

## Projected Population and HIV/AIDS Update

*The purpose of this series of policy briefs on National Health Insurance (NHI) and the related IMSA web-site is to put in the public domain material and evidence that will progress the technical work of developing a National Health Insurance system in South Africa. This includes tools for costing NHI and pathways for moving to a future mandatory system with universal coverage.*

The first policy brief in the IMSA NHI series<sup>1</sup>, produced in April 2009, dealt with the population of South Africa and how it was expected to evolve over time. The population projection recommended in that brief was the Actuarial Society of South Africa ASSA2003 model. Policy Brief 4 on HIV/AIDS<sup>2</sup> used the same model to produce estimates of the progression of the epidemic and the future numbers needing treatment.

At the time, it was recommended that when the revised ASSA model (then under development) was released, that the newer projection should be adopted. The ASSA2008 model was released in March 2011. This policy brief thus updates the earlier work and highlights the major changes in the projected population and projected HIV/AIDS epidemic.

### 1. Revised Total Population Estimates

The graph below compares the StatsSA population estimates for South Africa, the ASSA2003<sup>3</sup> projection and the new ASSA2008<sup>4</sup> projection for the total population to 2025. The NDoH/HISP projection is a set of future projections of the population used by the National Department of Health.

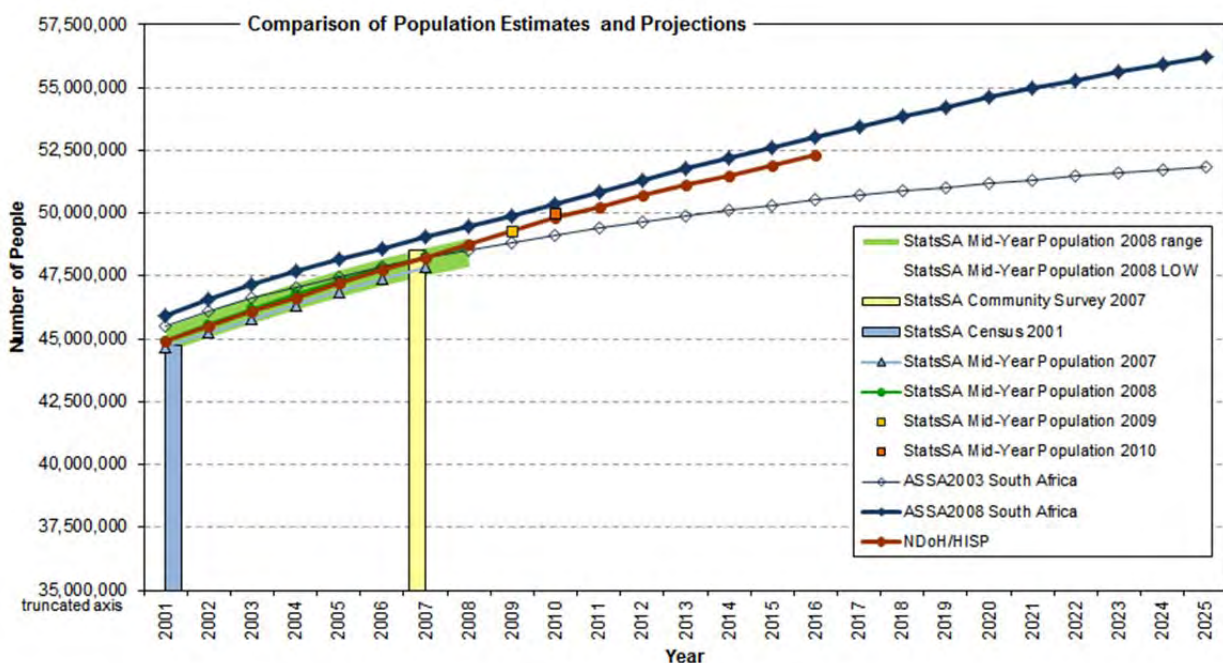
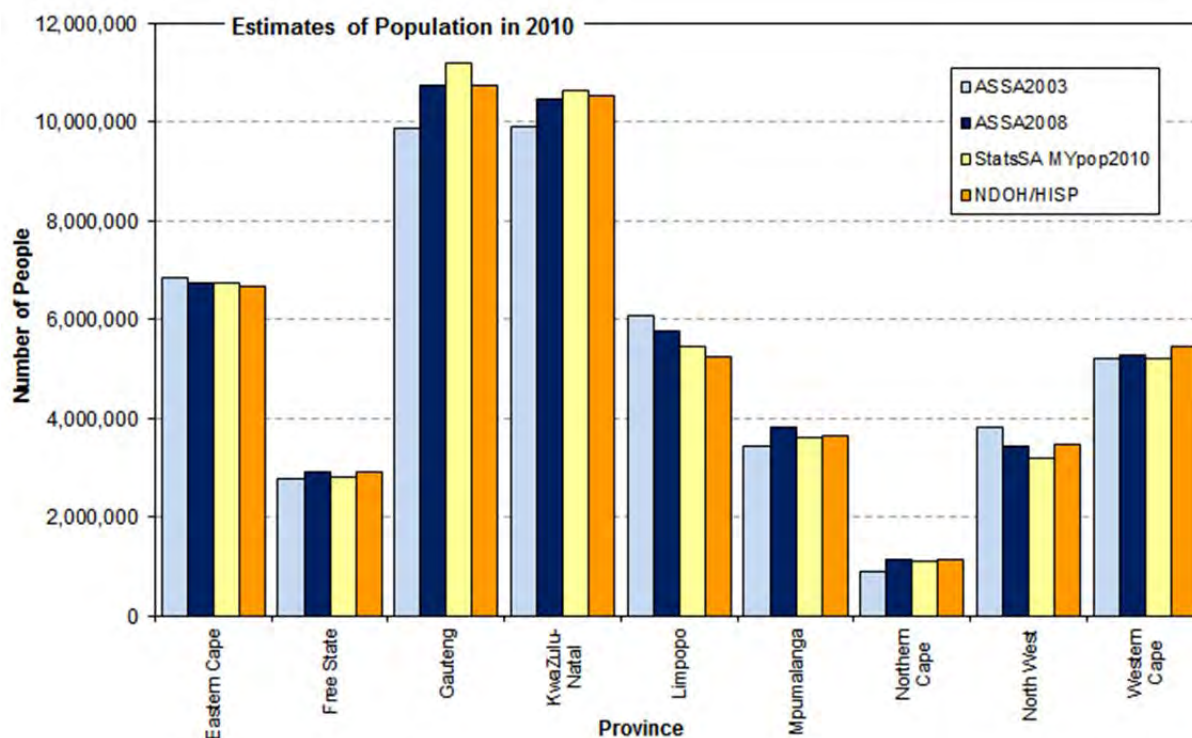


Figure 1: Comparison of Population Estimates and Projections for South Africa to 2025

ASSA2008<sup>a</sup> is projecting a larger and growing population compared to the earlier ASSA2003. There is a significant difference by 2025, with ASSA2008 now projecting 56.256 million people, an increase of 8.6% from ASSA2003 with 51.818 million people.

The NDoH/HISP projections are based on StatsSA mid-year population 2009 and are the only ones to provide projections at district level throughout the country. here are concerns with this projection as none of the totals sum to the underlying age profiles. The StatsSA figures for 2009 were subsequently revised upward in the StatsSA mid-year 2010 figures. The NDoH/HISP projections are of interest because of their use for planning by National Treasury, the Department of Health and provincial governments. Note that the 2009 version only provides projections to 2016, whereas the ASSA2008 can project for 40 years to 2025 or for longer periods if interim results are stored.

A caution is that different population projections can have very different projections at provincial level. The graph below shows the wide variation in provincial projections for 2010 from the two ASSA models, the NDoH/HISP projections (based on StatsSA MY2009) and the StatsSA MY2010 figures.

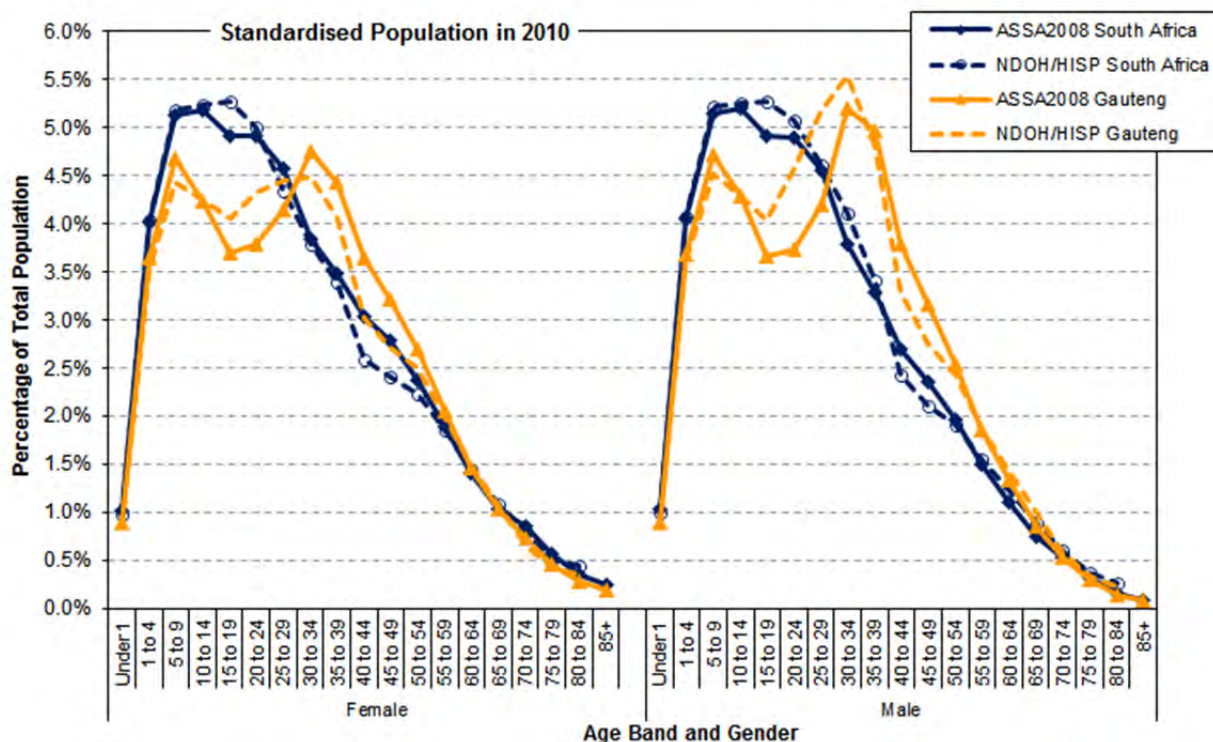


**Figure 2: Comparison of Provincial Population Estimates for 2010**

Some of the variation is due to changes in provincial boundaries (particularly true of Gauteng in the ASSA2003 and ASSA2008 figures). Migration between the provinces is difficult to predict and will always be a source of difference between projections. The last Census was in 2001 and the next census is due in 2011. The data from the Census may only emerge some time later as extensive post-enumeration checking is done. This will be the first census with the revised provincial and district boundaries and thus the results are eagerly awaited for planning purposes.

<sup>a</sup> Results extracted from the ASSA2008 (Full version) AIDS and Demographic model of the Actuarial Society of South Africa, file ASSA2008\_110309.xls, as downloaded on 27 March 2011 from <http://aids.actuarialsociety.org.za/ASSA2008-Model-3480.htm> .

In the analysis which follows ASSA2008 refers to the ASSA2008 model with standard assumptions as downloaded. Additional demographic data has been extracted from the standard model by the author<sup>b</sup>. The graph below illustrates the difference in age and gender profiles between using the ASSA2008 projection for South Africa as a whole and for Gauteng, compared to the NDoH/HISP projections.



**Figure 3: Age Profiles for 2010 for Gauteng and South Africa from ASSA Models**

At national level ASSA2008 shows fewer children age 15-19; slightly fewer young working age men; more men age 40-55; and substantially more women aged 35-55 than the NDoH/HISP projection. The shapes for the Gauteng population have substantial differences in shape for both men and women. Users of the two projections need to be keenly aware of the differences as these will cause a difference in the projected cost of NHI.

## 2. Key Changes in the ASSA2008 Projections

The press release for the ASSA2008 model said<sup>5</sup>: “The new model takes into account reported data for all recorded deaths up to 2008, recent antenatal surveys and household surveys, as well as recent data on the coverage of antiretroviral treatment and prevention of mother-to-child transmission programmes.”

The most substantial change to previously published ASSA estimates is a decline in AIDS mortality in recent years. The ASSA2003 model had projected that annual AIDS deaths would increase from

<sup>b</sup> In the age-gender analysis, the age category “0 to 5” has been split into “Under 1” and “1 to 4”. each item. In the age-gender-HIV analysis, age-gender profiles have been extracted each year for each stage of the epidemic. The amendments to the output have been cross-checked to the standard reported totals in each case.

326,000 in 2005 to 388,000 in 2010. The ASSA2008 model estimates that the annual number of AIDS deaths in South Africa has reduced from 257,000 in 2005 to 194,000 in 2010.

“This represents a significant departure from the estimates based on the ASSA2003 model.” “The change in mortality estimates is partly due to revised assumptions about mortality rates in untreated HIV-infected individuals prompted by studies showing higher survival rates in African adults than had previously been assumed. However, the more substantial reduction in estimated AIDS mortality for 2010 is largely due to the rapid expansion of the South African antiretroviral treatment programme.”

“The new model has also factored in substantial increases in condom use over the last decade, which is supported by findings from recent household surveys.” This results in a decrease in HIV prevalence in the younger groups. However there is an increase in HIV prevalence in older adults which “can be partly attributed to HIV-infected adults surviving for longer due to antiretroviral treatment.”

At a technical level<sup>6</sup>, the following significant changes have been made:

- Prevention of mother to child-transmission (PMTCT) takes into account the slower pace of rollout, and lower uptake of single-dose nevirapine. The modelling of the impact of interventions on vertical transmission has also been altered.
- Separate ART roll-out rates for men, women and children are now used. A greater reduction in viral load on ART is used, together with higher rates of retention on ART.
- There is a change to the way condom usage is modelled.
- Separate HIV survival for adult males and adult females is allowed.
- The survival of untreated adults is now assumed to follow an Exponential distribution rather than a Weibull distribution which leads to a longer mean survival time but with greater variance.
- Survival of untreated children is assumed to be longer, especially for children infected at or before birth. Because of this the model now allows for the survival of some infected children to adulthood.

The table below shows the substantial improvements in mean survival time between ASSA2003<sup>7</sup> and ASSA2008<sup>8</sup>, as reported in the respective User Guides.

**Table 1: Impact on Mean Survival Time from Infection to Death**

Mean survival time in years from infection to death (excluding non-ADS mortality)		
Model	ASSA2003	ASSA2008 in 2010
Adults infected under the age of 25	11	13.81
Adults infected between ages 25 and 34	10.25	12.11
Adults infected over the age of 34	9.5	10.42
Children infected perinatally	1	7.29
Children infected through breast milk	9	14.65
Note: figures from ASSA User Guides. Not all decimals given.		

As with ASSA2003, the ASSA2008 model is available as a suite of different versions. The "lite" version, like previous lite versions, treats the population of the country as one population group. The "full" version models each of the four population groups (Asian/Indian, black African, Coloured and White) separately at a national level, and aggregates to produce results for the population as a whole. Those modelling the population for NHI are advised to use the "full" version as the standard projection. The "full" model can also be run separately for each province.

There are differences in the provincial boundaries between ASSA2003 and ASSA2008. "Because of significant provincial boundary changes between 2006 and 2007, some of the provincial model estimates change substantially between these two years. These 'kinks' in the time trends are particularly noticeable for the North West and Northern Cape provinces."

ASSA<sup>5</sup> "warns that as new treatment guidelines and prevention strategies are introduced in South Africa, a new model will be needed to provide an on-going accurate description of the impact that HIV prevention and treatment programmes are having in South Africa. The ASSA2008 model does not, for example, allow for the new antiretroviral treatment guidelines that were introduced in 2010. The new guidelines have relaxed the eligibility criteria for antiretroviral treatment, making treatment available to HIV positive people not yet in the advanced stages of the disease."

ASSA has thus signalled that there are unlikely to be further changes to this family of models and that a new model will need to be built to handle the greater complexity in treatment and prevention strategies.

### 3. Impact of Revised Population Estimates on Price of NHI

The tables which follow show the impact of the new projections on the price of a PMB package; a package with PMBs and more primary care; and a comprehensive package of healthcare<sup>c</sup>.

**Table 2: Impact on Price pbpm<sup>d</sup> of Healthcare using ASSA2008 compared to ASSA2003**

Price pbpm relative to PMBs in 2010 using ASSA2003				
Year	2010	2010	2025	2025
Projection	ASSA2003	ASSA2008	ASSA2003	ASSA2008
Prescribed Minimum Benefits	100.0	99.8	109.6	110.9
Prescribed Minimum Benefits plus Primary Care	161.0	160.9	172.9	175.3
Comprehensive Benefit Package	214.3	214.2	230.4	233.5

The price of healthcare in 2010 is very slightly lower for all benefit packages using ASSA2008 rather than ASSA2003. However with the population living longer, the age profile becomes older and the price pbpm in 2025 goes up by between 1.2 and 1.4% compared to the earlier projection.

<sup>c</sup> These figures have been calculated using age-gender tables for various packages of healthcare. The tables were calculated in 2009 Rand terms and are indexed. The tables do not include the expected increase in HIV/AIDS treatment costs; administration and managed care costs; and increases in utilisation that might occur if a benefit is made part of the minimum benefit package.

<sup>d</sup> Per beneficiary per month

**Table 3: Impact on Total Cost of Healthcare using ASSA2008 compared to ASSA2003**

Total Cost relative to Cost of PMBs in 2010 using ASSA2003				
Year	2010	2010	2025	2025
Projection	ASSA2003	ASSA2008	ASSA2003	ASSA2008
Prescribed Minimum Benefits	100.0	102.3	115.5	127.0
Prescribed Minimum Benefits plus Primary Care	161.0	165.0	182.3	200.6
Comprehensive Benefit Package	214.3	219.6	242.9	267.3

The total cost of healthcare in 2010 is higher for all benefit packages using ASSA2008<sup>e</sup>. The total cost of PMBs for the whole country in 2010 is indexed to be 100. Using the ASSA2003 projection, the change in the age-gender profile and increased population to 2025 would have increased the total cost of healthcare to an index of 115.5, ignoring the effects of inflation. Using ASSA2008, the total cost in 2025 for PMBs is higher at an index of 127.0 or 9.9% higher than before. There are two effects at work: the slightly older population projected in 2025 and the much larger population in the new projections.

When applied to a comprehensive benefit package in 2010, the index increased from 100 to 214.3 using ASSA2003. That index becomes 219.6 using ASSA2008. By 2025, the ageing of the population and the larger population mean the total cost is indexed at 267.3. This forward planning for demographic change is critical for assessing the future cost of any National Health Insurance proposal.

#### 4. Revised Projection of HIV/AIDS

A significant advantage of using the ASSA models has been the detailed modelling of the HIV/AIDS epidemic. ASSA2008 produces a projection each year of the number of people in each stage of the disease. The User Guide<sup>6</sup> says: "In the absence of anti-retroviral treatment, adults are assumed to progress through four stages of disease before dying from AIDS. These four stages correspond to those defined in the WHO Clinical Staging System. The effects of anti-retroviral treatment (ART) are modelled by introducing a further two stages, which represent people receiving treatment and people who have started treatment but subsequently discontinued treatment." Descriptions of these six disease states are as follows:

- WHO stage 1: Acute HIV infection
- WHO stage 2: Early disease
- WHO stage 3: Late disease
- WHO stage 4: AIDS
- Receiving anti-retroviral treatment
- Discontinued anti-retroviral treatment.

"The first two stages are largely asymptomatic. Symptoms occur more frequently in stage 3, and include weight loss and oral infections. People in stage 4 experience a range of more severe conditions, such as pneumonia, extra-pulmonary TB and wasting syndrome. These conditions are referred to collectively as AIDS."

<sup>e</sup> Note that these effects do not yet take into account the impact of the greater numbers who are HIV+ or on ARVs.

The first graph below shows the very significant change from ASSA2003 to ASSA2008 in the numbers on anti-retroviral treatment. This has the effect of substantially increasing the numbers living with AIDS. The second graph shows the six stages of HIV infection, updated using the results from the ASSA2008 model. The large number of people on ARVs in Stage 5 is significantly different from earlier versions of this graph. In the slide pack on the IMSA web-site<sup>f</sup>, both the ASSA2003 and ASSA2008 slides are given for comparison.

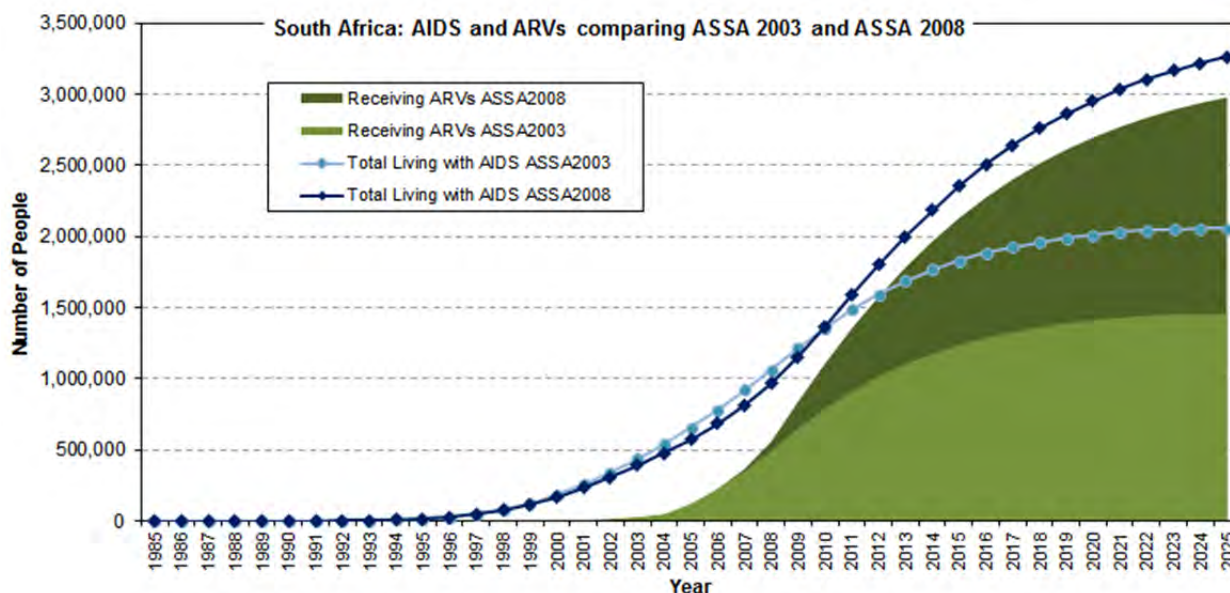


Figure 4: ASSA2003 vs. ASSA2008 Total Living with AIDS and Number Receiving ARVs

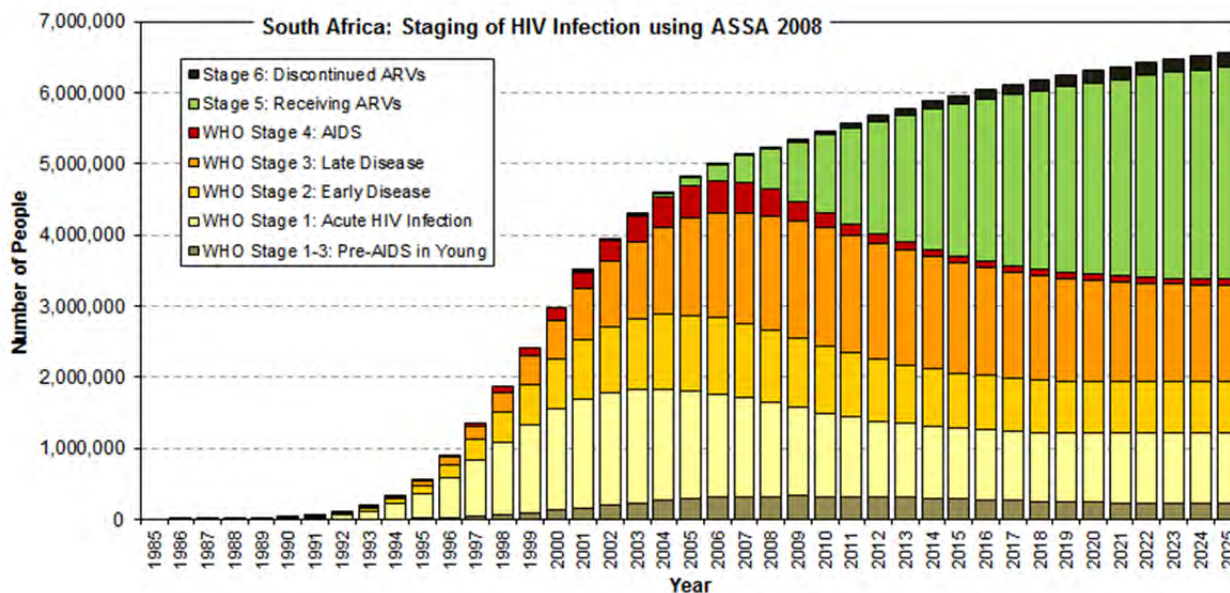
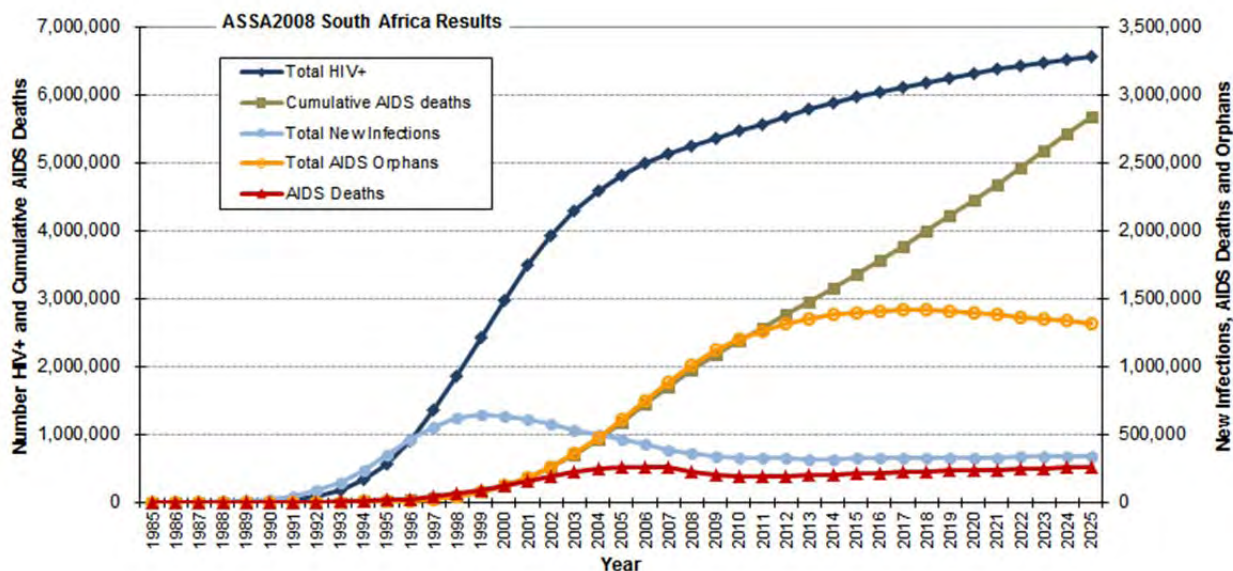


Figure 5: Staging of HIV Infection in South Africa from 1985 to 2025, using the ASSA2008 Model with standard assumptions about treatment and interventions

<sup>f</sup> [http://www.imsa.org.za/national\\_health\\_insurance\\_library.html](http://www.imsa.org.za/national_health_insurance_library.html)

The graph below shows the waves of the epidemic using the ASSA2008 model. Whereas under ASSA2003 it was expected that cumulative AIDS deaths would exceed the total number of people living with HIV by 2017 (some 6 million people), the updated model has a much lower number of cumulative deaths. By 2017 cumulative deaths are expected to reach 3.8 million which is a substantial reduction.



**Figure 6: Waves of the HIV/AIDS Epidemic in South Africa using the ASSA2008 Model**

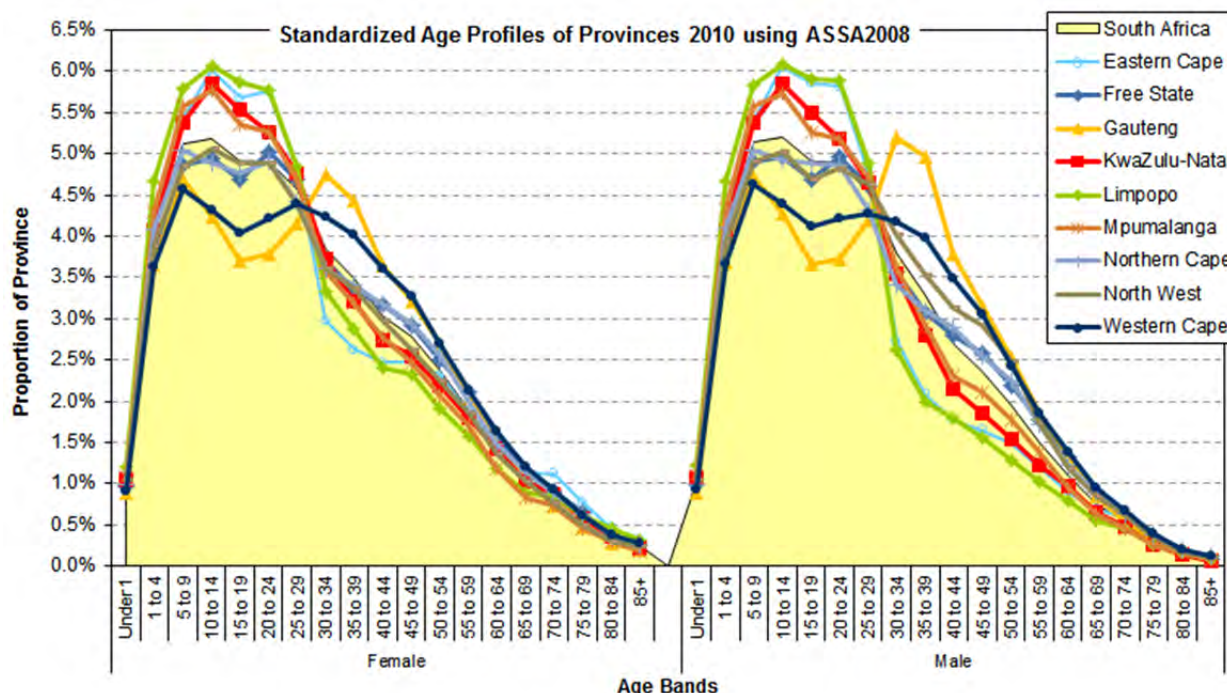
The improved survival times and greater numbers living on ARV treatment also mean a substantial reduction in the number of orphans. ASSA2003 projected a steep increase in the numbers of AIDS orphans to 2.2 million by 2025. The ASSA2008 projections are for 1.3 million AIDS orphans by 2025. This is an encouraging result in terms of family structures and social stability and is a major positive effect of the scaled up anti-retroviral programme.

## 5. Provincial Modelling using ASSA2008

There are substantial differences in the age and gender profile between provinces which affects price or the capitated amount needed for healthcare. The graph overleaf shows that the Western Cape and Gauteng continue to have more working-age adults than other provinces. The provinces with fewer economic opportunities tend to have fewer working age males and many more children.

This implies that health planning for the provinces needs to take into account the different demographic profiles. It was argued strongly in Policy Brief 1<sup>1</sup> that "Any allocation of funds to the provinces should take into account at least the differences in age and gender, but preferably also the disease burden of each province. This begins to hint at the need for risk-adjusted payments to the provinces or any other pools in a future NHI." In Policy Brief 4 on HIV/AIDS<sup>2</sup> that argument was strengthened, saying "there is a wide disparity in the need for treatment by province and this argues for a risk-adjusted payment to the provinces which includes HIV/AIDS as a risk factor."

A new risk-adjusted formula for calculating the health budget for the nine provinces has been discussed by the Department of Health and National Treasury.



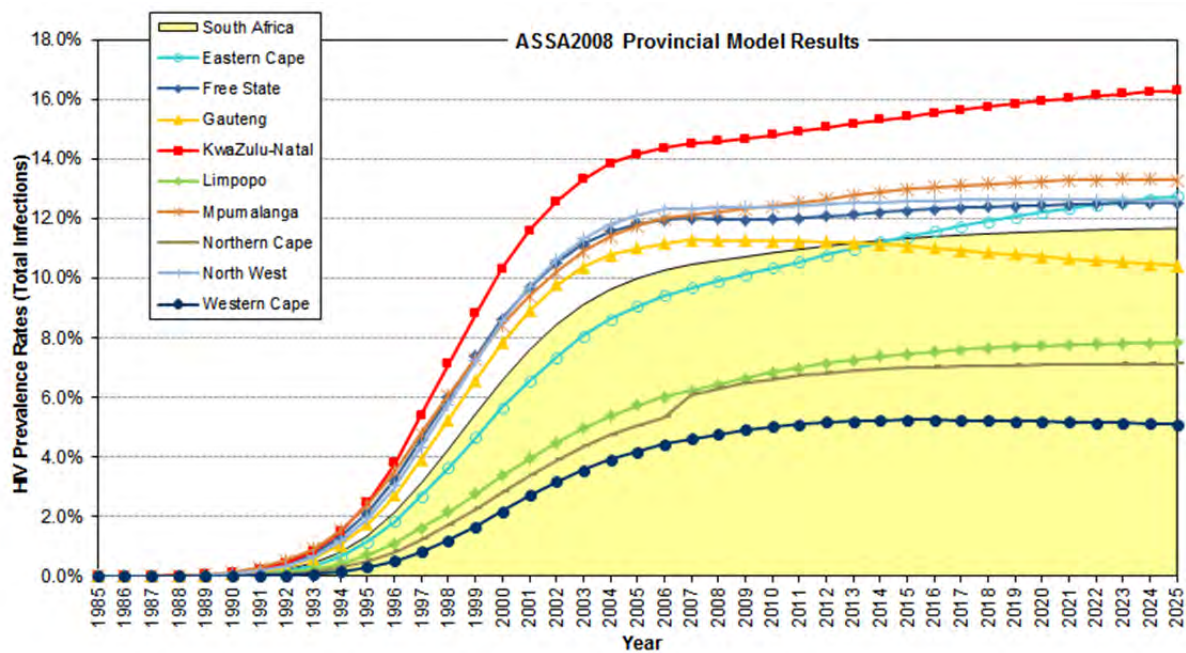
**Figure 7: Comparison of Age Profiles of Provinces in 2010 using ASSA2008**

The table below quantifies the effect on the price of healthcare per beneficiary per person, showing the different impact of different benefit packages. Note that the figures below show only the impact of age and gender differences and do not include the differential cost by province for HIV/AIDS treatment.

**Table 4: Impact on Price of Healthcare of Age and Gender Differences in 2010**

Price pbpm relative to South Africa in 2010 using ASSA2008			
Benefit Package	Prescribed Minimum Benefits	Prescribed Minimum Benefits plus Primary Care	Comprehensive Benefit Package
Eastern Cape	97.0	96.6	96.8
Free State	104.1	103.2	103.1
Gauteng	106.0	105.9	105.8
KwaZulu-Natal	95.4	96.0	96.1
Limpopo	91.4	92.3	92.4
Mpumalanga	93.5	94.6	94.5
North West	101.7	101.3	101.1
Northern Cape	103.5	102.6	102.6
Western Cape	108.9	107.5	107.5
<b>South Africa</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

A significant feature of the HIV/AIDS epidemic in South Africa has been the very different levels of infection by province. This is illustrated using the ASSA2008 model below.



**Figure 8: HIV Prevalence Rate by Province from 1985 to 2025 using ASSA2008**

KwaZulu-Natal continues to have the highest HIV prevalence and Western Cape the lowest. Abrupt changes in prevalence are due to boundary shifts in some provinces (as discussed earlier).

This means there is a wide disparity in the need for treatment by province and this confirms the need for a risk-adjusted payment to the provinces which includes HIV/AIDS as a risk factor.

## 6. Conclusions and Implications

This policy brief has updated earlier work on the total population, the provincial populations and the stages of the HIV/AIDS epidemic, using ASSA2008. The differences between the ASSA2008 population projections and those used by the Government have also been shown.

It is strongly recommended that any costings of healthcare for a future National Health System (NHS) or National Health Insurance (NHI) be updated to include the revised population projections from the ASSA2008 model. Where possible, researchers should include the NDoH/HISP projections as well in order to be able to illustrate differences between ASSA2008 and the projections in use by Government departments.

## Resources on the IMSA Web-site

The following is available on the NHI section of the IMSA web-site: [www.imsa.org.za](http://www.imsa.org.za)

- The slides and tables used in this policy brief [PowerPoint slides]. The pack includes versions of some slides produced using ASSA2003 to compare the effects of the revised projection.
- Tables by age and gender of the population in South Africa and each province, from 1985 to 2025, using ASSA2008. [Excel spreadsheets].
- Tables as above with additional with tables giving the WHO staging of HIV infection and the numbers needing and discontinuing antiretroviral treatment. The tables are from 1985 (which pre-dates the epidemic) to 2025. [Excel spreadsheets].

As the purpose of this series is to put in the public domain material and evidence that will progress the technical work of developing a National Health Insurance system, we would be delighted if you make use of it in other research and publications. All material produced for the IMSA NHI Policy Brief series and made available on the web-site may be freely used, provided the source is acknowledged. The material is produced under a Creative Commons Attribution-Noncommercial-Share Alike licence.



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