Sexually Transmitted Infection Prevalence in Women With HIV: Is There a Role for Targeted Screening?

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Background: Rates of sexually transmitted infections (STIs) and HIV are highest in the southern United States but vary widely by sex, age, and risk behavior. Current guidelines recommend annual screening for chlamydia, gonorrhea, syphilis, and trichomoniasis in all sexually active women with HIV.

Methods: Screening rates and test positivity for chlamydia, gonorrhea, syphilis, and trichomoniasis were determined per calendar year in this retrospective cohort study of women in care at an urban HIV clinic in Birmingham, Alabama, from 2013 to 2015. Chlamydia, gonorrhea, and trichomonas infections were detected by molecular diagnostics and syphilis by serology. A combined end point for chlamydia/gonorrhea/syphilis (STI-3) was created based on similar test positivity and predictors. Predictors of STI-3 were identified using logistic regression and generalized estimating equations.

Results: Among 745 women with HIV, median age was 46.8 years, 78.8% were black, and 61% were sexually active. In 2015, 83.7% of women were tested for STI. Test positivity was 1.0% for chlamydia, 0.5% for gonorrhea, 1.6% for syphilis, and 13.3% for trichomoniasis. Independent predictors of STI-3 were recent chlamydia or gonorrhea (odds ratio [OR], 3.7; 95% confidence interval [CI], 1–13.4; $P = 0.047$), public insurance compared with private (OR, 3.5; CI, 1–11.8; $P = 0.048$), and sex after drugs/alcohol (OR, 3.0; CI, 1.2–8.0; $P = 0.025$). Women 50 years or older were less likely to have STI (OR, 0.3; CI, 0.1–1; $P = 0.040$).

Conclusions: In a cohort of women engaged in HIV care in the southern United States, detection of chlamydia, gonorrhea, and syphilis was infrequent but trichomoniasis was common. Many women screened for STI were low risk and universal testing strategies warrant evaluation.

Women living in the southern region of the United States are at the epicenter of overlapping HIV and sexually transmitted infection (STI) epidemics.[1,2] More than 2 million cases of chlamydia (CT), gonorrhea (GC), and syphilis were reported to US Centers for Disease Control and Prevention (CDC) in 2016—the highest number in history.[3] Furthermore, CT and GC infection rates are highest in southern states, where an estimated 43% of people living with HIV reside.[2,3] In the setting of finite resources for STI control, infection prevalence is a key determinant of cost-effective screening practice. The rates of STI differ significantly by sex, age, and risk behavior, and these factors are incorporated into national STI screening guidelines for adolescents and adults, but not for adults living with HIV. This lack of specificity is increasingly relevant because the cohort of HIV-infected adults in the United States is aging (42% were ≥50 years old in 2013), and older age is associated with lower STI risk.[4]

Sexually transmitted infection screening of asymptomatic individuals is one cornerstone of an effective STI public health response. The rationale for annual STI screening in women with HIV is to prevent adverse outcomes of HIV-STI coinfection. These include a 2- to 3-fold increased risk of HIV transmission and negative birth outcomes.[5–7] Since 2006, CDC has recommended universal STI screening in *all* HIV-infected women and men at entry to care and every year if sexually active.[8] Routine testing includes the 3 most common, curable, reportable, bacterial STIs: CT (*Chlamydia trachomatis*), GC (*Neisseria gonorrhoeae*), and syphilis (*Treponema pallidum*). Annual screening for trichomoniasis in women with HIV has been recommended since 2010.[9] The HIV Medical Association of the Infectious Diseases Society of America recommends STI screening in adults with HIV at baseline and annually if "at risk," although risk is not defined. The US Preventive Services Task Force recommends annual syphilis screening with more frequent testing based on "individual risk behaviors and local epidemiology."[10] The task force has set a research priority to determine which subgroups benefit most from STI screening because poorly defined "risk" is a barrier to implementation.[11] In contrast to guidelines for persons living with HIV, national STI screening guidelines for the general population are age and sex specific: annual screening is recommended for CT and GC in sexually active women younger than 25 years or women 25 years or older if additional risk factors are present.[12] This recommendation is based on models that estimate annual CT screening in women (age, 15–29 years) to be cost-effective when infection prevalence is greater than 3%.[13,14] Because STI rates vary by sex, predictors of STI may also vary by sex and tailored screening guidelines for women living with HIV could reduce unnecessary testing.

Our hypothesis was that annual, universal screening for CT, GC, and syphilis for women engaged in HIV care in the current era is low yield. We undertook a retrospective cohort study to document annual STI testing rates and detection rates in this group. We also sought to identify independent predictors of bacterial STI to inform future screening practice.

METHODS

Study Overview

We performed a retrospective cohort study at the 1917 clinic at the University of Alabama at Birmingham, where primary

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and specialty HIV care is provided. Study participants completed a series of patient-reported outcomes (PROs) on touch-screen computers during routine visits. Surveys included validated questions about sexual practices and behaviors, alcohol intake (AUDIT-C questionnaire), and drug use (ASSIST questionnaire).[15,16] All HIV-positive, female clinic patients who were 19 or older in care from 2013 to 2015 were included in the cohort. We calculated the proportion of women in care screened for each STI (CT, GC, syphilis, and trichomoniasis) during each calendar year and at least once over the study period. We determined annual test positivity for individual and composite reportable STI measures (CT, GC, and/or syphilis, called STI-3). We did not include trichomoniasis in the final model for 2 reasons: trichomoniasis was significantly more common which skewed the model, and predictors of trichomoniasis in our study population have previously been published.[17] We sought to identify unique predictors of CT, GC, and syphilis among demographic, clinical, and risk behaviors using univariate and multivariable models. Finally, we tested the performance characteristics of CDC STI screening recommendations for sexually active adults by comparing screening rates and test positivity according to whether or not women reported sexual activity in the past 6 months.

Definitions

The analysis was restricted to women who were engaged in HIV care for at least one calendar year during the 2013–2015 period. Engagement was defined using the standard Health Resources and Services Administration HIV AIDS Bureau measure: at least 2 clinic visits separated by 90 days in a calendar year.[18] Clinic visits included routine visits, women's health visits, and sick call visits (where some women presented with an unrelated complaint but were screened for STI). Sexually transmitted infection screen was defined as having at least one STI test during the calendar year. Because information on the presence or absence of STI symptoms at the time of sample collection was not available, the measure of "test positivity" was used. The time of positivity for STI-3 was the first occurrence of CT, GC, or syphilis during the study period. An anchor date for each year in care was created for time-dependent variables (age, CD4, HIV viral load, and PROs). The hierarchy for this anchor date was the date of the positive STI test result, or the date of the STI screening test result (if negative), or July 1 (if no STI testing was performed). Variables were captured closest to the anchor date and within ±180 days for age, CD4, and HIV viral load and within ±365 days for PROs about sexual behaviors and substance use.

Participant Characteristics

Demographics and comorbidity data were collected from the electronic medical record: age (categorized 19–24, 25–29, 30–39, 40–49, 50+ years), race (white, black, other/unknown), insurance (private, public, none), time since HIV diagnosis (<2, 2–9, >10 years), CD4 count (<200, 200–350, >350 cells/mm^3), undetectable HIV viral load (<50 copies/mL), and active hepatitis B infection (hepatitis B surface antigen test positive). Recent history of CT or GC was defined as laboratory-confirmed nucleic acid amplification testing (NAAT) for CT or GC during the previous calendar year. Information on recent STI in sex partners was not available. Cervical dysplasia was defined as atypical squamous cells of undetermined significance, cervical intraepithelial neoplasia I–III, or cervical cancer on the problem list. Patient-reported outcomes included the following: active problem alcohol use, number of sexual partners (0, 1, 2+), anal sex (ever), sex with an HIV-infected partner, sex with a partner with unknown HIV status, condom use "always" (yes/no/not applicable if no sex partners), sex after drugs or alcohol, and history or current drug abuse with cocaine, heroin, methamphetamine, or opiates in the past 3 months. Except for drug abuse, all PROs referred to the preceding 6 months.

Diagnostic Testing

Nucleic acid amplification testing for CT, GC, or trichomoniasis was performed on vaginal or cervical swabs, or on urine samples. *C. trachomatis* and *N. gonorrhoeae* NAATs were performed on the DNA-based BD Viper system (BD Diagnostics, Sparks, MD) until 2014 when the laboratory switched to the RNA-based Aptima Hologic system (San Diego, CA). *Trichomonas vaginalis* was diagnosed with the InPouch system (BioMed Diagnostics, Santa Clara, CA) until August 2014, when it was replaced by RNA-based Aptima testing. For syphilis, rapid plasma reagin (RPR) was used as the initial screening test until the reverse testing algorithm (starting with syphilis IgG EIA) was adopted in March 2015. Treponemal antibody IgG testing was performed with the Trep-Sure qualitative enzyme immunoassay (Trinity Biotech, Jamestown, NY). Positive treponemal and nontreponemal test results (any titer) were required for syphilis cases, and chart review was conducted for disease staging.

Statistical Analysis

Descriptive statistics were used to summarize cohort characteristics. Findings were stratified by women with a positive test result for CT, GC, and/or syphilis (STI-3). χ^2 Test or Fisher exact tests were used to compare categorical variables, and Wilcoxon rank sum tests were used for continuous measures. Unadjusted and multivariable logistic regression models were created to identify predictors of STI-3. Variables for the multivariable model were chosen from literature review and significance and effect size in the UV models. Because individual study participants could contribute up to 3 separate years of time, generalized estimating equations with an exchangeable correlation structure were used to account for repeated measures. The sensitivity, specificity, negative predictive value, and positive predictive value of CDC STI screening criteria were determined for women based on self-reported sexual activity. A *c*-statistic was calculated to measure goodness of fit. Analyses were performed using SAS 9.4 (SAS Institute Inc, Cary, NC).

Ethics

The study was approved by the University of Alabama at Birmingham Institutional Review Board.

RESULTS

Of 834 women with HIV infection who received care between January 1, 2013, and December 31, 2015, 745 (89.3%) were engaged in care during at least one calendar year. These 745 women comprise our study population. Baseline participant characteristics stratified by STI test results are shown in Table 1. Median age was 46.8 years (range, 19.9–78.1 years), 70.4% of women were 40 years or older, and older women were less likely to have STI ($P = 0.02$). Most study participants were black (78.8%), and more than half (54.0%) were diagnosed as having HIV at least a decade earlier. The median CD4 was 581 cells/mm^3 (interquartile range [IQR], 366–867 cells/mm^3), and 65.7% of women had an undetectable HIV viral load (<50 copies/mL). Nearly 1 (19.7%) in 5 had documentation of cervical dysplasia. Although 26% had history of STI per the record, only 0.9% had laboratory-confirmed CT/GC infection in the past year.

Patient-reported outcome data were available for 66% of women in 2013 (n = 359), 71% in 2014 (n = 437), and 71% in 2015 (n = 421). Study participants with and without PRO data had similar baseline characteristics. Nearly 4 (39.0%; 184/472)

TABLE 1. Baseline Characteristics of 745 Women in HIV Care during 2013–2015*

Characteristic	Total (n = 745)	Tested for CT, GC, and/or Syphilis (STI-3; n = 684)		
		Positive (n = 19)	Negative (n = 665)	$P^{\dagger}$
Sociodemographic				
Median age (IQR), y	46.8 (38.3–53.7)	40.9 (32.0–44.9)	46.7 (38.1–53.4)	<0.01
Age, y				
19–24	14 (1.9)	2 (10.5)	12 (1.8)	0.02
25–29	28 (3.8)	1 (5.3)	26 (3.9)	
30–39	178 (23.9)	6 (31.6)	160 (24.1)	
40–49	235 (31.5)	8 (42.1)	215 (32.3)	
≥50	290 (38.9)	2 (10.5)	252 (37.9)	
Race				
White	144 (19.3)	3 (15.8)	124 (18.7)	0.48
Black	587 (78.8)	15 (79.0)	528 (79.4)	
Other/Unknown	14 (1.9)	1 (5.2)	13 (1.9)	
Insurance status				
Private	204 (27.4)	2 (10.5)	177 (26.6)	<0.01
Public	293 (39.3)	3 (15.8)	276 (41.5)	
None	248 (33.3)	14 (73.7)	212 (31.9)	
Clinical				
Timing of HIV diagnosis				
0–2 y ago	113 (15.5)	8 (44.4)	95 (14.6)	
3–9 y ago	223 (30.5)	7 (38.9)	196 (30.0)	
10+ y ago	395 (54.0)	3 (16.7)	361 (55.4)	<0.01
Median CD4 count (IQR)	581 (366–867)	540 (290–726)	579 (366–867)	0.53
CD4 count, cells/mm^3				
<200	89 (12.1)	3 (15.8)	80 (12.2)	0.77
200–350	79 (10.8)	2 (10.5)	66 (10.1)	
>350	565 (77.1)	14 (73.7)	508 (77.7)	
HIV viral load, copies/mL				
<50	486 (65.7)	8 (42.1)	434 (65.7)	0.03
≥50	254 (34.3)	11 (57.9)	227 (34.3)	
CT/GC infection in the previous 12 mo				
Yes	7 (0.9)	2 (10.5)	5 (0.8)	0.01
No	738 (99.1)	17 (89.5)	660 (99.2)	
Active hepatitis B infection				
Yes	15 (2.0)	0 (0)	13 (2.0)	1.0
No	730 (98.0)	19 (100)	652 (98.0)	
Cervical dysplasia (ever)				
Yes	147 (19.7)	0 (0)	133 (20.0)	0.03
No	598 (80.3)	19 (100)	532 (80.0)	
PROs[‡]				
Problem alcohol intake				
Yes	137 (29.1)	3 (15.8)	69 (10.4)	0.44
No	334 (70.9)	16 (84.2)	596 (89.6)	
Drug abuse (cocaine, heroin, meth, opiates)				
Current (in the past 3 mo)	35 (7.4)	3 (23.1)	29 (6.9)	0.09
History (ever)	112 (23.8)	3 (23.1)	100 (23.6)	
No	324 (68.8)	7 (53.9)	294 (69.5)	
No. sex partners				
0	184 (39.0)	2 (15.4)	156 (36.8)	0.01
1	255 (54.0)	7 (53.9)	240 (56.6)	
2+	33 (7.0)	4 (30.8)	28 (6.6)	
Sex with HIV+ partner				
Yes	87 (18.9)	5 (38.5)	79 (19.1)	0.15
No	374 (81.1)	8 (61.5)	334 (80.9)	
Sex with partner of unknown HIV status				
Yes	41 (8.7)	3 (23.1)	38 (9.0)	0.09
No	431 (91.3)	10 (76.9)	386 (91.0)	
Condom use "always"				
Yes	157 (33.1)	7 (53.9)	145 (34.0)	0.19
No	128 (27.0)	4 (30.8)	120 (28.2)	
Not applicable	189 (39.9)	2 (15.4)	161 (37.8)	
Sex after drugs/alcohol				
Yes	53 (11.3)	5 (38.5)	47 (11.1)	0.01
No	417 (88.7)	8 (61.5)	375 (88.9)	
Anal sex (ever)				
Yes	144 (30.4)	7 (53.9)	129 (30.4)	0.12
No	329 (69.6)	6 (46.1)	296 (69.7)	

Missing data for each variable: timing of HIV infection, 14; CD4, 12; HIV viral load, 5; drug use, 274; alcohol intake, 274; number of sex partners, 273; sex with HIV+ partner, 284; sex with partner with unknown HIV status, 273; condom use, 271; sex after drugs or alcohol, 275; anal sex, 272; STI-3, 61.

*Characteristics during the first full year engaged in HIV care at the time of STI diagnosis, STI screening test, or July 1 (if not screened). First year in care 2013 (n = 542), 2014 (n = 158), 2015 (n = 45).

$^{\dagger}P$ value from $\chi 2$ tests or Fisher exact tests.

[‡]Refers to behavior during the past 6 months unless specified.

TABLE 2. STI Screening Among Women With HIV

	CT, %	GC, %	Syphilis, %	Trichomoniasis, %
2013* (n = 542)	69.4	68.8	87.3	0
2014* (n = 613)	71.5	71.5	74.4	33.6
2015* (n = 594)	67.2	67.0	64.8	58.4
At least once 2013–2015† (n = 745)	71.4	71.0	82.7	12.1
In care all of 2013–2015 (n = 391)‡	93.9	93.9	99.0	71.6

*At least 1 STI test during the calendar year.
†At least 1 STI test during 1st full year engaged in HIV care.
‡At least 1 STI test during 3 years in care.

in 10 women with PRO data reported no sexual activity in the past 6 months. Among women who were sexually active, most were practicing safer sex: 88.5% (255/288) reported monogamy and 55.1% (157/285) always used condoms. Some other risk behaviors were relatively infrequent: 7.4% reported active drug use, 8.7% had sex with a partner of unknown HIV status, and 11.3% had sex after drugs or alcohol (Table 1).

Screening rates per person-year for STI are shown in Table 2. Between 67% and 72% of study participants were screened for CT and GC in any given year, and 94% of women were screened at least once if they were in care for 3 years. Of 1919 CT tests performed, 1221 samples (63.6%) were from cervical or vaginal sites and 698 (36.4%) were urine; dual testing for GC was performed in 100%. Annual syphilis screening rates decreased from 87.3% in 2013 to 64.8% in 2015, but 99.0% of participants in care for 3 years were tested at least once. The 2015 screening rate for trichomoniasis by NAAT was only 58.4%. Women who reported sexual activity on PROs were more likely to be screened for STI (annual rate of 75%–83% for CT/GC) compared with women who reported no sex partners (annual rate of 57%–59% for CT/GC; all $P < 0.001$; data not shown). One (33.2%; 239/720) in 3 CT and GC tests performed in 2015 were in women who reported not having sex in the past 6 months.

Annual test positivity for individual and composite STI outcomes is shown in Table 3, with findings stratified by sexual activity for women with PRO data available. Rates of CT (1.0%–2.1%), GC (0–0.8%), and syphilis (0.4%–1.6%) were low but trichomoniasis was common (11.2%–13.3%). A graph of 2015 STI test positivity by age category demonstrates the inverse association between STI and age (Fig. 1). Twelve cases of syphilis were detected over 3 years: all had low titer RPR (8 with 1:1, 2 with 1:2, 2 with 1:4) and positive treponemal test result. Upon medical record review, 10 cases were categorized as possible early or latent syphilis and 2 had decreasing RPR titers, but timing of therapy and historical test results were not available to allow for accurate disease staging. Table 3 also compares STI rates based on self-reported sexual activity. On average, sexually active women were more likely to have STI. Using sexual activity alone to direct bacterial STI screening yielded a sensitivity of 85.7% (95% confidence interval [CI], 42.1–99.6), specificity of 38.7% (CI, 33.5–44.1), positive predictive value of 2.8% (CI, 1.0–6.0), and negative predictive value of 99.3% (CI, 95.5–100.0). The *c*-statistic value for the area under the receiver operating characteristic curve was 0.62, indicating poor performance of using self-reported sexual activity as the sole criterion to guide STI screening.

Table 4 shows the STI-3 prediction model based on 1055 observations and 26 positive tests for CT, GC, or syphilis. In the unadjusted model, age 19 to 24 years was highly predictive of bacterial STI and women 50 years or older were less likely to have STI (both compared with age 25–49 years). Other predictors in the unadjusted model were as follows: CT/GC infection in the past 12 months, multiple sex partners, lack of medical insurance, sex after drugs or alcohol, sex with an HIV-infected partner, and detectable HIV viral load. In the multivariable model, older age (≥50 years) had a significant and inverse association with STI (adjusted odds ratio [aOR], 0.3; 95% CI, 0.1–1.0; $P = 0.040$). Factors positively associated with STI were as follows: CT/GC infection in the past 12 months (aOR, 3.7; 95% CI, 1.0–13.4; $P = 0.047$), public insurance compared with private insurance (aOR, 3.5; 95% CI, 1.01–11.8; $P = 0.048$), and sex after drugs or alcohol (aOR, 3.0, 95% CI, 1.2–8.0; $P = 0.025$).

DISCUSSION

Women in HIV care in urban Alabama had low annual detection rates of CT, GC, and syphilis (<2.2%) despite residence in

TABLE 3. Annual STI Detection in Women With HIV: Overall and by Sexual Activity Status*

	CT, n (%)	GC, n (%)	Syphilis, n (%)	Trichomoniasis, n (%)	STI-3† (CT/GC/Syphilis) n (%)
2013					
Overall	8/376 (2.1)	3/373 (0.8)	2/473 (0.4)	N/A	13/506 (2.6)
Sexually active	7/166 (4.2)	1/164 (0.6)	0/195 (0)	N/A	8/205 (3.9)
Not sexually active	0/86 (0)	1/86 (1.2)	0/112 (0)	N/A	1/126 (0.8)
2014					
Overall	7/438 (1.6)	0/438 (0)	4/456 (0.9)	23/206 (11.2)	11/539 (2.0)
Sexually active	3/210 (1.4)	0/210 (0)	4/206 (1.9)	11/109 (10.1)	7/237 (3.0)
Not sexually active	3/102 (2.9)	0/102 (0)	0/124 (0)	2/37 (5.4)	3/149 (2.0)
2015					
Overall	4/399 (1.0)	2/398 (0.5)	6/385 (1.6)	46/347 (13.3)	12/493 (2.4)
Sexually active	3/184 (1.6)	2/184 (1.1)	1/169 (0.6)	26/152 (17.1)	6/215 (2.8)
Not sexually active	0/102 (0)	0/101 (0)	1/108 (0.9)	3/89 (3.4)	1/133 (0.8)

*Sexual activity status among women with PRO data available. Active if 1+ sex partners in the past 6 months. Not active if reported 0 sex partners in the past 6 months.
†Among women screened for at least one STI during the calendar year.
N/A indicates not applicable.

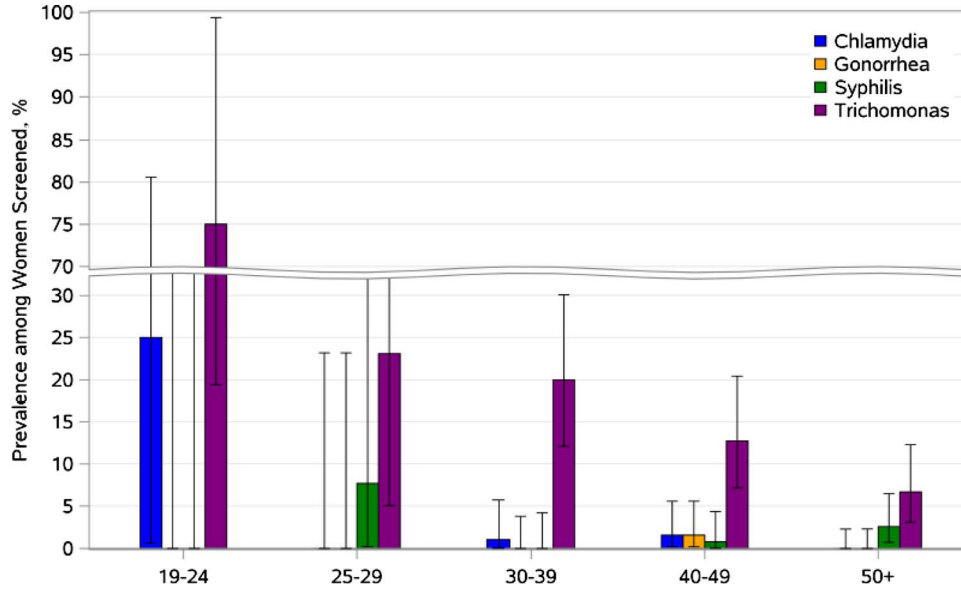

Figure 1. Sexually transmitted infection positivity among women with HIV by age group, 2015.

a region of the United States, where STI is endemic. Older age (>50 years) was associated with lower STI prevalence, and 3 factors were identified as independent predictors of STI: CT or GC infection in the past 12 months, sex after drugs or alcohol, and public health insurance. Trichomoniasis was common across all age categories.

Our findings add to accumulating evidence that show comparable STI rates among women in the United States, irrespective of HIV status. The most recent data from the National Health and Nutrition Examination Survey showed a 2% annual population prevalence of CT in sexually active females aged 14 to 39 years compared with 1% to 2.1% in our older HIV cohort.[19] Two US studies of young, sexually active women documented a 0.3% GC detection rate compared with 0 to 0.8% in our study.[20,21] Finally, national *T. vaginalis* prevalence in the National Health and Nutrition Examination Survey was 3.1% among women aged 14 to 49 years but 10-fold higher in black women, which approximated the 11.2% to 13.3% positivity rate seen in our study.[21] If STI rates in HIV-infected women are comparable to national STI rates, it may no longer be appropriate to consider all women living with HIV as "high risk" in terms of STI acquisition and STI/HIV transmission. It is not clear whether women with HIV with STI have higher rates of negative infection outcomes, but better predictors of STI risk than HIV status alone are needed to guide screening in this key population.

Age is one of the most consistent predictors of bacterial STI acquisition. Peak rates of CT, GC, and syphilis among women in the 2016 CDC STD Surveillance Report occurred in the 20- to 24-year age group, whereas age 15 to 24 years is consistently associated with high risk of incident STI.[3] However, the median age of female study participants living with HIV in Alabama was 47 years. Although safer sex counseling is important for women of all ages, one recent multicenter study of women living with HIV in the United States showed that only 1 in 3 women older than 50 years were sexually active.[22] Most participants in our cohort reported few (if any) traditional STI risk behaviors, yet many were routinely screened for STI. Annual CT/GC screening rates of 65% to 70% increased to 75% to 80% among study participants who reported sexual activity. These rates are suboptimal but similar to CT/GC screening rates in HIV-infected men who have sex with men (MSM) and significantly higher than other US women in HIV care during the 2009–2013 period (27%–45%).[23,24] In terms of sexual behaviors, nearly 4 (39%) in 10 women had not been sexually active in the past 6 months and 54% had acquired HIV more than 10 years ago. Most sexually active women were practicing safer sex with a single male partner. These risk behaviors in study participants differ compared with 890 MSM surveyed in the same HIV clinic; 64% of MSM reported multiple partners in the past 6 months, 56% had unprotected sex, and 58% had a history of STI.[25] Although bacterial STI rates have increased to 20 million new infections each year, rates stratified by sex show that much of the trend is explained by increasing incidence among men[2,26] For example, according to the 2016 CDC surveillance report, the GC case rate was 171 cases per 100,000 males compared with 121 cases per 100,000 females, and in 2015, the rate of primary and secondary syphilis was 309 cases per 100,000 MSM compared with 1.4 cases per 100,000 females.[3,27]

Most cost-effective screening strategies target populations based on individual risk. Screening recommendations for STI are limited by a paucity of risk factor data, particularly for women living with HIV.[28] Also, risk-based STI screening is less useful when the provider or patient is unaware of the risk behavior. Predictors of CT infection among HIV-uninfected women include the following: younger age (<20 years), new or multiple sex partners, and having a partner with STI symptoms.[29] Predictors of GC among young women are a new partner in the past 60 days and black or Native American race.[20] Predictors of STI among incarcerated black women are partner concurrency, inconsistent condom use, sex work, prior STI, and drug abuse.[30] One of few studies to identify predictors of incident STI in women with HIV was conducted in Africa, where age less than 25 years and recent STI were predictive.[31] Published predictors of trichomoniasis among women with HIV in our clinic include black race, cocaine use, and age 40 years or less.[17] Because trichomoniasis was common, molecular testing for trichomonas alone may be more cost-reasonable than combination testing for CT/GC/trichomonas.

In sum, in our model, younger age and recent STI are the best predictors of STI acquisition among women engaged in HIV care. The development and validation of a simple prediction model to allow for targeted bacterial STI screening in women with HIV could advance clinical care and reduce cost. The most useful predictors to include in a model would be easily ascertained

TABLE 4. Predictors of Bacterial STI (CT/GC/Syphilis) in Women With HIV*

Characteristic at Time of STI	Unadjusted OR (95% CI)	*P*	Adjusted OR† (95% CI)	*P*
Sociodemographics				
Age, y				
<50	Ref		Ref	
50+	0.3 (0.1–0.7)	0.005	0.3 (0.1–1)	0.040
Race				
White	Ref			
Black	0.9 (0.4–2.1)	0.843		
Insurance				
Private	Ref		Ref	
Public	2.1 (0.7–6.5)	0.188	3.5 (1–11.8)	0.048
None	3.9 (1.3–11.8)	0.015	2.8 (0.8–9.9)	0.108
Clinical				
Years since HIV Diagnosis				
0–2	1.8 (0.8–4.0)	0.188		
3–9	Ref	<0.001		
>10	0.2 (0.1–0.5)			
CD4, cells/mm^3				
<200	1.9 (0.8–4.8)	0.162		
200–350	1.4 (0.5–4.1)	0.490		
>350	Ref			
HIV viral load, copies/mL				
<50	Ref	<0.001		
>50	2.4 (1.2–4.7)			
CT/GC infection in the previous 12 mo				
No	Ref		Ref	
Yes	16.3 (5.9–44.9)	<0.001	3.7 (1–13.4)	0.047
Cervical dysplasia (ever)				
No	Ref			
Yes	0.6 (0.3–1.6)	0.353		
Chronic hepatitis B infection				
No	Ref			
Yes	1.4 (0.2–9.7)	0.735		
PROs				
Problem alcohol intake in the past 6 mo				
No	Ref	0.008		
Yes	3.0 (1.3–6.8)			
Drug abuse				
Never	Ref			
Active	2.8 (1.0–7.9)	0.054		
History	1.2 (0.5–3.1)	0.735		
No. sex partner in the past 6 mo				
0	Ref	0.157	Ref	0.658
1	2.1 (0.8–5.9)	0.001	1.3 (0.5–3.6)	0.142
2+	7.1 (2.2–22.9)		2.8 (0.7–10.9)	
Sex with HIV+ partner in the past 6 mo				
No	Ref			
Yes	2.7 (1.1–6.6)	0.027		
Sex with partner of unknown HIV status in the past 6 mo				
No	Ref			
Yes	1.4 (0.4–5.0)	0.570		
Condom use “always” in the past 6 mo				
No	Ref			
Yes	1.0 (0.4–2.4)	0.932		
N/A	0.3 (0.1–1)	0.056		
Sex after drugs/alcohol in the past 6 months				
No	Ref		Ref	
Yes	3.8 (1.6–9.1)	0.003	3.0 (1.2–8.0)	0.025
Anal sex (ever)				
No	Ref			
Yes	1.5 (0.7–3.3)	0.272		

*ORs, resulting 95% CIs, and *P* values from logistic regression models with a positive STI result during the calendar year as the event. Individual women contribute a separate observation for each year screened for at least 1 STI (up to 3). Generalized estimating equation with an exchangeable correlation structure used to account for possible correlation due to women contributing multiple observations.

†Adjusted ORs from single multivariable model including the variables with results shown in the table. Based on 1055 observations, 26 positive STI tests.

N/A indicates not applicable; Ref, reference.

factors, such as age and sex. Findings from this study suggest additional risk factors to test: recent CT/GC in the past year, sex after drugs/alcohol, and socioeconomic status. The CDC recommends repeat CT and GC testing 3 months after diagnosis due to high reinfection rates—our data support this practice in women with HIV.[8] Additional data from a national, longitudinal HIV cohort study with validated STI outcomes and risk behaviors would provide the best opportunity to assess demographic and behavioral factors in a predictive model that could be subsequently validated for performance characteristics. Such an analysis within the Center for AIDS Research Network of Integrated Clinical Systems is ongoing. It is also important for future studies to explore STI outcomes in women who are not engaged in HIV care because higher infection rates and missed opportunities are likely. In the meantime, the high negative predictive value of using sexual activity in screening criteria indicates that it is reasonable for HIV providers to follow CDC guidelines and defer routine STI screening for women who are not having sex.

Our study had limitations. Low STI positivity rates limited our ability to assess all potential predictors. Study findings are not generalizable to pregnant women with HIV or women not engaged in care. Findings likely generalize to women with HIV in care living in urban areas in the US South but may not extend to communities with a larger proportion of young women with newly diagnosed HIV. Screening of STI in regions with lower infection rates may be even less useful than screening in Alabama. Also, risk behavior data were not available for all study participants, and information on recent STI in sex partners was not captured. Because we did not capture symptoms, some testing was performed for diagnostic purposes, but had we excluded testing among symptomatic women, we expect that STI detection rates would have been even lower. Screening of STI was not universal but comparable to other US HIV clinics.[24] Finally, although our composite STI measure included 12 cases of syphilis, we were unable to stage cases which may have overestimated infectious syphilis. Strengths of this study include the size of the HIV cohort with the provision of primary care in a setting with frequent follow-up, routine STI testing, and high levels of HIV care engagement and retention. High-quality information on sensitive risk behaviors was collected using validated computerized questionnaires.

The major implication of this study is that current CDC STI screening recommendations based solely on sexual activity for women living with HIV may be inadequate. Older women with few or no STI risk factors may be overscreened for CT, GC, and syphilis but insufficiently screened for trichomoniasis. Study findings support CDC guidelines to screen women with HIV annually for trichomoniasis, but we documented an annual CT rate well below the <3% threshold that dictates cost-effective screening practices. HIV clinics and public health services must prioritize high-impact activities, and STI molecular diagnostic testing is highly sensitive but costly. Moreover, many STI outcomes built into screening models are adverse pregnancy and fertility outcomes with less relevance in determining screening efficacy in postmenopausal women.[13,14]

In conclusion, many women engaged in HIV care in Alabama are older and have few STI risk factors and infrequent infection with CT, GC, and syphilis. Current guidelines that recommend universal annual STI screening in women with HIV should be refined based on an improved understanding of risk. A simple STI prediction model based on age and recent STI may be effective.

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