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ORIGINAL PAPER

Incidence and Predictors of HIV Infection Among Men Who Have Sex with Men Attending Public Sexually Transmitted Disease Clinics, New York City, 2007–2012

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Abstract We examined five annual cohorts (2007–2011) of men who have sex with men (MSM) attending New York City STD clinics who had negative HIV-1 nucleic acid amplification tests (NAATs) on the day of clinic visit. Annual HIV incidence was calculated using HIV diagnoses within 1 year of negative NAAT, determined by matching with the citywide HIV registry. Predictors (demographic; behavioral; bacterial STD from citywide STD registry match) of all new HIV diagnoses through 2012 were calculated from Cox proportional hazards models. Among 10,487 HIV NAAT-negative MSM, 371 had an HIV diagnosis within 1 year. Annual incidence was 2.4/100 person-years, and highest among non-Hispanic black MSM (4.1/100 person-years) and MSM aged <20 years (5.7/100 person-years). Characteristics associated with all 648 new HIV diagnoses included: black race (aHR 2.2; 95 % CI 1.6–3.1), condomless receptive anal sex (aHR 2.1; 95 % CI 1.5–2.8), condomless insertive anal sex (aHR 1.3; 95 % CI 1.1–1.8), and incident STD diagnosis (aHR 1.6; 95 % CI 1.3–1.9). MSM attending STD clinics have substantial HIV incidence and report risk behaviors that are highly associated with HIV acquisition. Increased uptake of effective interventions, e.g., pre- and post-exposure prophylaxis, is needed.

Keywords HIV incidence · Men who have sex with men · STD clinics

Introduction

In the United States (U.S.), men who have sex with men (MSM) contribute the largest proportion of new HIV infections [1]. Annual HIV incidence among MSM, as high as 10 % in the early years of the epidemic [2], fell to under 1 % in the late 1980s and early 1990s [3]. Since then, HIV incidence among MSM has increased, likely due to increases in high-risk sexual behaviors, substance use, and sexually transmitted diseases (STD) [4–6]. Recent longitudinal studies of HIV incidence and risk factors for HIV have generally enrolled high-risk HIV-negative MSM, such as men reporting recent unprotected anal intercourse [7, 8] or recent anal sex with partners who are HIV-positive or have an unknown serostatus [9]. These studies have found annual HIV incidence estimates in the range of 2–3 %.

Compared to the general population, STD clinic attendees are likely to have an elevated HIV incidence rate; in a previous study of MSM diagnosed with rectal STD at New York City (NYC) STD clinics, annual incidence was as high as 6.7 % [10]. Risk for HIV infection among an entire STD clinic patient population of MSM may be similar to that of high-risk MSM enrolled in large cohort studies, and MSM attending STD clinics can serve as sentinel populations for tracking the HIV epidemic; repeated measure of incidence and predictors of acquisition among them can inform prevention efforts. Using population-level measures

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of new HIV diagnoses, we present one-year incidence estimates among five annual cohorts of HIV-negative MSM attending public STD clinics in NYC, and demographic and behavioral factors associated with HIV acquisition over the 5-year period (2007–2011).

Methods

Study Population

HIV-negative persons attending NYC public STD clinics who were not tested for HIV during the previous 3 months are tested with a rapid point-of-care HIV antibody test, on an opt-out basis. Since 2007, MSM whose rapid HIV tests are negative are tested with HIV-1 nucleic acid amplification tests (NAAT). NAAT testing was phased in over time, and fully implemented in all 9 NYC STD clinics in 2009.

Data Sources

STD clinic visit data were extracted from clinic medical records, and included patient demographics and sexual behaviors, clinic visit dates, HIV testing results, and STD diagnoses. History of STD (chlamydia, lymphogranuloma venereum, gonorrhea, syphilis) was determined through a match of clinic MSM with the population-based citywide STD registry, which includes reports of notifiable STD among NYC residents reported by all diagnosing providers. Incident HIV was identified through deterministic record linkage with the citywide HIV surveillance registry of all persons diagnosed and reported with HIV/AIDS in NYC; negative test results are not reported to the registry. New HIV diagnoses recorded in the HIV registry are generally based on positive Western blot tests [11].

HIV Incidence

MSM with negative HIV NAAT results who attended STD clinics between January 1, 2007 and December 31, 2011 were matched against the HIV surveillance registry in November 2013. The match was based on 36 combinations of patient information (e.g., name, date of birth, social security number). Records that matched based on the strictest criteria of 7 combinations were accepted without further review. Records that matched on another set of 17 combinations were defined as probable matches and manually reviewed by two trained staff, with inter-reviewer discrepancies settled by a third staff member; manual reviews required that records match on gender and incorporated other patient demographic variables available in the disease registries (e.g., race, ethnicity, address). Records that linked on the remaining 12 of 36 combinations or did not link on any combination were considered non-matches. This matching algorithm has been used previously [10, 12].

For our HIV incidence analysis, the outcome of interest was an HIV diagnosis within 1 year of a negative HIV NAAT result. We constructed five annual cohorts, such that the contribution of person-time to the incidence denominator started at the date of the negative HIV NAAT; for MSM with multiple negative tests in a calendar year, follow-up time started at the date of the last test. The incidence analysis was visit based; MSM with negative tests in multiple calendar years were included in multiple cohorts. For MSM who matched to the HIV registry and were diagnosed with HIV within 1 year of their negative test, HIV-free time-at-risk was the number of days between the negative NAAT date and the HIV diagnosis date; men without reported HIV within 1 year of the negative test were classified as uninfected and contributed 365 days to the follow-up period for that annual cohort. We estimated overall HIV incidence (per 100 person-years) for the 5-year period, calculated incidence rate ratios according to race/ethnicity and age, and evaluated time trends in the proportions that were HIV-diagnosed using Cochrane-Armitage tests for trend (statistical significance at $p < .05$).

Factors Associated with HIV Acquisition

To identify correlates of HIV acquisition, we switched to a person-based analysis and counted all new HIV diagnoses within the follow-up period, instead of just those occurring within 1 year of negative NAAT date. We examined the following demographic and behavioral characteristics recorded at STD clinic visits: age, race/ethnicity, condomless insertive anal sex, condomless receptive anal sex, both condomless receptive and condomless insertive anal sex, number of sex partners, and report of any HIV-positive partner(s) and/or injection drug using (IDU) partner(s). The referent period for questions on sexual practices was usually 3 months before the clinic visit (for 95 % of visits). We also assessed associations between HIV infection and diagnosis of any reportable STD, and specific diagnoses of rectal *Chlamydia trachomatis* (chlamydia NAAT) and/or rectal *Neisseria gonorrhoeae* (gonorrhea culture) infection. We used survival analysis to account for varying times to HIV diagnosis. For MSM diagnosed with HIV, follow-up time was from the last negative NAAT date during 2007–2011 to HIV diagnosis date; men without reported HIV were presumed uninfected and follow-up was from the last negative NAAT date to the censor date of 12/31/2012.We conducted univariate Cox proportional hazards regression for each of the demographic, behavioral, and STD diagnosis-related covariates. Variables that were significant in univariate analyses ($p < 0.05$) were included in a multivariable proportional hazards model.

For the regression analyses, we included the subset of MSM who had any clinic visit(s) that included clinician evaluation, as behavioral risk information is collected only at clinician visits. We utilized information from all visits for MSM with multiple clinician visits during 2007–2011. Age and race/ethnicity were classified according to information recorded at the first visit between 2007 and 2011. MSM who reported performing insertive sex and sometimes or never using a condom during anal sex for the referent period were categorized as having condomless insertive anal sex, and those who reported receptive anal sex and sometimes/never using a condom during anal sex were categorized as having condomless receptive anal sex. MSM who had any condomless insertive anal sex (and no condomless receptive anal sex) across all visits were categorized as having 'condomless insertive anal sex only'. MSM who had any condomless receptive anal sex (and no condomless insertive anal sex) across all visits were categorized as having 'condomless receptive anal sex only'. MSM who reported condomless insertive anal sex at any visit and also reported condomless receptive anal sex at any visit were categorized as having both 'condomless insertive and receptive anal sex'. The comparison group for MSM in these sexual behavior groups comprised MSM who reported always using condoms during insertive and/or receptive anal sex. The variable for number of partners in the past 3 months was constructed using the largest number of partners reported by the patient at any clinic visit during 2007–2011. MSM who reported sex with an HIV-positive or IDU partner during a referent period at any visit were grouped as having an HIV-positive or IDU partner, respectively. We considered MSM to have had an incident STD if they had $\geq$1 diagnosis in the STD registry after the negative HIV NAAT and before the end of the observation period. Finally, we assessed the association between HIV and rectal chlamydia and/or gonorrhea among the subset of MSM diagnosed with chlamydia/gonorrhea in the STD clinics; MSM with any rectal chlamydia/gonorrhea diagnosis after the negative HIV NAAT were included in this group, and compared to MSM who had only urethral chlamydia/gonorrhea infections.

Analyses were performed using SAS 9.1 (SAS Institute, Cary, NC). The NYC Department of Health and Mental Hygiene considered this project to be public health surveillance that is non-research.

Results

HIV Incidence

During 2007–2011, 10,487 unique MSM attending NYC STD clinics had negative HIV NAAT results. Over one-third of MSM (37.8 %) were non-Hispanic white, and approximately one-quarter each was non-Hispanic black (24.1 %) or Hispanic (28.5 %). Of the MSM, 4.9 % were <20 years old, 26.7 % were 20–24 years old, 27.5 % were 25–29 years old, 15.9 % were 30–34 years old, and the remaining 25.1 % were aged 35 years or older at the time of last negative NAAT. Of all MSM, 66.6 % (6989/10,487) had negative HIV NAAT visit(s) in a single year during the 5-year analytic period. Of the remaining MSM, 2361 had visits in 2 separate years, and 1137 had visits in 3, 4, or all 5 years; these MSM with multiple visits were included once in each yearly cohort. MSM in multiple cohorts were more likely than those in a single cohort to be younger and of minority race/ethnicity (Table 1).

The 10,487 MSM contributed 15,370 HIV-negative visits, and 15,203.4 person-years (PY) of follow-up. A total of 371 new HIV diagnoses were reported to the HIV surveillance registry within 1 year of the last negative NAAT; of those, 141 (38.0 %) were diagnoses made by non-STD clinic healthcare providers in NYC. The overall annual HIV incidence across years was 2.4 per 100 PY (95 % CI 2.2–2.7). Table 2 shows HIV incidence by demographic group. The incidence among black MSM (4.1/100 PY) was almost 3 times the incidence among white MSM (1.5/100 PY) (rate ratio = 2.8; 95 % CI 2.1–3.7) and almost double the incidence among Hispanic MSM (2.5/100 PY) (rate ratio = 1.7; 95 % CI 1.3–2.1). Incidence among MSM aged <20 years (5.7/100 PY) was significantly higher compared to incidence among other age groups.

As HIV NAAT testing was progressively implemented at the clinics, numbers of MSM with negative NAATs increased; from 391 in 2007 to 1582 in 2008, 4375 in 2009, 4352 in 2010, and 4670 in 2011. After 2007, when the highest HIV incidence was observed (3.4/100 PY), annual incidence stabilized, ranging from 2.2/100 PY to 2.5/100 PY. There was no significant decline in overall incidence over time ($p = 0.47$), and there were no significant changes in incidence over 5 years across race/ethnicity or age groups.

Factors Associated with HIV Acquisition

In total, 9532 of the 10,487 MSM (90.9 %) had clinician visits between 2007 and 2011, and were included in analyses examining predictors of HIV infection. There were no significant differences between the analytic group and the 955 MSM who were excluded with regard to race/ethnicity, age, or HIV status outcome (data not shown). Most of the 9532 MSM were aged under 30 years (62.3 %), and over one-third (38.0 %) were black. Over the 5 years, 41.7 % reported that they always used condoms during anal sex, while 17.0 % reported condomless insertive anal sex only,

Table 1 Race/ethnicity and age of MSM testing HIV-negative at New York City sexually transmitted disease clinics, by membership in one year versus multiple year cohorts, 2007–2011

Characteristic	1 Cohort		>1 Cohort		*p* value
	No. of MSM	% of MSM	No. of MSM	% of MSM	
All	6989	100	3498	100	
Age					<.0001
<20	424	6.1	47	8.3	
20–24	1898	27.2	132	31.9	
25–29	1818	26.0	94	26.4	
30–34	1050	15.0	56	13.8	
≥35	1799	25.7	42	19.6	
Race/ethnicity					<.0001
Black	1596	22.8	950	27.2	
Hispanic	1865	26.7	1069	30.6	
White	2839	40.6	1139	32.6	
Other[a]	689	9.9	340	9.7	

[a] Includes Asian, Pacific Islander, Native American, multi-race, and "other" race

Table 2 HIV incidence (per 100 person-years), overall, by age group, and by race/ethnicity, men who have sex with men attending New York City sexually transmitted disease clinics, 2007–2011

Characteristic	No. of MSM visits	% of MSM visits	No. new HIV diagnoses	% of new HIV diagnoses	Person-years (PY)	HIV incidence per 100 PY	95 % CI (HIV incidence)
All	15,370	100	371	100	15,203.4	2.4	2.2–2.7
Age							
<20	846	5	47	13	828.8	5.7	4.2–7.5
20–24	4283	28	132	36	4221.9	3.1	2.6–3.7
25–29	4229	27	94	25	4185.5	2.2	1.8–2.7
30–34	2362	15	56	15	2337.5	2.4	1.8–3.1
≥35	3650	24	42	11	3629.7	1.2	0.8–1.6
Race/ethnicity							
Black	3906	25	158	43	3838.0	4.1	3.5–4.8
Hispanic	4520	29	110	30	4469.2	2.5	2.0–3.0
White	5468	36	80	22	5430.0	1.5	1.2–1.8
Other[a]	1476	10	23	6	1466.2	1.6	1.0–2.3

[a] Includes Asian, Pacific Islander, Native American, multi-race, and "other" race

CI confidence interval

7.1 % reported condomless receptive sex only, and 34.3 % reported both condomless insertive and receptive anal sex. Of the MSM, 22.7 % reported a maximum of 0–1 sex partner, 42.7 % reported a maximum of 2–3 partners, and 33.8 % reported a maximum of ≥4 partners in the referent period; 16.6 % reported any HIV-positive partner, and 1.0 % reported any IDU sex partner. Of the 9532 MSM, 3421 (35.9 %) had an incident STD reported to the STD registry. A total of 2809 MSM were diagnosed with chlamydia and/or gonorrhea at the STD clinics during the follow-up period; 35.3 % (993/2809) had any rectal infections, and 64.6 % (1816/2809) had only urethral infections.

Of the 9532 MSM, 648 (6.8 %) were diagnosed with HIV during the follow-up period. In univariate analyses, MSM under 30 years of age, black MSM, and Hispanic MSM were more likely to be newly diagnosed with HIV (Table 3). Sexual risk behaviors associated with a higher HIV risk included: condomless insertive anal sex only, condomless receptive anal sex only, both condomless insertive and receptive anal sex, multiple sex partners, and a known HIV-positive partner. Risk according to type of anal sex followed a gradient: hazard ratio (HR) = 1.73 for condomless insertive sex only, HR = 2.65 for condomless receptive sex only, and HR = 3.17 for both condomless insertive and receptive sex; however, risk did not vary

Table 3 Correlates of new HIV infection among men who have sex with men attending New York City sexually transmitted disease clinics, 2007–2011

Variable	No. MSM	No. new HIV diagnoses	Univariate		Multivariate	
			HR	95 % CI	HR	95 % CI
Age at time of first clinic visit						
<30	5943	498	2.13	1.77–2.55	1.72	1.43–2.07
≥30	3589	150	REF		REF	
Race/ethnicity						
Black	3621	144	2.43	1.76–3.36	2.32	1.68–3.22
Hispanic	2342	268	1.57	1.13–2.18	1.45	1.04–2.02
White	2657	193	0.83	0.59–1.16	0.87	0.62–1.23
Other[a]	912	43	REF		REF	
Anal sex						
Condomless insertive only	1621	100	1.73	1.34–2.23	1.38	1.07–1.78
Condomless receptive only	669	60	2.65	1.96–3.57	2.12	1.55–2.86
Condomless insertive & receptive	3267	337	3.17	2.61–3.84	2.22	1.82–2.72
Protected	3975	151	REF		REF	
No. of sex partners						
0–1	2167	98	REF		REF	
2–3	4069	271	1.48	1.18–1.85	1.29	1.02–1.61
>=4	3226	272	2.00	1.60–2.51	1.58	1.25–2.00
HIV-positive partner						
Yes	1585	167	1.94	1.63–2.32	1.61	1.34–1.93
No	7947	481	REF		REF	
Injection drug using partner						
Yes	100	10	1.42	0.76–2.65	[b]	
No	9432	638	REF			
Incident STD						
Yes	3421	363	2.71	2.32–3.17	1.61	1.35–1.92
No	6111	285	REF		REF	
Chlamydia and/or gonorrhea infection						
Rectal	993	161	3.36	2.81–4.02	1.83	1.49–2.25
Urethral	1816	155	REF		REF	

[a] Includes Asian, Pacific Islander, Native American, multi-race, and "other" race

[b] Not included in final multivariate model

HR hazard ratio; *CI* confidence interval, *STD* sexually transmitted disease

significantly between the three types. Having an IDU partner was not associated with newly diagnosed HIV. Having any incident STD was associated with a higher risk of HIV, as was having a rectal chlamydia and/or gonorrhea diagnosis specifically. All statistically significant variables in the univariate analyses remained significant in the multivariable model.

Discussion

We found that MSM attending NYC STD clinics have a substantial risk for HIV acquisition. Prior incidence estimates from HIV testing in U.S. STD clinics had mostly relied on samples which use the BED HIV-1 assay within the serologic testing algorithm for ascertainment of recent infections [13–15]. One study from Baltimore, Maryland STD clinics from 1993 to 2002 presented HIV incidence among 100 MSM using positive HIV tests following recent HIV-negative tests [16]. HIV incidence in that study, estimated at 3.14 per 100 person-years, was based on HIV detected only by testing in the clinics and thus likely an underestimate of true incidence at that time. Our study presents a recent estimate of the one-year HIV incidence (2.4 per 100 person-years) among a large cohort of MSM attending STD clinics, based on ascertainment of incident infections among MSM who were negative by HIV NAAT and matched against the population-based HIV registry.

HIV incidence and risk for acquisition among MSM attending STD clinics were highest among young MSM and black MSM, two subgroups that are disproportionately affected by HIV in NYC [17] and have the largest increases in rates of new infections nationally [18]. A new generation of young, minority MSM could comprise the leading edge of a surge in HIV infections. Increasing opportunities for routine HIV testing for younger and black MSM across all healthcare and outreach settings is especially important to increase the number of persons who are not only aware of their infections, but aware earlier in the course of infection, with the dual aim to improve clinical outcomes and reduce ongoing HIV transmission. Among our study population, 38 % of the incident HIV infections were diagnosed by non-STD clinic providers, indicating that MSM in NYC are tested for HIV in a variety of venues. It is important for providers in varied settings to routinely assess patients' risks, offer HIV testing, deliver culturally sensitive risk-reduction counseling, and connect patients with HIV pre- and post-exposure prophylaxis when indicated.

Several of our findings have implications for counseling and screening patients who are at a high risk for STD/HIV infection. With the exception of having an IDU partner, every risk factor we examined conferred a significant level of risk for HIV infection. Condomless receptive anal sex has been established to be among the riskiest of sexual practices among MSM [19]. Consistent with prior epidemiologic research, we found that MSM engaging in condomless receptive anal sex were at greater risk of subsequently being diagnosed with HIV when compared to MSM who reported always using condoms during sex. We also observed a gradient in risk in that those who had both condomless receptive and condomless insertive anal sex had the highest risk. Previous studies have found that the probability of HIV transmission is an order of magnitude lower with condomless insertive sex [19] and that HIV incidence among MSM consistently practicing only condomless insertive anal sex was similar to incidence among those who consistently used condoms [20]. Notably, we found an elevated risk of HIV among MSM who exclusively practiced condomless insertive sex, indicating that sexual positioning strategies for unprotected anal intercourse may not be effective approaches for risk reduction, at least in this population.

Reporting multiple sexual partners was associated with a higher risk for HIV, but the risk was not significantly higher with an increasing number of partners. This lack of a dose–response effect may reflect the effects of membership in high-risk sexual networks in which there is a greater risk of contracting HIV, and that partner number may not be as influential on the probability of HIV transmission as the risk profiles of partners in those networks. This finding highlights the importance of counseling about prevention strategies other than a reduction in partner number, such as correct/consistent condom use and more recently available biomedical interventions. Importantly, one-third of MSM who tested HIV-negative in NYC STD clinics were subsequently diagnosed with an STD, indicating ongoing sexual risk behaviors, and underscoring the need for frequent HIV testing as well as recommended STD screenings at each HIV testing visit. Increased funding to support STD control and public health infrastructure is urgently needed [21], and improved screening practices in outreach programs and private health care venues are also vital to prevent the spread of STD, including HIV.

Our findings on the substantial risk for HIV infection among MSM attending STD clinics point to the need to decrease barriers to providing HIV pre-exposure and post-exposure prophylaxis in these settings, and for MSM patients to avail themselves of these interventions. HIV post-exposure prophylaxis (PEP) is a 28-day course of pills to be taken immediately following a high-risk exposure to HIV. HIV pre-exposure (PrEP) is a daily pill that is highly effective at preventing HIV acquisition when used as directed and in combination with other risk-reduction strategies. A recent analysis modeling the value and effectiveness of different PrEP prioritization strategies in NYC found that with 50 % uptake, 15 % of new HIV infections could be averted by prioritizing provision of PrEP to MSM at highest risk for HIV, defined as populations for which annual probability of infection is at least 4 % or in which multiple, concurrent sexual partnerships occur [22]. A sizable proportion of MSM seeking care at STD clinics likely have multiple, concurrent partners, suggesting that most of them should be on PrEP. In modeling PrEP effectiveness and cost-effectiveness, Juusola and colleagues found that for MSM with an average of 5 annual partners and an annual HIV incidence of 2.3 % (similar to our HIV incidence estimate), PrEP for 20 years would cost approximately $50,000 per QALY gained and an additional $75.5 billion in total healthcare costs compared with the status quo (approximately $600,000 per HIV infection prevented) [23]. Cost-effectiveness improves with lower coverage levels (e.g., $460,000 per infection prevented if 20 % of MSM are on PrEP), so if resources to provide PrEP medication are limited, targeting this intervention to subgroups for which there is higher incidence should be considered.

Estimates of PrEP and PEP use in NYC remain relatively low (15 % in 2015) [24], despite high (>80 %) levels of awareness [25]. Knowledge and use of PrEP among STD clinic attendees was found to exceptionally low; only 40 % of patients surveyed in NYC STD clinics in 2013–2014 had heard of PrEP and none of them had ever used it. PrEP was explained to survey respondents, after which 65 % of them reported that they would participate in

an STD clinic-based PrEP program, indicating an opportunity to provide information and prevention tools to those at highest risk of acquiring HIV [26]. Currently, NYC STD clinics refer patients to partnering clinical sites for PrEP, and are assessing the feasibility and challenges to providing PrEP within the STD clinic setting.

Our analysis has limitations. Our outcome of interest was diagnosed HIV infection; true annual HIV incidence may have been underestimated if men did not have an HIV test during the 1 year follow-up period, or if men who acquired HIV were diagnosed outside of NYC and not reported to the NYC HIV registry. STD screening and detection may occur at higher rates among persons who are testing for and have the opportunity to be diagnosed with HIV, leading us to have overestimated the association between incident STD and new HIV diagnoses. Finally, HIV incidence rates and predictors of HIV among STD clinic patients may not be generalizable to other patient populations or the general population of MSM. Visits to STD clinics are typically prompted by symptoms or patient recognition of high-risk behaviors [27] and thus result in a high yield of HIV and other STD diagnoses. However, we believe that our findings may well apply to other MSM populations, given the high per-act probability of HIV infection with receptive anal intercourse [28].

The clinic data included in our analysis covered the years immediately preceding the 2012 U.S. Food and Drug Administration's approval of HIV medication to be used as PrEP. Subsequent to that, noteworthy actions have been taken in New York State to facilitate access to PrEP for high-risk persons to keep them HIV-negative; these are detailed in New York Governor Cuomo's 2014 plan for Ending the Epidemic [29]. At current HIV diagnosis rates, 1 in 6 U.S. MSM will be diagnosed with HIV in their lifetime [30]. Changing the trajectory of new HIV infections requires identification of key affected populations and monitoring the impact of interventions, including risk-reduction counseling and PEP and PrEP use. MSM attending STD clinics comprise an important sentinel group. There will be great value in monitoring how recent and significant advances in the HIV prevention landscape impact HIV incidence in this population.

Disclaimer The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Compliance with Ethical Standards

Conflicts of Interest Preeti Pathela, Kelly Jamison, Sarah L. Braunstein, Julia A. Schillinger, Jay K. Varma, Susan Blank the authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required. This article does not contain any studies with animals performed by any of the authors.

References

1. Centers for Disease Control and Prevention. HIV Surveillance Report, 2012; vol 24. http://www.cdc.gov/hiv/library/reports/surveillance/. Published November 2014. Accessed 20 Jan 2015.
2. van Griensven GJ, Hessol NA, Koblin BA, et al. Epidemiology of human immunodeficiency virus type 1 infection among homosexual men participating in hepatitis B vaccine trials in Amsterdam, New York City, and San Francisco, 1978–1990. Am J Epidemiol. 1993;137(8):909–15.
3. Vu MQ, Steketee RW, Valleroy L, Weinstock H, Karon J, Janssen R. HIV incidence in the United States, 1978–1999. J Acquir Immune Defic Syndr. 2002;31(2):188–201.
4. Catania JA, Osmond D, Stall RD, et al. The continuing HIV epidemic among men who have sex with men. Am J Public Health. 2001;91(6):907–14.
5. Wolitski RJ, Valdiserri RO, Denning PH, Levine WC. Are we headed for a resurgence of the HIV epidemic among men who have sex with men? Am J Public Health. 2001;91(6):883–8.
6. Centers for Disease Control and Prevention. Primary and secondary syphilis among men who have sex with men–New York City, 2001. MMWR. 2002;51(38):853–6.
7. Koblin BA, Husnik MJ, Colfax G, et al. Risk factors for HIV infection among men who have sex with men. AIDS. 2006;20(5):731–9.
8. Koblin BA, Mayer KH, Eshleman SH, et al. Correlates of HIV acquisition in a cohort of Black men who have sex with men in the United States: HIV prevention trials network (HPTN) 061. PLoS One. 2013;8(7):e70413.
9. Ackers ML, Greenberg AE, Lin CY, et al. High and persistent HIV seroincidence in men who have sex with men across 47 US cities. PLoS One. 2012;7(4):e34972.
10. Pathela P, Braunstein SL, Blank S, Schillinger JA. HIV incidence among men with and those without sexually transmitted rectal infections: estimates from matching against an HIV case registry. Clin Infect Dis. 2013;57(8):1203–9.
11. New York City HIV/AIDS Annual Surveillance Statistics. New York: New York City Department of Health and Mental Hygiene, 2015. http://www.nyc.gov/html/doh/html/data/hivtables.shtml#abbrev. Accessed 23 July 2015.
12. Pathela P, Braunstein SL, Blank S, Shepard C, Schillinger JA. The high risk of an HIV diagnosis following a diagnosis of syphilis: a population-level analysis of New York City Men. Clin Infect Dis. 2015;61(2):281–7.
13. McFarland W, Kellogg TA, Dilley J, Katz MH. Estimation of human immunodeficiency virus (HIV) seroincidence among repeat anonymous testers in San Francisco. Am J Epidemiol. 1997;146(8):662–4.
14. Schwarcz SK, Kellogg TA, McFarland W, et al. Characterization of sexually transmitted disease clinic patients with recent human immunodeficiency virus infection. J Infect Dis. 2002;186(7):1019–22.
15. Schwarcz S, Kellogg T, McFarland W, et al. Differences in the temporal trends of HIV seroincidence and seroprevalence among sexually transmitted disease clinic patients, 1989–1998:

application of the serologic testing algorithm for recent HIV seroconversion. Am J Epidemiol. 2001;153(10):925–34.
16. Mehta SD, Ghanem KG, Rompalo AM, Erbelding EJ. HIV seroconversion among public sexually transmitted disease clinic patients: analysis of risks to facilitate early identification. J Acquir Immune Defic Syndr. 2006;42(1):116–22.
17. Pathela P, Braunstein SL, Schillinger JA, Shepard C, Sweeney M, Blank S. Men who have sex with men have a 140-fold higher risk for newly diagnosed HIV and syphilis compared with heterosexual men in New York City. J Acquir Immune Defic Syndr. 2011;58:408–16.
18. Prejean J, Song R, Hernandez A, et al. Estimated HIV incidence in the United States, 2006–2009. PLoS One. 2011;6(8):e17502.
19. Vittinghoff E, Douglas J, Judson F, McKirnan D, MacQueen K, Buchbinder SP. Per-contact risk of human immunodeficiency virus transmission between male sexual partners. Am J Epidemiol. 1999;150(3):306–11.
20. Jin F, Crawford J, Prestage GP, et al. Unprotected anal intercourse, risk reduction behaviours, and subsequent HIV infection in a cohort of homosexual men. AIDS. 2009;23(2):243–52.
21. Wong W, Miller S, Rabins C, et al. STD Program Capacity and Preparedness in the United States: Results of a National Survey, 2009 [abstract]. In: The National STD Prevention Conference; March 2010; Atlanta, GA. Abstract number D2a.
22. Kessler J, Myers JE, Nucifora KA, et al. Evaluating the impact of prioritization of antiretroviral pre-exposure prophylaxis in New York. AIDS. 2014;28(18):2683–91.
23. Juusola JL, Brandeau ML, Owens DK, Bendavid E. the cost-effectiveness of preexposure prophylaxis for HIV prevention in the United States in men who have sex with men. Ann Intern Med. 2012;156:541–50.
24. Scanlin KK, Salcuni PN, Edelstein Z, et al. Increasing PrEP Use Among Men Who Have Sex With Men, New York City, 2013–2015. In: Conference on Retroviruses and Opportunistic Infections (CROI); February 2016; Boston, MA. Abstract number 888.
25. Scanlin KK, Salcuni PN, Edelstein Z, et al. Increasing PrEP Use Among Men Who Have Sex With Men, New York City, 2013–2015. In: Conference on Retroviruses and Opportunistic Infections (CROI); February 2016; Boston, MA. Abstract number 888.
26. Borges C, Westheimer E, Edelstein Z, Golub S, Myers J. Limited knowledge, but high interest in HIV pre-exposure prophylaxis among patients attending New York City Health Department STD Clinics, 2013–2014 [abstract]. In: The National STD Prevention Conference; June 2014; Atlanta, GA. Abstract number LB5.
27. Centers for Disease Control and Prevention. HIV Prevalence Trends in Selected Populations in the United States: Results from National Serosurveillance, 1993–1997. Atlanta: Centers for Disease Control and Prevention; 2001:1–51.
28. Baggaley RF, White RG, Boily MC. HIV transmission risk through anal intercourse: systematic review, meta-analysis and implications for HIV prevention. Int J Epidemiol. 2010;39(4):1048–63.
29. New York State Department of Health. Ending the Epidemic Blueprint 2015. http://www.health.ny.gov/diseases/aids/ending_the_epidemic/. Accessed 24 July 2015.
30. Hess K, Hu X, Lansky A, Mermin J, Hall I. Estimating the Lifetime Risk of a Diagnosis of HIV Infection in the United States [abstract]. In: Conference on Retroviruses and Opportunistic Infections (CROI); February 2016; Boston, MA. Abstract number 52.