Paper IV

Antenatal clinic HIV data found to underestimate actual prevalence declines: Evidence from Zambia

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Abstract

Background: We examined to what extent antenatal (ANC)-based estimates pick HIV prevalence trends among men and women in a high prevalence urban population.

Methods: The data stem from serial population-based HIV surveys in 1995 (n=2115), 1999 (n=1962) and 2003 (n=2692), and ANC-based surveillance in 1994 (n=450), 1998 (n=810) and 2002 (n=786) in the same site in Lusaka, Zambia. The population-based surveys recorded refusal rates between 6-10% during the three rounds.

Findings: Among ANC attendees, prevalence declined by 20% (25.0% to 19.9%; P=0.101) in age group 15-24 years and was stable overall. In the general population, prevalence declined by 49% (P<0.001) and by 32% (P<0.001) in age group 15-24 and 15-49 respectively. Among women only, HIV prevalence declined by 44% (22.5% to 12.5%; P<0.001) and by 27% (29.6% to 21.7%; P<0.001) in age group 15-24 and 15-49 years respectively. In addition, prevalence substantially declined in higher educated women aged 15-24 years (20.7% to 8.5%, P<0.001). Furthermore, in age group 15-19 years, proportion ever given birth declined from 17% to 8% (P<0.001).

Conclusion: ANC-based estimates substantially underestimated declines in HIV prevalence in the general population. This seemed to be partially explained by a combination of marked differentials in prevalence change by educational attainment and changes in fertility related behaviours among young women. These results have important implications for the interpretation of ANC-based HIV estimates and underscore the importance of population-based surveys.

Key words*: HIV prevalence, antenatal, population survey, trends and Zambia*

Introduction

HIV prevalence among pregnant women attending antenatal clinics (ANCs) remains the principal data source of infection trends in sub-Saharan Africa (Ghys P D *et al.*, 2006, Kwesigabo G *et al.*, 2000). This type of surveillance has been revised to meet changing needs yet maintaining the original objective (WHO/UNAIDS, 2003). Despite this usefulness, ANC-based HIV prevalence estimates should be interpreted with caution due to multiple potential inherent selection biases (Mills Stephen *et al.*, 2005). Methods of adjustment on some of the factors have improved the estimation (Boisson E *et al.*, 1996, Fabiani M *et al.*, 2003, Zaba B W *et al.*, 2000, Fabiani M *et al.*, 2006). Despite these drawbacks regarding point estimates, it has often been argued that ANC sentinel surveillance data collected over time will reasonably well capture infection trends of men and women in the general population (Kwesigabo G *et al.*, 2000). The basis for this argument assumes that the inherent biases remain constant over time, hence are assumed not to influence patterns drastically (Mills Stephen *et al.*, 2005). In the 1990s, very few communities had serial data to check this hypothesis and most validations of ANC-based HIV prevalence used single time-points or relatively short periods of time raising validity and accuracy concerns on the reliability of such extrapolations (Fylkesnes K *et al.*, 2001, Ghys P D *et al.*, 2006).

In Zambia, the HIV epidemic has been monitored using both ANC-based and population-based data. The ANC-based surveillance system was established with few sites in 1990, and in 1994 a total of 27 sites were selected representing both rural and urban populations in all the provinces (Fylkesnes K *et al.*, 1998b, Fylkesnes K *et al.*, 2001). Since then, two other rounds of surveillance have been conducted in 1998 and 2002 (Sandøy Ingvild F *et al.*, 2006). In one of the surveillance sites in Lusaka urban, serial cross-sectional surveys on HIV prevalence and risk factors were also conducted in 1995, 1999 and 2003 among randomly selected men and women (Fylkesnes K *et al.*, 2001, Michelo C *et al.*, 2006). Presently, this is the only site that has both ANC-based and population-based HIV prevalence estimates from the same population consistently.

We investigated how well antenatal-based HIV prevalence estimates capture trends in this general population between 1994 and 2003.

Methods

Antenatal based surveillance design

The data stem from serial antenatal-based HIV surveys conducted in Chelstone in 1994 (n=450), 1998 (n=810) and 2002 (n=786). The first epidemiological HIV sentinel surveillance among ANC attendees in Chelstone was conducted in 1990 as a pilot followed by another in 1993. However, the sample sizes in these surveys were very low. In 1994, the core antenatal based HIV surveillance for the whole country was established, repeated in 1998 and in 2002. The detailed methods and major findings of the earlier national surveys have been reported elsewhere (Fylkesnes K *et al.*, 1998b, Fylkesnes K *et al.*, 2001, Sandøy Ingvild F *et al.*, 2006). Pregnant women who were attending the antenatal clinic for the first time in the pregnancy were enrolled consecutively. Data was collected within a maximum of 4 months. The target number for Chelstone was 800 participants. Serum from blood samples drawn for syphilis screening was tested unlinked and anonymously using Capillus HIV-1/HIV-2 rapid test (Cambridge Biotechnology, Galway, Ireland) at the ANC clinics. Randomly selected negative samples (5% in 1994 and 1998, 10% in 2002) and all positive samples were re-tested at the national laboratory using Wellcozyme HIV Recombinant HIV-1 (Murex, Johannesburg, South Africa). A third test, Bionor HIV-1 & 2 (Bionor As, Skien, Norway), was employed on the samples with discordant results of tests one and two, and this third result was considered final.

Population based surveillance design

The first population-based HIV survey in Zambia was conducted in 1995 in Chelstone and Kapiri Mposhi and two follow-up surveys were later conducted. The detailed methods and major findings of these populations based studies have been reported elsewhere (Michelo C *et al.*, 2006, Fylkesnes K *et al.*, 1998b, Fylkesnes K, Musonda, R. M., Kasumba, K., Ndhlovu, Z., Mluanda, F., Kaetano, L., Chipaila, C. C., 1997, Fylkesnes K *et al.*, 2001). The data we used stem from the surveys conducted in Chelstone in 1995 (n=2115), 1999 (n=1986) and 2003 (n=2589) using random-cluster sampling method. The Zambian census population mapping system was used to establish the sampling frame, which consisted of 24 Standard Enumeration areas (SEAs) with 2786 households. Using "probability proportional to size", 10 SEAs were selected for this study. In the sampled clusters, a personal structured interview was carried out with all eligible household members aged ≥15 years in order to collect information on education, socio-demographic characteristics and risk behaviours. The second part of the interview involved HIV testing using saliva. In 1995, all saliva samples were tested using Gacelisa HIV 1 & 2 (Welcome Diagnostics, Dartford, Kent,

U.K.) and initially 450 randomly selected samples were tested using Bionor HIV- 1 & 2 (Bionor AS, Skien, Norway) magnetic particle assay following modifications for saliva. Agreement between the two test kits was 99.8%(Fylkesnes K *et al.*, 1998a). In the 1999 and 2003 follow-up surveys, samples were tested using Bionor HIV 1& 2.

Validation strategy and statistical Analyses

The ANC surveillance was conducted from August to November of 1994, 1998 and 2002. Each population survey was conducted within a year of carrying out the antenatal surveillance, that is, from October to December in 1995, October 1998 to May 1999 and from February to May in 2003. For comparability purposes, these years have been denoted as period 1, 2 and 3 to represent 1994, 1998 and 2002 for the ANC-based reports, whereas it is 1995, 1999 and 2003 in the population data, respectively. The health post where the antenatal clinic services are provided serves the same catchment area from which the sample for the population survey was drawn. Data from the 1990 pilot and 1993 survey were excluded in the analyses due to lack of appropriate population data for validation at the time. Analyses (stratified by age and sex) were performed using Intercooled Stata version 8 (Texas, USA). The Mantel-Haenszel chi square test (1 degree of freedom and with continuity correction) was used to test the linear trend of HIV prevalence patterns over the periods. In order to check the effect of age structure, the estimates were standardised using the 2000 census urban female reference population. The ANC-based estimates were then compared with the population-based estimates for similarity.

Ethics

The National AIDS Research Committee approved the protocol for the ANC based surveillance system in 1990 and all HIV testing was done unlinked and anonymously as part of routine standard antenatal care in Zambia (Fylkesnes K *et al.*, 1998c). The testing algorithm complied with the WHO/UNAIDS guidelines for conducting such surveys. The population based survey protocols received clearance from the National AIDS Research Council and the University of Zambia Research Ethics Committee. The ethical details for both data sources are reported already elsewhere (Sandøy Ingvild F *et al.*, 2006, Michelo C *et al.*, 2006).

Results

Description

In the population-based survey, 60% of the respondents were females and 40% were males. The overall mean age was 26.2 years. The mean age among ANC attendees was 24.1 years. Furthermore, ANC attendees had significantly lower educational level (P<0.001) than the respondents in the population-based survey, (mean school years: 7.2 vs. 8.6 in period 1, 7.2 vs. 9.2 in period 2 and 7.6 vs. 10.1 in period 3). In the population-based surveys the overall response rate in the was 89% and antenatal attendance at the public health facility during the last pregnancy was 97%, 98% and 93% in 1995, 1999 and 2003 respectively.

Age-specific HIV infection trends

Table 1 illustrates both ANC and population based age-specific HIV prevalence trends. Population-based HIV prevalence of men and women in age group 15-49 years between 1995 and 2003, declined by 32% (26.5%, 23.7% to 18.0%, P<0.001). Among women only aged 15-49, prevalence declined by 27% (29.6%, 27.1% to 21.7%, P<0.001). In the same age group, ANC-based prevalence over the period remained stable (24.2%, 25.9% to 24.3%, P=0.821). In age-group 15-24 years, population based prevalence declined from 16.5%, 13.9% to 8.5% (P<0.001) among men and women, representing a 49% decline and in young women only, prevalence declined by 44% (22.5%, 18.3% to 12.5%, P<0.001). However, ANC based data in this age group showed marginal decline of 20% (25.0%, 22.8% to 19.9%, P=0.101).

In the general population, we further observed that the prevalence declines were largely seen in age group 15-29 years, whereas among the ANC attendees, prevalence only significantly declined in the group aged 15-19 years. Furthermore, although ANC-based age-specific point estimates matched population based estimates of young women aged 15-24 in time 1 (25% vs. 22.5%) and time 2 (22.8% vs. 18.3%), the ANC-based point estimate was significantly higher than population-based estimate in time 3, (19.9%, 95%CI 16.2-23.6.8 vs.12.5%, 95%CI 9.2-15.8). When considering men and women together however, ANC-based estimates still significantly over-estimated population prevalence in the groups aged 15-24 years throughout the survey rounds; time 1 (25%, 95%CI 19.8-30.2 vs. 16.5%, 95%CI 13.3-19.8), time 2 (22.8%, 95%CI 18.9-26.6 vs. 13.9%, 95%CI 12.3-15.5) and time 3 (19.9%, 95%CI 16.2-23.6 vs. 8.5%, 95%CI 6.5-10.6).

HIV and educational attainment

In general, population-based estimates showed a universal shift towards declining prevalence of HIV infection in groups with higher education over the period, as illustrated in Table 2. Among higher educated young men and women aged 15-24 years, prevalence declined from 16.1%, 11.7% to 5.3% (P<0.001). In the same age group, prevalence declined from 20.7%, 16.1% to 8.5% (P<0.001) among women only with higher education. Similarly, in higher educated groups of men and women aged 25-49 years, prevalence declined from 43.2% to 26.4% (P<0.001) and from 45.6% to 29.0% (P<0.001) in women only. Overall (men and women), prevalence declined from 32.0% to 14.8% (P<0.001) and from 34.1% to 17.5% (P<0.001) in women only. In sharp contrast, among ANC attendees, prevalence remained stable over the study in all age groups and irrespective of educational attainment. The overall educational level of ANC attendees did not significantly change over the period (mean school years: 7.2, 7.2 and 7.6, P=0.219). Among young women aged 15-24 years, the pooled proportion of pregnant women with up to 7 years of school remained over 60% whereas those with >=11 school years was <15% in all the surveys. The distribution was the same even in age group 15-19 years.

Population based sexual debut and ever given birth by educational attainment

In the general population of women aged 15-24 years, the mean of years in school increased from 8.64(95%CI 8.64-8.83) in 1995, 9.21(95%CI 9.04-9.38) in 1999 to 10.1(95%CI 9.95-10.26) in 2003. In this group, increase in age at first sex was associated with higher educational attainment. In 2003, the mean age for sexual debut among women aged 15-29 years and with more than 11 years of school was 19.0 compared to 16.6 (95%CI 16.2-17.0) in groups with 0-7 years of school. Following a similar pattern, higher educated young people showed significant postponement in ages at first birth. Consequently, among women with more than 11 school years, the proportion ever given birth in age group 15-24 years decreased from 33.1%, 22.2% to 19.2% (p=0.002) whereas the decline was marginal in groups with 0-7 school years (figure 1). In age group 15-19, the proportion of women ever given birth declined by 57% (16.8%, 9.4% to 7.9%; OR 0.43 95%CI 0.26-0.68) and from 65.5%, 47.5% to 41.7% (p<0.000) in age group 20-24 years, see table 4. Figure 2 illustrates further the general decline in age at first birth among women under 30 years of age in the general population.

Discussion

We found diminishing representativeness of ANC-based data in capturing HIV prevalence and trends in the general population. Firstly, that the overall ANC-based HIV prevalence estimates remained stable, contrasting the population-based pattern where prevalence declined in both women and men. Secondly, both sources of data showed HIV declines in age-group 15-24 years, but declines were substantially steeper in population-based data (by 49%) compared with ANC-based data (by 20%). These findings seemed to be partially explained by a combination of marked differentials in prevalence change by educational attainment as well as marked changes in fertility related behaviours such as the postponement of first birth among young women. This postponement was associated with educational attainment, and we have already reported substantial HIV declines among higher educated groups in this population (Michelo C *et al.*, 2006). The findings are challenging HIV surveillance systems, and generalising to other areas in Zambia and countries in sub-Saharan Africa merits further study. A similar pattern of change in ANC-based HIV prevalence reported here has been observed in the majority of surveillance sites in Zambia, and the most likely scenario is that similar change mechanisms were seen in many of these populations (Sandøy Ingvild F *et al.*, 2006). The parallel declines observed from both antenatal- and population-based data in Kagera during the 1990s may have been a signal of continuing declines in the general population as the epidemic matured (Kwesigabo G *et al.*, 2000, Kwesigabo G, Killewo, J., Godoy, C., Urassa, W., Mbena, E., Mhalu, F., Biberfeld, G., Wall, S., Sandstrom, A., 1998, Asiimwe-Okiror G *et al.*, 1997, Kwesigabo G *et al.*, 2005). At this stage of the epidemic, dynamics among antenatal attendees differ with the general population, hence using ANC-based estimates alone could even lead to a possibility of serious underestimation of what could be intervention-linked impacts.

The basis for our assessment of how well ANC-based data capture HIV trends in the general population was data from a population-based survey conducted in the area covered by the antenatal clinic. There is a potential of non-response to have biased the results. Among ANC attendees, non-response can be estimated largely by ANC coverage, and coverage was been stable and above 90% in all the surveys (estimated to be 98% in Lusaka)(Central Statistical Office (Zambia) C B o H Z, and ORC Macro). In the population-based study, the most significant cause of non-participation was absence of men. Refusal to give saliva for HIV testing was low in all the three surveys. In view of this, non-response bias seems not likely to have been an important factor affecting the results. In addition, fertility linked factors which could be the other possible sources of selection bias were critical explanatory factors

in this study. Furthermore, we also exclude laboratory associated differentials in test result to have been a factor (Fylkesnes K *et al.*, 1998a, Fylkesnes K *et al.*, 1998b).

There is convincing evidence that HIV transmission among adults in sub-Saharan Africa is predominantly heterosexual (Schmid G P *et al.*, 2004). Secondly, women tend to under-report socially undesirable sexual behaviours including early age of sexual debut (Upchurch D M *et al.*, 2002, Central Statistical Office, Zambia *et al.*, 2002. However, elsewhere we have argued that "it is reasonable to believe that asking a woman whether she has a ever given birth will give more reliable answers than whether she has ever had sex, as childbearing is associated with high respect in this society and is difficult to keep secret" (Sandøy, 2006; *unpublished*). Therefore the reduction in the proportion ever given birth and parallel postponement of age at first birth among higher educated young people in the general population reported here, suggests a convincing behaviour change. Postponement of childbearing might be due to a combination of abstinence, consistent use of condoms as well as utilisation of other contraceptives, all of which have increased during the period (Central Statistical Office, Zambia *et al.*, 2002. These factors were of critical importance in explaining the reduced odds of HIV infection among higher educated groups in the general population of young females (Fylkesnes K *et al.*, 1998b, Michelo C *et al.*, 2006).

In sharp contrast however, the picture is dissimilar among ANC attendees. Firstly, we observed that the over-estimation of HIV prevalence seen in ANC data from age-group 15-19 years might be related to the fact that this group engaged in unprotected sex thereby increasing the likelihood of infection more than counterparts in the general population of which some are not sexually active (Fylkesnes K *et al.*, 1998b, Gray R H *et al.*, 1998, Konde-Lule J K *et al.*, 1997, Pettifor A E *et al.*, 2004). Secondly, the higher prevalence in age group 20-24 years also suggests that there is a steady increase in the number of newly infected women arising from younger age groups. Since male HIV prevalence in parallel ages in the general population is generally low, these young women most probably were involved in cross-generation relationships and had unprotected sex with infected older men (Gregson S *et al.*, 2002). This could be the major reason why young antenatal women have a higher likelihood HIV infection. (Gregson S *et al.*, 2002, Strickler H *et al.*, 1995, Mills Stephen *et al.*, 2005, Fabiani M *et al.*, 2003, Fylkesnes K *et al.*, 1998b) We also noted that the observed parallel HIV declines associated with education in the general population was absent among ANC attendees. Higher educated young women in the general population were postponing pregnancy and the postponement was substantial in a relatively short

period of time. This is likely to be due to a combination of an on-going process of fertility change and as a preventive strategy against HIV transmission. In contrast young ANC women may have ignored messages about abstinence and protection against HIV infection. This differentiating feature between ANC attendees and young women in the general population merits further study and monitoring, especially that the population distribution continues to be highly dynamic.

Therefore, the interpretation of ANC-based HIV prevalence estimates and its extrapolation to the general population, remains a difficult task (Mills Stephen *et al.*, 2005, Strickler H *et al.*, 1995). This is largely because in general, ANC generated prevalence is also vulnerable to several time dependent sources of bias such as usage and coverage of ANC services, migration, deaths, convenience sampling of sites, population distribution by age, differential distribution by social classes, contraceptive use, and fertility differences with HIV negative women including behavioural differences, making generalizability limited (Mills Stephen *et al.*, 2005). In earlier studies, adjusting for fertility risk using data from a reference general population has been shown to improve estimates from ANC attendees (Fabiani M *et al.*, 2003).

In summary, these results have some important implications for the interpretation of ANC-based HIV estimates. They underscore the importance of population-based surveys, and particularly surveys conducted in selected communities in order to improve the interpretation of HIV trends captured by ANC attendees. These surveys should measure biological, behavioural and socio-demographic information concomitantly so as to generate critical knowledge for improving our understanding of dynamics of population responses.

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Authors' Contribution

CM participated in the design of the study, data collection, cleaning and analysis, and was the main author of the manuscript. KF was the main in-charge of the project and participated in the design of the study, data collection, analysis and intellectual content of the manuscript. IF participated in the data analysis, review and writing of the final draft for scientific content, clarity and coherence.

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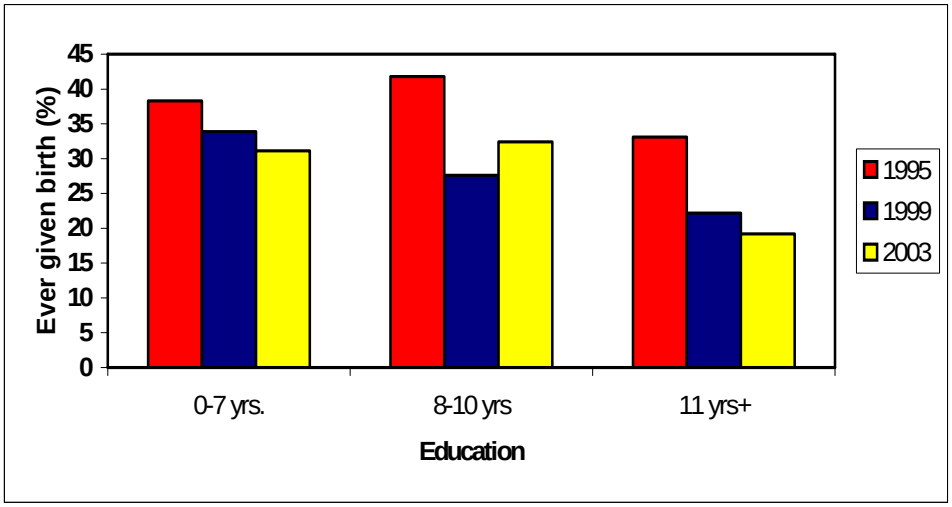
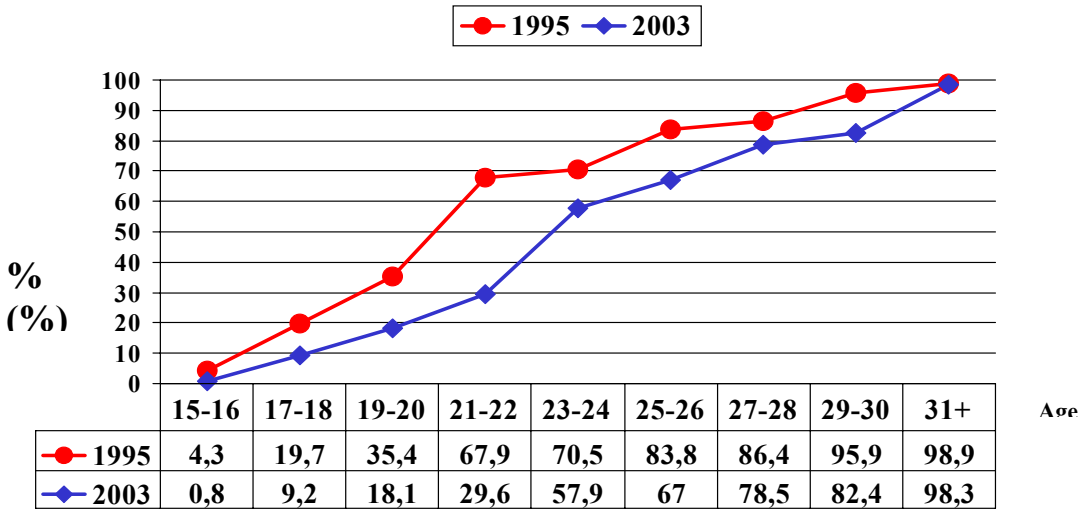
Figure 1: Proportion (percent) of women "ever given birth" by educational level in aged 15-24 years in Chelstone (urban), Zambia.



Notes: 1. Sample sizes n=886, 853 and 1018 in 1995, 1999 and 2003 respectively 2. P value for MH χ^2 for trend: 0-7 school years, P=0.405, 8-10 school years, P=0.289 and for ≥11 school years, P= 0.0001.

Figure 2: Increase in age at first birth (1995-2003) among HIV negative women ever given birth in Chelstone (Lusaka urban), Zambia



	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31+
1995	4,3	19,7	35,4	67,9	70,5	83,8	86,4	95,9	98,9
2003	0,8	9,2	18,1	29,6	57,9	67	78,5	82,4	98,3

Notes: 1.Sample sizes in group aged 15-30 years, n=1511, 1462 and 1994 in 1995, 1999 and 2003 respectively (overall all ages, n=6665) 2. P value for the increase in age at first birth was significant (P<0.05) in all age groups <31 years of age.

Table 1: Age-specific adjusted prevalence differential trends of HIV infection by sex in Chelstone, Lusaka: 1995-2003

Survey type	Time	Age-specific Prevalence [% (95%CI*), n]						
		15-19	20-24	25-29	30-39	40-49	15-24	15-49
ANC Sentinel Surveillance	1994	21.7% (13.7, 29.7) n=106	27.2% (20.2, 34.1) n=162	27.8% (18.9, 37.2) n=90	20.0% (11.3, 28.7) n=85	n=7	25.0%(19.8, 30.2) n=268	24.2% (20.2, 28.2) n=450
	1998	15.1% (10.1, 20.1) n=199	28.4% (23.0, 33.7) n=275	31.9% (24.8, 39.1) n=166	29.4% (21.6, 37.2) n=136	n=10	22.8% (18.9, 26.6) n=474	25.9% (22.9, 28.0) n=786
	2002	9.2%(4.5, 13.8) n=153	25.5%(20.5, 30.5) n=294	28.7%(22.2, 35.3) n=188	33.1%(25.4, 40.9) n=145	n=6	19.9% (16.2, 23.6) n=447	24.3%(21.3, 27.3) n=786
	Trend, P value: 1994-2002	**0.008**	0.611	0.972	**0.042**	--	0.101	0.913
Population Based Surveillance (Females)	1995	12.3% (7.4, 17.1) n=391	35.4% (26.7, 43.9) n=311	48.7% (42.6, 54.9) n=199	34.5% (28.0, 41.0) n=310	26.0% (13.8, 38.2) n=100	22.5% (19.2, 25.8) n=702	29.6% (26.8, 32.4) n=1311
	1999	9.5% (5.5, 13.6) n=336	27.9% (24.3, 31.4) n=305	41.2% (35.6, 46.8) n=221	39.3% (34.9, 43.8) n=244	22.3% (15.9, 28.7) n=112	18.3% (16.3, 20.2) n=641	27.1% (25.2, 28.8) n=1218
	2003	7.7% (4.7, 10.6) n=431	17.6% (13.3, 21.9) n=409	31.1% (26.1, 36.1) n=286	39.6% (33.9, 45.2) n=273	22.9% (17.0, 28.9) n=148	12.5% (9.2, 15.8) n=840	21.7% (19.4, 24.1) n=1547
	Trend, P value: 1995-2003	**0.026**	**<0.001**	**<0.001**	0.202	0.614	**<0.001**	**<0.001**
Population Based Surveillance (Males and Females)	1995	9.1% (5.3, 12.9) n=657	26.7% (19.6, 33.8) n=479	43.1% (37.9, 48.4) n=313	36.3% (31.1, 41.5) n=460	33.9% (25.8, 42.2) n=206	16.5%(13.3, 19.8) n=1136	26.5% (23.9, 28.9) n=2115
	1999	8.2% (5.2, 11.2) n=560	20.1% (17.6, 23.6) n=513	34.8% (29.7, 40.2) n=330	39.3% (34.9, 43.6) n=365	29.9% (24.7, 35.1) n=194	13.9%(12.3, 15.5) n=1073	23.7% (22.3, 25.2) n=1961
	2003	5.4% (3.4, 7.3) n=745	11.8% (9.0, 14.6) n=718	24.7% (21.1, 28.2) n=446	37.9% (31.9, 43.8) n=454	26.5% (17.2, 35.9) n=226	8.5% (6.5, 10.6) n=1463	18.0% (15.3, 20.8) n=2589
	Trend, P value: 1995-2003	**0.007**	**<0.001**	**<0.001**	0.626	0.091	**<0.001**	**<0.001**

Notes: 1. *Confidence Intervals adjusted for clustering effect in the population-based estimates 2.¶ Estimates for age group 15-24 and 15-49 are adjusted for fertility risk and standardised with the Zambia 2000 census of men and women as reference population 3. Chi square for linear trend: all significant P values are highlighted in bold 4. Sample sizes were a) ANC: 450, 786 and 786 in 1994, 1998 and 2002 respectively b) Population-based: 2115, 1961 and 2589 in 1995, 1999 and 2003 respectively

Table 2: Comparing trends of HIV prevalence by years of schooling between antenatal clinic attendees and the general population in (1995-2003) Chelstone

Age	Population	Education	Prevalence, % (n)			§MH χ^2 for linear trend
			Time 1	Time 2	Time 3	Time 1 to 3
15-24	**ANC attendees**	0-7 years	27.2%(53/195)	22.6%(56/248)	20.8%(49/236)	0.118
		8-10years	19.4%(7/36)	21.0%(26/124)	19.2%(23/120)	0.840
		>=11 years	20.0%(4/20)	23.7%(14/59)	18.5%(15/81)	0.634
	PBS (F)	0-7 years	21.5%(59/274)	18.4%(32/174)	20.2%(35/173)	0.664
		8-10years	23.8%(66/277)	20.0%(50/250)	13.8%(33/240)	**0.004**
		>=11 years	20.7%(30/145)	16.1%(35/217)	8.5%(36/423)	**0.000***
	PBS (M+F)	0-7 years	16.8%(64/380)	17.5%(41/234)	15.9%(39/244)	0.802
		8-10years	16.2%(77/476)	14.0%(59/421)	10.0%(44/440)	0.006
		>=11 years	16.1%(44/273)	11.7%(49/418)	5.3%(41/774)	**0.000***
25-49	**ANC attendees**	0-7 years	26.2%(28/107)	34.9%(51/146)	29.8%(45/151)	0.646
		8-10years	14.3%(3/21)	27.4%(20/73)	32.2%(19/59)	0.166
		>=11 years	21.1%(4/19)	27.3%(9/33)	33.8%(25/74)	0.264
	PBS (F)	0-7 years	28.5%(63/221)	26.7%(47/176)	34.6%(55/159)	0.245
		8-10years	41.2%(86/209)	42.4%(86/203)	36.5%(78/214)	0.317
		>=11 years	45.6%(77/169)	39.9%(79/198)	29.0%(96/331)	**0.000***
	PBS (M+F)	0-7 years	30.1%(84/279)	26.5%(56/211)	36.1%(74/205)	0.219
		8-10years	38.8%(116/299)	38.2%(100/262)	34.9%(98/281)	0.327
		>=11 years	43.2%(168/389)	38.6%(160/415)	26.4%(168/637)	**0.000***
15-49	**ANC attendees**	0-7 years	26.8%(84/314)	27.2%(116/426)	24.3%(101/415)	0.423
		8-10years	17.2%(10/58)	22.5%(46/204)	22.9%(44/192)	0.469
		>=11 years	22.0%(9/41)	26.6%(25/94)	26.1%(43/165)	0.707
	PBS (F)	0-7 years	24.7%(122/495)	22.6%(79/350)	27.1%(90/332)	0.504
		8-10years	31.3%(152/486)	30.0%(136/453)	24.5%(111/454)	**0.021**
		>=11 years	34.1%(107/314)	27.5%(114/415)	17.5%(132/754)	**0.000***
	PBS (M+F)	0-7 years	22.5%(148/659)	21.8%(97/445)	25.2%(113/449)	0.344
		8-10years	24.9%(193/775)	23.3%(159/683)	19.7%(142/721)	**0.016**
		>=11 years	32.0%(212/662)	25.1%(209/833)	14.8%(209/1411)	**0.000***

Notes: 1. OR denotes age adjusted odds ratio and significant estimates are shown in bold; cluster effect was controlled for in all confidence intervals in population based data 2. Years: ANC: - 1=1994, 2=1998, 3=2002; PBS: - 1=1995, 2=1999, 3=2003 3. Sample sizes: PBS: - n=2115 in 1995; n= 1961 in 1999; n=2589 in 2003; ANC: - n=450 in 1994; n=786 in 1998; n= 786 in 2002 4. § MH Denotes Mantel-Haenszel chi square for linear trend, (1 degree of freedom and with continuity correction): a) Statistically significant P values are highlighted in bold b) *signifies P<0.001

Table 3: Population based declining trend in the proportion of women ever given birth in Chelstone (urban), Zambia: 1995-2003

Age	Proportion of women ever given birth in respective periods			P value (trend)
	1995	1999	2003	
	%(n)	%(n)	%(n);$^{\Psi}$OR 95%CI	
15-19	16.8% (382)	9.4% (330)	7.9% (355); 0.43 95%CI 0.26-0.68	<0.001
20-24	65.5% (310)	47.5% (299)	41.7% (384); 0.38 95%CI 0.28-0.51	<0.001
25-29	85.4% (198)	83.9% (218)	74.8% (282); 0.51 95%CI 0.32-0.82	0.003
30-39	95.2% (310)	95.0% (242)	94.5% (273); 0.38 95%CI 0.28-0.51	0.722

Notes: 1. Sample sizes: n=1100, 1089 and 1294 in 1995, 1999 and 2003 respectively 2. $^{\Psi}$OR denotes odds ratio for the proportions in 2003 using the proportions in 1995 as a reference category**.**

Annex 1:

QUESTIONNAIRE: FOLLOW-UP PBS SURVEY 2003

1. Cluster identification:

☐☐ ☐ ☐

CSA SEA Rural/Urban

2. Housing identification:

☐☐☐ ☐ ☐

Building Unit Household

3. Personal number: ☐☐

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4. AGE ☐☐
5. SEX (Male=1, Female=2) ☐
6. What is your mother Language? (1=Bemba, 2= Kaonde, 3=Lozi, 4=Lunda, 5=Luvale, 6=Nyanja, 7=Tonga, 8=other) ☐
7. For how long have you been living continuously in this household? (if less than 1 year, code 0, else years) ☐☐
8. Just before you moved here, did you live in a 1=Village, or 2=Lusaka, or 3=other city or town? ☐
9. Marital status: Are you now (1)Single, never married, (2) Single but engaged, (3) Living as married, (4) Married, (5)Widowed, (6) Separated/div. ☐

<u>If single, never married, skip to Q 14</u>

10.For how long have you been married to this person? (if less than 1 year, code 0, else years) ☐☐
11. How old is this person (spouse)? ☐☐
12. How old were you when you first got married? ☐☐

13. Now think back to the past. Apart from this spouse, how many have you been married to/living with in your whole life? ☐

14. For how many years did you go to school? ☐☐

15. What is your highest level of education completed? (1=Never attended, 2=Grade 1-4, 3=Grade 5-7, 4=Grade 8-9, 5=Grade 10-12, 6=Higher) ☐

16. Are you still in school? ☐

Score for all yes/no Qs: Yes=1, No=2

17. Are you employed at present? (1=Unemployed, 2=Unpaid family worker, 3=Self employed, 4=Employee, 5=Employer) ☐

Does your household have

18. Electricity? ☐
19. A radio? ☐
20. A refrigerator? ☐
21. A bicycle? ☐
22. A plough? ☐
23. A donkey? ☐

24. What is your religion? (1=None, 2=Catholic, 3=Liberal protestant, 4=Strict protestant, 5=Muslim, 6=other) ☐

25. Have you during the past years been on regular trips where you have to stay away from home for several days or more? (1=Never, 2=Sometimes, 3=Often, 4=Very often) ☐

26. How would you say your health is at the moment? Is it (1 =) Very poor, (2 =) Poor, (3 =) Fair, (4=) Good, (5 =) Excellent ☐

During the last one year, how many times did you visit

27. a traditional healer? ☐☐
28. a spiritual healer? ☐☐
29. private doctor/clinic? ☐☐
30. the local health centre? ☐☐
31. the hospital? ☐☐
32. How many times were you admitted in hospital during the last one year? ☐☐
33. If ever admitted in hospital, did you ever receive blood (transfusion)? ☐
34. Are you on any type of medication? (1=No, 2=Traditional, 3=Professional) ☐

During the last one year, did you suffer from

35. Malaria ☐
36. TB ☐

37. Any STD (sexually transmitted disease) ☐

Now I will ask you some few questions related to certain pains and problems, that might have bothered you the last 30 days. If you think the question applies to you and you have had the problem in the last 30 days, answer Yes. If not, answer No.

(Codes: Yes=1, No=2, Don't know=3)

38. Do you sleep badly? ☐
39. Do you cry more than usual? ☐
40. Do you find it difficult to enjoy your daily activities? ☐
41. Do you find it difficult to make decisions? ☐
42. Is your daily life suffering? ☐
43. Are you unable to play a useful part in life? ☐
44. Has the thought of ending your life been on your mind? ☐
45. Do you feel tired all the time? ☐
46. Do you often have headaches? ☐
47. Is your digestion poor? ☐

Do you agree or disagree with the following statements?: (Read and obtain a response for each statement: Code 1 when Agreeing, 2 when Disagreeing).

48. Condoms are safe preventing HIV/AIDS ☐
49. Most women don't like men to use condoms ☐
50. Condoms are embarrassing to obtain ☐
51. Using condoms shows responsibility ☐
52. Most men do not like using condoms ☐
53. Condoms are too expensive ☐
54. Using condoms is against my religion ☐

55. Have you ever had sexual relations? ☐

If no, skip to Q 67

56. At what age did you first have sex? ☐☐
57. Have you had sex the last 12 months? ☐
58. Have you ever used a condom? ☐
59. Did you use a condom last time you had sex? ☐

60. Is it easy to get a condom when needed? ☐
61. Did you have a regular sex partner during the last 12 months? ☐
62. Did you have sex with anyone else apart from your regular sex partner last year? ☐
63. If yes on Q62: Approximately how old ☐☐

was the last casual sex partner?

64. Did you use a condom when you last had sex with a casual partner? ☐

65. With how many different people have you had sex in the last 12 months? (include spouse) ☐☐

66. How many different people have you had sex with in your life? ☐☐

67. Have you ever contracted any STD? ☐

If no, skip to Q 69

68. Did you tell your partner? ☐

Do you agree or disagree with the following statements: (Read and obtain a response for each statement, code 1 when Agreeing, 2 when Disagreeing)

69. I have less sexual partners at present compared to some years ago ☐

70. My friends have not changed their sexual behaviour despite the AIDS risk ☐

71. Some years ago I did not use condoms ☐

72. Most of my friends never use condoms ☐

73. I always use a condom nowadays ☐

74. In your situation, do you think that you are at risk of getting (catching) HIV?
Would you say that
1= You are not at risk, or
2= the risk is moderate, or
3= the risk is high, or
4= the risk is very high ☐

75. How worried are you about actually being infected by HIV/AIDS?
1= Always worried, or
2= Sometimes worried, or
3= Seldom worried, or
4= Never worried ☐

Now I will ask you some hypothetical questions

76. If a member of your family became sick with the HIV/AIDS virus, would You be willing to care for him or her in your household? ☐

77. If you knew that a shopkeeper or food seller had the HIV/AIDS virus, would you buy fresh vegetables from him? ☐

78. If a female teacher has the HIV/AIDS virus but is not sick, should she be allowed to continue teaching in school? ☐

79. If a member of your family became infected with the AIDS virus, would you want it to remain a secret? ☐

MALES ONLY:

80. Have you been circumcised? ☐
81. How many wives do you have? ☐
FEMALES ONLY: ☐
82. Have you ever given birth? ☐
83. Are you pregnant at present? ☐
If not given birth, skip to 91
84. How many have you given ☐☐
birth to all in all?
85. How long is it since you last ☐☐
gave birth?
(if less than 1 year, code 0, else years)
86. Do you want another child? ☐
87. How did the last pregnancy end? ☐
(1=live, 2=still, 3=abortion)
88. Did you visit any antenatal
care services during last pregnancy?
1= No; 2= Yes, traditional practitioner or midwife
3= Yes, clinic/hospital ☐
4= Yes, Private clinic
89. Have any of your children died
before the age of one? ☐
Code the number, if none, score 0.

90. Have any of your children died ☐
before the age of 5?
Code the number, if none score 0.
91. Do you use any of the following contraceptive methods currently?
(mention all)
1=Pill; 2=Injections; 3=IUD; 4=Condom; 5=Natural; 6=Traditional; 7=Any other; ☐
8=None
92. Have you ever used a condom ☐
as your contraceptive method?

93. Does your husband have other ☐
wives?

94. Do you often use traditional agents
like herbs or other agents for self-
treatment when experiencing vaginal discharge or itching?
(1=Most often, 2=Sometimes, 3=Never) ☐

95. Do you often use traditional agents
like herbs or a cloth before having sex? ☐
(1=most often, 2=sometimes, 3=never)

96. Is your usual (regular) male ☐
partner circumcised?
Yes=1,No=2, don't know=3

Do you agree or disagree with the following statement: 1=agree, 2=disagree

97. If my husband had a STD, I could either refuse to have sex with him or I would get him to use a condom? ☐

ALL RESPONDENTS

Inform on saliva samples; anonymity, consent; and on the voluntary option of being counselled and tested

98. Have you ever been HIV tested? ☐

99. If tested: Did you receive the test result? ☐

100. Would you like us to arrange for you to be HIV tested? ☐

101. Attendance
1=Completed (both interview and saliva)
2=Refused saliva
3=Refused interview
4=Refused both interview and saliva
5=Not found ☐

102. Number of interviewer ☐

103. Date: day:..... /month...../year.....

Annex 2: Population- based follow-up survey 2003

Invitation to see a counsellor

Dear participant,

This is a letter of invitation to see one of the two counsellors we have made available for participants in this survey. Their names are Mrs Eurita M Phiri and Ms Fatima C. Tembo. You should feel free to discuss any kind of personal issue with them. If you consider to go for voluntary HIV counselling and testing (VCT), the counsellor will arrange for that.

Whatever information is shared this will be strictly between you and the counsellor. The counsellor will be able to inform and guide you about how to get support and care if this should be needed

We have learned from similar surveys that some will like to see the counsellor at home, other prefer to go to the VCT centre at the local clinic. Therefor, you should feel free to decide yourself where to receive these services. Just indicate your preferences to the person who gives this letter to you – and he or she will guide you further.

Any services offered you by the counsellors will be free of charge.

Please present this letter to your counsellor if deciding to use the VCT centre at Chelston clinic.

Good luck.

HHN ☐☐☐ ☐☐☐ ☐☐☐ ☐☐

Annex 3: Letter of Introduction

Zam Core EPI 3000: Population-based follow-up survey 2003

Dear participant,

This is part of a program carried out by the **School of Medicine, University of Zambia and the Central Statistical** Office. The program staff is here to ask you, and also 6000 other Zambians from different parts of the country, to provide them with some information. This information is needed in order to strengthen the fight against infectious diseases including HIV. The way you can help is simply by spending some time answering questions. Most of them are simple, but some are very personal ones. The information you give will be kept between you and the interviewer. Indeed, everything will be arranged in such a way that your answers are not to be known by anyone else, just for the purpose of research. The information you provide will be put together with the information coming from the other 6000 being invited to answer the same questions. Researchers will then analyse this information in order to learn more about how to reduce the spread of HIV and other infectious diseases.

After the interview you will be asked if you will provide a specimen of your saliva. This will take only about 2 minutes. Your saliva can be used for testing for HIV, but the test result will be anonymous and thus only for research purposes. However, if you will like to know your HIV-status, you will be given the opportunity to see one of the well trained counsellors who are part of our team. Any personal matter can be discussed with the counsellor. Also, if you decide to go for voluntary HIV counselling and testing (VCT), the same counsellor will also take care of that and also inform and guide you about how to receive support and care if this should be needed. Whatever information is shared this will be strictly between you and the counsellor. You will not be charged anything from us.

Voluntary participation: You can have this information form for keep, and you will also be asked to sign a consent form. Your participation is very important for the program, but participation is voluntary which means that it is totally up to you to decide.

Who can you contact if more information is needed?

If you have questions about this program please contact either of the following:

1. Dr Seter Siziya, Head, Department of Community Medicine, School of Medicine, University of Zambia , Telephone 252641.
2. Mr Kumbutso Dzekedzeke, Principal Statistician, Central Statistical Office, Lusaka.
   Telephone 255740/251377