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## Kenya AIDS Indicator Surveys 2007 and 2012: Implications for Public Health Policies for HIV Prevention and Treatment

William K. Maina, MBChB, MPH<sup>\*</sup>, Andrea A. Kim, PhD, MPH<sup>†</sup>, George W. Rutherford, MD, AM<sup>‡</sup>, Malayah Harper, MA<sup>§</sup>, Boniface O. K'Oyugi, PhD, MBS<sup>||</sup>, Shahnaaz Sharif, MD, MMed, MSc<sup>¶</sup>, George Kichamu, MSc<sup>||</sup>, Nicholas M. Muraguri, MBChB, MMed<sup>\*</sup>, Willis Akhwale, MBChB, MMed, PhD<sup>¶</sup>, and Kevin M. De Cock, MD, FRCP(UK), DTM&H<sup>†</sup> for the KAIS Study Group

<sup>\*</sup>National AIDS and Sexually Transmitted Infection (STI) Programme, Ministry of Health, Nairobi, Kenya

<sup>†</sup>Division of Global HIV/ AIDS, Center for Global Health, US Centers for Disease Control and Prevention, Nairobi, Kenya

<sup>‡</sup>Global Health Sciences, University of California, San Francisco, San Francisco, CA

<sup>§</sup>The Joint United Nations Program on HIV/AIDS, Nairobi, Kenya

<sup>||</sup>National Council for Population and Development, Nairobi, Kenya

<sup>¶</sup>Ministry of Health, Nairobi, Kenya

### Abstract

AIDS Indicator Surveys are standardized surveillance tools used by countries with generalized HIV epidemics to provide, in a timely fashion, indicators for effective monitoring of HIV. Such data should guide responses to the HIV epidemic, meet program reporting requirements, and ensure comparability of findings across countries and over time. Kenya has conducted 2 AIDS Indicator Surveys, in 2007 (KAIS 2007) and 2012–2013 (KAIS 2012). These nationally representative surveys have provided essential epidemiologic, socio-demographic, behavioral, and biologic data on HIV and related indicators to evaluate the national HIV response and inform policies for prevention and treatment of the disease. We present a summary of findings from KAIS 2007 and KAIS 2012 and the impact that these data have had on changing HIV policies and practice.

### Keywords

Kenya; HIV/AIDS; AIDS Indicator Survey; surveillance; policy

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Correspondence to: William K. Maina, MBChB, MPH, Ministry of Health, National AIDS and STI Control Programme, Kenyatta National Hospital Grounds, 19361-00202 Nairobi, Kenya (drmainawk@nascop.or.ke).

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## INTRODUCTION

Despite the advent of highly active antiretroviral therapy (ART) and availability of a host of effective prevention interventions, HIV remains a significant global health problem, and sub-Saharan Africa bears the greatest burden of HIV disease. The HIV pandemic has been extensively studied epidemiologically, yielding crucial information on trends, risk factors, and successes and failures of HIV prevention and treatment programs.

Approaches to monitoring HIV/AIDS epidemiology in a country include HIV and AIDS case reporting, surveys, and other special studies. In sub-Saharan Africa, HIV sentinel surveillance among pregnant women has been used to formulate estimates of HIV prevalence and trends in the general population. In addition, direct measurement through population-based surveys with serologic testing has been used to provide comprehensive information on the epidemiology of HIV in a country by linking demographic and behavioral profiles with HIV infection. Such surveys have included Demographic and Health Surveys, Behavioral Surveillance Surveys, Multiple Indicator Cluster Surveys, Reproductive Health Surveys, and AIDS Indicator Surveys.<sup>1,2</sup>

AIDS Indicator Surveys were introduced to provide countries with generalized HIV epidemics with a standardized tool to provide indicators for effective monitoring of HIV/AIDS. These data are key to ensuring an informed response to the HIV epidemic and allow for comparisons across time and settings.<sup>2</sup> This article reviews the key findings of Kenya's first and second AIDS Indicator Surveys (KAIS 2007 and KAIS 2012) and explores how findings from AIDS Indicator Surveys can influence changes in national HIV policy.

## KENYA AIDS INDICATOR SURVEY 2007

### Study Design

KAIS 2007 was a population-based, cross-sectional household survey that used a 2-stage stratified cluster sampling design to obtain a nationally representative sample of persons aged 15–64 years.<sup>3</sup> The first stage included selection of clusters from the National Sample Survey and Evaluation Programme (NASSEP IV) household-based sampling frame, developed in 1999; the second stage included selecting a sample of 25 households within each selected cluster. The sample was powered so that the survey could provide national and subnational estimates of HIV prevalence, including regional and urban/rural residential estimates. Household questionnaires were administered to the head of household to identify eligible household members and capture household characteristics. Household members were administered individual questionnaires to collect information on demographic, behavior, knowledge, and access to services. Blood specimens were collected for centralized testing for HIV, syphilis, and herpes simplex virus type 2 infections and CD4 counts for HIV-positive samples.

Before KAIS 2007, only one other national household survey had been conducted that included HIV testing: the 2003 Kenya Demographic and Health Survey (KDHS 2003).<sup>4</sup> Key differences in KAIS 2007 compared to KDHS 2003 were the expansion of the national sample to an upper age limit of 64 years, serological testing for herpes simplex virus type 2

and syphilis infection, CD4 count measurement among HIV-infected participants, new questions about knowledge of participants' own and their partners' HIV status, assessment of access to care, treatment, and prevention services, and estimation of the number of persons in need of ART and related care services.

### Key Findings and Public Health Policy Implications

Key findings from KAIS 2007 resulted in important changes to the national HIV program in the areas of HIV prevention, care, and treatment. In Table 1, we summarize these findings and how HIV programming and policy have changed in response to these data.

**HIV Epidemiology**—KAIS 2007 found that 7.1% of Kenyans aged 15–64 years and 7.4% of those aged 15–49 years were infected with HIV.<sup>3</sup> There was disproportionate distribution of HIV infection by sex and age; women had nearly 30% more infections than men of the same age, with the difference more pronounced in younger women. There was regional variation in HIV prevalence, ranging from a high of 14.9% in Nyanza region to a low of 0.8% in North Eastern region. HIV prevalence was higher among urban residents (8.4%) than rural residents (6.7%).<sup>3</sup> Among married and cohabiting couples, 5.9% were HIV serodiscordant, where one partner was HIV infected and the other was HIV uninfected.<sup>3</sup> This translated to approximately 340,000 discordant couples in the country.<sup>4</sup>

Serologic testing for recent infection showed stable HIV incidence among persons aged 15–49 years, ranging from 0.8–1.0% in 2003 to 0.6–0.7% in 2007.<sup>6</sup> In 2007, the majority of recent infections (85.6%) were detected in married or cohabiting individuals, broadly consistent with findings from the Joint United National Program on HIV/AIDS modes of transmission model that suggested that almost half (44%) of new infections in 2006 were occurring among persons in marital or cohabiting relationships in Kenya.<sup>7</sup>

Results from KAIS 2007 confirmed that the HIV epidemic in Kenya was stable but substantial. With approximately 1,400,000 persons living with HIV in 2007, it was evident that significant revisions to the national strategy for HIV prevention, care, and treatment were needed to change the trajectory of the epidemic.

**HIV Testing and Knowledge of HIV Serostatus**—HIV testing and counseling is essential for identifying HIV-infected persons and linking them to vital interventions, including prevention of mother-to-child transmission of HIV (PMTCT) programs and care and treatment services. In KAIS 2007, wide gaps were revealed in HIV testing and knowledge of HIV serostatus. The survey reported that only 36.6% of Kenyan adults had been tested for HIV; women (44.6%) were nearly 2 times more likely to have been tested for HIV than men (25.6%).<sup>3</sup> Among HIV-infected persons, 83.6% did not know they were infected.<sup>8</sup> Additionally, 77.9% of those who reported one or more sexual partners in the past 12 months did not know their partners' HIV status.

Following these results, the Kenyan Ministry of Health (MOH) developed the National Guidelines for HIV Counselling and Testing in 2008, replacing the earlier National Guidelines for Voluntary Counselling and Testing (VCT) and Guidelines for Testing in Clinical Settings.<sup>9</sup> These updated recommendations diversified HIV testing using

approaches that brought testing services directly to the client rather than relying on clients to seek testing on their own. New HIV testing approaches included provider-initiated testing and counseling in health care settings, home-based testing and counseling (HBTC), mobile VCT, and outreach activities aimed to test a large number of persons in the community within a short period of time.

**Sexual Behavior**—In 2001, the Kenyan MOH implemented its first national condom policy and strategy document covering the period 2001–2004.<sup>10</sup> However, results from KAIS 2007 highlighted major challenges in this strategy, particularly around the use of condoms among sexually active persons.<sup>3</sup> Among persons who reported not knowing their sexual partners' HIV status, condom use with these partners was only 14.1% among men and 4.8% among women. Among youth aged 15–24 years, 26.7% reported using a condom the first time they had sexual intercourse.

Following KAIS 2007, behavior change interventions among in- and out-of-school youth were expanded and focused on sexual risk reduction, delaying sexual debut, and imparting skills on how to negotiate abstinence as well as correct and consistent condom use. In addition, the MOH issued a policy statement emphasizing the importance of a sustainable condom supply to ensure universal access to condoms for all sexually active persons. Subsequently, from 2007 to 2009, the annual number of male condoms distributed increased by about 30%, with approximately 15 million condoms distributed per month.<sup>11</sup>

**Voluntary Male Medical Circumcision**—Between 2005 and 2007, unequivocal evidence from randomized clinical trials in sub-Saharan Africa demonstrated a significant protective effect of male circumcision against HIV acquisition.<sup>12–14</sup> KAIS 2007 supported these findings on a population level, showing that uncircumcised men were at least 3 times as likely to be infected with HIV (13.2%) than circumcised men (3.9%). Nationally, 85.0% of men reported being circumcised. However, circumcision rates were much lower in Nyanza region (48.2%) where HIV prevalence was highest.<sup>3</sup>

In 2008, the Kenyan MOH implemented a new 5-year national strategy for voluntary male medical circumcision (VMMC), with a specific focus on 4 VMMC priority regions in the country: Nyanza, Western, Rift Valley, and Nairobi.<sup>15</sup> By year-end 2012, it was estimated that more than 550,000 male circumcisions were performed, with 80% of these in Nyanza region alone (Personal communication, Kenya Ministry of Health, June 26, 2013).

**HIV Care and Treatment**—Among all persons aged 15–64 years living with HIV in 2007, only 12.1% of persons were taking daily cotrimoxazole and only 40.5% of adults eligible to initiate treatment based on the immunologic criterion at that time (CD4 < 250 cells/ $\mu$ L) were receiving ART.<sup>3</sup> Coverage of ART based on a criterion of CD4 < 350 cells per micro-liter (which was not applicable at that time) was 28.6%. Among persons who were aware of their HIV infection, use of care and treatment was higher, with 76.1% taking cotrimoxazole daily and 91.6% of ART-eligible adults currently receiving ART.<sup>3</sup>

With only 1 in 8 HIV-infected persons aware of their HIV infection in 2007, KAIS 2007 demonstrated that HIV testing and treatment goals were far from being reached. The

revision of national guidelines for HIV testing and counseling in 2008<sup>8</sup> was instrumental in assuring increased identification of HIV-positive persons. Through expansion of facility-based testing strategies, direct and increased linkages to care programs were established. Decentralization of CD4 testing was expanded, allowing for more facilities at the district level to quickly identify patients in need of treatment. Subsequently, between 2008 and 2012, the number of children and adults receiving HIV-related care increased from approximately 151,000 to 857,000 and the number of children and adults receiving ART increased from 216,000 to 579,000.<sup>16</sup>

## KENYA AIDS INDICATOR SURVEY 2012

### Study Design

In 2012, 5 years after KAIS 2007, a second AIDS Indicator Survey was conducted to monitor progress on key indicators in the national HIV prevention, care, and treatment programs (Table 1). KAIS 2012 used the same sampling methods and laboratory-based HIV testing algorithm as KAIS 2007.<sup>17</sup> A  $z$  test was used to test for differences in estimates between the 2 surveys, and the difference was considered statistically significant if  $P$  was  $<0.05$ .

### Key Differences Between KAIS 2007 and KAIS 2012

KAIS 2012 was different from KAIS 2007 in several aspects. The survey used a new national household sampling frame (NASSEP V), developed in 2012, to sample households. However, due to regional insecurity at the time of the sampling frame development, the sparsely populated North Eastern region was not included in the sampling frame and, thus, was excluded from KAIS 2012. For the first time, the survey included children aged 18 months to 14 years to provide national estimates of HIV prevalence for the pediatric population. Children aged 10–14 years were also interviewed to understand knowledge, attitudes, and behavior in this population in relation to HIV. For persons aged 15–64 years, new questions on high-risk sexual behavior, including transactional sex, anal sex, same-sex behavior, injection drug use, and correct and consistent condom use, were added.

Blood samples were collected from all individuals for centralized HIV testing, and if HIV-positive, testing for CD4 counts and viral load were conducted. In contrast to KAIS 2007, where participants were provided their test results in a nearby health facility 6 weeks after survey teams visited their home, home-based HIV testing and counseling, using rapid HIV tests based on the national HIV testing algorithm, was offered to participants who wished to learn their HIV status on the day of the survey.<sup>8</sup> In addition, point-of-care CD4 testing using the PIMA CD4 Analyzer (Alere, Inc., Waltham, MA) was offered for persons who were found to be HIV infected in home-based testing and counseling.

KAIS 2012 also used portable netbook computers (Mirus Innovations, Mississauga, Ontario, Canada) to collect data in the field. Data were transmitted to a central data server in Nairobi using a secure virtual private network, allowing for increased efficiency and accuracy in data collection and data management.<sup>18</sup>

## Key Findings and Public Health Policy Implications

**HIV Epidemiology**—In 2012, the prevalence of HIV among children aged 18 months to 14 years was 0.9%, representing an estimated national total of 104,000 HIV-infected children.<sup>19</sup> Among adults and adolescents aged 15–64 years, the prevalence of HIV was 5.6%, representing an estimated 1,192,000 persons living with HIV, 106,000 of which were new HIV infections.<sup>20</sup> This estimate was significantly lower than that reported in 2007 when the prevalence of HIV, excluding North Eastern region, was 7.2% ( $P = 0.002$ ).

HIV prevalence was 6.9% among women and 4.4% among men. In urban areas, HIV prevalence was 6.5% compared to 5.4% in rural areas. Regional variations in HIV prevalence persisted, with the highest prevalence in Nyanza region (15.1%) and lowest in the Eastern South (2.1%) region. Overall, 4.8% of married and cohabiting couples were HIV serodiscordant, where either the male or female partner was HIV infected, representing an estimated 260,000 HIV-uninfected persons at risk for HIV transmission within marital or cohabiting relationships.<sup>21</sup> Among HIV-infected persons, 11.6% reported ever having had tuberculosis, and among persons with a history of tuberculosis disease, 33.2% were HIV infected.<sup>22</sup>

In the absence of a surveillance system that monitors new HIV infections and HIV-related deaths, trends in HIV prevalence are increasingly difficult to interpret in the face of increased access to ART that reduces mortality. As HIV interventions and services continue to be scaled-up, routine surveillance of HIV incidence and HIV mortality will need to be integrated into the national HIV surveillance system to understand trends and programmatic impact. This should allow determination of which services are required in specific populations and locations for a more efficient and effective response.

**HIV Testing and Knowledge of HIV Status**—Impressive strides in HIV testing and counseling were observed between 2007 and 2012, with HIV testing rates doubling from 33.6% in 2007 to 71.6% in 2012 ( $P < 0.001$ ) (Table 1).<sup>23</sup> Women surpassed the universal access target for HIV testing, with 80.4% of women reporting that they had ever been tested compared to 62.5% of men. Among persons living with HIV, correct knowledge of HIV infection tripled from 16.4% in 2007 to 46.9% in 2012 ( $P < 0.001$ ).<sup>3,22</sup> Despite this progress, over half of HIV-infected persons were not aware of their infection. This level of awareness represents a major barrier to HIV prevention, care, and treatment. Significant work is needed to increase diagnosis of HIV-infected persons and to educate the general public on when to re-test for HIV. All facility and community-based testing approaches should be expanded and new strategies, such as family testing and self-testing (currently available in private facilities), should be promoted in efforts to improve access among men and children.

**High-Risk Behavior**—Between 2007 and 2012, the proportion of persons reporting a recent partner of unknown HIV status reduced substantially from 77.9%<sup>3</sup> to 46.4% (Personal communication, Kenya Ministry of Health, December 10, 2013). However, condom use with partners of unknown HIV status in the past year remained low, with only 11.8% of men and 3.8% of women reporting that they used condoms with these partners. Among youth

aged 15–24 years, 62% reported using a condom at first sexual intercourse, a substantial increase from KAIS 2007 when only 26.7% of youth reported this behavior.<sup>3</sup>

These data demonstrate encouraging improvement in behavior change among youth, coinciding with declines in HIV prevalence in this age group.<sup>20</sup> However, condom use among adults remained lower than desired. Recognizing that condom use within established relationships is difficult, condom use messages should be emphasized for populations where risk is elevated, including unmarried youth and persons engaging in high-risk or casual sex. To meet these goals, it is critical that Kenya's condom supply and distribution in the county work toward better sustainability to ensure that all sexually active persons have access to condoms.

Although a national household survey sampling frame is not optimal for capturing key populations at high risk for HIV infection, such as men who have sex with men, persons who inject drugs, and persons who engage in transactional sex, KAIS 2012 did identify persons who were engaging in these high-risk behaviors. A history of anal sex was reported by 1.8% of men and women (Personal communication, Kenya Ministry of Health, December 10, 2013). Among men, 0.6% reported ever having had sex with another man; 3.1% had ever received money, gifts, or favors for sex.<sup>24</sup> Among women, 4.1% had received money, gifts, or favors in exchange for sex. Overall, 0.1% of men and women had ever injected illicit drugs.<sup>23,24</sup> Given the established role of key populations at high risk for HIV infection in HIV epidemics, HIV testing services should expand to reach key populations, many of whom are hidden. These services should also ensure immediate linkages to HIV prevention, care, and treatment services.

**Voluntary Male Medical Circumcision**—The proportion of men who reported being circumcised increased significantly from 85.0% in 2007 to 91.2% in 2012 ( $P < 0.001$ ).<sup>25</sup> Significant increases were observed in the 4 priority regions within the national VMMC strategy: Nyanza (from 48.2% to 66.3%,  $P < 0.001$ ), Nairobi (from 83.2% to 92.2%,  $P < 0.001$ ), Rift Valley (88.7% to 92.8%,  $P = 0.001$ ), and Western regions (87.8% to 92.9%,  $P < 0.001$ ). Circumcision rates increased among men aged 15–24 years, from 78.7% in 2007 to 88.1% in 2012 ( $P < 0.001$ ) and for men aged 25–34 years from 87.4% in 2007 to 93.4% in 2012 ( $P < 0.001$ ).

These findings demonstrate substantial population-level advancement toward bringing VMMC to scale within a short period. Rapid results initiatives, aimed to reach many people within a short period, have helped to quickly increase access to VMMC. Continued work is needed, especially in Nyanza region, to bring male circumcision rates higher. In moving forward, integration of VMMC into routine maternal and child health services and scale-up of infant circumcision services is expected to maximize the long-term public health impact of VMMC on the broader HIV epidemic.

**Prevention of Mother-to-Child Transmission**—Family planning to prevent unplanned pregnancies is a key element in the national PMTCT strategy. KAIS 2012 established that unmet need for family planning among HIV-infected women was high, with only 68.7% of

HIV-infected women who did not desire children in the future reporting that they used some form of contraception compared with 52.0% in 2007 ( $P = 0.07$ ).<sup>26</sup>

Among female respondents aged 15–54 years who reported 1 or more live births in the past 5 years, 95.4% attended an antenatal clinic during their last pregnancy; of these, 93.1% were tested for HIV at the clinic. This was higher than reported in KAIS 2007 when 89.6% of women had attended an antenatal clinic during their last pregnancy ( $P < 0.001$ ), and 64.9% of these women had been tested for HIV as part of antenatal care ( $P < 0.001$ ).<sup>3,27</sup> Among women who tested HIV-positive or were already aware of their HIV infection, 90.1% received maternal or infant prophylaxis for PMTCT during pregnancy and/or during postpartum, and of the infants born to these mothers, 82.5% were tested for HIV infection. The cumulative 5-year mother-to-child transmission rate based on the mother's report was 15.1% (95% confidence interval: 2.4 to 27.8).<sup>27</sup>

The elimination of mother-to-child transmission framework is an important element in the Government of Kenya strategy to achieve elimination of mother-to-child transmission in Kenya by 2015.<sup>28</sup> Provision of ART for all HIV-infected pregnant women (“Option B+”), regardless of whether diagnosis is made during pregnancy, labor, and delivery, or postnatally, will be a critical step in achieving these goals. To address the gap in family planning for HIV-infected women, there is need for wider integration of family planning services in PMTCT programs, maternal and child health, and reproductive health services.

**HIV Care and Treatment**—In 2012, coverage of cotrimoxazole was 41.5% among all HIV-infected persons aged 15–64 years.<sup>21</sup> Coverage of ART was 60.5% among those eligible for treatment using the current Kenyan treatment guidelines (based on an immunologic threshold of CD4 350 cells per microliter), and 45.9% using the 2013 World Health Organization guidelines on treatment initiation (based on an immunologic threshold of CD4 500 cells per microliter).<sup>29–31</sup> Although these coverage rates highlight gaps in the continuum of care for HIV-infected persons, they represent significant improvement from 2007, when coverage for cotrimoxazole was only 12.1% ( $P < 0.001$ ) among HIV-infected persons and coverage for ART at an immunologic threshold of CD4 350 cells per microliter was only 28.6% ( $P < 0.001$ ).<sup>3</sup> We found that linkage to care among persons who had been previously diagnosed with HIV infection to be high, at 89.9%.<sup>32</sup> Equally impressive, we found that three-quarters (75.3%) of persons in care and on ART had achieved viral suppression, comparable to levels observed in developed countries. In contrast, among all persons living with HIV (including those undiagnosed and not in care), only 40.0% achieved viral suppression, indicating that widespread transmission risks persists in the population.<sup>21</sup>

For the first time in a national survey, we were able to estimate the population size of orphans and vulnerable children due to HIV/AIDS. We estimated that there were approximately 2.6 million orphans and vulnerable children in 2012, of whom approximately 7 in 10 were orphaned and 3 in 10 were vulnerable.<sup>33</sup> We also found that testing, care, and treatment among HIV-infected children between the ages of 18 months and 14 years to be concerning. Only 11 of 28 HIV-infected children in KAIS 2012 had been diagnosed previously, and although all children with previous diagnosis were accessing care, only 8 were receiving ART, and of those, only half had achieved viral suppression.<sup>19</sup>

As Kenya moves forward in response to these findings and with anticipated changes in the national treatment guidelines, it will be critical for the country to evaluate the readiness of facilities to absorb a higher number of patients and ensure that the quality of care and ability to monitor adherence, drug resistance, and treatment success are not compromised. Viral load monitoring should be routinely conducted and decentralized to improve the quality of care. The national early infant diagnosis program should also be carefully evaluated and monitored to ensure that all HIV-infected children are diagnosed and linked into care. In addition, further emphasis should be directed toward understanding the cascade of care through establishment of routine monitoring and evaluation systems that allow for following cohorts of HIV-infected persons from the point of diagnosis to death.

## DISCUSSION

AIDS Indicator Surveys have proven instrumental in assessing Kenya's national HIV response. Results from KAIS 2007 and KAIS 2012 have helped to redesign elements in the national strategy for HIV prevention, treatment, and care to address deficiencies and seize opportunities as new interventions have been introduced. With nearly 1.2 million people living with HIV in 2012, continued refinement of national strategies and policies will be required to impact the HIV/ AIDS epidemic in Kenya. Based on the results of KAIS 2012, these strategies should include more effective identification of HIV-infected persons in settings that will provide high yield and immediate linkage to care. The unmet need for family planning and provision of life-long ART for HIV-infected pregnant women will be essential for eliminating pediatric HIV disease. Prevention efforts must encompass provision of ART for HIV-infected partners in serodiscordant couple relationships. On the laboratory front, implementation of routine viral load monitoring, improvements in early infant diagnosis, and enhanced HIV drug resistance monitoring will be required. In addition, we anticipate scale-up of infant circumcision services in priority regions, as well as provision of universal ART for children younger than 5 years of age.

Kenya is currently undergoing the process of devolving control and management of government services, including health, to 47 counties. Devolution, mandated through the revised Kenya Constitution, presents an opportunity to ensure efficiency and effectiveness of these interventions but will require close monitoring at the national level in the early stages of devolvement.

The next KAIS, planned for 2017, will be conducted towards the end of the implementation period of the Kenya National AIDS Strategic Plan IV, which begins in 2014. KAIS 2017 will therefore provide essential information to evaluate the impact of the new HIV prevention, care, and treatment strategies laid out in the new national strategic plan. The next KAIS should also be leveraged to assess other health outcomes that may be associated with HIV disease such as tuberculosis, malaria, and malnutrition. These efforts will help to reduce costs by combining disease surveillance efforts, improving integration across the health sector, and allowing assessment of the extent to which HIV/AIDS services have strengthened health systems.

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TABLE 1

Key Indicators and Programmatic Changes in the National HIV Response in Kenya, Kenya AIDS Indicator Survey 2007 and 2012

Programmatic Indicator	KAIS 2007		KAIS 2012	
	Weighted % (95% CI)	Programmatic Changes After KAIS 2007	Weighted % (95% CI)	Programmatic Implications After KAIS 2012
<b>HIV testing and counseling</b>				
% of persons aged 15–64 yrs who have ever been tested for HIV	36.6 (35.2 to 38.0)	Revision of national guidelines on HIV testing and counseling with emphasis on modalities that bring services to the client (eg, provider-initiated counseling and testing, HBTC)	71.6 (70.2 to 73.1)*	Scale-up of all testing strategies, with focus on reaching men and children; more emphasis on identifying HIV-infected key populations and linking them to care; provision of ART for HIV-infected persons in HIV serodiscordant relationships
% of HIV-infected persons aged 15–64 yrs who were aware of their HIV infection	16.4 (13.2 to 19.6)		46.9 (41.3 to 52.4)*	
% of persons aged 15–64 yrs reporting a partner of unknown HIV status in the past year	77.9 (76.6 to 79.1)		46.4 (44.7 to 48.1)*	
% of married or cohabiting couples that are HIV discordant	5.9 (4.4 to 7.3)		4.8 (3.6 to 6.1)	
<b>VMMC</b>				
% of men aged 15–64 yrs who have been circumcised	National: 85.0 (83.2 to 86.8)	Implementation of national 5-year VMMC strategic plan, 2008–2013, with focus on rapid results initiatives in priority regions of Nairobi, Nyanza, Rift Valley, and Western	National: 91.2 (89.7 to 92.7)*	Scale-up of infant circumcision strategies and evaluation of devices
	Nyanza: 48.2 (42.0 to 54.3)		Nyanza: 66.3 (57.0 to 75.6)*	
	Nairobi: 83.2 (79.9 to 90.5)		Nairobi: 92.2 (89.0 to 95.4)*	
	Rift Valley: 88.7 (85.4 to 91.9)		Rift Valley: 92.8 (90.8 to 94.9)	
	Western: 87.8 (82.0 to 93.5)		Western: 92.9 (89.2 to 96.7)	
<b>PMTCT of HIV</b>				
% of women aged 15–54 yrs who attended an antenatal clinic during last pregnancy in the past 5 yrs	89.6 (88.1 to 91.2)	Expansion of PMTCT programs in medical facilities that offer prenatal or obstetrical care	95.4 (94.3 to 96.4)*	Provision of lifelong ART for pregnant women regardless of CD4 count; integration of family planning in PMTCT, maternal and child health, and reproductive health services
% of women aged 15–54 yrs that tested for HIV at antenatal clinic during last pregnancy in the past 5 yrs	64.9 (62.3 to 67.5)		93.1 (91.5 to 94.7)*	
% of women aged 15–49 yrs with known HIV infection and who do not desire children who were using contraception	52.0 (36.8 to 67.1)		68.7 (58.9 to 87.5)	
<b>Condom use</b>				
Consistent condom use among persons aged 15–64 yrs with partners of unknown HIV serostatus in the past year	14.1 (12.7 to 15.4) among men	Implementation of behavioral interventions, especially among youth	11.8 (10.7 to 13.0) among men	Emphasis around condom use for unmarried youth and for high risk and casual sex
	4.8 (4.0 to 5.6) among women		3.5 (2.9 to 4.1) among women	
Condom use at first sex among youth aged 15–24 yrs	26.7 (24.7 to 28.6)		61.9 (58.8 to 64.9)*	
Cotrimoxazole coverage among HIV-infected persons				

Programmatic Indicator	KAIS 2007		KAIS 2012	
	Weighted % (95% CI)	Programmatic Changes After KAIS 2007	Weighted % (95% CI)	Programmatic Implications After KAIS 2012
Coverage among HIV- infected persons aged 15–64 yrs who were aware of their HIV infection	76.1 (68.4 to 83.8)	Decentralization of HIV care services	88.6 (84.7 to 92.5)*	Improving adherence to clinical care guidelines among pre-ART population
Coverage among all HIV-infected adults aged 15–64 yrs	12.1 (9.3 to 15.0)		41.5 (36.2 to 46.8)*	
ART coverage among HIV- infected persons eligible for treatment <sup>†</sup>		Implementation of revised national guidelines for ART (CD4 > 350 cells/ μL, active tuberculosis, and chronic Hepatitis B virus infection requiring treatment). Decentralization of CD4 monitoring		Implementation of revised national guidelines for ART (CD4 > 500 cells/μL, all pregnant and breastfeeding women, active tuberculosis, chronic Hepatitis B virus infection requiring treatment, and children younger than 5 yrs); expansion of early infant diagnosis, routine viral load monitoring, and cohort analysis
Coverage among persons aged 15–64 yrs who were aware of their HIV infection	91.6 (86.0 to 97.2)		84.5 (75.2 to 93.7)	
Coverage among HIV- infected persons aged 15– 64 yrs	40.5 (32.2 to 48.8)		60.5 (50.8 to 70.2)*	

\* Difference between KAIS 2007 and KAIS 2012 is statistically significant based on  $P < 0.05$ .

<sup>†</sup> Immunological criterion for ART eligibility was CD4 > 250 cells per microliter in 2007 and CD4 > 350 cells per microliter in 2012.

CI, confidence interval.