The burden of disease attributable to sexually transmitted infections in South Africa in 2000

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Objectives. To estimate the burden of disease attributable to sexually transmitted infections (STIs) in South Africa, to identify the factors contributing to this burden, and to review successes and failures in reducing this burden.

Design. Years of life lost (YLL) and years lived with disability (YLD) were estimated using different approaches for HIV/AIDS, other STIs and cervical cancer. Burden in respect of HIV/AIDS was estimated using the ASSA2002 model, and for the other diseases the revised national burden of disease estimates for 2000 based on 1996 cause-of-death data were used. The ASSA2002 model was used to estimate numbers of AIDS deaths under different prevention and treatment scenarios.

Setting. South Africa.

Outcome measures. Deaths, YLL and disability-adjusted life years (DALYs) associated with HIV/AIDS, other STIs and cervical cancer.

Results. STIs accounted for more than 26% of all deaths and over 5 million DALYs in 2000 and over 98% of this burden was due to HIV/AIDS. A combination of social, behavioural and biological conditions contribute to this burden. HIV/AIDS mortality and morbidity are estimated to have increased significantly since 2000, and the future change in this burden is largely dependent on the extent to which antiretroviral treatment and HIV prevention programmes are introduced. 2.5 million AIDS deaths could be prevented by 2015 if high levels of access to antiretroviral treatment are achieved.

Conclusion. South Africa faces one of the largest STI epidemics in the world. A multifaceted strategy to prevent and treat STIs is needed, and burden of disease assessments should look beyond the role of 'unsafe sex' when attributing this disease burden to risk factors.

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South Africa's burden of disease due to sexually transmitted infections (STIs) is currently one of the largest in the world. It is estimated that there are now more than 5 million HIV infections in South Africa, and there has been a rapid rise in mortality due to HIV/AIDS over the last decade.[1] The prevalence of other STIs is also high,[2] and these STIs are a significant threat – both as a common cause of infertility and adverse pregnancy outcomes, and as infections that increase the risk of HIV transmission. Cervical cancer, which accounts for more female deaths than any other cancer in South Africa,[3] also forms part of the STI burden, as it is caused by the sexually transmitted human papillomavirus (HPV). The prevention and treatment of STIs is therefore immensely important to public health in South Africa. It is also important that this disease burden be quantified and monitored.

Attempts to determine the total burden of disease attributable to STIs typically focus on 'unsafe sex' as the risk factor responsible for this disease burden.[4,5] In the World Health Organization (WHO) comparative risk assessment (CRA) study,[5] unsafe sex is defined as unprotected sex with a partner who has an STI, and the approach for this risk factor is therefore different from that for other risk factors, which have a single characteristic resulting in a poor health outcome. In the case of 'unsafe sex', the outcome itself contributes to the risk factor; STI transmission is the result of both unprotected sex and one partner already being infected. The latter depends as much on the population prevalence of the STI as on risky sexual behaviours and individual susceptibility. The analysis that follows quantifies the total burden of disease attributable to STIs in South Africa, without attempting to frame this in terms of a particular definition of 'unsafe sex'. The analysis therefore differs from the conventional approach to attributing disease burden to other risk behaviours, which are typically more clearly defined characteristics.

In addition to quantifying the STI burden of disease in South Africa, this article provides a qualitative assessment of the social, behavioural and biological factors responsible for the high STI prevalence in South Africa. Past successes in STI prevention and treatment are briefly outlined, and recommendations for future prevention and treatment initiatives are made.

Estimation of the burden of disease due to STIs

For the purposes of this analysis, the burden of disease due to STIs has been split into two components, namely the burden due to HIV/AIDS, and the burden due to other STIs. The

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Table I. Disability-adjusted life year (DALY) estimates for sexually transmitted infections (STIs) in South Africa, 2000

	Males				Females				Persons			
	Deaths	YLLs ('000)*	YLDs ('000)	DALYs ('000)	Deaths	YLLs ('000)	YLDs ('000)	DALYs ('000)	Deaths	YLLs ('000)	YLDs ('000)	DALYs ('000)
HIV/AIDS	64 418	1 721	550	2 271	68 572	2 022	710	2 733	132 990	3 743	1 261	5 004
Other STIs	172	5	12	17	299	8	23	31	471	14	35	49
Cervical cancer	-	-	-	-	3 498	50	4	54	3 498	50	4	54
Total	**64 590**	**1 726**	**563**	**2 289**	**72 369**	**2 080**	**738**	**2 818**	**136 959**	**3 806**	**1 300**	**5 106**
% of total	**23.6%**	**30.0%**	**20.7%**	**27.0%**	**29.3%**	**42.3%**	**26.2%**	**36.4%**	**26.3%**	**35.6%**	**23.5%**	**31.5%**

*Numbers in these columns are expressed in thousands, except for the percentages in the last row.
YLLs = years of life lost; YLDs = years lived with disability; DALYs = disability-adjusted life years.

burden due to HIV/AIDS in 2000 was determined using the ASSA2002 AIDS and Demographic model, a spreadsheet model of the South African HIV/AIDS epidemic, developed by the Actuarial Society of South Africa.[6] The model is calibrated to the data collected in the antenatal prevalence surveys as well as death notification data and HIV prevalence estimates from household surveys. For other STIs (syphilis, gonorrhoea, chlamydia and cervical cancer), years of life lost (YLLs) were estimated based on the 1996 cause-of-death data, adjusted for under-registration and mis-classification of causes, and years lived with disability (YLDs) were estimated by assuming that the ratio of YLDs to YLLs is the same as that estimated by the WHO for all countries in the AFR-E region, for each STI.[3]

The results are shown in Table I. The total disability-adjusted life years (DALYs) attributable to STI in 2000 is estimated at over 5 million. Of this, 98% is due to HIV/AIDS. For HIV/AIDS and cervical cancer, most of the burden is made up of YLLs, while for other STIs, the YLD component exceeds the YLL component. The burden due to STIs in women is more than 20% greater than that in men, partly because of the higher STI prevalence in women and partly because of the greater number of women in the adult population.

Factors promoting the spread of HIV and other STIs in South Africa

The high prevalence of STIs in South Africa is to a significant extent the legacy of the country's political and economic history. The migrant labour system has contributed considerably to the disruption of stable sexual partnerships,[7,8] and high levels of migration persist, with associated high levels of vulnerability to STIs. The problem was compounded in the past by poor access to STI treatment and poor quality of STI treatment in previously disadvantaged groups. South Africa has a high level of urbanisation compared with other African countries, and this has been shown to be strongly positively correlated with HIV prevalence.[9] South Africa's relatively well-developed transport infrastructure may also have contributed to the rapid geographical spread of the HIV/AIDS epidemic.

The low socio-economic status of women has also played an important role in the spread of STIs and is a continuing obstacle to STI prevention efforts. Women are often economically dependent on men, and a significant proportion of women engage in 'transactional sex'.[10] Women often report not being able to insist on condom use or to refuse sex due to fear of partner violence or curtailment of material support.[11-13] Socio-economic pressures on young women to find financially secure partners also frequently lead to partnerships with men significantly older than they are.[14] In addition, low socio-economic standing is a barrier to women disclosing their STI status to their partners. African studies show that a high proportion of women do not inform their partners if they test HIV-positive, because of fear of violence or abandonment,[15] and South African studies suggest that individuals rarely inform their partners after receiving treatment for other STIs.[16]

Coupled with the high prevalence of transactional sex is the high rate of partner concurrency in South Africa. Surveys of sexually active youth have found that around one-quarter of youth currently in relationships have more than one partner,[17,18] and this is thought to be a significant factor promoting the spread of HIV and other STIs.[19] Use of alcohol also appears to be a risk factor for STIs, with heavy drinkers reporting higher numbers of partners, greater experience of STIs and greater experience of condom failure.[20]

A large number of biological factors have been implicated in the transmission of HIV and other STIs. Most importantly: (*i*) men who are uncircumcised face a higher risk of infection with HIV, syphilis, chancroid and gonorrhoea;[21,22] (*ii*) the high prevalence of cervical ectopy in young women has been shown to increase susceptibility to HIV and chlamydia;[23,24] (*iii*) bacterial STIs generally increase susceptibility to HIV, as do other STIs such as trichomoniasis and herpes simplex

virus type 2 (HSV-2);[25] and (*iv*) bacterial vaginosis appears to be associated with the transmission of HIV and other STIs.[25-27]

Many of these co-factors for STI transmission are common in South Africa. For example, roughly 65% of adult men in South Africa are uncircumcised,[18] and the prevalence of bacterial vaginosis in pregnant women is typically between 25% and 50%.[2] Bacterial STIs are common, and HSV-2 and trichomoniasis are even more highly prevalent. Behavioural factors may compound the effect of biological factors; for example, the effect of the high prevalence of cervical ectopy at young ages could be particularly pronounced if sexual debut is relatively early.

Interventions and behaviour change

Significant STI prevention programmes have been introduced in South Africa over the past decade. Since 1994, syndromic management protocols for STI treatment have been introduced in public health facilities. This may partly explain the dramatic decline in the prevalence of syphilis measured at antenatal clinics, from 11% in 1997 to 3% in 2005.[28] However, syndromic management protocols have not been adopted with equal enthusiasm by private practitioners, who are estimated to treat roughly half of all STI cases.[29] In some public STI clinics, drug shortages and heavy patient loads limit capacity to implement syndromic management protocols.[30] Evidence of changes in the prevalence of STIs other than syphilis and HIV is generally lacking, and there is a need for more periodic cross-sectional studies in sentinel populations, that can be used to monitor prevalence trends.[2]

Other prevention programmes have emphasised the need for behaviour change. Social marketing programmes such as Khomanani and loveLife have been complemented by steady increases in condom distribution by the Department of Health over recent years.[31] Voluntary counselling and testing (VCT) has also been heavily promoted, and it is estimated that by 2003, 70% of public primary health care facilities offered VCT services.[32] These social marketing and VCT programmes appear to have had some impact on sexual behaviour. For example, rates of condom usage at last sex, reported by women aged 15 - 49, have increased from 8% in 1998[33] to 29% in 2002.[18] However, there is no evidence of delay in sexual debut, and it is unclear whether numbers of partners are declining.[34]

Success in introducing STI screening programmes has been variable. Although public antenatal clinics have been conducting antenatal screening for syphilis for a number of decades, these programmes continue to experience difficulties in terms of lengthy delays between drawing of blood and return of test results, women presenting too late in pregnancy to receive the full course of syphilis treatment, and women not going to the clinics to which they are referred for treatment,[35-37] with these problems being particularly significant in rural areas. Programmes for the prevention of mother-to-child transmission (PMTCT) of HIV have also been introduced in the public health sector since 2001. These appear to have been successful in the Western Cape, but have not achieved significant reductions in vertical transmission in less well-resourced settings.[38] South Africa is one of the few developing countries to have a public cervical cancer screening programme, but access to this programme remains poor in rural areas, and utilisation of screening services has been low due to the common misconception that this screening is diagnostic rather than preventive.[39]

Before 2004 treatment for HIV/AIDS was limited mainly to the private health sector. In 2003, however, the Department of Health announced a comprehensive plan for the treatment of HIV/AIDS, including highly active antiretroviral treatment (HAART).[40] By June of 2006, approximately 180 000 individuals had started receiving HAART through the public health sector,[41] although access to HAART in the public health sector remains variable between South Africa's provinces. Obstacles to the rollout of this intervention have included lack of clarity regarding the accreditation process for clinics wanting to provide HAART, lack of trained personnel and lack of continuity of drug supply in some provinces. Access to other forms of HIV treatment and prophylaxis is also limited in many areas.

Effects of prevention and treatment programmes

The effect of HIV/AIDS prevention and treatment programmes in South Africa is demonstrated by the ASSA2002 AIDS and Demographic Model.[6] Fig. 1 shows the projected annual numbers of AIDS deaths in South Africa in four different scenarios: (*i*) a 'no intervention' scenario, in which no prevention or treatment programmes are introduced; (*ii*) a 'prevention only' scenario, allowing for the introduction of VCT, social marketing, PMTCT of HIV and improved STI treatment at the rates of phase-in achieved in South Africa; (*iii*) a 'constrained' scenario, the same as the 'prevention only' scenario but also including allowance for HAART, which is assumed to reach a maximum of 50% of newly eligible individuals by 2008; and (*iv*) an 'optimistic' scenario, the same as the 'constrained' scenario but assuming HAART reaches a maximum of 90% of newly eligible individuals by 2008.

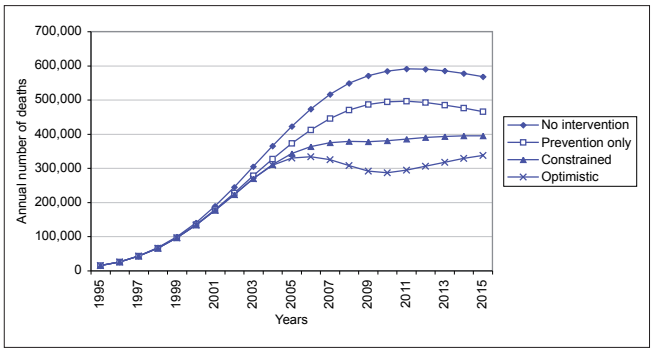

Fig. 1. Annual numbers of AIDS deaths in South Africa.

The results of the model suggest that prevention and treatment programmes have had a significant impact on AIDS mortality in South Africa and will continue to have a significant impact in future. By 2015, the projected annual number of AIDS deaths in the 'prevention only' scenario is 18% below the level that would be expected in the 'no intervention' scenario, and the number in the 'optimistic' scenario is 41% below the 'no intervention' scenario estimate. The cumulative number of AIDS deaths between 1995 and 2015 is reduced by 930 000 in the 'prevention only scenario' and by 2 500 000 in the 'optimistic' scenario, when compared with the 'no intervention' scenario.

Discussion

This analysis demonstrates that STIs are contributing significantly to the burden of disease in South Africa, accounting for almost one-third of the overall burden. Ninety-eight per cent of this burden of disease was due to HIV/AIDS in 2000, and Fig. 1 demonstrates that the HIV/AIDS burden has increased substantially since then. The change in the HIV/AIDS burden over the next decade will depend largely on the extent to which HAART and HIV prevention strategies are introduced in South Africa, and it is encouraging that the new HIV and AIDS and STI Strategic Plan[42] aims to provide HAART to 80% of people progressing to AIDS by 2011. Changes in the burden due to other STIs are difficult to predict owing to the lack of STI studies conducted periodically in the same population.

The quantitative analysis has a number of limitations. The extent of the HIV/AIDS epidemic, which accounts for most of the STI disease burden, is uncertain. In a recent Bayesian analysis of HIV prevalence data and vital registration data in South Africa,[43] it was estimated that the 95% prediction interval around the number of AIDS deaths in 2000 was 117 000 - 185 000. In assessing uncertainty around these estimates, it should also be recognised that the YLDs in respect of HIV/AIDS are very sensitive to the disability weights chosen. In an earlier assessment,[44] for example, YLD rates varied between 2.3 and 6.0 per 1 000 when different disability weights were used.

A further limitation of this analysis is that it does not include the burden of disease due to trichomoniasis, HSV-2 and sexually transmitted hepatitis B. Other assessments[4,45] have shown that these infections contribute significantly to the burden of disease, although in this context their effect is likely to be small relative to HIV/AIDS. This analysis also does not split the STI disease burden according to the mode of transmission. In South Africa there is little information on the contribution of unsafe injections and transfusions to STI transmission, although the contribution is believed to be small.[46] Paediatric HIV infection is almost all due to mother-to-child transmission, as shown in a recent study of HIV-infected South African children,[47] 99% of whom were found to have HIV-positive mothers. In adults, almost all HIV and STI transmission is sexual. Transmission of HPV is also thought to be almost exclusively sexual, and this virus has been shown to account for more than 99% of cervical cancer cases.[48]

The review of the factors driving the STI epidemic in South Africa demonstrates that there is a host of political, economic, social, behavioural and biomedical factors influencing the STI epidemic. Because of this complexity, it is neither accurate nor helpful to describe the STI burden as being due solely to 'unsafe sex'. To succeed in reducing the STI burden it will be necessary to adopt a multifaceted strategy that aims to change more than just sexual behaviour. The new HIV and AIDS and STI Strategic Plan[42] recognises the need for such a multifaceted approach.

As a first step, information and education campaigns need to accommodate a broader range of messages. Social marketing programmes have to date been successful in increasing condom usage, but other forms of behaviour change have not been observed[34] and might therefore need to be promoted in a different manner. More emphasis should be placed on STI education, with more education on the recognition of STI symptoms, the need for prompt treatment and the need for partner notification. There is also a need for promotion of regular screening for cervical cancer precursors, with emphasis on the preventive benefit of this screening.

There is also room for improvement in HIV and STI treatment. Training of general practitioners in syndromic management protocols and providing access to cheaper STI treatment may bring about improvements in the quality of STI treatment in the private health sector.[29] In the public health sector, improving access to HIV treatment is a significant challenge. To expand access to HAART in future it will be necessary to invest more in the public health infrastructure and in recruiting and retaining doctors and nurses in this health sector.

The socio-economic environment should also be considered in designing HIV prevention strategies. For example, it has been suggested that economic empowerment projects targeting young women would reduce their economic reliance on men, and thus curb HIV incidence in young women.[14] Employers should also be discouraged from following recruitment and deployment practices that promote migration and long absences from home.[49]

Lastly, advances in biotechnology have the potential to reduce the STI burden in South Africa in the long term. Microbicides may be effective in preventing the transmission of HIV and other STIs, but it is likely to be a number of years before an effective microbicide is commercially available.[50] There is an urgent need for vaccines that are effective against the main viral STIs: HIV, HSV-2 and HPV. Encouragingly, vaccines effective against HPV types 16 and 18 have been developed recently,[51] and could have a significant impact in

South Africa, where HPV types 16 and 18 account for the majority of cervical cancer cases.[52]

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