60%, 80% ART initiation scenario results in an increase in the order of 36% across 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 section 4.2.1). Quantifying the economic benefits of early treatment is outside of the scope of this paper but is an area for further research.

**Figure 21: Cost per HIV and ART stage per annum**



6.7.10 According to the Report of the Registrar of Medical Schemes (2005), the combined gross contributions received by the three medical schemes during 2004 was R19.5bn, with contributions per average beneficiary per month 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.

**Table 7: Estimated costs per beneficiary per month based on 20% take-up in HIV stage 3 and 80% ART take-up in HIV stage 4.**

Prevalence scenario	2005	2006	2007	2008	2009	2010
Scenario 1	R 31.12	R 35.50	R 39.41	R 42.81	R 45.64	R 47.90
Scenario 2	R 11.06	R 12.60	R 13.96	R 15.14	R 16.11	R 16.89
Scenario 3	R21.06	R 24.34	R 27.33	R 29.97	R 32.24	R 34.10
Scenario 4	R 7.05	R 8.06	R 8.96	R 9.73	R 10.38	R 10.89

**Table 8: Estimated costs per beneficiary per month based on 60% take-up in HIV stage 3 and 80% ART take-up in HIV stage 4.**

Prevalence scenario	2005	2006	2007	2008	2009	2010
Scenario 1	R 42.13	R 48.27	R 53.81	R 58.65	R 62.73	R 66.00
Scenario 2	R 14.92	R 17.09	R 19.03	R 20.73	R 22.16	R 23.30
Scenario 3	R 28.36	R 32.93	R 37.14	R 40.90	R 44.14	R 46.84
Scenario 4	R 9.54	R 10.95	R 12.23	R 13.34	R 14.28	R 15.04

6.7.11 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.

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

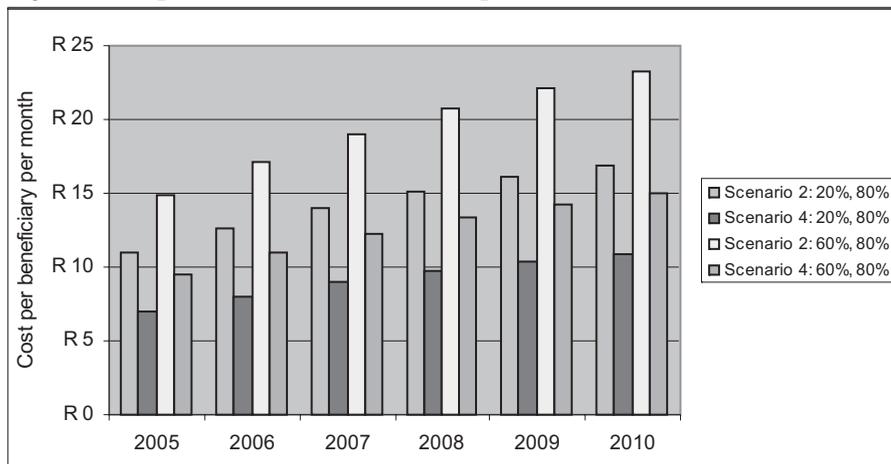
## 7. DISCUSSION AND CONCLUSION

7.1 The impact of HIV/AIDS is 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 health care workers, the private health sector has a pivotal role to play in combating HIV/AIDS going forward. 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 health care. Since many of the people living with HIV/AIDS have low incomes, access to private health care facilities and services is problematic and initiatives in this regard are currently being investigated by the Council for Medical Schemes (through LIMS). Even though the aforementioned health reforms are yet to be completed such reforms represent a significantly positive move forward for South Africa's health care 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 impact of the reforms noted above with regard to HIV-related costs.
- 7.3 The Council for Medical Schemes undertook a Medical Schemes Fairness Treatment Project (2004) in which they revealed the importance of fairness in medical scheme benefits to consumer protection and examples of alleged unfairness in this regard. Alleged unfairness has been found to include discrimination against HIV/AIDS sufferers, restrictions to access 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.

**Figure 22: Impact of ART initiation assumptions**



- 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 the 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 Prescribed Minimum Benefits package and by promoting prevention initiatives. Through these actions, 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 a 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  $CD4 < 200$ , 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, nor incentivised to promote early registration onto a HIV DMP.
- 7.7 Current medical scheme contributions are underpinned by the principles of cross subsidy and equity. This is expected to be furthered under impending SHI reforms whereby contributions will be structured for risk and income cross subsidies, and mandatory membership for those earning above a minimum threshold is envisaged. 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 with using the methodologies presented in this paper.
- 7.8 The data used in this paper is intended to be a reasonable representation of the medical scheme population in terms of demographic risk factors for HIV. However, in order to increase the credibility of the results, there would need to be an increase in the number of schemes covered and a greater spread in terms of the sizes such of schemes, and the mix of open and restricted schemes.
- 7.9 The methodology used above is a broad-brush approach to measuring 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 As with all modelling exercises, the choice of a model and the underlying parameters has 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, unless where otherwise mentioned (particularly the fact that the models were not calibrated).

- 7.11 There is considerable scope for further research on the financial impact of HIV on medical schemes in terms of extending the methodology presented in this paper, analysing the costs of managed versus unmanaged patients and assessing the economic benefits of HIV treatment strategies.

## ACKNOWLEDGEMENTS

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## REFERENCES

- Ball, H.M. (2003). *Disease Management and healthcare resource allocation*, Thesis (M. Comm.), University of the Witwatersrand.
- Barnett, T. and Whiteside, A. (2002). *AIDS in the Twenty-First Century. Disease and Globalisation*, Palgrave Macmillan. ISBN 1 4039 0066 X
- Bradshaw D., Nannan N., Laubscher R., Groenewald P., Joubert J., Nojilana B., Norman R., Pieterse D., Schneider M. (2006). *Summary report on the South African National Burden of Disease Study 2000*, Medical Research Council
- Bradshaw, D. and Dorrington, R. (2005). *AIDS-related mortality in South Africa. Chapter 27 in HIV/AIDS in South Africa*, Editors: Abdool Karim S.S. and Abdool Karim Q.
- Carpenter CC, Cooper DA, Fischl MA, et al (2000), *Antiretroviral therapy in adults: updated recommendations of the International AIDS Society – USA Panel*. JAMA 2000; 283: 381–90
- Carpenter, L.M., Kamali, A., Ruberantwari, A., Malamba, S.S., Whitworth, J.A. (1999). *Rates of HIV-1 transmission within marriage in rural Uganda in relation to the HIV sero-status of the partners*, Medical Research Council Programme on AIDS, Uganda Virus Research Institute, Entebbe. AIDS June 18; 13(9): 1083–9
- Centre for Disease Control and Prevention (2006). *CDC HIV/AIDS Fact Sheet, Mother to Child (Perinatal) HIV Transmission and Prevention* [www.cdc.gov/hiv/resources/factsheets/perinatl.htm](http://www.cdc.gov/hiv/resources/factsheets/perinatl.htm)
- Chen R, Westfall A, Cloud G, Chatham A, Acosta E, Raper J, et al (2001). *Long-term survival alters initiation of antiretroviral therapy*,. Eighth Conference on Retroviruses and Opportunistic Infections. Chicago, February 2001 [abstract 341]
- Connelly, P and Rosen, S. (2005). *Treatment of HIV/AIDS at South Africa's largest employers: myth and reality*, Centre for International Health and Development, Boston University. Health and Development Discussion Paper No. 5, June 2005.
- Council for Medical Schemes (2005). Annual Report 2004–5. Available:[www.medicalschemes.com](http://www.medicalschemes.com)
- Cowlin R, Regensberg L, Hislop M. (2003). *Counting the Cost of Care: do HIV/AIDS Disease Management Programmes Deliver?* AIDS Management Report, 2003, 1(3), 20–23
- Da Silva, R. (2002). *Report to the Policy Board for Financial Services and Regulation. The expected effect of HIV/AIDS on the Financial Services Sector of South Africa for the period 2000 to 2015*. (Unpublished)
- Da Silva, R. (2006). *ARV Roll Out*, AIDS Management Report Volume 4, Issue 1, 2006
- Department of Health and Human Services, Centers for Disease Control and Prevention, CDC fact sheet, May 2006. *Mother-to-Child (Perinatal) HIV Transmission and Prevention*. Available: <http://www.cdc.gov/hiv/resources/factsheets/perinatl.htm>
- Department of Health and Population Development (1998). *White Paper on Population Policy*. Available: [www.polity.org.za/govdocs/white\\_papers/popwp.html](http://www.polity.org.za/govdocs/white_papers/popwp.html)
- Etard, JF., Ndiaye, I., Thierry-Mieg, M., Fatou Ngom Gueye, N., Mandoumbe Gueye, P., Laniece, I., Baba Dieng, A., Diouf, A., Laurent, C., Mboup, S., Salif Sow, P. and Delaporte, E. (2006). *Mortality and causes of death in adults receiving highly active antiretroviral therapy in Senegal: a 7-year cohort study*, AIDS 2006, 20:1181–1189
- Geffen N, Nattrass N, Raubenheimer C (2003). *The Cost of HIV Prevention and Treatment Interventions in South Africa*, Published by the Centre for Social Science Research,

- University of Cape Town 2003. CSSR Working Paper No. 28. Available: [www.uct.ac.za/depts/cssr/pubs.html](http://www.uct.ac.za/depts/cssr/pubs.html)
- Hugonnet, S., Mosha, F., Todd, J., Mugeye, K., Klokke, A., Ndeki, L., Ross, D., Grosskurth, H., Hayes, R. *Incidence of HIV infection in stable sexual partnerships: a retrospective cohort study of 1802 couples in Mwanza region, Tanzania*, London School of Hygiene and Tropical Medicine, London, UK. *Journal of Acquired Immune Deficiency Syndrome*. March 2003 32(3):349–51; author reply 351.
- Johnson, L. (2006). *Estimated numbers of patients on antiretroviral treatment in the South African private health sector*, AIDS Analysis Africa Online, January / February issue 2006.
- Johnson, L. and Budlender, D. (2002). *HIV Risk Factors: A Review of the Demographic, Socio-economic, Biomedical and Behavioural Determinants of HIV Prevalence in South Africa*, CARE Monograph Number 8. Centre for Actuarial Research. University of Cape Town.
- Johnson, L. and Dorrington, R. (2002). *The Demographic and Epidemiological Impact of HIV/AIDS Treatment and Prevention Programmes: An Evaluation based on the ASSA2000 Model*. Presented at the 2002 Demographic Association of Southern Africa Conference.
- Kaiser, J., Baum, M. and Campa, A. (2006). *Micronutrient supplementation increases CD4 count in HIV-infected individuals on HAART: a prospective, double-blinded, placebo-controlled trial*. Abstract MOAB0402. XVI International AIDS Conference, Toronto, 2006.
- King JT, Justice AC, Roberts MS, Chung-Chou H Chang, Fusco JS (2003). *Long-Term HIV/AIDS Survival Estimation in the Highly Active Antiretroviral Therapy Era*, Medical Decision Making. Jan-Feb 2003, Volume 23, Part 1, pp. 9–20.
- Losina E et al (2004). *Effectiveness of antiretroviral therapy after Protease Inhibitor failure: an analytic overview*, *Clinical Infectious Diseases*. 38(11): 1613–1622. June 1, 2004
- McLeod H, Matisonn S, Fourie I, Grobler P, Mynhardt S and Marx G (2004). *Extended Executive Summary of the Determination of the Formula for the Risk Equalisation Fund in South Africa*. January 2004. Prepared for the Risk Equalisation Fund Task Group. Available: <http://196.23.139.67/REF/>
- National Department of Health South Africa (2003). *Operational Plan for Comprehensive HIV and AIDS Care, Management and Treatment for South Africa*, [www.doh.gov.za](http://www.doh.gov.za).
- National Department of Health South Africa (2006). *National HIV and Syphilis Prevalence Survey South Africa, 2005*. Available: [www.doh.gov.za](http://www.doh.gov.za)
- National Department of Health South Africa (2004). *National Antiretroviral Therapy Guidelines*, Available: [www.doh.gov.za](http://www.doh.gov.za)
- Ntuli and Day (2004). *Ten Years on – Have We Got What we Ordered?* The South African Health Review 2004. Chapter 1. A Health Systems Trust Publication.
- Quinn, T.C. (2000). *Viral load, circumcision and heterosexual transmission*, The John Hopkins AIDS Report, May 2000. Available: [www.hopkins-aids.edu/publications/report/may00\\_1.html](http://www.hopkins-aids.edu/publications/report/may00_1.html)
- Risk Equalisation Technical Advisory Panel (2005), *Recommendations by the Risk Equalisation Technical Advisory Panel to the Council for Medical Schemes. Methodology for the Determination of the Risk Equalisation Fund Contribution Table [Base 2002, Use 2005]*. RETAP Recommendations Report No. 1 of 2005. Available on [www.medicalschemes.com](http://www.medicalschemes.com)
- Rosenberg S, Johnson L, Schneider D and Dorrington R (2000). *ASSA Multi-State Select Population Model*. Transactions of the Actuarial Society of South Africa, 2000.

- Shisana O, Hall E, Maluleke KR, Stoker DJ, Schwabe C, Colvin M, Chauveau J, Botha C, Gumede T, Fomundam H, Shaikh N, Rehle T, Udjo E, and Gisselquist D (2002). *The Impact of HIV/AIDS on the Health Sector. National Survey of Health Personnel, Ambulatory and Hospitalised Patients and Health Facilities, 2002*. Report prepared for the South African Department of Health. Available: [www.hsrapublishers.ac.za](http://www.hsrapublishers.ac.za)
- Stein AM, Achmat Z and McLeod H (2003). *Minimum benefits for HIV/AIDS in SA Medical Schemes*, South African Actuarial Journal. Volume 3, 2003.
- The World Bank (1997). *Confronting AIDS*, Oxford University Press, New York, 1997, p. 59.
- The World Bank (2004). *Battling HIV/AIDS. A Decision Maker's Guide to the Procurement of Medicines and Related Supplies*. Editor: Taylor, Y. ISBN 08213 58480
- UNAIDS/WHO (2006). *AIDS Epidemic Update 2006*. Available: [www.unaids.org](http://www.unaids.org)
- Van den Heever, A (1998). *Evaluation of the employee benefits environment in South Africa with respect to the HIV/AIDS epidemic*, Centre for Health Policy. University of the Witwatersrand, 1998. Unpublished.
- Whiteside, A and Sunter, C (2000). *AIDS The Challenge for South Africa*, Human and Rousseau/Tafelberg. ISBN 0 981 4062 3
- World Health Organisation (2004). *The World Health Report 2004: Changing History*, Available: [www.who.org](http://www.who.org).

## 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” (Merck Manual, 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, 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 and Whiteside, 2003). 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 and Whiteside, 2003).

#### A.3 Measuring HIV infection

The primary indicators of HIV infection are:

- CD4 cell count: 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 is indicative of 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 as follows:

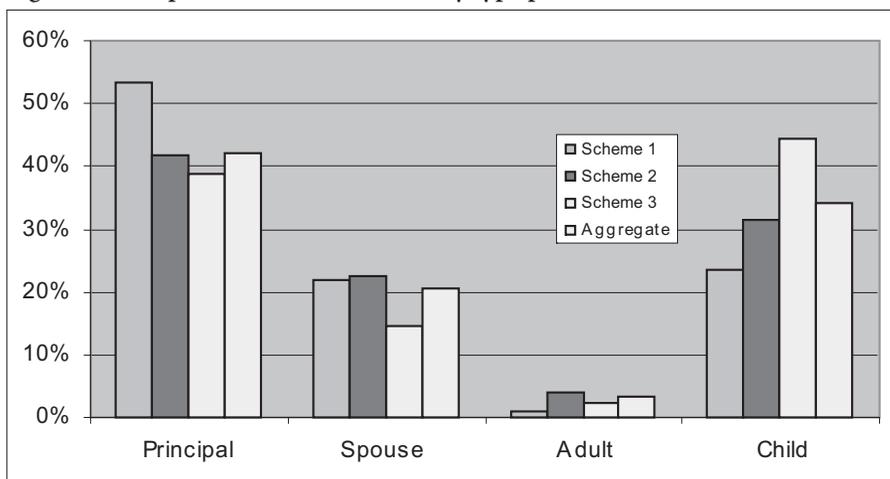
**Table A1: Generalised disease stages**

	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

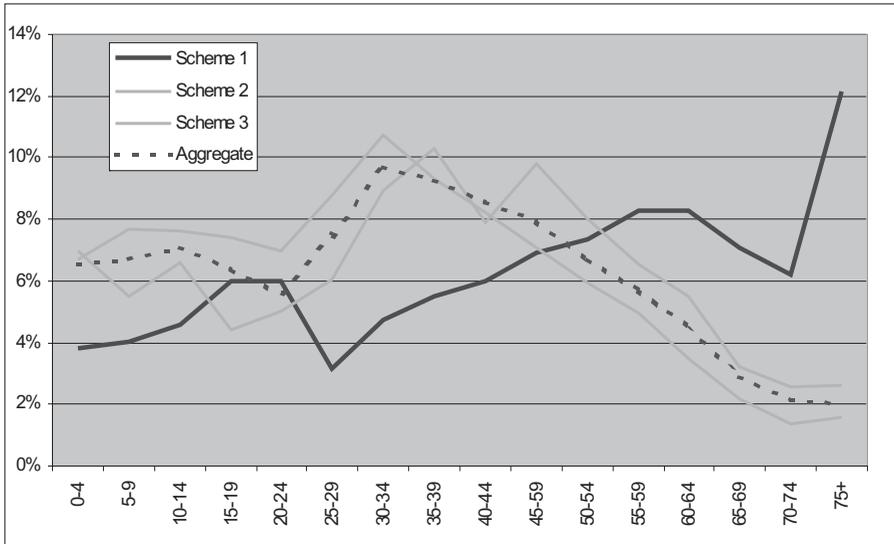
## APPENDIX B SUMMARY OF DATA

**B.1** A summary of the data from the three participating medical schemes is presented below.

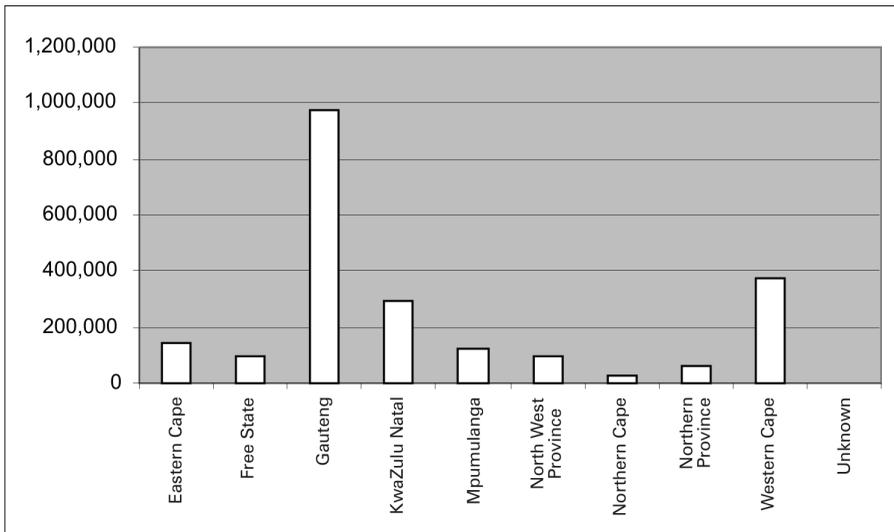
**Figure B1: Proportion of each beneficiary type per medical scheme**



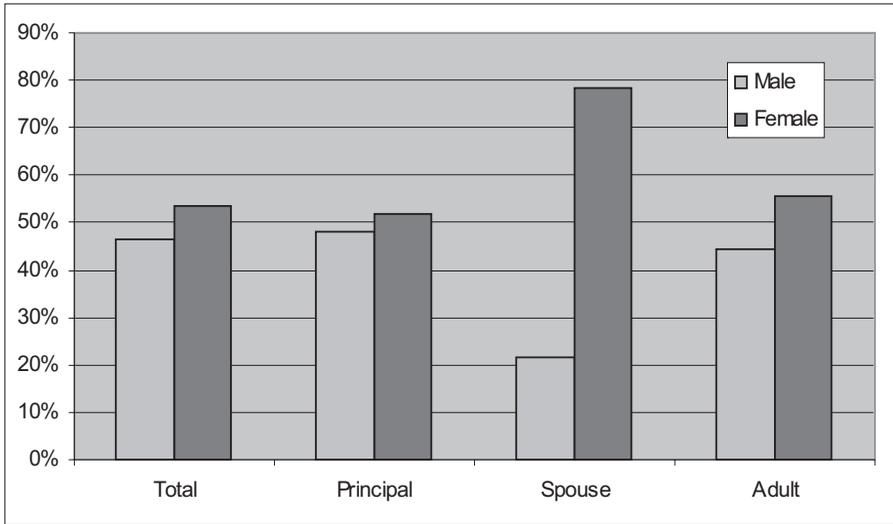
**Figure B2: Age distribution for each medical scheme**



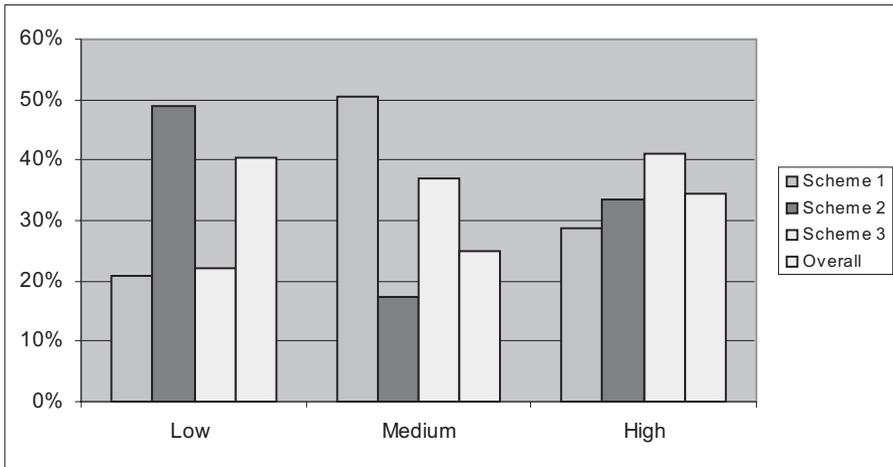
**Figure B3: Total provincial distribution (aggregate membership)**



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



**Figure B5: Membership by contribution band**



## APPENDIX C

### COSTS AND UTILISATION OF TREATMENT

**C.1** The following costs have been assumed to apply to each of the four HIV and ART stages in the Select Model, as described in Section 6.6. All costs are presented in 2005 Rands.

**C.2 Antiretroviral therapy<sup>7</sup> – ART stages only**

All medication listed below, unless otherwise stated, is presented on the basis of being administered to patients on a monthly basis.

**Table C1: Antiretroviral therapy per ART stage**

ART stage	Antiretroviral therapy	Total cost per ART stage
1	Staduvine, Lamivudine, Efavirenz	R 360.42
2	Staduvine, Lamivudine, Efavirenz	R 360.42
3	Zidovudine, Didanosine, Ritonavir & Lopinovir (Kaletra)	R 952.07
4	Invirase, Lamivudine, Ritonavir & Lopinovir (Kaletra)	R 1,373.12

**C.3** Other non-antiretroviral medications to be taken in conjunction with the ART in ART stage 2 are Purbac (R 25.25 per month) and Rifafour, (R 108.30 per month for six months (TB treatment)).

**C.4** 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.<sup>8</sup>

**C.5.** 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. The opportunity to lower costs through the utilisation of generic ART medications is likely to occur in practice.

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

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

## C.6 Immune supplementation

Immune supplements are administered to patients during each of the four ART stages. For the HIV stages, it is assumed that patients in all HIV and ART stages. The cost per patient per month is assumed to be R153.

## C.7 Pathology testing

Pathology testing includes CD4, viral load and full blood count. The cost of these combined tests is R 1210. Other tests such as liver function, cholesterol and glucose are not included. The frequency per stage is assumed to correspond to the doctor consultations (see below).

## C.8 Doctor consultations

The NHRPL cost per doctor consultation (general practitioner) is R 172. 60.<sup>9</sup>

## C.9 Hospitalisation

In- and out-patient costs 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. Therefore, these costs were inflated by 17.8% for two years so that the costs of hospitalisation reflect 2005 Rand amounts. This inflation assumption was derived from the Report of the Council for Medical Schemes (2004/5) and reflects the annual increase between 2003 and 2004 in total hospitalisation benefits (private and provincial) per average beneficiary per annum.

**Table C2: Cost per claim**

Price per item	ART	Immune modulators	Pathology	Doctor Consultations	Hospitalisation
HIV stage 1		R 153	R 1,210	R 172	R 1,912
HIV stage 2		R 153	R 1,210	R 172	R 1,912
HIV stage 3		R 153	R 1,210	R 172	R 9,120
HIV stage 4		R 153	R 1,210	R 172	R 25,006
ART stage 1	R 569	R 153	R 1,210	R 172	R 1,912
ART stage 2	R 569	R 153	R 1,210	R 172	R 1,912
ART stage 3	R 829	R 153	R 1,210	R 172	R 9,120
ART stage 4	R 1,373	R 153	R 1,210	R 172	R 25,006
Children pre-AIDS		R 153	R 1,210	R 172	R 1,912
Children AIDS	R 569	R 153	R 1,210	R 172	R 25,006

**Table C3: Claim frequency**

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

**Table C4: Cost per annum per stage**

Cost per annum	ART	Immune modulators	Pathology	Doctor Consultations	Hospitalisation
HIV stage 1		R 1,836	R 2,420	R 344	R 1,912
HIV stage 2		R 1,836	R 2,420	R 344	R 1,912
HIV stage 3		R 1,836	R 2,420	R 344	R 9,120
HIV stage 4		R 1,836	R 2,420	R 344	R 25,006
ART stage 1	R 6,825	R 1,836	R 2,420	R 344	R 1,912
ART stage 2	R 6,825	R 1,836	R 2,420	R 344	R 1,912
ART stage 3	R 9,946	R 1,836	R 4,840	R 688	R 9,120
ART stage 4	R 16,476	R 1,836	R 4,840	R 688	R 25,006
Children pre-AIDS	R 0.00	R 1,836	R 2,420	R 344	R 1,912
Children AIDS	R 6,825	R 1,836	R 4,840	R 688	R 25,006