# Using prevalence data from the programme for the prevention of mother-to-child-transmission for HIV-1 surveillance in North Uganda

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**Objectives:** To validate the use of data from a programme for the prevention of mother-to-child transmission (PMTCT) in estimating HIV-1 prevalence in North Uganda.

**Methods:** The study was conducted at St. Mary's Hospital Lacor. We compared the estimated prevalence for 3580 attendees at the antenatal clinic who were selected for anonymous surveillance to that for 6785 pregnant women who agreed to undergo voluntary counselling and testing (VCT) for enrolment in the PMTCT programme. Log-binomial regression models were used to identify the factors associated with both VCT uptake and HIV-1 infection, which could bias the prevalence estimates based on PMTCT data.

**Results:** In 2001–2003, the age-standardized prevalence was similar (11.1% in the anonymous surveillance group and 10.9% in the VCT group). The estimates were also similar when compared for each year tested. Analogously, no important differences were observed in age-specific prevalence. Of the factors associated with HIV-1 infection, only time of residence at current address [prevalence proportion ratio (PPR) = 1.05; 95% confidence interval (CI), 1.00–1.10], marital status (PPR = 1.05; 95% CI, 1.01–1.10) and partner's occupation (PPR = 1.05; 95% CI, 1.01–1.10) were associated with VCT uptake, yet the associations were weak.

**Conclusions:** The prevalence estimated based on the VCT data collected as part of the PMTCT programme could be used for HIV-1 surveillance in North Uganda. At the national level, however, it needs to be evaluated whether PMTCT data could replace, or instead be combined with, the data from sentinel surveillance.



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## Introduction

In sub-Saharan Africa, the necessary resources for conducting HIV-1 incidence studies are often not available and the epidemic is commonly monitored by conducting anonymous sentinel surveillance among pregnant women attending antenatal clinics (ANC) [1]. Although the trend of HIV-1 prevalence does not provide

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a completely accurate description of the dynamics of the infection, it remains an important indicator for planning and evaluating public health interventions. In this region, where heterosexual intercourse is the main mode of HIV transmission [2], although estimates of HIV-1 prevalence derived from anonymous surveillance in ANCs are likely to underestimate the prevalence among the general female population of reproductive age [3,4], the prevalence of infection among ANC attendees is usually assumed to be representative of that among the general population (males and females combined) and is thus used to estimate national prevalence [5,6].

In recent years, the increased availability of effective and sustainable short-course drug regimens for the prevention of mother-to-child-transmission (PMTCT) of HIV-1 infection has allowed many sub-Saharan countries to implement national PMTCT programmes [7–10], which include, as the first step, voluntary counselling and testing (VCT) for HIV-1 among pregnant women attending ANCs.

In certain areas, both HIV-1 surveillance among ANC attendees and a PMTCT programme exist. Since the prevalence data from these sources may be overlapping, HIV-1 surveillance among ANC attendees may be unnecessary. However, if HIV-1 surveillance among ANC attendees is to be discontinued, it must first be ensured that the estimates of HIV-prevalence based on the two data sources are equivalent.

In Uganda, a national HIV-1 sentinel surveillance system has existed for more than 15 years and currently involves 19 ANCs located in 18 of the country's 56 districts [11]. There also exists a national PMTCT programme, which was created by the Ugandan Ministry of Health in 2000 and which currently involves health facilities in 35 districts [12].

The objective of the present study was to evaluate whether the HIV-1 prevalence estimated using data from the PMTCT programme in the Gulu District of North Uganda is consistent with that using data from the anonymous HIV-1 surveillance among ANC attendees and to identify factors potentially associated with VCT uptake that could bias HIV-1 prevalence estimates.

## Material and methods

The study was carried out at the ANC of St. Mary's Hospital Lacor, which is located in the Gulu District of North Uganda. Gulu district borders on Sudan, and approximately 75% of its population lives in rural areas [13]. The hospital has participated in the national HIV-1 sentinel surveillance system since 1993 and in the national PMTCT programme since late 2000.

In the period from 2001 to 2003, a total of 14 040 pregnant women living in the Gulu District attended the ANC of St. Mary's Hospital Lacor for their first pregnancy-related visit. Information on socio-demographic characteristics and reproductive history was collected through a questionnaire administered by specifically trained midwives. For an age-stratified random sample of 3580 of these women, left-over serum samples from the routine syphilis test were anonymously tested for HIV-1 surveillance after having removed any possible identifier. As recommended in the guidelines for second generation HIV surveillance developed by the Joint United Nations Programme on HIV/AIDS (UNAIDS) and the World Health Organization (WHO), the sera tested for HIV-1 infection were over-sampled from women aged 15–24 years, among whom changes in prevalence more closely reflect changes in incidence [14].

In the same period, of the 14 040 first-time ANC attendees, 1841 did not return for a second visit (i.e., when VCT was offered); of the remaining 12 199 women, 6785 agreed to be tested for HIV-1 infection as the first step in enrolling in the PMTCT programme (5414 women refused).

We compared the overall and age-specific HIV-1 prevalence among pregnant women selected for anonymous HIV-1 surveillance and among those who participated in VCT, both for the overall study period and separately for each year. The overall HIV-1 prevalence rates were calculated by directly standardizing by age, using as reference the distribution of all ANC attendees in the corresponding time period. Log-binomial regression models were used to evaluate the factors that could introduce a participation bias when VCT data are used to estimate the HIV-1 prevalence (i.e., factors associated with both VCT uptake among all ANC attendees and testing HIV-1 positive in the group of women selected for anonymous HIV-1 surveillance). The adjusted prevalence proportion ratios (PPR) and their 95% confidence intervals (CI) were used to describe the strength of the associations. We used log-binomial regression rather than logistic regression because the odds ratios derived from logistic regression greatly overestimate the risk ratios when the outcome variable is not a rare event (i.e., frequency higher than 10%) [15,16].

## Results

The HIV-1 prevalence among the women who underwent anonymous surveillance and those who underwent VCT are shown in Table 1, by age group and year of testing. The age-standardized HIV-1 prevalence was similar for the two groups both when considering the

**Table 1. HIV-1 prevalence by age group and year among pregnant women selected for anonymous surveillance (AS) and among those who accepted voluntary counselling and testing (VCT) at the antenatal clinic of St. Mary's Hospital Lacor (Gulu District, North Uganda, 2001–2003).**

| | 2001 | | 2002 | | 2003 | | Overall | |
|---|---|---|---|---|---|---|---|---|
| Age group | AS | VCT | AS | VCT | AS | VCT | AS | VCT |
| < 20 years | 6.1 (293) | 7.8 (567) | 5.5 (271) | 6.7 (436) | 5.6 (430) | 5.6 (479) | 5.7 (994) | 6.7 (1482) |
| 20–24 years | 11.3 (301) | 11.0 (708) | 11.2 (339) | 11.3 (779) | 8.6 (487) | 8.0 (865) | 10.1 (1127) | 10.0 (2352) |
| 25–29 years | 18.1 (144) | 15.7 (540) | 15.6 (192) | 14.3 (523) | 15.4 (241) | 13.5 (570) | 16.1 (577) | 14.5 (1633) |
| ≥ 30 years | 9.9 (243) | 12.1 (387) | 14.3 (259) | 13.9 (346) | 12.9 (380) | 12.6 (585) | 12.5 (882) | 12.8 (1318) |
| Overall[a] | 11.4 (981) | 11.5 (2202) | 11.7 (1061) | 11.5 (2084) | 10.6 (1538) | 9.9 (2499) | 11.1 (3580) | 10.9 (6785) |

[a]HIV-1 prevalence rates directly standardized by age using the distribution of all antenatal clinic attendees as reference. Values are HIV-1 prevalence percentage (number of women tested).

entire study period (11.1% among women selected for anonymous surveillance and 10.9% among those who underwent VCT) and when considering individual years, with the highest relative difference in 2003 (10.6% in the surveillance group and 9.9% in the VCT group). The age-specific prevalence rates for the entire study period were also similar; the greatest difference was observed for women less than 20 years of age, among whom the prevalence was 1.18 times higher in the VCT group (6.7 versus 5.7% in the anonymous surveillance group).

Among the 14 040 ANC attendees, the VCT uptake rate was 48.3%, with a slight increase in the annual rate during the study period (from 45.8% in 2001 to 48.2% in 2003). Women residing in urban areas (PPR = 1.06; 95% CI, 1.02–1.11), those who have been residing at their current address for 2 years or less (PPR = 1.05; 95% CI, 1.00–1.10), those with no more than 7 years of education (PPR = 1.06;, 95% CI, 1.01–1.14), those who were cohabitating but not married (PPR = 1.05; 95% CI, 1.01–1.10), and those whose partner had a 'modern' occupation (PPR = 1.05; 95% CI, 1.01–1.10) were more likely to undergo VCT (Table 2). Of these factors, only time of residence at current address (PPR = 1.35; 95% CI, 1.09–1.67), marital status (PPR = 1.39; 95% CI, 1.13–1.71), and partner's occupation (PPR = 2.08; 95% CI, 1.63–2.65) were also associated with being HIV-1 positive in the group of pregnant women selected for anonymous HIV-1 surveillance.

## Discussion

The results of this study show that, in the Gulu District of North Uganda, the estimated overall HIV-1 prevalence based on VCT data is similar to that based on anonymous surveillance and that the age-specific differences were small and did not greatly affect the estimates for the entire study period or for the individual years considered. These findings are consistent with those of the few recent studies on this topic [17,18].

In actually deciding whether or not data from a PMTCT programme can be used as a substitute for data from anonymous surveillance in estimating HIV-1 prevalence, potential biases should be taken into consideration. In our study, a participation bias may have been introduced by the fact that VCT uptake was low (48.3%) and that some of the factors associated with it (i.e., time of residence at current address, marital status and partner's occupation) were associated with being HIV-1 positive. However, the associations between these factors and VCT uptake, although statistically significant, were quite weak and probably did not greatly affect the prevalence estimates. Although other factors that were not investigated in this study could be strongly associated with VCT uptake (e.g. accessibility of the clinic, relationship with staff, etc.), the results suggest that these factors were probably not significantly associated with HIV-1 infection and did not lead to biased prevalence estimates. It should also be noted that, in this study, data from anonymous surveillance was not linkable to data from VCT; thus we were not able to directly evaluate the association between HIV-infection and VCT uptake in a more accurate manner.

It should also be mentioned that in Uganda there has been some concern over whether or not the national-level prevalence estimates based on the HIV-1 sentinel surveillance system can be considered as representative, especially considering that rural sites are under-represented [19]. In this system, 18 districts are represented, whereas the national PMTCT programme is currently implemented in 35 districts [12], 23 of which are not included in the national surveillance system. By integrating the data provided by the national surveillance system with those from the PMTCT programme in these 23 sites, nearly 75% of Uganda's districts would be represented.

In light of these results, in the specific site evaluated in this study, the prevalence of HIV-1 infection could be estimated based on data provided by the PMTCT programme instead of using data from anonymous sentinel surveillance among ANC attendees. This would reduce costs and the workload in the ANC, and the additional available resources could be used, for example, to improve access to the PMTCT programme. At the

**Table 2. Factors associated with having tested HIV-1 positive in the group of women selected for anonymous surveillance and with the uptake of voluntary counselling and testing (VCT) among all attendees of the antenatal clinic of St. Mary's Hospital Lacor (Gulu District, North Uganda, 2001–2003).**

| | HIV-1 infection ($n = 3580$) | | VCT acceptance ($n = 14\,040$) | |
|---|---|---|---|---|
| | Adjusted PPR[a] (95% CI) | *P*-value | Adjusted PPR[a] (95% CI) | *P*-value |
| Age group | | | | |
| < 20 years | 1 | | 1 | |
| 20–24 years | 1.56 (1.09–2.23) | 0.014 | 1.04 (0.98–1.10) | 0.241 |
| 25–29 years | 2.65 (1.81–3.88) | < 0.001 | 1.00 (0.93–1.07) | 0.937 |
| ≥ 30 years | 2.36 (1.60–3.48) | < 0.001 | 1.03 (0.96–1.11) | 0.350 |
| Residence | | | | |
| Rural | 1 | | 1 | |
| Urban | 1.13 (0.91–1.42) | 0.268 | 1.06 (1.02–1.11) | 0.007 |
| Residence at current address | | | | |
| > 2 years | 1 | | 1 | |
| ≤ 2 years | 1.35 (1.09–1.67) | 0.007 | 1.05 (1.00–1.10) | 0.053 |
| Level of education | | | | |
| ≤ 7 years | 1 | | 1 | |
| > 7 years | 1.18 (0.92–1.51) | 0.205 | 0.94 (0.88–0.99) | 0.022 |
| Occupation[b] | | | | |
| Traditional | 1 | | 1 | |
| Modern | 1.02 (0.78–1.35) | 0.872 | 1.01 (0.95–1.07) | 0.808 |
| Marital status | | | | |
| Married | 1 | | 1 | |
| Cohabitating | 1.39 (1.13–1.71) | 0.002 | 1.05 (1.01–1.10) | 0.008 |
| Single/divorced/widowed | 1.90 (1.33–2.72) | < 0.001 | 1.08 (0.99–1.16) | 0.069 |
| Occupation of partner[b] | | | | |
| Traditional | 1 | | 1 | |
| Modern | 2.08 (1.63–2.65) | < 0.001 | 1.05 (1.01–1.10) | 0.018 |
| Parity | | | | |
| Primipara | 1 | | 1 | |
| Multipara | 1.45 (1.04–2.02) | 0.029 | 1.02 (0.96–1.08) | 0.462 |

[a]Prevalence proportions ratios (PPRs) adjusted for all the variables listed in the Table.
[b]Traditional occupation: agricultural worker and housewife; modern occupation: clerk, business woman/man, professional, soldier, student and other. CI, confidence interval.

national level, however, additional studies will be needed to evaluate whether data from PMTCT programmes could replace, or instead be combined with, the data provided by sentinel surveillance, especially in settings where VCT uptake among pregnant women is low and, as a consequence, the potential risk of participation bias is high.

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