National HIV surveillance — South Africa, 1990 - 1992

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Abstract **The findings of three annual surveys of women attending antenatal clinics (at the end of 1990, 1991 and 1992) are presented here. These surveys form part of the National HIV Surveillance Programme. This programme is probably the most useful means of monitoring the trend and distribution of the epidemic. In all strata, a consistent rise in the HIV prevalence rate was found; it doubled almost every 12 months. The point prevalence rate in antenatal clinic attenders in South Africa increased from 0,76% in 1990 to 1,49% in 1991 and 2,69% in 1992. The prevalence rate was found to vary widely geographically: Natal/KwaZulu formed the spearhead of the epidemic with a 4,77% rate of HIV infection in 1992. Venda and the Cape appeared to be the least affected with rates of 0,64% and 0,66% respectively.**

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The first cases of AIDS in South Africa were recorded in 1982.[1,2] On 8 March 1985 the South African AIDS Advisory Group was established to advise the Department of National Health and Population Development (DNHPD) on all aspects of the disease. The systematic national surveillance of AIDS was assigned to the DNHPD with the proviso that a suitable central unit situated outside of it should receive all in-coming reports on AIDS patients. After reports were rendered anonymous, the data were forwarded to the DNHPD to be used for national AIDS surveillance. In keeping with the procedures adopted initially by the World Health Organisation, provision was thus made to record on a voluntary and anonymous basis all known instances where those infected with the virus had developed full-blown AIDS.

As knowledge of the disease increased and tests for HIV antibodies were developed, it became increasingly clear that for national AIDS surveillance to focus exclusively on documented cases was inappropriate, and that it would be far more useful to monitor HIV seroprevalence rates at regular intervals.

In 1990, the DNHPD instituted an HIV surveillance programme based on annual surveys of women attending antenatal clinics in South Africa.

The aim of the National HIV Surveillance Programme was to provide annual estimates of the point prevalence rate of HIV infection in antenatal clinic attenders and, in particular, its rate of change over time. The number of AIDS patients reported varied widely in respect of region and population group. Separate estimates of the point prevalence were therefore obtained for each of the provinces and population groups.

Although the HIV estimates pertain specifically to antenatal clinic attenders, they also mirror the course of the HIV epidemic in the heterosexually active population.[3] This report summarises the first 3 surveys of the HIV surveillance programme. The methodology of the first national HIV survey is described in detail. Subsequent surveys followed this methodology, so only those alterations applicable to the subsequent surveys are mentioned.

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Methods

First national HIV survey, October/November 1990

Sampling

The DNHPD runs a programme for the prevention of haemolytic disease in the newborn. Women attending antenatal clinics have a blood specimen tested for, *inter alia*, rhesus factor (Rh) antibodies and ABO grouping. After routine antenatal screening, an anonymous sample of specimens collected in October and November 1990 was used in the HIV surveillance programme.

The number of Rh/ABO tests paid for by the DNHPD during 1988 was used as a basis for planning the sampling strategy. In 1988, 538 940 such tests were carried out, covering all population groups. Nine laboratories comprising all the blood transfusion services, selected regional laboratories of the South African Institute for Medical Research (SAIMR) and the Provincial Laboratory for Tissue Immunology, provide a service throughout the country and performed 97% of these tests. These laboratories (listed individually in the acknowledgements) were requested to participate in the survey.

Prevalence rates found in previous studies (0,008% in white potential blood donors in 1988 and 1,95% in black women attending STD clinics from 1988 to 1989)[4] served as a guideline for estimation of the sample sizes in different strata. The Dodge-Romig chart, a graphical presentation of the cumulative probabilities of the Poisson distribution of rare events, was used to determine the required sample sizes.[5] Theoretically, a sample size of 2 000 with no HIV-positive specimens results in an estimate of 0% with a 95% confidence interval (CI) upper limit of 0,19%. A sample of 1 000 will enable the detection of prevalence levels of 0,1% (95% CI 0,03 - 0,56).

The following were the strata identified: the four provinces of South Africa, namely the Cape, Natal, Orange Free State and Transvaal, and each of the four major population groups.

The participating laboratories serve overlapping areas, making it difficult to specify an exact number of specimens to be collected by each laboratory. Based on the number of blood specimens processed by these laboratories during 1988, a time interval was specified during which consecutive specimens were to be selected for inclusion in the survey. These time intervals varied according to population group: blacks — 1 week, coloureds and whites — 4 weeks each and Asians — 8 weeks. Based on the 1988 Haemolytic Disease Programme, the expected sample consisted of specimens from 2 130 Asians, 8 610 blacks, 5 320 coloureds and 2 250 whites.

HIV testing

Specimens were initially screened with one of the commercially available enzyme-linked immunosorbent assays (ELISAs). In general, these tests have sensitivities and specificities in excess of 99%. Specimens positive on ELISA screening were subjected to confirmatory testing.

Participating laboratories which included HIV screening in their routine procedures were asked to conduct the HIV screening on the specimens themselves after removal of all personal identifiers. Although this procedure could potentially introduce inter-laboratory variation, many logistical difficulties and the possible loss of specimens on separation were thereby avoided. Positive specimens were sent to one of three accredited virology laboratories for confirmatory testing. Immunofluorescent assay (IFA) or Western blot were used for confirmation. If the laboratory did not conduct routine HIV screening tests, the selected blood specimens were sent to one of these virology laboratories for both screening and confirmatory testing after the completion of routine antenatal tests.

Data collected

Each specimen was accompanied by a form drawn up especially for the survey. Details included the name of the clinic supplying the specimen as well as the population group, age and place of residence of the woman. The final test result — negative, indeterminate or positive — was also recorded on the form.

Analysis

The combined results of all participating laboratories were stratified by province and population group. Place of residence was used as the place variable — when this was not available, the district in which the clinic or hospital was situated was taken as the district of residence. For analytical purposes, Transvaal includes KaNgwane, KwaNdebele, Gazankulu and Lebowa, the Orange Free State includes QwaQwa and Natal includes KwaZulu.

Since the sample was disproportionately stratified by population group and province, the stratum-specific results were weighted by the corresponding estimated number of children under 1 year to obtain the prevalence rate of HIV infection in women attending antenatal clinics. The under 1 population was used as a proxy for the number of pregnant women. Simple random sampling was assumed within each stratum for the calculation of variances and thus CIs. Separate estimates of HIV infection rates were calculated for each population group and each province.

Unless otherwise specified, population figures used in the analysis are estimates derived by the Directorate: Epidemiology of the DNHPD, based on the 1985 census results.[6]

Second national HIV survey, October/ November 1991

Sampling

The sampling strategy for the second national HIV survey was slightly adapted following the results of the first national survey.

The estimated sample size for the first survey was not reached in all the strata identified, and very few specimens were received from the TBVC states. A need for HIV prevalence estimates pertaining specifically to these regions led to an invitation to each of these states to submit 1 000 specimens for inclusion in the second national survey. Based on the number of specimens received in the first national survey, laboratories were requested to collect a specified number of consecutive specimens per population group during October and November 1991. With the exception of Shongwe Mission Hospital Laboratory, which screened KaNgwane's antenatal specimens, the laboratories were the same as those that participated in the first national survey.

Testing

HIV screening followed the same procedure as in the first survey. In accordance with WHO recommendations,[7] ELISA-positive specimens were subjected to confirmatory testing with Western blot, IFA or repeat ELISA testing with a different antigen preparation and/ or different test preparation.

Analysis

The prevalence rate of HIV infection was estimated for each population group and region. In order to compare the results with those obtained in the first national HIV survey, the same geographical base was used, i.e. South Africa (excluding the TBVC states). No data, however, were obtained from QwaQwa and Gazankulu. When the overall prevalence rate was estimated, it was therefore assumed that the HIV prevalence in QwaQwa was the same as that in the Orange Free State; the prevalence in Gazankulu was assumed to be the same as that in the Transvaal.

Three of the TBVC states, namely Ciskei, Transkei and Venda, participated in the second national HIV survey. It was therefore also possible to estimate the prevalence of HIV infection for South Africa (excluding Bophuthatswana).

Information on age was far more complete for this survery than for the first one in 1990. Details were available for 91% of the specimens received and for 94% of the HIV-positive specimens, compared with 78% and 43% respectively in 1990. Age-specific HIV prevalences could thus be estimated. Specimens with unknown ages were proportionately re-distributed according to the age distribution of the sample by region and population group. The estimated number of births in each region per population group and age group of mother, derived from the age-specific fertility rates[8] and the estimated female population, were used as weighting factors.

Simple random sampling was again assumed within each stratum. In those instances where the weighted estimate of HIV prevalence was 0%, the CI was determined by means of Clopper and Pearson's equation.[9]

Third national HIV survey, October/ November 1992

The same methodology as in the second survey was used, with the following modifications. The South African Blood Transfusion Services tested the blood specimens previously assigned to Highveld Blood Transfusion Service as a result of the closing down of the latter. The participating laboratories included the Virology Department of the University of the Orange Free State (UOFS) which screened a large number of antenatal clinic attenders seen at the Gynaecology Department of UOFS.

HIV serology results from Gazankulu were included in this estimate of HIV prevalence. Although no specimens from Gazankulu were submitted for the national HIV survey, the antenatal clinic at Tintswalo Hospital in Gazankulu is one of the sentinels of the surveillance programme run by the National Institute for Virology. The results from the specimens collected between 1 October 1992 and 31 December 1992 were included in the analysis of this survey. All stratum-specific results were weighted by the estimated number of births based on the 1991 population census.[10]

Results

During the course of the 3 national surveys, 50 858 specimens representing almost all statistical regions in South Africa were received — 14 571 in 1990, 17 318 in 1991 and 18 969 in 1992. Of these, 517 had to be excluded from the analysis as a result of haemolysis or because an insufficient amount of serum had been supplied for testing (1990 — 195, 1991 — 163, 1992 — 159) (Fig. 1). The 1992 estimate includes 506 specimens from Gazankulu collected during a sentinel survey by the National Institute for Virology, and excludes a further 103 specimens which either originated outside the survey area or for which information on population group was not available. The age distribution of the samples for the various years closely resembled the age distribution of the estimated number of women who gave live births in each year; this indicated that the selected sample was representative of the pregnant population (Fig. 2).

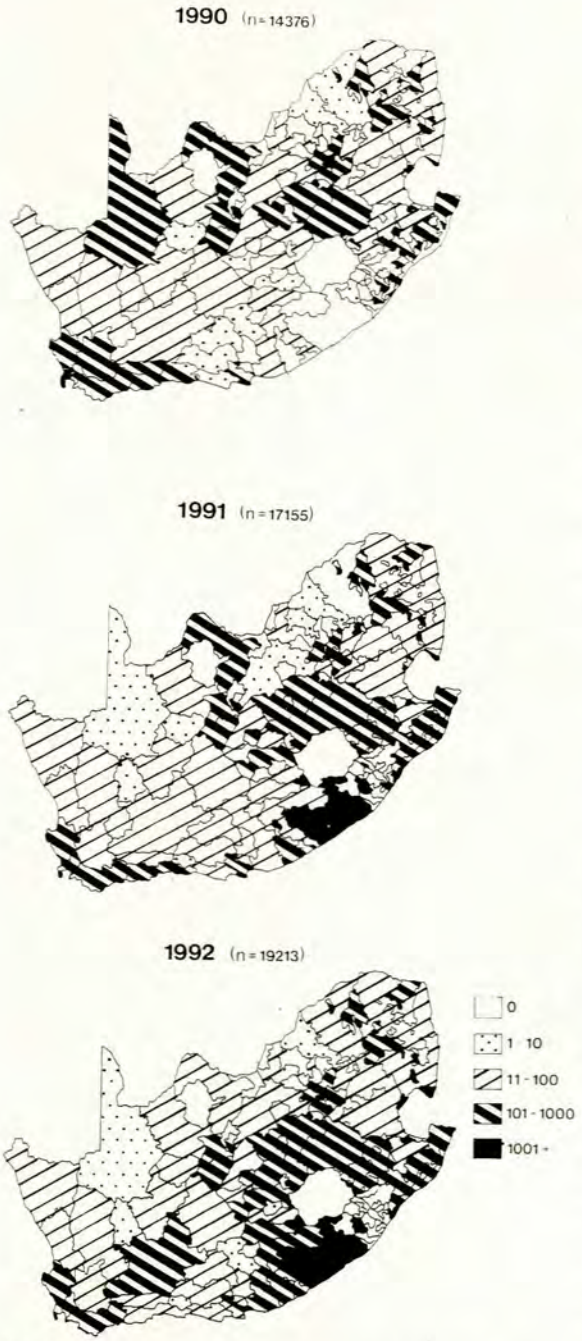

FIG. 1.
Geographical distribution of antenatal specimens included in the national surveillance programme — 1990, 1991 and 1992.

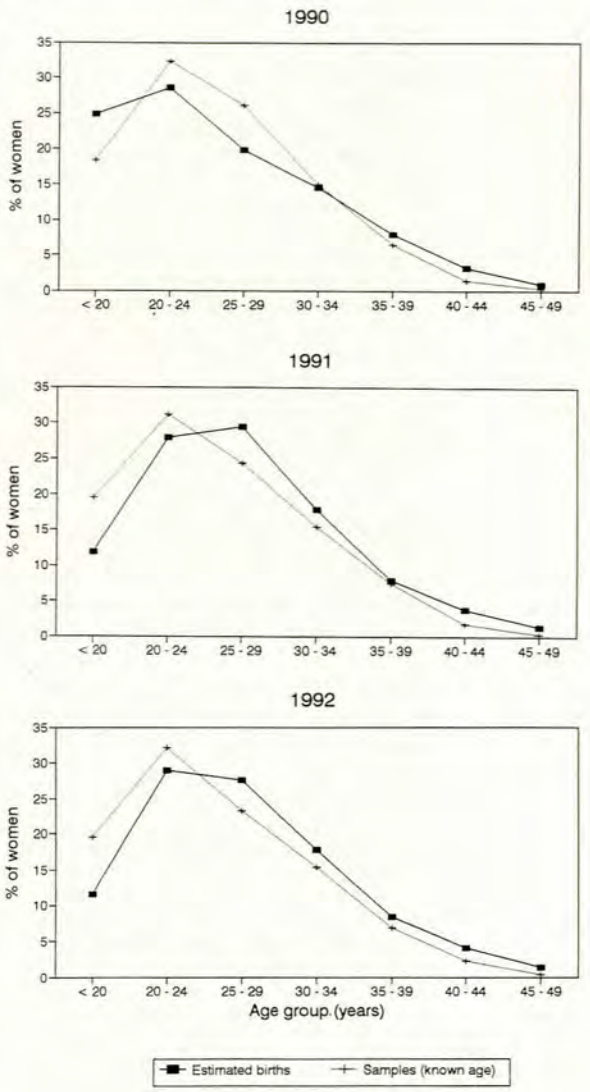

FIG. 2.
Age distribution of women included in the national surveillance programme in comparison with that of women who gave birth — 1990, 1991 and 1992.

Of the specimens tested, 70 were confirmed HIV-positive in 1990, 167 in 1991 and 326 in 1992. Although indeterminate results may indicate early seroconversion, this could not be assumed at the time of the survey. The 63 indeterminate specimens in 1990, 16 in 1991 and 16 in 1992 were therefore regarded as negative at the time of the survey and included in the negative findings. The results obtained in the 3 national HIV surveys are given in Table I.

In 1990, 0,76% of the women attending antenatal clinics were HIV-infected. Of the 4 provinces, Natal had the highest prevalence with 1,61% whereas, at the other extreme, only 0,16% of women in the Cape were infected. HIV prevalence rates in the Transvaal and the Orange Free State were 0,53% and 0,58% respectively. Countrywide, HIV infection increased in the subsequent surveys to 1,49% in 1991 and 2,69% in 1992.

TABLE I.
National HIV surveys 1990, 1991 and 1992 — estimated prevalence (%) of HIV infection in women attending antenatal clinics

	1990		1991		1992	
	PR	CI	PR	CI	PR	CI
By region						
Cape	0,16	0,05 - 0,27	0,37	0,18 - 0,57	0,66	0,38 - 0,94
Natal	–		–		2,89	2,13 - 3,64
KwaZulu	–		–		5,34	3,68 - 7,00
Natal/KwaZulu	1,61	1,06 - 2,16	2,87	2,18 - 3,56	4,77	3,58 - 5,95
OFS (including QwaQwa)	0,58	0,10 - 1,06	1,49	0,72 - 2,26	2,87	1,94 - 3,80
Transvaal	–		–		2,56	0,85 - 4,27
Gazankulu	–		–		1,58	0 - 3,77
KaNgwane	–		1,71	0,84 - 2,57	3,28	1,27 - 5,30
KwaNdebele	–		0,70	0,21 - 1,19	1,10	0 - 2,88
Lebowa	–		0,55	0,07 - 1,02	1,10	0,46 - 1,74
Transvaal (including Gazankulu, KaNgwane, KwaNdebele, Lebowa)	0,53	0,29 - 0,77	1,11	0,69 - 1,52	2,16	1,72 - 2,61
Ciskei	–		0,94	0,34 - 1,55	1,20	0,22 - 2,19
Transkei	–		0,49	0,19 - 0,80	0,83	0,22 - 1,44
Venda	–		0,45	0,02 - 0,88	0,64	0,14 - 1,15
SA (excluding TBVC)	0,76	0,57 - 0,96	1,49	1,21 - 1,58	2,69	2,29 - 3,09
SA (excluding Bophuthatswana)	–		1,35	1,11 - 1,59	2,42	2,08 - 2,76
By population group						
Asian	1,53	0 - 3,74	0,11	0 - 0,31	0,33	0 - 0,70
Black (SA excluding TBVC)	0,89	0,66 - 1,13	1,84	1,49 - 2,18	3,22	2,74 - 3,70
Black (SA excluding Bophuthatswana)	–		1,60	1,32 - 1,89	2,80	2,40 - 3,20
Coloured	0,16	0,04 - 0,28	0,14	0,02 - 0,26	0,33	0,12 - 0,54
White	0,06	0 - 0,18	0	0 - 0,22	0,09	0 - 0,22
By age group*						
SA (excluding Bophuthatswana)						
< 20	–		1,58	0,83 - 2,33	2,40	1,55 - 3,26
20 - 24	–		1,97	1,47 - 2,47	3,54	2,82 - 4,27
25 - 29	–		1,27	0,82 - 1,73	1,82	1,24 - 2,40
30 - 34	–		0,60	0,24 - 0,97	1,84	1,01 - 2,67
35 - 39	–		0,33	0 - 0,70	1,64	0,54 - 2,75
40 - 44	–		1,03	0 - 2,60	0,14	0 - 0,33
45 - 49	–		0	0 - 6,44	0	0 - 4,95

PR = prevalence rate; CI = confidence interval.
* Results for Gazankulu not included since age was unknown for the entire sample.

Regional variations in HIV infection continued with Natal clearly forming the spearhead at 2,87% in 1991 and 4,77% in 1992 (Fig. 3).

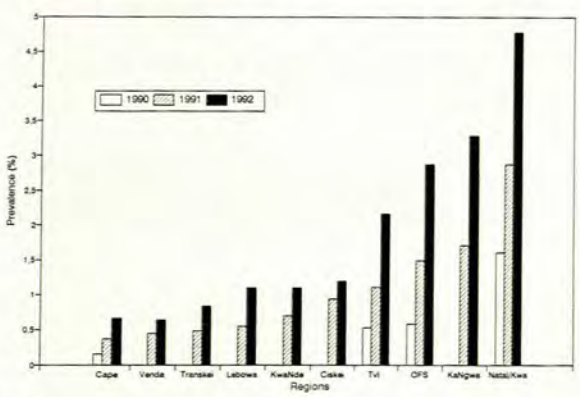

FIG. 3.
Estimated HIV prevalence by region — 1990, 1991 and 1992.

Although information on age was requested from the outset, the ages of more than 50% of positive specimens received during the first national HIV survey were unknown. Age was better recorded in subsequent surveys enabling age-specific HIV prevalence estimates. The 20 - 24-year-olds consistently demonstrated the highest rates (Fig. 4). Teenagers (15 - 19-year-olds) were also heavily infected.

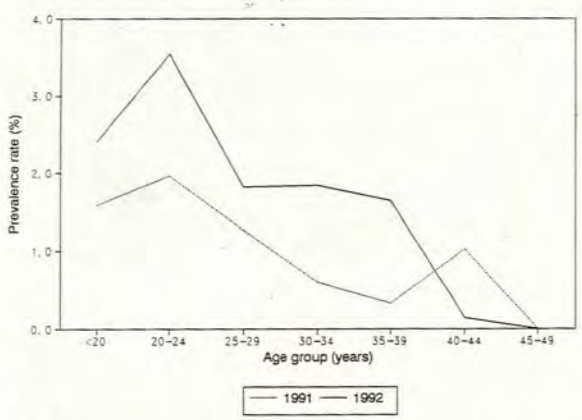

FIG. 4.
Age-specific prevalence of HIV in women attending antenatal clinics in 1991 and 1992.

A substantial difference was found in the extent to which the different population groups were infected. Because of the very small sample of specimens from the Asian population submitted during the first survey, a high but very non-sensitive estimate of HIV infection was obtained. The infection prevalence in the Asian, coloured and white populations is still low (less than 4/1 000) but has increased over time. HIV infection in the black population of South Africa (excluding the TBVC countries) increased from 0,89% in 1990 to 1,84% in 1991 and 3,22% in 1992.

The incidence of HIV infection in South Africa

The primary aim of the surveillance programme is to monitor the HIV epidemic, especially its geographical distribution and time trend in South Africa. An estimate of the number of people infected with HIV at a specific time highlights the magnitude of the problem.

These estimates cannot be offered without a word of caution. The final figures arrived at are crude estimates which are only as good as the validity of the underlying assumptions and the generalisability of the survey results.

Given the assumptions that: (*i*) the HIV prevalence rate in all pregnant women is the same as the prevalence rate in women attending antenatal clinics; and (*ii*) the prevalence rates found in the national surveys reflect the prevalence in all women of child-bearing age (15 - 49 years), it was estimated that 50 179 women in South Africa (excluding the TBVC countries) were infected at the end of 1990, 93 712 at the end of 1991 and 175 380 at the end of 1992.

Assuming that 30% of the babies born to HIV-infected mothers are infected vertically, 1 936, 3 897 and 8 045 HIV-infected babies respectively were born in the years 1990 - 1992.

Based on the male/female ratio of 0,73:1 (R. Crookes — personal communication), 128 027 heterosexual men were estimated to be infected. By the end of 1992, therefore, 311 452 heterosexual adults and babies under 1 year were estimated to be HIV-infected.

Further details on each of the surveys are available in the in-house publication, *Epidemiological Comments*, of the DNHPD, which is available free of charge.[10-12]

Discussion

The Epidemiology Directorate of the DNHPD is in charge of official disease surveillance on behalf of the public health service. Notifiable diseases have always played a central role in this regard, but many other conditions attest to the broader nature of the surveillance. At the time of writing, opinion was divided on the advisability of including HIV infection and full-blown AIDS on the list of notifiable conditions. To date they have never been notifiable.

These surveys based on the screening of anonymous, unlinked specimens have provided estimates of HIV infection in the study group and the trend of the epidemic. The results have been used by many sectors outside the medical field in the planning of future strategies. Complemented by the results of sentinel surveys, the information can be employed in the planning and evaluation of prevention and control programmes. The areas most affected and the most vulnerable age groups have been identified. The issue of how representative the study group and the serological testing by different laboratories with different testing procedures are, has been raised.

According to the WHO, unlinked anonymous testing is consistent with existing global guidelines on human rights in biomedical research.[13] Unlinked anonymous screening is also recommended by the WHO as an accurate and effective method of public health surveillance in respect of HIV infection. Failure of a voluntary, named HIV testing scheme at antenatal clinics in the UK and a subsequent anonymous investigation of antenatal clinic attenders, led the authors to conclude that 'anonymous testing is the only method whereby health authorities can rapidly assess the gravity of the AIDS problem'.[14]

Anonymous testing in low prevalence areas requires large numbers of individuals from whom blood samples are taken for another reason for which informed consent must be given. There are few sources on such a scale which are readily accessible. Pregnant women attending antenatal clinics provide such a source. Some bias may be introduced by the inclusion only of antenatal clinic attenders and therefore the exclusion of many women of childbearing age. This group should however mirror the trend of the HIV epidemic in the heterosexually active population.

A number of laboratories kindly assisted the DNHPD in the national HIV surveillance programme. It was an important consideration to plan the survey within the financial constraints and with as little disruption as possible of the routine laboratory activities. Inclusion of several laboratories in the testing procedure, in the absence of a quality assurance programme for HIV testing, has the potential to introduce bias into the test results. The problem of laboratory performance assessment to address the complexity of HIV screening was discussed at a meeting of the AIDS research working party of the Commission of the European Community (EC). At the end of the meeting, attended by virologists from EC member countries, Norway, Sweden, Finland and Switzerland, the consensus was that 'given the generally high standard of testing and the rapidity with which new assays are appearing it would be difficult and of little benefit to try to introduce obligatory standards'.[15]

The decision to classify indeterminate results with negative results may lead to an underestimate of the HIV prevalence rate. However, without a change in the indeterminate result on follow-up specimens taken at least 1 month later, the result cannot be considered to be an early conversion. Cross-reaction with a related retrovirus or an aberration of unknown origin in healthy individuals can also give rise to an indeterminate result. 'The vast majority of low-risk individuals with indeterminate results are negative for HIV infection and would not need further follow up after 6 months . . .'[16]

The use of similar methodology for all surveys helps ensure a reliable reflection of the course of the epidemic and its distribution. These results, however, should be complemented by sentinel surveillance programmes to monitor problem areas at local level.

This survey was a joint venture involving many participants. The directors and/or heads of the following laboratories, together with their personnel, are thanked most sincerely for their willing co-operation: the Virology Laboratories of the Universities of Cape Town, Natal and the OFS, the Gynaecology Department of UOFS, the National Institute for Virology, the Blood Transfusion Services of the Western Province, Eastern Province, Border, Natal, Highveld and the South African Blood Transfusion Service, the SAIMR regional laboratories in Northern Transvaal, Kimberley, Bloemfontein, Bethlehem, Kroonstad and Welkom, and Shongwe Mission Hospital Laboratory.

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