

**B.G. Williams, C. MacPhail, [C. Campbell](#), D. Taljaard,
E. Gouws, S. Moema, Z. Mzaidume and B. Rasego**

The Carletonville-Mothusimpilo project: limiting transmission of HIV through community-based interventions

**Article (Published version)
(Refereed)**

Original citation:

Williams, B., MacPhail, Catherine, Campbell, Catherine, Taljaard, D., Gouws, E., Moema, S., Mzaidume, Zodwa and Rasego, B. (2000) *The Carletonville-Mothusimpilo project: limiting transmission of HIV through community-based interventions*. [South African Journal of Science](#), 96 (6). pp. 351-359. ISSN 0038-2353

© 2000 [Academy of Science of South Africa](#) © CC BY 2.5 ZA

This version available at: <http://eprints.lse.ac.uk/4142/>

Available in LSE Research Online: May 2014

LSE has developed LSE Research Online so that users may access research output of the School. Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Users may download and/or print one copy of any article(s) in LSE Research Online to facilitate their private study or for non-commercial research. You may not engage in further distribution of the material or use it for any profit-making activities or any commercial gain. You may freely distribute the URL (<http://eprints.lse.ac.uk>) of the LSE Research Online website.

The Carletonville-Mothusimpilo Project: limiting transmission of HIV through community-based interventions

B.G. Williams^a, C. MacPhail^a, C. Campbell^b, D. Taljaard^c, E. Gouws^c, S. Moema^d, Z. Mzaidume^d and B. Rasego^d

For all of the last century, the economy of South Africa, and so also of its neighbouring countries, has depended on migrant labour from rural areas. This is particularly so for the mining industry, especially hard-rock mining, and this has led to a system of 'oscillating' migration whereby men from rural areas come to live and work on the mines, without their wives or families, but return home regularly. This pattern of oscillating migration is an important determinant of health and, especially at the start of the epidemic, contributed to the spread of HIV in the region. In this paper we describe an extensive, community-led, intervention designed to develop ways to manage and limit the spread of HIV in Carletonville, the largest gold-mining complex in the world. We first consider the political and economic context within which earlier attempts to develop HIV intervention programmes were made and then show how the Carletonville project was designed to go beyond these early attempts and avoid some of the pitfalls encountered then. The Carletonville project was based on a set of assumptions. First, that HIV should not be treated as another biomedical problem to be dealt with by changing individual behaviour but rather that it must be understood within the social, cultural and normative conditions that pertain in particular communities. Secondly, that in the short to medium term the most effective interventions would involve the treatment of sexually transmitted diseases and the use of community-based peer educators to promote safer sexual practices and the use of condoms. Thirdly, that for the intervention to be sustainable in the long term, it would require the full commitment of all the local stakeholders including the state, the private sector, the trade unions and local community-based organizations. Fourthly, that in order to understand the nature and pattern of the epidemic, to focus our intervention efforts so that they have the maximum effect, to make sensible predictions as to the likely future course of the epidemic, and finally, to evaluate the impact of the interventions, it is essential to carry out detailed monitoring and evaluation of the epidemic using both biomedical and behavioural markers of infection and behaviour. The background and current status of the project are described in detail. The surveys have shown that the situation is even worse than envisaged at the start of the project and have highlighted the importance of protecting young women from infection. Valuable lessons have been learnt concerning the reasons for the continued spread of the epidemic and some success has been achieved especially in the empowerment of women at high risk and the mobilization of people from all sectors of the community to join the fight against HIV/AIDS. It is still too early to show significant changes in STI or HIV rates but it is hoped that this will become apparent over the course of the next one or two years.

Mining is one of the most important sectors of the South African economy, especially as an earner of foreign exchange.¹ Gold miners, in particular, are predominantly migrant workers from rural areas within South Africa or from neighbouring countries, including Botswana, Mozambique and Lesotho. Remittances from mineworkers are very important to the economies of the labour source areas.^{1,2} These countries are particularly badly affected by the rapidly spreading epidemic of HIV and infection rates in this region are among the highest in the world.³ The role of migrancy in the spread of HIV infection has been well documented.⁴ The migrant labour system encourages unsafe sexual behaviour by removing men from their families and regular partners, while providing a means of transmitting the disease to people living in rural areas when men return to their homes during periods of leave or after completion of their mining contracts.⁵ Early estimates within the mining industry placed levels of HIV infection at between 20% and 30%.⁶ Figures from Carletonville support this, with a survey in 1998 indicating that 22% of sampled mineworkers were HIV positive.⁷ While HIV appears to be one of the most serious health threats to face the mining industry, it is not the only health problem attending those employed in mining.

There has been extensive documentation of the disease burden associated with the living and working conditions of gold mine employees. These diseases include tuberculosis, silicosis and more recently HIV.⁸ Some diseases, such as silicosis, can be directly attributed to working conditions, while others are the result of more complex interactions. There is a long history of tuberculosis among mineworkers,⁹ a disease that is now being exacerbated by the high levels of HIV infection experienced in South Africa, and within the gold mining industry in particular.¹⁰ Between 1990 and 1992, the incidence of active tuberculosis in one group of mineworkers was steady at about 600 cases per 100 000 but by 1994 had almost doubled to about 1000 cases per 100 000 people per year¹¹ and by 1998 had doubled again to over 2000 cases per 100 000 people per year on some gold mines.¹⁴ The problem of tuberculosis on the mines has been further exacerbated by high levels of silicosis, which greatly increases the likelihood of developing tuberculosis.^{8,12-14} These occupational diseases are expensive not only for the private mining houses and the state health services^{15,16} but place a substantial burden on rural communities.^{17,18}

In addition to the burden of obvious occupational diseases such as tuberculosis and silicosis, migrant mineworkers also suffer from high levels of sexually transmitted diseases (STDs). A random sample of 228 mineworkers in Carletonville indicated that infection rates for syphilis, chlamydia and gonorrhoea were 4.6%, 6.7% and 8.1%, respectively.¹⁹ Because other STDs predispose to infection with HIV, these infections not only lead to increased morbidity among miners but also contribute to the spread of HIV on the mines.

In this paper we report on a project in which attempts are

^aCSIR Miningtek, P.O. Box 91230, Auckland Park, 2006 South Africa.
E-mail: bgwillia@csir.co.za

^bDepartment of Social Psychology, London School of Economics, Houghton Street, London, WC2A 2AE, U.K.

^cMedical Research Council, P.O. Box 17120, Congella, 4013 South Africa.

^dMothusimpilo HIV/AIDS Outreach Project, Carletonville.

being made to reduce the spread of HIV infection in a mining community near Johannesburg, South Africa. We begin by considering previous efforts by the South African government, the mining unions, and mine management to reduce the spread of HIV infection. We then consider the development of the Carletonville project and outline the ways in which this exercise echoes similar projects in other regions and, more importantly, consider some of the ways in which the Mothusimpilo-Carletonville Project differs from other initiatives in the region. Consideration will then turn to some of the achievements and lessons learnt during the first two years of the project's full operation in the Carletonville area. Finally, we present some of the results of surveys carried out in Carletonville covering social as well as biomedical aspects of the epidemic.

HIV in the mining sector and previous responses

The mining industry began to react to the epidemic of HIV in the late 1980s, long before there had been any response from the apartheid government.^{6,20} The industry made substantial efforts to provide mineworkers with compulsory education on modes of transmission and prevention, and at the same time provided free condoms.^{21,22} However, these attempts to reduce transmission relied heavily on information-based health education and biomedical STD services. Thus, mineworkers returning for new contracts were required to attend education programmes that would increase their knowledge of HIV transmission and presumably the likelihood that they would engage in safe sex. The results of these interventions have been disappointing,²³ for while factual knowledge of HIV/AIDS among mine employees has increased dramatically, there has been little evidence of significant behaviour change or of any impact on HIV transmission. In addition to the HIV education, the mines also provide free health care for employees infected with STDs through a system of mine medical centres using the most modern drugs and state-of-the-art diagnostic facilities. Unfortunately, in the case of STDs, the treatment provided has not been extended to the patient's sexual partners, who are often commercial sex workers, so that the cycle of re-infection is not broken. Recently, fears have been expressed that the provision of high-quality free curative and tertiary medical care²⁴ may not be sustainable as the impact of HIV and AIDS is felt within the industry.

At the same time the trade unions have tended to focus their efforts on HIV as a human rights issue, and have made few substantial contributions to HIV prevention efforts. While they have argued, in opposition to mine management, that there is a link between HIV, housing and migrancy, they have not been successful in engendering change in these areas of the mining system.²⁵ The unions have, however, succeeded in negotiating an end to pre-employment testing and are involved in negotiations about changes that may have to be made in death benefits and in the premiums that are levied. In addition, the unions have been involved in bipartite and tripartite agreements to protect workers against unfair dismissals and discrimination.^{6,26}

Investigations of the psychosocial context of sexuality and disease among mineworkers^{27,28} confirmed the findings of earlier work indicating that HIV, far from being an individually determined disease as conceptualized by mine management, cannot be dealt with effectively unless the social and developmental context of the disease is clearly understood.²⁹ In these studies, Macheke and Campbell²⁸ use their findings to develop a critique of the assumptions underlying traditional health educational approaches, namely that health-related behaviour such as condom use is determined by the rational choice of individuals based on accurate health-related information. In opposition to

this view, they argue that decisions about health-related behaviour are made within the context of a broad range of social, cultural and normative constraints, which often undermine the likelihood that people will act on the information provided by health education programmes. They argue further that health-related behaviour is mediated not only by individuals' perceived vulnerability and health-related beliefs, but also by the dominant social, cultural and normative attitudes about sexuality and about health and healing in general. Didactic information-based health educational approaches — which seek only to increase peoples' levels of perceived vulnerability to HIV, and to provide them with health-related factual knowledge — are unlikely to have much impact because they fail to deal with these crucial social, cultural and normative variables.

For example, among men employed on the mines, levels of self-efficacy associated with health-promoting behaviour appeared to be low: high levels of disease and injury were regarded as the norm, and miners felt that there was little that they could do to protect their health in their unhealthy and dangerous working and living conditions. Norms of masculinity that equip men to face the dangers of underground work are also associated with frequent unprotected sex with multiple partners, thus increasing men's vulnerability to HIV infection.²⁷ Other studies carried out in Carletonville indicate that gender norms may also serve to promote unsafe sexual behaviour among women at high risk who provide sexual services to mineworkers as well as among adolescents in the general township populations, where many mineworkers conduct their social and sexual lives.³⁰⁻³² Such social and cultural factors are unlikely to be changed by factual information-based health education programmes formulated and presented by health professionals, many of whom come from outside the target communities. Furthermore, HIV education initiatives of the type traditionally provided by the mines have failed to lead to widespread condom use by mineworkers, despite increasing their levels of factual knowledge about transmission of the disease.

Macheke and Campbell²⁸ also discuss factors that reduce the likelihood that mineworkers, and their partners, will seek speedy and appropriate treatment for STDs at local mine or provincial clinics. Beliefs that associate STDs with the build-up of bodily toxins that are best purged from the system by traditional medicines mean that many mineworkers first seek treatment from traditional healers rather than from biomedical sources. At the same time, the ease with which Western medicine is able to cure many STDs means that mineworkers are less concerned about them than they might otherwise be.

These studies demonstrated the need to design HIV prevention programmes that take account of the social and cultural determinants of HIV transmission as well as the biomedical and behavioural perspectives that have prevailed in traditional mine programmes.

The Carletonville project

Discussions around the issue of HIV transmission within the mining sector culminated in a workshop that was held in Johannesburg in 1995. It was agreed to develop a project directed towards the mining industry in which innovative methods of preventing the transmission of HIV could be piloted and lessons learned for the future through thorough research and evaluation.³³ Carletonville was chosen as the site for a trial intervention because a local grassroots community organization was already engaged in work aimed at combating HIV infection in the area, and had identified the urgent need for a larger-scale initiative.³⁴ From a demographic point of view, Carletonville was particu-

larly suitable because it is the largest gold-mining complex in South Africa, then employing approximately 75 000 workers (although this number is currently falling due to changes in the mining industry).

Initial funding for the project came almost entirely from the U.K. Department for International Development and was subsequently supplemented by sponsorship from the provincial Department of Health and the Old Mutual Assurance Company. Further funding has more recently been committed by the United States Agency for International Development.

Study site

The Carletonville district includes the town of Carletonville, Khutsong township and 12 mine shafts as well as some smaller residential areas. Khutsong township has a range of housing types, including private and council houses, site and service plots and squatter settlements. The mine shafts have hostels, clinics and often concession stores near them and can be thought of as separate social units. Many of the women who come to the mines seeking employment become commercial sex workers, and live either in Khutsong or in small squatter settlements close to mine compounds. Many of these women are marginalized from their home communities, have little contact with their families and are generally uneducated.³¹ The intervention area covers approximately 25 × 25 km.

Structure of the Carletonville project

The field work for the intervention is carried out by three full-time workers: a project manager, an STD coordinator and a community outreach coordinator, who know the community well and have previous experience in HIV prevention work. Unlike earlier projects on the mines, the Carletonville project is integrated into the entire community. Rather than treating STDs and providing education to mineworkers alone, the project works closely with the surrounding communities from which mineworkers select their sexual partners and which include not only the general community in the Carletonville area but also the small groups of commercial sex workers in the areas surrounding the mines, known locally as 'hotspots'. Working with the broader community is more likely to lead to a reduction in STDs and HIV infections among mineworkers.⁵ An interesting intervention in the Free State gold fields showed that providing periodic presumptive treatment to women at high risk led to substantial declines in sexually transmitted infections among mineworkers, especially at the mine hostels closest to the intervention.³⁵

The results of a pilot survey had indicated that the prevalence of HIV was high among mineworkers, single women in hotspots and adolescents⁷ and the project started by recruiting and training peer educators, who would then provide education and training to people in these groupings. Within these communities a variety of norms function to control and determine sexual behaviour. Qualitative research with mineworkers,²⁷ sex workers^{30,36} and adolescents in the Carletonville community³² has elucidated ways in which sexual and social norms, operating at the peer and community levels, have served to entrench behaviours that increase susceptibility to HIV infection. By using peer educators, the project provides a context within which people can collectively challenge group norms and create community contexts that enable and support behaviour change. For example, the project has increased assertiveness and confidence among women at high risk, who have traditionally felt unable to challenge men who were reluctant to use condoms. Similar programmes have had some success in other regions of southern

Africa.³⁷⁻³⁹ Peer educators in the community also give out condoms and so supplement their distribution by local authority clinics and mine hostels.

While grassroots participation is essential for the success of projects such as this, the creation of alliances at a higher political level is equally important. Gillies,⁴⁰ in her study of best practices for health care, has indicated the importance of developing partnerships across sectors, across professional and lay boundaries and among public, private and governmental organizations. Alliances such as these serve to address the broader determinants of health and make it more likely that such projects will be sustainable. The Carletonville project has sought to coordinate the efforts of both the formal health establishments in the community, such as private practitioners, government health clinics and mine medical stations, as well as informal health care provided by traditional healers. In mining areas, much of the responsibility for dealing with HIV has previously fallen on mine management⁵ but the Carletonville project is guided by a committee consisting of representatives from the local community, provincial and national departments of health, mining houses and researchers.

The success of this approach is illustrated by the way in which it has been possible to train the health care providers in government clinics, private practices and mine medical stations in the syndromic management of STDs. In addition to ensuring that treatment is of a uniformly high quality, this encourages and facilitates referrals among facilities and ensures that patients' partners have access to treatment. By using syndromic management of STDs, immediate treatment is provided and there are opportunities for counselling and condom demonstrations.⁴¹ Finally, as part of the syndromic management, staff are trained to collect STD surveillance data and to give out partner notification slips. Furthermore, by bringing the traditional healers into the process there is common recognition of the symptoms of STDs and more rapid referral to the formal health care facilities.

Activities of the project to date

The initial phase of the project was funded by the U.K. Department for International Development for three years (January 1998 to December 2000) on the assumption that by then the programme should be self-sustaining and that funding should be provided by local organizations. Work on the ground started in January 1998, but only after almost two years of negotiation and discussion with all stakeholders to ensure that there was agreement on the form the project would take and the activities that would be carried out.

In discussion with local community representatives, three high-risk groups were identified including mineworkers, sex workers and people living in squatter camps. It was already known that the migrant labour system predisposes mineworkers to ill health as illustrated by exceptionally high levels of STDs and tuberculosis found in hostels.⁴² Commercial sex workers in the district, particularly those operating in the hotspots near the mines, were also identified as being at particularly high risk. These women often have little education and depend on this work for their economic survival.²¹ Finally, there is a substantial squatter community in Khutsong, among which live many illegal immigrants, and this too was identified as being at high risk. The decision was made to stage the intervention by beginning with the sex workers, who were seen to be at greatest risk, and then moving to other communities as the project unfolded. However, an unforeseen consequence of the surveys carried out as part of the evaluation was the realization that rates of HIV infection were extremely high among young people in the general

community; almost 60% of 25-year-old women in Khutsong were already infected.⁴³ For this reason the project has begun to work much more closely with young people.

Peer education and condom distribution

The training of peer educators began with sex workers. Through extensive meetings with community leadership structures, the outreach coordinator has been able to recruit and train close to one hundred peer educators and of these a little over half are deployed in the hotspots while the remainder work within the township. During 1999, these peer educators held over 1500 meetings in various communities, including bars and shebeens within mine property, attended by almost 400 000 individuals, including repeat attendees. While their main target is other commercial sex workers, mineworkers have also benefited from their outreach activities. During the meetings people are taught about the symptoms of STDs, the necessity of seeking rapid treatment, the link between STDs and HIV, and condom use and promotion. In 1998, the project distributed almost 1.5 million condoms; in 1999 the figure was over 3 million.

A continuing longitudinal study of one sex worker community where peer education has been introduced indicates that the project has done more than educate and distribute condoms and has engendered far-reaching social and community changes in this location. Sex workers have risen in status through the appreciation by the community of the work that the peer educators do. While initial reactions to the project and the peer educators included jealousy, resentment and outright hostility, people have become more positive. There is greater realization of the extent of peer educators' involvement in their duties and there is greater respect among the community for women engaged in sex work. The women trained as peer educators have gained confidence and self-esteem. Nevertheless, some barriers remain. High levels of alcohol consumption mitigates against the use of condoms among sex workers and their clients and many people still have negative attitudes towards HIV-positive people.⁴⁴

The peer education programme among mineworkers has not been as successful as that among commercial sex workers. The highly regulated mining industry has made negotiation of training times and free time for peer education among miners a problem. In the early stages of the project there was little cooperation from mine management, who regarded their own HIV and STD programmes as adequate. Despite these initial difficulties, 60 mineworker peer educators were trained in two of the mining houses in the area in the second half of 1999, and more should be trained in a third mining house during the year 2000. Condom distribution in these areas has been very successful and over 650 000 were distributed during 1999.

Young people were identified as a particularly vulnerable group only as a result of the pilot survey conducted in early 1998; peer education efforts on the part of the Carletonville-Mothusimpilo Project started later than among other populations. Fortunately, the community was already involved in some AIDS awareness programmes sponsored by the Old Mutual Assurance Company. A total of 51 peer educators have now been trained in the six local high schools. Some of these were trained by Old Mutual (involving largely AIDS awareness) and others were instructed by the outreach coordinator of the project (including participatory approaches). Attempts are being made to provide more training to ensure that these two different groups work together with adequate coordination and cooperation.

In addition to those who are still at school in Carletonville, unemployment among the youth is very high and the project

has provided training for seventeen unemployed young people who provide counselling on a number of topics, including STDs and HIV. Although some schools still refuse to allow condom distribution on their property, young people in Carletonville have become a substantial source of condoms for the community and gave out 10 000 in 1999.

The project has successfully raised the profile of HIV/AIDS throughout the community and members of the project team have addressed meetings ranging from church groups to school-teachers. Carletonville has been recognized by central government as an important model project and there have been HIV-related activities organized by government within the Carletonville district, including a successful home-based care programme.

Syndromic management of STDs

A critical aspect of any HIV intervention is the management of STDs. These services include free care at municipal clinics (local health authority), the provincial hospital and at mine medical stations at which mineworkers can receive treatment. Private medical practitioners operate both within Carletonville town and Khutsong.

Training has been carried out with the assistance of the South African Institute for Medical Research. Of 145 nurses in the district, 114 have already been trained, and the remainder will be trained during the year 2000. At clinics where staff have received training, STD statistics are routinely collected to help monitor the impact of the project. The project provides an ongoing programme of continuous medical training through which 57 of the district's 68 doctors have received instruction in the syndromic approach.

Evaluation activities

The project also includes an extensive monitoring and evaluation component. In addition to the annual biomedical and behavioural surveys, some of the results of which are discussed below, there has been extensive qualitative outcome analysis and process analysis using in-depth interviews and focus group discussions.⁴⁵

In-depth interviews with mineworkers have sought to develop a better understanding of health and health-seeking behaviour in the context of the mining industry.^{27,28} Among sex workers these studies have been conducted in a particular community and have sought to explore the social and economic environment of sex workers in relation to their sexual practice and the implications that this has for adopting safe sex behaviour.^{30,31} This work seeks to uncover the various factors that have assisted and hindered the development of the peer education programme, in particular to establish and document changes in community mobilization and response to the project.

In-depth interviews and focus group discussions have been conducted with young people. Focus group discussions have sought to understand the reasons why few young people consider themselves to be at risk, so that condom use remains low despite the high infection rates and the high levels of knowledge of HIV/AIDS. These discussions have shown that a multitude of factors, at the peer, social and community levels, all contribute to young people's inability to use condoms consistently in their relationships.³² The in-depth interviews are being used to investigate attitudes and beliefs about health (HIV and STDs in particular) as well as the various factors shaping young people's sexuality in Carletonville. Greater understanding of these factors may assist researchers in developing further programmes aimed at reducing HIV infection among young people.

The quality of care being provided within the various health care facilities is also being evaluated and this work started in 1998 when few health care providers had been trained in syndromic management.⁴⁶ At the time it was found that more than half the providers in the public sector gave adequate treatment as laid out in the guidelines for syndromic management of STDs, but general practitioners were not using syndromic management. At all facilities there was little condom distribution and patients were not being educated about the link between STDs and HIV. The attitudes of staff in public facilities were often perceived to be negative towards STD patients and there was the need for improved counselling in all facilities. A second quality of care evaluation is being conducted during May and June 2000 to establish the changes that have taken place following more widespread training of health care providers and greater cooperation from the private sector.

A key component of the evaluation is the continuing stakeholder analysis. A crucial determinant of the impact of the project will be (i) the extent to which the project has succeeded in pulling together and coordinating the efforts of various service providers and interest groups (e.g. the STD services provided by mine and provincial clinics, general practitioners and traditional healers; the peer education activities among mineworkers, sex workers and other Carletonville residents); and (ii) the extent to which the various groups represented on the stakeholder committee have supported the project and ensured that their constituencies provide a context which enables and supports the exercise.

While the project has succeeded in pulling together a highly diverse group of contributors (including the mining industry, trade unions, provincial health department representatives, local community groupings, researchers, and international funding agencies), the management of a multi-stakeholder project is complex and difficult. Concerned individuals differ in their views about the nature of the problem and how to address it, in their motives for being involved, and the commitments they are able or willing to make. Some see HIV/AIDS as a biomedical problem to be dealt with through drugs and clinics, others as a problem of poverty and underdevelopment, to be dealt with through the empowerment of people in high-risk situations. Project workers have no authority over stakeholders, whose involvement is voluntary and who might not always have the authority or influence to elicit the levels of participant cooperation that would optimize the likelihood of project success.

The final aspect of the evaluation concerns the quantitative surveys which began with a pilot survey in January 1998 and was followed by a baseline survey in August 1998. The survey used a questionnaire based on the UNAIDS multi-site study questionnaire,⁴⁷ while blood and urine samples were also collected to test for HIV, gonorrhoea, chlamydia and syphilis. In August 1999, a follow-up survey was conducted but in the general community was limited to young people between the ages of 15 and 25 years to obtain more detailed information about this particularly important risk group. Analysis of the 1999 survey is still under way and a final survey is planned for August 2000. Some preliminary findings from the 1998 baseline survey are presented in the following section and a detailed report will be available separately.⁴⁸

Results of the surveys

Mineworkers, sex workers and the general population of Khutsong were sampled separately. Within Khutsong the population was stratified according to housing type. Given the differ-

ences in socioeconomic status and in place of origin of people living in the various housing sectors, it was important to ensure that all were represented approximately in proportion to their numbers in the overall community.

From sample size calculations, it was decided to include approximately 1000 mineworkers, 1500 people from Khutsong and a further 100 women at high risk, living in the hotspots, to complement the qualitative, in-depth studies that were planned as part of the project. Multi-stage sampling strategies were used. Communities were prepared for recruitment through community organizations in Khutsong and by distributing pamphlets in the private housing sector. Every effort was made to ensure that all members of the selected households took part in the survey.

The men and women from Khutsong were a random sample of 13–59-year-old people living in the township. The women living in hotspots generally worked as commercial sex workers. The mineworkers were all migrants either from rural areas within South Africa or from similar areas in neighbouring countries. Most statistical analyses were therefore carried out separately for the men in Khutsong, miners, women in Khutsong, and women in hotspots.

Age prevalence of HIV infection

Susceptibility to HIV infection varied according to age, gender and migrancy status, and was particularly high among commercial sex workers (CSWs). As expected, the highest HIV prevalence was found among women in hotspots, where nearly 70% were HIV-positive as compared to 37% of the general female population of Khutsong. The mean prevalence among men in Khutsong was 22%, while that among miners was 29%.

It is important to examine the variation in the prevalence with age and this is shown in Fig. 1 for the various populations. Considering first the age prevalence of HIV infection for men and women in Khutsong, we note that among 13- and 14-year-olds the prevalence was zero ($\leq 4.9\%$; 95% CI, males and females combined). At 20 years of age the prevalence of infection among women had reached 39% while among men it was still only 8% (fitted curves in Fig. 1). The prevalence eventually peaks at 58% among 26-year-old women and at 45% among 32-year-old men.

The pattern of infection among mineworkers and sex workers is quite different (note also the change of scale). For mineworkers

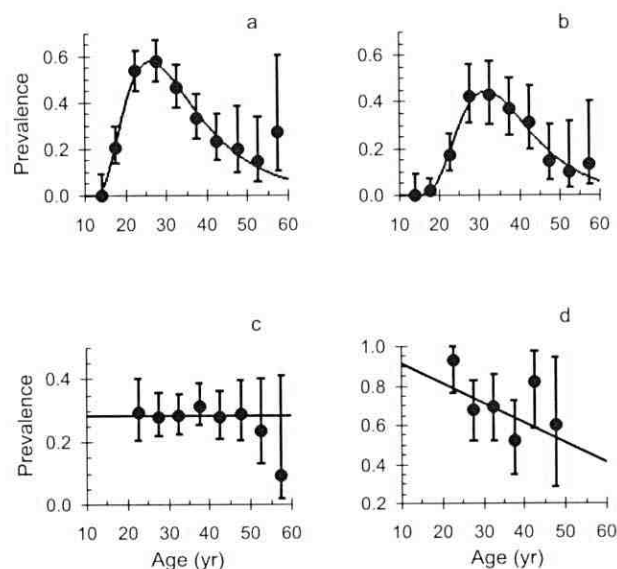


Fig. 1. The age prevalence of HIV-infection among (a) Women in Khutsong, (b) men in Khutsong, (c) mineworkers and (d) women in hotspots.

Table 1. STD prevalences (percentages) among Khutsong men, mineworkers, women in Khutsong, and women in hotspots.

STD	Mineworkers	Khutsong men	Khutsong women	Women in hotspots
Life-time syphilis	30.3	27.7	48.4	76.9
Syphilis	5.2	6.1	9.7	23.3
Gonorrhoea	3.0	3.4	6.9	5.7
Chlamydia	3.8	5.2	8.1	9.1
One or more STD	11.4	13.7	21.5	36.4

the age prevalence does not differ significantly from a constant ($P = 0.506$; χ^2 test of deviance). For women living in hotspots the age prevalence declines significantly with age ($P = 0.028$; χ^2 test of deviance) but from an estimated high of about 80% among 20-year-old women to 50% among 50-year-old women.

The simplest explanation for these differences starts from the observation that in a rapidly spreading epidemic the age prevalence is proportional to the age incidence, to a first approximation, because any infections will have been acquired recently. Young women and men in Khutsong become sexually active in their teenage years but sexual activity declines in older people. The differences between men and women in Khutsong can be partly attributed to differences in the age of sexual partners and partly to women's susceptibility to infection. For mineworkers, on the other hand, the risk of infection is independent of age and this may well be a consequence of their living conditions, which remove them from their families and provide few alternatives to sex workers for men seeking comfort and companionship. For women living in the hotspots, it is not surprising that the prevalence of infection is very high and it may well be that younger women have more sexual partners than older women, so that the incidence is highest among the former.

Partner prevalence

Figure 2 gives the prevalence of infections plotted against the reported number of sexual partners. The patterns of infection are again quite different. Among men the rate of infection increases much more slowly than among women and levels off at a substantially lower prevalence. Among mineworkers the prevalence of infection increases almost as quickly as among

women but then shows no further increase after about the second partner.

Sexually transmitted diseases

Table 1 shows the prevalence of syphilis, gonorrhoea and chlamydia infections among mineworkers, men and women living in Khutsong, and women living in hotspots separately. For each of the STDs, prevalences among women in Khutsong were approximately twice as high as those among men, whereas prevalences among women in hotspots were twice as high as among women in Khutsong. For example, almost 28% of the men in Khutsong and 30% of miners had had a syphilis infection at least once in their lives (positive TPHA test) compared to more than 48% of the women in Khutsong and 77% of the women in hotspots. When the TPHA and the RPR test are both positive, this is taken as an indicator of current or recent syphilis and 6.1% of the men in Khutsong, 5.2% of miners, 10% of the women in Khutsong, and 23% of women in hotspots (Table 1) were both TPHA and RPR positive.

Since the TPHA test indicates lifetime exposure to syphilis, it is interesting to examine the age prevalence of exposure to the disease. The data are given in Fig. 3 (but not for women living in hotspots, for whom the numbers were too small). The fitted curves are maximum likelihood fits to logistic curves with variable asymptotes.

The asymptotic values of the prevalences for men and women living in Khutsong, which give the expected lifetime risk of contracting syphilis, are both about 60%; a remarkably high figure. Furthermore, the patterns of infection are similar to those for HIV, with the rate of increase among young women about 2.5

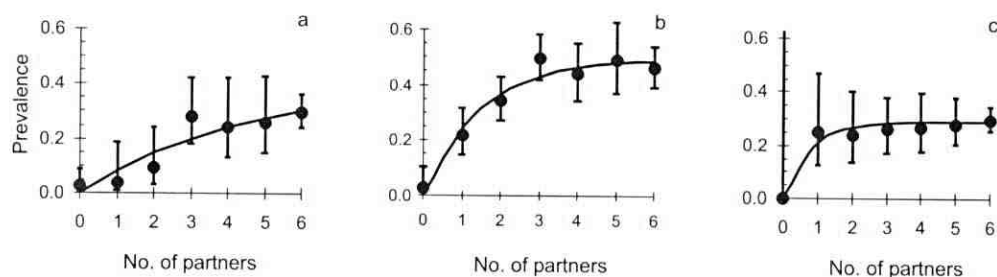
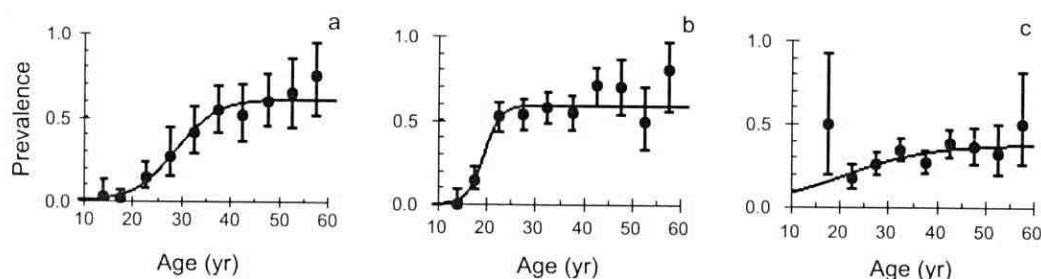
**Fig. 2.** The prevalence of HIV-infection plotted against the reported number of sexual partners for (a) men in Khutsong, (b) woman in Khutsong and (c) mineworkers.**Fig. 3.** Life-time exposure to syphilis for (a) men and (b) women living in Khutsong, and (c) mineworkers.

Table 2. Male participants' answers to questions about prevention of HIV infection, expressed as percentages. Correct answers indicated by bold type.

Statement	Khutsong men			Mineworkers		
	True	Not true	Don't know	True	Not true	Don't know
Remain faithful	82.2	14.0	3.8	83.5	10.1	6.3
Use condoms	87.8	6.8	5.4	83.3	9.9	6.8
Use clean needles	86.6	5.6	7.8	86.9	4.1	8.9
Avoid public toilets	29.7	56.5	13.8	37.4	48.7	13.9
Avoid touching	28.5	60.8	10.6	37.4	48.3	14.4
Avoid sharing food	31.2	57.8	11.0	38.2	46.6	15.3
Avoid mosquito bites	54.3	28.9	16.8	52.8	28.8	18.4
HIV+ show symptoms	29.1	50.1	20.8	37.5	36.9	25.6

times that of men. For mineworkers the curve is much flatter (the intrinsic rate of increase is only about half that of men living in Khutsong) and the asymptotic prevalence is about two-thirds of that for men and women living in Khutsong. This probably reflects the better access to treatment and antibiotics among miners.

Knowledge

Information about HIV knowledge and perceptions of HIV/AIDS was gained from participants' spontaneous answers to multiple-choice questions. Some of the questions, mainly those concerning behaviour, provided opportunities for additional remarks that were included in the analyses.

Knowledge of the most important risk factors for infection and ways of preventing transmission was good. Between 83% and 87% of participants correctly answered questions about the importance of faithfulness, condom use and use of clean needles in the prevention of HIV transmission. However, 29% of the men and 30% of the women expected HIV-positive people to show symptoms of the infection. The answers given by men and women were remarkably similar (men in Table 2, women in Table 3). These percentages were compared with HIV prevalence among men in Khutsong, mineworkers, women in Khutsong, and women in hotspots separately. No statistically significant correlations were found between HIV seroprevalence and peoples' perceptions of how transmission of HIV is prevented.

Most men and women knew that it is very important to remain faithful and to use condoms. Yet 32% of the men in Khutsong, 53% of the miners, and 22% of the women in Khutsong reported sexual intercourse with at least one casual partner during the year prior to the survey. A total of 60% of the men in Khutsong, 68% of the miners and 74% of the women in Khutsong believed that their casual partner had had other sexual partners at the time.

Perceived risk

Respondents were asked if they thought they were at risk of contracting HIV (Table 4). Only 20% of men and 17% of women living in Khutsong considered that they had a 'good chance' of being infected. Among miners and women in hotspots the corresponding figures were 23% and 36%, respectively.

There is a strong mismatch between perceived and actual risk among both men and women. A substantial proportion of respondents thought that they were at no risk of infection (Table 4). Yet among those people, infection rates varied from 15% among men in Khutsong to 28% among mineworkers. None of the respondents said that they knew their HIV status.

Condom use

Although condom use was higher with casual than with regular partners among all groups, especially among sex workers, the rates were still disappointingly low (Table 5). Furthermore, among the nearly 14% of the men in Khutsong and 11% of the miners who were diagnosed as having one or more of syphilis, gonorrhoea or chlamydia, 85% said that they never used condoms with their regular partner, 12% that they used condoms sometimes and only 3.2% that they always used condoms. Approximately half of these men reported a relationship with a casual partner. One in three STD-infected men never used condoms with the casual partner at the time of the symptoms, one in 10 sometimes did, and one in eight always did. No correlation was found between infection with at least one STD and the number of casual sexual partners in the previous week or in the previous month.

Among the women in Khutsong with a regular partner, 24% were diagnosed with at least one of the above three STDs. Of these women, 80% never used condoms with their regular partner, 13% sometimes did, and 7% always did. Of the women who reported a casual partner, 29% were infected with at least one STD and of these 60% never used condoms, 4% sometimes did

Table 3. Female participants' answers to questions about prevention of HIV infection, expressed as percentages. Correct answers indicated by bold type.

Statement	Khutsong women			Women in hotspots		
	True	Not true	Don't know	True	Not true	Don't know
Remain faithful	84.2	9.9	5.9	84.6	10.6	4.9
Use condoms	85.6	7.2	7.3	88.6	3.3	8.1
Use clean needles	85.3	6.0	8.7	85.4	4.9	9.8
Avoid public toilets	37.6	45.7	16.7	47.2	38.2	14.6
Avoid touching	28.4	57.3	14.3	35.8	49.6	14.6
Avoid sharing food	29.3	56.5	14.2	35.8	47.2	17.1
Avoid mosquito bites	54.1	27.8	18.1	51.2	29.3	19.5
HIV+ show symptoms	29.5	44.9	25.6	35.8	37.4	26.8

Table 4. Proportion of men and women in each category of perceived risk and the prevalence of HIV infection in each risk group.

Perceived risk	Khutsong men		Mineworkers		Khutsong women		Women in hotspots	
	Yes	HIV+	Yes	HIV+	Yes	HIV+	Yes	HIV+
No chance	33.3	15.3	22.0	28.3	26.3	27.6	16.5	70.0
Moderate chance	15.8	24.1	12.1	23.9	13.5	46.3	7.4	75.0
Good chance	19.4	27.1	23.0	30.4	16.7	37.8	36.4	75.0
Don't know	31.5	23.4	42.8	29.2	43.7	40.1	39.7	69.0
Already infected	0.0	—	0.0	—	0.0	—	0.0	—

Table 5. Percentage of people who use condoms never, sometimes and always, respectively, with their regular and last casual partners.

	Khutsong men	Khutsong women	Mineworkers	Women in hotspots
Regular partner	<i>n</i> = 352	<i>n</i> = 538	<i>n</i> = 838	<i>n</i> = 94
Never	76.7	83.1	82.8	58.5
Sometimes	14.2	10.6	11.5	15.9
Always	9.1	6.3	5.7	25.5
Last casual partner	<i>n</i> = 158	<i>n</i> = 158	<i>n</i> = 471	<i>n</i> = 78
Never	62.7	72.8	70.7	26.9
Sometimes	9.5	5.7	10.6	14.0
Always	27.8	21.5	18.7	58.9

and 36% reported that they always used condoms with their casual partners.

More than one in three women in the hotspots was infected with at least one STD. Of these, 61% never used condoms with their regular partner, 16% sometimes did and 23% always did. Of women with an STD, 20% never used condoms with their casual partner, 17% sometimes did and 63% always did. As among men, there was no significant correlation between current infection with at least one STD and the number of casual sexual partners in the previous week or month, either among women in Khutsong or in hotspots. Among those with one or more STDs, 65% the men in Khutsong, 64% of the miners, and 84% of Khutsong women believed that their casual partner had other concurrent sexual partners.

Conclusion

South Africa, like other countries in the region, faces a disastrous epidemic of HIV/AIDS. There is an urgent need to develop effective and sustainable interventions that will reduce transmission of the virus as rapidly as possible. Since neither vaccines nor cures are currently available, the best hope in the short to medium term is to begin to manage other sexually transmitted diseases effectively and to find ways to bring about behaviour change and to increase the use of condoms. The Carletonville-Mothusimpilo Project was designed to investigate the extent to which these aims could be achieved in a community-based intervention programme, so that the project might be used to inform the development of a national programme based on such methods. Carletonville presents, in microcosm, many of the problems facing South Africa and which contribute to the spread of HIV/AIDS. It is a major mining centre with a substantial urban population and a large number of migrant workers from rural areas across the region. Lessons learnt there should be applicable in many other places.

One acknowledges immediately that the problem is difficult and the way forward is still not certain, so that much work is still needed.⁴⁹ We believe that some of the key reasons for the success

of the project so far include basing the intervention firmly in the community while involving all the major stakeholders in the area, ensuring that what is done is potentially sustainable, carrying out detailed evaluations, using social as well as biomedical methods, and exploring in detail the biological and social determinants of the epidemic.

It is clear that earlier attempts to manage HIV/AIDS in Carletonville and other mining centres have been largely unsuccessful but this project was able to draw on the lessons of those earlier attempts and to move forward. The growing global tendency to conceptualize HIV as a social and developmental disease, which has been taken up by the Carletonville project, allows for a greater understanding of the determinants of disease and the possibility of developing innovative methods of preventing transmission.

There have been some indications that two years after the start of the intervention some changes are taking place in the Carletonville area. HIV and AIDS have gained a greater profile and community involvement and initiation of related interventions, especially around home-based care and among the youth, has increased. There has been substantial progress in the empowerment of women at high risk, people from all levels of the society are becoming increasingly involved, and local political, religious and other groups are starting to take their own initiatives. The project has recently embarked on a programme to provide periodic presumptive treatment to women at high risk and the mining houses, trade unions and health authorities are in discussion as to how they might take over the funding and the support of the intervention. While it is still too early to demonstrate a reduction in the incidence of HIV infection directly, the surveys that will continue to be carried will make it possible to do this in the next one to two years. Possibly the most important lesson from the project is that starting such an intervention takes time, implementing it takes more time, and seeing significant changes takes even longer. Commitments must be made now to develop effective programmes but these must be seen as long-term resolves. There will be no 'quick fixes'.

We thank the Department for International Development (U.K.), the Population Council, the Department of Health and Old Mutual for their financial contributions to the intervention and evaluation of the programme reported on in this paper. G. Phatedi has frequently assisted the evaluation team in their community research and his contribution to the project is gratefully acknowledged. Finally, we thank the community members of Carletonville who have allowed us to work with them over the last two years and who have made the project a success.

- Baxter R. (1996). The economics of South African mines. In *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*, eds B.G. Williams and C.M. Campbell, pp. 37–43. ERU, Johannesburg.
- Crush J. and James W. (1995). *Crossing Boundaries: Mine Migrancy in a Democratic South Africa*. IDASA, Cape Town.
- UNAIDS website <http://www.unaids.com>. *Spread of HIV in Sub-Saharan Africa*, 1997.
- Jochelson K., Mothibeli M. and Leger J.P. (1991). Human immunodeficiency virus and migrant labour in South Africa. *Int. J. Hlth Serv.* **21**, 157–173.
- Campbell C. and Williams B. (1998). Managing disease in the goldmines: 'work-related' and 'non-work-related' diseases. *S. Afr. med. J.* **88**, 789–795.
- Campbell C. and Williams B. (1999). Beyond the biomedical and behavioural: towards an integrated approach to HIV prevention in the southern African mining industry. *Soc. Sci. Med.* **48**, 1625–1639.
- Williams B., Campbell C. and MacPhail C. (1999). The Carletonville pilot survey. In *Managing HIV/AIDS in South Africa: Lessons from Industrial Settings*, eds B. Williams, C. Campbell and C. MacPhail, pp. 131–149. CSIR, Johannesburg.
- Williams B.G., Campbell C.M., Mqoqi N.P. and Kleinschmidt I. (1998). Occupational health, occupational illness: tuberculosis, silicosis and HIV on the South African mines. In *Occupational Lung Disease: An International Perspective*, eds Daniel E. Banks and John E. Parker, pp. 95–103. Chapman and Hall Medical, London.
- Packard R. (1989). *White Plague, Black Labour: Tuberculosis and the Political Economy of Health and Disease in South Africa*. University of Natal Press, Pietermaritzburg.
- Corbett E.L., Churchyard G.J., Clayton T., Herselman P., Williams B., Hayes R., Mulder D. and De Cock K.M. (1999). Risk factors for pulmonary mycobacterial disease in South African gold miners. *Am. J. respir. crit. Care Med.* **159**, 94–99.
- Churchyard G. (1996). Of soil and seed: HIV related TB on the mines. In *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*, eds B.G. Williams and C.M. Campbell, pp. 117–119. Epidemiology Research Unit, Johannesburg.
- Cowie R.L. (1994). The epidemiology of tuberculosis in gold miners with silicosis. *Am. J. respir. crit. Care Med.* **150**, 1460–1462.
- Williams B., Campbell C., Mqoqi N. and Kleinschmidt I. (1998). Occupational health, occupational illness: tuberculosis, silicosis and HIV on the South African mines. In *Occupational Lung Disease*, eds D.E. Banks and J.E. Parker, pp. 95–103. Chapman and Hall, New York.
- Corbett E. (2000). *Mycobacterial disease in South African gold miners: associations with HIV infection and occupational lung disease*. Ph.D. thesis, London School of Hygiene and Tropical Medicine.
- Trapido A., Goode R. and White N.W. (1999). Costs of occupational lung disease in South African gold mining. *Journal of Mineral Policy, Business and Environment*. **13**, 26–33.
- Trapido A. and Goode R. (1999). Polluters should pay. *S. Afr. Labour Bull.* **4**, 53–58.
- Trapido A.S.M., Mqoqi N.P., Macheke C.M., Williams B.G., Davies J.C.A. and Panter C. (1996). Occupational lung disease in ex-mineworkers — sound a further alarm! *S. Afr. med. J.* **86**, 559.
- Trapido A., Mqoqi N., Williams B., White N., Solomon A., Goode R., Macheke C., Davies J. and Panter C. (1998). Prevalence of occupational lung disease in a random sample of former mineworkers, Libode District, Eastern Cape Province, South Africa. *Am. J. ind. Med.* **34**, 305–313.
- Ballard R. (1996). STDs on the mines: the nature of the problem. In *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*, eds B.G. Williams and C.M. Campbell, pp. 111–114. Epidemiology Research Unit, Johannesburg.
- Decosas J. (1994). The answer to AIDS lies in united commitment. *AIDS Analysis Africa (Southern African Edition)* **5**, 3–4.
- Stein J. and Steinberg M. (1995). *Response of the mining sector to the HIV/AIDS epidemic in South Africa*. Unpublished report to the Human Resources Development Division, Economic Development Institute, World Bank Policy and Planning Coordination Unit, Global Programme on AIDS, World Health Organization, Geneva.
- Gahagen P. (1996). An integrated approach to HIV/AIDS prevention programmes: the New Vaal experience. In *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*, eds B.G. Williams and C.M. Campbell, pp. 95–100. Epidemiology Research Unit, Johannesburg.
- Crisp J. (1996). AIDS programmes in the mining industry: an overview. In *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*, eds B.G. Williams and C.M. Campbell, pp. 91–92. Epidemiology Research Unit, Johannesburg.
- Fourie I. (1996). Health care in the mining industry. In *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*, eds B.G. Williams and C.M. Campbell, pp. 53–57. Epidemiology Research Unit, Johannesburg.
- Anon. (1988). AIDS a reason to stop migrant labour — NUM. *Business Day* (Johannesburg). 12 April 1988.
- Williams B. and Campbell C. (1998). Creating alliances for disease management in industrial settings: a case study of HIV/AIDS in workers in South African gold mines. *Int. J. occup. environ. Med.* **4**, 257–264.
- Campbell C. (1997). Migrancy, masculine identities and AIDS: the psychosocial context of HIV transmission on the South African gold mines. *Soc. Sci. Med.* **45**, 273–281.
- Macheke C. and Campbell C. (1998). Perceptions of HIV/AIDS on a Johannesburg gold mine. *S. Afr. J. Psychol.* **28**, 146–153.
- Klouda A. (1995). Responding to AIDS: are there any appropriate development policies? *Journal of International Development*. **7**, 467–487.
- Campbell C. (1998). Representations of gender, respectability and commercial sex in the shadow of AIDS: a South African case study. *Social Science Information* **37**, 687–707.
- Campbell C. (2000). Selling sex in the time of AIDS: the psycho-social context of condom use by sex workers on a southern African mine. *Soc. Sci. Med.* **50**, 479–494.
- MacPhail C. and Campbell C. (in press). 'I think condoms are good but, aai, I hate those things': condom use among adolescents and young people in a southern African township. *Soc. Sci. Med.*
- Williams B. and Campbell C. (1996). *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*. Epidemiology Research Unit, Johannesburg.
- Mzaidume Y. (1999). In *Managing HIV/AIDS in South Africa: Lessons from Industrial Settings*, eds B. Williams, C. Campbell and C. MacPhail, pp. 103–106. CSIR, Johannesburg.
- De Coito A.J. (1999). Periodic presumptive treatment of women at high-risk. In *Managing HIV/AIDS in South Africa: Lessons from Industrial Settings*, eds B. Williams, C. Campbell and C. MacPhail, pp. 31–33. CSIR, Johannesburg.
- Campbell C., Mzaidume Y. and Williams B. (1998). Gender as an obstacle to condom use: HIV prevention amongst commercial sex workers in a mining community. *Agenda* **39**, 50–57.
- Wilson D. (1995). *Community peer education to prevent STD/HIV/AIDS among women in Zimbabwe and Zambia*. Unpublished report by the Project Support Group, Psychology Department, University of Zimbabwe.
- Dube N. and Wilson D. (1996). Peer education programmes among HIV-vulnerable communities in Southern Africa. In *HIV/AIDS Management in South Africa: Priorities for the Mining Industry*, eds B.G. Williams and C.M. Campbell, pp. 30–40. Epidemiology Research Unit, Johannesburg.
- Machekano R., McFarland W., Mbizvo M.T., Bassett M.T., Katzenstein D. and Latif A.S. (1998). Impact of counselling and testing on HIV seroconversion and reported STD incidence among male factory workers in Harare. *Cent. Afr. J. Med.* **44**, 98–102.
- Gillies P. (1998). Effectiveness of alliances and partnerships for health promotion. *Health Promotion International* **13**, 1–21.
- Ballard R. (1999). Syndromic management of STDs. In *Managing HIV/AIDS in South Africa: Lessons from Industrial Settings*, eds B.G. Williams, C. Campbell and C. MacPhail, pp. 82–95. CSIR, Johannesburg.
- Williams B.G. and Campbell C. (1997). How to control the AIDS epidemic. *Focus* April 1998, 12–13.
- Campbell C., MacPhail C. and Williams B.G. (2000). Relative risk of infection amongst young men and women in a South African township. Submitted to *Journal of Adolescent Health*.
- Community-led peer education by sex workers in Carletonville: preliminary results from an on-going evaluation study*. Unpublished report, 24 January 2000.
- MacPhail C. and Campbell C. (1999). Evaluating HIV/STD interventions in developing countries: do current indicators do justice to advances in intervention approaches? *S. Afr. J. Psychol.* **29**, 149–165.
- Harrison A. and Ntuli N. (1998). *Assessment of services for sexually transmitted diseases in the public and private sectors: perspectives of service users and providers*. Medical Research Council, Durban.
- UNAIDS (1998). *Looking Deeper Into the HIV Epidemic: a Questionnaire for Tracing Sexual Networks*. UNAIDS Best Practice Collection, Key Material. UNAIDS, Geneva.
- Williams B.G., Gilgen D. and Campbell C.M. (2000). *Exploring the epidemic biomedical and social indicators of HIV/AIDS in Carletonville, South Africa*. Unpublished report, available on request from B.G.W.
- Beeker C., Guenther-Grey C. and Raj A. (1998). Community empowerment, paradigm drift and the primary prevention of HIV/AIDS. *Soc. Sci. Med.* **46**, 831–842.

Copyright of South African Journal of Science is the property of South African Assn. for the Advancement of Science and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.