Engagement in HIV Care Among Kenyan Adults and Adolescents: Results From a National Population-Based Survey

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Background: Increasing access to care and treatment for HIV-infected persons is a goal in Kenya's response to the HIV epidemic. Using data from the second Kenya AIDS Indicator Survey (KAIS 2012), we describe coverage of services received among adults and adolescents who were enrolled in HIV care.

Methods: KAIS 2012 was a population-based survey that collected information from persons aged 15–64 years that included self-reported HIV status, and for persons reporting HIV infection, use of HIV care and antiretroviral therapy (ART). Blood specimens were collected and tested for HIV. HIV-positive specimens were tested for CD4 counts and viral load.

Results: Among 363 persons who reported HIV infection, 93.4% [95% confidence interval (CI): 87.2 to 99.6] had ever received HIV care. Among those receiving HIV care, 96.3% (95% CI: 94.1 to 98.4) were using cotrimoxazole prophylaxis, and 74.6% (95% CI: 69.0 to 80.2) were receiving ART. A lower proportion of persons in care and not on ART reported using cotrimoxazole (89.5%, 95% CI: 82.5 to 96.5 compared with 98.6%, 95% CI: 97.1 to 100) and had a CD4 count measurement done (72.9%, 95% CI: 64.0 to 81.9 compared with 90.0%, 95% CI: 82.8 to 97.3) than persons in care and on ART, respectively. Among persons in care and not on ART, 23.2% (95% CI: 6.8 to 39.7) had CD4 counts ≤350 cells per microliter. Viral suppression was observed in 75.3% (95% CI: 68.7 to 81.9) of persons on ART.

Conclusions: Linkage and retention in care are high among persons with known HIV infection. However, improvements in care for the pre-ART population are needed. Viral suppression rates were comparable to developed settings.

Key Words: HIV, viral suppression, antiretroviral therapy, cotrimoxazole, Kenya

(*J Acquir Immune Defic Syndr* 2014;66:S98–S105)

INTRODUCTION

With an estimated 23.5 million people living with HIV in sub-Saharan Africa by year-end 2012, HIV remains one of the most serious health problems in the region.[1] Timely access to HIV care and treatment significantly reduces HIV-related morbidity and improves survival for HIV-infected persons.[2,3] In June 2011, the United Nations General Assembly High Level Meeting on AIDS reaffirmed the urgent need for universal access to HIV treatment by 2015.[4] During the early years of treatment scale-up in sub-Saharan Africa, attention was focused on initiating eligible patients on antiretroviral therapy (ART). Since then, efforts to maintain patients on treatment and to ensure sustained viral suppression have become priorities.[5]

In 2012, an estimated 1.2 million adults and adolescents aged 15 years to 64 years were living with HIV in Kenya.[6] In 2011, the Kenyan government estimated that over 60% of persons diagnosed with HIV were receiving care,[7] and in 2012, they estimated that 61% of treatment-eligible adults were receiving ART.[7,8] The Kenya National AIDS Strategic Plan calls for increasing and sustaining care and treatment among HIV-infected persons to reduce HIV-related morbidity and mortality, HIV transmission, the number of new HIV infections, and the socio-economic impact of HIV.[9] The

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KAIS 2012 was supported by the National AIDS and STI Control Programme (NASCOP), Kenya National Bureau of Statistics (KNBS), National Public Health Laboratory Services (NPHLS), National AIDS Control Council (NACC), National Council for Population and Development (NCPD), Kenya Medical Research Institute (KEMRI), U.S. Centers for Disease Control and Prevention (CDC/Kenya, CDC/Atlanta), United States Agency for International Development (USAID/Kenya), University of California, San Francisco (UCSF), Joint United Nations Team on HIV/AIDS, Japan International Cooperation Agency (JICA), Elizabeth Glaser Paediatric AIDS Foundation (EGPAF), Liverpool Voluntary Counselling and Testing (LVCT), African Medical and Research Foundation (AMREF), World Bank, and Global Fund. This publication was made possible by support from the U.S. President's Emergency Plan for AIDS Relief through cooperative agreements [PS001805, GH000069, and PS001814] from the U.S. Centers for Disease Control and Prevention, Division of Global HIV/AIDS. This work was also funded in part by support from the Global Fund, World Bank, and the Joint United Nations Team for HIV/AIDS.

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention and the Government of Kenya.

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Government of Kenya conducted a second Kenya AIDS Indicator Survey (KAIS 2012) to collect nationally representative data on HIV indicators including use of HIV-related care and treatment services among persons who were aware of their infection. Here, we report HIV care and treatment coverage among HIV-infected persons who were aware of their HIV infection in KAIS 2012.

METHODS

Study Design, Sampling, and Population

KAIS 2012 was a national, population-based, cross-sectional household survey of adults and children aged 18 months to 64 years conducted from October 2012 through February 2013. KAIS 2012 included 9 of 10 programmatic regions in Kenya; the North Eastern region was not sampled because of regional insecurity. The KAIS 2012 methods have been presented in detail elsewhere.[10] Household and individual questionnaires were administered to eligible and consenting respondents by trained interviewers. Information obtained included household and demographic characteristics, HIV testing history and status, and, among persons who reported HIV infection, use of HIV care and treatment services. Data were collected onto tablet computers (Mirus Innovations, Mississauga, Ontario, Canada) and transmitted electronically from the field to a central database in Nairobi without personally identifying information using a virtual private network. In this article, we limited our analysis to persons aged 15–64 years who self-reported having HIV infection.

Laboratory technicians collected whole blood samples from participants using CD4 stabilization tubes [Becton Dickinson (BD) Vacutainer Systems, Franklin Lakes, NJ]. At the end of each day, whole blood was used to prepare up to 4 S&S 903 dried blood spot (DBS) cards per participant using 50 μL of blood per spot (Schleicher & Schuell Bioscience Inc, Keene, NH). DBS samples were dried overnight on a drying rack, which was maintained at ambient temperature. CD4 stabilization tubes and DBS were transported several times a week to the National HIV Reference Laboratory (NHRL). At NHRL, DBS specimens were tested for HIV antibodies (Vironostika HIV-1/2 UNIF II Plus O Enzyme Immunoassay; BioMerieux, Marcy d'Etoile, France, and Murex HIV1.2.0 HIV Enzyme Immunoassay; DiaSorin, SpA, Saluggia, Italy). Specimens that tested HIV-positive were tested for $CD4^+$ T-cell counts using the BD FACSCalibur flow cytometer (Becton Dickinson Biosciences, San Jose, CA) on whole blood samples within 7 days of blood collection. HIV-positive specimens were also tested for HIV RNA concentration using the Abbott M2000 Real-Time HIV-1 Assay (Abbott Laboratories, Abbott Park, IL) on DBS specimens. Because of hemolysis during transport, more than half (53.8%) of the HIV-positive specimens received at NHRL could not be tested for $CD4^+$ T-cell counts.[10]

Measures

We classified subjects as ever in care if they reported that they had ever attended a clinic to receive HIV care. Subjects were classified as currently receiving HIV care if they reported attending the clinic within the previous 6 months. Subjects who reported that they had attended the clinic within the previous 3 months were classified as being retained in HIV care. Subjects who reported that they had never received HIV care or who reported they had received care in the past but not in the previous 6 months were classified as not currently receiving HIV care. Persons who reported using ART at the time of the survey were classified as currently using ART, and persons who indicated that they had never received ART or had received ART in the past but were not currently using ART were classified as not using ART. Persons were considered eligible for ART if their $CD4^+$ T-cell count was 350 cells per microliter or less and virally suppressed if HIV RNA concentration was <1000 copies per milliliter.[11]

Data Analysis

To obtain nationally representative estimates from the sample, we calculated sampling weights for each individual and household based on selection probability, taking into account cluster-level nonparticipation for both the interview and blood specimen collection. These weights were used to calculate weighted percentages with 95% confidence intervals (CI). We used the Rao–Scott χ^2 test to measure associations between categorical predictor and outcome variables. Associations were considered significant if the P value was <0.05. All analyses were performed in SAS version 9.3 (SAS Institute Inc., Cary, NC) using the SURVEYFREQ procedure to take into account the stratified cluster design of the survey.

Ethical Approval

This survey protocol and activities were reviewed and approved by the Kenya Medical Research Institute's Ethical Review Committee, the United States Centers for Disease Control and Prevention's Institutional Review Board, and the Committee on Human Research of the University of California, San Francisco.

RESULTS

We identified 16,383 potential participants aged 15–64 years and interviewed 13,720 (83.7%). Three hundred sixty-three (2.7%, 95% CI: 2.2 to 3.1) reported that they were previously diagnosed with HIV. Of these, 68.8% (95% CI: 64.0 to 73.7) were women, 32.7% (95% CI: 27.5 to 37.9) were aged 30–39 years, 61.1% (95% CI: 54.4 to 67.9) were married or cohabiting, 41.9% (95% CI: 36.1 to 47.6) reported a primary school education or less, and 63.0% (95% CI: 56.8 to 69.2) had been employed in the past year (Table 1). The majority resided in rural areas (59.4%, 95% CI: 50.8 to 67.9). Relatively equal proportions of HIV-infected persons fell within the second and third lowest wealth quintiles (25.8%, 95% CI: 18.5% to 33.2% and 24.3%, 95% CI: 18.6 to 30.0, respectively). Just over one-third (35.3%, 95% CI: 28.7 to 41.9) had been diagnosed with HIV infection within the 24 months preceding the survey. Overall 89.9% (95% CI:

TABLE 1. Characteristics of Adults and Adolescents Who Self-Reported Being HIV Infected, Kenya AIDS Indicator Survey 2012

	Total Unweighted, N = 363			
Variable	**Unweighted, n***	**Unweighted, %**	**Weighted %**	**95% CI**
Sex				
Men	91	25.1	31.2	26.3 to 36.0
Women	272	74.9	68.8	64.0 to 73.7
Age group, yrs				
15–29	77	21.2	20.5	15.9 to 25.2
30–39	124	34.2	32.7	27.5 to 37.9
40–49	98	27.0	29.0	23.3 to 34.7
>50	64	17.6	17.7	13.4 to 22.1
Marital status				
Ever widowed	83	22.9	21.6	16.3 to 26.8
Married/cohabiting	212	58.4	61.1	54.4 to 67.9
Others	68	18.7	17.3	12.9 to 21.7
Highest educational attainment				
Primary or less	162	44.6	41.9	36.1 to 47.6
Secondary/vocational	82	22.6	23.8	18.2 to 29.5
College	119	32.8	34.3	27.8 to 40.8
Employed				
Yes	226	62.2	63.0	56.8 to 69.2
No	137	37.7	37.0	30.8 to 43.2
Region				
Nairobi	37	10.2	8.4	5.6 to 11.2
Central	34	9.4	8.7	5.1 to 12.4
Coast	33	9.1	6.5	3.2 to 9.8
Eastern	38	10.5	9.6	5.3 to 14.0
Nyanza	145	39.9	40.0	31.3 to 48.8
Rift Valley	36	9.9	15.4	8.4 to 22.4
Western	40	11.0	11.3	5.6 to 17.0
Residence				
Rural	211	58.1	59.4	50.8 to 67.9
Urban	152	41.9	40.6	32.1 to 49.2
Religious affiliation				
Christian	336	92.6	94.0	90.1 to 97.9
Muslim	13	3.6	1.4	0.3 to 2.4
No religion/other	14	3.9	4.7	0.8 to 8.5
Wealth index				
Poorest	51	14.0	14.7	9.5 to 19.9
Second	92	25.3	25.8	18.5 to 33.2
Third	84	23.1	24.3	18.6 to 30.0
Fourth	84	23.1	21.4	15.4 to 27.5
Richest	52	14.3	13.7	8.9 to 18.5
Time since diagnosis, months†				
≤24	108	35.8	35.3	28.7 to 41.9
25–48	66	21.9	20.5	15.5 to 25.6
49–72	61	20.1	21.4	16.5 to 26.2
>72	67	22.2	22.8	17.7 to 28.0
HIV care status				
Currently in care	326	89.8	89.9	86.0–93.7
In care in past, but not currently in care	10	2.8	3.5	1.2 to 5.9
Never in care	27	7.4	6.6	4.0 to 9.2

*Because of missing responses totals vary between variables.
†Data missing for 61 records.

TABLE 2. Characteristics of HIV-Infected Adults and Adolescents Who Were Currently Receiving HIV Care, Kenya AIDS Indicator Survey 2012

	Total, N = 326		
Variable	**Unweighted, n***	**Weighted %**	**95% CI**
Total			
Sex			
Men	79	30.2	25.0 to 35.4
Women	247	69.8	64.6 to 75.0
Age group, yrs			
15–29	62	18.4	13.8 to 23.1
30–39	116	33.8	28.1 to 39.4
40–49	89	29.8	23.9 to 35.7
>50	59	18.0	13.4 to 22.6
Marital status			
Ever widowed	76	21.9	16.2 to 27.6
Married/cohabiting	189	60.9	53.7 to 68.2
Other	61	17.2	12.8 to 21.5
Highest educational attainment			
Primary or less	143	41.3	35.0 to 47.5
Secondary/ vocational	75	23.7	18.2 to 29.3
College	108	35.0	28.2 to 41.8
Employed			
Yes	204	63.2	57.3 to 69.2
No	122	36.8	30.8 to 42.7
Region			
Nairobi	35	8.7	6.5 to 10.9
Central	30	8.7	5.6 to 11.8
Coast	29	6.5	4.1 to 9.0
Eastern	36	10.2	7.5 to 12.9
Nyanza	134	41.2	33.5 to 48.9
Rift Valley	28	13.7	8.4 to 19.0
Western	34	11.0	5.6 to 16.4
Residence			
Rural	191	60.2	52.8 to 67.6
Urban	135	39.8	32.4 to 47.2
Time since diagnosis, months			
≤24	90	31.6	24.8 to 38.3
25–48	62	21.3	15.8 to 26.7
49–72	59	23.0	17.7 to 28.2
>72	63	24.2	18.6 to 29.8
Wealth index			
Poorest	45	14.6	9.2 to 20.0
Second	84	26.8	19.0 to 34.7
Third	77	24.8	18.6 to 30.9
Fourth	73	20.2	14.3 to 26.1
Richest	47	13.7	8.9 to 18.4
Time from diagnosis to entry into care, months			
3 or less	204	81.3	76.2 to 86.4
More than 3	48	18.7	13.6 to 23.8
Time from last clinic visit, months			
3 or less	272	83.3	78.9 to 87.7
More than 3	53	16.7	12.3 to 21.1
Current use of cotrimoxazole			
Yes	314	96.3	94.1 to 98.4
No	11	3.7	1.6 to 5.9
Taking daily nutritional supplements			
Yes	93	29.0	22.5 to 35.4
No	233	71.0	64.6 to 77.5
Ever had $CD4^+$ T-cell count measured			
Yes	286	85.7	79.7 to 91.7
No	40	14.3	8.3 to 20.3

*Because of missing responses totals vary between variables.

86.0 to 93.7) were in care at the time of the survey, and a small proportion (3.5%, 95% CI: 1.2 to 5.9) had received care at some point in the past but were no longer in care.

The demographic characteristics of persons who were currently in care were similar to persons not in care (data not shown). Among persons currently in care, 69.8% (95% CI: 64.6 to 75.0) were female, 33.8% (95% CI: 28.1 to 39.4) were aged 30–39 years, 60.9% (95% CI: 53.7 to 68.2) were married or cohabiting, and 41.3% (95% CI: 35.0 to 47.5) had received primary school education or less (Table 2). We found that 81.3% (95% CI: 76.2 to 86.4) of persons who were currently in care had accessed care within 3 months of HIV diagnosis, and 83.3% (95% CI: 78.9 to 87.7) had their last clinic visit within 3 months of the survey. Ninety-six percent (95.3%, 95% CI: 94.1 to 98.4) of persons who were currently in care were taking cotrimoxazole, and 29.0% (95% CI: 22.5 to 35.4) were taking daily nutritional supplements. Overall, 85.7% (95% CI: 79.7 to 91.7) had ever had their $CD4^+$ T-cell counts measured.

Of 326 persons currently in HIV care, 74.6% (95% CI: 69.0 to 80.2) were receiving ART (Table 3). A lower proportion of persons receiving ART were under 30 years of age (14.3%, 95% CI: 9.9 to 18.6) compared with those not receiving ART (30.6%, 95% CI: 20.0 to 41.2), and a higher proportion of persons on ART were retained in care (87.2%, 95% CI: 82.4 to 92.1) than persons not on ART (71.9%, 95% CI: 60.9 to 82.9). Among persons currently in care and not on ART, 10.5% (95% CI: 3.5 to 17.5) were not receiving cotrimoxazole prophylaxis, 27.1% (95% CI: 18.1 to 36.0) had never had their $CD4^+$ T-cell counts measured, and 23.2% (95% CI: 6.8 to 39.7) were eligible for ART treatment based on the immunologic criterion at the time of the survey (CD4 ≤350 cells/μL). An additional 15.7% (95% CI: 2.6 to 28.8)

TABLE 3. Demographic and Clinical Characteristics of HIV-Infected Adults and Adolescents Who Were Currently Receiving HIV Care by ART* Use, Kenya AIDS Indicator Survey 2012

	Total in HIV Care†	Currently on ART Unweighted, N = 240‡			Not on ART Unweighted, N = 86§			
Variable	**Unweighted, N†**	**Unweighted, n**	**Weighted %**	**95% CI**	**Unweighted, n**	**Weighted %**	**95% CI**	***P***
Total	326							
Sex								0.2683
Men	79	61	31.9	25.7 to 38.0	18	25.3	15.7 to 34.8	
Women	247	179	68.1	62.0 to 74.3	68	74.7	65.2 to 84.3	
Age group, yrs								<0.0001
15–29	62	37	14.3	9.9 to 18.6	25	30.6	20.0 to 41.2	
30–39	116	79	30.7	24.5 to 36.9	37	42.8	32.8 to 52.9	
40–49	89	73	33.6	26.7 to 40.5	16	18.7	9.4 to 28.0	
50 and above	59	51	21.4	15.6 to 27.2	8	7.9	2.4 to 13.4	
Marital status								0.9198
Ever widowed	76	59	22.4	16.3 to 28.6	17	20.3	10.1 to 30.4	
Married/cohabiting	189	138	60.4	52.4 to 68.4	51	62.4	50.5 to 74.4	
Other	61	43	17.1	12.1 to 22.2	18	17.3	9.2 to 25.4	
Highest educational attainment								0.1295
Primary or less	143	103	40.4	32.9 to 48.0	40	43.7	33.6 to 53.9	
Secondary/vocational	75	52	21.5	15.1 to 27.9	23	30.2	19.4 to 41.0	
College	108	85	38.1	29.7 to 46.4	23	26.1	16.6 to 35.6	
Employed								0.3576
Yes	204	145	61.7	54.8 to 68.5	59	67.7	56.7 to 78.8	
No	122	95	38.3	31.5 to 45.2	27	32.3	21.2 to 43.3	
Region								0.5958
Nairobi	35	25	8.6	6.1 to 11.0	10	9.0	3.8 to 14.3	
Central	30	24	9.5	5.8 to 13.1	6	6.3	2.1 to 10.6	
Coast	29	21	5.9	4.1 to 7.7	8	8.5	2.2 to 14.8	
Eastern	36	31	11.7	7.3 to 16.0	5	6.0	0.6 to 11.4	
Nyanza	134	97	40.3	32.2 to 48.4	37	43.8	29.6 to 58.0	
Rift Valley	28	21	14.4	7.6 to 21.1	7	11.8	3.4 to 18.1	
Western	34	21	9.8	4.0 to 15.5	13	14.5	6.2 to 22.7	
Residence								0.8803
Rural	191	140	60.5	52.8 to 68.1	51	59.4	45.8 to 73.0	
Urban	135	100	39.5	31.9 to 47.2	35	40.6	27.0 to 54.2	
Wealth index								0.6592
Poorest	45	36	16.4	10.0 to 22.8	9	9.2	2.7 to 15.8	
Second	84	59	25.9	17.4 to 34.5	25	29.5	17.7 to 41.3	
Third	77	56	24.4	17.3 to 31.5	21	25.7	16.2 to 35.2	
Fourth	73	55	19.6	12.9 to 26.3	18	21.9	11.4 to 32.4	
Richest	47	34	13.7	8.1 to 19.2	13	13.7	6.3 to 21.1	
Time from diagnosis to care, months								0.6398
3 or less	204	149	82.1	75.4 to 88.7	55	79.2	70.0 to 88.4	
More than 3	48	34	17.9	11.3 to 24.6	14	20.8	11.6 to 30.0	
Time since last clinic visit, months								0.0065
3 or less	272	210	87.2	82.4 to 92.1	62	71.9	60.9 to 82.9	
More than 3	53	29	12.8	7.9 to 17.6	24	28.1	17.1 to 39.1	
Current use of cotrimoxazole								0.0004
Yes	314	236	98.6	97.1 to 100	78	89.5	82.5 to 96.5	
No	11	3	1.4	0 to 2.9	8	10.5	3.5 to 17.5	
Ever had $CD4^+$ T-cell count measurement								0.0076
Yes	286	222	90.0	82.8 to 97.3	64	72.9	64.0 to 81.9	
No	40	18	10.0	2.7 to 17.2	22	27.1	18.1 to 36.0	
$CD4^+$ T-cell counts, cells/μL¶								0.3876

TABLE 3. (*Continued*) Demographic and Clinical Characteristics of HIV-Infected Adults and Adolescents Who Were Currently Receiving HIV Care by ART* Use, Kenya AIDS Indicator Survey 2012

	Total in HIV Care†	Currently on ART Unweighted, N = 240‡			Not on ART Unweighted, N = 86§			
Variable	Unweighted, N†	Unweighted, n	Weighted %	95% CI	Unweighted, n	Weighted %	95% CI	*P*
≤350	43	35	35.2	23.8 to 46.7	8	23.2	6.8 to 39.7	
351–500	20	14	16.2	6.2 to 26.2	6	15.7	2.6 to 28.8	
>500	84	60	48.6	35.2 to 62.0	24	62.4	43.7 to 81.1	
HIV RNA concentration, copies/mL#								<0.0001
<1000	168	146	75.3	68.7 to 81.9	22	30.2	20.7 to 39.6	
≥1000	97	48	24.7	18.1 to 31.3	49	69.8	60.4 to 79.3	

*ART, antiretroviral therapy.
†Because of missing responses totals vary between variables.
‡Weighted percentage of persons in care who were receiving ART: 74.6% (95% CI: 69.0 to 80.2).
§Includes 12 participants who were currently in care and had initiated but later discontinued ART.
¶Excludes 179 specimens that could not be tested.
#Excludes 61 specimens that could not be tested.

had CD4$^+$ T-cell counts between 351 and 500 cells per microliter. Among persons on ART, 75.3% (95% CI: 68.7 to 81.9) had HIV RNA concentration of <1000 copies per milliliter compared with 30.2% (95% CI: 20.7 to 39.6) of persons who were not on ART.

DISCUSSION

The findings from KAIS 2012 provide population-level data on access to and quality of HIV care services among HIV-infected persons. Our data show evidence of success in linking HIV-infected persons who were aware of their infection into HIV care, in retaining persons in care, in the use of the recommended components of care including cotrimoxazole and ART, and in achieving viral suppression among those on ART.

Importantly, we found that 96% of HIV-infected persons currently in care were taking cotrimoxazole, highlighting progress since KAIS 2007, when 89% of HIV-infected persons who were aware of their HIV infection were taking cotrimoxazole.[12] Revision of policy guidelines for care and treatment, decentralization of care and treatment services, capacity building of the health workforce, and improved procurement of supplies have contributed to improvements in the proportion of HIV-infected persons receiving care.[13] Access to cotrimoxazole is used routinely by the Government of Kenya as a programmatic indicator of engagement in care; our results support its continued utility in approximating access to HIV care among HIV-infected persons. Although differences in study designs limit direct comparisons, the proportion of HIV diagnosed persons reporting current use of care in Kenya is comparable to results from other studies in the United States.[14,15]

Despite this progress, we also identified areas where improvement is needed. In particular, we found that persons who were in care but had not yet initiated ART were less likely to have a recent clinic visit, less likely to be receiving cotrimoxazole, and less likely to have a CD4$^+$ T-cell count measurement than persons who were on ART. Moreover, nearly one-quarter of these individuals were eligible for ART based on the current immunologic criterion for ART initiation in Kenya. Studies from other resource-constrained settings have also found suboptimal care outcomes in the pre-ART population, including high rates of loss to follow-up, death, and failure to return to the clinic for CD4$^+$ T-cell count testing.[16–18] To a large extent, a patient's CD4$^+$ T-cell count determines eligibility for ART initiation. Therefore, failure to meet timely initiation of ART based on immunologic criterion can result in increased morbidity and mortality. Although the reasons for these findings have not been fully investigated, it is possible that shortages in reagents for CD4$^+$ T-cell count testing and cotrimoxazole supplies could have impacted access to these services for pre-ART populations. Under such circumstances, health care workers prioritize care for those in greatest need, such as persons receiving ART. Such differences among persons in care must be explored further, and if adherence to clinical care guidelines is found to be suboptimal, retraining of health care staff should be prioritized. Given our findings of differential care among persons based on receipt of ART, raising the immunologic threshold for ART initiation, as recommended by the World Health Organization,[19] to CD4 ≤500 cells per microliter could potentially improve retention in care and access to recommended services, resulting in better clinical outcomes.

Three-quarters of HIV-infected persons who were currently in care and on ART had achieved viral suppression. These findings are consistent with other studies that have reported that 78%–93% of persons on ART were virologically suppressed.[14,15] It is possible that this is an underestimate of true population levels of viral suppression on ART. Because we did not determine the duration of ART use, some subjects may have recently started therapy and not yet reached viral suppression. Alternatively, because viral load monitoring is not currently a routine part of care, unsuppressed persons may reflect true treatment failures or poor adherence to ART.[20,21] Our finding of viral suppression in 30% of persons who were not currently using ART is surprising because elite controllers of HIV infection are considered to be rare.[22–24] Although a study of undiagnosed men in San

Francisco had a similar finding, other factors must be considered.[25] Persons receiving ART may have been misclassified, or laboratory error in the viral load results may have contributed to this finding. Furthermore, persons who reported that they were not currently receiving ART may have recently or temporarily discontinued treatment because of difficulty returning to the pharmacy for refills or insufficient drug supplies. Continued exploration of this finding is warranted, including a detailed assessment of respondents' understanding of the question and laboratory analysis of blood samples for the presence of antiretroviral drugs in untreated and suppressed persons.

There are limitations to consider when interpreting the findings from our study. First, we relied on self-reported data that may have underestimated the proportion of persons who were aware of their HIV infection and may have overestimated the use of care. Recall of events in the distant past may have resulted in inaccurate responses. Potential bias could have resulted from the substantial number of blood specimens that were hemolyzed and unable to be used for $CD4^+$ T-cell measurements. However, no significant differences in demographic characteristics were observed between HIV-infected persons with and without $CD4^+$ T-cell count data, leading us to believe that this limitation did not bias our findings. Finally, although the survey excluded the North Eastern region, this region has a HIV prevalence of $<1\%$, and its exclusion is not likely to have impacted our findings.[12]

We believe that these limitations are offset by the strength of the nationally representative sample and that our estimates provide essential information on use of HIV-related care services among persons with known HIV infection. Although progress has been made in diagnosing and treating HIV-infected persons in Kenya, our study identified important priorities for the future including provision of essential medical services to persons before initiating ART. Our study also confirms that there is a loss of persons along the path from diagnosis to viral suppression, resulting in a sizable proportion of diagnosed persons in need of ART who are not receiving it and capable of transmitting infection. Continued exploration of factors that undermine providing care to all persons diagnosed with HIV infection and corrective interventions are needed.

ACKNOWLEDGMENTS

The authors thank the fieldworkers and supervisors for their work during KAIS data collection and the individuals who participated in this national survey. The authors thank Joy Mirjahangir, Veronica Lee, George Rutherford, and Kevin DeCock for reviewing and providing suggestions on the manuscript. They also thank the KAIS Study Group for their contribution to the design of the survey and collection of the data set: Willis Akhwale, Sehin Birhanu, John Bore, Angela Broad, Robert Buluma, Thomas Gachuki, Jennifer Galbraith, Anthony Gichangi, Beth Gikonyo, Margaret Gitau, Joshua Gitonga, Mike Grasso, Malayah Harper, Andrew Imbwaga, Muthoni Junghae, Mutua Kakinyi, Samuel Mwangi Kamiru, Nicholas Owenje Kandege, Lucy Kanyara, Yasuyo Kawamura, Timothy Kellogg, George Kichamu, Andrea Kim, Lucy Kimondo, Davies Kimanga, Elija Kinyanjui, Stephen Kipkerich, Danson Kimutai Koske, Boniface O. K'Oyugi, Veronica Lee, Serenita Lewis, William Maina, Ernest Makokha, Agneta Mbithi, Joy Mirjahangir, Ibrahim Mohamed, Rex Mpazanje, Silas Mulwa, Nicolas Muraguri, Patrick Murithi, Lilly Muthoni, James Muttunga, Jane Mwangi, Mary Mwangi, Sophie Mwanyumba, Francis Ndichu, Anne Ng'ang'a, James Ng'ang'a, John Gitahi Ng'ang'a, Lucy Ng'ang'a, Carol Ngare, Bernadette Ng'eno, Inviolata Njeri, David Njogu, Bernard Obasi, Macdonald Obudho, Edwin Ochieng, Linus Odawo, Jacob Odhiambo, Caleb Ogada, Samuel Ogola, David Ojakaa, James Kwach Ojwang, George Okumu, Patricia Oluoch, Tom Oluoch, Kenneth Ochieng Omondi, Osborn Otieno, Yakubu Owolabi, Bharat Parekh, George Rutherford, Sandra Schwarcz, Shanaaz Sharrif, Victor Ssempijja, Lydia Tabuke, Yuko Takanaka, Mamo Umuro, Brian Eugene Wakhutu, Celia Wandera, John Wanyungu, Wanjiru Waruiru, Anthony Waruru, Paul Waweru, Larry Westerman, and Kelly Winter.

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