

Estimation of HIV Prevalence, Risk Factors, and Testing Frequency among Sexually Active Men Who Have Sex with Men, Aged 18–64 Years—New York City, 2002

Susan E. Manning, Lorna E. Thorpe, Chitra Ramaswamy, Anjum Hajat, Melissa A. Marx, Adam M. Karpati, Farzad Mostashari, Melissa R. Pfeiffer, and Denis Nash

ABSTRACT *Population-based estimates of human immunodeficiency virus (HIV) prevalence and risk behaviors among men who have sex with men (MSM) are valuable for HIV prevention planning but not widely available, especially at the local level. We combined two population-based data sources to estimate prevalence of diagnosed HIV infection, HIV-associated risk-behaviors, and HIV testing patterns among sexually active MSM in New York City (NYC). HIV/AIDS surveillance data were used to determine the number of living males reporting a history of sex with men who had been diagnosed in NYC with HIV infection through 2002 (23% of HIV-infected males did not have HIV transmission risk information available). Sexual behavior data from a cross-sectional telephone survey were used to estimate the number of sexually active MSM in NYC in 2002. Prevalence of diagnosed HIV infection was estimated using the ratio of HIV-infected MSM to sexually active MSM. The estimated base prevalence of diagnosed HIV infection was 8.4% overall (95% confidence interval [CI] = 7.5–9.6). Diagnosed HIV prevalence was highest among MSM who were non-Hispanic black (12.6%, 95% CI = 9.8–17.6), aged 35–44 (12.6%, 95% CI = 10.4–15.9), or 45–54 years (13.1%, 95% CI = 10.2–18.3), and residents of Manhattan (17.7%, 95% CI = 14.5–22.8). Overall, 37% (95% CI = 32–43%) of MSM reported using a condom at last sex, and 34% (95% CI = 28–39%) reported being tested for HIV in the past year. Estimates derived through sensitivity analyses (assigning a range of HIV-infected males with no reported risk information as MSM) yielded higher diagnosed HIV prevalence estimates (11.0–13.2%). Accounting for additional undiagnosed HIV-infected MSM yielded even higher prevalence estimates. The high prevalence of diagnosed HIV among sexually active MSM in NYC is likely due to a combination of high incidence over the course of the epidemic and prolonged survival in the era of highly active antiretroviral therapy. Despite high HIV prevalence in this population, condom use and HIV testing are low. Combining complementary population-based data sources can provide critical HIV-related information to guide prevention efforts. Individual counseling and education interventions should focus on increasing condom use and encouraging safer*

At the time this work was conducted, Manning and Marx were with the Epidemic Intelligence Service, Office of Workforce and Career Development, Centers for Disease Control and Prevention, Atlanta, GA, USA; Thorpe, Ramaswamy, Hajat, Marx, Karpati, Mostashari, and Pfeiffer are with the New York City Department of Health and Mental Hygiene, New York, NY, USA; Nash is with the Department of Epidemiology and International Center for AIDS Care and Treatment Programs, Columbia Mailman School of Public Health, New York, NY, USA; Manning is with the Massachusetts Department of Public Health, Bureau of Family and Community Health, Boston, MA, USA.

Correspondence: Susan E. Manning, MD, MPH, Massachusetts Department of Public Health, Bureau of Family and Community Health, 250 Washington Street, 4th Floor, Boston, MA 02108, USA. (E-mail: aci6@cdc.gov)

sex practices among all sexually active MSM, particularly those groups with low levels of condom use and multiple sex partners

KEYWORDS *Condom use, HIV prevalence, HIV testing, Human immunodeficiency virus, Men who have sex with men.*

INTRODUCTION

Men who have sex with men (MSM) have been disproportionately affected by the human immunodeficiency virus (HIV) epidemic in the United States. An estimated 1 million persons were living with HIV/AIDS in the United States as of the end of 2003,¹ and MSM accounted for 68% of the male subset.² Results from a serosurvey conducted among MSM attendees of sexually transmitted disease clinics indicate an overall HIV prevalence of 26%, with estimates ranging from 8–39% across geographic regions.³ The 1994–2000 Young Men’s Survey (YMS) was a two-phase, cross-sectional, venue-based survey conducted in seven large U.S. cities to estimate HIV prevalence and risk behaviors among young MSM aged 15–22 years (Phase I) and 23–29 years (Phase II).⁴ The overall prevalence of HIV infection among participants who reported ever having had sex with a man was 7.2% nationally⁴ and 12.1% in New York City (NYC)⁵ during Phase I, and 13% nationally⁶ and 17% in NYC⁷ during Phase II. The National HIV Behavioral Surveillance (NHBS) System collects data from three groups at high risk for HIV infection (MSM, injection drug users, and heterosexual adults in areas where HIV is prevalent) attending public venues to estimate the prevalence of HIV infection and risk behaviors.⁸ Among NYC MSM NHBS participants surveyed during July 2004–January 2005, the prevalence of HIV infection was 18%.⁷ However, estimates of HIV prevalence obtained through sexually transmitted disease (STD) clinic and venue-based serosurveys are likely to overestimate the actual prevalence of HIV among MSM and are not generalizable to the overall MSM population.

Population-based studies of HIV prevalence among MSM should provide the least biased and most generalizable estimates, but are not available nationally or in the majority of local jurisdictions. HIV surveillance systems can provide population-based estimates of the number of HIV-infected persons and limited information on transmission risk behaviors. However, a barrier to the estimation of HIV prevalence among any particular transmission risk group, including MSM, is the lack of denominator estimates for specific populations at risk. Therefore, other data sources in addition to routine case surveillance are needed to calculate risk group-specific HIV prevalence estimates.

NYC has one of the largest and most heterogeneous HIV epidemics in the United States. Survival among persons with HIV infection has improved substantially in NYC, particularly among MSM, since the introduction of highly active antiretroviral therapy (HAART) in 1995.^{9,10} The incidence of HIV infection among MSM was recently estimated to be 2.5% per year;¹¹ however, there are no historical data on HIV incidence to suggest whether it is stable, increasing, or declining. Since June 2000, the NYC Department of Health and Mental Hygiene (DOHMH) has been conducting name-based surveillance to track diagnoses of HIV (non-AIDS) and AIDS among NYC residents. As of December 31, 2002, 80,862 New Yorkers, 1% of the city’s population, had received diagnoses of and were known to be living with HIV/AIDS.⁹

The NYC Community Health Survey (CHS) is a local, population-based, cross-sectional telephone survey conducted annually since 2002. In addition to other key health indicators, CHS provides local estimates of the prevalence and estimated number of MSM living in NYC, measures that are not available from other existing data sources. CHS also provides information on the proportion of New Yorkers reporting certain behaviors that have been associated with risk of HIV infection, including condom use, number of sex partners, history of recent sexually transmitted infections, and HIV testing. We combined data from the NYC DOHMH HIV/AIDS Surveillance Registry and the CHS to derive population-based estimates of HIV prevalence among sexually active MSM in NYC in 2002. We also used CHS data to determine the frequency of HIV risk and testing behaviors.

METHODS

Data Sources

Community Health Survey The 2003 NYC CHS was a population-based, cross-sectional, random-digit-dialed telephone survey of noninstitutionalized New Yorkers aged greater than or equal to 18 years stratified by 34 neighborhoods. Data from each neighborhood are pooled to produce representative estimates for the adult population of NYC. A total of 9,802 adults completed an interview from 16,633 households with a landline telephone contacted. The 2003 NYC CHS response rate was 26%, and the cooperation rate (the proportion of eligible households that participated) was 56%. These rates were only slightly lower than the 2003 New York State Behavioral Risk Factor Surveillance System (BRFSS) response and cooperation rates of 29.1 and 68.6%, respectively. Interviews were conducted in 26 languages. Because the CHS asks about health behaviors occurring in the 12 months before the survey, 2003 CHS data, which were collected between April and August 2003, were used as the best indicators of the behaviors of interest during 2002. We used responses to questions regarding sexual behaviors from this survey to estimate the number of sexually active MSM living in NYC during 2002. Male respondents aged 18–64 years who reported having sex (oral or anal) with one or more men during the past 12 months were included in the analysis. Male respondents who reported having sex with both men and women during the past 12 months were included. Condom use was assessed on the basis of responses to the question, “The last time you had sex, did you or your partner use a condom?” HIV testing was assessed on the basis of responses to the question, “Have you had an HIV test during the last 12 months? Do not count tests you might have had as part of a blood donation.” A recent history of sexually transmitted infection (STI) was assessed by using responses to questions asking whether the respondent had ever had genital warts or genital herpes diagnosed or had gonorrhea or chlamydia diagnosed during the past 12 months. The first two STIs measured are viral infections and are likely to have been present in the past 12 months, even if the diagnosis was made before the past year. Respondents answering “yes” to at least one of the questions were classified as having a recent history of STI.

HIV/AIDS Surveillance Registry

We compiled data on persons who had diagnoses of and were known to be living with HIV/AIDS as of December 31, 2002, and had been reported to the NYC HIV/

AIDS Surveillance Registry through April 2005. Data on HIV-infected male NYC residents aged 18–64 years for whom sex with another male was the reported risk factor were included in the analysis as the numerator for the estimated prevalence of diagnosed HIV infection. MSM who reported a history of injection-drug use (6.5% of the 21,449 HIV-infected MSM) were also included. Males whose reported HIV transmission risk was heterosexual, perinatal, or unknown were excluded. Information on race/ethnicity, age at the end of 2002, and borough of residence at the time of HIV or AIDS diagnosis was obtained from HIV surveillance records. Additional details on NYC DOHMH HIV surveillance methods have been described previously.¹²

Data Analysis The number, weighted number, and weighted percentage of sexually active males who had sex with another male during the previous year were estimated on the basis of responses to CHS questions. All CHS analyses applied sample weights to account for the sampling design of the survey. Selection weights equaled the inverse of the probability of selection. Poststratification weights extrapolated survey findings to neighborhood populations, on the basis of the age, sex, and race of the respondent. Weighted percentages were age-adjusted to the 2000 U.S. standard population. Standard errors for all point estimates were estimated by using SAS[®]-callable SUDAAN[®] version 9.0 (Research Triangle Institute, Research Triangle Park, NC). Data were analyzed by using SAS[®] version 8.2 (SAS Institute, Inc., Cary, NC).

The prevalence of diagnosed HIV infection among sexually active MSM in NYC in 2002 was estimated by dividing the number of MSM with diagnoses and who were known to be living with HIV (from the HIV/AIDS Surveillance Registry) by the estimated population of MSM (from CHS). Population estimates from CHS were rounded to the nearest hundred due to lack of precision. The number of HIV-infected MSM enumerated from the Surveillance Registry was divided by the upper and lower confidence limits of the estimated population of MSM to determine the lower and upper 95% confidence limits, respectively, for prevalence estimates. Sensitivity analyses were performed to assess the impact of various assumptions on the HIV prevalence estimates.

RESULTS

Proportion of New York City Adult Males with a Recent History of Sex with Another Male

U.S. census 2000 data indicate that 2,443,626 males aged 18–64 years were living in New York City in 2000.¹³ On the basis of data from the 2003 CHS, an estimated 254,400 (13.7%; 95% CI=12.1–15.4) males in this age range reported having had sex with another male during the previous 12 months (Table 1). The proportion of sexually active MSM did not vary significantly by race/ethnicity. Approximately 15.0% (95% CI=11.8–18.9) of Hispanic, 14.5% (95% CI=12.2–17.2) of non-Hispanic white, and 12.4% (95% CI=9.5–16.0) of non-Hispanic black males reported sexual activity with another male during the previous year. A slightly higher proportion of sexually active MSM was identified among younger age groups; an estimated 16.2% (95% CI=11.7–22.1) of males aged 18–24 years and 15.8% (95% CI=13.0–19.1) of males aged 35–44 years reported having had sex with another man during the previous year. Geographically, the proportion of males

TABLE 1. Number, weighted number, and age-adjusted weighted percentage of sexually active men who have sex with men by selected characteristics—New York City, 2002^a

Characteristics	Number ^b	Estimated MSM population size ^c	Estimated percentage (%) of MSM in population	95% CI ^d
Total	352	254,400	13.7	12.1–15.4
Race/ethnicity				
Non-Hispanic white	169	105,000	14.5	12.2–17.2
Non-Hispanic black	64	46,800	12.4	9.5–16.0
Hispanic	88	76,400	15.0	11.8–18.9
Other	31	26,300	9.6	6.4–14.1
Age group (years)				
18–24	41	42,800	16.2	11.7–22.1
25–34	92	68,200	12.3	9.6–15.6
35–44	115	73,900	15.8	13.0–19.1
45–54	70	45,300	12.6	9.6–16.4
55–64	34	24,100	11.7	7.9–17.0
Borough of residence				
Bronx	48	45,400	16.8	12.0–22.9
Brooklyn	95	68,500	12.7	10.2–15.7
Manhattan	113	65,000	15.7	12.5–19.6
Queens	78	61,000	11.4	8.9–14.5
Staten Island	18	14,700	14.4	8.8–22.5

^aData are from the 2003 NYC Community Health Survey, which asked respondents to report on sexual behaviors during the 12 months preceding the interview.

^bNumber of males reporting having had sex with another male in the past 12 months

^cEstimated population size is rounded to the nearest 100.

^dCI Confidence interval

estimated to be sexually active MSM was slightly lower in Brooklyn, Queens, and Staten Island than in the Bronx or Manhattan, although the differences between the boroughs were not significant.

NYC MSM with Diagnosed HIV Infections

According to HIV surveillance data, 21,449 males for whom sex with another male was the reported HIV transmission risk factor were diagnosed and living with HIV infection at the end of 2002. MSM constituted 41% of the 52,932 HIV-infected males in New York City and 53% of the 40,724 males whose HIV transmission risk was known; 12,208 (23%) HIV-infected NYC males had unknown transmission risk information. Among MSM who were diagnosed with HIV infection, 43% were non-Hispanic white, 28% Hispanic, and 27% non-Hispanic black; 2% were aged 18–24 years, 17% aged 25–34 years, 43% aged 35–44 years, and 28% aged 45–54 years; and 54% were residents of Manhattan.

Risk Behaviors and HIV Testing Although the majority of sexually active MSM (74.2%; 95% CI=68.5–79.3) reported having had only one sex partner during the past 12 months, 16.2% (95% CI=12.1–21.2) had had three or more partners, and 9.6% (95% CI=6.7–13.7) had had two partners. Approximately one quarter of sexually active MSM (28.7%; 95% CI=21.3–37.4) reported having had one or

more recent sexually transmitted infections (any history of genital herpes or genital warts diagnosis or diagnosis of gonorrhea or chlamydia during the previous 12 months) (data not shown). Approximately one-third (37.3%; 95% CI=31.8–43.1) of all MSM reported that a condom had been used during their last sexual encounter (Table 2), and 62.4% (95% CI=46.6–76.0) of those with three or more sex partners in the past year reported having used a condom at last sex. Condom use was highest among MSM who were non-Hispanic black (49.5%; 95% CI=37.4–61.7) and among MSM aged 18–24 years (69.0%; 95% CI=51.8–82.2).

One-third (33.5%; 95% CI=28.3–39.2) of sexually active MSM in NYC reported being tested for HIV during the past 12 months (Table 2). Approximately one quarter (29.7%; 95% CI=23.8–36.2) of MSM with one sex partner, 49.0%

TABLE 2. Age-adjusted^a percent using a condom at last sex and percent testing for HIV in the past year among men who report having sex with other men, by selected characteristics^b—New York City, 2002

Characteristics	Percentage (%) using condom at last sex	95% CI ^c (%)	% Testing for HIV in past 12 months	95% CI ^c (%)
Total	37.3	31.8–43.1	33.5	28.3–39.2
Race/ethnicity				
Non-Hispanic white	32.9	25.3–41.5	23.3	16.8–31.2
Non-Hispanic black	49.5	37.4–61.7	37.7	27.4–49.2
Hispanic	34.1	23.7–46.4	47.4	35.8–59.2
Other	30.9	17.3–49.0	16.4	6.3–36.5
Age group (years)				
18–24	69.0	51.8–82.2	61.7	44.6–76.3
25–34	33.2	22.3–46.3	43.8	31.6–56.9
35–44	35.6	26.7–45.6	29.6	21.2–39.6
45–54	30.5	19.2–44.7	14.3	7.4–25.9
55–64	20.0	9.6–37.1	21.7	9.6–42.0
Borough of residence				
Bronx	44.0	31.0–57.9	49.6	37.3–61.7
Brooklyn	35.8	27.1–45.5	31.7	23.3–41.5
Manhattan	42.3	31.2–54.1	37.4	26.6–49.7
Queens	35.1	23.7–48.5	24.3	15.6–35.9
Staten Island	^d	^d	^d	^d
Number of sex partners in past year				
1	27.5	21.8–34.0	29.7	23.8–36.2
2	69.0	48.4–84.1	49.0	32.7–65.5
≥3	62.4	46.6–76.0	46.3	31.9–61.3
History of sexually transmitted disease ^e				
Yes	42.3	30.7–54.9	32.5	21.7–45.6
No	36.1	30.2–42.4	33.6	27.9–39.8

^aAge-adjusted using the 2000 standard U.S. population

^bData are from the 2003 NYC Community Health Survey.

^cCI confidence interval

^dSample size is limited.

^eRespondents reporting ever having been diagnosed with genital warts or genital herpes or having been diagnosed with gonorrhea or chlamydia during the 12 months before the survey

(95% CI=32.7–65.5) of MSM with two sex partners, and 46.3% (95% CI=31.9–61.3) of MSM with three or more sex partners reported having been tested for HIV during the past year. The prevalence of HIV testing during the past year was highest among sexually active MSM who were Hispanic (47.4%; 95% CI=35.8–59.2), aged 18–24 years (61.7%; 95% CI=44.6–76.3), and residents of the Bronx (49.6%; 95% CI=37.3–61.7).

Estimated Prevalence of Diagnosed HIV Infection There were 21,449 MSM aged 18–64 years who had been diagnosed with HIV/AIDS and reported to the HIV/AIDS Surveillance Registry and approximately 254,000 sexually active MSM for an estimated prevalence of diagnosed HIV infection among sexually active MSM in NYC of 8.4% (95% CI=7.5–9.6) (Table 3). While the proportions of MSM did not vary by race/ethnicity, estimates of diagnosed HIV infection varied substantially: 12.6% among non-Hispanic blacks (95% CI=9.8–17.6); 8.8% among non-Hispanic whites (95% CI=7.4–10.7); 7.8% among Hispanics (95% CI=6.2–10.5); and 1.5% among persons of other race/ethnicities (95% CI=1.1–2.7).

Estimated prevalence of diagnosed HIV infection among MSM was lowest in the younger age groups and substantially higher among older MSM: 1.1% (95% CI=0.8–1.7) among those aged 18–24 years; 5.4% (95% CI=4.3–7.3) among those aged 25–34 years; 12.6% (95% CI=10.4–15.9) among those aged 35–44 years; 13.1% (95% CI=10.2–18.3) among those aged 45–54 years; and 8.7% (95% CI=6.2–14.8) among those aged 55–64 years. Diagnosed HIV prevalence levels were geographically clustered (Table 3). The estimated prevalence of diagnosed HIV infection among sexually active MSM in Manhattan was 17.7% (95% CI=14.5–22.8); approximately half of the HIV-infected men with documented histories of MSM in NYC resided in Manhattan. In the other NYC boroughs, the estimated prevalence of diagnosed HIV infection among MSM ranged from 1.8% (Staten Island) to 5.7% (Bronx and Brooklyn).

Sensitivity Analysis

HIV surveillance data underestimate the true number of diagnosed HIV-infected MSM because they do not completely capture risk information for all persons diagnosed with HIV in NYC. Among the 52,932 males aged 18–64 years who had an HIV diagnosis and were known to be living with HIV/AIDS as of the end of 2002, a total of 12,208 (23%) had unknown transmission risk information. An unknown proportion of these males were MSM, resulting in an underestimate of the true prevalence of diagnosed HIV infection among MSM. We conducted sensitivity analyses to investigate the impact of this limitation. MSM constitute 53% (21,449/40,724) of HIV-infected males with known HIV transmission risk information. If MSM constituted either the same proportion of HIV-infected males with unknown transmission risk, or if all HIV-infected males with unknown risk were MSM, this would increase our HIV prevalence estimate from 8.4 to 11.0% (95% CI=9.8–12.5) or 13.2% (95% CI=11.8–15.1), respectively (Table 4).

Surveillance data are also unable to account for HIV-infected persons who have not been diagnosed because they have not been tested for HIV. Nationally, it is estimated that 25% of HIV-infected persons have not been diagnosed and are unaware of their HIV infection.¹⁴ Assuming that 25% of HIV-infected MSM have not been diagnosed, we calculated estimated overall (diagnosed and undiagnosed)

TABLE 3. Estimated prevalence of diagnosed HIV infection among sexually active MSM, number of MSM with diagnosed HIV infection, and estimated number of sexually active MSM, by selected characteristics—New York City, 2002

Characteristics	MSM ^a Diagnosed with HIV infection		Sexually active MSM ^b		Estimated Prevalence of Diagnosed HIV Infection	
	Number	Estimated number ^c	Standard Error	95% CI ^d	Percentage (%)	95% CI ^d
Total	21,449	254,400	16,252	222,546–286,254	8.4	7.5–9.6
Race/ethnicity						
Non-Hispanic white	9,188	105,000	9,583	86,217–123,783	8.8	7.4–10.7
Non-Hispanic black	5,895	46,800	6,741	33,588–60,012	12.6	9.8–17.6
Hispanic	5,959	76,400	9,932	56,933–95,867	7.8	6.2–10.5
Other	407	26,300	5,672	15,183–37,417	1.5	1.1–2.7
Age group (years)						
18–24	477	42,800	7,645	27,816–57,784	1.1	0.8–1.7
25–34	3,657	68,200	9,064	50,435–85,695	5.4	4.3–7.3
35–44	9,285	73,900	7,823	58,567–89,233	12.6	10.4–15.9
45–54	5,934	45,300	6,564	32,435–58,165	13.1	10.2–18.3
55–64	2,096	24,100	5,079	14,145–34,055	8.7	6.2–14.8
Borough of residence						
Bronx	2,592	45,400	8,125	29,475–61,325	5.7	4.2–8.8
Brooklyn	3,898	68,500	7,998	52,824–84,176	5.7	4.6–7.4
Manhattan	11,501	65,000	7,378	50,539–79,461	17.7	14.5–22.8
Queens	3,195	61,000	8,045	45,232–76,768	5.2	4.2–7.1
Staten Island	263	14,700	3,872	7,111–22,289	1.8	1.2–3.7

^aBased on data from the NYC DOHMH HIV/AIDS Surveillance Registry for persons known to be living with diagnosed HIV/AIDS as of December 31, 2002 and reported through April 2005^bBased on data from 2003 NYC Community Health Survey^cEstimated number is rounded to the nearest 100.^dCI Confidence interval

TABLE 4. Range of estimates of the prevalence of HIV infection among MSM based on varying assumptions about HIV transmission risk and undiagnosed HIV infections—New York City, 2002

	MSM ^a diagnosed with HIV infection		Estimated total of HIV-infected MSM ^b		Estimated prevalence of diagnosed HIV infection		Estimated overall prevalence of HIV infection (diagnosed and undiagnosed)	
	Number		Number		Percentage (%)	95% CI ^c	Percentage (%)	95% CI ^c
Current analysis prevalence estimate: assuming 0% of HIV-infected males with unknown transmission risk are MSM	21,449		28,599		8.4	7.5–9.6	11.2	10.0–12.8
Assumption 1: MSM constitute the same % of HIV-infected males with unknown risk as known risk (53%)	27,919 (21,449+6,470)		37,225		11.0	9.8–12.5	14.6	13.0–16.7
Assumption 2: 100% of HIV-infected males with unknown transmission risk are MSM	33,657 (21,449+12,208)		44,876		13.2	11.8–15.1	17.6	15.7–20.2

^aBased on data from the NYC DOHMH HIV/AIDS Surveillance Registry using varying assumptions about HIV transmission risk for HIV-infected males with unknown risk information

^bBased on the assumption that 25% of HIV-infected MSM have not been diagnosed and are not aware of their HIV infection¹⁴

^cCI Confidence interval

prevalence of HIV infection among MSM ranging from 11.2% (95% CI=10.0–12.8) to 17.6% (95% CI=15.7–20.2) (Table 4).

DISCUSSION

This analysis combined two population-based data sources to estimate the prevalence of diagnosed HIV infection among sexually active MSM in NYC. Findings suggest an overall high prevalence of diagnosed HIV infection (8.4%), and sensitivity analyses suggest this to be a conservative estimate. The HIV epidemic in NYC disproportionately affects certain segments of the NYC MSM population, particularly non-Hispanic black MSM and MSM in their late 30s–50s. Significant geographic variability also exists in the prevalence of diagnosed HIV infection among sexually active MSM in NYC, with prevalence estimates by borough of residence ranging from less than 2% in Staten Island to approximately 18% in Manhattan. The high prevalence of diagnosed HIV infection among MSM in NYC is likely due to the combination of high HIV incidence over the course of the epidemic and improved survival in the era of HAART.

The population-based estimates of the prevalence of diagnosed HIV infection among sexually active NYC MSM from our analysis are lower than those resulting from studies conducted among high-risk MSM attending STD clinics or other venues known to be frequented by MSM.^{4–8} Among NYC MSM NHBS participants, the prevalence of HIV infection was 18%⁷, and among NYC MSM participating in YMS I and II, HIV prevalences were 12.1 and 17%.^{5,7} These prevalences are higher than our estimate of the prevalence of diagnosed HIV infection of 8.4%. In the NYC YMS analysis, HIV prevalence was highest among those who were black, Hispanic, or of mixed race/ethnicity and among 20- to 22-year olds.⁵ Our analysis also revealed a high prevalence of diagnosed HIV infection among sexually active non-Hispanic black MSM, but we identified a lower estimated HIV prevalence (1%) among sexually active MSM in the youngest age group (18–24 years). Methodologic differences between the two studies might account for some of the discrepant findings. The YMS study estimated the prevalence of diagnosed and undiagnosed HIV infection based on serologic testing. HIV surveillance can only account for diagnosed HIV infections that are reported to the HIV/AIDS surveillance registry. We accounted for undiagnosed HIV-infected MSM in our sensitivity analyses to compensate for this limitation. Our overall prevalence estimate increased to 11.2–17.6% when the estimated percent of undiagnosed HIV-infected MSM was included. YMS participants were sampled from public venues frequented by MSM and did not include young MSM who do not frequent such venues. Our population-based estimates are not affected by this selection bias.

In a serosurvey conducted in 1999 among persons attending two public NYC STD clinics, 18% of MSM clinic attendees were determined to be HIV-infected.¹⁵ This study was conducted among STD clinic attendees, 60% of whom had an STI diagnosed at the same visit the HIV testing was done, indicating recent unsafe sexual practices and higher risk for HIV infection. Because of the higher risk profile, prevalence estimates based on a serosurvey of MSM attending a public STD clinic are not widely generalizable to the overall NYC MSM population.

The levels of risky behaviors observed in our population-based survey are cause for concern, particularly in light of the high HIV prevalence estimates calculated here. We do not have information on the exact nature of sexual contact or the HIV-status of sexual partners of the MSM in our study population. However,

approximately 60% of sexually active MSM reported that a condom was not used during their last sexual encounter, including over one-third of MSM with three or more sex partners in the past year. One in four MSM reported having had one or more recent STIs. This tendency for unsafe sexual practice is reflected in recently reported increases in *Neisseria gonorrhoeae*¹⁶ and syphilis¹⁷ infections and the emergence of lymphogranuloma venereum¹⁸ among NYC MSM. A case-control study conducted among NYC MSM in 2001 reported that 50% of MSM with primary or secondary syphilis were coinfecting with HIV and had acquired HIV a median of 7 years before their syphilis diagnosis.¹⁹ This finding indicates that risky sexual behaviors are occurring among NYC MSM who are known to be HIV-infected and should have been counseled about reducing risk behaviors.

The number of diagnosed and reported cases of HIV is dependent upon rates of HIV testing. One-third of sexually active MSM reported having been tested for HIV during the past year, and only 46% of MSM with three or more sex partners were tested for HIV during the past year. The prevalence of diagnosed HIV-infection was highest among non-Hispanic black MSM, a racial/ethnic group among whom the prevalence of HIV testing during the previous 12 months was only 38%. Therefore, an even more pronounced racial/ethnic disparity possibly exists in HIV prevalence than our results indicate. Testing rates observed in our study are low, relative to other estimates of HIV testing among MSM. The HIV Testing Surveys are anonymous, cross-sectional interview studies of persons at high-risk for HIV infection.¹⁹ Findings from 2002 HITS indicate that 77% of MSM participants had been tested for HIV in the past 12 months.²⁰ A related survey conducted in NYC during 2000–2002 (HITS-NYC) found that 52% of NYC MSM were tested for HIV during the past year.²¹ Although lower than national estimates, this finding of 52% of MSM reporting having been tested for HIV during the past year is higher than our overall finding of only 34%. As seen with YMS, differences might be the result of the fact that the HITS participants are recruited from venues that are known to be frequented by persons who are at high risk for HIV and are therefore likely to be the focus of HIV prevention and testing programs by community-based organizations.²² However, larger proportions of MSM in certain subgroups, Hispanic (47%), aged 18–24 years (62%), residents of the Bronx (50%), and having more than one sex partner (>46%), reported having been tested for HIV in the past year. These subgroup findings are more consistent with the HITS-NYC result than is our overall finding of 34%.

The findings of this analysis are subject to methodologic limitations. Barriers to obtaining an accurate estimate of the number of HIV-infected MSM from HIV surveillance data include incomplete reporting of HIV transmission risk information to the HIV surveillance system and the presence of undiagnosed cases of HIV-infection. HIV transmission risk information was unknown for almost a quarter of HIV-infected males in our surveillance system as of the end of 2002. An unknown proportion of these males were MSM. In our sensitivity analyses, we calculated HIV prevalence based on varying assumptions regarding what proportion of this population might be MSM. The resulting HIV prevalence estimates ranged from 11–13%. Nationally, an estimated 25% of persons living with HIV infection have not been diagnosed and are unaware of their infection status.¹⁴ These persons are therefore not counted by public health surveillance systems and, consequently, are not included in the numerator of our main analysis. Based on the assumption that 25% of HIV-infected persons have not been diagnosed and are unaware of their HIV infection, resulting adjusted HIV prevalence ranged from 11.2–17.6%.

In contrast, other potential biases might serve to artifactually inflate the prevalence estimate. For example, our prevalence estimate includes all HIV-infected MSM identified through the surveillance registry, whether or not they have been sexually active during the past 12 months. However, the target population derived from the CHS for our prevalence estimate is sexually active MSM only, potentially inflating the estimated prevalence. The estimated number of MSM living in NYC is based on males who reported in a household telephone survey that they had sex with one or more males during the previous 12 months. This excludes MSM who have not been sexually active in the past year, such as those who might have ceased sexual activity when they were diagnosed with HIV to reduce transmission risk or because they were too sick to engage in sexual activity.²³ Also excluded from the survey estimates were males who have been sexually active with another male during the past year but chose not to disclose that information. Lau et al. investigated differences in responses to sensitive sexual behavior questions between the conventional telephone interview and a computerized data collection method and concluded that respondents were more likely to report risk behaviors when responding to the computerized system.²⁴ Reporting bias due to social desirability might underestimate the number of MSM living in NYC, and thus, overestimate the prevalence of diagnosed HIV infection. If underreporting of MSM varied by race/ethnicity, this would also contribute to observed racial/ethnic disparities in estimated HIV prevalence. Finally, the CHS does not sample the entire NYC population. Persons who live in nonresidential settings, such as prisons and college dormitories, and persons who do not have telephone service or who exclusively use cellular phones were not surveyed, thus, limiting ability to generalize these findings to those populations. Although these restrictions limit generalizability, these populations are not represented in comparable surveys providing national estimates of various health indicators, such as the BRFSS.

Despite high HIV prevalence among sexually active NYC MSM, prevalence of condom use and HIV testing are low. One quarter of sexually active MSM reported having a recent STI, an unknown proportion of whom are coinfecting with HIV. The Centers for Disease Control and Prevention emphasizes the incorporation of HIV prevention efforts into the medical care of all HIV-infected persons through provider screening for HIV transmission risk behaviors and STIs, the provision of behavioral risk-reduction interventions, and assistance with partner notification.²⁵ Education and prevention interventions should continue to focus on all MSM in NYC, but particularly those with higher estimated HIV prevalence including those who are non-Hispanic black, aged 35–54 years, and residents of Manhattan. HIV prevention programs should be culturally appropriate and tailored to the needs of the specific target group. Increased awareness of HIV status through frequent testing and safer sex practices among all MSM are essential to reduce transmission of HIV.

Combining data sources provides useful, replicable measures of the prevalence of diagnosed HIV infection among a population at high risk for HIV transmission. Although estimation through use of multiple sources is subject to the limitations described here, the findings are important for ongoing surveillance and targeting resources. Other jurisdictions with large, concentrated HIV epidemics can apply these novel methods to estimate the prevalence of HIV infection among specific at-risk populations such as sexually active persons and injecting drug users and to inform HIV education and prevention programs.

DISCLAIMER

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

Conflict of Interest Statement

We declare that we have no conflicts of interest.

REFERENCES

1. Glynn M, Rhodes P. Estimated HIV prevalence in the United States at the end of 2003. Presented at: 2005 National HIV Prevention Conference; June 12–15, 2005, Atlanta, GA.
2. Centers for Disease Control and Prevention. *A Glance at the HIV/AIDS Epidemic*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2005. Available at: <http://www.cdc.gov/hiv/PUBS/Facts/At-A-Glance.htm>. Accessed on: March 15, 2005.
3. Centers for Disease Control and Prevention. *HIV Prevalence Trends in Selected Populations in the United States: Results from National Serosurveillance, 1993-1997*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2001:1–51.
4. Valleroy LA, MacKellar DA, Karon JM, et al. HIV prevalence and associated risks in young men who have sex with men. *JAMA*. 2000;284:198–204.
5. Koblin BA, Torian LV, Guilin V, et al. High prevalence of HIV infection among young men who have sex with men in New York City. *AIDS*. 2000;14:1793–1800.
6. Centers for Disease Control and Prevention. HIV incidence among young men who have sex with men—seven U.S. cities, 1994–2000. *MMWR Morb Mortal Wkly Rep*. 2001;50:440–444.
7. New York City Department of Health and Mental Hygiene. HIV prevalence and risk factors among men who have sex with men in New York City: Results from the National HIV Behavioral Surveillance (NHBS). Available at: http://home2.nyc.gov/html/doh/downloads/pdf/dires/msm_riskbehavior_102105.pdf. Accessed on: August 22, 2006.
8. Centers for Disease Control and Prevention. Human immunodeficiency virus (HIV) risk, prevention, and testing behaviors—United States, National HIV Behavioral Surveillance System: Men who have sex with men, November 2003–April 2005. *MMWR Morbid Mortal Wkly Rep*. 2006;SS06:1–16.
9. New York City Department of Health and Mental Hygiene. HIV Surveillance and Epidemiology Program quarterly report, July 2003. Vol. 1, No. 4. Available at: <http://www.nyc.gov/html/doh/downloads/pdf/dires/qtr4-2003.pdf>. Accessed on: March 20, 2005.
10. Nash D, Katyal M, Shah S. Trends in predictors of death due to HIV-related causes among persons living with AIDS in New York City: 1993–2001. *J Urban Health*. 2005;82:584–600.
11. Nash D, Bennani Y, Ramaswamy C, et al. Estimates of HIV incidence among persons testing for HIV using the sensitive/less sensitive enzyme immunoassay, New York City, 2001. *JAIDS*. 2005;39:102–111.
12. Centers for Disease Control and Prevention. Implementation of named HIV reporting—New York City, 2001. *MMWR Morbid Mortal Wkly Rep*. 2004;52:1248–1252.
13. New York City Department of City Planning, Population Division, Demographic tables. Available at: http://www.nyc.gov/html/dcp/html/census/demo_tables.html. Accessed on: March 15, 2005.
14. Fleming P, Byers RH, Sweeney PA, et al. HIV prevalence in the United States, 2000. Presented at: 9th Conference on Retroviruses and Opportunistic Infections; 2002; Seattle, Washington.

15. Torian LV, Makki H, Menzies IB, et al. HIV infection in men who have sex with men, New York City Department of Health sexually transmitted disease clinics, 1990–1999: a decade of serosurveillance finds that racial disparities and associations between HIV and gonorrhea persist. *Sex Transm Dis.* 2002;29:73–78.
16. Centers for Disease Control and Prevention. Increases in fluoroquinolone-resistant *Neisseria gonorrhoeae* among men who have sex with men—United States, 2003, and revised recommendations for gonorrhea treatment, 2004. *MMWR Morb Mortal Wkly Rep.* 2004;53:335–338.
17. Centers for Disease Control and Prevention. Primary and secondary syphilis among men who have sex with men—New York City, 2001. *MMWR Morb Mortal Wkly Rep.* 2002;51:853–856.
18. New York City Department of Health and Mental Hygiene, Press Release, February 2, 2005. Two New York City residents diagnosed with rare sexually transmitted infection; same strain found in Europe. Available at: <http://www.nyc.gov/html/doh/html/public/press05/pr011-05.html>. Accessed on: April 20, 2005.
19. Paz-Bailey G, Meyers A, Blank S, et al. A case-control study of syphilis among men who have sex with men in New York City: association with HIV infection. *Sex Transm Dis.* 2004;31:581–587.
20. Centers for Disease Control and Prevention. HIV Testing Survey, 2002. HIV/AIDS Surveillance Special Report - Number 5. Available at: http://www.cdc.gov/hiv/topics/surveillance/resources/reports/2004spec_no5/default.htm. Accessed on: April 20, 2005.
21. New York City Department of Health and Mental Hygiene. HIV Surveillance and Epidemiology Program quarterly report, July 2003. Vol. 1 No. 3. Available at: <http://www.nyc.gov/html/doh/downloads/pdf/dires/qtr3-2003.pdf>. Accessed on: April 20, 2005.
22. Kellerman SE, Lehman JS, Lansky A, et al. HIV testing within at-risk populations in the United States and the reasons for seeking or avoiding HIV testing. *JAIDS.* 2002;31:202–210.
23. Centers for Disease Control and Prevention. Adoption of protective behaviors among persons with recent HIV infection and diagnoses—Alabama, New Jersey, and Tennessee, 1997–1998. *MMWR Morb Mortal Wkly Rep.* 2000;49:512–515.
24. Lau JTF, Tsui HY, Wang QS. Effects of two telephone survey methods on the level of reported risk behaviors. *Sex Transm Infect.* 2003;79:325–331.
25. Centers for Disease Control and Prevention. Incorporating HIV prevention into the medical care of persons living with HIV: recommendations of CDC, the Health Resources and Services Administration, the National Institutes of Health, and the HIV Medicine Association of the Infectious Diseases Society of America. *MMWR Morb Mortal Wkly Rep.* 2003;52 (No. RR-12):1–24.