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Trends in Condom Use among Men Who Have Sex with Men in the United States: the Role of Antiretroviral Therapy and Sero-Adaptive Strategies

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Abstract

Objective: Evaluate changes in condomless anal sex at last sex among MSM and assess if these changes are associated with the adoption of serosorting and biomedical prevention.

Design: The National HIV Behavioral Surveillance (NHBS) is a cross-sectional survey done in up to 21 cities in 2005, 2008, 2011 and 2014.

Methods: MSM were recruited through venue-based sampling. Among men reporting ≥1 male partner we evaluated changes in condomless anal sex at last sex with a partner with: 1) HIV-concordant (proxy for sero-sorting), or 2) HIV-discordant (discordant/unknown) status. We hypothesized that if concordant condomless sex was increasing while discordant was stable/declining, the increases could be driven by more men attempting to serosort. We used generalized estimating equations assuming a Poisson distribution and robust variance estimator to explore whether temporal changes in the outcomes varied by selected characteristics. We also assessed changes in condomless anal sex by antiretroviral therapy (ART) use among HIV-positive MSM.

Results: Among 5,371 HIV-positive MSM, there were increases in concordant (19% in 2005 to 25% in 2014, $p<0.001$) and discordant condomless sex (15% to 19%, $p<0.001$). The increases were not different by ART use. Among 30,547 HIV-negative MSM, concordant (21% to 27%, $p<0.001$) and discordant condomless sex increased (8% to 13%, $p<0.001$).

Conclusions: Our data suggest that condom use decreased among MSM and that the trends are not explained by serosorting or ART. Promotion of condoms and increased access to PrEP, are vital to ensure that the benefits of ART in reducing transmission of HIV are not undermined.

Keywords: MSM, United States, behaviors, trends, condom use, serosorting, antiretrovirals, pre-exposure prophylaxis, PrEP

Background

Condom use affects the likelihood of HIV sexual transmission when a contact is made between an infected and susceptible individual [1], and is one of the key indicators measured in behavioral surveillance and prevention research. While condoms can reduce the risk of HIV transmission, they do not eliminate risk and are often not used consistently[2]. Some men who have sex with men (MSM) attempt to decrease their HIV risk by engaging in seroadaptive practices such as serosorting and seropositioning [3]. Seroadaptive practices have been shown to reduce the risk of HIV acquisition compared to having no strategy but increase the risk of infection compared to consistent condom use [3] . Other biomedical prevention strategies are now available, such as treatment as prevention and pre-exposure prophylaxis (PrEP) [4]. Some men may also choose these strategies instead of using condoms.

Previous analyses from CDC's National HIV Behavioral Surveillance (NHBS) showed that condom use among MSM declined 20% from 2005 to 2011[5]. This follow-up analysis includes new data (2014) and investigates if the increases in condomless sex were associated with use of other perceived prevention strategies. We investigated trends in concordant condomless sex at last sex as a proxy for serosorting and trends in the adoption of the insertive or receptive role when having condomless sex as an indication of seropositioning. We compared the trends in condomless sex among HIV-positive men on antiretroviral treatment (ART) versus not on ART to investigate if the overall increases were mainly due to reliance among HIV-positive MSM on the protective role of ART. Finally, we investigated the association of PrEP use and condomless sex.

Methods

Serial cross sectional data for NHBS among MSM are collected every 3 years. Data are from MSM recruited for interviews and HIV testing through venue-based, time-space sampling in 2003-2005 (referred to as 2005), 2008, 2011 and 2014[1]. NHBS eligibility criteria and procedures have been previously published [6, 7]. Activities were approved by local institutional review boards in each participating city and by the CDC.

Measures

Information on the HIV status of partners was only available for the last sexual partner. Therefore, we used information on the last anal sex act (condom use, insertive or receptive position) and self-reported HIV status of the participant and his last sex partner[2] to construct the following condomless anal sex outcomes[8]: 1) any; 2) concordant (partner of the same HIV status, proxy for serosorting), 3) discordant (partner of discordant/unknown status), 4) receptive, and 5) insertive. In 2005 12% had missing information on the most recent partner and it was assigned using imputation[3]. Data imputation was not necessary for other years of data. We hypothesized that if the proportion of men reporting concordant condomless sex increased over time while discordant sex remained stable or declined, that the overall

[1] The first MSM cycle of NHBS in 2005 included the following cities: Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Denver, Colorado; Fort Lauderdale, Florida; Houston, Texas; Los Angeles, California; Miami, Florida; Newark, New Jersey; New York City, New York; Philadelphia, Pennsylvania; San Diego, California; San Francisco, California; and San Juan, Puerto Rico. The second MSM cycle of NHBS in 2008 included all the cities in the first cycle except Fort Lauderdale, Florida; plus the following cities: Washington DC, Dallas, Texas; Detroit, Michigan; New Orleans, Louisiana; Nassau-Suffolk, New York; St. Louis, Missouri; and Seattle, Washington. The third and fourth MSM cycles of NHBS included all the cities in the second cycle except for St. Louis, Missouri.

[2] HIV status was assessed with the following questions: "What was the result of your most recent test"? And "Before your test on [DATE] did you ever test positive for HIV"? Self-reported HIV-positive were those who answered positive to the first question or yes to the second question. Self-reported HIV-negative were those who answered negative to the first question. And self-reported unknown status were those participants who answered don't know or never obtained results to the first question and no to the second question. Participants were asked if they knew the HIV-status of their last sex partner at the time of last sex and, if so, what was their partner's HIV-status.

[3] In 2015 date of last sex for last main and casual partners was collected. Based on the most recent date we selected the last sexual partner. When it was unclear between the last type because of similar dates or because it was missing date were imputed. The proportion of casual and main partners was determined from entire sample combining all cycles (2005-2014). For each person for which we imputed we simulated a uniform (0,1) random variable. If that random number was less than or equal to the computed proportion of main partners in the pooled sample the person unknown partner taken to be a main partner otherwise it was a casual partner.

increases in condomless sex could be driven by increased reliance on serosorting strategies. We evaluated the position at last sex as a proxy for seropositioning. Receptive condomless sex with a discordant partner at last sex among HIV-positive MSM and insertive condomless sex at last sex among HIV-negative MSM was considered lower risk than the opposite role or practicing both positions at last sex. If the increases in condomless sex were due to an increased reliance on seropositioning we expected the lower risk practice to increase while the other behaviors would remain stable or decrease. Outcomes are presented separately by the self-reported HIV status of the participants.

Analysis

The analysis included all MSM who had a sex partner in the past 12 months, irrespective of whether they had an HIV test through NHBS. All cities that participated in any of the four cycles of NHBS were included. Separate Poisson models using Generalized Estimating Equations (GEE) were used to test for a linear trend between 2005, 2008, 2011 and 2014 for each of the outcomes. All models include year, age, race, and city. Models for concordant and discordant condomless sex included interactions terms for year by age and race if significant (defined as $p<0.05$). Year was treated as a continuous variable. Additional models were run among HIV-positive individuals for concordant and discordant condomless sex including an interaction term for year by ART. Among MSM of unknown status, we did not evaluate seroadaptive practices. To account for PrEP, we conducted a sensitivity analysis excluding men who reported being on PrEP in 2011 and 2014 for any, discordant and concordant condomless sex.

Results

The percent of black participants and those recruited at bars and clubs increased from 2005 to 2014. Other characteristics of the sample remained unchanged (Supplemental Table, http://links.lww.com/QAD/A926).

Concordant and discordant sex

Among HIV-positive MSM, condomless sex at last sex increased from 34% in 2005 to 44% in 2014 ($p<0.001$). There were increases in both concordant ($p<0.001$) and discordant condomless sex ($p<0.001$), although the former was more common (Table 1). These increases did not differ significantly by age, race or ART use (Supplemental Figure, http://links.lww.com/QAD/A926). However, in 2014 most HIV-positive MSM were on ART (90%) and of those reporting discordant condomless sex, 88% were on ART (258/293).

Overall (all years), 41% of HIV-negative MSM reported a discordant partner (37% with a partner of unknown status and 4% with an HIV-positive partner). Among HIV-negative MSM condomless sex at last anal sex increased from 29% in 2005 to 41% in 2014 ($p<0.001$) (Table). Both concordant and discordant condomless sex increased (both $p<0.001$). The increases did not vary by race. The increase did vary by age ($p=0.003$), and was greatest among MSM ages 18-24 years. (Figure).

Insertive and receptive sex

Among HIV-positive MSM an increase was noted for discordant receptive condomless sex ($p<0.001$) while the percent engaging in discordant insertive sex ($p=0.34$) remained unchanged. Among HIV-negative MSM both insertive and receptive anal sex with a discordant partner increased from 2005 to 2014 (both $p<0.001$).

PREP use

PREP use among HIV-negative MSM was 0.5% in 2011 and 3.5% in 2014. When excluding men on PREP from the analyses the increasing trend in any, concordant and discordant condomless anal sex remained unchanged.

Discussion

This analysis explored whether documented increases in condomless sex among MSM were associated with adoption of other prevention strategies. We found that among HIV-negative MSM condomless sex increased with both concordant and discordant partners and there was no indication that sero-adaptive behaviors were associated with the increases. In the years studied, PrEP use was too low to contribute to the increases in condomless sex, and excluding MSM on PrEP from the analyses did not change the results. Although discordant condomless receptive anal sex was rare among HIV-negative MSM, our data suggest that this practice has increased. While we found increases in concordant and discordant condomless sex among HIV-positive MSM, we also found evidence of sero-adaptive behaviors among HIV-positive MSM; the increase in discordant condomless anal sex was only statistically significant for receptive sex but not insertive sex, which carries higher risk of HIV transmission. The data also suggest that HIV treatment does not explain the increase in condomless sex among HIV-positive MSM, however, most HIV-positive MSM were on ART.

These findings corroborate previous reports of increases in condomless sex among MSM in the United States[9]. We cannot establish if these trends are contributing to the documented increase in HIV incidence among MSM. However, the increase in concordant condomless sex among HIV-negative MSM was highest among the youngest age group, among whom the greatest increase in the number of new HIV infections has occurred [10]. Men may perceive themselves and their partners to be HIV-negative, however, many men who are HIV-positive are not aware of their infection, and awareness is

lowest among the youngest age groups [11]. Although men could be choosing other prevention strategies such as PrEP, this strategy was uncommon and did not explain the increases in condomless sex. Men with discordant partners could be choosing not to use condoms if their HIV-positive partner is on ART. However, most discordant partnerships among HIV-negative MSM in this analysis were with a partner of unknown status as opposed to an HIV-positive partner. There may be other reasons for the increases in condomless sex that were not explored such as changing social norms around condom use [12].

Similar increases in condomless sex have been reported from other developed countries[13-17]. Mathematical modeling from the United Kingdom [18] and the Netherlands [19] suggests that reductions in HIV incidence due to ART and earlier HIV diagnosis have been offset by increases in condomless sex among MSM.

The findings in this report are subject to limitations. NHBS data are from MSM who were recruited at venues in cities with high AIDS burden. Thus, results may not be generalizable to all MSM. Further, analyses were based on self-reported data and may be subject to social-desirability bias. Several studies have previously documented misreporting of HIV status [20]. However, trends by HIV-status were similar and we do not believe the potential biased introduced by this would affect the conclusion of our analyses. It is not possible to fully exclude a methodological change in NHBS contributing to our findings. One major change in NHBS methods was the inclusion of sexual behavior questions during eligibility screening starting in 2011. Requiring disclosure of sexual behaviors at the time of screening could have differentially selected participants who were more comfortable with disclosing their sexuality. Another possible explanation for our findings is that MSM may be more willing to disclose their risk behaviors in later years if stigma associated with HIV infection or homosexuality is

decreasing, for which some evidence exists[21, 22]. Finally, data are not weighted to account for the complex sampling methodology used to recruit MSM. Point estimates may therefore be biased by over- or under-represented subgroups of the population. We did not present behaviors by partner type, because condomless sex with regular partners is also risky [23].

Our data suggests that condom use has decreased among MSM and that the trends are not explained by serosorting, seropositioning, PrEP use or HIV treatment, and should continue to be monitored. The promotion of condom use among HIV-negative as well as HIV-positive MSM remains vital to ensure the benefits of ART in reducing transmission of HIV are not undermined. However, MSM comprise diverse populations that vary in socio-demographic and behavioral characteristics and have different prevention needs and preferences. In this new era of HIV prevention, MSM have more tools available to them than ever before. There are new strategies, such as PrEP for those who are negative and at high risk and treatment as prevention for HIV-positive men, and previously recognized methods which can substantially reduce risk such as using condoms consistently and correctly. Since no single strategy provides complete protection in real-world use, multiple approaches are needed to reduce new HIV infections.

References

1. Patel P, Borkowf CB, Brooks JT, Lasry A, Lansky A, Mermin J. Estimating per-act HIV transmission risk: a systematic review. *AIDS* 2014,**28**:1509-1519.
2. Smith D, Herbst JH, Zhang X, Rose C. Condom efficacy by consistency of use among MSM: US. In: *Conference on Retroviruses and Opportunistic Infections*. Atlanta, Georgia; 2012.
3. Vallabhaneni S, Li X, Vittinghoff E, Donnell D, Pilcher CD, Buchbinder SP. Seroadaptive practices: association with HIV acquisition among HIV-negative men who have sex with men. *PLoS One* 2012,**7**:e45718.
4. Grant RM. Antiretroviral agents used by HIV-uninfected persons for prevention: pre- and postexposure prophylaxis. *Clin Infect Dis* 2010,**50 Suppl 3**:S96-101.
5. Centers for Disease C, Prevention. HIV testing and risk behaviors among gay, bisexual, and other men who have sex with men - United States. *MMWR Morb Mortal Wkly Rep* 2013,**62**:958-962.

6. MacKellar DA, Gallagher KM, Finlayson T, Sanchez T, Lansky A, Sullivan PS. Surveillance of HIV risk and prevention behaviors of men who have sex with men--a national application of venue-based, time-space sampling. *Public Health Rep* 2007,**122 Suppl 1**:39-47.
7. Finlayson TJ, Le B, Smith A, Bowles K, Cribbin M, Miles I, *et al.* HIV risk, prevention, and testing behaviors among men who have sex with men--National HIV Behavioral Surveillance System, 21 U.S. cities, United States, 2008. *MMWR Surveill Summ* 2011,**60**:1-34.
8. CDC. HIV Infection, Risk, Prevention, and Testing Behaviors among Men Who Have Sex with Men, National HIV Behavioral Surveillance, 20 U.S. Cities, 2014. In: *HIV Surveillance Special Report*: Centers for Disease Control and Prevention; 2016. pp. 32.
9. CDC. Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 U.S. dependent areas—2013. *HIV Surveillance Supplemental Report* 2015,**20**.
10. CDC. Estimated HIV incidence in the United States, 2007–2010. *HIV Surveillance Supplemental Report* 2012,**17**.
11. Wejnert C, Hess KL, Rose CE, Balaji A, Smith JC, Paz-Bailey G, *et al.* Age-specific race and ethnicity disparities in HIV infection and awareness among men who have sex with men-20 US cities, 2008-2014. *J Infect Dis* 2015.
12. van den Boom W, Stolte IG, Roggen A, Sandfort T, Prins M, Davidovich U. Is anyone around me using condoms? Site-specific condom-use norms and their potential impact on condomless sex across various gay venues and websites in The Netherlands. *Health Psychol* 2015,**34**:857-864.
13. Elford J, Bolding G, Davis M, Sherr L, Hart G. Trends in sexual behaviour among London homosexual men 1998-2003: implications for HIV prevention and sexual health promotion. *Sex Transm Infect* 2004,**80**:451-454.
14. Elford J. Changing patterns of sexual behaviour in the era of highly active antiretroviral therapy. *Curr Opin Infect Dis* 2006,**19**:26-32.
15. Cowan SA, Gerstoft J, Haff J, Christiansen AH, Nielsen J, Obel N. Stable incidence of HIV diagnoses among Danish MSM despite increased engagement in unsafe sex. *J Acquir Immune Defic Syndr* 2012,**61**:106-111.
16. Casalino E, Choquet C, Leleu A, Hellmann R, Wargon M, Juillien G, *et al.* Trends in condom use and risk behaviours after sexual exposure to HIV: a seven-year observational study. *PLoS One* 2014,**9**:e104350.
17. Hart GJ, Williamson LM. Increase in HIV sexual risk behaviour in homosexual men in Scotland, 1996-2002: prevention failure? *Sex Transm Infect* 2005,**81**:367-372.
18. Phillips AN, Cambiano V, Nakagawa F, Brown AE, Lampe F, Rodger A, *et al.* Increased HIV incidence in men who have sex with men despite high levels of ART-induced viral suppression: analysis of an extensively documented epidemic. *PLoS One* 2013,**8**:e55312.
19. Bezemer D, de Wolf F, Boerlijst MC, van Sighem A, Hollingsworth TD, Prins M, *et al.* A resurgent HIV-1 epidemic among men who have sex with men in the era of potent antiretroviral therapy. *AIDS* 2008,**22**:1071-1077.
20. Sanchez TH, Kelley CF, Rosenberg E, Luisi N, O'Hara B, Lambert R, *et al.* Lack of Awareness of Human Immunodeficiency Virus (HIV) Infection: Problems and Solutions With Self-reported HIV Serostatus of Men Who Have Sex With Men. *Open Forum Infect Dis* 2014,**1**:ofu084.
21. Glick SN, Golden MR. Persistence of racial differences in attitudes toward homosexuality in the United States. *J Acquir Immune Defic Syndr* 2010,**55**:516-523.
22. Herek GM, Capitanio JP, Widaman KF. HIV-related stigma and knowledge in the United States: prevalence and trends, 1991-1999. *Am J Public Health* 2002,**92**:371-377.

23. Rosenberg ES, Grey JA, Paz-Bailey G, Hall I, Lansky A, J. M, *et al.* Estimating the number and characteristics of HIV transmissions in serodiscordant male-male partnerships in the United States In: *Conference of Retroviruses and Opportunistic Infections*. Seattle, Washington; 2015.

Table. Sexual behaviors at last sex among sexually active men who have sex with men by self-reported HIV status, National HIV Behavioral Surveillance, United States, 2005-2014

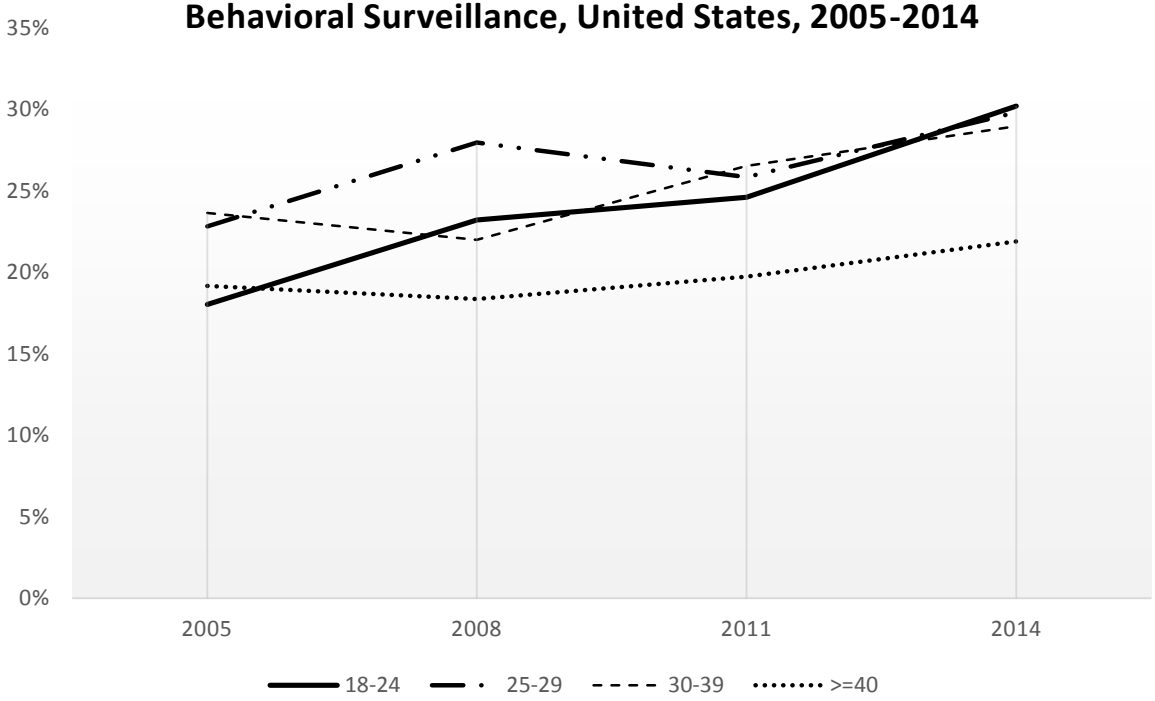
	2005		2008		2011		2014		Adjusted p-value[1]
	n	(%)	n	(%)	n	(%)	n	(%)	
HIV-positive MSM									
Any condomless anal sex (CAS)	489	34.2	410	37.3	495	39.8	703	44.5	<0.001
Concordant[2] CAS	279	19.0	231	21.1	318	25.6	401	25.4	<0.001
Receptive only[3]	101	7.3	71	6.5	109	8.8	151	9.6	<0.001
Any insertive[4]	178	12.3	160	14.6	209	16.9	250	15.8	<0.001
Discordant[5] CAS	210	15.0	177	16.1	174	14.0	301	19.0	<0.001
Receptive only[3]	102	6.8	87	7.9	90	7.3	167	10.6	<0.001
Any insertive[4]	108	7.7	90	8.2	84	6.8	134	8.5	0.3426
Total	**1440**	**100.0**	**1101**	**100.0**	**1244**	**100.0**	**1586**	**100.0**	
HIV-negative MSM									
Any CAS	2522	28.7	2304	32.8	2472	34.7	2998	40.5	<0.001
Concordant[2] CAS	1828	21.2	1576	22.4	1700	23.9	2023	27.4	<0.001
Insertive only[6]	854	9.9	699	9.9	740	10.4	847	11.5	<0.001
Any receptive[7]	972	11.3	877	12.5	960	13.5	1174	15.9	<0.001
Discordant[5] CAS	692	7.6	724	10.3	768	10.8	971	13.1	<0.001

Insertive only[6]	387	4.2	369	5.3	404	5.7	521	7.0	<0.001
Any receptive[7]	304	3.4	354	5.0	363	5.1	448	6.1	<0.001
Total	**8943**	**100.0**	**7049**	**100.0**	**7131**	**100.0**	**7424**	**100.0**	
Unknown HIV-status MSM									
Any CAS	259	27.2	362	32.8	324	37.0	240	38.5	<0.001
Total	**1068**		**1103**		**878**		**626**		

Note: Denominator may vary for certain outcomes due to missing data. Numbers and percentages for 2005 include imputed values.

1. Seven models included for HIV-positive and HIV-negative MSM on the following outcomes: any condomless sex at last anal sex; concordant condomless anal sex, concordant insertive condomless anal sex, concordant receptive condomless anal sex, discordant condomless anal sex, discordant receptive condomless anal sex, and discordant insertive condomless anal sex. For MSM of unknown HIV-status only one model is presented for any condomless anal sex. We used generalized estimating equations models using a robust variance estimate and assuming a Poisson distribution to test for a linear trend between 2005, 2008, 2011 and 2014 for each of the outcomes. All models include year, age, race, and city.
2. Condomless anal sex at last sex with a partner of the same HIV status.
3. Respondent assumed receptive role during last sexual episode.
4. Respondent assumed insertive role during last sexual episode and includes those reporting both insertive and receptive sex.
5. Discordant condomless anal sex was defined as not using a condom for anal sex with a last partner of discordant or unknown HIV status at last sex.
6. Respondent assumed insertive role during last sexual episode.
7. Respondent assumed receptive role during last sexual episode and includes those reporting both insertive and receptive sex.

Figure. Concordant condomless sex among HIV-negative men who have sex with men by age, National HIV Behavioral Surveillance, United States, 2005-2014



Note: Adjusted increase in concordant condomless sex per every 3 years was for 18-24 years 16% (CI: 12%, 20%), 25-29 years 9% (CI: 5%, 12%), 30-39 years 9% (CI: 5%, 12%) and 40 years and older 7% (3%, 11%).