

# Incidence and Risk Factors of HIV-1 Infections among Pregnant Women in Burkina Faso from 2012 to 2016

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## Abstract

**Background:** New cases of HIV/AIDS are still being reported and threaten the achievement of the HIV-1 elimination goal in Burkina Faso. An adequate assessment of the extent of this problem is key to redistributing available resources. HIV-1 incidence and associated risk factors among pregnant women estimated in Burkina Faso.

**Materials and Methods:** We conducted a cross-sectional survey of pregnant women in all 13 administrative regions of Burkina Faso from 2012 to 2016. Collected sera analyzed by Vironostika HIV Uniform II Plus O, ImmunoComb II HIV-1 & 2 Bispot, HIV BLOT 2.2 assays to determine serological status. HIV-1 LAg-Avidity EIA performed on HIV-1 positive samples to differentiate between recent and old infections. Sociodemographic information collected for all participants. Data analysis performed using EPI Info and XLSTAT.

**Results:** A total of 36,848 pregnant women included in the analyses. Serological testing showed 483 HIV-1 positive, 18 HIV-2 positive, 7 HIV-1 + 2 coinfection cases. Overall, 355 HIV-1 positive samples tested with HIV-1 LAg-Avidity EIA; the remaining samples had insufficient volume to be tested. The adjusted incidence rates were 0.17% and 0.09% ( $p=0.0919$ ) in 2015 and 2016, respectively. Sociodemographic factors associated with recent infections included the 25-34 and  $\geq 35$  year age groups, high education level, household and secretary occupations, trader wife, civil servant wife, residence in urban sites, being married, a length of stay in the administrative region of  $<1$  year.

**Conclusion:** HIV-1 incidence is decreasing in Burkina Faso. However, women with certain risk factors should be targeted in prevention programs to reach the country's HIV-1 elimination goal.

**Keywords:** Female • Humans • Pregnancy • HIV-2 • HIV-1 • Acquired Immunodeficiency Syndrome • Risk Factors • Coinfection • Cross-Sectional Study • HIV Seropositivity • Incidence • Burkina Faso

## Introduction

Overcoming the HIV/AIDS epidemic remains a top priority at the heart of public health objectives and is a significant challenge worldwide. The pandemic remainder widespread in many sub-Saharan African countries and HIV infections still represent the leading cause of morbidity and mortality [1-3]. Despite the introduction of Antiretroviral Therapy (ART) in 1996, 36.7 million people globally were reported to be living with HIV in 2016 [4,5]. Among them, 17.8 million are women aged fifteen years or older [6]. New infections are evidence of weaknesses in health programs aiming to prevent HIV transmission. The estimation of the number of new HIV infections is essential for a better understanding of the epidemic trend. That is a crucial criterion for an adequate assessment of the impact of implemented

prevention measures. Worldwide, 1.8 million people became newly infected with HIV in 2016, with 370,000 of these cases occurring in West and Central Africa [6]. Burkina Faso remained a generalized epidemic country in 2014, with HIV prevalence estimated at 1.3% among pregnant women [7]. HIV serosurvey activities at sentinel sites are conducted annually in Burkina Faso to determine the annual prevalence of HIV in pregnant women. However, the World Health Organization's second-generation strategy used for this purpose does not distinguish between recent and long-term HIV infections. Over the last decade, many laboratory tests have developed to distinguish between recent and old HIV-1 infections. These methods based on the reactivity of specific HIV biomarkers [8-11]. One of the most recently developed tests is the HIV-1 Limiting Antigen Avidity Enzyme Immunoassay (HIV-1 LAg-Avidity EIA), developed by the United States Centers for Disease Control and Prevention (US CDC; Atlanta, GA, USA) and marketed by Sedia

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Biosciences Corp. (Portland, OR, USA). HIV-1 LAg-Avidity EIA uses a limited concentration of multiple subtypes of antigens from the immunodominant region of gp41. The limitation of antigen-only assays is that they allow high avidity antibodies to bind, which then dissociated with pH3 buffer [11].

Laboratory tests rarely used in sub-Saharan Africa; they are generally limited to English-speaking countries, despite the large number of new infections in this region [12-14]. Most resource-limited countries, such as Burkina Faso, use sentinel site data and national surveys combined with mathematical models to estimate the national incidence [15,16]. Indeed, in Burkina Faso, study at sentinel sites is conducted annually and has shown a decline in overall HIV seroprevalence over the past decade. However, little information investigated the contribution of new cases in this HIV global landscape. Therefore, the purpose of the present study was to estimate HIV incidence and determine risk factors associated with the occurrence of new cases among pregnant women from 2012 to 2016 in Burkina Faso using HIV-1 LAg-Avidity EIA.

## Methods and Materials

### Ethical considerations

We obtained the approval of the National Ethics Committee for Health Science Research. The approval number is DELIBERATION N° 2014-10-115. All women who enrolled were verbally informed of the study purpose and provided their verbal informed consent to participate in this study. Consent was verbal because the study used the unlinked anonymous testing method recommended by the World Health Organization (WHO) in which participation was voluntary, and no identifiable information linked to the samples [17]. This method respects the confidentiality of the results and does not allow any identification of the participants through data collection. All the specimens have the serial number and age. Also, the HIV survey in Burkina Faso is a routine activity of the Ministry of Health. Although this guideline concerns prevalence surveys, we used the same samples for this incidence study.

### Sites and study period

The study conducted in all 13 administrative regions of the country. Those are namely: the Mouhoun, Cascades, Center, Center-East, Center-North, Center-West, Center-South, High-Basins, North, Central Plateau, Sahel, South-West, and East regions. These thirteen Districts divided into seven urban sites and six rural sites. The selected sentinel sites represent the chief towns of Burkina Faso's 13 Districts. Burkina Faso comprises thirteen administrative regions, seven urban and six rural. These Districts represented by a central city. Serological testing carried out at the National Reference Laboratory for HIV/AIDS and Sexually Transmitted Infections (NRL-HIV/AIDS-STI) in the Bacteriology and Virology Department of Yalgado Ouedraogo teaching hospital in Ouagadougou. This study covered from 2012 to 2016.

### Study population

The study population consisted of pregnant women between 15 and 49 years of age who screened for HIV during the annual HIV sentinel survey in Burkina Faso. Women were consecutively enrolled for three weeks at each site during each year of study from 2012 to 2016. In the sentinel site, HIV monitoring protocol in Burkina Faso, the WHO recommended the sample size according to the total population of the sample areas; the recommendation was 800 samples for each of the two capitals and 400 specimens for each of the eleven other sites.

## Collection of socio-demographic data and sera

During the study period, a questionnaire administered to collect sociodemographic data from each pregnant woman visiting the health care center for routine antenatal care. Also, 10 mL of venous blood received from each woman. Blood samples centrifuged, and serum was aliquoted into sterile cryotubes and stored at -20°C before being transferred to the NRL-HIV/AIDS-STI for analysis. Each year, after serological testing, all HIV-1 positive sera were stored at -80°C until molecular analysis in 2016.

### Serological HIV testing

A serum analyzed according to the WHO/UNAIDS HIV detection strategy II [18]. Briefly, sera tested by a highly sensitive enzyme-linked immunosorbent assay, Vironostika HIV Uniform II Plus O (bioMérieux, Marcy-l'Etoile, France). Any sample that tested negative by this test defined as "negative"; those that tested positive were reanalyzed by the ImmunoComb II HIV 1&2 Bispot test (Orgenics Ltd, Yavne, Israel) to determine the type (s) of HIV (HIV-1, HIV-2 or HIV-1+2). Any samples with discordant results tentatively classified as "indeterminate"; HIV-2 and HIV-1+2 positive samples, as well as "indeterminate" samples, then underwent confirmatory testing using HIV BLOT 2.2 (MP Biomedicals, Singapore, Asia Pacific). The results obtained by western blot analysis were interpreted according to the WHO criteria and classified as positive (HIV-1, HIV-2 or HIV-1+2), negative or indeterminate [19]. Overall annual and virus type frequencies determined by taking into account the number of positive, negative, and uncertain samples and total serum samples analyzed. However, the HIV-1 positive and Western blot indeterminate results were all confounded and tested for incidence.

### Serological testing for the detection of recent HIV-1 infections

All HIV-1 positive serum samples were retested by HIV-1 LAg-Avidity EIA (Sedia Biosciences Corp., Portland, OR, USA) according to the manufacturer's instructions. The test carried out in five steps. HIV-1 LAg-Avidity EIA is an antigen-capture EIA that is limited to a single well. Samples were incubated for 60 min at 37°C, during which time low-avidity and high-avidity HIV-1-specific IgGs were captured by an HIV-1 recombinant antigen (rIDR-M) and coated at a known concentration to the microplate. Dissociation buffer was then added and incubated for 15 min at 37°C to help remove low-avidity IgG from the antigen-coated plate. Specimens then incubated for 30 min at 37°C with IgG-HRP conjugate, which attached to the remaining IgG bound to the microplate. Then, the samples produced with 3, 3', 5, 5'-tetramethylbenzidine substrate for 15 min at 25°C. The color intensity of the reaction was proportional to the amount of HRP. The Optical Density (OD) of each well was then measured. The OD value was divided by the OD value of an internal kit calibrator to generate the normalized OD (OD<sub>n</sub>). The OD<sub>n</sub> value indicates whether a result should be confirmed and whether the HIV infection is recent (OD<sub>n</sub> ≤ 1.5) or old (OD<sub>n</sub> >1.5). Operationally, a virus was defined as current when it occurred ≤ six months prior and mature if it occurred >6 months prior [20]. All samples classified as recent crude infections then analyzed by the Abbott RealTime HIV-1 quantitative test with the m2000 system (Abbott, Illinois, USA).

### Molecular test for the detection of false recent HIV-1 infections

The viral load of samples classified as crude new infections (OD<sub>n</sub> ≤1.5) quantified in the molecular biology section of the NRL-HIV/AIDS-STI for confirmation. Measuring viral load can improve the accuracy of the HIV-1 LAg-Avidity EIA without necessarily controlling for ART. The Abbott RealTime HIV-1 assay uses RT-PCR to generate an amplified product from extracted HIV-1 RNA in clinical samples. The protocol carried out in three steps.

The first step consisted of viral RNA extraction. Viral membranes and capsids were lysed by mixing microparticles, lysis buffer, and samples in a

tube. Nucleic acid was separated through successive washing steps using the first washing solution. RNA was then purified through successive washings using the second washing solution. Elution buffer then added to the tube containing purified RNA to separate the different fragments of viral RNA and to recover the eluate containing viral RNA.

The second step consisted of master mix preparation by mixing the HIV-1 activation reagent with thermostable DNA polymerase enzyme and HIV-1 oligonucleotide reagent. Oligonucleotide reagents added to the enzyme vial, and then the amplification master mix was aliquoted in wells of a 96-well optical reaction plate placed in a StrataCooler benchtop cooler.

The third step consisted of the amplification step. The template (HIV-1 RNA) added to wells containing the master mix, and the plate transferred to the amplification zone. Reverse-transcription of RNA into cDNA, amplification and, detection simultaneously is occurred in the Abbott RealTime HIV-1 assay. Reverse-transcription completed in 1 cycle, and amplification achieved in 50 periods with the DNA to amplified being denatured into two single-stranded strands. Hybridization of the primers at the 3' ends of each strand, an extension of the introduction by Taq polymerase, and a final extension in 1 cycle that ends the RT-PCR. We classified samples that had a viral load  $\geq 1,000$  copies/mL as recent infections and those with a viral load  $<1,000$  copies/mL classified as long-term (old) infections. These individuals were on ART or elite suppressors or individuals maintaining a low viral load.

### Statistical analyses

All results were processed and stored in an Excel file "Burkina Faso- CDC LAg Incidence Calculator R1.1\_3-15-17" developed by the US CDC. The obtained ODn values recorded under unique identification numbers and the Excel file generated the result indicating the status of recent (crude) or old infections of each sample. These results merged with sociodemographic data of sentinel site HIV surveillance from 2012 to 2016 in Burkina Faso using Excel. Impact (crude and adjusted) was determined using the incidence calculator developed by the US CDC. The average duration of recent infections was estimated at 130 days (95% confidence interval (CI): 118-142) by Sedia Biosciences Corp. The rate of recent false infections set at 0% (95% CI: 0.00-0.00%), according to the incidence calculator provided by the US CDC. These parameters used for incidence calculations.

XLSTAT and GraphPad Prism version 7 software programs used to calculate the threshold of statistical significance for multiple comparison tests and odds ratios between variables at the level of  $p < 0.05$ . The odds ratio (OR) and 95% confidence interval (CI) used to estimate risk factors using the Epi Info Version 7 software program with a p-value  $< 0.05$  indicating significance. The  $\chi^2$  values calculated using the Friedman test (XLSTAT) to perform comparisons between the variables and  $\chi^2$  tests for trends (GraphPad Prism) used to determine the significant value costs that were significantly important. We used univariate analysis and a simple regression model with StatCalc from Epi Info version 7 to calculate the odds ratio to determine significant risk factors. The risk factors that take into account were the factors related to sociodemographic characteristics such as age group, education, occupation of the wife and her spouse, place of residence, marital status, and length of stay in the health care locality.

### Quality assurance

The National HIV Reference Laboratory has procedures in place to ensure and monitor the quality of manipulations, reagents and devices; the

correct management of records; the performance of analyses and the accuracy of the retranscription of results.

For the performance of the analyses, and internal control used. One in twenty (20) of the negative sera and one in five (5) aliquots among the positive sera retested, and the results compared to the first results obtained to judge their concordance.

The national reference laboratory participates in a national and international system of external quality control. A WHO Regional Quality Assurance Program does this external quality control.

## Results

### Rate of types of HIV in Burkina Faso from 2012 to 2016

In total, 36,848 pregnant women participated in the incidence study. Of these, anti-HIV antibodies were detected in 508 samples, including 483 (90.0%-97.8%) HIV-1, 18 (2.1% to 5.5%) HIV-2 and 7 (0.0% to 4.4%) HIV-1+2 coinfection (Table 1). Subsequent results of recent infections included only those positive for anti-HIV-1 antibodies.

**Table 1:** Types of HIV detected in pregnant women from 2012 to 2016 in Burkina Faso.

Year	Samples tested			Rate of types of HIV		
	Total (n=36848)	Negative (n=36340)	Positive	HIV-1 (n=483)	HIV-2 (n=18)	HIV-1+2 (n=7)
2012	7294	7174	120	116 (96.6%)	4 (3.4%)	0
2013	6093	6003	90	81 (90.0%)	5 (5.5%)	4 (4.4%)
2014	7562	7467	95	93 (97.8%)	2 (2.1%)	0
2015	8131	8023	108	102 (94.4%)	3 (2.9%)	3 (2.7%)
2016	7768	7673	95	91 (95.7%)	4 (4.2%)	0

### Dynamics of HIV-1 annual incidence among pregnant women from 2012 to 2016 in Burkina Faso

The annual incidence before confirmation assay decreased from 1.15% in 2012 to 0.32% in 2014 ( $\chi^2=9.752$ ,  $df=4$ ,  $p=0.0448$ ) and from 0.94% in 2015 to 0.49% in 2016. The annual incidence after confirmation assay was 0 from 2012 to 2014 and decreased from 0.17% to 0.09% over the last two years of the study, although this difference was not significant ( $\chi^2=2.841$ ,  $df=1$ ,  $p=0.0919$ ) (Table 2).

**Table 2:** Annual Incidence of HIV-1 in pregnant women.

Year	Total tested for HIV (+ and -)	LAg-Avidity EIA	Incidence per 100 people/year [95% CI]
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		Total collected	Total tested	Recent infections 1	Recent infections 2	A	B
2012	7294	116	67	17	0	1.15% (0.60%-1.71%)	0
2013	6093	81	46	4	0	0.33% (0.00%-0.65%)	0
2014	7562	93	66	6	0	0.32% (0.06-0.57%)	0
2015	8131	102	102	27	5	0.94% (0.58%-1.30%)	0.17% (0.02%-0.33%)
2016	7768	91	74	11	1	0.49% (0.20%-0.78%)	0.09% (0.00%-0.21%)

False Recent Rate=0 (for each year); += positive; -=negative; 1=with ODn ≤1.5; 2=with viral load ≥ 1,000 copies/mL; A= with OD ≤ 1.5; B= with viral load ≥ 1,000 copies/mL

### Risk factors associated with recent infections with ODn 1.5 in pregnant women with HIV-1

Significant ORs described. Risk factors for exposure to recent HIV-1 infections reported in Table 3 and Table 4. In 2012, significant risk factors for recent HIV-1 infection were identified as the 25-34 year age group vs. the

15-24 year age group (OR=4.90, 95% CI: 1.39-17.23, p=0.005), high vs. primary education level (OR=5.64, 95% CI: 0.93-34.11, p=0.03), household occupation vs. traders (OR=56.57, 95% CI: 12.16-263.08, p <0.0001), secretary vs. traders (OR=28.93, 95% CI: 1.73-483.69, p=0.0003) and trader's wife vs. farmer/breeder's wife (OR=3.43, 95% CI: 0.99-11.88, p=0.03).

**Table 3:** Odds Ratio of Recent Infections with ODn ≤1.5 in Pregnant Women in 2012 and 2014.

Year	Settings	Positive	Negative	Odds Ratio	P value
2012	Age group (Years) 25-34/15-24	13-Mar	3074/3480	4.90 (1.39-17.23)	0.005
	Schooling High/Primary	02-Mar	115/973	5.64 (0.93-34.11)	0.03
	Occupation Household/Traders	12-Feb	5923/330	56.57 (12.16-263.08)	<0.0001
	Secretary/Traders	01-Feb	16/330	28.93 (1.73-483.69)	0.0003
	Spouse's occupation Trader/Farmer or breeder	05-May	1153/3959	3.43 (0.99-11.88)	0.03
2014	Age group (Years) 35 or older/15-24	02-Jan	791/3494	8.83 (0.80-97.55)	0.03

**Table 4:** Odds Ratio of Recent Infections with ODn ≤1.5 in Pregnant Women in 2015 and 2016.

Year	Settings	Positive	Negative	Odds Ratio	P value
2015	Locality Urban/Rural	24-Feb	4932/3981	7.52 (1.77-31.94)	0.001
	Age group (Years) 25-34/15-24	17-Jun	3466/3738	3.05 (1.20-7.75)	0.01
	Marital status Married/ Single	21-May	7379/644	2.72 (1.02-7.25)	0.03
	Length of Stay in the Health Locality- Less than 1 year/1 year or more	18-Aug	796/7150	3.99 (1.73-9.21)	0.0004
2016	Spouse's Occupation Civil servant/ Trader	17-Jan	885/1317	25.29 (3.36-190.44)	<0.0001
	Length of Stay in the Health Locality- Less than 1 year/1 year or more	04-Jul	772/6901	5.10 (1.49-17.48)	0.003

In 2014, a significant risk factor for recent HIV-1 infection identified as the ≥35-year age group vs. the 15-24-year age group (OR=8.83, 95% CI: 0.80-97.55, p=0.03).

In 2015, significant risk factors for recent HIV-1 infection were identified as urban vs. rural sites (OR=7.52, 95% CI: 1.77-31.94, p=0.001), the 25-34 year

age group vs. the 15-24 year age group (OR=3.05, 95% CI: 1.20-7.75, p=0.01), married vs. single (OR=2.72, 95% CI: 1.02-7.25, p=0.03) and a length of stay at the locality of <1 year vs. ≥1 year (OR=3.99, 95% CI: 1.73-9.21, p=0.0004).

In 2016, significant risk factors for recent HIV-1 infection identified as civil servant's wife vs. trader's wife (OR=25.29, 95% CI: 3.36-190.44,  $p < 0.0001$ ) and a length of stay at the health locality of  $<1$  year vs.  $\geq 1$  year (OR=5.10, 95% CI: 1.49-17.48,  $p=0.003$ ). In 2013, no significant factors associated with recent HIV-1 infection identified in 2013.

## Discussion

### Rate of type of HIV in Burkina Faso from 2012 to 2016

From 2012 to 2016, HIV-1 (90.0%-97.8%) was the predominant infection type in the study. This result is similar to that observed in Guinea-Bissau, with 70% of infections from HIV-1 between 2005 and 2013, and the results are in line with a previous study conducted in Burkina Faso, where HIV-1 accounted for 90.0-97.9% of HIV infections [21,22].

### Dynamics of HIV-1 incidence among pregnant women from 2012 to 2016 in Burkina Faso

The HIV-1 incidence among pregnant women for all regions combined decreased (0.17% to 0.09%) during the last two years of the study, but this difference was not significant. Ongoing monitoring is necessary to determine if there is, in fact, a statistically significant decrease over time.

This trend is comparable to those reported in other studies in South Africa. The reported decrease in South Africa was from 2.0% to 1.3% in 2012 [23].

The decrease in (gross) HIV-1 incidence was statistically significant from 2012 (1.15%) to 2014 (0.32%) but was not significant between 2015 (0.94%) and 2016 (0.49%). This downward trend is in line with UNAIDS data pointing to a reduction in the incidence from 2010 to 2015 in West and Central Africa [7]. However, these rates are lower than those found in South Africa (2.28%, 95% CI: 1.84-2.74) in 2012 and Uganda (3.37%, 95% CI: 2.22-5.13) in 2014 [24,25].

### Risk factors associated with recent HIV-1 infections

Significant risk factors associated with recent infections were household occupation (OR=56.57, 95% CI: 12.16-263.08), including secretary (OR=28.93, 95% CI: 1.73-483.69), trader's wife (OR=3.43, 95% CI: 0.99-11.88). These results linked to the adoption of risky behaviors over time. Traders spend several hours outside the home. They may then be at risk of HIV infection and subsequently infect their wives [26]. In contrast, in Rakai (Uganda), the partner's occupation was not significantly associated with women's risk of being infected with HIV (relative hazard=1.09, 95% CI: 0.88-1.35) [27].

Besides, in our study, a high education level was a risk factor associated with recent infection. However, in Ghana in 2014, pregnant women with secondary and tertiary education levels were less likely to be infected with HIV than those who were out of school or had a primary education (OR=0.53) [28]. In our study, women in the 25-34 (OR=4.90, 95% CI: 1.39-17.23 in 2012, OR = 3.05 and 95% CI: 1.20-7.75 in 2015) and  $\geq 35$  (OR= 8.83, 95% CI: 0.80-97.55) year age groups were more likely to have new HIV-1 infections. Our results contrast those reported in South Africa in 2012 and Kenya in 2012-2013, where a high-risk factor for HIV incidence was the  $\leq 24$  year age group (Hazard Ratio=1.85, 95% CI: 1.24-2.77) and the 34-39 year age group (AOR=4.5, 95% CI: 1.1-18.3,  $p=0.037$ ) respectively [29,30].

Our study also revealed that residing in urban sites (OR=7.52, 95% CI: 1.77-31.94), being married (OR=2.72, 95% CI: 1.02-7.25) and a length of stay in the locality of  $<1$  year (OR=3.99, 95% CI: 1.73-9.21 in 2015 and OR=5.10, 95% CI: 1.49-17.48 in 2016) were also associated with a high risk of recent HIV-1 infection. A previous study in South Africa in 2012 did not identify a significant association between urban and rural sites (HR=1,

HR=1.15 [0.94-1.40]) and a high risk of recent HIV-1 infection [29]. Another study from 2012-2013 revealed a high risk of HIV incidence in separated or divorced women (adjusted OR=2.3, 95% CI: 1.1-5.0,  $p=0.033$ ) in Kenya and women living in urban areas (adjusted OR=1.8, 95% CI: 1.1-2.7,  $p=0.012$ ) [30]. However, in this study, no factor was significantly associated with recent HIV-1 infection in 2013. This result was comparable to that observed in South Africa in 2012, where no factors were significantly associated with recent HIV infection [31].

## Limitations

The samples were used for further serologic testing to determine the types of HIV, resulting in a small amount remaining for the incidence test.

Excluding the sites of Ouagadougou and Bobo-Dioulasso, the expected sample size was similar (400) for both urban and rural locations. However, the populations are much higher in urban sites than in rural areas. These limitations mentioned above could constitute sampling biases in this study. The obtained results interpreted with reserve.

## Conclusion

This study showed HIV-1 predominance and a low incidence of HIV-1 infections in Burkina Faso in 2015 and 2016. Risk factors associated with current diseases changed over the years. They included the 25-34 and  $\geq 35$ -year age groups, high education level, household, and secretary occupations, trader wife, civil servant wife, residence in urban sites, married and a length of stay in the locality of  $<1$  year. Taking these factors into account would greatly help to reduce HIV-1 incidence in this population. Data from sentinel HIV surveillance can be used to obtain estimates of the number of people infected with HIV in the country and to make short-term projections of the annual incidence of AIDS cases. This information used to allocate resources for the management of AIDS cases and to develop prevention plans. This new method should be implemented in HIV surveillance programs in resource-limited settings to determine the actual level of the epidemic in these countries. Identified risk factors should be targets of specific HIV programs. They would identify individuals who have high-risk behaviors and to whom information, education, and other interventions can be directed.

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