

# Modelling the Relationship between Antiretroviral Treatment and HIV Prevention: The Limits of Spectrum's AIDS Impact Model in a Changing Policy Environment

## Abstract

*This paper shows how two different publicly available epidemiological modelling packages (namely the Spectrum AIDS Impact Model and the ASSA 2003 model) predict very different impacts of rolling out highly active antiretroviral treatment (HAART) on new HIV infections. Using South Africa as a case study, it shows that ASSA 2003 predicts a significant drop in new HIV infections as HAART is rolled out, whereas Spectrum assumes that HAART will not have a preventative impact (and in fact generates a small increase in new HIV infections). Users will thus draw different conclusions about the public health benefits of HAART depending on which modelling package they use. Despite being presented as a policy-oriented modelling tool capable of exploring 'what if' questions about the impact of different policy choices, the Spectrum model is ill-equipped to do so with regard to a HAART rollout. Unlike Spectrum, the ASSA 2003 model is more flexible and transparent. Better modelling and more information (including about the relationship between HAART and risky sex) is required to develop appropriate public policy modelling for the HAART era.*

# Introduction

The past five years have witnessed a massive sea-change in attitudes towards rolling out highly active antiretroviral treatment (HAART) to AIDS-sick people in developing countries. In the early 2000s, most health economists counterposed HIV prevention with AIDS treatment, arguing that the former was more cost-effective than the latter (e.g. Marseille *et al* 2002; Creese *et al* 2002). However, as antiretroviral drug prices fell and as international mobilisation in favour of universal access to HAART gained momentum, the ethical and economic underpinnings of the old ‘prevention *instead* of treatment’ position were undermined (Schwartlander *et al* 2006). Increasingly, calls were made to extend the overall resource budget for both HIV prevention *and* access to treatment (e.g. Sachs and Sachs, 2004; Binswanger, 2003; Moati *et al*, 2003b).

This helped support an international policy shift towards mobilising substantial financial resources to increase HAART coverage – most notably through the Global Fund to fight AIDS, TB and Malaria, and through the World Health Organisation’s ‘three by five’ initiative to have three million people on treatment by 2005 (Piot 2006; Schwartlander *et al* 2006; Feachem and Sabot 2006). Although the target was not met, this unique global effort resulted in the numbers of people on HAART in developing countries rising from 240,000 in 2001 to 1.3 million by the end of 2005 (UNAIDS, 2006: 151-2). Stephen Lewis, the UN Secretary General’s Special Envoy for HIV/AIDS in Africa, recalled this policy about-turn in his memoir of a 2001 request to a senior World Bank official for funding for AIDS treatment:

“I laid out the request. I will never, but never forget the gist of the reply....: ‘You see, Stephen, it’s difficult. Let’s face the painful truth: the people with AIDS are going to die. The money would probably be better used for prevention. It’s all a matter of trade-offs.’”

I remember nearly jumping through the phone....‘Trade-offs,’ I spluttered ‘You speak to me of *trade-offs*? You have drugs to keep people alive and you’re going to let them die because of a trade-off? Why don’t you find more money and do both treatment and prevention, and screw the trade-off’”

I lost the argument. But I mention it now because for the longest time, this pernicious frame of mind ruled the dialectical roost. Somehow the people living with AIDS were expendable, in vast numbers, while people in power persuaded themselves that it was better to practice prevention. One of the most excellent things about ‘three by five’ is the way in which it has rejuvenated prevention and made everyone understand that treatment is far more than treatment and that treatment and prevention are inseparable” (2005: 157-8).

Lewis's anecdote highlights not only the policy shift in favour of a HAART rollout, but also the parallel shift in discourse from prevention *or* treatment, to broad acceptance that HAART *is* a form of prevention. There are three components to this argument: that people on HAART have reduced viral load and hence are less infectious (e.g. Porco *et al*, 2004; Cohen and Hosseinipour, 2005; Montaner *et al*, 2006; Graham *et al*, 2007); that a HAART rollout encourages more people to participate in voluntary counselling and testing (VCT) programmes, and hence will expose more people to HIV prevention messaging (e.g. WHO, 2005); and that mathematical modelling has shown that although HIV-positive people on HAART live longer and therefore have more time to infect others, the net impact, at least in the short- to medium-term, is probably to reduce the number of HIV infections (see e.g. Blower *et al*, 2000; McCormick *et al*, 2007).

The new international consensus on rolling out HAART is, however, fragile – as illustrated by the gap between promises of funding to support universal access to HAART and actual resources allocated for this purpose (Piot 2006; Feachem and Sabot, 2006). Although research has shown that rolling out HAART can be cost-saving for government (e.g. Nattrass and Geffen 2005; Badri *et al*, 2006), concerns continue to be raised about the level and pattern of resource allocation for AIDS (e.g. England 2007). And, although it is now recognised that HAART can help reduce the number of new HIV infections, there are ongoing concerns about whether this is sustained over time (e.g. McCormick *et al*, 2007) and whether HAART could result in an increase in risky sex (either amongst HAART patients or the general population) as people possibly become 'disinhibited' as a consequence of the availability of treatment (e.g. van der Snoek *et al* 2005).

One way that researchers, opinion-leaders and policy makers could explore whether a HAART rollout is likely to result in more, or fewer, new HIV infections, is to consult the publicly available policy-oriented demographic models of the impact of AIDS interventions. However, as demographic models are the product of the epidemiological, biological and behavioural assumptions that make up their architecture, the answer to this question is likely to vary depending on the model being used. As shown below using South Africa as a case study, the Spectrum AIDS Impact Model and the ASSA 2003 model adopt different modelling strategies and come to different conclusions.

The Spectrum model (produced by the Policy Project under the leadership of John Stover) is the most influential AIDS impact model internationally (see Stover 2004 and Stover *et al* 2006 for a discussion of this model and its uses).<sup>1</sup> It is used by UNAIDS to produce its country- and regional-level estimates of HIV

prevalence. According to the accompanying manual, Spectrum was designed to enable policy makers to explore ‘what if’ questions about the impact of AIDS and related policy interventions in their countries (Stover, 2005: 2). Originally designed to model the impact of the AIDS epidemic (Stover 2004: i14), it was subsequently updated to include projections of the demographic impact of mother to child transmission prevention (MTCTP) programmes and/or a HAART rollout (Stover *et al*, 2006).

This paper discusses the output produced by the Spectrum model when used to explore the consequences of rolling out HAART in South Africa. South Africa is a useful case study because an alternative publicly-available AIDS model (the ASSA 2003 demographic model) exists which can be used for comparative purposes. This Excel-based demographic model is produced by the Actuarial Society of South Africa (ASSA) and, like Spectrum, can be downloaded from the Internet free of charge.<sup>2</sup> It comes in several versions, a full model (modelling different racial groups separately), a provincial model (modelling the epidemic by province) and a ‘lite’ version modelling the epidemic as a single epidemic. The most recent version is known as the ASSA 2003 model because 2003 is the most recent data incorporated in the model from the government’s antenatal clinic surveys of HIV prevalence amongst pregnant women. As the ASSA 2003 lite model best approximates the modelling approach taken by Spectrum, it was selected for this comparative analysis.

As shown below, the two models predict very different outcomes for a HAART rollout (relative to a no-HAART scenario). Whereas Spectrum assumes that HAART will not reduce the number of new HIV infections (and in fact generates a small increase in HIV infections), the ASSA 2003 model predicts that HAART will help prevent a significant number of new HIV infections. Users will thus draw different conclusions about the public health benefits of HAART depending on which modelling package they use.

The paper argues that the ASSA model is more comprehensive, transparent and flexible and, unlike Spectrum, enables the user to explore the consequences of different sexual behaviour changes following a HAART rollout. Spectrum, by contrast, is poorly equipped to do so, despite being presented as a policy tool for exploring the demographic impact of a range of interventions including HAART. Spectrum was developed to model the impact of AIDS at a time when HAART was not widely available. Until it is revamped to cope with the modelling needs of the post HAART rollout environment, users should be warned about its limitations in answering ‘what if’ questions about providing HAART.

# HAART and New HIV Infections in South Africa: Different Results from Different Models<sup>3</sup>

The Spectrum and ASSA models were designed as user-friendly tools to assist those wishing to estimate the scale of the AIDS epidemic, understand its demographic impact and explore the effects of different policy scenarios. When using Spectrum, the user is required to key in a set of adult HIV prevalence rates. These can be obtained from secondary sources, or can be generated from antenatal survey data using the Epidemic Projection Package (a publicly available epidemiological modelling package designed to produce a set of population estimates of HIV prevalence from antenatal clinic survey data<sup>4</sup>). The implicit assumption is that the adult HIV prevalence rates keyed into Spectrum pertain to a world where HAART is not provided. Spectrum then generates a new set of HIV prevalence estimates and related demographic output depending on what policy interventions MTCTP and HAART interventions are assumed to be in place.

In order to eliminate differences between Spectrum and ASSA projections arising from different data inputs, the adult HIV prevalence estimates keyed into Spectrum as part of this comparative exercise were generated using the ASSA 2003 model in a projection assuming no MTCTP or HAART rollout. Assumptions about coverage of MTCTP and HAART in Spectrum were similarly drawn from the default settings for these variables in the ASSA 2003 model. These are displayed in Table 1.

*Table 1: Assumptions on the Rollout of MTCTP and HAART (ASSA 2003 Model – Base Line projection)*

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Subsequent
MTCTP	0%	10%	40%	60%	80%	90%	90%	90%	90%	90%
HAART	2%	4%	6%	8%	23%	30%	37%	44%	50%	50%

One of the chief advantages of the ASSA model is that it is transparent about the default parameters used in the projections, and many of these can be changed by the user. For example, all of the values in Table 1 can be changed. The same is true for the values reported in Table 2 (except for the values in bold) which displays the assumptions used by the model when processing the impact of various interventions. Note that the ASSA model distinguishes between different risk groups and between people at different stages of HIV infection and accords them different behavioural parameters. It also includes assumptions about the coverage and impact of VCT, and how this relates to behaviour change –

including in the presence of a HAART rollout. Table 2 shows that the ASSA model assumes that the probability of not using a condom drops by 53% once a person goes on HAART and that the frequency of sex drops by 45% (relative to people with asymptomatic HIV infection who are not aware of their HIV status).

*Table 2: Base Line Assumptions (ASSA 2003 Model)*

<i>Voluntary Counselling and Testing (VCT) assumptions</i>	<i>Not at risk</i>	<i>Uninfected at risk</i>	<i>HIV Stage 1</i>	<i>HIV Stage 2</i>	<i>HIV Stage 3</i>	<i>AIDS – pre HAART</i>
% of target group reached per year with 100% roll-out	5%	6%	6%	6%	6%	6%
% increase in VCT access with HAART roll-out	0%	0%	0%	0%	0%	0%
Reduction in amount of sex	0%	0%	19%	19%	19%	31%
Reduction in % of sex acts that are unprotected	0%	0%	36%	36%	36%	53%
Rate of return to 'untested' state	20%	20%	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
% reduction in benefit from VCT per year.	20%	<b>20%</b>	<b>20%</b>	<b>20%</b>	<b>20%</b>	<b>20%</b>
<i>MTCTP assumptions</i>						
		<i>HAART assumptions</i>				
VCT take-up rate	80%	Log reduction in viral load on HAART				1.76
Antiretroviral treatment for MTCTP take-up rate	100%	Increase in transmissibility per log increase in viral load				3
Formula milk take-up rate	50.25%	% reduction in AIDS morbidity on HAART - adults				75%
Reduction in perinatal transmission from HAART	47%	% reduction in AIDS morbidity on HAART – children				75%
Reduction in transmission through breast milk (for mother who takes HAART & formula feeding)	100%	% reduction in benefits from social marketing				0%
% of births that are live births	98.25%	Relative transmissibility on HAART				<b>0.14</b>
<i>Initial Multiples (not allowing for the impact of VCT)</i>						
	<i>Initial Multiples (not allowing for the impact of VCT)</i>			<i>Current Multiples (allowing for the cumulative impact of VCT)</i>		
	<i>Transmission efficiency</i>	<i>Condom non-usage</i>	<i>Amount of sex</i>	<i>Condom non-usage</i>	<i>Amount of sex</i>	
Stage 1	0.5	1	1	<b>1</b>	<b>1</b>	
Stage 2	0.4	1	1	<b>1</b>	<b>1</b>	
Stage 3	1.5	1	0.65	<b>1</b>	<b>0.65</b>	
Stage 4 (AIDS)	2.9	1	0.25	<b>1</b>	<b>0.25</b>	
HIV Stage 5 (on HAART)	<b>0.419435</b>	<b>1</b>	0.8	<b>0.47</b>	<b>0.552</b>	
Stage 6 (AIDS, off HAART)	<b>2.9</b>	<b>1</b>	<b>0.25</b>	<b>0.47</b>	<b>0.1725</b>	

There is some flexibility in Spectrum with regard to MTCTP, but unlike the ASSA model, changes to the transmission rates and probabilities are limited, and are fixed to selection of ‘radio button’ settings (rather than being open to direct manipulation by the user). The modeller can choose the median duration of breast-feeding (six months or less, between 7-17 months, or eighteen months and above) whether exclusive breast-feeding or replacement feeding is promoted, and whether the MTCTP entails Nevirapine only, or a combination of Nevirapine and AZT. In order to keep the Spectrum base-line (i.e. default) settings as close as possible to the ASSA base line parameters, the projection was run on the assumption that dual therapy (Nevirapine and AZT) was provided as part of MTCTP, that replacement feeding was promoted and that the median duration of breast-feeding was between 7 and 17 months. (The ASSA model assumes that only Nevirapine is provided, but because its other assumptions are more optimistic than those in Spectrum, the preventative impact of providing MTCTP is similar in both models.) Otherwise, the rollout assumptions used in the Spectrum modelling were taken from the base line ASSA assumptions with respect to MTCTP and adult HAART (Table 1).

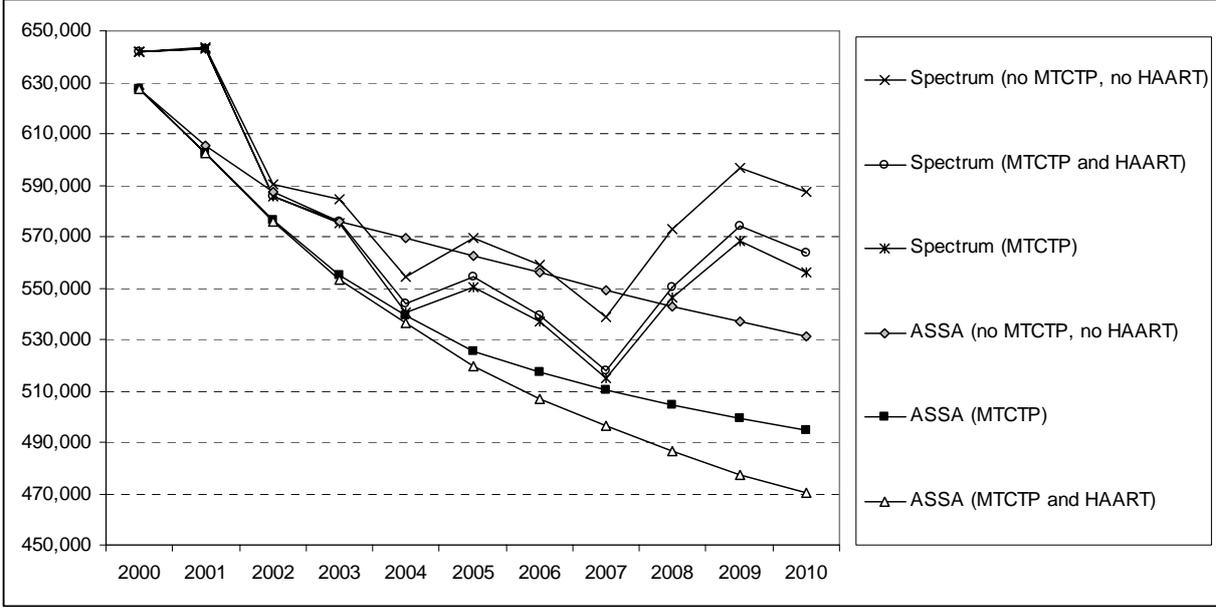


Figure 1: The Number of New HIV Infections in South Africa Using Different Scenarios from the ASSA2003 Model and the Spectrum AIDS Impact Model

Figure 1 shows the estimated number of new HIV infections in South Africa under different scenarios using the two models. Spectrum predicts that between 2000 and 2010, MTCTP reduces new HIV infections by 179,000 but that rolling out HAART generates a small increase in new HIV infections. By contrast, the

ASSA 2003 model predicts that rolling out HAART will prevent 100,000 new HIV infections (and that MTCTP will reduce new HIV infections by 292,000).

The key reason for the ASSA model's prediction that HAART will result in fewer new HIV infections is the decline in infectivity of people on HAART. As shown in Table 2, transmission efficiency is assumed to drop by over 80% once a person goes on HAART. Thus, even though HIV positive people live longer as a result of HAART and their sexual activity is assumed to increase (from 0.25 of the amount that a healthy person would have to 0.8 once they go on HAART), HIV incidence falls because of reduced infectivity. However, the fact that they have also been through VCT (and that this helps encourage safer sexual behaviour) also contributes to the estimated preventative impact of rolling out HAART.

The Spectrum model has a very different architecture. It does not model any relationship between HAART and sexual behaviour and there are no automatic links between HAART and new HIV infections (email from John Stover, 13 April 2007). Instead, the model assumes that HIV prevalence rises with HAART (as people on HAART live longer) and that this, in turn, requires a mechanical adjustment to HIV incidence (which, in the model, is derived from HIV prevalence). According to Stover, the direct estimating procedure used in the model is 'close but not perfect' and that this is the only reason for the small difference in new HIV infections reported by the model (*ibid*). In other words, the increase in new HIV infections following a HAART rollout is a consequence of an in-built assumption and modelling strategy.

*Table 3 Changes between 2000-2010 as a result of rolling out HAART*

	ASSA 2003 lite	Spectrum
Increase in life expectancy at birth in 2010	46.8 to 50.5 (+3.7 years)	46.7 to 48.9 (+2.2 years)
AIDS deaths prevented over the period	599,000	353,000
Change in the number of new HIV infections over the period	-100,000	31,000
Change in the crude death rate in 2010	18.6 to 16.1 (-2.5 deaths per thousand)	17.2 to 15.7 (-2.0 deaths per thousand)
Unmet need for HAART (adults) in 2010	846,000 to 461,000 (-385,000)	876,000 to 554,000 (-322,000)
Increase in HIV prevalence (adult) in 2010	18.6% to 18.9% (+0.3)	18.3% to 19.1% (+0.8)

In essence, the Spectrum model simply assumes that HAART will *not* have a net preventative impact on new HIV infections. This assumption reverberates through the model to produce more pessimistic public health benefits than the ASSA model on a range of related outputs. As can be seen in Table 3, the potential benefits of HAART such as increase in average life expectancy, decline in AIDS deaths and overall mortality rates, and reduction in the unmet need for HAART, are all smaller when projected by Spectrum than by ASSA 2003.

Given that the Spectrum AIDS Impact Model is supposedly designed to answer ‘what if’ questions about different AIDS policy scenarios, the fact that a prior, inflexible, assumption is driving the output is a rather serious flaw – at least as far as a HAART rollout is concerned. As noted earlier, Spectrum was designed in the pre-HAART rollout era to estimate the demographic impact of the AIDS epidemic. Subsequent adaptations to the model enabled it to explore the impact of policy interventions such as MTCTP and HAART. However, in the case of HAART, projection results are fundamentally structured by a modelling architecture which simply assumes that HAART will have no benefits in terms of preventing new HIV infections. Despite being presented as helpful for exploring ‘what if’ questions about a HAART rollout, it is thus ill-equipped to do so. At the very least, this should be made a lot clearer to users, and ideally the model should be revised to include a set of behavioural and other dynamics so that users are genuinely empowered to explore ‘what if’ questions about a HAART rollout.

One of the key limitations of the Spectrum model in this respect is that it does not include any potential impact of HAART on sexual behaviour either in the general population, or amongst HAART patients. Fortunately, the ASSA model has this flexibility and is used to explore this issue below.

## **Modelling the Relationship between HAART and Sexual Behaviour**

As noted earlier, there is some concern that a HAART rollout could result in the general population becoming less concerned about HIV infection now that treatment is available. However, the existing data is unclear on the dynamic linkages between HAART and risky sex. In their meta-analytic review of existing quantitative studies published between January 1996 and August 2003, Crepaz *et al* (2006: 233) found that that twelve out of the eighteen included studies reported a significant relationship between believing that HAART reduces HIV transmission and/or makes HIV a less life-threatening condition

and practicing unsafe sex (*ibid*: 233, 235)). Other papers published since 2003 (the cut-off for their meta-analysis) have provided further support for the association between risky sexual behaviour and such HAART-related ‘HIV optimism’ (e.g. Van der Snoek *et al*, 2005). However, just because people express optimistic views about HAART does not mean that HAART has caused an attitudinal shift in favour of unsafe sex. As Crepaz *et al* point out, it could be that the beliefs about HAART existed prior to, and contributed to the risky sexual behaviour – or it could be that those who engage in risky sexual behaviour articulate such beliefs as a psychological defence mechanism to reduce anxiety (*ibid*: 234). According to a longitudinal study which reported a positive association between unsafe sex and HIV optimism, the rise in unsafe sex over time was unrelated to such attitudes and thus cannot be explained by them (Elford *et al*, 2002: 1542). The rise in unsafe sex may be a consequence of factors other than the availability of HAART – such as the replenishment of individuals who enjoy unsafe sex in the population (Boily *et al* 2005), increasing use of ‘poppers’ (Cox *et al* 2004), the rise of Internet dating (Elford *et al*, 2002: 1543; Halkitis and Parsons, 2003), broader changes in sexual culture towards less open discussion of HIV (Morin *et al*, 2003) and safe sex fatigue (Sepkowitz, K, 2000; Cox *et al*, 2004). If the rise in new HIV infections is unrelated to HAART, then rolling out HAART to more people will reduce the number of new infections (Blower *et al*, 2000: 653).

It is important to note that the studies showing increases in risky sexual behaviour are conducted overwhelmingly amongst men who have sex with men (MSM) and very few are cohort-based, longitudinal studies. The Swiss cohort study, which tracks over six thousand HIV positive people of all sexual orientations, social class and ethnic background found no increase in reported risky sexual behaviour between 2000 and 2003 (Glass *et al*, 2004). This highlights the importance of obtaining good local information about sexual behaviour trends before modelling the epidemic in any one country – rather than trying to rely on some rule of thumb about a supposed increase in risky sexual behaviour and accompanying speculations about its probable causes.

The base-line ASSA projection assumes that there is no increase in risky sexual behaviour in the general population consequent on a HAART rollout. In other words, it assumes that no ‘disinhibition’ takes place arising from ‘HIV optimism’ once people become aware of the availability of life-prolonging treatment. As can be seen in Table 2, the ASSA base line projection assumes a ‘0% reduction in the benefits from social marketing’ – i.e. that there is no disinhibition and that unsafe sex does not increase in the population once HAART is available.

It is easy to manipulate the ASSA model to include a disinhibition effect. So, for example, if one assumed that the HAART rollout was accompanied by a 10% decrease in condom use, then one would simply need to change the 0% ‘reduction in the benefits from social marketing’ to 10%. Similarly, if one had good reason for believing that the HAART rollout will encourage people to get tested, then the default setting for the ‘% increase in VCT access with 100% HAART roll-out’ can easily be changed from 0% to whatever value is assumed plausible by the modeller.

Interestingly, the ASSA model predicts that an increase of 100% in the uptake of VCT (as a consequence of the HAART rollout) will reduce the number of new HIV infections, but that this positive impact will be eliminated if condom use in the general population declines by 10% as a result of HAART-related disinhibition. These results are similar to those of Blower *et al* (2000) who model the impact of HAART on the San Francisco AIDS epidemic. They show that even with the most pessimistic assumptions about the efficacy of HAART, increasing HAART coverage reduces the number of new HIV infections. However, if risky sexual behaviour increases by 10% in the general population, then these positive benefits are negated (2000: 653). In other words, the potential impact of HAART on sexual behaviour is an important issue which has implications for whether a HAART rollout has a net preventative benefit or not.

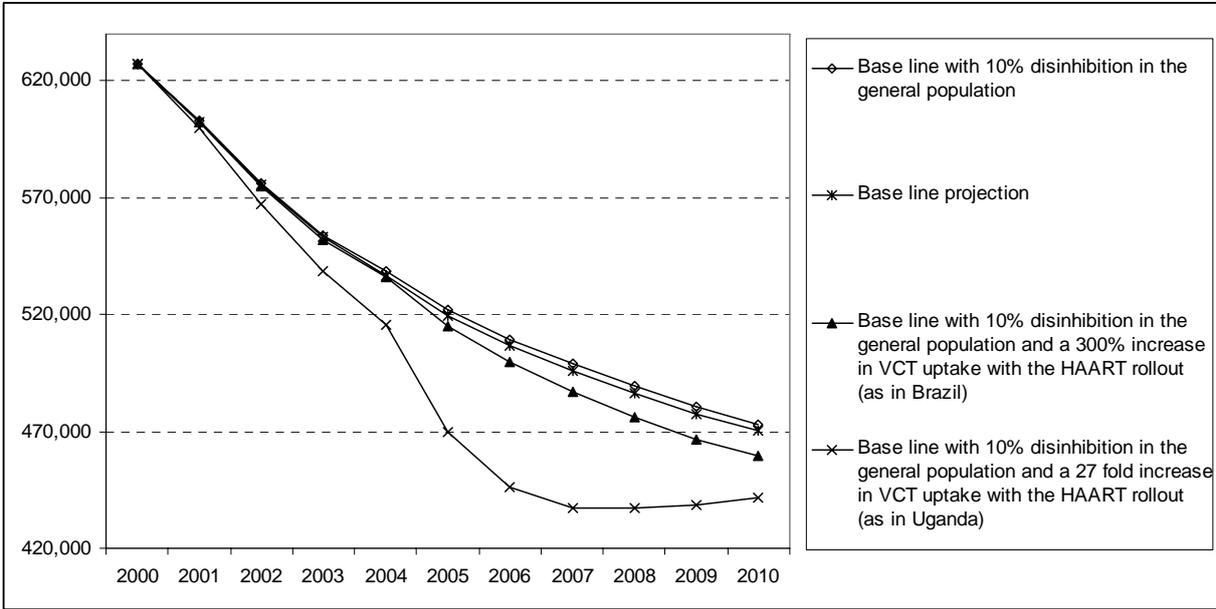


Figure 2: The Number of New HIV Infections in South Africa Using Different Scenarios from the ASSA2003 Model

Figure 2 shows, using the ASSA 2003 model, the differential impact on new HIV infections depending on what is assumed in the modelling. It shows that a 10% disinhibition effect arising from HAART will increase the number of new HIV infections (by 2,800 a year by 2010), but that if this is accompanied by a substantial increase in the uptake of VCT, then the net impact is to reduce the number of new HIV infections. Two scenarios are presented: one showing an increased uptake in VCT of 300% (as happened in Brazil between 2001 and 2003); and the other showing a 27 fold increase in VCT (as happened in Uganda when HAART was introduced) (WHO, 2005: 20). The 27 fold increase is, of course, an extreme outcome which is likely to be feasible only if coming off a low base. Nevertheless, it is included in Figure 2 for illustrative purposes. The key lesson is that different scenarios are possible and that ultimately the impact of HAART on new HIV infections is an empirical question which should not be pre-empted a priori by demographic models. Unfortunately, this is precisely what the Spectrum AIDS Impact model does because unlike the ASSA2003 model, it lacks the flexibility to allow users to incorporate the best available country level information about the impact of HAART on behaviour.

In addition to concerns about HIV optimism leading to unsafe sex in the general population, there is some concern that people on HAART themselves practice riskier sex (perhaps to the point of cancelling out the benefits of lower viral load).<sup>5</sup> In their meta-analytic review, Crepaz *et al* concluded that there was no over-arching relationship between being on HAART and engaging in risky sex (*ibid*, 2006: 231). Of the 21 studies included in the meta-analysis, only seven showed significant findings, and of these, four showed that HAART was associated with a decrease in risky sex and only three with an increase. The authors also pointed out that irrespective of whether the studies were conducted with MSM or with heterosexuals, “the group receiving HAART was significantly less likely than the group not receiving HAART to have engaged in unprotected sex” (*ibid*). This suggests that the ASSA model was probably correct to assume that HAART results in *safer* sexual behaviour rather than riskier sexual behaviour amongst those on HAART (see Table 2).

Cohort studies are even stronger on this. The Swiss Cohort Study found that those on HAART were less likely to report unsafe sexual behaviour (Glass *et al*, 2004; Wolf *et al*, 2003) and that the group at greatest risk of unsafe sex were young female injecting drug users. A recent sub-study of the SMART treatment trial reported that people on HAART were less likely to practice risky sex than those who had never been on it, or had had their treatment interrupted (Burman *et al*, 2007). I have yet to find a cohort study that shows *any* increase in risky sexual behaviour of heterosexual people on HAART in developing countries. Cohort studies in Brazil and Cote d’Ivoire found that people on HAART were more likely to use condoms than untreated HIV-infected people (Moatti *et al*,

2003: Moatti *et al*, 2003b: 1449-50). Similarly, a recent study from Kenya found that people on HAART were significantly more likely to practice safe sex than those who were HIV-positive but not yet clinically eligible to be on HAART (Sarna *et al*, 2005). This supports those who argue that HAART is a form of prevention (e.g. Farmer *et al*, 2001) and provides further support for the modelling approach adopted by the ASSA modellers.

The literature on the relationship between HAART and risky sex focuses exclusively on the possible impact of providing these life prolonging drugs. It does not consider the counter-factual proposition that the *failure* to provide HAART may itself result in unsafe sex amongst those living with AIDS. The implicit assumption is that the absence of treatment possibilities will have no adverse effects on behaviour. But what if this is incorrect? What if HIV-positive people in developing countries feel so marginalised and rejected by the absence of treatment possibilities that this prompts some of them to infect others with the virus? According to a KwaZulu-Natal survey in 2001 (before South Africa's HAART rollout began), just over 60% of respondents said it was common or very common for people to be spreading AIDS deliberately. Twenty-four percent of them said that they knew people who were spreading HIV deliberately, and a "small, but important portion" reported that they would spread HIV deliberately if they found they were HIV-positive (Jones and Varga, 2001: 31-2).

According to Leclerc-Madlala, such behaviour stemmed primarily from a lack of hope and a desire not to die alone. As one of the HIV positive respondents in her 1997 qualitative study of Zulu youth put it: "You lose hope. You know that you'll be rejected; you know you're going to die. All you can do is go off and spread it. It's your only hope knowing that you won't die alone" (1997: 369). Another respondent had more aggressive reasons for pursuing the same strategy: "If I have HIV I can just go out and spread it to 100 people so that we all go together. Why should they be left behind having fun if I must die?" (*loc. cit*). Leclerc-Madlala argues that this amounted to a group philosophy "which says 'If I don't have a future (now because of AIDS), then I will try my best to ensure that others don't have one either'" (*ibid*: 371). Providing HAART to AIDS-sick people is an important way of restoring hope in the future.

It is, of course, impossible to know how many people might share such destructive social attitudes, and if they do, to what extent this would actually translate into dangerous behaviour. Nevertheless, cognizance should be taken of the possibility that for some people, receiving a positive HIV test in the absence of treatment possibilities could result in them engaging in riskier, rather than safer, sex as a consequence. Figure 3 shows the impact on new HIV infections of such a scenario (using the ASSA 2003 lite model). It shows that if the

benefits of VCT in terms of the reduction in unprotected sex are cut in half (to 18% for those in Stages 1 to 3 and to 26.5% for those with AIDS) to take into account aggressive infectious behaviour on the part of some people, then this will have a significant impact on the number of new HIV infections. If this projection is the actual 'baseline' no HAART scenario, then the benefits in terms of HIV infections averted of a HAART rollout would be much greater than that indicated in Figure 1 and Table 3.

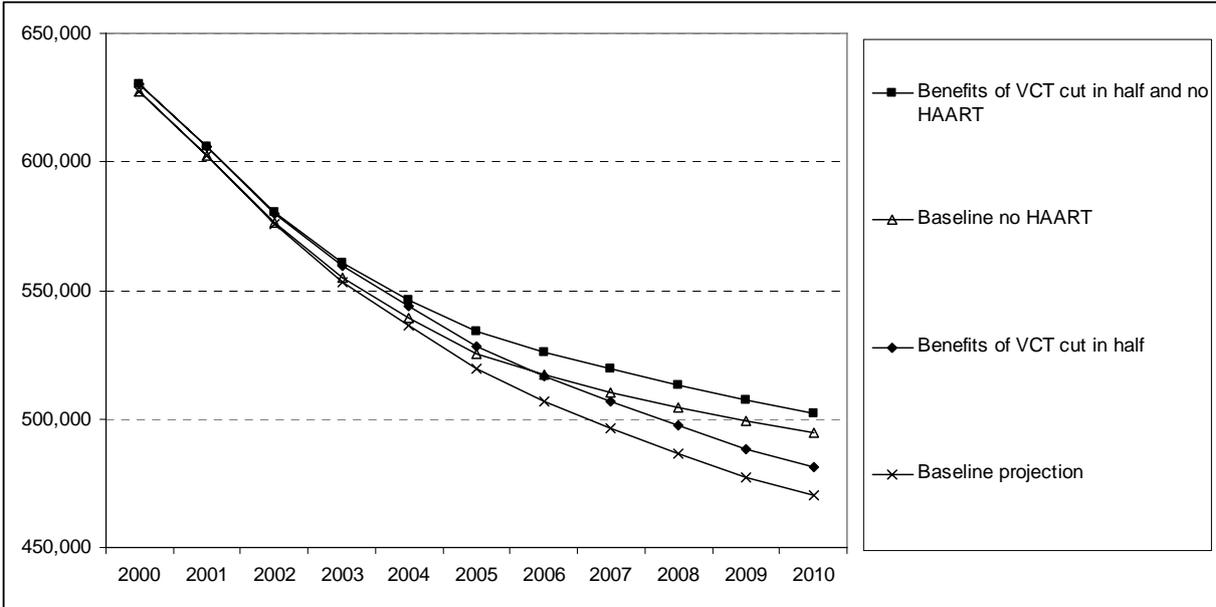


Figure 3: The Number of New HIV Infections in South Africa With and Without HAART (ASSA2003 Model)

Such modelling is inevitably highly speculative and should be considered for illustrative purposes only. Nevertheless, it is a reasonable proposition that a social response to AIDS which includes treatment – and thus the gift of hope and longer life for those already infected – is likely to deliver greater social benefits (in terms of lower rates of HIV transmission) than an uncaring response which leaves HIV infected people without any possibility of obtaining life-prolonging treatment.

## Conclusion

Continued support for a HAART rollout will depend in large part on empathy for HIV-positive people and this could decline if HAART results in, or is seen to result in, more new HIV infections. Whether HAART has a net preventative benefit depends on a range of clinical (viral load suppression) and behavioural factors. Country-level research is urgently required into these outcomes and behaviours.

Demographic modelling packages can assist users to explore the potential impact of HAART on the course of the AIDS epidemic. However, the models should be transparent about their limitations, and should be flexible enough to incorporate country-level behavioural data relating to the HAART rollout. This is the case with regard to the ASSA 2003 model – but not with regard to the Spectrum AIDS Impact Model. The Spectrum model is ill-equipped to deal with policy modelling requirements of the post HAART rollout era and should be revised accordingly.

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## Endnotes

<sup>1</sup> Spectrum can be downloaded from this web-site:

<http://www.policyproject.com/software.cfm?page=Software&ID=Spectrum>.

<sup>2</sup> The ASSA model is produced by the Actuarial Society of South Africa under the leadership of Prof Dorrington and Leigh Johnson at the University of Cape Town. It can be downloaded free of charge from <http://www.assa.org.za>. For more discussion of the ASSA model and its key outputs, see Dorrington *et al* 2006.

<sup>3</sup> I am grateful to Leigh Johnson for his technical and critical inputs on this section.

<sup>4</sup> EPP is available on:

[http://www.unaids.org/en/resources/epidemiology/epi\\_softwaretools.asp](http://www.unaids.org/en/resources/epidemiology/epi_softwaretools.asp)

<sup>5</sup> Note that if HAART patients do subsequently engage in riskier sex, this does not necessarily negate the preventative benefits of reduced viral load. For example, Porco *et al* (2004) found that even though unprotected sex increased in their cohort study of MSM after HAART was introduced, this was associated with fewer new HIV infections, thus indicating that the decline in infectivity associated with HAART had more than compensated for the increased sexual risk taking.