# Prevalence of HIV infection and median CD4 counts among health care workers in South Africa

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*Objective.* To determine the prevalence of HIV infection and the extent of disease progression based on CD4 count in a public health system workforce in southern Africa.

*Design.* Cross-sectional voluntary, anonymous, unlinked survey including an oral fluid or blood sample and a brief demographic questionnaire.

*Setting.* Two public hospitals in Gauteng, South Africa.

*Subjects.* All 2 032 professional and support staff employed by the two hospitals.

*Outcome measures.* HIV prevalence and CD4 cell count distribution.

*Results.* Overall prevalence of HIV was 11.5%. By occupation, prevalence was highest among student nurses (13.8%) and nurses (13.7%). The highest prevalence by age was in the 25 - 34-year group (15.9%). Nineteen per cent of HIV-positive participants who provided blood samples had CD4 counts less than or equal to 200 cells/μl, 28% had counts 201 - 350 cells/μl, 18% had counts 351 - 500 cells/μl, and 35% had counts above 500 cells/μl.

*Conclusions.* One out of 7 nurses and nursing students in this public sector workforce was HIV-positive. A high proportion of health care workers had CD4 counts below 350 cells/μl, and many were already eligible for antiretroviral therapy under South African treatment guidelines. Given the short supply of nurses in South Africa, knowledge of prevalence in this workforce and provision of effective AIDS treatment are crucial for meeting future staffing needs.

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The widespread rollout of treatment for HIV/AIDS in the developing world has brought into stark relief the shortage of trained health care workers available to implement interventions and mount successful public health campaigns. HIV/AIDS in the health care workforce challenges the success of both general and AIDS-related health care investments by reducing the productivity of HIV-positive health care workers, increasing labour turnover, diminishing the average level of work experience, and driving up costs for public sector health budgets. For local and national departments of health and individual facility managers to formulate an effective response to AIDS in the health care workforce, an accurate assessment is needed of the prevalence of HIV infection and the proportion of infected workers who are at risk of opportunistic infections (OIs) and who should be on antiretroviral therapy (ART).

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In South Africa, one of the countries hardest hit by the global AIDS epidemic, national HIV prevalence among working-aged adults is estimated at 16.2%.[1] In Gauteng, the location of the current study, adult prevalence was estimated at 15.8% in 2005.[1] A year earlier, a prevalence study using a cluster sample methodology estimated the HIV prevalence among public hospital employees in South Africa at 11% nationwide, although the study was limited by small sample size and low participation.[2] In Gauteng, prevalence among public hospital employees was estimated to be 15.9%, nearly identical to that found in the adult population as a whole.[2]

Although HIV seroprevalence surveys can provide a general picture of the extent of the epidemic in a population, information on disease progression is needed for planning and budgeting a programmatic response. Since disease progression within an HIV-positive population is likely to vary with epidemic maturity, progression in South Africa, where the AIDS epidemic is relatively young, may not resemble that found in other countries. We located only two population-based studies that measured CD4 counts among asymptomatic HIV-positive individuals in South Africa. In a South African township in Gauteng in 2002, 9.5% of HIV-positive adults had a CD4 count below 200 cells/μl, and 28.4% had a CD4 count below 350 cells/μl.[3] A recent survey[4,5] of South African teachers found that 22% of HIV-positive respondents had CD4 counts below 200 cells/μl and 52% had CD4 counts below 350 cells/μl. No data on disease progression are available for health care workers, whose level of health education, access to health care,

115

and exposure to infectious diseases differ from those of other populations.

To provide relevant, practical information to hospital managers and health department policy makers, we measured the prevalence of HIV and the extent of disease progression based on CD4 cell counts among health care workers at two public hospitals in an urban area of Gauteng, South Africa. This article reports on prevalence of HIV infection in the workforce and the distribution of CD4 cell counts among HIV-positive health care workers.

## Methods

### Study sites and population

The study was conducted at Helen Joseph and Coronation hospitals, two jointly managed public hospitals of the Gauteng Department of Health. Helen Joseph Hospital provides outpatient clinical care, secondary care, and tertiary care in surgery, orthopaedics, psychiatry, and internal medicine; Coronation Hospital offers clinical care in paediatrics, gynaecology, and obstetrics to the same patient base. The study population included all 2 032 professional and support staff at the two hospitals. For the purposes of this study, professional staff were defined as medical doctors, nurses, assistant nurses, nursing students, and allied health care workers (pharmacists, psychologists, occupational therapists, social workers, and other professionals at the same level). Support staff included maintenance, cleaning and kitchen staff known as general assistants. All hospital employees who attended work on at least 1 of the test days were included in the study. Employees who were absent from work on all test days were excluded, as were hospital volunteers and security personnel employed by an outside contractor because their attendance could not be verified on the hospitals' human resource rosters. HIV counsellors were excluded because many were deliberately recruited from the HIV clinic's patient pool.

### Procedures

Data for this study were collected in February 2005 using a cross-sectional, voluntary, anonymous, unlinked survey comprising two parts: (i) an oral fluid or blood sample taken from each participant; and (ii) a brief demographic questionnaire completed by each participant. No sampling was done; the goal was to test all employees in attendance at work on the data collection days. Both the oral fluid sample and blood sample options were offered to each participant in order to maximise participation. The demographic questionnaire was completed in a brief face-to-face encounter between research staff and each participant. Participation was purely voluntary. No monetary compensation was provided, but each participant received a T-shirt as a token of appreciation for his/her time and potential discomfort.

Building on previous experience with private sector workforce surveys in South Africa, extensive efforts were made to ensure that the prospective participants: (i) understood the purpose, benefits, risks, and voluntary nature of the survey; (ii) were comfortable with the steps taken to ensure anonymity and confidentiality; and (iii) were willing to participate. Information was provided via posters, letters, and staff meetings. A series of meetings was held with hospital stakeholders (managers, human resource staff, ward matrons, and workers' union representatives) to answer questions and solicit suggestions regarding the implementation of the survey. One of the key messages communicated to participants was that they would not be able to obtain their HIV results from this survey since it was entirely unlinked and anonymous, but that they would be informed of where to obtain free voluntary counselling and testing (VCT) if they wished to know their HIV status.

The Medical Research Ethics Committee of the University of the Witwatersrand provided ethical approval for the study.

### Data collection and laboratory analysis

Samples were collected at each study site from 09h00 to 14h00 on 4 consecutive days and also from 19h00 to 21h00 on 2 consecutive nights, thus giving night shift staff an opportunity to participate. Samples were collected using the OraSure collection device (OraSure Technologies, Bethlehem, Pennsylvania, USA) or by means of phlebotomy. In cases where blood was drawn, 2 vacutainers of 2 ml each were collected per volunteer, one for enzyme-linked immunosorbent assay (ELISA) testing and the other for CD4 testing. Phlebotomists from outside the two study hospitals drew the blood samples. Each participant was also asked to provide basic demographic information on a form filled out by a member of the research team. Information was limited to four demographic variables: gender (male or female), age range (18 - 24, 25 - 34, 35 - 44, 45 - 54, 55 years and older), professional level (medical officer, nurse, allied staff, or general assistant), and ethnic designation (black, coloured, white or Asian, which are the official descriptors used in South Africa). No individual identifiers such as employee or ID number, name or address were collected. Samples and questionnaires for each participant were marked with an identical computer bar code and deposited in a large container at the entrance to the testing room so that participants could see that the process was genuinely anonymous. Research study staff were available to assist with sample collection, answer questions as needed, discourage repeat participation, and prevent ineligible individuals from giving samples.

Oral fluid specimens were stored at room temperature, and blood samples at between 10°C and 15°C. Both types of specimens were transported to the Contract Laboratory Services (CLS) of the National Health Laboratory Services

(NHLS) laboratory in Johannesburg at approximately 2-hour intervals, with the exception of samples collected at night which were transferred to the laboratories within 9 hours. Both oral fluid and blood samples were tested using the ELISA HIV-1 and HIV-2 antibody tests. Blood samples were then processed further to determine CD4 cell count.

To determine the participation rate for the survey at each site, employee attendance records were collected for each day and night of the survey to generate a complete roster of employees who were at work during the 3-day period and who could therefore potentially have participated. Attendance records were cross-checked with human resources records. Employees who were absent for any reason (scheduled vacations, maternity leave, study leave, sick leave, etc.) on all test days or nights were excluded from the analysis. All employees in attendance on at least 1 day or night comprised the participation denominator; all those who were tested were included in the numerator.

### Statistical analysis

HIV test results and questionnaire responses were entered into an Excel database at the laboratory and sent to the lead researcher (DC) for analysis. Sample containers and questionnaires were matched using duplicate bar codes. Univariate analysis was used to calculate the prevalence of HIV infection in the study population as a whole and median CD4 count. Results were then stratified into subgroups by sex, age range, race and job level. Chi-square tests were used to determine differences in HIV prevalence between subgroups. Kruskal-Wallis tests were used to assess differences in median CD4 counts. All data were analysed using Statistical Analysis System (SAS) software version 9.1 (SAS Institute, Cary, North Carolina, USA).

## Results

Of the 2 032 health care workers employed by the two hospitals, 1 813 (89.2%) attended work on at least one day or night of the study period and were therefore eligible to participate in the survey. Of the eligible population, 1 522 (83.9%) volunteered to be tested (Table I); 82.3% (1 493 individuals) provided complete demographic questionnaire data and comprised our analytical sample. The overall participation rate increases to 89.5% if doctors are excluded. Of the 1 493 individuals in the analytic sample, 788 (53%) provided blood samples and 705 (47%) oral fluid samples. Reflecting the gender distribution at the two hospitals, the overwhelming majority (88%) of the employees tested were female. Characteristics of the health care workers tested are reported in Table I.

The overall HIV prevalence in the tested population was 11.5% (Table I). By job level, prevalence was highest among student nurses (13.8%) and nurses (13.7%). Consistent with population trends in South Africa, women were more likely to be HIV-positive than men (12.0% v. 7.9%), but the difference

**Table I. HIV prevalence among health workers stratified by sociodemographic characteristics, Coronation and Helen Joseph Hospitals, 2005**

| | Available (N) for testing | Tested with complete demographic data (N) | Response rate (%) | HIV-positive (N) | Prevalence (%) |
|---|---|---|---|---|---|
| Overall | 1 813 | 1 493 | 82.3 | 172 | 11.5 |
| Job category | | | | | |
| Medical doctors | 200 | 49 | 24.5 | 1 | 2.0 |
| Allied staff | 278 | 247 | 88.8 | 14 | 5.7 |
| Nurses | 708 | 644 | 91.0 | 88 | 13.7 |
| Student nurses | 66 | 65 | 98.5 | 9 | 13.8 |
| General assistants | 561 | 488 | 87.0 | 60 | 12.3 |
| Gender | | | | | |
| Female | | 1 315 | | 158 | 12.0 |
| Male | | 178 | | 14 | 7.9 |
| Age (years) | | | | | |
| 18 - 24 | | 105 | | 7 | 6.7 |
| 25 - 34 | | 327 | | 52 | 15.9 |
| 35 - 44 | | 530 | | 69 | 13.0 |
| 45 - 54 | | 393 | | 40 | 10.2 |
| 55+ | | 138 | | 4 | 2.9 |
| Racial group | | | | | |
| Black | | 1 028 | | 156 | 15.2 |
| Coloured | | 318 | | 15 | 4.7 |
| Asian | | 42 | | 1 | 2.4 |
| White | | 105 | | 0 | 0.0 |

117

was not statistically significant ($p = 0.10$). Prevalence was highest in the 25 - 34-year age group (15.9%) and among black participants (15.0%).

Table II stratifies HIV prevalence by age and occupation; the analysis is limited somewhat by small cell sizes. Seventy-four of 172 HIV-positive workers (43%) provided blood samples for CD4 testing. Although there was a higher HIV prevalence among those who provided oral fluid samples than among those who gave blood (13.6% v. 9.6%, $p = 0.0104$), there were few demographic differences between the HIV-positive participants who gave blood rather than oral fluid, except that a smaller proportion of HIV-positive nurses and a larger proportion of HIV-positive general assistants gave blood (data not shown). Small cell sizes prevented statistical assessment of differences in other characteristics. The median CD4 cell count among HIV-positive participants was 397 (69 - 1 359)

cells/μl, and the median CD4 cell count among HIV-negative participants was 1 036 (266 - 2 815) cells/μl. Based on CD4 cell count, the distribution of disease progression was as follows: 14 (19%) of the HIV-positive participants had CD4 counts less than or equal to 200 cells/μl, 21 (28%) had counts 201 - 350 cells/μl, 13 (18%) had counts 351 - 500 cells/μl, and 26 (35%) had counts above 500 cells/μl (Table III).

## Discussion

This study estimated the prevalence of HIV infection and the extent of disease progression based on CD4 counts among health care workers at two local hospitals in Gauteng. The overall prevalence for this population was 11.5%, with nearly 20% of those who tested HIV-positive already eligible for ART at the time of the survey and almost 30% more approaching that stage.

**Table II. HIV prevalence among health workers stratified by occupation and age, Coronation and Helen Joseph hospitals**

| Age (years) | Tested (N) | HIV-positive (N) | Prevalence (%) |
|---|---|---|---|
| Allied staff | | | |
| 18 - 24 | 30 | 1 | 3.3 |
| 25 - 34 | 55 | 2 | 3.6 |
| 35 - 44 | 96 | 6 | 6.3 |
| 45 - 54 | 54 | 5 | 9.3 |
| 55+ | 12 | 0 | 0.0 |
| General assistants | | | |
| 18 - 24 | 3 | 0 | 0.0 |
| 25 - 34 | 13 | 3 | 23.1 |
| 35 - 44 | 154 | 28 | 18.2 |
| 45 - 54 | 225 | 26 | 11.6 |
| 55+ | 93 | 3 | 3.2 |
| Nurses | | | |
| 18 - 24 | 35 | 3 | 8.6 |
| 25 - 34 | 214 | 43 | 20.1 |
| 35 - 44 | 255 | 32 | 12.5 |
| 45 - 54 | 111 | 9 | 8.1 |
| 55+ | 29 | 1 | 3.4 |
| Student nurses | | | |
| 18 - 24 | 29 | 3 | 10.3 |
| 25 - 34 | 23 | 4 | 17.4 |
| 35 - 44 | 12 | 2 | 16.7 |
| 45 - 54 | 1 | 0 | 0.0 |
| 55+ | 0 | 0 | - |

**Table III. CD4 cell counts (/μl) among HIV-positive health workers, Coronation and Helen Joseph hospitals, 2005***

| Stage | Number of persons | Percent of total |
|---|---|---|
| ≤ 200 | 14 | 18.9 |
| 201 - 350 | 21 | 28.4 |
| 351 - 500 | 13 | 17.6 |
| > 500 | 26 | 35.1 |
| Total | 74 | 100.0 |

* Overall mean = 451, standard deviation = 286, median = 397.

Our study gathered data directly from a contained and defined population, avoiding sampling biases by attempting to test the whole population. With a participation rate of 82% (90% if physicians are excluded), it is unlikely that we missed any large trends. We may have underestimated HIV prevalence if the workers who were absent from work and therefore excluded from the survey were more likely to be infected, as may well have been the case for those on sick or bereavement leave. Within the HIV-positive population, those absent on sick leave may have had more advanced disease than those who were able to attend work. Because participants could choose between providing a blood sample and an oral fluid sample, it is possible that our CD4 cell count staging results could suffer from self-selection bias (e.g. if HIV-positive employees at more advanced disease stages were either more or less likely to provide a blood sample because of knowledge of their HIV status). We were not able to assess this statistically.

The overall prevalence estimated in our study is substantially lower than estimates made for other adult populations in South Africa, such as the 16% prevalence estimated for both all adults in Gauteng and among the health workforce nationwide.[2] The main exception is the national survey of educators conducted in 2004, which estimated a 6.4% prevalence among teachers in Gauteng and 12.7% in South Africa overall.[4,5] The national health care worker study[2] used broad age bands and reported 20.0% prevalence in the 18 - 35-year age band and 16.6% in the 36 - 45-year age band. Our study found little difference between the age bands when we aggregated by broad age bands. It is unclear why our results are generally lower than other estimates within the general South African population, but the difference may be related in part either to a different socio-economic profile or to the success of prior HIV prevention efforts in Gauteng or at these two facilities. Our result is comparable to studies of other workforces in Gauteng which have estimated prevalence in the region of 5 - 15%[6] (and Colvin M, Connolly C, Madurai L – unpublished research).

There is little published on how prevalence may vary among different segments of the health workforce. Wilkinson and Gilks[7] found no difference in incidence of tuberculosis (TB) between health professionals and ancillary staff. In the South African Human Sciences Research Council (HSRC) health care worker study,[2] non-professional health care workers had a prevalence of 20.3% compared with 13.7% among professionals. We did not find a significant difference in prevalence between professional staff (11.1%) and non-professional staff (12.3%) (data not shown).

Perhaps the most concerning of our findings is the high prevalence of HIV infection among nursing students. Nursing students are already in short supply in South Africa and are urgently needed to fill vacant nursing posts. Given the extent of HIV infection among nurses, even more students will

have to be recruited. Training of nurses also requires a large investment of public resources. High HIV prevalence, and therefore high impending morbidity and mortality, among nursing students is very bad news and should cause nursing school faculty to take notice.

In terms of disease progression, among those health care workers who tested positive for HIV and provided blood samples, many had advanced disease, with a median CD4 count of 397 cells/µl. In our study, 18.9% of health care workers who tested positive for HIV had CD4 cell counts less than or equal to 200 cells/µl, making them eligible for treatment according to both World Health Organization and South African national treatment guidelines.[8,9] Moreover, nearly half of HIV-positive employees had a CD4 count less than or equal to 350 cells/µl. The percentage of individuals eligible for ART may therefore actually be higher, since HIV-positive health care workers with CD4 counts between 200 and 350 cells/µl may have AIDS-defining opportunistic infections that make them eligible for treatment.

Documenting HIV prevalence within a given health facility and the proportion of those infected who are at risk of higher morbidity has several important implications. First is the question of who is responsible for protecting HIV-positive health care workers from being exposed to potentially fatal opportunistic infections like TB. Does the onus lie on the employee to: (*i*) know his/her HIV status, and (*ii*) if positive, maintain his/her CD4 cell count above 350 cells/µl, or should the public health sector devise strategies to encourage workers to ask to be removed from high-risk clinical wards because of their HIV status? A second implication of many workers having CD4 cell counts 350 cells/µl or below is that there is a need for accessible, efficient HIV clinical management and access to ART for these employees. Third, the fact that approximately 20% of HIV-positive workers in our sample have AIDS, including 20% of HIV-positive nursing students and nurses under age 35, suggests that the public sector must improve efforts to secure the supply of future health staff.[10]

The benefits of ascertaining the HIV prevalence within a health facility can be immediate and tangible. An unanticipated result of our study was that, at the request of HIV-positive employees, the study hospitals established an HIV clinic solely for health care workers. Health care workers can obtain confidential counselling, testing, and treatment for HIV/AIDS on site during working hours without enduring very long waits in outpatient lounges. Since the opening of this service, more than 60 staff have enrolled in the in-house HIV clinic. Only when the extent of the problem was understood could management and unions formulate appropriate strategies for care and support of HIV-positive health care workers.

**119**

employees. The South African National Departments of Health and Social Development and the Gauteng Department of Health and the Employees Wellness Program (EWP) also provided important support.

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References

1. Shisana O Rehle T, Simbahi L, et al. South African National HIV Prevalence, HIV Incidence, Behaviour and Communication Survey, 2005. Cape Town, HSRC Press, 2005.
2. Shisana O, Hall EJ, Maluleke R, Chauveau J, Schwabe C. HIV/AIDS prevalence among South African health workers. S Afr Med J 2004; 94: 846-850.
3. Auvert B, Males S, Puren A, Taljaard D, Carael M, Williams B. Can highly active antiretroviral therapy reduce the spread of HIV? A study in a township of South Africa. J Acquir Immune Defic Syndr 2004; 36(1): 613-621.
4. Shisana O, Peltzer K, Zungu-Dirwahi N, et al. The Health of our Educators: A Focus on HIV/AIDS in South African Public Schools, 2004/5 Survey. Cape Town: Human Sciences Research Council, 2005.
5. Rehle T, Shisana O. Estimates of eligibility for antiretroviral treatment (ART) and projected ART impact on AIDS mortality among South African educators. Journal of Social Aspects of HIV/AIDS 2006; 2(3): 304-310.
6. Evian C, Fox M, MacLeod W, Slotow SJ, Rosen S. Prevalence of HIV in workforces in southern Africa, 2000-2001. S Afr Med J 2004; 94: 125-130.
7. Wilkinson D, Gilks CF. Increasing frequency of tuberculosis among staff in a South African district hospital: impact of the HIV epidemic on the supply side of health care. Trans R Soc Trop Med Hyg 1998; 92(5): 500-502.
8. World Health Organization. WHO Case Definitions of HIV for Surveillance and Revised Clinical Staging and Immunological Classification of HIV-Related Disease in Adults and Children. Geneva: WHO, 2006: 1-48.
9. Department of Health, Republic of South Africa. National Antiretroviral Treatment Guidelines. Pretoria: DOH, 2004: 1-56.
10. Department of Health, Republic of South Africa. A National Human Resource Plan for Health. Pretoria: DOH, 2006: 1-72.

# High prevalence of abnormal Pap smears among young women co-infected with HIV in rural South Africa – implications for cervical cancer screening policies in high HIV prevalence populations

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*Objective.* To establish the relationship between HIV infection and cervical dysplasia in young women in rural South Africa.

*Methods.* This cross-sectional study was conducted at a primary health care clinic in Vulindlela, KwaZulu-Natal. Standardised questionnaires were used to collect sociodemographic and clinical presentation data from women attending family planning and other reproductive health services. Pap smears were done using standard methods. Pap smear data were linked to HIV serostatus.

*Results.* Four hundred and sixty-six women were included in the study. The median age was 24.3 years (range 15 - 55 years), and 80% were younger than 30 years. The HIV prevalence rate was 24.5% (95% confidence interval: 20.7 - 28.7%) and the prevalence of abnormal Pap smears was 16.9 - 6.4% ASCUS (atypical squamous cells of undetermined significance), 9.2% LGSIL (low-grade squamous intraepithelial lesions), and 1.3% HGSIL (high-grade squamous intraepithelial lesions). The association between HIV seropositivity and abnormal Pap results was statistically significant (p < 0.05).

*Conclusion.* There is a need for more data on cervical changes in HIV co-infected women and for review of guidelines on selective Pap smear screening in high HIV prevalence settings such as sub-Saharan Africa and where access to antiretroviral treatment remains limited.

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Carcinoma of the cervix is the commonest genital malignancy afflicting women in the developing world. An estimated 190 000 women die each year as a result of cervical cancer, with 80% of these deaths occurring in the developing world.[1] Rates are highest in central America, sub-Saharan Africa and Melanesia, making it one of the most important reproductive health problems of public health importance in these regions. Cervical cancer is preventable by instituting cervical cytological screening and treatment of early lesions. In countries where screening quality and coverage have been high, Papanicolaou

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