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Rising Syphilis Infection among Rural HIV-Infected Men who Routinely Received Risk-Reduction Counseling: New Challenges to HIV Prevention in Clinical Care

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Abstract

Objective: Syphilis incidence has been steadily increasing among HIV-infected men in the United States, representing an important public health challenge to HIV prevention. Clinic-based HIV prevention interventions are available but may need to be revisited in response to syphilis epidemic. We wanted to better understand the current epidemiology of syphilis in rural HIV-infected men who routinely received HIV risk-reduction counseling in order to plan more effective HIV prevention strategies in clinical care.

Methods: We conducted a retrospective cohort study to examine factors associated with syphilis infections in rural HIV-infected men who received sexually transmitted disease screening and HIV risk-reduction counseling during HIV primary care from January 2008 to June 2013. We assessed patients' demographic, clinical, behavioral and psychosocial characteristics and performed a multivariable exact logistic regression to identify factors related to syphilis.

Results: Despite routine risk screening and HIV risk-reduction counseling, a total of 51 syphilis infections were diagnosed among 702 HIV-infected men (5 patients were diagnosed ≥ 2 episodes). The majority of the study participants was sexually active and reported at least one unsafe sexual behavior, mainly inconsistent condom use. Younger age (<35 years, adjusted odds ratio (aOR)=3.09), higher educational attainment (some college or above, aOR=3.72), and perception that the partner may have sex with other people (aOR=3.10) were significantly associated with syphilis infection. Non-injection drug use was related to syphilis in HIV-infected men who have sex with men (aOR=2.86).

Discussion: Some HIV-infected men, especially young, educated men, or those who perceived that their partners may have sex with other people, continue to have high-risk behaviors that increase their own risks of acquiring syphilis and may also facilitate HIV transmission. New strategies need to be developed for HIV primary care providers to help HIV-infected patients maintain safer sex practices.

Keywords: HIV-infected men; Men who have sex with men; Syphilis; Rural HIV population; Clinic-based HIV prevention; HIV risk-reduction counseling

Introduction

Prevention of human immunodeficiency virus (HIV) infection continues to be an important public health challenge in the United States as multiple approaches are needed for HIV prevention in the era of combined antiretroviral therapy (cART) [1-3]. One of the essential HIV prevention efforts, known as "Prevention-with-Positives", focuses on prevention of secondary transmission by reducing high-risk sexual behaviors among people living with HIV/AIDS (PLWHA) [4]. Consequently, HIV primary care providers play a critical role in evaluating HIV transmission risk behaviors, screening for sexually transmitted diseases (STDs), and delivering tailored HIV prevention messages to HIV-infected patients at the point of HIV care [4-7]. Strategies such as "Partnership for Health-Safer Sex" have been developed by the Diffusion of Effective Behavioral Interventions (DEBI) project specifically for clinicians to conduct a brief intervention in clinical settings [8]. Evidence has demonstrated that clinician-delivered risk-reduction counseling and behavioral interventions are effective in reducing HIV/STD transmission risk behaviors among HIV-infected patients [6,9-14]. Therefore, routine HIV risk-reduction counseling during HIV care has been recommended as a necessary component of comprehensive HIV prevention efforts [4,6].

The incidence of syphilis, however, has been gradually increasing among HIV-infected men, especially men who have sex with men (MSM), in the US during the past decade [15-25]. As syphilis is an STD, co-infection with syphilis is an indication of continuous high-risk sexual behaviors in HIV-infected men. Additionally, syphilis may increase HIV viral load and subsequent HIV transmission risk [26,27]. Thus, HIV-infected men with syphilis infection may represent an important source of HIV transmission [28,29]. The reasons for the reemergence of syphilis are not completely understood. Previous studies suggest that multiple factors, including younger age, minority race, non-injection drug use, increased unprotected sexual intercourse, and more casual or anonymous sexual partners, may have contributed to the resurgence of syphilis in HIV-infected men [19,20,22,25,30-34]. Nonetheless, limited studies have evaluated acquisition of syphilis among HIV-infected men in the presence of routine clinic-based risk-reduction counseling [14].

Our institution has been providing HIV primary care services

to PLWHA in south central Pennsylvania, which is a region that includes both large rural areas and small urbanized cities. Beginning in 2007, in concordance with the "Prevention-with-Positives" initiative recommended by the Centers for Disease Control and Prevention (CDC), we have implemented a formalized HIV transmission risk screening program and routinely provided a brief HIV risk-reduction counseling based on the DEBI "Partnership for Health" to all HIV patients who were 18 years or older at the point of care [4,8,35]. Since 2008 we have observed an increased number of syphilis infections in our HIV-infected population. During 2002 to 2007 we diagnosed a total of 15 syphilis cases (all in men), while from 2008 through June 2013 without major changes in our HIV population and syphilis screening practice (annual serology testing), there were 51 syphilis diagnoses. The fundamental causes for this increase are unclear, but HIV-infected men living in a rural environment may have different risk profiles for syphilis [36]. Therefore, we examined patients' demographic, clinical, psychosocial and behavioral characteristics to better understand the epidemiology of syphilis in our HIV patient population and to help us plan more effective HIV/STD prevention strategies in clinical care.

Methods

Study population and procedures

Our HIV Comprehensive Care Program, currently funded by the Ryan White Part C Program, serves nearly 800 HIV-infected patients across 25 counties in Pennsylvania. The program provides the full spectrum of HIV care including primary health care services, comprehensive case management, women's health services, medical specialty services, adherence counseling, substance abuse/dependence and mental health counseling. Patients' demographics, HIV transmission risk, and psychosocial characteristics (including drug and alcohol use and mental health disorders) were assessed by the HIV providers at patients' initial HIV primary care visits and were updated every year. Annual serum rapid plasma reagin (RPR) testing has been routinely performed to identify patients with syphilis since the late 1990s. Except for adding urine nucleic acid testing for chlamydia and gonorrhea in 2008, there was no major change in the HIV program that could affect syphilis screening during the study period. For our "Prevention-with-Positives" initiative, a succinct risk screening survey was developed in 2007 and was administered by a member of the HIV treatment team during patients' HIV primary care visits to collect the following behavioral information: sexual activity in the past 12 months; sexual practices (sex of the partners, oral, vaginal, and anal sexual intercourse); any unsafe behaviors (inconsistent condom use, sex under the influence of alcohol or drugs, or exchange of sex for money); partners' characteristics (partners' HIV infection status, partners' awareness of HIV infection status of the patient, and perceived partners' sexual behavior); STD symptoms; and injection drug use [35]. The screening results were reviewed by HIV primary care providers in order to provide specific risk-reduction counseling at the point of care. The risk screening and behavior intervention initiative was conducted at patients' initial visits for newly enrolled HIV patients and was intended to be updated at least annually on all HIV-infected patients. Patient participation was very high (>98%). All adult HIV-infected men who received HIV care at our institution and participated in risk screening between January 1, 2008 and June 30, 2013 were included in this study. HIV-infected women were excluded from this study due to the fact that 100% of syphilis infections were diagnosed in men. This study was approved by the Pennsylvania State University College of Medicine Institutional Review Board (IRB) in compliance with the IRB and federal regulations governing the protection of human subjects.

All work was performed in accordance with the ethical standards that guide biomedical research involving human subjects.

Study outcome

The study outcome was having a syphilis infection during the study period. The diagnosis of syphilis was made based on a positive RPR screening result (seroconversion with a titer ≥ 1:4 or a 4-fold increase in the RPR titer), followed by a confirmatory treponemal test. Patients could be diagnosed with syphilis more than one time. For syphilis patients, stage of syphilis, treatment and treatment outcome, CD4 counts, and HIV RNA viral load at the time of syphilis diagnosis were also evaluated.

Patients' characteristics

Patients' demographics (age, race-ethnicity, educational attainment), CDC-defined HIV transmission risk category, length of HIV or AIDS diagnosis, history of AIDS complications, psychosocial factors (drug and alcohol use and a history of mental health disorders), and sexual behaviors (having a new partner, unsafe sexual behaviors, and partner's characteristics) were included in the analyses to assess risk factors associated with syphilis infection in this cohort of rural HIV-infected men. For those with more than one risk screening/psychosocial assessment, the results were summarized to indicate the overall history of a certain behavior.

Statistical analysis

In descriptive analysis, the characteristics between HIV-infected men with syphilis and those without syphilis were compared. The Mantel-Haenszel chi-square test for general association or the Fisher's exact test was used to evaluate the significance of the associations between patients' characteristics and syphilis infection. Since syphilis infection is a rare event, in the multivariate analysis restricted to sexually active men, a logistic regression model with a forward selection procedure was first performed to screen for variables with P-values ≤ 0.2. Age, educational attainment, HIV transmission risk category, length of HIV or AIDS diagnosis, non-injection drug use, behavioral disorder, and perceived partners' sexual behavior met the criterion and then were entered into a multivariate exact logistic regression model. The adjusted odds ratios (aOR) and their 95% confidence intervals (C.I.) were reported and statistical significance was evaluated at two-sided P-value <0.05. Because the majority of syphilis cases were HIV-infected MSM, a subgroup analysis was also conducted to examine characteristics associated with syphilis in sexually active HIV MSM. All data were analyzed using software by SAS ®, Version 9.2 (SAS Institute Inc., Cary, NC, U.S.A.).

Results

A total of 702 HIV-infected men were included in this retrospective cohort study between January 2008 and June 2013. The median follow-up time was 4.4 years with an interquartile range (IQR) of 1.6 to 5.3 years. Eight men were diagnosed with syphilis at their initial HIV primary care visits. During the study period, 43 new syphilis infections were diagnosed in 37 HIV-infected men (5 men were diagnosed with 2 or more episodes), with a median interval of 2.2 years between the time of enrollment to the study and the onset time of syphilis infection (IQR: 1.1-4.1 years). The incidence of syphilis increased from 1% in 2008 (5 cases) to 2.6% (14 cases) in 2012 (the 2013 data was not complete). Of those 51 syphilis diagnoses, 23 were primary or secondary syphilis, 7 were neuro- and/or ocular syphilis, 18 were asymptomatic seroconversion, and 3 were poorly characterized (Table 1). At the time

Patients' characteristics	N (%)
On antiretroviral treatment at diagnosis	36 (70.6%)
CD4 count (cells/ml)	
<200	2 (3.9%)
200-349	8 (15.7%)
350-499	10 (19.6%)
≥ 500	31 (60.8%)
Nadir CD4 count (cells/ml)	
<200	16 (31.4%)
200-349	9 (17.6%)
350-499	10 (19.6%)
≥ 500	16 (31.4%)
HIV RNA viral load (copies/ml)	
Undetectable (≤ 75)	32 (62.8%)
Detectable (>75)	18 (35.3%)
Syphilis diagnosis	
Asymptomatic seroconversion	18 (35.3%)
Primary syphilis	6 (11.8%)
Secondary syphilis	17 (33.3%)
Neuro- or ocular syphilis	7 (13.7%)
Unknown	3 (5.9%)
RPR value	
<16	13 (25.5%)
16-32	12 (23.5%)
64-128	20 (39.2%)
>128	6 (11.8%)
Syphilis treatment	
Benzathine penicillin one dose	15 (29.4%)
Benzathine penicillin three doses	23 (45.1%)
IV penicillin G	4 (7.8%)
Other	9 (17.6%)
Patients' treatment outcome (N=45)	
Cured, no sequelae	37 (82.2%)
Cured, with sequelae	4 (8.9%)
Uncertain	4 (8.9%)

Abbreviations:HIV: Human Immunodeficiency Virus; CD4: Cluster of Differentiation 4; RNA: Ribonucleic Acid; IV: Intravenous.

Table 1: Characteristics of HIV-infected men at the time of syphilis diagnosis (N=51 diagnoses).

of syphilis diagnosis, 70.6% were taking antiretroviral therapy; however, a low CD4 count (<350 cells/ml) and a detectable HIV RNA viral load (>75 copies/ml) were seen in 10 (19.6%) and 18 patients (35.3%), respectively. After penicillin treatment 37 syphilis patients were cured, 4 developed sequelae, and 4 had uncertain outcomes.

Our study participants were mainly older than 40 years (mean age=49 years), non-Hispanic whites (70.5%), MSM (66.7%), and had low educational attainment (a high school degree or less, 60.7%). Most men had been infected with HIV for more than 10 years (62.5%), and had a history of AIDS complications (56.1%) (Table 2a). The majority of HIV-infected men reported non-injection drug use (65.6%) and alcohol consumption (84.9%), and 53.1% indicated a history of mental health disorders, mostly anxiety and depression. Over 70% of the study participants were sexually active. Of those 505 sexually active men, 47.7% had new sexual partner(s), and 67.1% reported at least one unsafe sexual behavior, mainly inconsistent condom use. Most HIV-infected men (89.5%) disclosed their HIV infection status to their partner(s) and 36.6% stated that their partner was also HIV infected; however, nearly 50% perceived that their partner(s) may have sex with other people.

A total of 42 HIV-infected men who were diagnosed with syphilis completed at least one risk screening before or in the same year of their syphilis diagnosis. Results from bivariate analyses suggested that HIV-infected men with syphilis infection were younger, mainly MSM, had better educational attainment, had a shorter length of HIV infection, and were less likely to have AIDS complications compared with those without syphilis (P-values<0.05, Table 2A). There were no noticeable differences in psychosocial factors between syphilis and non-syphilis HIV-infected men. As we expected, HIV-infected men with syphilis were more likely to be sexually active (95.2%), but interestingly two men with syphilis infection reported not being sexually active during the study period. Among sexually active HIV-infected men (Table 2b), those with syphilis infection appeared more likely to have new partner(s) (70% vs. 45.8%, P-value<0.05), engage in at least one unsafe behavior including inconsistent condom use or sex under the influence of alcohol and/or drugs (82.5% vs. 65.8%, P-value<0.05), and perceive that their partner(s) may have sex with other people (75% vs. 43.9%, P-value<0.05); however they were less likely to disclose HIV infection status to their sexual partner(s) than HIV-infected men without syphilis (80% vs. 90.3%, P-value<0.05).

In multivariate analysis restricted to sexually active HIV-infected men, factors significantly associated with syphilis infection included younger age (<35 years; aOR=3.08, 95% C.I.=1.12, 8.48; P-value=0.03), higher educational attainment (some college or above, aOR=3.72,

Characteristics *	Total N(%)	Syphilis N (%)	Non-syphilis N (%)
Demographics			
Age (in years) **			
<35	83 (11.8%)	12 (26.7%)	71 (10.8%)
35-49	284 (40.5%)	20 (44.4%)	264 (40.2%)
≥ 50	335 (47.7%)	13 (28.9%)	322 (49.0%)
Race-ethnicity			
Hispanic	80 (11.4%)	2 (4.4%)	78 (11.9%)
Non-Hispanic black	125 (17.8%)	10 (22.2%)	115 (17.5%)
Non-Hispanic white	495 (70.5%)	32 (71.1%)	463 (70.5%)
Educational attainment **			
GED/High school or below	409 (60.7%)	8 (18.2%)	257 (40.8%)
Some college/college or above	265 (39.3%)	36 (81.8%)	373 (59.2%)
HIV transmission risk category **			
MSM or MSM&IDU	468 (66.7%)	40 (88.9%)	428 (65.1%)
Non-MSM (IDU, heterosexual, or other/unknown)	234 (33.3%)	5 (11.1%)	229 (34.9%)
Length of HIV or AIDS diagnosis **			
<10 years	250 (37.5%)	25 (69.4%)	227 (39.7%)
≥ 10 years	416 (62.5%)	11 (30.6%)	344 (60.3%)
History of AIDS complications **	394 (56.1%)	18 (40.0%)	376 (57.2%)
Non-injection drug use	442 (65.8%)	32 (72.7%)	410 (65.1%)
Cocaine	200 (28.5%)	10 (22.2%)	190 (28.9%)
Marijuana	214 (30.9%)	20 (44.4%)	194 (29.5%)
Alcohol consumption	571 (84.9%)	38 (86.4%)	534 (84.8%)
Behavioral disorder	358 (53.1%)	21 (47.7%)	337 (53.5%)
Anxiety	175 (24.9%)	8 (17.8%)	167 (25.4%)
Depression	191 (27.2%)	17 (37.8%)	174 (26.5%)
Have been sexually active **	505 (72.3%)	40 (95.2%)	465 (70.8%)

Abbreviations: HIV: Human Immunodeficiency Virus; GED: General Educational Development; MSM: Men who Have Sex with Men; IDU: Injection Drug Users; AIDS: Acquired Immune Deficiency Syndrome.
* Missing values to some questions were excluded from the analysis.
** The distributions were statistically different (P<0.05) between syphilis and non-syphilis HIV-infected men.

Table 2a: Characteristics of 702 HIV-infected men in Pennsylvania, 2008-2013.

Sexual practices in the past 12 months*	Total N(%)	Syphilis N (%)	Non-syphilis N (%)
Have had new partner(s) **	241 (47.7%)	28 (70.0%)	213 (45.8%)
Oral sex history	355 (70.3%)	31 (77.5%)	324 (69.7%)
Anal sex history **	245 (48.5%)	27 (67.5%)	218 (46.9%)
Have had any unsafe sexual behaviors **	339 (67.1%)	33 (82.5%)	306 (65.8%)
Inconsistent condom use *	300 (59.4%)	29 (72.5%)	271 (58.3%)
Sex under the influence of alcohol or drugs	119 (23.6%)	14 (35.0%)	105 (22.6%)
Exchange of sex for money	13 (2.6%)	0 (0%)	13 (2.8%)
HIV disclosure: "Partner(s) know you have HIV"**	452 (89.5%)	32 (80.0%)	420 (90.3%)
Partner(s) have HIV	185 (36.6%)	17 (42.5%)	168 (36.1%)
Perceived partner's behavior: "Partner(s) have sex with other people (Yes or uncertain)" **	234 (46.3%)	30 (75.0%)	204 (43.9%)

* Missing values to some questions were excluded from the analysis.
** The distributions were statistically different (P<0.05) between syphilis and non-syphilis HIV-infected men.

Table 2b: Sexual practices among 505 sexually active HIV-infected men in Pennsylvania, 2008-2013.

Characteristics	All HIV men (N=505) aOR (95% CI)	HIV MSM (N=346) aOR (95% CI)
Age (vs. ≥ 50 years)		
<35	3.08 (1.12, 8.48)*	3.03 (1.00, 9.21)
35-49	1.38 (0.61, 3.13)	1.68 (0.70, 4.03)
Educational attainment (vs. ≤ High school)		
Some college or above	3.72 (1.51, 9.15)**	4.75 (1.70, 13.3)**
HIV transmission risk category (vs. non-MSM)		
MSM	2.83 (0.94, 8.51)	---
Length of HIV or AIDS diagnosis (vs. ≥ 10 years)		
<10 years	2.08 (0.93, 4.61)	1.77 (0.76, 4.13)
Non-injection drug use (vs. No)		
Yes	2.16 (0.93, 5.05)	2.65 (1.05, 6.69)*
Behavioral disorder (vs. No)		
Yes	0.59 (0.28, 1.22)	0.50 (0.23, 1.09)
Perceived that partners may have sex with other people (vs. No)		
Yes or uncertain	3.10 (1.42, 6.75)**	2.86 (1.26, 6.52)*

Abbreviations: aOR: Adjusted Odds Ratio; CI: Confidence Interval.
A multivariate exact logistic regression model was performed. In the model restricted to HIV-infected MSM, HIV transmission risk category was not included.
*P<0.05; ** P<0.01

Table 3: Factors associated with syphilis diagnosis among sexually active HIV-infected men in Pennsylvania, 2008-2013, multivariate analysis.

95% C.I.=1.51, 9.15; P-value=0.004), and perceived partner's behavior (partner may have sex with other people) (aOR=3.10, 95% C.I.=1.42, 6.75; P-value=0.005) (Table 3). MSM, length of HIV infection (<10 years), and non-injection drug use seemed related to syphilis as well, but the associations were not significant (P-values<0.10 but >0.05). In a subgroup analysis focusing on sexually active HIV-infected MSM, educational attainment and perceived partner's behavior remained statistically significant in the multivariate model (aOR=4.75, P-value=0.003; and aOR=2.86, P-value=0.01, respectively), and non-injection drug use was also associated with syphilis (aOR=2.65, 95% C.I.=1.05, 6.69; P-value=0.04).

Discussion

In this study of rural HIV-infected men, we observed that the burden of syphilis continued to increase despite the implementation of routine clinic-based risk screening and HIV risk-reduction counseling. The rising incidence of syphilis (from 1% in 2008 to 2.6% in 2012) is unlikely due to improved STD screening and instead represents a true resurgence of syphilis in our HIV population. As syphilis is now one of the most common STDs in HIV-infected men, concerns have been raised that some HIV-infected people may continue to engage in high-risk sexual behaviors and transmit HIV infection [22,23,25,28,29]. Therefore, identifying risk factors associated with syphilis infection in HIV-infected men will help us target HIV prevention efforts toward high-risk individuals and improve our current HIV prevention strategies in clinical care.

We found that younger age (<35 years), higher educational attainment (some college or above), and perceived partner's sexual behavior (i.e., partners may have sex with other people) were significantly associated with syphilis, and non-injection drug use may also contribute to acquisition of syphilis in HIV-infected MSM. Our results are consistent with previous findings that younger age is a major risk factor of syphilis infection in HIV-infected men, and the association between non-injection drug use and high-risk sexual behaviors among HIV-infected MSM has also been well documented [20,22,25,31-33,37]. Young HIV-infected men may not experience serious adverse health outcomes following HIV infection (e.g. dying of AIDS) and therefore may not perceive the importance of safer sex practice [38]. Other research also indicates that using the Internet to meet sexual partners and having unprotected anal intercourse are common in rural MSM, thus, it is likely that young, educated HIV-infected men in our patient population may have better access to the Internet or other venues to find sexual partners and engage in high-risk behaviors [36]. Additionally, we have identified that the perceived partner's behavior may play an important role in influencing individual's sexual practices and the subsequent risk of getting syphilis infection. It is possible that some HIV-infected men do not believe it is necessary to practice safer sex with a partner who may have sex with other people. As our study showed

that 18 HIV-infected men with syphilis had a detectable HIV viral load, unsafe sex practices in PLWHA would also result in an increased risk of transmitting HIV to uninfected partners and immediate interventions need to be provided to help PLWH reduce high-risk sexual behaviors. The current "Partnership for Health" intervention includes three core messages (Self-protection, Partner-protection, and Disclosure) that can be applied to all HIV-infected patients, and the Consequences Frame message that is specifically designed for HIV-infected patients with high-risk sexual behaviors [8]. Considering the changing epidemiology of syphilis in HIV-infected men, HIV primary care providers need to develop tailored prevention messages or perform more frequent STD screenings targeting young, educated HIV-infected men or those with casual or non-committed sexual partners. In addition, drug and alcohol counseling should be incorporated into routine HIV care to help HIV-infected MSM avoid high-risk sexual behaviors following substance use.

While other studies have shown successful decreases in high-risk behaviors and STD incidence in HIV-infected patients following risk-reduction intervention conducted in HIV care [6,9,11-14], the steady increase in syphilis infection among HIV-infected men across the US suggests that current HIV/STD prevention strategies for PLWHA need to be improved in response to syphilis epidemic. Although we have identified factors significantly associated with syphilis infection, we are unable to address the causes for high-risk sexual behaviors in HIV-infected men. Previous studies propose that HIV treatment optimism and safer sex fatigue may lead to high-risk sexual behaviors among HIV-infected men, presenting new challenges for HIV/STD prevention in the era of cART [37-41]. Therefore, more research needs to be conducted to examine current attitudes toward safer sex practices and changing behavioral patterns among PLWHA in order to help us design more effective prevention strategies.

In our study, 67% of sexually active HIV-infected men reported having any unsafe sexual behaviors, mainly inconsistent condom use. However, we did not detect the association between inconsistent condom use and syphilis infection after adjusting for partners' characteristics. Condom use behavior seemed to vary by different types of sexual partners as HIV-infected men with syphilis were less likely to use condoms with new partners, HIV-infected partners, or partners in polygamous relationship. Additionally, although HIV-infected MSM had more high-risk sexual behaviors, they did not have a significantly higher risk for syphilis infection(P-value<0.10 but >0.05). The similar increased but non-significant association between HIV-infected MSM and syphilis infection was also reported by other studies [20,23]. These results could be due to the small sample size of syphilis cases and insufficient statistical power for detecting the associations. Unlike previous studies, the syphilis epidemic in our HIV patients occurred after 2007, and we did not observe the racial difference in syphilis infection or detect any syphilis cases in HIV-infected women [18-22,25]. The unique social and population characteristics in south central Pennsylvania may contribute to the different epidemiology of syphilis in our study, as our HIV-infected patients are mainly older than 40 years, non-Hispanic whites, and living in a rural environment.

There are several limitations to our study. Because of clinical barriers and time constraints, we were unable to conduct detailed behavioral surveys to collect all the information related to sexual practices, use of the Internet or mobile device to find partners, and partners' characteristics. Since the risk screening was administered via a face-to-face interview, it is possible that some patients may not want to report their high-risk behaviors to the clinical team member. Therefore, our risk screening may not fully capture patients' behavioral risk profiles. Second, because of a small sample size of syphilis patients, we did not conduct the survival analysis and were unable to detect the associations of some variables that may have been related to syphilis. Also, our HIV patients may differ from previous study populations that mainly include urban HIV-infected men, thus, future studies with larger populations are needed to confirm our study findings.

In conclusion, some HIV-infected men, especially young, educated men, or those who perceived that their partners may have sex with other people, continue to have high-risk behaviors that increase their own risk for syphilis infection and may facilitate HIV transmission as well. As the majority of HIV-infected men are sexually active, along with well-established behavioral interventions and routine STD screening in HIV care, new strategies need to be developed for HIV primary care providers to help PLWHA maintain safer sex practices.

Sources of support

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