

# Sexually Transmitted Infection Transmission Dynamics During the Coronavirus Disease 2019 (COVID-19) Pandemic Among Urban Gay, Bisexual, and Other Men Who Have Sex With Men

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**Background.** The impact of coronavirus disease 2019 (COVID-19) mitigation measures on sexually transmitted infection (STI) transmission and racial disparities remains unknown. Our objectives were to compare sex and drug risk behaviors, access to sexual health services, and STI positivity overall and by race during the COVID-19 pandemic compared with pre-pandemic among urban sexual minority men (MSM).

**Methods.** Sexually active MSM aged 18–45 years were administered a behavioral survey and STI testing every 3-months. Participants who completed at least 1 during-pandemic (April 2020–December 2020) and 1 pre-pandemic study visit (before 13 March 2020) that occurred less than 6 months apart were included. Regression models were used to compare during- and pre-pandemic visit outcomes.

**Results.** Overall, among 231 MSM, reports of more than 3 sex partners declined (pandemic-1: adjusted prevalence ratio 0.68; 95% confidence interval: .54–.86; pandemic-2: 0.65, .51–.84; pandemic-3: 0.57, .43–.75), substance use decreased (pandemic-1: 0.75, .61–.75; pandemic-2: 0.62, .50–.78; pandemic-3: 0.61, .47–.80), and human immunodeficiency virus/preexposure prophylaxis care engagement (pandemic-1: 1.20, 1.07–1.34; pandemic-2: 1.24, 1.11–1.39; pandemic-3: 1.30, 1.16–1.47) increased. STI testing decreased (pandemic-1: 0.68, .57–.81; pandemic-2: 0.78, .67–.92), then rebounded (pandemic-3: 1.01, .87–1.18). Neither Chlamydia (pandemic-2: 1.62, .75–3.46; pandemic-3: 1.13, .24–1.27) nor gonorrhea (pandemic-2: 0.87, .46–1.62; pandemic-3: 0.56, .24–1.27) positivity significantly changed during vs pre-pandemic. Trends were mostly similar among Black vs. non-Black MSM.

**Conclusions.** We observed sustained decreases in STI risk behaviors but minimal change in STI positivity during compared with pre-pandemic. Our findings underscore the need for novel STI prevention strategies that can be delivered without in-person interactions.

**Keywords.** COVID-19 pandemic; sexually transmitted infections; MSM.

The impact of coronavirus disease 2019 (COVID-19) mitigation measures on sexually transmitted infection (STI) transmission in the United States is unknown. Since the COVID-19 pandemic emerged, reported STI diagnoses in the United States have decreased [1–6]. Several reasons may explain observed declines.

The COVID-19 pandemic caused substantial disruptions to STI and human immunodeficiency virus (HIV) clinical,

laboratory, and prevention services (ie, HIV preexposure prophylaxis [PrEP]) [5, 7–12]. Disruptions were due to staff redeployment to COVID-19 care and response, reductions/restrictions on clinic hours and in-person clinical exams, laboratory supplies/resource shortages, and patient reluctance to seek in-person care [7, 13, 14]. Also, delivery of routine STI/HIV follow-up services (ie, contact tracing, treatment verification, linkage to care) that facilitate the treatment of infected and potentially exposed individuals may have been hampered by redirection of STI/HIV prevention program staff to the COVID-19 response [15]. Combined, these disruptions may have caused decreased STI and HIV screening, testing, and treatment, and thus, reported STI diagnoses during the pandemic. Additionally, these disruptions may have caused increased prevalence of untreated infections, presenting opportunities for increased transmission.

Mitigation measures such as social distancing may have impacted behaviors associated with STI acquisition, leading to

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opportunities for decreased transmission. Emergency orders that closed or restricted attendance in public spaces, such as bars and clubs, may have decreased attendance and, therefore, opportunities for important subgroups such as gay, bisexual, and other men who have sex with men (MSM) to meet new and casual sex partners, thus limiting mixing between infected and susceptible MSM and decreasing transmission [16–20]. Several studies among MSM have reported substantial declines in the reported number of sex partners during the pandemic [10, 21–26]. Others reported increased or no change in the number of sex partners and variability over the pandemic time period [10, 27, 28]. Additionally, substance use, specifically methamphetamine use, has previously been associated with STI and HIV risk among MSM [29–31]. Though data are limited, at least 2 studies showed decreased reported illicit drug use among MSM during compared with pre-pandemic [23, 32], while another reported similar proportions of MSM reporting decreased and increased drug use during the pandemic [21].

Our goal was to provide insight into changes in STI transmission dynamics during the COVID-19 pandemic among MSM and, specifically, among Black MSM who suffer extremely disproportionate STI and HIV infection burdens [33–35] to ensure appropriate intervention. The objectives were to examine trends in sexual and drug risk behaviors (ie, number/type of partners, substance use), access to sexual health services (ie, care engagement, testing), and STI positivity (ie, chlamydia, gonorrhea) overall and by race before and during the COVID-19 pandemic among 1 urban MSM cohort.

## METHODS

### Overview

The Understanding Sexual Health in Networks study is a prospective cohort study focused on elucidating the network epidemiology of syphilis among MSM to inform and strengthen local health department syphilis prevention programs. The Johns Hopkins School of Medicine Institutional Review Board (IRB) approved this study.

### Study Population

Participants were recruited from 2 health department sexual health clinics, a federally qualified health center (FQHC), a community-based LGBTQ+ organization, community engagement events, and respondent driven sampling (RDS). Eligibility criteria included male sex at birth and gender identity, aged 18–45 years, residence with a Baltimore City zip code, reporting sex with a man (past 6 months), and willingness and ability to give informed consent for the study. Participants were enrolled between 20 July 2018 and 14 February 2020 and followed every 3 months for up to 2 years. This analysis included information from participants who attended any study visit during the

COVID-19 pandemic, defined as any study visit that occurred after 13 March 2020, and who attended at least 1 study visit prior to 13 March 2020 within 6 months of their first “pandemic visit.” Up to 3 visits that occurred during the pandemic until 31 December 2020 were included.

### Pre-Pandemic and Pandemic Study Visits

Pre-pandemic study visits included an audiocomputer self-assisted interview (ACASI) behavioral survey, a face-to-face network interview of recent sex partners, and biologic testing for syphilis and chlamydia/gonorrhea at 3 anatomic sites (urogenital, rectal, oropharyngeal). During the pandemic, interviewers administered ACASI and network interviews via telephone or virtual platform (ie, Zoom). Study visits, including interviews and biologic testing, were suspended on 13 March 2020 due to enactment of pandemic remote-work policies at the Johns Hopkins University. Interviewing resumed on 2 April 2020, once the IRB approved remote study visit protocols. Chlamydia/gonorrhea testing resumed on 23 June 2020 through use of at-home self-testing kits. Participants were mailed triple site chlamydia/gonorrhea testing kits upon completion of their study interview. Kits included detailed instructions on how to collect specimens as well as instructions and materials to mail specimens to the Johns Hopkins University laboratory. Syphilis testing was suspended throughout the observation period for this analysis.

Study visits that occurred on or before 13 March 2020 were categorized as pre-pandemic. To examine changes over time and in alignment with timing of follow-up visits, pandemic visits were categorized based on the visit date as pandemic-1 (April 2020–June 2020), pandemic-2 (July 2020–September 2020), and pandemic-3 (October 2020–December 2020).

### Measures

Participants were questioned regarding activities during the prior 3 months. Outcomes included the number and type of sex partners, substance use, access to sexual healthcare, and STI positivity.

We examined the reported number of total, new, and casual sex partners. Binary variables were created using the median reported pre-pandemic value as a cut point (total: more than 3 sex partners; new: more than 2 sex partners; and casual: more than 2 sex partners).

Substance use risk was defined as reporting use of any substance and, separately, methamphetamine in response to either of the following questions: “In the past 3 months, which of the following drugs did you use?” and “Have you used any of the following before or during sex in the past 3 months?” Response options included crack/cocaine, methamphetamine (eg, crystal, tina, meth, speed), heroin, prescription painkillers, downers, psychedelics, and party drugs (eg, ecstasy, E, Molly, MDMA, GHB, Special K, or poppers).

Access to sexual healthcare included the following 2 measures: HIV or PrEP care engagement and STI testing. Care engagement was defined as self-reported attendance (in-person or telemedicine) to a routine HIV (if living with HIV) or PrEP (if not living with HIV) care visit or currently taking antiretroviral medication for HIV/PrEP. STI testing was defined as self-report of any STI testing (past 3 months) that was not related to study visits.

For both chlamydia and gonorrhea, positivity was defined as a positive nucleic acid amplification test at any anatomic site for each study visit when biologic testing was available (pre-pandemic, pandemic-2, and pandemic-3).

Demographics (ie, race) were collected at baseline. Race was dichotomized as Black/non-Black. HIV status was confirmed through HIV laboratory testing or medical record documentation and ascertained during the pre-pandemic study visit.

### Statistical Analyses

Descriptive statistics were used to examine changes in each outcome across all 4 time periods overall and by race. A series of regression models was performed to estimate the likelihood of reporting outcomes at each during-pandemic visit compared with pre-pandemic. Generalized estimating equations with modified Poisson regression (ie, with robust standard errors) were used to account for repeated measures within individuals and to correct for overestimation of prevalence ratios with nonrare binary outcomes. All models were adjusted for the reported value of the specific outcome at the pre-pandemic visit. Regression models stratified by race also were generated. Analyses were performed using Stata version 15.1 (Stata Corp, College Station, TX).

## RESULTS

### Study Population

Among 567 individuals screened, 74.4% (422) were eligible, among whom 98.8% (417 of 422) were enrolled in the cohort. Among these, 55.4% (231 of 417) met this analysis's inclusion criteria. At baseline, participants in the analytic cohort (vs those excluded) were similar by race, age, HIV status, syphilis history, reported number of sex partners, and substance use but were significantly more likely to be recruited from the sexual health clinics (28.1% vs 14.3%), report HIV/PrEP care engagement (61.9% vs 48.9%), and report any nonstudy-related STI test (93.9% vs 86.5%).

Among participants included in the analytic cohort, 96.1% (222 of 231) completed a pandemic-1 visit, 84.0% (194 of 231) completed a pandemic-2 visit, including 9 who missed a pandemic-1 visit, and 61.9% (143 of 231) completed a pandemic-3 visit. Pre-pandemic characteristics of participants who completed study follow-up (8.2%, 19 of 231) or were lost to follow-up (29.9%, 69 of 231) were similar to those retained during

pandemic-3. Overall, 73.6% (170 of 231) were Black/African American, 60.6% (140 of 231) had completed high school, and 35.9% (83 of 231) reported they were not currently working. The median age was 31 years (interquartile range, 19–47), and 31.6% (73 of 231) were aged 24–29 years. A plurality was recruited through RDS (39.4% 91 of 231), followed by the sexual health clinics (28.1%, 65 of 231) and the FQHC (23.4%, 54 of 231). At the pre-pandemic visit, 37.7% (87 of 231) were living with HIV and 41.3% (95 of 231) had a history of syphilis infection.

### Changes in Reported Number of Sex Partners

The number of reported total, new, and casual sex partners in the past 3 months declined during the pandemic; these declines were sustained over time. The median number of total sex partners declined from 2 (range, 0–75) pre-pandemic to 1 during all 3 pandemic periods (pandemic-1: 1, 0–25; pandemic-2: 1, 0–20; pandemic-3: 1, 0–20). Sustained declines in the proportion reporting more than 3 total sex partners, multiple new partners, and multiple casual partners were observed (Table 1). Among Black MSM, the median number of total sex partners (pre-pandemic: 1, 0–75; pandemic-1: 1, 0–25; pandemic-2: 1, 0–20; pandemic-3: 1, 0–20) and the proportion reporting multiple casual sex partners were similar over time.

Regression models showed statistically significant decreased likelihood in reporting more than 3 total sex partners during compared with pre-pandemic (pandemic-1: adjusted prevalence ratio [aPR], 0.68; 95% confidence interval [CI]: .54–.86; pandemic-2: aPR, 0.65; 95% CI: .51–.84; pandemic-3: aPR, 0.57; 95% CI: .43–.75; Table 1). Similar declines in reports of multiple new partners over time were observed. Participants were less likely to report multiple casual partners during compared with pre-pandemic; associations only were significant during pandemic-1.

Black MSM were less likely to report more than 3 sex partners and multiple new sex partners (total partners pandemic-1: aPR, 0.82; 95% CI: .62–1.07; pandemic-2: aPR, 0.71; 95% CI: .52–.97; pandemic-3: aPR, 0.53; 95% CI: .37–.78 and new partners pandemic-1: aPR, 0.72; 95% CI: .55–.93; pandemic-2: aPR, 0.65; 95% CI: .48–.89; pandemic-3: aPR, 0.53; 95% CI: .35–.80) but similarly likely to report multiple casual partners during compared with pre-pandemic. Non-Black MSM were significantly less likely to report more than 3 total sex partners, multiple new partners, and multiple casual partners during each pandemic period (vs pre-pandemic).

### Changes in Reported Substance Use

Reported use of hard substances was consistently lower during compared with pre-pandemic (pandemic-1: aPR, 0.75; 95% CI: .61–.92; pandemic-2: aPR, 0.62; 95% CI: .50–.78; pandemic-3: aPR, 0.61; 95% CI: .47–.80; Table 2). Reported methamphetamine use declined during compared with pre-pandemic but only was statistically significant during pandemic-3 (pandemic-1: aPR,

**Table 1. Reported Number of Sex Partners (Past 3 Months) Among MSM Before and During the Coronavirus Disease 19 Pandemic**

	N	Reported More Than 3 Total Sex Partners				Reported More Than 2 New Sex Partners				Reported More Than 2 Casual Sex Partners			
		n	%	aPR <sup>a</sup>	95% CI	n	%	aPR <sup>a</sup>	95% CI	n	%	aPR <sup>a</sup>	95% CI
<b>Overall</b>													
Pre-pandemic	231	77	33.3	Ref		84	36.4	Ref		83	35.9	Ref	
Pandemic-1	222	53	23.9	<b>0.68</b>	<b>(.54–.86)</b>	51	23.0	<b>0.64</b>	<b>(.51–.81)</b>	61	27.5	<b>0.74</b>	<b>(.60–.92)</b>
Pandemic-2	194	42	21.7	<b>0.65</b>	<b>(.51–.84)</b>	44	22.7	<b>0.65</b>	<b>(.50–.83)</b>	56	28.9	0.82	(.66–1.02)
Pandemic-3	143	29	20.3	<b>0.57</b>	<b>(.43–.75)</b>	27	18.9	<b>0.53</b>	<b>(.38–.74)</b>	44	30.8	0.82	(.63–1.04)
<b>Black MSM</b>													
Pre-pandemic	170	47	27.6	Ref		55	32.4	Ref		48	28.2	Ref	
Pandemic-1	161	39	24.2	0.82	(.62–1.07)	36	22.4	<b>0.72</b>	<b>(.55–.93)</b>	44	27.3	0.91	(.70–1.18)
Pandemic-2	141	28	19.8	<b>0.71</b>	<b>(.52–.97)</b>	29	20.6	<b>0.65</b>	<b>(.48–.89)</b>	38	27.0	0.96	(.72–1.27)
Pandemic-3	105	17	16.2	<b>0.53</b>	<b>(.37–.78)</b>	17	16.2	<b>0.53</b>	<b>(.35–.80)</b>	30	28.6	0.93	(.68–1.27)
<b>Non-Black MSM</b>													
Pre-pandemic	61	30	49.2	Ref		29	47.5	Ref		34	55.7	Ref	
Pandemic-1	61	14	23.0	<b>0.47</b>	<b>(.30–.73)</b>	15	24.6	<b>0.52</b>	<b>(.32–.84)</b>	17	27.9	<b>0.50</b>	<b>(.34–.74)</b>
Pandemic-2	53	14	26.4	<b>0.56</b>	<b>(.36–.88)</b>	15	28.3	<b>0.62</b>	<b>(.40–.97)</b>	18	34.0	<b>0.62</b>	<b>(.43–.90)</b>
Pandemic-3	38	12	31.6	<b>0.62</b>	<b>(.41–.95)</b>	10	26.3	<b>0.53</b>	<b>(.30–.95)</b>	14	36.8	<b>0.65</b>	<b>(.43–.97)</b>

Among gay, bisexual and other men who have sex with men participating in the Understanding Sexual Health in Networks Study, Baltimore, Maryland, December 2019 - December 2020. Pandemic-1: April 2020–June 2020; pandemic-2: July 2020–September 2020; pandemic-3: October 2020–December 2020.

Abbreviations: aPR, adjusted prevalence ratio; CI, confidence interval; MSM, men who have sex with men.

<sup>a</sup> Prevalence ratios calculated using generalized estimating equations and Poisson regression with robust standard errors to account for repeated measures among individuals and adjusting for reported value during the pre-pandemic study visit. Bolded values are significant using  $P < .05$ .

0.81; 95% CI: .57–1.16; pandemic-2: aPR, 0.88; 95% CI: .62–1.26; pandemic-3: aPR, 0.84; 95% CI: .75–.95).

Compared with pre-pandemic, fewer Black and non-Black MSM reported using any hard substances during the pandemic.

These decreases were statistically significant or borderline significant. Reported methamphetamine use also was less frequent during compared with pre-pandemic but was not statistically significant among Black MSM. Regression models for

**Table 2. Reported Substance Use (Past 3 Months Among Gay, Bisexual, and Other Men Who Have Sex With Men Overall and By Race Before and During the Coronavirus Disease 2019 Pandemic, Understanding Sexual Health in Networks Study, Baltimore City, Maryland, December 2019–December 2020**

	N	Any Substance Use <sup>a</sup>				Methamphetamine Use <sup>b</sup>			
		n	%	aPR <sup>c</sup>	95% CI	n	%	aPR <sup>c</sup>	95% CI
<b>Overall</b>									
Pre-pandemic	231	98	42.4	Ref		22	9.5	Ref	
Pandemic-1	222	70	31.5	<b>0.75</b>	<b>(.61–.92)</b>	17	7.7	0.81	(.57–1.16)
Pandemic-2	194	51	26.3	<b>0.62</b>	<b>(.50–.78)</b>	13	6.7	0.88	(.62–1.26)
Pandemic-3	143	38	26.6	<b>0.61</b>	<b>(.47–.80)</b>	6	4.2	<b>0.84</b>	<b>(.75–.95)</b>
<b>Black MSM</b>									
Pre-pandemic	170	67	39.4	Ref		18	10.6	Ref	
Pandemic-1	161	48	29.8	<b>0.77</b>	<b>(.60–.99)</b>	12	7.5	0.71	(.45–1.11)
Pandemic-2	141	33	23.4	<b>0.58</b>	<b>(.43–.78)</b>	11	7.8	0.73	(.50–1.07)
Pandemic-3	105	24	22.9	<b>0.58</b>	<b>(.42–.80)</b>	5	4.8	0.60	(.35–1.04)
<b>Non-Black MSM</b>									
Pre-pandemic	61	31	50.8	Ref		4	6.6	...	...
Pandemic-1	61	22	36.1	<b>0.71</b>	<b>(.51–.99)</b>	5	8.2	...	...
Pandemic-2	53	18	34.0	0.72	(.52–1.00)	2	3.8	...	...
Pandemic-3	38	14	36.8	0.68	(.44–1.06)	1	2.6	...	...

Abbreviations: aPR, adjusted prevalence ratio; CI, confidence interval; MSM, men who have sex with men.

Pandemic-1: April 2020–June 2020; pandemic-2: July 2020–September 2020; pandemic-3: October 2020–December 2020.

<sup>a</sup> Any use of methamphetamine (eg, crystal, meth, tina, speed), party drugs, cocaine/crack, heroin, prescription painkillers, downers, psychedelics, including use before or during sex in the past 3 months.

<sup>b</sup> Any use of methamphetamine including use before or during sex in the past 3 months.

<sup>c</sup> Prevalence ratios calculated using generalized estimating equations and Poisson regression with robust standard errors to account for repeated measures among individuals and adjusting for reported value during the pre-pandemic study visit. Regression models for methamphetamine use among non-Black MSM are not presented due to small sample sizes. Bolded values are significant using  $P < .05$ .

methamphetamine use among non-Black MSM were not performed due to small sample sizes.

### Changes in Reported Access to Sexual Healthcare

Overall, reported HIV/PrEP care engagement significantly increased during the pandemic (pandemic-1: aPR, 1.15; 95% CI: 1.05–1.25; pandemic-2: aPR, 1.16; 95% CI: 1.06–1.26; pandemic-3: aPR, 1.22; 95% CI: 1.11–1.33; Table 3). STI testing significantly decreased during pandemic-1 and pandemic-2 but was similar to pre-pandemic levels during pandemic-3 (pandemic-1: aPR, 0.68; 95% CI: .57–.81; pandemic-2: aPR, 0.78; 95% CI: .67–.92; pandemic-3: aPR, 1.01; 95% CI: .87–1.18).

Reported HIV/PrEP care engagement significantly increased among Black MSM during the pandemic (pandemic-1: aPR, 1.20; 95% CI: 1.07–1.34; pandemic-2: aPR, 1.24; 95% CI: 1.11–1.39; pandemic-3: aPR, 1.30; 95% CI: 1.16–1.47). No significant changes in care engagement were observed among non-Black MSM. Reported STI testing trends among Black and non-Black MSM were similar to those observed overall.

### Changes in STI Positivity

Pre-pandemic, 75.3% (174 of 231) of participants were tested at a study visit for chlamydia/gonorrhea, among whom 6.9% (12 of 174) and 15.5% (27 of 174) were chlamydia and gonorrhea positive, respectively (Table 4). During pandemic-2, 67.0% of participants were tested (130 of 194). Among these, 9.2% (12 of 130) were chlamydia positive and 16.9% (22 of 130) were

gonorrhea positive. During pandemic-3, 60.1% (86 of 143) were tested, among whom 8.1% (7 of 86) were chlamydia positive and 7.0% (6 of 86) were gonorrhea positive. Regression models revealed no statistically significant differences in chlamydia or gonorrhea positivity over time.

Time trends in chlamydia and gonorrhea positivity were generally similar among Black vs non-Black MSM. However, chlamydia and gonorrhea positivity was substantially higher among Black compared with non-Black MSM.

## DISCUSSION

Among this MSM cohort, we found evidence of significant and sustained decreased sexual risk behavior (measured by number and type of sex partners), any substance use, and STI testing, and increased HIV/PrEP care engagement during the pandemic. Among those tested, no significant differences in chlamydia or gonorrhea positivity were observed during compared with pre-pandemic.

Important differences in risk behavior change by race were observed. Notably, among Black MSM, we observed no change in the median total number of sex partners and no change in the likelihood of reporting multiple casual sex partners during compared with pre-pandemic. In contrast, declines in all 3 sex partner measures were observed among non-Black MSM. No substantial differences by race in trends in substance use, sexual healthcare access, and STI positivity were observed.

**Table 3. Reported Access to Sexual Health Services (Past 3 Months) Among Gay, Bisexual, and Other Men Who Have Sex With Men Overall and by Race Before and During the Coronavirus Disease 2019 Pandemic, Understanding Sexual Health in Networks Study, Baltimore City, Maryland December 2019–December 2020**

	N	Engaged in Preexposure Prophylaxis Care (if Not Living With HIV) or HIV Care (if Living With HIV)			Received More Than 1 Nonstudy-Related Sexually Transmitted Infection Test <sup>a</sup>				
		n	%	aPR <sup>b</sup>	95% CI	n	%	aPR <sup>a</sup>	95% CI
<b>Overall</b>									
Pre-pandemic	231	140	60.6	Ref		134	58.0	Ref	
Pandemic-1	222	154	70.3	<b>1.15</b>	<b>(1.05–1.25)</b>	87	39.2	<b>0.68</b>	<b>(0.57–0.81)</b>
Pandemic-2	194	138	71.5	<b>1.16</b>	<b>(1.06–1.26)</b>	90	46.4	<b>0.78</b>	<b>(0.67–0.92)</b>
Pandemic-3	143	106	76.3	<b>1.22</b>	<b>(1.11–1.33)</b>	82	57.3	1.01	(0.87–1.18)
<b>Black MSM</b>									
Pre-pandemic	170	97	57.0	Ref		101	59.4	Ref	
Pandemic-1	161	109	67.7	<b>1.20</b>	<b>(1.07–1.34)</b>	68	42.2	<b>0.72</b>	<b>(0.60–0.86)</b>
Pandemic-2	141	102	72.3	<b>1.24</b>	<b>(1.11–1.39)</b>	70	49.6	<b>0.82</b>	<b>(0.69–0.96)</b>
Pandemic-3	105	77	73.3	<b>1.30</b>	<b>(1.16–1.47)</b>	61	58.1	1.03	(0.87–1.23)
<b>Non-Black MSM</b>									
Pre-pandemic	61	43	70.5	Ref		33	54.1	Ref	
Pandemic-1	61	45	73.8	1.05	(0.94–1.17)	19	31.1	<b>0.58</b>	<b>(0.39–0.86)</b>
Pandemic-2	53	36	67.9	0.97	(0.84–1.12)	20	37.7	0.70	(0.46–1.06)
Pandemic-3	38	29	76.3	1.03	(0.91–1.16)	21	55.3	0.97	(0.70–1.34)

Pandemic-1: April 2020–June 2020; pandemic-2: July 2020–September 2020; pandemic-3: October 2020–December 2020.

Abbreviations: aPR, adjusted prevalence ratio; CI, confidence interval; HIV, human immunodeficiency virus; MSM, men who have sex with men.

<sup>a</sup>Includes any sexually transmitted infection test (syphilis, gonorrhea/chlamydia, HIV) in the past 3 months excluding those performed as part of study visits.

<sup>b</sup>Prevalence ratios calculated using generalized estimating equations and Poisson regression with robust standard errors to account for repeated measures among individuals and adjusting for reported value during the pre-pandemic study visit. Bolded values are significant using  $P < .05$ .

**Table 4. Chlamydia and Gonorrhea Positivity (Past 3 Months) Among Gay, Bisexual, and Other Men Who Have Sex With Men Overall and By Race Before and During the Coronavirus Disease 2019 Pandemic, Understanding Sexual Health in Networks Study, Baltimore City, Maryland December 2019–December 2020**

	N	Chlamydia <sup>a</sup>				Gonorrhea <sup>a</sup>			
		n	%	aPR <sup>b</sup>	95% CI	n	%	aPR <sup>b</sup>	95% CI
<b>Overall</b>									
Pre-pandemic	174	12	6.9	Ref		27	15.5	Ref	
Pandemic-2	130	12	9.2	1.62	(.75–3.46)	22	16.9	0.87	(.46–1.62)
Pandemic-3	86	7	8.1	1.13	(.24–1.27)	6	7.0	0.56	(.24–1.27)
<b>Black MSM</b>									
Pre-pandemic	125	10	8.0	Ref		24	19.2	Ref	
Pandemic-2	87	10	11.5	1.83	(.81–4.13)	18	20.7	0.88	(.45–1.72)
Pandemic-3	66	6	9.1	1.11	(.45–2.73)	5	7.6	0.53	(.21–1.35)
<b>Non-Black MSM</b>									
Pre-pandemic	49	2	4.1	...	...	3	6.1	...	...
Pandemic-2	43	2	4.7	...	...	4	9.3	...	...
Pandemic-3	20	1	5.0	...	...	1	5.0	...	...

Pandemic-1: April 2020–June 2020; pandemic-2: July 2020–September 2020; pandemic-3: October 2020–December 2020.

Abbreviations: aPR, adjusted prevalence ratio; CI, confidence interval; MSM, men who have sex with men.

<sup>a</sup>Among those tested via a nucleic acid amplification test at any anatomic site. Biologic testing was unavailable during the first 3 study visits that occurred during the pandemic (April 2020–June 2020).

<sup>b</sup>Prevalence ratios calculated using generalized estimating equations and Poisson regression with robust standard errors to account for repeated measures among individuals and adjusting for reported value during the pre-pandemic study visit. Regression models for chlamydia and gonorrhea positivity among non-Black MSM are not shown due to small sample sizes. Bolded values are significant using  $P < .05$ .

Findings that showed sustained decreases in the reported number of sex partners and substance use among MSM during the COVID-19 pandemic corroborate some prior studies [10, 21, 23–26, 28] and contrast others that found declines in sexual behaviors early in the pandemic followed by increases over time [10, 28]. Our findings also confirm prior work showing decreased STI testing during the pandemic [5, 8, 9]; however, we observed a rebound to pre-pandemic levels in STI testing in late 2020. Findings from prior studies may not be directly comparable with the findings herein. Most other studies were conducted primarily among White MSM during the pandemic’s early stages while the strictest emergency orders were in effect, and several recruited participants solely through online platforms. Nonetheless, this study supports previous evidence that COVID-19 mitigation measures temporarily decreased population-level STI/HIV risk behaviors and access to STI testing.

Surprisingly, we found increased, rather than decreased, HIV/PrEP care [10–12]. This could be attributable to selection biases (participants retained in the study are also those likely to be engaged in HIV/PrEP care). Possibly, implementation of alternative modalities for healthcare delivery (ie, telemedicine) may have removed barriers to HIV/PrEP care retention for some. Future work should examine the impact of telemedicine on HIV/PrEP care retention.

This study also provides information on STI positivity during the pandemic, for which data have been limited. One MSM cohort study in Amsterdam reported small but significant declines in bacterial STI diagnoses during compared with pre-pandemic [23]. Another study of at-home STI testing in 1 New York City

PrEP clinic reported chlamydia and gonorrhea positivity similar to our findings and no change in pre- and during-pandemic positivity [36]. Three studies reported increased chlamydia and 2 reported increased gonorrhea positivity during the pandemic, but these increases were in the context of decreased testing volumes, and increased positivity may be an artifact of shifts toward testing symptomatic individuals [8, 9, 37].

Findings from this and other studies suggest that, among MSM, the impact of COVID-19 mitigation measures on transmission has been limited. One explanation is that the impact of decreased number of sex partners was sufficient to offset, but not overcome, the impact of increased prevalence of untreated infections due to disruptions to clinical and prevention services, as one modeling study suggested [38]. In this cohort, a substantial proportion (28%–31%) of participants continued to report multiple casual partners during the pandemic (vs 36% pre-pandemic), which likely facilitated ongoing transmission. Similarly, despite declines in the number and type of sex partners, underlying sexual network structures that facilitate STI transmission (ie, partner concurrency, network density) [39] may not have been sufficiently altered. This may be particularly true for networks of Black MSM, among whom we observed fewer and smaller declines in the number of sex partners and higher pre-pandemic STI positivity (vs non-Black MSM). Future work will examine sexual network characteristics and their relationship to STI positivity during compared with pre-pandemic.

There are several limitations to this study. Administering biologic testing during the pandemic has been extremely challenging. Sample sizes for chlamydia/gonorrhea results were

limited because a substantial proportion of testing kits were not returned. Results may overestimate positivity if symptomatic participants differentially returned testing kits and may underestimate positivity if those at highest acquisition risk differentially did not return kits. Information on symptoms consistent with chlamydia/gonorrhea was not ascertained, which is an important limitation. However, our test kit return rates were consistent with prior work utilizing mailed testing kits [40], and characteristics of those tested (vs those not tested) were similar. Syphilis testing did not resume until early 2021, and future work will explore syphilis trends. Observed decreases in reported behaviors over time may reflect preexisting trends [41] or may be attributed to participation in a research study [42, 43], social desirability bias, and/or attrition bias. We believe social desirability and attrition biases were minimal. During the pandemic, interviewers administered surveys, while ACASI surveys were used pre-pandemic. However, pre-pandemic, interviewers routinely obtained sensitive information through network interviews and had well-established rapport with participants. Participants who completed study follow-up were similar to those lost to follow-up, and sensitivity analyses restricted to participants who attended all 4 study visits showed similar results. Finally, this study population was drawn from a convenience sample in 1 city; therefore, results may not be generalizable to all MSM in this or other urban settings.

This analysis provides important information on longitudinal trends in sexual behaviors, substance use, access to sexual health-care and STI positivity among MSM throughout the pandemic. Promisingly, HIV/PrEP care engagement and STI testing appeared to improve over time, and we found no evidence that racial STI disparities were exacerbated. Concerns remain regarding potential increased STI transmission during and post pandemic among MSM and, specifically, Black MSM, given continued diversion of clinical and public health staff to pandemic response and restrictions on in-person clinical evaluations. Our findings of sustained decreases in STI risk behaviors during compared with pre-pandemic without evidence of decreased STI positivity underscores the urgent need for frequent STI testing and treatment in this population. Research to evaluate novel strategies (ie, increased implementation of at-home testing kits, providing medication to sex partners, less invasive testing) to deliver STI/HIV services without in-person interactions is needed.

## Notes

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