Mother-to-Child Transmission of HIV in Kenya: Results From a Nationally Representative Study

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Background: Kenya has an estimated 13,000 new infant HIV infections that occur annually. We measured the burden of HIV infection among women of childbearing age and assessed access to and coverage of key prevention of mother-to-child transmission interventions.

Methods: The second Kenya AIDS Indicator Survey was a nationally representative 2-stage cluster sample of households. We analyzed data from women aged 15–54 years who had delivered a newborn within the preceding 5 years and from whom we obtained samples for HIV testing.

Results: Of 3310 women who had ≥1 live birth in the preceding 5 years, 2862 (86.5%) consented to HIV testing in the survey, and 171 (6.1%) were found to be infected. Ninety-five percent received prenatal care, 93.1% were screened for HIV during prenatal care, and of those screened, 97.8% received their test results. Seventy-six women were known to be infected in their last pregnancy. Of these, 54 (72.3%) received antepartum antiretroviral prophylaxis, and 51 (69.1%) received intrapartum prophylaxis; 56 (75.3%) reported their newborns received postpartum prophylaxis. Of the 76 children born to these mothers, 63 (82.5%) were tested for HIV at the first immunization visit or thereafter, and 8 (15.1%) were HIV infected.

Conclusions: We found a substantial burden of HIV in Kenyan women of childbearing age and a cumulative 5-year mother-to-child transmission rate of 15%. Although screening has improved over the past 5 years, fewer than three-quarters of infected pregnant women are receiving antiretroviral prophylaxis. Universal antiretroviral therapy for HIV-infected pregnant women will be essential in achieving Kenyan's target to eliminate mother-to-child transmission to <5% by 2015.

Key Words: HIV, pediatric HIV infection, population-based survey, Kenya, pregnant women, transmission

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INTRODUCTION

In 2011, an estimated 330,000 children became newly infected with HIV worldwide.[1] Over 90% of these infections were acquired through mother-to-child transmission (MTCT), and more than 90% of these occurred in sub-Saharan Africa.[1,2] Worldwide, HIV accounts for 1.5% of all deaths in infants younger than 12 months of age and 4.9% of deaths in 1- to 4-year-old children.[3] Kenya is among the 22 countries that collectively account for 90% of all pregnant women living with HIV. The country accounts for 4% of all new pediatric HIV infections globally and 7% of all child deaths, and each year an estimated 13,000 new HIV infections occur among Kenyan children.[4] Kenya has subscribed to the *Global Plan Towards the Elimination of New HIV Infections Among Children by 2015 and Keeping Their Mothers Alive*, which seeks to reduce MTCT to below 5% by 2015 and prevent mothers from dying.[5] For these goals to be realized, more than 90% of HIV-infected women need to be identified through screening and receive antiretroviral drugs and other interventions for prevention of MTCT (PMTCT).

MTCT can occur during pregnancy, labor and delivery or post-natally through breastfeeding. The risk of MTCT can be reduced to <5% using a comprehensive PMTCT strategy.[6]

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In 2012, Kenya launched a plan for elimination of MTCT which involved the Joint United Nations Programme on HIV/AIDS (UNAIDS) 4-pronged strategy that includes (1) providing HIV prevention services for women of reproductive age with reproductive health services; (2) opt-out HIV testing during pregnancy and, for HIV-infected pregnant women, access to antiretroviral prophylaxis during pregnancy and the immediate postpartum period, safe delivery methods, antiretroviral prophylaxis for infants during breastfeeding, and promotion of exclusive, rather than mixed, breastfeeding; (3) provision of contraceptives to women living with HIV for family planning; and (4) provision of treatment, care, and support for women and children living with HIV infection and their families.[5] Coverage of HIV testing among pregnant women in Kenya is now above 80%, but the incidence of MTCT at 18 months of age was estimated to be as high as 15% in 2011.[7,8] In the absence of complete longitudinal follow-up data for HIV-exposed children, HIV incidence in infants attributable to MTCT has only been inferred from early infant diagnosis at the first immunization visit or from cohort data at a few selected sites.[9] As part of the strategy to reduce MTCT to $<5\%$ by 2015 and reduce HIV-related maternal mortality, Kenya is in the process of adopting the World Health Organization's recommendation of providing lifelong antiretroviral therapy (ART) for HIV-infected pregnant and breastfeeding women.[10]

In 2012, PMTCT programs were available in 4622 sites, representing 95% of all medical facilities that offered prenatal or obstetrical care in the country [Personal communication, National AIDS and Sexually Transmitted Infection Control Programme (NASCOP), Kenya Ministry of Health, June 27, 2013]. With the expansion of PMTCT, there is need for a more comprehensive examination of the impact of PMTCT on perinatal transmission. We evaluated data collected from the second Kenya AIDS Indicator Survey (KAIS 2012) to understand access to, coverage of, and impact of interventions for PMTCT for HIV-infected mothers.

METHODS

Study Design

We conducted a national population-based cross-sectional household survey in 9 of 10 NASCOP programmatic regions of Kenya from October 2012 to February 2013. Details of the survey design and execution are presented elsewhere.[11] Briefly, we used a 2-stage cluster sampling design; in the first stage, we selected geographical clusters from Kenya National Bureau of Statistics' household-based sampling frame using systematic random sampling, and in the second stage households were randomly selected from the chosen clusters. Eligible households were invited to participate in the survey. In this article, we present data obtained from interviews with female respondents who had delivered live-born children within the 5 years preceding the survey.

Study Population

We interviewed all women residing in an eligible household who were aged 15–54 years and who had 1 or more live births within the 5 years preceding the survey. We also obtained blood samples from consenting women for HIV testing at the National HIV Reference Laboratory (NHRL) in Nairobi.

Measures

We obtained verbal informed consent for survey procedures before the interview. Trained research assistants administered a structured questionnaire in English, Kiswahili, or other local languages where necessary. The questionnaire covered multiple domains, including sociodemographic characteristics, parity and place of delivery, antenatal care (ANC) clinic visits, and history of HIV testing. For those who self-reported that they were infected with HIV, we asked additional questions regarding use of ART for their own health, antiretroviral prophylaxis use by the mother and her infant, breastfeeding behavior, and family planning practices. These women were also asked whether their infants had been tested for HIV at their first immunization visit or thereafter and, if tested, the HIV test result. We recorded all information on portable laptop computers (Mirus Innovations, Mississauga, Ontario, Canada).

Laboratory Testing

Blood specimens were tested for HIV antibody at NHRL using Vironstika HIV-1/2 Enzyme Immunoassay (BioMerieux, Marcy l'Etoile, France) as the screening assay and Murex HIV.1.2.0 Enzyme Immunoassay (DiaSorin, SpA, Saluggia, Italy) as the confirmatory assay. Specimens that tested HIV-negative by the screening assay were classified as HIV-negative. Specimens that tested HIV-positive by the screening assay were tested by the confirmatory assay, and, if they tested positive on the confirmatory assay, they were classified as HIV-positive. Specimens that were discordant on the screening and confirmatory assays were re-tested using the same testing algorithm. If results remained discrepant, polymerase chain reaction (Cobas Amplicor HIV-1 Monitor Test, version 1.5; Roche Molecular Diagnostics, Pleasanton, CA) was used to determine the final result.

Data Analysis

We assessed both access to and coverage of PMTCT interventions at ANC clinics. We defined access as the proportion of women who self-reported that they had been diagnosed with HIV during or before the last pregnancy and who reported that they or their infants had received antiretroviral prophylaxis or ART. We excluded from the analysis women who reported a previous diagnosis of HIV infection but were found to be HIV-negative by laboratory testing in the survey (N = 8). Women who reported a previous diagnosis of HIV infection but did not consent to a blood sample were included in the analysis (N = 8). We defined coverage as the proportion of women that tested positive for HIV in KAIS 2012, regardless of whether they knew that they were infected or not, who themselves or their infants had received any antiretroviral prophylaxis or ART. We conducted a subanalysis of women who reported the birth of the child within the 2 years

preceding the survey to better approximate the HIV status of the woman at the time of her last pregnancy.

We analyzed data from respondents using survey procedures in SAS version 9.3 (SAS Institute, Cary, NC). To minimize recall bias, we restricted our analysis to information about the most recent reported birth. We weighted estimates to account for the survey's cluster design and calculated population proportions and 95% confidence intervals (CI). Statistical significance in cross tabulations was assessed based on Rao–Scott χ^2 P values.

Ethical Considerations

Adult participants aged 18 years and older consented separately for the interview, blood draw, and HIV testing. Minors aged 15–17 years provided assent for these procedures with parental or guardian consent unless they were pregnant, married, or parents, in which case they were allowed to provide consent as adults for participation. HIV test results from the laboratory were merged with the survey database using a unique study identification number. The KAIS 2012 protocol was approved by the Ethics and Research Committee of the Kenya Medical Research Institute (KEMRI), the Institutional Review board of the U.S. Centers for Disease Control and Prevention (CDC), and the Committee on Human Research of the University of California, San Francisco (UCSF).

RESULTS

We identified 8301 potentially eligible women between the ages of 15 and 54 years, and 7429 (89.4%) were interviewed. Of these women, 3310 (44.5%) reported they had at least 1 live birth in the 5 years preceding the survey and provided interview information about their last birth. The median age of women interviewed was 27 years (interquartile range, 23–33 years). The majority (83.2%, 95% CI: 81.6 to 84.7) of women were either married or cohabiting with a partner, and 90.7% (95% CI: 89.0 to 92.4) were in a monogamous relationship (Table 1). About half (47.1%, 95% CI: 44.4 to 49.8) had completed secondary education or higher, 29.1% (95% CI: 26.0 to 32.2) resided in the Rift Valley region, and 65.1% (95% CI: 62.2 to 68.0) lived in rural settings.

Of the 3310 participants who had had at least 1 live birth in the previous 5 years, 2862 (86.5%) consented to having a blood sample collected for HIV testing in a laboratory (Table 2). The HIV prevalence for these women was 6.1% (95% CI: 4.9 to 7.4), which was lower than women aged 15–54 years who did not have a live birth (7.9%, 95% CI: 6.7 to 9.0) ($\chi^2 = 4.4$, $P = 0.03$, $df = 1$). HIV prevalence increased significantly with older age group ($\chi^2 = 9.0$, $P = 0.03$, $df = 3$) and was significantly higher among widowed respondents at 23.6% (95% CI: 9.3 to 37.9) compared with other marital categories ($\chi^2 = 31.5$, $P < 0.0001$, $df = 3$). Women who had no formal education had significantly lower prevalence (1.3%, 95% CI: 0.1 to 2.6) than women with higher education levels ($\chi^2 = 9.8$, $P = 0.02$, $df = 3$). Women living in Nyanza region had significantly higher prevalence at 18.5% (95% CI: 12.2 to 24.9) than women living in other regions ($\chi^2 = 102.7$, $P < 0.0001$, $df = 8$). HIV prevalence was similar by rural/urban residential settings ($\chi^2 = 0.64$, $P = 0.42$, $df = 1$), but significantly higher among women who did not want more children in the future (8.7%, 95% CI: 6.6 to 10.8) compared with women who desired more children (4.0%, 95% CI: 2.7 to 5.2) or were unsure (2.0%, 95% CI: 0.2 to 3.8) ($\chi^2 = 28.8$, $P = <0.0001$, $df = 1$).

TABLE 1. Characteristics of Women Who Had ≥1 Live Births in the 5 Years Preceding the Survey, Kenya AIDS Indicator Survey 2012

	N = 3310	
Variable	Unweighted, n	Weighted % (95% CI)
Age group, yrs		
≤24	1105	33.7 (31.5 to 35.9)
25–29	928	28.3 (26.5 to 30.1)
30–39	1007	30.3 (28.1 to 32.6)
>40	270	7.7 (6.6 to 8.7)
Marital status		
Never married/never cohabited	307	9.5 (8.1 to 10.9)
Ever widowed	82	2.5 (1.9 to 3.2)
Divorced/separated	159	4.8 (3.9 to 5.7)
Married/cohabiting	2762	83.2 (81.6 to 84.7)
Does husband have other wives?		
Yes	336	9.3 (7.6 to 11.0)
No	2974	90.7 (89.0 to 92.4)
Highest educational attainment		
No primary	506	9.1 (6.3 to 11.9)
Incomplete primary	278	8.0 (6.5 to 9.4)
Complete primary	1084	35.9 (33.3 to 38.4)
Secondary or higher	1442	47.1 (44.4 to 49.8)
Region		
Nairobi	346	9.2 (7.9 to 10.6)
Central	300	10.6 (8.9 to 12.3)
Coast	416	9.1 (7.4 to 10.8)
Eastern	696	14.8 (12.8 to 16.8)
Nyanza	455	15.4 (13.5 to 17.2)
Rift Valley	671	29.1 (26.0 to 32.2)
Western	426	11.8 (10.2 to 13.4)
Residence		
Rural	2165	65.1 (62.2 to 68.0)
Urban	1145	34.9 (32.0 to 37.8)
Wealth index		
Poorest	826	23.4 (20.0 to 26.9)
Second	729	22.2 (19.8 to 23.1)
Middle	655	20.6 (18.1 to 23.9)
Fourth	539	16.3 (14.0 to 18.7)
Richest	561	17.5 (14.8 to 20.2)
Desires more children in the future*		
Yes	1484	41.5 (39.0 to 44.0)
No	1511	48.6 (46.0 to 51.1)
Undecided/do not know	302	9.5 (8.1 to 10.8)

*Category frequencies do not add to the total because of missing responses.

TABLE 2. Characteristics of Women Who Had ≥1 Live Births Within the 5 Years Preceding the Survey by Laboratory-Confirmed HIV Status, Kenya AIDS Indicator Survey 2012

	Total	HIV Infected		HIV Uninfected	
	Unweighted, N	Unweighted, n	Weighted % (95% CI)	Unweighted, n	Weighted % (95% CI)
Overall*	2862	171	6.1 (4.9 to 7.4)	2691	93.9 (92.6 to 95.1)
Last birth					
Within past 2 years	1524	79	5.1 (3.7 to 6.5)	1445	94.9 (93.5 to 96.3)
More than 2 years ago	1338	92	7.2 (5.4 to 9.0)	1246	92.8 (91.0 to 94.6)
Age group, y					
≤24	964	39	4.0 (2.6 to 5.5)	925	96.0 (94.5 to 97.4)
25–29	796	53	7.1 (4.9 to 9.4)	743	92.9 (90.6 to 95.1)
30–39	871	61	7.0 (4.9 to 9.2)	810	93.0 (90.8 to 95.1)
>40	231	18	7.9 (3.8 to 11.9)	213	92.1 (88.1 to 96.2)
Marital status					
Never married/never cohabited	264	19	7.3 (4.0 to 10.6)	245	92.7 (89.4 to 96.0)
Ever widowed	74	13	23.6 (9.3 to 37.9)	61	76.4 (62.1 to 90.7)
Divorced/separated	148	14	9.0 (4.3 to 13.7)	134	91.0 (86.3 to 95.7)
Married/cohabiting	2376	125	5.3 (4.0 to 6.5)	2251	94.7 (93.5 to 96.0)
Does husband have other wives?					
Yes	292	26	9.4 (2.5 to 16.3)	266	90.6 (83.7 to 97.5)
No	2570	145	5.8 (4.7 to 6.9)	2425	94.2 (93.1 to 95.3)
Highest educational attainment					
No primary	423	7	1.3 (0.1 to 2.6)	416	98.7 (97.4 to 99.9)
Incomplete primary	244	18	7.8 (3.6 to 12.0)	226	92.2 (88.0 to 96.4)
Complete primary	955	65	6.4 (4.5 to 8.2)	890	93.6 (91.8 to 95.5)
Secondary or higher	1240	81	6.4 (4.8 to 8.1)	1159	93.6 (91.9 to 95.2)
Region					
Nairobi	280	16	5.5 (2.6 to 8.4)	264	94.5 (91.6 to 97.4)
Central	269	13	4.1 (1.8 to 6.3)	256	95.9 (93.7 to 98.2)
Coast	361	13	3.3 (1.3 to 5.4)	348	96.7 (94.6 to 98.7)
Eastern	618	21	3.0 (1.1 to 4.8)	597	97.0 (95.2 to 98.9)
Nyanza	408	74	18.5 (12.2 to 24.9)	334	81.5 (75.1 to 87.8)
Rift Valley	561	16	3.3 (1.6 to 4.9)	545	96.7 (95.1 to 98.4)
Western	365	18	5.5 (2.8 to 8.2)	347	94.5 (91.9 to 97.2)
Residence					
Rural	1891	105	5.7 (4.4 to 7.0)	1787	94.3 (93.0 to 95.6)
Urban	971	66	6.8 (4.3 to 9.4)	905	93.2 (90.6 to 95.7)
Desires more children in the future†					
Yes	1279	49	4.0 (2.7 to 5.2)	1230	96.0 (94.8 to 97.3)
No	1330	117	8.7 (6.6 to 10.8)	1213	91.3 (89.2 to 93.4)
Unsure/do not know	241	5	2.0 (0.2 to 3.8)	236	98.0 (96.2 to 99.8)

*Includes only female respondents who consented to a blood draw.
†Category frequencies do not add to the total because of missing responses.

All women who consented for an interview were asked if they had been previously tested for HIV and had received results back from this test. Seventy-six women reported that they had been diagnosed with HIV infection at any time in the past (Table 3). Of the 2773 women who had reported having previously tested HIV-negative during their last pregnancy, 81 (2.9%) were found to have laboratory-confirmed HIV infection in the survey contributing to almost half (47.4%) of all 171 HIV-positive tests in our study population (data not shown).

Among women who had had at least 1 live birth within the 5 years preceding the survey, the large majority (95.4%, 95% CI: 94.3 to 96.4) had attended an ANC clinic at least 1 time during their last pregnancy, and among these, 61.7% (95% CI: 59.0 to 64.5) had attended the recommended 4 or more visits (Table 3). Two-thirds (66.0%, 95% CI: 63.9 to 68.1) of women had presented for ANC in their second trimester, and 19.1% (95% CI: 17.4 to 20.9) presented in their first trimester. Of the women who had attended an ANC clinic, 93.1% (95% CI: 91.5 to 94.7) accepted HIV testing at the facility, 1.6% (95% CI: 1.1 to 2.1) had been offered but refused testing, and 5.3% (95% CI: 3.7 to 6.9) had not been offered a HIV test at the ANC clinic. Of those who had been tested for HIV at ANC, 97.8% (95% CI: 97.2 to 98.4)

TABLE 3. ANC Interventions for PMTCT Among Women Who Had ≥1 Live Births Within the 5 Years Preceding the Survey, Kenya AIDS Indicator Survey 2012

Intervention	Unweighted, n	Weighted % (95% CI)
Attended ANC clinic during pregnancy (N = 3310)		
Yes	3132	95.4 (94.3 to 96.4)
No	178	4.6 (3.6 to 5.7)
Number of ANC visits among women who attended (N = 3132)		
1	96	3.1 (2.4 to 3.9)
2–3	1027	33.9 (31.4 to 36.5)
≥4	1969	61.7 (59.0 to 64.5)
Does not know	40	1.2 (0.7 to 1.7)
Timing of first ANC visit among women who attended (N = 3132)		
0–3 months	623	19.1 (17.4 to 20.9)
4–6 months	2061	66.0 (63.9 to 68.1)
7–9 months	415	13.7 (12.1 to 15.3)
Does not know	33	1.1 (0.7 to 1.6)
HIV tested at ANC visit among women who attended (N = 3132)		
Tested at ANC	2924	93.1 (91.5 to 94.7)
Offered but not tested	45	1.6 (1.1 to 2.1)
Not offered	163	5.3 (3.7 to 6.9)
Received HIV results among women tested (N = 2924)		
Yes	2865	97.8 (97.2 to 98.4)
No	59	2.2 (1.6 to 2.8)
HIV status (N = 2869)		
HIV-negative	2773	96.4 (95.4 to 97.4)
HIV-positive*	76	2.9 (2.0 to 3.8)
Unwilling to disclose	20	0.69 (0.4 to 1.0)
Place of birth (N = 3310)		
Home	1472	42.3 (38.9 to 45.7)
Hospital	1820	57.1 (53.8 to 60.5)
Other place	18	0.60 (0.3 to 0.9)

*Includes 4 women who already knew they were HIV-positive.

received their HIV results. Of women who received results, 2.9% (95% CI: 2.0 to 3.8) reported that they had been diagnosed with HIV during their last pregnancy or were known to be infected before their last pregnancy.

All women reporting a previous HIV-positive diagnosis had received prenatal care; 80.5% (95% CI: 69.7 to 91.3) had their first visit to the ANC in their second trimester or earlier, and 56.5% (95% CI: 44.7 to 68.2) attended for the recommended 4 ANC visits (Table 4). About three-quarters (72.3%, 95% CI: 61.0 to 83.5) of diagnosed women reported that they had received antepartum antiretroviral prophylaxis during their pregnancy, 69.1% (95% CI: 56.5 to 81.7) reported receiving intrapartum prophylaxis at labor or delivery, and, among mothers who had breastfed their infants, 83.1% (95% CI: 73.2 to 93.1) reported taking maternal prophylaxis while breastfeeding. Three-quarters (75.3%, 95% CI: 64.8 to 85.8) of diagnosed mothers reported that their newborns received postpartum prophylaxis at delivery, and 80.4% (95% CI: 68.6 to 92.1) reported that their babies received prophylaxis during breastfeeding. Of all diagnosed women, 90.1% (95% CI: 82.3 to 97.8) reported they received either maternal or infant prophylaxis during their pregnancy. Of children born to diagnosed mothers, 82.5% (95% CI: 73.0 to 92.1) of mothers reported that their children were tested for HIV at their first immunization visit or later, and 15.1% (95% CI: 2.4 to 27.8) of these these children were reported by the mothers to be HIV-positive.

Women Whose Last Birth Was Within the 2 Years Preceding the Survey

Of the 1524 women who had given birth within the 2 years preceding the survey, 79 (5.1%) were found to have laboratory-confirmed HIV infection in KAIS 2012 (Table 4). Most HIV-infected women reported receiving prenatal care at an ANC clinic (96.2%, 95% CI: 90.9 to 100.0), 56.3% (95% CI: 44.0 to 68.6) attended an ANC at least 4 times during their pregnancy, and 78.6% (95% CI: 68.2 to 88.9) made their first ANC clinic visit in their second trimester or earlier. The majority of HIV-infected women (84.7%, 95% CI: 74.6 to 94.8) were tested for HIV at the ANC clinic during their last pregnancy, with slightly more than half (55.6%, 95% CI: 42.3 to 68.9) who reported they were diagnosed with HIV at the ANC or at any time before that pregnancy. Among all infected women, 42.9% (95% CI: 31.2 to 54.5) received antepartum antiretroviral prophylaxis during their pregnancy, 38.8% (95% CI: 25.6 to 51.9) received intrapartum prophylaxis at labor or delivery, and, among those who breastfed their baby, 46.8% (95% CI: 32.2 to 61.4) received antiretroviral drugs while breastfeeding. For infant prophylaxis, 42.9% (95% CI: 31.2 to 54.5) of mothers reported that their newborns received prophylaxis at delivery, and, among those who breastfed their baby, 45.8% (95% CI: 33.7 to 57.9) of babies received infant prophylaxis while breastfeeding. Overall, 52.8% (95% CI: 39.2 to 66.4) of infected mothers received any form of maternal or infant prophylaxis during their last pregnancy. Among infants born to HIV-infected mothers, 44.4% (95% CI: 31.3 to 57.5) infants had been tested for HIV at the time of their first immunization visit or later.

Figure 1 illustrates the cascade of PMTCT care for women with laboratory-confirmed HIV infection whose last birth was within the 2 years preceding the survey, with coverage reflected as percentages within the bars and access reflected as percentages between the bars. With respect to access, of the 96.2% of women who had visited an ANC clinic during pregnancy in the previous 2 years, 88.1% were tested for HIV infection at ANC. Of those, 59.6% were diagnosed HIV-positive at ANC or had reported previous HIV-positive diagnosis. Among women with diagnosed infection, 94.9% received any form of maternal or infant prophylaxis for PMTCT, and of those, 78.7% reported that their infant had been tested for HIV at the first immunization visit or later. For children who were tested, 7.4% (95% CI: 0.0 to 15.9) were reported by the mother to be HIV-positive, 85.4% (95% CI: 74.0 to 96.9) were HIV-negative, 3.3% (95% CI: 0.0 to 9.7) had indeterminate results, and 3.9% (95% CI: 0.0 to 9.3) of mothers did not disclose the results.

TABLE 4. Access to and Coverage of ANC Interventions for PMTCT Among Women Who Were Known to be HIV Infected Who Had ≥1 Live Births Within the 5 Years Preceding the Survey and Women with Laboratory-Confirmed HIV Infection Whose Last Birth Was Within the 2 Years Preceding the Survey, Kenya AIDS Indicator Survey 2012

	Women Who Had ≥1 Live Births Within the 5 Years Preceding the Survey and Who Were Diagnosed With HIV During or Before Their Last Pregnancy (N = 76)		Women with Laboratory-Confirmed HIV Infection Whose Last Birth Was Within the 2 Years Preceding the Survey (N = 79)	
Intervention	**Unweighted, n**	**Weighted % (95% CI)**	**Unweighted, n**	**Weighted % (95% CI)**
Attended ANC clinic during pregnancy				
Yes	76	100	76	96.2 (90.9 to 100.0)
No	0	—	3	3.8 (0 to 9.1)*
Number of ANC visits				
1–3	27	42.7 (30.9 to 54.4)	33	39.9 (28.2 to 51.6)
≥4	48	56.5 (44.7 to 68.2)	43	56.3 (44.0 to 68.6)
Does not know	1	0.9 (0 to 2.6)*	0	—
Did not attend ANC	0	—	3	3.8 (0 to 9.1)*
Timing of first ANC visit				
≤6 months	62	80.5 (69.7 to 91.3)	19	78.6 (68.2 to 88.9)
7–9 months	14	19.4 (8.7 to 30.2)*	14	17.6 (7.9 to 27.4)*
Did not attend ANC	0	—	3	3.8 (0 to 9.1)*
HIV tested at ANC visit				
Yes	76	100	69	84.7 (74.6 to 94.8)
No	0	—	7	11.5 (2.4 to 20.5)*
Did not attend ANC	0	—	3	3.8 (0 to 9.1)*
Diagnosed with HIV at ANC visit				
Yes	76†	100	40†	55.6 (42.3 to 68.9)
No	0	—	36	40.6 (27.6 to 53.6)
Did not attend ANC	0	—	3	3.8 (0 to 9.1)*
Maternal use of ARVs				
During pregnancy	54	72.3 (61.0 to 83.5)	29	42.9 (30.6 to 55.2)
During labor/delivery	51	69.1 (56.5 to 81.7)	26	38.8 (25.6 to 51.9)
During breastfeeding‡	53	83.1 (73.2 to 93.1)	33	46.8 (32.2 to 61.4)
No maternal use of ARVs	6	7.6 (1.2 to 14.0)*	39	43.9 (30.6 to 57.1)
Place of birth				
Home	25	31.0 (15.7 to 46.3)*	29	35.5 (22.8 to 48.3)
Hospital	51	69.0 (53.7 to 84.3)	49	64.5 (50.6 to 76.2)
Other	0	—	1	1.1 (0 to 3.3)*
Postpartum infant ARV prophylaxis				
After delivery	56	75.3 (64.8 to 85.8)	30	42.9 (31.2 to 54.5)
During breastfeeding‡	51	80.4 (68.6 to 92.1)	33	45.8 (33.7 to 57.9)
No postpartum infant ARV prophylaxis	8	8.7 (2.4 to 15.0)*	38	45.0 (32.8 to 57.3)
Any form of maternal or infant prophylaxis	69	90.1 (82.3 to 97.8)	38	52.8 (39.2 to 66.4)
No form of maternal or infant prophylaxis	7	10.0 (2.2 to 17.7)*	41	47.2 (33.6 to 60.8)
Child tested for HIV at first immunization visit or later§				
Yes	63	82.5 (73.0 to 92.1)	32	44.4 (31.3 to 57.5)
No	13	17.5 (8.0 to 27.0)*	47	55.6 (42.6 to 68.7)
Child's HIV test result (reported by mother)				
Positive	8/63	15.1 (2.4 to 27.8)*	3/32	7.4 (0 to 15.9)*
Negative	50/63	77.6 (64.1 to 91.0)	26/32	85.4 (74.0 to 96.9)
Unknown‖	5/63	6.0 (0.5 to 11.6)*	3/32	7.2 (0 to 15.3)*
Child did not test for HIV	13	—	47	—

ARV, antiretroviral drug.
*Because of a small sample size, this estimate may be unreliable.
†Includes 4 women who already knew they were HIV-positive.
‡Excludes women who did not breastfeed.
§This analysis includes children who may not have yet reached the recommended age for the first immunization visit.
‖Unknown status includes mothers who did not disclose test results or reported the result as indeterminate.

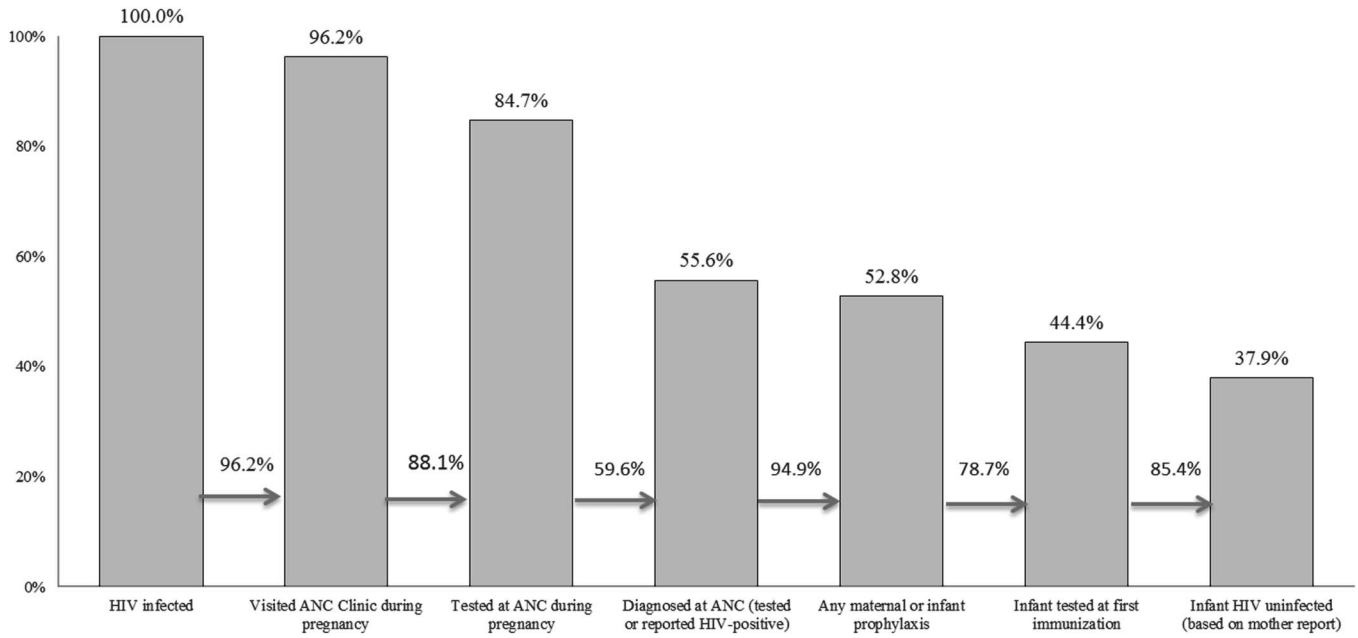

FIGURE 1. Coverage (% top of bars) of and access (% between bars) to PMTCT interventions at antenatal care clinics among women with laboratory-confirmed HIV infection whose last birth was within the 2 years preceding the survey, Kenya AIDS Indicator Survey 2012.

DISCUSSION

We found that 6.1% of women in our nationally representative sample who had delivered infants in the preceding 5 years were infected with HIV. Of concern, about half were unaware of their HIV infection before participating in the survey. Although this may reflect intercurrent infection since their last pregnancy, it may also reflect low HIV risk perception, not having sought testing outside of ANC, reluctance to report HIV infection, denial or lack of understanding of previous diagnosis, or false-negative laboratory results. However, we did find an overall improvement in HIV testing among ANC clinic attendees during their pregnancy and in comparison to KAIS 2007, where testing rates significantly increased from 64.9% (95% CI: 62.3 to 67.5) in 2007 to 93.1% (95% CI: 91.5 to 94.7) in 2012.[12]

Among women who reported that they had been diagnosed with HIV in their last pregnancy within the 5 years preceding the survey or were known to be infected before their last pregnancy, reported use of any form of maternal or infant antiretroviral prophylaxis was over 90%, with antiretroviral prophylaxis provided to about two-thirds of women and 75% of HIV exposed infants. Although these findings are encouraging, findings from our subanalysis of HIV-infected women whose last birth was within the 2 years preceding the survey were less so, revealing large gaps in the PMTCT cascade when HIV infection remains undiagnosed. With only 56% of HIV-infected women reporting a previous HIV-positive diagnosis at ANC in their last pregnancy or at any time before their last pregnancy, use of maternal antiretroviral prophylaxis during breastfeeding, a practice recommended by the World Health Organization and in the national guidelines on postpartum prophylaxis, was reported by $<50\%$.[6,13] Moreover, infant prophylaxis was provided only to 46% of babies during breastfeeding. Additionally, coverage of any form of maternal or infant prophylaxis among women who were in need of PMTCT was low, at 53%. Of the infants likely exposed to HIV infection, only 44% had been tested. This is consistent with the national program estimate for coverage of early infant diagnosis over the same period of time, which improved from 23% in 2009 to 68% in 2012.[9] Finally, we found that 83% of exposed infants whose mothers knew they were infected were reported to have been tested for HIV at the first immunization visit or later and calculated a cumulative MTCT rate of 15.1% (95% CI: 2.4 to 27.8) over a 5-year period. Although this estimate reflects potential transmission for births that occurred in the past 5 years, this rate is similar to the current program transmission rates as determined by PCR before 1 year of age, which ranges from 10% to 15% and overlaps with the confidence bounds of published rates from a research cohort in western Kenya.[14,15] Notably, because of small sample sizes, the uncertainty around our 5-year cumulative MTCT estimate is wide, with a lower bound of 2.4% and an upper bound of 27.8%. Therefore, caution should be used in interpreting this finding.

Our study had several limitations. All exposure history was from mother's self-report, and it was not possible to corroborate reported information with clinic records. Given the phrasing of the questionnaire, we were unable to differentiate which mothers began lifelong ART and who received antiretroviral prophylaxis but stopped at cessation of breastfeeding.[16] The timing of infant PCR testing was not precisely determined, and we can only report that infants were diagnosed at their first immunization visit or later. In the subanalysis of HIV-infected women who had

given birth in the 2 years preceding the survey, assessment of coverage of and access to PMTCT interventions assumed that these women were in need of PMTCT. However, despite high HIV testing rates among pregnant women attending ANC clinics, we found that only half of women with laboratory-confirmed HIV infection in the survey reported they were previously diagnosed with HIV at ANC or at any point before that visit. This suggests that some of these women may have been unwilling to disclose their HIV status, had false-negative results on previous tests, or became infected after their last live birth. Consequently, the low prevalence of reported HIV diagnosis in this subgroup may be an underestimate of the true prevalence of diagnosed HIV infection among women who recently gave birth.

With over half of potentially exposed infants untested in our subanalysis of women with laboratory-confirmed HIV infection, the documented MTCT rate of 7.4% among those tested for HIV may be unreliable because of a small sample size. Nonetheless, the particular strengths of our study are its nationally representative framework and our determination of actual HIV status by laboratory testing. Moreover, for women who have completed all steps in the PMTCT cascade, the MTCT rate is plausible.

In conclusion, we found that there remains a substantial burden of HIV among Kenyan women of childbearing age. About 40% of HIV-infected women and 45% of exposed infants did not receive antiretroviral prophylaxis, highlighting current challenges in the PMTCT cascade. However, the proportion of women who reported being screened for HIV at ANC has risen substantially since 2007. We also were encouraged to see that once diagnosed, 90% of HIV-infected pregnant women received any form of maternal or infant PMTCT prophylaxis. Provision of lifelong ART for pregnant women at diagnosis will be an essential step toward realizing the national goal of eliminating MTCT to <5% by 2015. As the national PMTCT program prepares to transition from prophylactic ART to universal ART, routine cohort analyses among HIV-infected pregnant women will be needed to track the national scale-up of this intervention and respond to challenges encountered.

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