

Research Article

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# Knowledge of HIV Transmission and Associated Factors among HIV-Positive and HIV-Negative Patients in Rural Kenya

Steven Y Hong<sup>1,2\*</sup>, Daria Thompson<sup>2</sup>, Christine Wanke<sup>1,2</sup>, Gloria Omosa<sup>3</sup>, Michael R Jordan<sup>1,2</sup>, Alice M Tang<sup>2</sup>, Shem Patta<sup>3</sup>, Ben Mwero<sup>3</sup>, Innocent Mjomba<sup>3</sup> and Mkaya Mwamburi<sup>2,3</sup>

<sup>1</sup>Division of Geographic Medicine and Infectious Diseases, Tufts Medical Center, Boston, USA

<sup>2</sup>Department of Public Health and Community Medicine, Tufts University School of Medicine, Boston, USA

<sup>3</sup>Clinical Research Division, Voi Research Centre, Voi, Kenya

## Summary

Knowledge of HIV transmission is a prerequisite to practicing safer behaviors to prevent HIV infections and may be expected to vary by region because of cultural and socioeconomic determinants. A cross-sectional study was conducted in rural Kenya using a standardized questionnaire assessing HIV transmission knowledge, socio-demographic and other characteristics. Participants were recruited from the voluntary counseling and testing clinic and the general hospital population of Moi District Hospital. "High" HIV transmission knowledge scorers ( $\geq 81\%$ ) (Mean score) were compared with "low" scorers ( $<81\%$ ). Bivariate and multivariate logistic regression analyses were performed to examine factors associated with HIV transmission knowledge. Of 214 participants, 70 (33%) were HIV-positive, 104 (49%) were HIV-negative, and 40 (19%) did not know. Factors associated with low knowledge in multivariate analyses were lower education (OR 2.36, CI 1.03-5.46), lower household money on healthcare (OR 2.03, CI 1.28-3.21), higher clinic transportation costs (OR 3.14, CI 1.20-9.82), sex without a condom (OR 2.18, CI 1.12-4.26), positive HIV status vs. negative (OR 2.50, CI 1.22-5.26) and positive HIV status vs. unknown (OR 3.57, CI 1.33-9.09). Mean HIV transmission knowledge score was relatively high; however, a large proportion of patients demonstrated low knowledge. Identifying individuals at risk for low knowledge will support targeted HIV education and prevention programs.

## Introduction

Although knowledge about HIV transmission and acquisition cannot ensure the practice of "safe sex" or other HIV infection risk-reduction strategies, it is a necessary prerequisite towards safer behaviors among HIV-negative and HIV-positive individuals [1]. Therefore, ignorance about how HIV is transmitted and acquired is detrimental to HIV prevention efforts. HIV transmission knowledge among HIV-negative individuals is essential to reduce risk of infection; and HIV transmission knowledge among HIV-positive individuals is necessary to reduce risk of super-infection, as well as to prevent spread of infection. Identification of correlates of poor HIV transmission knowledge in both HIV-positive and HIV-negative individuals will aid in developing effective measures to improve health knowledge about HIV transmission, thus potentially decreasing HIV incidence.

Many studies have investigated HIV knowledge among uninfected individuals [2-4]. However, less data assessing HIV knowledge in HIV-infected patients are available. Existing literature demonstrates that some HIV-positive patients continue to engage in risky behaviors [5-7], however, little information is available regarding HIV transmission knowledge among HIV-positive patients and the role it may play in altering risky behavior [8,9]. Additionally, little published information is available on the factors associated with HIV transmission knowledge among those infected with HIV.

Of the 33 million people infected with HIV worldwide, the majority live within resource-limited settings [10]. Of the 39 million people in Kenya [11], 6% of adults age 15-49 are infected with HIV. The estimated number of incident cases of HIV infections in Kenya in 2009 was 120,000 children and adults [12]. HIV in Kenya is mainly transmitted through heterosexual contact. Therefore, HIV prevention programs in Kenya have focused messages on three aspects of behavior: delaying sexual debut for young persons (abstinence), limiting the number of sexual partners (be faithful to one partner), and using condoms, also labeled "ABC" [12].

According to the 2008-09 Kenya Demographics and Health Survey [12], knowledge of methods to avoid HIV transmission is generally high. For example, 88% of women and 90% of men know that abstaining from sex reduces chances of getting HIV. Similarly, 92% of women and 93% of men know that limiting sex to one faithful partner reduces chances of acquiring HIV. Additionally, 75% of women and 81% of men know that the risk of acquiring HIV can be reduced by using condoms. However, "comprehensive knowledge" about HIV was lower (males 56%, females 49%), defined as knowing that both consistent use of condoms and also having just one uninfected partner can reduce the chance of infection, knowing that a healthy-looking person can have HIV, and knowing that HIV cannot be transmitted by mosquito or by sharing food [12]. It has been shown in the literature that even in populations with accurate knowledge about HIV transmission, high levels of incorrect knowledge about HIV transmission can co-occur largely independent of the accurate knowledge [13]. Therefore, HIV education and prevention programs must seek to assess for and address specific inaccurate beliefs about HIV transmission that may be coexisting with accurate knowledge as part of their efforts to promote behavior change.

**\*Corresponding author:** Steven Y. Hong MD, MPH, Department of Public Health and Community Medicine, Tufts University School of Medicine, 150 Harrison Avenue, Jaharis 2, Boston, MA 02111, USA, Tel: 1-617-636-0827; Fax: 1-617-636-3810; E-mail: [shong@tuftsmedicalcenter.org](mailto:shong@tuftsmedicalcenter.org)

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Data in Kenya indicate that rural dwellers are less knowledgeable about all methods of reducing the risk of HIV infection than their urban counterparts [12]. Considering that more than 75% of the Kenyan population lives in rural settings [14], more data are needed about HIV transmission knowledge and correlates in these settings. The objective of this study was to estimate the level of HIV transmission knowledge among HIV-positive and HIV-negative individuals in a rural Kenyan setting and to assess for factors associated with low HIV transmission knowledge.

## Methods

### Study population

We conducted a cross-sectional study utilizing a structured questionnaire in a rural region of Kenya. Between June and August 2010, a convenience sample of HIV-positive and HIV-negative adults  $\geq 18$  year of age was recruited from the voluntary counseling and testing clinic and the general hospital population of Moi District Hospital in Voi which is located in the Taita-Taveta County, one of the 47 counties of Kenya. Taita-Taveta County has a population of 300,000 and HIV prevalence of 5.6% (Ministry of Health Taita District, Kenya, personal communication). After obtaining written informed consent, subjects were interviewed in a private room by a trained interviewer. Ethical approval was obtained from the institutional review board at Tufts University School of Medicine, Boston, USA and the Kenyatta National Hospital/University of Nairobi, Kenya.

### Study questionnaires

A pre-tested questionnaire assessing socio-demographic characteristics, HIV transmission knowledge, access to healthcare, and substance abuse, was administered. The questionnaire was translated into Swahili and back-translated by a separate translator to ensure accuracy. The questionnaire was administered in English or Swahili depending on the participant's preference.

HIV transmission knowledge questions were adapted from a study conducted in a Prevention and Access to Care and Treatment program based in the Division of Social Medicine and Health Inequalities at the Brigham and Women's Hospital, Boston, USA [1]. We utilized the 22-item combined scale which had been developed based on two scales which demonstrated good reliability and validity [15,16]; internal consistency reliability for the combined scale was estimated at 0.84 (Cronbach's alpha). Questions were not significantly changed, to allow for comparability.

HIV transmission knowledge score was estimated by calculating the percent of correct responses on a true/false scale. Knowledge score was summarized in two ways: (1) as the proportion of correct responses over the total number of possible responses from all participants [1] and (2) as the mean of individual scores (calculated only among the 214 individuals who completed the entire 22-item knowledge scale). "High" HIV transmission knowledge scorers i.e. those with  $\geq 81\%$  (mean score) were compared with "low" scorers ( $<81\%$ ). Eighty-one percent was used as a cut-off because it was the mean knowledge score for this study population and approximately equal-sized groups for 'high' versus 'low' knowledge were generated for the analysis [1]. Bivariate analyses were performed to examine the associations between HIV transmission knowledge and other factors. Multivariate logistic regression analyses were performed to control for potential confounders. Factors with statistically significant associations or potential confounders were considered for multivariate models. Results were analyzed using SAS version 11.

QUESTION	n/N* (%)	Correct answer
Knowledge of Sexual Transmission		
Having more than one sexual partner without using protection will increase a person's chances of becoming infected with HIV	226/230 (98.3)	T
A person can be exposed to the HIV in one sexual contact	215/229 (93.9)	T
The main body fluids that contain HIV are semen, blood, and vaginal secretions	223/231 (96.5)	T
Oral intercourse carries risk for HIV transmission	188/230 (81.8)	T
Pre-ejaculatory fluids carry the AIDS virus	214/225 (95.1)	T
Only receptive (passive) anal intercourse transmits HIV	118/229 (51.5)	F
Mean score (for correct responses)	1184/1374 (86.2)	
Knowledge of Prevention		
A person can protect him/herself from HIV infection by using a latex condom during sex	187/230 (81.3)	T
Condoms makes intercourse completely safe	93/231 (40.3)	F
Showering after sex greatly reduces the transmission of HIV	213/231 (92.2)	F
Keeping in good physical condition is the best way to prevent exposure to HIV	120/230 (52.2)	F
Mean score (for correct responses)	613/922 (66.5)	
Knowledge of Blood Transmission		
If someone infected with HIV uses injection drugs and shares needles, he/she can spread HIV	224/231 (97.0)	T
HIV does not penetrate unbroken skin	164/230 (71.3)	T
Donating blood carries a risk of getting HIV for the donor	84/230 (36.5)	F
Mean score (for correct responses)	472/691 (68.3)	
Knowledge of HIV Testing		
A blood test is what tells you if you are infected with HIV	228/231 (98.7)	T
If someone has a negative HIV test (meaning they don't have HIV), that means they cannot get HIV	201/226 (88.9)	F
Someone can have a negative HIV blood test and still have the virus	212/229 (92.6)	T
Mean score (for correct responses)	641/686 (93.4)	
Knowledge of Common Misconceptions		
Only homosexual ("gay") people can become infected with HIV	219/231 (94.8)	F
A person can get HIV by sitting next to someone who is infected with HIV or by touching or hugging someone who is HIV infected	223/231 (96.5)	F
You can always tell when a person is infected with HIV	196/228 (86.0)	F
Most persons exposed to the HIV virus know they are exposed	113/230 (49.1)	F
If a person has HIV but doesn't know it, he/she can still give it to someone else	219/228 (96.1)	T
Mean score (for correct responses)	1190/1379 (86.3)	
Total mean score (for correct responses)#	4100/5052 (81.2)	

\* Number of respondents varied.

# Mean score of individual scores = 80.9%

**Table 1:** Description of HIV-related knowledge (percent responding correctly).

## Results

### Participant characteristics

Two hundred thirty-one patients participated (Table 1); 82 (35%) were from VCT; 214 participants had complete data on HIV transmission knowledge (i.e. all 22 items) (Table 2). Of these, 114 (53%) were female. Mean age was 36.0 years (SD 10.5). Sixty-nine participants (32%) were single. Seventy (33%) were HIV-positive, 104 (49%) were HIV-negative, and 40 (19%) did not know their status. One hundred

Characteristics	Knowledge Score < 81% (n=96)	Knowledge Score > 81% (n=118)	P-Value	Overall# (n=214)
Age (years), mean (SD)	37.7 ± 10.6	34.6 ± 10.3	0.04	36.0 (10.5)
Sex (female), n (%)	53 (55)	61 (52)	0.61	114 (53)
Marital status (single), n (%)	29 (30)	40 (34)	0.32	69 (32)
Education level (< Diploma), n (%)	81 (84)	84 (71)	0.02	165 (77)
Religion (Christian-Protestant), n (%)	45 (47)	53 (45)	0.86	98 (46)
HIV status, n (%)				
Negative	36 (37)	68 (58)	0.00	104 (49)
Positive	47 (49)	23 (19)		70 (33)
Unknown	13 (14)	27 (23)		40 (19)
Household HIV status (no one with HIV), n (%)	73 (76)	97 (82)	0.31	170 (79)
Alcohol use (none), n (%)	76 (79)	78 (66)	0.03	154 (72)
Recreational drug use (none), n (%)	77 (80)	97 (83)	0.61	174 (81)
Current drug use (none), n (%)	90 (94)	115 (98)	0.08	205 (96)
Injection drug use (none), n (%)	91 (95)	118 (100)	0.01	209 (98)
Number of sex partners, n (%)				
None	19 (20)	10 (8)	0.02	29 (14)
1 partner	47 (49)	76 (64)	0.02	123 (58)
>1 partner	30 (31)	32 (27)	0.51	62 (29)
Sex without a condom (mostly/always), n (%)	42 (44)	30 (25)	0.01	72 (34)
Sex for money or gifts (none), n (%)	83 (86)	110 (93)	0.10	193 (90)
Monthly household income (Ksh*), n (%)				
0-999	47 (51)	43 (38)	0.01	90 (42)
1000-1999	20 (22)	34 (30)		54 (25)
2000-2999	6 (6)	21 (19)		27 (13)
>3000	20 (22)	15 (13)		35 (16)
Monthly household money on healthcare (lowest quintile†), n (%)	68 (71)	57 (49)	0.02	125 (58)
Transport cost to clinic (Ksh*), n (%)				
0-19	47 (49)	69 (58)	0.03	116 (54)
20-199	25 (26)	36 (31)		61 (29)
>200	24 (25)	13 (11)		37 (17)
Time travel to clinic (minutes), n (%)				
0-29	44 (46)	72 (61)	0.09	116 (54)
30-59	36 (38)	32 (27)		68 (32)
>60	16 (17)	14 (12)		30 (14)

\* Kenya Shillings (exchange rate on December 8, 2011, 1 USD = 89.2 Ksh)

Overall numbers of participants are based on completed HIV transmission knowledge questionnaires.

† <500 Ksh/month vs. ≥500 Ksh/month

**Table 2:** Participant characteristics and factors associated with HIV transmission knowledge, bivariate analysis.

seventy (79%) did not have a household member with HIV. Most participants had an education level less than a Diploma (165, or 77%) (Diploma is equivalent of college level). Ninety (42%) had a monthly household income of less than Kenya Shillings (Ksh) 1,000 and only 35 (16%) had a monthly household income greater than Ksh 3,000. (Kenya's gross national income per capita per month = US dollars 61.44 (Ksh 5,480.59 with exchange rate on December 8, 2011 of US Dollars 1 = Ksh 89.20)) [17]. One hundred sixteen participants (54%) spent less than Ksh 20 for travel costs to get the hospital and spent less than 30 minutes for travel. Thirty-seven patients (17%) spent more than Ksh

200 for travel costs to the hospital, and 30 patients (14%) spent more than 60 minutes for travel. More than half the participants (125, or 58%) were in the lowest quintile of household money spent on healthcare.

Alcohol and injection drug use (IDU) were reported as very low in this population, with 154 (72%) and 209 (98%) reporting no alcohol or IDU respectively. Sixty-two patients (29%) reported currently having more than one sex partner. One hundred ninety-three (90%) participants reported not having sex for money or gifts.

### HIV transmission knowledge score

Table 1 shows the individual items of the HIV transmission knowledge questionnaire and the proportion of participants who responded correctly. Mean HIV transmission knowledge score was 81.2%. The mean of the individual HIV transmission knowledge scores (among 214 individuals completing the entire scale) was 80.9% (SD 11.2).

HIV transmission knowledge questions were divided into five categories including: knowledge of sexual transmission, knowledge of prevention, knowledge of blood transmission, knowledge of HIV testing, and common misconceptions. Mean scores for knowledge of sexual transmission (86.2%), knowledge of HIV testing (93.4%), and knowledge of common misconceptions (86.3%) were high. However, mean scores for knowledge of prevention (66.5%) and knowledge of blood transmission (68.3%) were lower. (Table 1)

Knowledge of sexual transmission was high, with over 80% responding correctly in 5 of the 6 questions in this category. However, only 118 of 229 (52%) correctly responded false to the question "Only receptive (passive) anal intercourse transmits HIV." Knowledge of prevention was lower, with over 80% responding correctly in only 2 of the 4 questions in this category. Only 93 of 231 (40%) correctly responded false to the question, "Condoms makes intercourse completely safe," and only 120 of 230 (52%) correctly responded false to the question, "Keeping in good physical condition is the best way to prevent exposure to HIV." Knowledge of blood transmission was somewhat lower, with over 80% responding correctly in only 1 of the 3 questions in this category. Only 84 of 230 (37%) correctly responded false to the question, "Donating blood carries a risk of getting HIV for the donor," and 164 of 230 (71%) correctly answered "HIV does not penetrate unbroken skin." Knowledge of HIV testing was high, with over 80% responding correctly in 3 of 3 questions in this category. Knowledge of common misconceptions was high, with over 80% responding correctly in 5 of 6 questions for this category. Only 113 of 230 (49%) correctly answered false to the question, "Most persons exposed to the HIV virus know they are exposed."

### Bivariate and multivariate analyses

Of the 214 completing the HIV transmission knowledge questionnaire, 118 had high transmission knowledge (>81%) and 96 had low transmission knowledge (<81%) (Table 2). The mean score of the high group was 88.8% (SD 6.5) and the low group was 71.3% (SD 7.7). A comparison of characteristics associated with high vs. low knowledge is shown in table 2. Significant factors associated with low transmission knowledge with bivariate analyses included: older age (p=0.04), lower education level (<Diploma) (p=0.02), lower monthly household income (p=0.01), positive HIV status (p=0.00), no alcohol intake (p=0.03), IDU (p=0.01), having no sex partners (p=0.02), having one sex partner (p=0.02), practicing sex mostly or always without a condom (p=0.01), lower monthly household money spent on healthcare (p=0.02), and higher costs associated with transportation to the clinic (p=0.03).



Factors	Odds Ratio (95% CI)	P-value
Age	1.02 (0.99 - 1.06)	0.17
Sex (female)	1.23 (0.60 - 2.50)	0.57
Education level (< Diploma)	2.36 (1.03 - 5.46)	0.04
Alcohol use (none)	1.76 (0.82 - 3.77)	0.14
Monthly household money on healthcare (lowest quintile)	2.03 (1.28 - 3.21)	0.00
Transport cost to clinic (highest tertile vs lowest tertile)	3.14 (1.20 - 9.82)	0.02
Transport cost to clinic (highest tertile vs middle tertile)	1.93 (0.69 - 5.41)	0.83
Sex without a condom (mostly/always)	2.18 (1.12 - 4.26)	0.02
HIV status (positive vs negative)	2.50 (1.22 - 5.26)	0.01
HIV status (positive vs unknown)	3.57 (1.33 - 9.09)	0.01
Number of sex partners	1.34 (0.91 - 1.97)	0.14

**Table 3:** Multivariate logistic regression analysis showing factors associated with low HIV transmission knowledge.

Factors	Mean HIV transmission knowledge score (%)	Standard deviation
HIV status		
HIV positive	75.6	11.0
HIV negative	83.1	10.1
Status unknown	84.7	11.0
Education		
Low education (<Diploma)	79.3	11.1
High education (≥Diploma)	86.6	9.7
Healthcare costs		
<500 Ksh/month	78.7	10.3
500-1000 Ksh/month	84.2	10.4
1000-2000 Ksh/month	81.5	17.6
2000-3000 Ksh/month	83.8	12.8
>3000 Ksh/month	93.2	3.2
Travel cost to clinic		
0-19 Ksh	81.5	10.8
20-199 Ksh	81.7	12.4
>200 Ksh	78.0	10.2
Condom use		
Mostly/always	79.2	11.0
Never/rarely/sometimes	81.9	11.2

**Table 4:** Mean HIV transmission knowledge scores for significant factors in multivariate logistic regression.

Factors associated with low transmission knowledge with multivariate analyses (Table 3) were lower education level (<Diploma) (OR 2.36, CI 1.03-5.46), spending less household money on healthcare (OR 2.03, CI 1.28-3.21), higher costs associated with transportation or travel to the clinic (OR 3.14, CI 1.20 - 9.82), practicing sex mostly or always without a condom (OR 2.18, CI 1.12-4.26), positive HIV status vs. negative (OR 2.50, CI 1.22- 5.26) and positive HIV status vs. status unknown (OR 3.57, CI 1.33-9.09). Mean HIV transmission knowledge scores for significant factors in multivariate logistic regression are described in table 4.

## Discussion

The objective of this study was to estimate the level of HIV transmission knowledge among HIV-positive and HIV-negative individuals attending a healthcare facility in a rural setting in Kenya and to assess for factors associated with low HIV transmission knowledge. The mean HIV transmission knowledge score was relatively high and was very similar to that found utilizing the same knowledge scale in a resource-limited setting in Boston and India [1,18]. Respondents

performed well on questions about knowledge of sexual transmission, with the majority knowing about the risk of HIV transmission from sexual contact, about the risk of multiple sex partners, and about the risk of contact with which certain body fluids. However, we observed limitations in the area of receptive anal intercourse that may have placed some patients at risk of acquiring infection or transmitting the virus to others. Men who have sex with men and prison populations contribute 15% of new HIV infections. Furthermore, it has generally been reported that the epidemic in Kenya is driven primarily by heterosexual relations [12]. However, to answer incorrectly to the question, "Only receptive anal intercourse transmits HIV," would indicate a gap in knowledge that is important even in people not engaging in anal intercourse, as they may believe that other forms of unprotected sex would be "safe".

Respondents performed worse on questions about knowledge of prevention. Although most people knew the general message that condoms offer protection from HIV, of concern was that many people thought the use of condoms made intercourse completely safe and that keeping in good physical condition was the best way to prevent exposure to HIV. These responses may reflect an understanding of the general message about condoms without grasping the nuanced risk of condom failure. Also, people may have understood the general message of the benefit of good physical conditioning without grasping the specific information that good physical conditioning does not prevent the acquisition of HIV.

Respondents performed poorly on questions about knowledge of blood transmission. Although most respondents knew that IDU and sharing of needles carried a risk of spreading HIV, many believed donating blood carried a risk of getting HIV for the donor, and a significant proportion of respondents believed that HIV penetrates unbroken skin. These misconceptions can have a significant effect on the willingness of individuals to donate blood. Additionally, misconceptions about HIV penetrating unbroken skin can have implications on stigma and how people living with HIV are treated. These responses reflect good understanding of the general message of parenteral transmission of HIV without grasping some of the more specific information about the inability of the virus to penetrate intact skin and the current use of proper phlebotomy techniques in Kenya [19]. These data show that further content-based education initiatives should be targeted at common misconceptions that may exist alongside correct knowledge.

Respondents performed well on questions on HIV testing. Respondents did not only know the general knowledge that HIV blood testing can indicate if someone is infected with HIV, but they also knew that a person could have HIV and still have a negative HIV test. It is not clear whether or not respondents understood the reasons why false negative tests occur, but these responses demonstrate a good grasp of important basic concepts surrounding HIV testing.

Respondents performed well on questions pertaining to common misconceptions. Importantly, respondents seemed to know the specific ways HIV is and is not spread. They also knew that a person could be infected with HIV and not know they are infected. However, a majority of respondents stated that they believed most people who were exposed to HIV knew they were exposed. This incorrect response may reflect equating of risky behavior with actual knowledge of exposure.

A significant proportion of patients demonstrated a limited knowledge of HIV transmission. Factors associated with low HIV transmission knowledge were lower education, lower money spent on healthcare, higher clinic transportation costs, positive HIV status, and

sex without a condom. Importantly, although those factors are mostly non-modifiable, these factors can be used to identify and target groups of patients at risk for low HIV transmission for education interventions.

Respondents whose education status was less than a Diploma were at risk for low knowledge scores, which corresponds with what was observed in the 2008-09 Kenya Demographics and Health Survey [12]. Similar associations between education and HIV knowledge have been described in other studies among general populations and in HIV patients [18,20,21]. This is an important finding since we found that a large proportion of our population were at this low education level.

Lowest quartile of money spent on healthcare was associated with low transmission knowledge. However, monthly income became insignificant after controlling for other factors. Therefore, we hypothesize that lower money spent on healthcare in this setting may be a marker for less access to healthcare instead of a marker for low income. To support this hypothesis, we found higher clinic transportation costs to be associated with low transmission knowledge. Therefore, access to care may be a risk factor for poor HIV transmission knowledge. Identifying these individuals will support targeted HIV education and prevention programs.

HIV positive participants had less knowledge of HIV transmission than those who were HIV negative and those who did not know their status. Therefore, we hypothesize that lower HIV transmission knowledge is a risk factor for infection with HIV. Interestingly, there was no difference in HIV transmission knowledge between those who knew they were HIV-negative and those who did not know their status, which may indicate that those who did not know their status were a low-risk group. This pattern was mirrored when we evaluated transmission knowledge by site of enrolment i.e. those enrolled in general care had higher HIV transmission knowledge compared to those enrolled in VCT setting. It is possible that those enrolled in VCT may reflect a higher risk group that has lower knowledge about HIV transmission.

Participants who practiced sex without condoms had less knowledge of HIV transmission. These data may intuitively suggest that lower HIV transmission knowledge may lead to less condom use. However, it is difficult to interpret data about condom use without knowing whether or not the person not using a condom is in a stable monogamous relationship or has multiple sex partners. Nevertheless, it may be possible that after many years of HIV education in the communities, it is those who lag behind in HIV transmission knowledge that still practice unsafe sex.

This study is not without limitations. Since this was a cross-sectional study, causality between the factors analyzed cannot be inferred. Also, since the study population was a convenience sample from patients in a rural area in Kenya, these findings may not necessarily be generalizable to other resource-limited settings. However, results may be more relevant for HIV-positive and negative populations in Kenya, particularly in the rural areas.

While mean scores of HIV transmission is generally high, our findings speak in favor of targeting prevention and education initiatives in two distinct dimensions rather than accepting the generalized perception that Kenyans have a sufficiently high level of HIV transmission knowledge. First, is to target education programs at those individuals with lower education and lack of access to medical care. Secondly, education topics emphasized should match specific sub-topics to impart a more nuanced and accurate knowledge of HIV transmission and acquisition. Having correct information about one route of HIV infection does not preclude an individual from having misinformation

about another route of HIV infection [13]. Therefore, these individuals having incomplete and therefore contradictory information may be the population still engaging in high-risk behaviors.

## Conclusions

In conclusion, the results of this study conducted in rural Kenya demonstrate overall levels of HIV transmission knowledge in HIV-positive and HIV-negative participants comparable to those demonstrated in other resource-limited settings. However, these results also demonstrate some limitations in knowledge of HIV transmission in important topics and among a significant proportion of patients. A greater lack of knowledge was observed among especially vulnerable individuals affected by combinations of lower education and lack of access to care. This paper aims to alert public health providers that although overall levels of general HIV transmission knowledge may appear high, some vulnerable groups may be at an increased risk due to incomplete or contradictory HIV knowledge. ART programs in resource-limited settings should ensure adequate knowledge of HIV transmission in all areas and especially in their vulnerable populations to reduce the overall burden of HIV infection.

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