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Integrating Sexually Transmitted Infection Testing and Treatment With Routine HIV Care in Gaborone, Botswana

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Background: Sexually transmitted infection (STI) testing is not routinely offered in many countries, and management is symptoms based. *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (NG) are associated with an increased risk of HIV transmission. We assess the feasibility and acceptability of integrating CT/NG testing into routine HIV care in Botswana, as well as the prevalence and correlates of CT/NG infections.

Method: A prospective study was conducted at an HIV clinic in Gaborone between February and October 2019. Eligibility criteria included the following: ≥18 years, HIV infected, and not treated for CT/NG in the past month. Participants self-collected samples and responded to a questionnaire on sociodemographic and health characteristics. Samples were processed using the GeneXpert. Patients were offered same-day results in person or by telephone. Those who tested positive were treated.

Results: Of 806 patients informed of the study, 526 (65%) expressed interest and 451 (60%) were enrolled. The median age was 48 years, and 66% were women. All participants provided self-collected samples, were successfully tested, and received results. Almost all reported sample self-

collection was easy. The prevalence of CT/NG was 5%. Most participants (73%) with a positive result were asymptomatic. Among infected, 20 (91%) received same-day results and all were treated. Younger age, female sex, and pain during sex were associated with having CT/NG.

Conclusions: Integrating STI testing into routine HIV care was feasible, self-collecting specimens was highly acceptable, but uptake of testing was low. Where blanket screening to the entire clinic population may not be feasible because of resource limitation, one strategy could be to prioritize sexually active patients, younger patients, and women.

Chlamydia trachomatis and *Neisseria gonorrhoeae* are among the most common curable sexually transmitted infections (STIs) worldwide, with 127 million (95% uncertainty interval, 95.1–165.9 million) and 86.9 million (95% uncertainty interval, 58.6–123.4 million) cases, respectively, in 2016.¹ Approximately 90% of STIs occur in low- and middle-income countries.² These infections are responsible for significant morbidity including pelvic inflammatory disease and female infertility.^{3–5} There is also increasing evidence of antimicrobial-resistant strains of *N. gonorrhoeae* globally, and as a result, it has been listed as a priority pathogen by the World Health Organization (WHO).^{6,7}

Previous research has demonstrated a synergistic relationship between HIV and other STIs. Global studies have found higher rates of curable STIs among HIV-positive participants compared with those without HIV and have shown that those living with HIV are at higher risk of acquiring additional STIs.^{8–10} Research has demonstrated that the presence of a genital infection can increase the risk of both acquisition and transmission of HIV, including mother-to-child transmission.^{11,12} Although most studies assessing STI control at a population level as an intervention for HIV prevention have not demonstrated any significant reduction in HIV incidence,¹³ the potential benefits and importance of integrating quality sexual health programs into HIV services have been widely discussed,^{11,13–16} and this is reflected in WHO guidance and most national guidelines.

The Global Health Sector Strategy on STIs 2016–2021 identifies the elimination of STIs as a public health concern and recommends that routine screening, diagnosis, and management of STIs be offered as part of comprehensive HIV care.^{15,17} The strategy aims to have 70% of countries integrating STI services into HIV care by 2020 and aims for a 90% reduction in the incidence of *N. gonorrhoeae* by 2030.

Most low- and middle-income countries, including Botswana, offer a syndromic approach to STIs with standardized treatment regimens for syndromes (e.g., vaginal discharge syndrome) based on a range of symptoms.¹⁷ Although this approach offers point-of-care treatment of symptoms, asymptomatic infections are

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unidentified and therefore remain untreated.^{15,18} Furthermore, given the poor diagnostic accuracy of syndromic management, unnecessary exposure to antibiotics is common.^{19,20} Although the drawbacks to the syndromic approach are well documented, there are barriers to offering and scaling up etiological STI testing, including burdens on health care personnel and infrastructure, and costs.²¹

Recent innovations in STI testing have emerged, including self-collected specimens and rapid, near-patient tests that are affordable, sensitive, and specific as well as require minimal training for health care staff. Near-patient or point-of-care tests are diagnostic tests performed outside the conventional laboratory and near, or at, the point of patient care.²² Such innovations may facilitate decentralized testing, expand access to etiological management of STIs, and offer rapid treatment.²¹ Although research in high-income countries found high levels of acceptability and uptake of testing,^{23–28} challenges at the health care, patient, and provider levels, including distrust and disruption of clinical flow, have been identified as potential barriers to implementation.^{16,18,21} Thus, further studies are required to explore barriers specific to lower-resource settings and evaluate the potential benefit of integrating these services into routine HIV care.

This study conducted in Gaborone, Botswana, aimed to assess the feasibility and acceptability of incorporating screening for *C. trachomatis* and *N. gonorrhoeae* into routine outpatient HIV care with the use of Xpert CT/NG assay and self-collected samples. We also assessed the prevalence and correlates of *C. trachomatis* and *N. gonorrhoeae* infections among people living with HIV and seeking care.

MATERIALS AND METHODS

Study Design, Setting, and Recruitment

We conducted a prospective cohort study to assess the feasibility and acceptability of incorporating etiological testing for *C. trachomatis* and *N. gonorrhoeae* into HIV care using self-collected samples and the GeneXpert system (Cepheid, Sunnyvale, CA). The study was conducted in the Infectious Disease Care Clinic at Princess Marina Hospital, Gaborone, which is a specialist outpatient clinic providing care to adults living with HIV.

Participants were recruited between February and October 2019. Eligibility criteria were as follows: living with HIV, >18 years of age, no treatment of *C. trachomatis* and/or *N. gonorrhoeae* in the previous 30 days, and less than 34 weeks' gestation if pregnant.

The recruitment, enrollment, and testing processes were developed in consultation with Infectious Disease Care Clinic health care providers and management staff to minimize disruption to clinic flow and reflect a service that could be incorporated into the current setting. The study was advertised to patients by clinic staff and study team members during vitals recording before being seen by an HIV care provider. Patients were informed of the preliminary interview, sample collection, 90-minute wait to results, and treatment available. Those interested were directed to study staff for assessment of eligibility, more detailed information about the study, and written informed consent. Those who declined were asked to state a reason.

Sample and Data Collection

After informed consent, participants responded to an interviewer-administered questionnaire provided in either English or Setswana. The questionnaire collected sociodemographic information and HIV treatment status, including current viral load. Participants were then asked about STI symptoms including vaginal discharge, genital ulceration, lower abdominal pain, dysuria, and spotting. Information regarding sexual behavior, including number of partners, condom use, and previous STIs, was also collected. The study did not incorporate detailed history taking, physical examination,

or assessment for other genital conditions such as *Trichomonas vaginalis*, bacterial vaginosis, *Candidiasis*, or pelvic inflammatory disease; therefore, syndromic management was not offered by the study staff, and participants who reported symptoms were referred to a local clinic providing STI services. These patients were included in the study sample and completed testing before referral. The result of the study test and any treatment provided in the study were detailed in a referral letter to the clinic. Any participants reporting severe or concerning symptoms were assessed by clinic doctors on the same day during their appointment.

After the interview, verbal instruction was provided by study staff to participants for self-collected samples. Women were instructed to self-take a vaginal swab, and men were instructed to provide first-catch urinary samples. After collection, exit interviews were conducted, and patients were asked how easy they found self-collecting samples and whether they would choose this method in the future.

Sample Processing

Testing of samples was conducted onsite using a GeneXpert CT/NG assay, which is a near-patient, dual nucleic acid amplification test used to detect *C. trachomatis* and *N. gonorrhoeae* DNA in endocervical, vaginal, and urine samples of women, and urine samples of men. For male urine samples, studies have demonstrated a sensitivity and specificity of 97.5% and 99.4% for *C. trachomatis*, respectively, and a sensitivity and specificity of 98% and 100% for *N. gonorrhoeae*, respectively.²⁹ In women, studies have demonstrated a higher sensitivity and specificity for *N. gonorrhoeae* detection using self-collected vaginal samples than using urine samples (99.9% and 100% vs. 95.6% and 99.9%, respectively). The sensitivity and specificity for *C. trachomatis* detection in self-collected vaginal samples are 98.7% and 99.4%.²⁹ Therefore, men were requested to provide first-catch urine samples, and women were asked to provide self-collected vaginal samples. Verbal and visual instructions were provided to aid with sample collection.

Two 4-module GeneXperts were maintained in a portacabin outside the clinic. Samples resulting in errors were reprocessed. Sample processing time was 90 minutes.

Results and Treatment

To receive their results, participants were given the choice to be contacted by study staff either by telephone or in person at the clinic. Among those who tested positive, efforts were made to provide same-day results and treatment; otherwise, suitable dates and times were determined for the participant to return for directly observed treatment.

In the absence of any local microbiological resistance data or local guidelines, antimicrobial treatment was provided in accordance with WHO recommendations.^{3,4} Participants in whom *C. trachomatis* was detected were given directly observed therapy with 1 g of oral azithromycin, and those with *N. gonorrhoeae*, or both *C. trachomatis* and *N. gonorrhoeae* were given 250 mg intramuscular ceftriaxone plus 1 g of oral azithromycin. All positive results were documented in individual confidential medical notes held by the clinic, in addition to the treatment they received.

Partner Notification and Test of Cure

All participants who tested positive were counseled regarding partner notification. Partner notification forms were provided for all recent partners in line with the Botswana standard of care. Partners could either contact study staff to arrange treatment at a suitable date and time or attend a clinic of their choice and receive treatment using the partner notification form. Pregnant women were invited for a test of cure after 4 weeks.

Outcomes and Data Analysis

Feasibility was assessed by the proportion of participants able to provide adequate samples, the proportion of samples processed with determined results, and proportion of participants contacted and successfully treated.

Acceptability of testing was assessed by the uptake of testing (the proportion enrolled among clinic attendees informed about the study during vitals recording). The acceptability of self-collected samples was assessed using exit questions on experiences and preferences related to sample collection. Prevalence was assessed as the proportion of those who tested positive out of all participants tested with exact binomial 95% confidence intervals (CIs).

We also assessed correlates of infections via bivariate comparisons using χ^2 or Fisher exact test for categorical variables, and Student *t* test or Wilcoxon-Mann-Whitney test for continuous variables. We also assessed independent associations using a multivariable logistic regression model and included covariates that were significantly associated with an STI at the $P < 0.05$ level in bivariate comparisons. Analysis was undertaken using STATA v.16.

Ethics

The institutional review boards at the University of Botswana (URB/IRB/1547), the Botswana Ministry of Health, Health Research Development Committee (PPME 13/18/1 IX(434)), and Princess Marina Hospital (PMH 5/79(223-3-2016)) approved the study protocol.

RESULTS

Uptake of Testing

Of the 806 individuals offered enrollment, 65% ($n = 526$) demonstrated interest and 35% ($n = 280$) declined. The stated reasons for declining enrollment were as follows: not sexually active ($n = 68$; 24%), worried about time ($n = 52$; 19%), recent STI testing in the last 30 days ($n = 48$; 17%), believed they were not infected with an STI ($n = 17$; 6%), worried about sample collection ($n = 9$; 3%), did not state reason ($n = 60$; 22%), and other ($n = 26$; 9%).

Among the 526 who expressed interest in participating, 456 were screened for enrollment. Because of the high volume of patients in the clinic, there were significant time and resource limitations with a higher number of interested individuals than it was possible for study staff to process. Therefore 70 interested individuals were not able to meet with study staff to receive more information, be assessed for eligibility, or receive an enrollment offer (Fig. 1). Most participants were introduced to the study during the vitals recording encounter before their appointment; however, a number of patients did not attend vitals recording and were introduced to the study directly by nursing staff. Twenty-three of the participants who attended enrollment screening were directed to the study in this way. Of the 479 screened for enrollment, 451 were enrolled, 19 were found to be ineligible, and 9 declined.

Sample Enrolled

Among the 451 participants, the median age was 48 years, 66% were women, 26% were married, most had achieved an education level of senior secondary or less (70%), and 62% were employed (Table 1). The median number of years since first HIV diagnosis was 15, and 98% were on antiretroviral treatment. Among the 93% who had a recorded viral load, 95% had a viral load of ≤ 400 copies/mL. In terms of partners in the last 2 months, 21% reported no sexual partners, 74% reported one, and 5% had more than one sexual partner. Thirty-seven percent reported that they did not always use a condom with all sex partners. Among

women, abnormal vaginal discharge and lower abdominal pain symptoms were common at 15% and 14%, respectively. Among men, 5% reported testicular pain. Among the entire sample, 5% reported painful urination, 4% reported genital ulcers, and 5% reported experiencing genital warts. Women were more likely to report an STI-related symptom (Table 2).

Self-Collected Specimens

The ease of sample collection did not differ by sex (Table 2). Eight women (2.7%) and no men reported it as difficult. About half (52%) reported that they would choose to self-collect samples in the future, and a further 37% stated that they were indifferent about whether the sample was self-collected or collected by a health care professional. In terms of future preference, women were more likely to prefer to self-collect the sample, and men were more likely to report no preference. Among those who would prefer to self-collect their sample in the future, 39% reported that the reason they chose this method was because it is more comfortable and 8% reported self-collection was less embarrassing. Among the 10% who preferred a health care provider-collected sample, 67% said this was because they could feel more confident that the sample was collected properly.

Feasibility

All participants provided self-collected samples. A total of 14 (3%) sample errors occurred, and all were reprocessed successfully. To receive results, 83% of participants chose to be contacted by telephone and 17% chose to wait at the clinic. All participants were successfully contacted. Among the 22 participants who tested positive for *C. trachomatis* and/or *N. gonorrhoeae* infections, all were treated, including 4 (18%) who were treated on the same day as testing. Ten participants (45%) were treated within 1 day of testing, and 15 (68%) within 2 days. The remaining patients were treated on day 3 (1), day 4 (2), and day 6 (2). Two participants initially did not attend treatment appointments but were followed up and treated at 33 and 77 days after testing. No patients received treatment elsewhere before being treated by study staff, although those with symptoms were referred for full assessment. Among the 22 who tested positive, 19 preferred to notify partners themselves, 1 preferred to notify with the help of a doctor or nurse, and 2 preferred not to notify their partner.

Prevalence and Correlates

The prevalence of *C. trachomatis* and/or *N. gonorrhoeae* infections was 5%, including 16 with *C. trachomatis* only, 4 with *N. gonorrhoeae* only, and 2 with dual infection (Table 1). Of those testing positive, 20 (91%) were female. In bivariate comparisons, younger age ($P = 0.002$) and female sex ($P = 0.007$) were associated with infection. One hundred seven patients (24%) reported an STI-related symptom; 6 (6%) of these tested positive for an infection. Seventy-three percent of participants with a positive result were asymptomatic. Those diagnosed with an STI were more likely to report pain during sex ($P = 0.012$). No other STI-related symptom was associated with testing positive. Table 1 also provides the results of the simple multivariable logistic regression model, which controlled for age, sex, education, and pain during sex. Participants who were aged 41 to 60 years were less likely to be diagnosed with an STI (adjusted odds ratio [AOR], 0.36; 95% CI, 0.14–0.92) compared with participants aged 18 to 40 years. Furthermore, those who reported pain during sex (AOR, 5.47; 95% CI, 2.02–14.80) were more likely to be diagnosed with an STI compared with those who did not report pain. Female sex was associated with increased odds of an STI diagnosis (AOR, 4.43; 95% CI, 0.99–19.9).

DISCUSSION

We implemented a testing program for *C. trachomatis* and *N. gonorrhoeae* infections using near-patient technology in a specialty HIV clinic at Princess Marina Hospital in Gaborone, Botswana. We demonstrated that integrating STI testing into routine HIV care was feasible. All participants were able to provide adequate self-collected samples, were informed of their results, and were provided with treatment if required. Sample self-collection was also acceptable as most participants reported that it was easy, and they would choose to self-collect samples in the future.

C. trachomatis and/or *N. gonorrhoeae* infections were associated with female sex, younger age, and pain during sex.

Although STI testing was feasible and self-collecting samples was acceptable, uptake of testing was lower compared with other studies in Southern Africa. A 2016 study among pregnant women in Gaborone, Botswana, found that uptake of testing was 89%.³⁰ Another study using near-patient technology to incorporate STI screening in antenatal care in South Africa had an uptake of testing at 97%.^{31s} However, these studies were among pregnant women who may experience different STI risks and motivations for testing compared with individuals seeking routine HIV care.

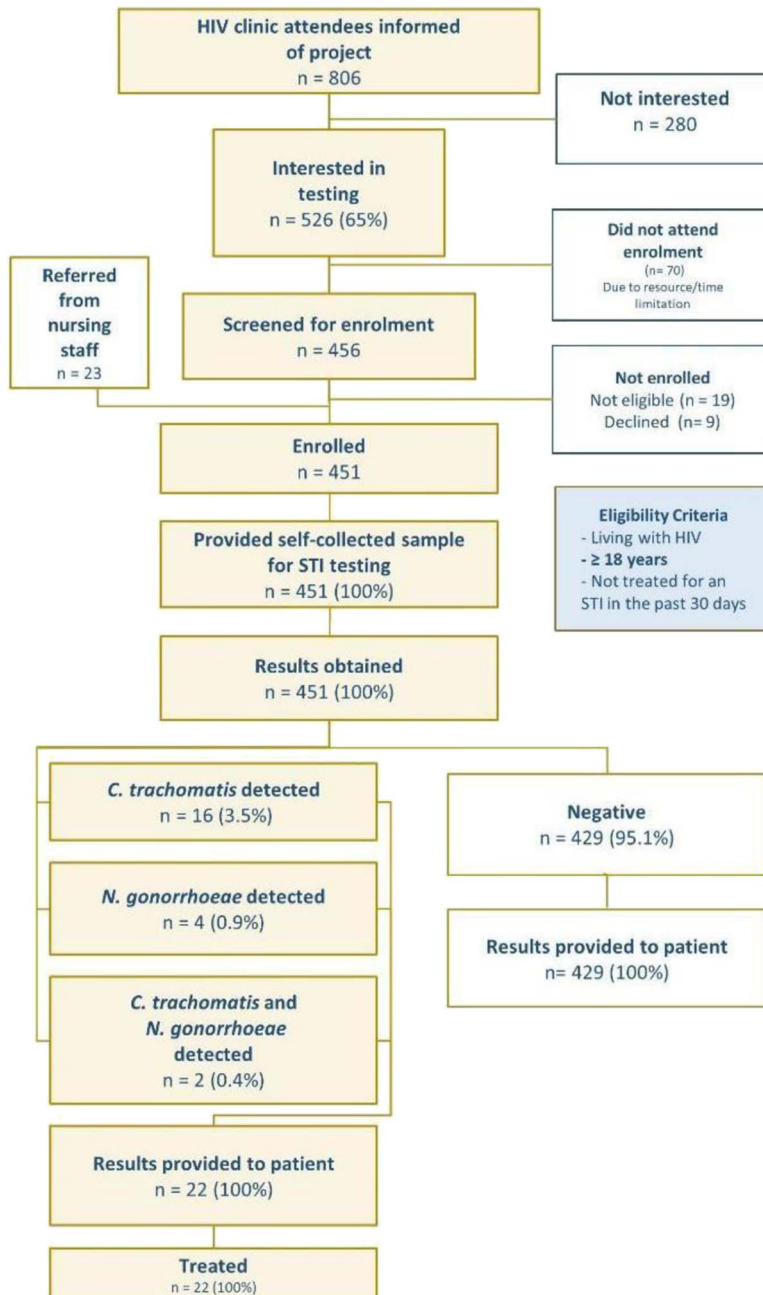


Figure 1. Diagram of enrollment, testing, results, and treatment among participants enrolled in a *Chlamydia trachomatis* and *Neisseria gonorrhoeae* testing study in Gaborone, Botswana.

TABLE 1. Characteristics of Participants Seeking HIV Care in Gaborone, Botswana, Between April and October 2019 by *C. trachomatis* and *N. gonorrhoeae* Diagnosis and Adjusted Logistic Regression Model

	Total Sample (n = 451), No.	STI Diagnosis		P	Adjusted Odds Ratio	95% CI	P
		Positive n = 22, (5%), No. (Row %)	Negative n = 429, (95%), No. (Row %)				
Age, median (range)	48 (18–72)	43 (18–69)	49 (21–72)	0.0007	0.93	0.87–0.99	0.022
18–40, y	81 (18)	9 (11)	72 (89)				
41–60, y	336 (74)	12 (4)	324 (96)				
61–73, y	34 (8)	1 (3)	33 (97)				
Sex				0.010			
Male	155 (34)	2 (1)	153 (99)		Referent		
Female	296 (66)	20 (7)	276 (93)		4.08	0.87–19.9	18.71
Relationship status				0.07			
Married	117 (26)	2 (2)	115 (98)		Referent		
Living together	112 (25)	8 (7)	104 (93)		3.10	0.62–15.54	0.17
Steady relationship	111 (25)	7 (6)	104 (94)		2.05	0.39–10.80	0.40
Casual	13 (3)	2 (15)	11 (84)		6.39	0.76–53.97	0.09
No partner	98 (22)	3 (3)	95 (97)		1.26	0.20–7.94	0.80
Education				0.407			
Primary or less	167 (37)	6 (4)	161 (96)		Referent		
Junior secondary	149 (33)	10 (7)	139 (93)		0.73	0.23–2.40	0.61
Senior secondary or more	135 (30)	6 (4)	129 (96)		0.45	0.11–1.89	0.27
Employed				0.823			
Yes	281 (62)	13 (5)	268 (95)				
No	170 (38)	9 (5)	161 (95)				
Years since HIV diagnosis, median (range)	15 (0–33)	14 (1–19)	15 (0–33)	0.08			
Viral load							
Do not know	33 (7)	1 (3)	32 (97)	0.51			
Know viral load	418 (93)	21 (5)	397 (95)				
Viral load ≤400 copies/mL	397 (95)	18 (5)	379 (95)	0.064			
Viral load ≥401 copies/mL	19 (5)	3 (16)	16 (84)				
STI-related symptoms							
None	344 (76)	6 (6)	101 (94)	0.62			
Abnormal vaginal discharge (women)	43 (15)	4 (9)	39 (91)	0.51			
Lower abdominal pain (women)	41 (14)	2 (5)	39 (95)				
Testicular pain (men)	7 (5)	0 (0)	7 (100)	1.00			
Painful urination (all)	21 (5)	0 (0)	21 (100)	0.633			
Genital ulcers (all)	19 (4)	1 (5)	18 (95)	0.621			
Genital warts (all)	23 (5)	3 (13)	20 (87)	0.222			
Pain during sex	21 (5)	4 (19)	17 (81)	0.015	2.82	0.79–10.12	0.110
Sex Partners in the past 2 mo				1.00			
0	98 (21)	3 (3)	95 (97)				
1	330 (73)	18 (5)	312 (95)				
>1	22 (5)	1 (5)	21 (95)				
Condom use				0.912			
Always (or no partner)	282 (63)	14 (5)	268 (95)				
Inconsistent	169 (37)	8 (5)	161 (95)				

Years with HIV is missing in 11 people. Ninety-nine percent of the sample was on antiretroviral therapy. Viral load (in copies per milliliter) was among those living with HIV who knew their viral load.

Evidence from the United States suggests that uptake of testing among people living with HIV may be lower in general than among pregnant women.¹⁶ Furthermore, many of the individuals offered enrollment felt that they were at low risk of having an STI and reported not being sexually active for many years, potentially representing the older population.

The overall prevalence of *C. trachomatis* and *N. gonorrhoeae* was lower in our study as compared with previous similar studies. In a 2016 study of STI prevalence among pregnant women in Gaborone, 8% tested positive for *C. trachomatis* and 2% for *N. gonorrhoeae*.^{32s} In a 2014 study among men who have sex with men in Botswana, the prevalence rates of urethral *C. trachomatis* and *N. gonorrhoeae* were 7.1% and 1.4%, respectively.^{33s} In 2002, the prevalence rates of *C. trachomatis* and *N. gonorrhoeae* among women attending a

family planning clinic in Botswana were 13.9% and 2.9%, respectively.^{34s} Global STI surveillance studies and meta-analyses have consistently found that STI incidence and prevalence are higher in younger age groups.^{35s,36s} Thus, our participants may represent a population with a lower rate of sexual risk behavior than in comparative studies.

No symptoms used in the syndromic approach were associated with testing positive for an STI, and most of those that tested positive were asymptomatic. This supports existing evidence that the majority of *C. trachomatis* and *N. gonorrhoeae* infections may be asymptomatic.²⁰

The Botswana STI treatment guidelines for syndromic management primarily rely on identifying vaginal and urethral discharge syndromes for managing curable STIs.^{37s} Therefore, it is likely that

TABLE 2. Characteristics of Participants Seeking HIV Care in Gaborone, Botswana, Between April and October 2019 by Sex

	Total Sample (n = 451), No.	Sex		P
		Male (n = 155; 34%), No. (col %)	Female (n = 296; 66%), No. (col %)	
		Age, median (range)	48 (18–72)	
18–40 y	81 (18)	17 (11)	64 (22)	
41–60 y	336 (74)	116 (75)	220 (74)	
61–73 y	34 (8)	22 (14)	12 (4)	
Relationship status				<0.0001
Married	117 (26)	56 (36)	61 (21)	
Living together	112 (25)	48 (31)	64 (23)	
Steady relationship	111 (25)	30 (19)	81 (27)	
Casual	13 (3)	4 (3)	9 (3)	
No partner	98 (22)	17 (11)	81 (27)	
Education				<0.0001
Primary or less	167 (37)	78 (50)	89 (30)	
Junior secondary	149 (33)	28 (18)	121 (41)	
Senior secondary or more	135 (30)	49 (32)	86 (29)	
Employed				0.365
Yes	281 (62)	101 (65)	180 (61)	
No	170 (38)	54 (35)	116 (39)	
Years since HIV diagnosis, median (range)	15 (0–33)	15 (0–33)	15 (1–30)	0.91
Viral load				
Do not know	33 (7)	14 (9)	19 (6)	0.51
Know viral load	418 (93)	141 (91)	277 (94)	
Viral load ≤400 copies/mL	397 (95)	137 (97)	260 (95)	0.226
Viral load ≥401 copies/mL	19 (5)	4 (3)	15 (5)	
STI-related symptoms				
None	344 (76)	135 (87)	209 (71)	<0.0001
Any*	107 (24)	20 (13)	87 (29)	
Sex partners in the past 2 mo				<0.0001
0	98 (21)	17 (11)	81 (27)	
1	330 (73)	121 (78)	209 (71)	
>1	22 (5)	17 (11)	5 (2)	
Condom use				0.068
Always (or no partner)	282 (63)	88 (57)	194 (66)	
Inconsistent	169 (37)	67 (43)	102 (34)	
Acceptability				0.110
How easy or difficult was self-collecting the sample?				
Easy	429 (95)	150 (97)	279 (94)	
Neither easy nor difficult	13 (3)	4 (3)	9 (3)	
Difficult	8 (2)	0 (0)	8 (3)	
In the future, which method would you choose?				<0.0001
Nurse/doctor collect	49 (11)	46 (11)	3 (14)	
Collect myself	236 (52)	62 (40)	174 (59)	
No preference	165 (37)	77 (50)	88 (30)	
Why do you prefer this method?				<0.0001
More comfortable	222 (46)	97 (64)	125 (42)	
Less embarrassing	89 (20)	15 (10)	74 (25)	
More confident sample collected properly	45 (10)	11 (7)	34 (12)	
Faster	78 (17)	3 (2)	9 (3)	
Other	171 (39)	37 (25)	134 (46)	

Years with HIV is missing in 11 people. Ninety-nine percent of the sample was on antiretroviral therapy. Viral load (in copies per milliliter) was among those living with HIV who knew their viral load.

many STIs are missed among people living with HIV in Botswana. The incorporation of etiological testing and rapid treatment may reduce the onward transmission of STIs and lower the burden of genital infections.

Recruitment, sample processing, and contacting patients were carried out by study staff. Treatment was provided by both clinic staff and study clinicians. Because of the addition of dedicated study staff, true incorporation into routine clinical activity was not reflected and would require extra personnel and resources with additional staff training.

We were not able to enroll all interested clients because of time and resource limitation; however, the limit on enrollment or testing capacity occurred at random and is not likely to have led to bias in the selection of study participants. In addition, the study was conducted at a single site in the largest tertiary referral hospital in Botswana, and results generated at this site may not be generalizable to other local clinics.

Testing was limited to *C. trachomatis* and *N. gonorrhoeae* and did not include other common STIs. Notably we were unable to incorporate testing for *T. vaginalis*, which has been demonstrated

to be prevalent in this population.^{32s} We were also unable to provide a dedicated clinician to assess and manage patients presenting with symptoms. A significant proportion of our patients presented with STI-related symptoms and therefore required onward referral for investigation and management of their symptoms. The Xpert platform has the capacity to include testing for other STIs, including *T. vaginalis* and human papillomavirus. Maximizing the multiplex capacity of assays could lead to more comprehensive testing and potentially increase the cost-effectiveness of services. In addition, introduction of a method for assessment, investigation and management of patients presenting with symptoms should be incorporated in order to provide a more effective integrated service.

We found that the majority of our participants preferred not to wait in the clinic but to receive results via telephone. A platform with faster processing (<60 minutes) may be beneficial to enable results to be provided in person and facilitate same-day treatment and further minimize the chance of onward transmission. The study setting was a centralized, specialist clinic, and therefore, many clinic attendees live a significant distance away, meaning they were not all able to return the next day. Future studies could explore the role of facilitating access to treatment in local clinics, even if testing is done elsewhere. This is particularly beneficial because many of the clinic attendees may well have concerns about the need for prolonged or additional appointments if there for significant travel to reach the appointment.

Our study did not assess cost or resource implications. There have been cost-effectiveness studies conducted in different settings. In an Australian study, Ong et al.^{38s} found that screening for *C. trachomatis* during antenatal visits was likely to be cost-effective during antenatal visits. A similar study in the United States^{39s} found that there was a low cost per individual associated with screening for *C. trachomatis* during antenatal visits, and it was associated with a significant reduction in morbidity. The cost of molecular testing equipment remains high, and further studies encompassing economic analyses are needed to determine the budget impact, economic feasibility, and cost-effectiveness of STI testing in this setting.

Our study participants represent an older population well established on HIV treatment, and the majority of those who declined the intervention had no recent sexual activity. In addition, our study found a low prevalence of STIs in men. Where blanket screening to the entire clinic population may not be feasible because of resource limitations, one strategy could be to prioritize sexually active patients, younger patients, and women. Additional research is also needed in HIV care clinics with younger populations and those newly diagnosed with HIV.

We demonstrated that incorporating STI testing into routine HIV care was feasible, testing using self-collected specimens acceptable but uptake of testing was low. Younger age, female sex, and pain during sex were associated with having an STI. Further studies are needed among younger populations and those newly diagnosed with HIV or not linked to care.

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For further references, please see “Supplemental References,” <http://links.lww.com/OLQ/A747>.