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Sexually transmitted diseases in South Africa

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Aim: To review the epidemiology of and data collection for sexually transmitted diseases (STDs) in South Africa.
Methods: Literature published since 1980 on STDs in South Africa were compiled and evaluated. Historical reports and salient unpublished literature were also used in the literature review. Studies were critically reviewed in the light of sample populations and study methods, and a baseline picture of the patterns of STD burden was developed.
Results: The STD burden in apparently asymptomatic study populations is significant. Ulcerative infections, primarily caused by syphilis and chancroid, are present in 5–15% of asymptomatic clinic attenders; prevalence rates of gonorrhoea average 8%, with up to 13% of gonococcal isolates resistant to penicillin antibiotics. In addition, on average, chlamydia and vaginal infections are detected in 16% and 20–49%, respectively, of antenatal and family planning clinic attenders. HIV seroprevalence rates have reached 7·6% in antenatal clinic attenders. Most South African STD data are derived from ad hoc surveys which have traditionally focused only on several major infections and particular urban centres. Almost all STD studies have been facility-based, with many studies based at STD clinics, thus reporting only relative frequencies and not population-based prevalences of STDs. With the possible exception of HIV, systematic surveillance data for STDs are conspicuously lacking.
Conclusion: The disease burden of classic sexually transmitted infections has historically been heavy, and continues to be a serious public health problem in South Africa. Morbidity from both ulcerative and non-ulcerative infections, particularly in women, is significant. The body of STD data, although mostly sound, remains incomplete, and with the rapid emergence of HIV in South Africa, surveillance of STDs and focused STD policies will be critical.
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Keywords: STD; South Africa; epidemiology

Introduction

With the appearance of HIV/AIDS, sexually transmitted diseases (STDs) have re-emerged as a grave public health problem, particularly in developing countries. There is strong evidence showing that the presence of genital ulcer disease and of some non-ulcerative STDs enhances the transmission of HIV.[1-3] In addition, the presence of HIV is known to alter the presentation and clinical course of STDs, and to increase the frequency of treatment failure for some sexually transmitted infections.[1] The inter-relationships between HIV and STDs mean that an understanding of the burden and transmission patterns of STDs is imperative if the control of both STDs and HIV is to be pursued in an informed manner.

In South Africa, the epidemiology of STDs has been largely neglected. The historical lack of interest in STDs as a health priority, the absence of a surveillance system which encompasses STDs, and the difficulties of collecting data from a fragmented health care system have resulted in a dearth of reliable STD data. Facility-based ad hoc surveys have provided some point estimates of the burden of particular STDs, but a broad cohesive picture of the state of STDs in South Africa is missing.

This review, encompassing STD literature since 1980, presents a contemporary examination of STDs in South Africa. The epidemiology of the most prevalent STDs is reviewed and the STD burden of the population is re-examined. The review also provides a close look at the state of STD data in South Africa.

Methods

Refereed literature published since 1980 on epidemiological aspects of STDs in South Africa were collected. Historical reports, unrefereed published literature, and unpublished literature such as official statistics, working papers, and conference proceedings, were also compiled. Studies were then critically reviewed on the basis of their broader relevance and study methods. Methodological issues evaluated included the size, significance, and representativeness of the sample populations, diagnostic criteria, clinical and laboratory methods used for diagnosis, and techniques of data analysis.

Published studies were included if the reported study methods met the listed methodological criteria; unpublished studies, however, were included only if they met the methodological criteria and if they represented significant developments which had not been published. In a few cases, weaker and less widely applicable studies were noted if they represented the only data set available for a particular infection. In these cases, deficiencies in the studies and related caveats were made explicit. Selected case reports and historical reports were included to provide background context.

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Ulcerative infections

Syphilis

Prior to the arrival of Europeans, venereal syphilis was apparently unknown in southern Africa. In fact, reports from the first European travellers to the region in the early 1800s specifically noted the absence of syphilis among the Xhosa and the Bechuana.[4] By 1887, however, with the development of the Kimberley diamond mines, syphilis had spread widely within the indigenous population, and Wassermann seroprevalence rates of higher than 80% were reported in some areas.[4] A 1949 review by Sidney Kark noted that syphilis seropositivity rates in expectant mothers ranged between 20% and 40%; not surprisingly, Kark remarked that "few countries can have a higher incidence . . . than has South Africa".[5]

Most of current South African syphilis data are serologically-based; thus, some caveats of syphilis serology should be borne in mind when examining this set of data. The main issues in syphilis serology particularly relevant to these data are: (1) nontreponemal reagin tests (rapid plasma reagin or VDRL) are sensitive, becoming negative after successful treatment of early infection, but remaining positive in cases of successful treatment of later stages of syphilis; (2) treponemal tests (fluorescent treponemal antibody absorption or *Treponema pallidum* haemagglutination) are more sensitive than reagin tests, but remain positive even after successful treatment; (3) the combination of a screening reagin test followed by a confirmatory treponemal test is generally accepted as a standard criterion for syphilis; (4) diagnosis of active syphilis based on either a reagin test alone or a treponemal test alone results in overestimation of true syphilis cases, but in high prevalence regions such as South Africa, the proportion of false positive reagin tests relative to actual active syphilis cases is small enough that diagnosis based on a reagin test alone may be sufficient.[6 7] For these reasons, the studies discussed are limited to those that used, as a diagnostic criterion for syphilis, either a positive reagin test or a positive reagin test confirmed with a positive treponemal test.

Table 1 Percentage seropositivity of syphilis in general population groups

Population studied and Region	*Year**	*Seropositivity (sample size)*
Health facility settings		
Women attending antenatal clinics		
Pretoria[8]	1982–83	15·0% (5,177)†
Cape Town[9]	1982–83	7·6% (18,163)†
Durban[10]	1983	5·5% (2,767)†
KwaZulu[11]	1987	11·9% (193)†
Cape Town[12]	1990–92	5·2% (1,973)†
Durban[13]	p1992	7·6% (170)†
Women presenting for delivery (unbooked)		
Johannesburg[14]	1985–86	16·2% (1,625)‡
Cape Town[15]	1990	32·3% (31)†
Durban[16]	1990–91	30·7% (114)‡
Women presenting for delivery (booked)		
Johannesburg[14]	1985–86	5·9% (6,287)‡
Cape Town[15]	1990	11·6% (576)†
Women attending FP clinics		
Johannesburg[17]	p1984	25·0% (104)†
Durban[18]	1986–87	8·0% (50)†
Women presenting at hospital or clinic		
Johannesburg[19]	1989–90	5·2% (7,212)‡
Women attending gyn/colp clinics		
Durban[20]	1990	15·5% (97)†
Durban[21]	p1993	14·3% (189)†
Non-facility settings		
Women living in rural areas		
Orange Free State[22]	1994	12·3% (465)†
Women living in urban areas		
Bloemfontein[22]	p1994	15·6% (403)†
Female urban migrant workers		
Cape Town[23]	1987	10·4% (154)‡
Male urban migrant workers		
Cape Town[23]	1987	6·9% (131)‡

*Date of survey or, if no survey date available, date of publication (p).
†Seropositivity based on positive reagin test confirmed with positive treponemal test.
‡Seropositivity based on positive reagin test.
FP: family planning; gyn/colp: gynaecology or colposcopy.

Syphilis in general population groups Most study estimates of syphilis seropositivity in general population groups, or more specifically, non-symptomatic groups, were gathered from health facility data. As shown in table 1, 16 of the 20 estimates were based on sample populations of hospital or clinic attenders. Rates among antenatal clinic attenders were typical of facility-based seropositivity rates in most other groups of women studied, with rates ranging from 5·2% to 15·0% (median 7·6%).[8–13]

Other groups of women, however, were found to have generally higher rates of seropositivity. One of these groups was the group of "unbooked" pregnant women—that is, women who had either not received antenatal care prior to delivery or had not attended an antenatal clinic a sufficient number of times (usually twice) to be notified of their syphilis status. Seroprevalence of "unbooked" women was reported to be 30·7% in Durban, 32·3% in Cape Town, and 16·2% in Johannesburg.[14–16] The Johannesburg study also confirmed that the difference in seropositivity rates between "booked" women, with seroprevalence of 5·9%, and "unbooked" pregnant women was significant.[14]

Unpublished studies of "unbooked" women have noted that these women generally tend to be single and unemployed, and have a poor relationship with the father of the child.[24–26] The major reasons given for not seeking antenatal care are lack of money (or that the clinic is too expensive) and distance from the clinic.[24 25] In addition, there is speculation that "unbooked" women may be less knowledgeable about the importance of antenatal care[25] or may have a more carefree attitude towards certain unhealthy behaviours affecting the fetus such as smoking and STDs.[26] Syphilis seropositivity status may thus be related to such as factors as access to information regarding the importance of antenatal care and STD treatment, and physical and financial access to clinics.

A second group of women with higher seropositivity rates were gynaecology/colposcopy clinic attenders.[20 21] These women either presented with a gynaecological complaint or, in the case of colposcopy clinic attenders, were referred for gynaecological anomalies, some of which may have been related to the presence of STDs. Thus, they would have been more likely than other clinic-attending populations to have tested positive for syphilis.

Notably, rates among women surveyed in non-facility settings also clustered around the high end of the range.[22 23] These women were

usually surveyed at their residences (homes or worker hostels), and data from these population samples are believed to be a realistic indication of general population seroprevalence. In comparison with rates from facility data, the generally higher seropositivity rates of these women suggest that facility-based data may often underestimate population seroprevalence. Some non-facility studies may, moreover, be a slight underestimate themselves. In particular, the migrant worker study may have been subject to a "healthy worker" effect in that migrant workers may represent a healthier range of individuals within the broader population.

Syphilis among persons with STDs Data collected at STD clinic sites are theoretically more accurate than those collected at antenatal or family planning (FP) clinics because diagnosis of syphilis in symptomatic patients can rely on clinical signs and dark field microscopy in addition to serology. Despite this advantage, however, studies often rely either on dark field microscopy or on serology—not on both. Another serious drawback of the STD clinic data is that reported prevalence at these sites reflects only relative prevalence, not true population prevalence.

Diagnosis of syphilis, based on either serology or dark field microscopy, is relatively common among men and women presenting with STDs, as shown in table 2. Among men with genital ulcer disease (GUD), the proportion of clients diagnosed with syphilis ranged from 16·7% to 49·0%.[27-31] This range is extremely wide, but part of the variation in estimates may be due to the choice of diagnostic criteria: whereas serological diagnoses are believed to overestimate the proportion of active syphilis cases, dark field microscopy, depending on the technical proficiency and experience of the microscopist, is believed to underestimate the number of active cases. The "true" proportion of active syphilis cases is believed to be between the serological and dark field-positive values. Indeed, recent results from a study of patients with GUD in Lesotho, a neighbouring southern African country, appear to support this assertion. The Lesotho study compared the number of syphilis diagnoses based on serology, dark field identification, and polymerase chain reaction (PCR), and showed that, whereas PCR identified syphilis infection in 19% of cases, dark field identification identified 0% and serology identified 26% (unpublished observations).

Table 2 Syphilis in population groups with STDs

Population studied and Region	*Year**	*% Diagnosed (sample size)*
Men with GUD		
Johannesburg[27]	p1981	16·7% (102)†
Pretoria[28]	1981	49·0% (100)†
Durban[29]	1984	44·0% (100)†
Carletonville[30]	1986	25·8% (240)†
Durban[31]	1988–89	42·0% (100)‡
Women with GUD		
Johannesburg[32]	p1984	43·0% (100)†
Durban[33]	1988–89	40·0% (100)‡
Women with PID		
Durban[18]	1986–87	34·0% (50)§
Women attending STD clinics		
Johannesburg[17]	p1984	34·9% (229)§

*Date of survey or, if no survey date available, date of publication (p).
†Diagnosis based on dark field identification or positive reagin test confirmed with positive treponemal test.
‡Diagnosis based on dark field identification or positive treponemal test.
§Diagnosis based on positive reagin test confirmed with positive treponemal test.
GUD: genital ulcer disease; PID: pelvic inflammatory disease; STD: sexually transmitted disease.

All the studies reviewed indicated that syphilis was a frequently-diagnosed infection in both men and women with GUD: syphilis was either the single most common infection, or the second most common infection after chancroid. Mixed infections were also frequent when positive syphilis serology was used as the primary diagnostic criterion. About 30% of GUD patients who had been diagnosed with syphilis harboured other pathogens, with chancroid and genital herpes being the most frequent accompanying infections. In addition, in a broad study of mixed infections, Sischy *et al* reported that 23% of clinic patients presenting with non-syphilitic GUD were syphilis seropositive, while 11% of urethritis patients tested positive for syphilis.[34]

Congenital syphilis In South Africa, estimates of congenital syphilis prevalence rates have been variable, from 0·05% of live births, based on clinical diagnosis, to 8% of deliveries, based on RPR of cord blood.[14 35-37] There is no dispute, however, that congenital syphilis remains a leading factor in perinatal mortality in South Africa. One study estimated that 3·2 perinatal deaths per 1000 live births were syphilis-related.[38] In addition, between 2·8% and 11% of stillbirths and perinatal deaths have been attributed to syphilis.[39-44] Although syphilis-related stillbirths are less frequent for mothers who seek antenatal care,[42] there is some unpublished evidence suggesting that, even among those who sought antenatal care, at least one-third of women were not tested for syphilis; moreover, among those who were tested for syphilis, a significant proportion were inadequately treated and as a result, lost their infants to syphilis-related deaths.[37 43 45]

In South Africa, congenital syphilis became a condition notifiable to the Department of National Health and Population Development in February 1991.[46] The notification statistics, however, have not been very reliable, with 994 cases notified in 1993 and 910 cases notified in 1994 (unpublished observations). Given the prevalence studies, these notifications clearly represent significant under-reporting of the disease.

Chancroid

Chancroid poses two particular difficulties with respect to diagnosis and treatment. Although the development of selective solid media for the culture of *Haemophilus ducreyi* has permitted a high degree of diagnostic accuracy on a microbiological level, accurate clinical diagnosis of chancroid is difficult. Chancroid often presents atypically, and without laboratory confirmation, is often misdiagnosed as syphilis, lymphogranuloma venereum, or genital herpes.[47 48] The treatment

of chancroid is also problematic because of the antibiotic resistance exhibited by local isolates of *H ducreyi*.

Chancroid among persons with STDs Despite the documented importance of chancroid in Africa, only a handful of studies have reported on the scope of chancroid in South Africa. Studies since 1980 reporting on the relative prevalence of chancroid in persons with GUD are shown in table 3. These studies show that chancroid is a leading infection in men with GUD, with *H ducreyi* being isolated in 40·0% to 68·3% of cases.[27-30]

Two studies, however, reported extremely low relative frequencies of chancroid among men and women with GUD.[31 33] Although there are slight epidemiological differences between Durban (where these joint studies were conducted) and the other areas surveyed, it is believed that the reasons for the discrepancy in rates are largely due to the particular study populations and laboratory methods used to identify chancroid. First, the Durban study populations may have included fewer prostitutes and their clients, a group believed to be a reservoir for chancroid[49]; as a result, one would expect the Durban study to report a low relative prevalence of chancroid while reporting a high relative prevalence of other STDs. In addition, laboratory methods used to diagnose chancroid in the 1988–89 Durban studies were slightly different from those used in the other studies; although the different methods are accepted laboratory techniques, the varying methodologies may mean that the reported values may not be directly comparable. Both of these factors may explain the low relative frequency of chancroid reported in these studies and may also explain the significant difference between the low 22% relative frequency reported in the male GUD study and the 40·0% rate reported for the same region in a study 4 years previously.[29]

Overall, the generally high relative frequency of chancroid in the studies suggest that chancroid is, along with syphilis, a leading infection in persons with GUD. In fact, two of the five GUD studies of men reported chancroid as the single leading infection,[27 30] while the other three reported chancroid as the second leading infection after serologically-diagnosed syphilis.[28 29 31] These studies indicate chancroid and syphilis are leading causes of GUD in South Africa, representing 70%-90% of cases of GUD.

Table 3 Chancroid in population groups with STDs

Population studied and Region	*Year*†	*% Diagnosed* (sample size)*
Men with GUD		
Johannesburg[27]	p1981	56·9% (102)
Pretoria[28]	1981	44·0% (100)
Durban[29]	1984	40·0% (100)
Carletonville[30]	1986	68·3% (240)
Durban[31]	1988–89	22·0% (100)
Women with GUD		
Johannesburg[32]	p1984	46·0% (100)
Durban[33]	1988–89	14·0% (100)

*Diagnosis based on isolation of *H ducreyi* from lesions.
†Date of survey or, if no survey date available, date of publication (p).
GUD: genital ulcer disease.

Antimicrobial susceptibilities of H ducreyi The problem of chancroid is compounded by the decreasing susceptibility of *H ducreyi* to a spectrum of antibiotics. Since the early 1980s, antimicrobial susceptibilities of *H ducreyi* strains in South Africa have been monitored. In 1982, 93% of isolates produced β-lactamase, but by 1988, 100% of the 122 tested isolates were shown to produce β-lactamase.[50 51] In addition, isolates were shown to be resistant to tetracycline, doxycycline, and sulfamethoxazole, and exhibited intermediate resistance to chloramphenicol and thiamphenicol.

Granuloma inguinale
Granuloma inguinale, or donovanosis, may well be the first disease to have "disappeared" only to reappear fifty years later. First reported in South Africa by Ricono in 1916,[52] donovanosis appeared sporadically in case reports until the late 1920s; between 1927 and 1981, no cases of donovanosis in South Africa were reported. Freinkel speculates that the unusual half-century "disappearance" of granuloma inguinale may have been due to a change in parasite virulence, regional migration to neighbouring countries, or mis-diagnosis, but concedes that none of these explanations is entirely satisfactory in explaining the apparent disappearance.[53] The first published re-emergence of granuloma inguinale was in 1981 in a study of men presenting with GUD when one case seen in Johannesburg was clinically and microscopically identified as donovanosis.[27] Since then, case reports from Durban, the Eastern Transvaal, and the Orange Free State have proliferated.[54-58]

Granuloma inguinale among persons with STDs
Granuloma inguinale appears to cause only a small proportion of genital ulcers seen at STD clinics. The five estimates from the Transvaal region indicate that *Calymmatobacterium granulomatis* is responsible for < 1% to 2% of GUD cases.[27 28 30 32]

Studies from Durban, however, are conspicuous for the reporting of relatively high donovanosis rates of 11% and 16% among persons with GUD. When adjusted for single infections only, relative prevalence rates of 9% and 10% for males and females, respectively, still remain surprisingly high.[31 33] Although KwaZulu-Natal may be one of the few focal centres of granuloma inguinale in the world, the high relative frequency of granuloma inguinale reported from these studies may be at least partially related to the low relative frequency of chancroid noted in the same studies. As discussed in the previous section, the particular study population and methods of isolation for *H ducreyi* may have resulted in a disproportionately low relative frequency of chancroid and high relative frequency of granuloma inguinale and other STDs.

Lymphogranuloma venereum
Lymphogranuloma venereum (LGV) appears

Table 4 Genital herpes infections

Population studied and Region	*Year*†	*% Diagnosed* (sample size)*
Men with GUD		
Johannesburg[27]	p1981	8·8% (102)
Pretoria[28]	1981	5·0% (100)
Durban[29]	1984	9·0% (100)
Carletonville[30]	1986	3·3% (240)
Durban[31]	1988–89	10·0% (100)
Women with GUD		
Johannesburg[32]	p1984	6·0% (100)
Durban[33]	1988–89	18·0% (100)
Women attending STD clinics		
Johannesburg[17]	p1984	1·8% (164)
Women attending gyn/colp clinics		
Johannesburg[60]	1986–87	6·0% (100)
Durban[21]	p1993	2·5% (199)
Women attending FP clinics		
Johannesburg[17]	p1984	1·0% (104)

*Diagnosis based on cytopathic activity in susceptible cells.
†Date of survey, or if no survey date available, date of publication (p).
GUD: genital ulcer disease; STD: sexually transmitted disease; gyn/colp: gynaecology or colposcopy; FP: family planning.

to be a minor contributor to GUD in South Africa, although it is known to be common in some distinct rural regions of the sub-continent, namely the Eastern Transvaal, Natal, and Transkei. LGV is a relatively minor cause of GUD in the major city centres surveyed, with isolation rates around 1%.[27–29 31] In the mining town of Carletonville, however, isolation rates are considerably higher: 7%.[30] This trend is consistent with the fact that many of the miners surveyed are migrant workers who may have acquired their infections from surrounding regions of Lesotho, Botswana, Swaziland, the Eastern Transvaal, and Transkei—areas with higher prevalence of LGV. Notably, although all three L-serovars of *Chlamydia trachomatis* known to cause LGV have been detected in South Africa, some apparently recombinant chlamydial strains have also recently been isolated.[59]

Table 5 Gonococcal infections

Population studied and Region	*Year*†	*% Diagnosed* (sample size)*
Men with urethritis		
Johannesburg[64]	1979–81	68·8% (237)
Cape Town[65]	1983–84	75·4% (276)
Durban[66]	1984	86·9% (206)
Durban[67]	1985	95·9% (217)
Johannesburg[68]	p1986	64·2% (165)
Port Elizabeth[69]	1986	80·3% (290)
Johannesburg[70]	1988	95·4% (216)
Pretoria[71]	p1991	77·1% (201)
Women with PID		
KwaZula[72]	p1984	56·6% (53)
Durban[18]	1986–87	62·0% (50)
Bloemfontein[73]	1987	40·0% (40)
Women with vaginal discharge		
Durban[74]	p1981	7·9% (127)
Pretoria[75]	p1986	3·3% (92)
Durban[21]	p1993	3·0% (67)
Women attending STD clinics		
Johannesburg[17]	p1984	13·6% (213)
Women attending gyn/colp clinics		
Durban[76]	1980	11·0% (100)
Durban[20]	1990	1·0% (97)
Durban[21]	p1993	6·5% (199)
Women attending FP or antenatal clinics		
Durban[74]	p1981	9·5% (105)
Bloemfontein[77]	1981	11·7% (1,200)
Johannesburg[17]	p1984	5·8% (103)
Durban[18]	1986–87	10·0% (50)
KwaZula[11]	1987	5·7% (193)
Durban[13]	p1992	4·1% (170)

*Diagnosis based on isolation of *N gonorrhoeae* from specimens obtained from urethral swab (men) or endocervical swab (women).
†Date of survey, or if no survey date available, date of publication (p).
PID: pelvic inflammatory disease; STD: sexually transmitted disease; gyn/colp: gynaecological or colposcopy; FP: family planning.

Genital herpes

One of the leading causes of genital ulceration in industrialised countries, herpes simplex virus (HSV) is seen far less frequently in developing countries. In South Africa, HSV is believed to be responsible for a moderately low proportion of GUD cases presenting at STD clinics. There is, however, recognition that, because of the latent and reactivation behaviour pattern of HSV, only a certain proportion of the pool of those infected with genital herpes is identified at any one time.

As shown in table 4, although HSV is present in a relatively small proportion of GUD cases, it is still a significant infection in GUD. Among men with GUD, HSV was isolated in 3·3% to 10·0% cases (median 8·8%).[27–31] Three surveys reported prevalence among non-STD clinic attenders. The rates, from a family planning clinic, a gynaecological clinic, and a colposcopy clinic, were 1%, 2·5%, and 6% respectively.[17 21 60] Rates of HSV infection, however, are expected to increase considerably as the HIV epidemic in southern Africa evolves.

Non-ulcerative infections

Gonococcal infections

Gonococcal urethritis Internationally, the aetiology of urethritis is complex and appears to vary according to the population groups being sampled. In the US, some attention has focused on apparent racial differences in the aetiology of urethritis; in particular, studies have reported that cases of gonorrhoea are more frequently reported in non-white populations.[61–63] Certainly, data from black men in South Africa, as shown in table 5, suggest high relative frequencies of gonococcal urethritis (GU). Studies from 1979 to 1991 show that 64%–96% (median 79%) of urethritis cases among black men are gonococcal in aetiology.[64–71] As consistent with American studies, the two South African studies which studied urethritis in Caucasian men reported lower relative frequencies of GU: 42·6% and 50·3%.[64 68]

A significant factor to consider with regard to these apparent racial discrepancies is that, particularly in South Africa, socioeconomic status (SES) is highly correlated with race. SES is, in turn, closely related to physical and financial access to health facilities. Poorer men, who more often than not are black, when faced with the milder symptoms of non-gonococcal urethritis (NGU), may choose to forego a visit to the clinic, in light of the financial, time, and distance constraints. As a result, the true frequency of NGU is most likely underestimated among the poorer, mostly black, population. Thus, racial differences in GU:NGU patterns may be explained by discrepancies in access to facilities and other, possibly economic, factors.

Gonorrhoea in women Data from women who present with an STD show that gonorrhoea is a major infection in salpingitis, or pelvic inflammatory disease (PID). In women with acute

PID, gonorrhoea, a known initiator of PID, is identified, on average, in 60% of cases in the KwaZulu-Natal area, and in about 40% of cases in the Bloemfontein area.[18 72 73] In the context of other STDs, however, gonorrhoea does not appear extremely frequently: among women presenting with gynaecological complaints other than acute PID, the relative prevalence of gonorrhoea appears to range from 3% to 14%.[17 21 74 75]

The data also show that there is a significant gonococcal burden among women attending FP and antenatal clinics. As shown in table 5, the range of prevalence rates is 4·1% to 11·7%,[11 13 17 18 74 77] with three studies reporting rates as high as 10–12%,[18 74 77] levels similar to those found in women presenting at STD clinics. Notably, although these antenatal and FP clinic attenders are assumed to be asymptomatic, this assumption was not verified explicitly in most studies. Of the six studies conducted at FP and antenatal clinics, only two studies reported from population groups which were specified as asymptomatic; these studies reported prevalence rates of 4·1% among antenatal clinic attenders and 10·0% among FP clinic attenders.[13 18] The other studies indicated that their survey groups were implicitly asymptomatic, that is, "apparently healthy". The danger with these implicit assumptions is illustrated in two studies in which clinic attenders were asked whether they had any vaginal complaints; when questioned, 55·3% of FP clinic attenders and 52·9% of antenatal clinic attenders confirmed that they had vaginal discharge.[11 17]

Gonococcal ophthalmia neonatorum In South Africa, very little has been reported during the last 20 years on rates of gonococcal ophthalmia neonatorum. A 1983–85 study in Cape Town reported an incidence rate of 0·27% of live births, confirming a previous unpublished rate of 0·25% of live births in 1980–82.[78] Although silver nitrate prophylaxis had been used routinely prior to the 1980s, there is currently no national prophylaxis policy for gonococcal ophthalmia.

Antibiotic resistance Since the detection of the first strains of penicillinase-producing *N gonorrhoeae* (PPNG) in South Africa, the gonococcus has continued to become resistant to a broad spectrum of antibiotics. South Africa's first PPNG strains, reported in Durban and in Johannesburg in 1977,[79 80] were apparently unrelated to emergent West African PPNG strains which were resistant to both penicillin and tetracycline. Subsequently, the prevalence of PPNG strains has increased dramatically, as shown in table 6. Over a 10 year period, the proportion of isolates of *N gonorrhoeae* producing β-lactamase has increased from < 1% to 13% in Johannesburg[70 81 82]; in Durban, PPNG was reported in more than 25% of gonococcal isolates recovered in the late 1980s.[11 18 67] Trends in other centres such as Pretoria, Carletonville, Cape Town, Port Elizabeth, and Bloemfontein appear to lag those of Johannesburg and Durban by several years, but the relative prevalence of PPNG still continues to rise.[65 69 71 77 82–84 86] In addition, emerging chromosomal resistance to β-lactam antibiotics in non-PPNG strains is also being documented.[70 85]

As compounding evidence made clear that penicillin would no longer be the treatment of choice for gonorrhoea, other antibiotics such as tetracycline, spectinomycin, and cephalosporins were recommended. In 1991, however, a study reported that 56% of PPNG strains and 34% of non-PPNG strains isolated in Johannesburg were now resistant to tetracycline.[70] Currently, all PPNG strains throughout the country are found to be fully susceptible to the newer cephalosporins and quinolone antibiotics, but there are some indications that chromosomal resistance is beginning to threaten the effectiveness of cefuroxime and cefoxitin.[84]

Table 6 N gonorrhoeae isolates resistant to penicillin G

*Region and Year**	*Source of isolates*	*Strains producing β-lactamase (PPNG)*	*Non-PPNG strains resistant to penicillin G*
Johannesburg			
1979–80[81]	STD clinic attenders	0%	0%
1985[82]	♂ STD clinic attenders	13%	...
1988[70]	♂ STD clinic attenders	13%	9%
Pretoria			
1984[83]	♂ with urethritis	4%	...
1985[82]	♂ STD clinic attenders	10%	...
p1991[71]	♂ with urethritis	11%	...
Carletonville			
1983–85[82]†	♂ STD clinic attenders	11%	...
p1993[86]	♂ with urethritis	15%	‡
Durban			
1983[85]	♂ with urethritis	5%	...
1986–87[18]	♀ with PID	33%	...
1987[11]§	antenatal clinic attenders	27%	...
1987[67]	♂ with urethritis	26%	1%
p1992[13]	antenatal clinic attenders	14%	...
Cape Town			
1983–84[65]	♂ with urethritis	2%	...
Port Elizabeth			
1986[69]	♂ with urethritis	4%	1%
Bloemfontein			
1981[77]	antenatal clinic attenders	0%	...
p1987[87]	♂ with urethritis	2%	...

*Date of survey or, if no survey date available, date of publication (p).
†Includes Johannesburg and Pretoria isolates.
‡Proportion not reported, but MIC_{90} 0·5 μg/ml with range of 0·008–2 μg/ml.
§KwaZulu-Natal region.
STD: sexually transmitted disease; PID: pelvic inflammatory disease; ♂: men; ♀: women; ... : not reported.

Chlamydial Infections

Chlamydial urethritis Non-gonococcal urethritis (NGU), 30–40% of which is caused by *Chlamydia trachomatis*, is seen far less frequently in public clinics than gonococcal urethritis, for reasons discussed in the gonorrhoea section. In South African studies of public clinics, NGU is diagnosed in 4%–36% of urethritis cases,[64 65 68] with isolation rates of chlamydia of 12·3% and 14·4%, as shown in table 7.

Studies in South Africa have employed a variety of tools such as serology, direct immunofluorescence (DIF), and isolation to diagnose chlamydial infection. Of these, isolation of *C trachomatis* is undoubtedly the best indicator of current active chlamydial infection. Some studies have shown that DIF has potentially high sensitivity and specificity in comparison to isolation, but ultimately DIF is subjective and is largely dependent on the experience of the microscopist.[88] As shown in

Table 7 Chlamydial infections

Population studied and Region	Year*	Prevalence (sample size)
Men with urethritis		
Johannesburg[64]	1979–81	14·4% (237)†
Johannesburg[68]	p1986	12·3% (155)†
Durban[67]	1985	17·0% (217)‡
Pretoria[71]	p1991	23·4% (201)‡
Women attending STD clinics		
Johannesburg[64]	1979–81	13·3% (135)†
Johannesburg[17]	p1984	13·8% (203)†
Women with PID		
Durban[18]	1986–87	30·0% (50)§
Durban[21]	p1993	10·9% (67)§
Women with vaginal discharge		
Pretoria[75]	p1986	18·5% (92)§
Durban[21]	p1993	7·5% (67)§
Women attending FP or antenatal clinics		
Johannesburg[64]	1979–81	16·1% (62)†
Johannesburg[17]	p1984	15·8% (101)†
Durban[18]	1986–87	26·0% (50)§
KwaZula[11]	1987	11·4% (193)§
Durban[13]	p1992	4·7% (170)§
Women attending gynaecology clinics		
Durban[21]	p1993	8·5% (199)§

*Date of survey or, if no survey date available, date of publication (p).
†Diagnosis based on isolation of *C trachomatis* from specimens obtained from urethral swab (men) or endocervical swab (women).
‡Diagnosis based on either isolation of *C trachomatis* from specimens obtained from urethral swab or on direct immunofluorescence of specimens from urethral swab.
§Diagnosis based on direct immunofluorescence of specimens obtained from endocervical swab.
PID: pelvic inflammatory disease; STD: sexually transmitted disease; FP: family planning.

table 7, rates using DIF exhibited considerable variability, but those based on isolation rates are tightly focused.

Serological tests are problematic but are useful in identifying lifetime exposure to chlamydia. Indeed, serological data indicate high levels of exposure to chlamydia among black men despite the low proportion of black men presenting at clinics with apparent chlamydial infection. One study, testing for antichlamydial antibody among black men presenting with urethritis found that 85% of these men had antibody titres $\geqslant$ 1:16.[89] Another study compared isolation rates of *C trachomatis* and antichlamydial antibody in black vs. Caucasian men with urethritis and found that, although isolation rates of *C trachomatis* were higher in Caucasian men, antichlamydial antibody titres were higher in black men.[90]

One reason posited for the low isolation rates in black men despite high antibody titres may be that asymptomatic carriage and repeated reinfection may be more common in this population group. In a study of a black mining community, Ballard *et al* estimated that at least 65% of cases of chlamydial urethritis may be asymptomatic.[91] These asymptomatic infections remain untreated, thus making continued repeated reinfection likely. This reinfection cycle may lead to hyperendemic conditions. In the case of trachoma, another chlamydial infection, hyperendemic conditions result in a failure to isolate *C trachomatis* from the conjunctiva after several reinfection episodes despite the presence of clinical disease.[90] Thus low isolation rates may not reflect the true prevalence of chlamydia in these populations. Clearly, isolation is not a good diagnostic criterion in hyperendemic areas, and chlamydial infections may be much more common than the isolation studies would indicate.

In South Africa, chlamydia is often associated with gonorrhoea. Mixed gonococcal/chlamydial infections account for 44% to 95% of cases where chlamydia is isolated, while *C trachomatis* is present in 7%–12% of GU cases.[64 67 68 71]

Chlamydial infections in women Data from women suggest that chlamydial infection is common, even among women who would normally be classified as "low-risk". In particular, isolation rates of chlamydia among STD clinic attenders are comparable with those from apparently asymptomatic women attending FP and antenatal clinics.[11 17 18 64] As shown in table 7, *C trachomatis* has been isolated from approximately 13–14% of female STD clinic attenders,[17 64] whereas isolation rates of FP and antenatal clinic attenders averaged 16%.[11 17 18 64] In fact, one study reported that there was no significant difference in prevalence of chlamydia in FP clinic attenders and STD clinic attenders,[17] and a second noted that there was no significant difference in chlamydial prevalence between FP clinic attenders and women with PID.[18] In addition, a large seroepidemiological study of over 2400 asymptomatic persons reported chlamydial seropositivity rates (titres $\geqslant$ 1:32) of 14% for women, indicating high levels of previous exposure to chlamydia within the general population.[92]

The role of *C trachomatis* in the aetiology of PID in South Africa appears complex. PID is recognised as the most frequent diagnosis made at gynaecology out-patient departments, and a review in 1978 estimated that cases of pelvic sepsis comprised approximately one-third of all admissions to gynaecology wards in South Africa.[93] The majority of these cases, however, had been attributed to infection with *N gonorrhoeae* with anaerobic superinfection playing a role in the more severe cases.

High titres of antichlamydial antibody $\geqslant$ 1:256) are detected in a significant proportion of severe and moderately severe PID cases, but *C trachomatis* is rarely isolated.[64] However, recent studies have indicated that *C trachomatis* may be recovered from the endocervix of approximately one-third of asymptomatic women who exhibit cervical excitation tenderness on routine examination (unpublished results). Other data also point to the role of chlamydia in infertility, confirming other international findings. Results from a micro-immunofluorescence study showed that significantly more infertile women with tubal pathology had had chlamydial exposure than had pregnant controls.[89] Moreover, in another study comparing pregnant women to women with acute PID, a lower prevalence of *C trachomatis* seropositivity was associated with pregnancy.[94]

Vaginal Infections

Trichomoniasis and genital candidiasis High rates of *Trichomonas vaginalis* and *Candida albicans* have consistently been detected in virtually all population groups of women surveyed in published studies (table 8). Household surveys and surveys of FP clinic

Table 8 Isolation rates of T vaginalis and C albicans

Population studied and Region	*Year**	*% T vaginalis (sample size)*	*% C albicans (sample size)*
Women with PID			
Durban[18]	1986–87	56·0% (50)	. . .
Women with vaginal discharge			
Johannesburg[95]	p1980	25·7% (330)	15·2% (330)
Pretoria[75]	p1986	29·4% (92)	16·9% (92)
Women attending STD clinics			
Johannesburg[17]	p1984	25·0% (212)	23·9% (209)†
Women attending FP clinics			
Johannesburg[17]	p1984	24·0% (104)	20·2% (104)†
Durban[18]	1986–87	20·0% (50)	. . .
Women attending antenatal clinics			
Durban[74]	p1981	48·6% (105)	22·9% (105)
KwaZulu[11]	1987	49·2% (193)	26·9% (193)
Women living in urban areas			
Bloemfontein[22]	p1994	29·6% (405)	6·7% (405)†
Women living in rural areas			
Orange Free State[22]	p1994	27·4% (470)	2·6% (470)†

*Date of survey, or if no survey date available, date of publication (p).
†Includes *Candida* spp.
PID: pelvic inflammatory disease; STD: sexually transmitted disease; FP: family planning; . . . not reported.

attenders and antenatal clinic attenders report trichomoniasis rates of 20% to 49% of these presumably asymptomatic groups.[11 17 18 22 74] One report noted no difference in rates of trichomoniasis or genital candidiasis between FP clinic attenders and STD clinic attenders.[17] *T vaginalis* and *C albicans* are often found together: in more than 50% of total vaginal infections in women seeking antenatal care, the two pathogens were found concurrently.[74]

Bacterial vaginosis Bacterial vaginosis, caused by the combination of *Gardnerella vaginalis* and mixed anaerobic bacteria, is also an important cause of vaginal discharge. Although several studies reported isolation rates of *G vaginalis*, these rates are not particularly helpful because many women may be colonised by *G vaginalis* without vaginosis. One study, however, diagnosing bacterial vaginosis on the basis of the characteristic "clue cells", found that 46·8% of STD clinic attenders, and 55·5% of FP clinic attenders had bacterial vaginosis.[17] Another study reported that 60·9% of women presenting with vaginal discharge were found to have bacterial vaginosis.[75]

Table 9 HIV seroprevalence rates among antenatal clinic attenders[109–113]

	Year				
Region/Province	*1990*	*1991*	*1992*	*1993*	*1994*
KwaZulu-Natal	1·6% (1·7–2·2%)	2·9% (2·2–3·6%)	4·7% (3·6–6·0%)	9·6% (8·0–11·2%)	14·4% (12·2–16·5%)
Free State	0·6% (0·1–1·1%)	1·5% (0·7–2·3%)	2·8% (1·9–3·8%)	4·1% (3·0–5·2%)	9·2% (7·9–10·4%)
Transvaal	0·5% (0·3–0·8%)	1·1% (0·7–1·5%)	2·2% (1·7–2·6%)	3·1% (2·5–3·7%)	
Eastern Transvaal					12·2% (11·6–12·7%)
Northern Transvaal					3·0% (2·4–3·7%)
Gauteng					6·4% (5·6–7·3%)
North-West					6·7% (4·6–8·8%)
Cape	0·2% (0·1–0·3%)	0·4% (0·2–0·6%)	0·7% (0·4–0·9%)	1·3% (0·9–1·8%)	
Northern Cape					1·8% (1·1–2·5%)
Eastern Cape					4·5% (3·9–5·2%)
Western Cape					1·2% (0·8–1·6%)
South Africa	0·8%* (0·6–1·0%)	1·5%* (1·2–1·6%)	2·7%* (2·3–3·1%)	4·3% (3·8–4·7%)	7·6% (7·0–8·1%)

95% confidence intervals, (—).
*Estimate excludes Transkei, Bophuthatswana, Venda, Ciskei.

The data are clear in showing that trichomoniasis, genital candidiasis, and bacterial vaginosis are highly prevalent and are often asymptomatic or inapparent. Although these infections are not considered to be sexually transmitted, bacterial vaginosis may ultimately be a factor related to the aetiology of PID. That many of these vaginal infections, when they are symptomatic, present with, and often mask, the more serious infections caused by *C trachomatis* and *N gonorrhoeae* indicate that these vaginal pathogens are also important to identify and control.

Human papillomavirus infections

Although South Africa is believed to have one of the highest prevalences of human papillomavirus (HPV) infections and cervical intraepithelial neoplasia (CIN) in the world,[96 97] there have been few studies documenting the prevalence of HPV in South Africa. Three studies during the past 10 years have attempted to estimate HPV prevalence, but all of them used cytological criteria for diagnosis, the sensitivity and specificity of which is unknown. One study, retrospectively diagnosing HPV from preserved hysterectomy specimens (from women who had been diagnosed with leiomyoma but for whom intra-epithelial carcinoma had been ruled out), reported extremely high prevalence rates of 66% and 64% for 1972 and 1982, respectively.[98] Another retrospective study in Cape Town noted an HPV prevalence rate of 27% in Papanicolou (Pap) smears of pregnant patients, and reported an increase in "incidence" of HPV at a tertiary hospital between 1982 and 1988.[99] A 1989 study, however, also diagnosing HPV on the basis of cytology observed in Pap smears reported a prevalence of 5·7% in pregnant women.[11] Notably, these last two studies were not explicit in their cytological criteria for HPV, and it is known that intra-observer and inter-observer reproducibility for cytological diagnosis of HPV is weak.[100 101] More accurate and reliable estimations of HPV prevalence in the future will need to rely on more sophisticated and reliable methods such as DNA hybridisation. In recent studies, hybridisation techniques have been used, but usually to classify HPV types found in cervical intraepithelial neoplasia and genital warts. These studies have noted that a significant proportion of HPV genotypes found in South Africa appear to be from "minor" or as yet unclassified genotype classes.[102–106]

HIV and the classic STDs

The link between HIV and many of the classic STDs has been well-documented internationally.[1] Strong evidence exists from prospective studies for increased transmission of HIV in the presence of genital ulcer disease as a syndrome, and of chancroid, syphilis, and genital herpes in particular.[1 2] The evidence for non-ulcerative diseases is weaker but still compelling, and several prospective studies in commercial sex workers have documented

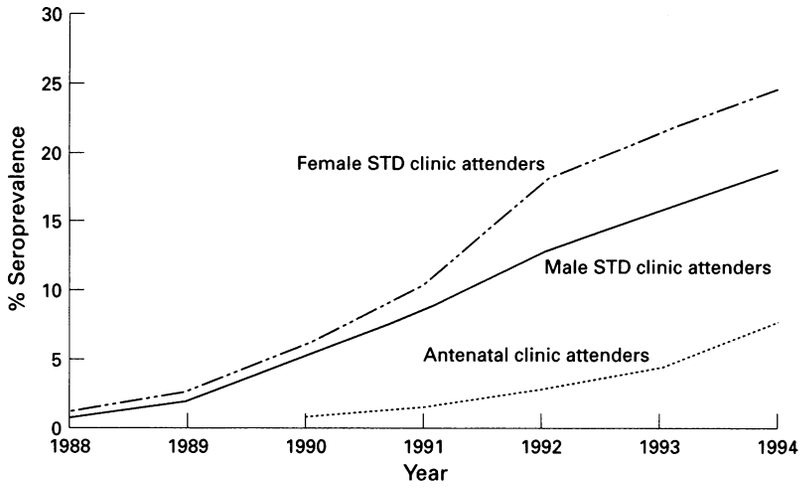

Figure HIV seroprevalence among STD clinic attenders (Johannesburg)[114] *and antenatal clinic attenders (national)*[109-113]

increased risk of HIV transmission in the presence of gonorrhoea, chlamydial infection, and trichomoniasis.[13] In South Africa, several univariate studies have reported on associations between HIV and other STDs, with results consistent with prevailing theories of increased risk of HIV in the presence of other STDs.[19 107 108]

Since 1989, HIV seroprevalence rates have been recorded at antenatal clinic sites throughout the country. National rates of 4·3% in 1993 and 7·6% in 1994 (table 9), suggest that the epidemic is rapidly progressing, and recent estimates have placed the doubling period at 15·4 months.[113] Regionally, KwaZulu-Natal has consistently reported the highest HIV seroprevalence rate, indicating the region is at the fore of the HIV epidemic. The Eastern Transvaal, a primary site of migrant workers working in the mines, has also reported high seroprevalence.

HIV seroprevalence has also been studied in selected high-risk populations. In Johannesburg, anonymous and unlinked blood specimens from patients presenting at the public STD clinics have been screened for HIV antibodies since 1988. The figure shows how these rates have increased considerably during the past 6 years. In 1988, HIV seroprevalence rates were 0·75% in males and 1·11% in females, but by 1994, rates had increased to 18·7% in males and 24·7% in females.[114] That these rates in high-risk groups, as early as 1990–91, are similar to current prevalence rates in antenatal clinic attenders indicates that there exists a 3–4 year lag in the antenatal clinic population, and that STD clinic attenders should be a prime target for interventions to control HIV.

Discussion and summary

This review has sought to provide a baseline picture of STDs and STD data in South Africa. The most compelling finding is undoubtedly that STDs are endemic in South Africa. Studies show that around 17% of antenatal clinic attenders harbour at least one urogenital tract infection, and between 49% and up to 90% of women attending FP and antenatal clinics have at least one STD. More specifically, this review shows data revealing that up to 15% of FP clinic and antenatal clinic attenders are seropositive for syphilis, 16% may be infected with chlamydia, 8% may be infected with gonorrhoea, and as many as 20–50% of women have vaginal infections. This high burden of disease, compounded with the 15-month doubling period of HIV seroprevalence and the complex interactions between HIV and STDs, starkly illustrate the gravity of the current STD problem.

Overall, the STD data are substantial but somewhat incomplete. Published literature has tended to focus on certain infections and survey populations; thus, while there is fairly comprehensive, if varied, reporting on syphilis and gonorrhoea, there is considerably less information on other epidemiologically important infections such as chlamydia and HPV. Moreover, for most infections, data have been reported only from STD facilities in the major urban centres; hence, relative prevalence estimates are abundant, but "general population" prevalence rates, particularly from rural areas, are scarce.

These data also highlight other widespread problems experienced in the study of STDs in Africa. The exact scope of syphilis has been difficult to define because of deficiencies in current syphilis serological methods. Syphilis serology tests are imprecise in diagnosing active syphilis, and interpretation of serological information poses a particular problem in cases of positive treponemal tests alongside negative reagin tests. In addition, diagnosis of gonorrhoea and chlamydia in women requires endocervical swabs, the invasive nature of which has restricted the scope of many studies. Isolation of *C trachomatis* under hyperendemic conditions is also problematic. With the development of non-invasive diagnostic techniques such as testing of first-catch urine specimens using amplified molecular techniques, the collection of more accurate community-based data on these infections will become more viable.

Sorely needed temporal data on STDs are conspicuously missing. This dearth of data is primarily a result of a lack of a surveillance system which encompasses the major STDs. Currently, syphilis is the only STD for which surveillance is on-going, and antenatal clinic attenders are the only sentinel group. However, high rates of tubal-related infertility in South Africa and the implicit exclusion of infertile women from the sentinel group of antenatal clinic attenders mean that the use of antenatal attenders as the only sentinel group for sexually transmitted disease surveillance merits review. Overall, this bird's-eye view of the data strongly argues for a more comprehensive system of STD surveillance. At this date, the only STD notifiable in South Africa is congenital syphilis, which was designated a notifiable condition in 1991. Because of the notorious under-reporting of notifiable conditions in general, however, the quality of this notification data is questionable, and the rele-

vance of conferring notifiability status to other STDs is unclear. The quality of syphilis seroprevalence data among antenatal clinic attenders is better, but this monitoring also only began in late 1991. Notably, a national STD surveillance system is currently in development. This system will attempt to include public and private facilities sampled from each province, and will attempt to collect both syndromic data and disease-specific data from patients with a particular disease syndrome.

In South Africa, the high prevalence of mixed infections, antibiotic resistance, prevalence of asymptomatic infections, diversity of pathogens, and atypical presentation of disease mean that both data collection and health policies must be adapted to suit local conditions. For example, the flow charts used for syndromic management must account for the presence of LGV and genital herpes.

In addition to these aspects of STD infections, STD control in South Africa must now face the operational challenge of a notoriously fragmented health system. Although a comprehensive and cohesive approach to HIV/STDs within the health services is currently being planned, the country's legacy of fragmentation has made a thorough review of STD services in South Africa difficult. A recent assessment of STD services in the Gauteng province, however, has provided an in-depth view of services which may be typical of those in highly urbanised provinces.[115] In Gauteng, a province which includes the cities of Johannesburg and Pretoria, public STD services in urban areas are provided by (i) local authorities, which run vertical STD programmes, (ii) the provincial administration which provides STD services through small vertical programmes for rural and peri-urban areas, and (iii) through comprehensive hospital-based Community Health Care Centres. In addition, there is a highly developed private sector comprised of private general practitioners, traditional healers, and pharmacists. There are also industrial (work-place based) clinics and private not-for-profit services. The report found that, although public STD services are theoretically within the scope of responsibility of the local authorities, STD care is limited in terms of times and venues available, and is not considered to be a part of the basic package of services. In addition, improper case management appeared to be a serious problem in many local authority clinics, and notably, among private general practitioners. The report also noted that private providers, and not the public services, saw a significant proportion, and possibly the majority, of STD cases.

Overall, perhaps one of the biggest STD policy gaps still found in South Africa is the lack of routine STD screening. Although HIV-positive patients and STD patients in some Johannesburg clinics are automatically screened for syphilis, serological screening for syphilis is not routine practice in general at many facilities, even where STD patients are seen. With the broader availability of rapid and non-invasive tests, broader screening for a variety of diseases may become more feasible. Such STD screening will be important for the prevention of complications such as infertility, and will also be particularly important for the prevention of congenital syphilis. Few hospitals routinely perform an RPR test on women presenting for delivery; because, on average, 1/4 to 1/3 of women presenting for delivery have unknown syphilis status, this type of screening may prevent significant postnatal morbidity and mortality caused by congenital syphilis.

The development of the STD surveillance system augurs well for the future of STD data collection, but the fruits of surveillance will need to be directly linked and fed back to the health services and to policy-makers. With the rapidly emerging HIV epidemic, the heavy STD burden, and the resource-intensiveness of interventions for STD and HIV, STD surveillance, streamlining of STD services, and focused STD policies will be more important than ever in the new South Africa.

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