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_____ _____

Johanna Chapin Date

HIV testing among men who have sex with men in Puerto Rico

By

Johanna Chapin

MPH

Global Epidemiology

_____ [Chair's signature]

Travis Sanchez, DVM, MPH

Committee Chair

_____ [Chair's signature]

Patrick S. Sullivan, DVM, PhD

Committee Chair

_____ [Member's signature]

Gabriela Paz-Bailey, MD, PhD

Committee Member

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By

Johanna Chapin

Bachelor of Arts
Johns Hopkins University
2008

Thesis Committee Chairs:
Travis Sanchez, DVM, MPH
Patrick Sullivan, DVM, PhD

An abstract of
A thesis submitted to the Faculty of the
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Abstract

HIV testing among men who have sex with men in Puerto Rico

By: Johanna Chapin

Background: Regular HIV testing has been widely supported as a key strategy to increasing awareness of HIV status, linking HIV-infected individuals to care, and preventing the ongoing transmission of HIV among MSM. While studies have investigated HIV testing for Hispanic MSM in the U.S. mainland, limited research has considered HIV testing practices of MSM in U.S. dependent areas such as Puerto Rico.

Objective: This study aimed to identify demographic and behavioral risk factors that are associated with not receiving an HIV test in the last 12 months among MSM in Puerto Rico.

Methods: As part of the National HIV Behavioral Surveillance system, venue-based, time-space sampling was used to recruit men in 2011. Men were interviewed and tested for HIV infection in 21 U.S. cities. Associations between participant characteristics and not having been tested for HIV in the last 12 months were determined through multivariate logistic regression.

Results: In total, 350 participants who self-reported negative or unknown HIV status during their NHBS survey were considered. Overall, 53% had not been tested for HIV in the last 12 months. Those who had fewer male partners in the last 12 months, had not visited a medical provider in the last year, had not told a health provider that they were attracted to men, and/or had not used non-injection drugs in the last year all had increased odds of not receiving an HIV test in the last year. Having fewer partners in the last 12 months (AOR(1 vs. $\geq$4)=2.7, 95% CI: 1.5, 5.0) and having not told a health provider that they were attracted to men (AOR=2.0, 95% CI: 1.3, 3.2) were significantly associated with not receiving an annual HIV test after adjusting for age, education, and type of health insurance.

Conclusion: MSM in Puerto Rico who had fewer sex partners and/or had not disclosed male-male attraction to a health care provider were more likely to have not been HIV tested in the last year. Future interventions should promote annual HIV testing for all MSM including those with fewer sex partners. HIV testing initiatives should also aim to improve patient-provider communication.

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CHAPTER I: A REVIEW OF THE LITERATURE

The current HIV epidemic in MSM the United States

In the United States, approximately 1.1 million individuals are currently living with the human immunodeficiency virus (HIV) and nearly 50,000 individuals are newly infected with the virus each year (1, 2). New infections are predominantly concentrated in high-risk populations including men who have sex with men (MSM), injection drug users (IDU), and high-risk heterosexuals. Though HIV prevalence and incidence remain elevated in each of these groups, a reemergence of new HIV infections among MSM has been observed in the last decade and has continued in recent years with the majority of current and new infections attributed to male-to-male sexual contact (3, 4).

While MSM total to approximately 4% of the U.S male population, they represent over half of all individuals living with an HIV infection in the country (1, 5). In 2008, the National HIV Behavioral Surveillance System (NHBS) conducted its second cycle among MSM in 21 participating U.S. cities. NHBS reported an HIV prevalence among MSM of 19% (6). From 2008 to 2010, new HIV infections in MSM rose by 12%, with male-to-male sexual transmission accounting for 63% of new HIV infections in 2010 (2). The high prevalence and incidence of HIV infection in the MSM community indicates that efforts are greatly needed to understand both why the epidemic continues to increase and how to better target prevention strategies in this population.

HIV infection among Hispanic MSM

Significant racial disparities in HIV infection exist in the U.S., with blacks and Hispanics sharing a disproportionate burden of HIV cases. While Hispanics make up about 16% of the total U.S. population, they accounted for 21% of new HIV infections in 2010 (2). In addition, Hispanics had an incidence rate of 27.5 per 100,000 persons—over three times that of whites during the same year (2).

Hispanic MSM are at particularly high risk for acquiring HIV/AIDS. Fifty-seven percent (57%) of infections among all Hispanics were attributed to male-to-male sexual transmission in 2009 (7). Hispanic men specifically experience nearly three times the rate of new HIV infections compared to white men, and male-to-male sexual contact represents close to 80% of new HIV infections among Hispanic men (2, 6, 8).

Recent literature on HIV in Hispanics has emphasized the importance of studying Hispanics separately based on their geographical differences. Hispanic MSM in Puerto Rico, for example, have been shown to vary significantly in rates of HIV incidence and HIV-to-AIDS intervals in comparison to Hispanic MSM in the U.S. mainland (9). In 2006, the HIV incidence rate for males in Puerto Rico was 45.0 per 100,000 population, almost twice that of mainland U.S. males and 1.5 times that of mainland U.S. Hispanic males (10). Several studies have investigated the HIV epidemic among Hispanic MSM in the U.S. mainland, however few research studies have been conducted to understand the epidemic in U.S. dependent areas such as Puerto Rico.

HIV Infection among Hispanic MSM in Puerto Rico

Research on HIV in Puerto Rico has traditionally focused on injection drug use (IDU) which accounts for 40% of prevalent HIV cases among males in the country (10). However, male-to-male sexual contact follows closely, estimated to account for 30% of prevalent cases among men (10). Little has been published about the epidemic among MSM, though case surveillance data has shown that from 2005 to 2007, HIV cases due to IDU decreased by 3.4% while cases due to male-to-male sexual contact increased by 9.1% (11, 12).

In a study conducted through the University of Puerto Rico School of Public Health in 2011 at a clinic that provides HIV treatment, 30.4% of men interviewed reported having had a male-to-male sexual encounter at least once in their lifetime, and of those, about 20% had had either receptive or insertive unprotected anal intercourse (UAI) (13). History of sexually transmitted infections (STI) was also found to be high, with self-reported diagnoses of syphilis

(30.8%), gonorrhea (16.5%), genital warts (14.3%), and herpes (14.3%) (13). Self-reported HIV was also very high (50.5%) given the study site was at a clinic that readily provides HIV treatment (13). Nonetheless, recent sexual activity in the last 90 days was common in over half of HIV-positive MSM, with 10-15% engaging in unprotected anal sex (13). Investigators at the University of Puerto Rico also conducted a secondary data analysis of a household survey of the adult population, and found that 6.4% of men in the general population reported ever having sex with another man, of which about 42% reported an early age of sexual debut (<15 years) and 61% reported having at least 10 sexual partners in their lifetime (11).

Behavioral surveillance data for Puerto Rico from the National HIV Behavioral Surveillance (NHBS) system operated by the CDC report that from the NHBS-MSM1 cycle in 2005 to the NHBS-MSM2 cycle in 2008, ***unprotected anal sex increased from 43% to 63% and from 23% to 42% for main and casual male partners respectively, while HIV testing in the past 12 months decreased from 79% to 52%*** (14, 15). Other notable risk behaviors in the most recent surveillance report included that 14% of MSM sampled in Puerto Rico had sex with both male and female partners in the last 12 months and just over 60% reported binge drinking in the last 30 days (14).

As the percentage of MSM in Puerto Rico receiving an annual HIV test is reportedly decreasing yet MSM in this context are increasingly engaging in unprotected sex, further research is warranted to identify current HIV testing practices as well as better understand demographic and behavioral factors associated with HIV risk and the use of prevention services including HIV testing in this population.

Lack of awareness of HIV status among Hispanic MSM

Approximately 20% of people living with HIV in the U.S. today are unaware of their HIV infection (16). Through mathematical modeling, it is estimated that this 20% of unaware HIV-positive individuals account for 49% of HIV transmissions across the country (17). In a national study conducted by the CDC among MSM, 44% of participants were unaware of their

HIV infection, and of these, 55% had not been tested for HIV in the last year (6).

Undiagnosed infection has several important implications for HIV prevention. HIV-positive individuals who are unaware of their HIV infection are more likely to experience illness and premature death since they are not engaging in timely and appropriate care to treat the infection early in its development (18). Undiagnosed infections that continue for a period of time and are finally diagnosed late into the disease can greatly increase the chances of an AIDS diagnosis soon after, as patients are unable to make lifestyle choices or uptake therapies that would prevent them from progressing quickly to AIDS (18). In addition, persons unaware of their infection likely have higher viral loads that increase the probability of transmitting the virus to others (19). Furthermore, because individuals are unaware of their infection, they may continue to engage in high-risk sexual behaviors or may communicate to partners that they are HIV-negative and make less safe decisions about the use of prevention methods (20). In fact, research has shown that individuals aware of their HIV-positive status are much less likely to engage in unprotected sex than those unaware of their HIV infection (20).

Because undiagnosed infections can have significant consequences on one's general health and life expectancy and can increase the likelihood of unknowingly transmitting the virus to others, identifying infections early in their progression is vital to protecting the health of individuals at risk and promoting HIV prevention at the population level. Early diagnosis can be obtained through regular HIV testing in order to detect HIV infection and connect individuals to proper and timely care. HIV testing not only provides an opportunity for individuals to become aware of their HIV status, but also offers risk counseling, even for HIV-negative individuals, to help identify high-risk behaviors, provide prevention education, and develop action steps towards safer sex behaviors that aim to reduce the individual's risk of an HIV diagnosis (21, 22).

In the revised HIV/STD clinical guidelines that were released in 2006, the Centers for Disease Control and Prevention (CDC) reiterated their formal recommendation for annual HIV testing for MSM in an effort to curb the spread of HIV in this vulnerable population (23). This federal recommendation was essential in setting a standard for HIV prevention, communicating

the importance of testing to members of the MSM community, and holding health providers accountable for ensuring regular HIV testing for MSM patients. Recently, new research may in fact provide evidence to support updated recommendations for more frequent HIV testing among MSM at 3 or 6-month intervals due to the large percentage of MSM who are unaware of their HIV status despite current testing recommendations (24, 25).

Among the Hispanic MSM community, national HIV case surveillance data from 2008 demonstrated that 23% of Hispanic MSM have an undiagnosed HIV infection (16). Another earlier study of MSM showed that 69% of Hispanics diagnosed as HIV-positive were unaware of their HIV infection (26). Hispanics also tend to be diagnosed later into infection, hindering individuals from being linked to the proper medical services needed to delay the progression of advanced disease and prevent co-morbidities and mortality. Of note, 58% of AIDS cases among Hispanics occurred within one year of their HIV diagnosis (27). This short HIV-to-AIDS interval for Hispanics has been observed in other research studies as well, indicating that there are unique delays in HIV testing that Hispanics experience (7). Late HIV testing could reflect insufficient health care for Hispanics, preventing them from getting tested regularly or from starting antiretroviral medications early enough to reduce viral loads and improve their overall health outcomes (7). Low knowledge about HIV transmission as well as low perceived risk may also contribute to late HIV testing (28).

Specifically for MSM in Puerto Rico, alongside decreasing HIV testing practices, the latest NHBS HIV Surveillance report noted that 72% of MSM in Puerto Rico who had a positive HIV test during the NHBS survey were unaware of their HIV infection (6). Data also showed that about 52% of respondents had been tested for HIV in the last year (14). This high percentage of men unaware of their HIV infection combined with the low level of annual HIV testing indicate that more information is needed to understand testing practices of MSM in Puerto Rico as well as the structural and cultural barriers that inevitably hinder the use primary prevention services such as HIV testing and counseling.

Potential Barriers to HIV prevention and testing for MSM in Puerto Rico

Based on previous literature, there are many important factors to consider in analyzing HIV testing data. Potential predictors of HIV testing in the last 12 months that have been previously identified for MSM in general include demographics such as age, education, race, sexual identity, health insurance, and household income (14). Factors associated with intention to test in the next year were similar, along with attendance of an in-person HIV-prevention session, use of non-injection drugs, number of sex partners in the last 12 months, and UAI with a male partner in the past 12 months (29). In addition, it has been documented that predictors of repeat testing among MSM include being very comfortable about sexual attraction to men, informing nearly all persons about sexual identity, having one or more steady partners, having one or more exchange partners, having one or more HIV-positive partners in the last 6 months, engaging in UAI with partners of unknown HIV status, having been under the influence of drugs during sex, as well as being first tested for HIV within one year after their first anal sex encounter (30). Main reasons for not getting HIV tested in other literature has included a fear of testing positive, structural barriers such as lack of awareness of HIV testing services, and low perceived risk (29).

Specifically for Hispanics and Hispanic MSM, factors that have been shown to affect HIV testing practices include healthcare access and access to HIV testing, low levels of HIV knowledge, low self-perception of HIV risk, geographic mobility, country of origin, survey venue, and sexual risk behaviors (28, 29). Among Hispanic MSM, being unaware of a positive HIV infection has been significantly associated with being bisexual, having UAI with casual partners in last 3 months, having a high perceived risk of testing positive, and believing that sex with men of the same race/ethnicity reduced one's risk of HIV infection (31). These variables are closely related to issues of recent HIV testing and will be considered inasmuch as possible in the proposed analysis.

Important characteristics of Hispanic culture and Judeo-Christian religion may further contribute to HIV risk and lower the uptake of prevention efforts for Hispanic MSM in Puerto Rico (32). The values of the Catholic Church and legacy of *machismo* still rooted in traditional

Hispanic culture have widely condemned homosexuality and bisexuality causing homosexual behavior and identity to remain an issue of much tension and stigma, particularly in regions that still maintain strong cultural ties to the Christian religion and traditional Hispanic gender roles (33). Internalized homonegativity, also called homophobia, can be defined as the "lack of positive beliefs about being gay, about valuation of the gay community, and about the morality of being gay," and can result in feelings of stigmatization, discrimination, and oppression among Hispanic MSM (34-36). Research on homophobia and shame felt by Hispanic MSM has further demonstrated that not only does stigma disempower an individual's interaction with other people in his society, but may also reduce his sense of self-worth and lead to higher sexual risk taking (37, 38). In addition, male-to-male sexual behavior may not necessary reflect homosexual identity among Hispanic men who experience homophobia in their family or neighborhoods (39, 40). Men who have sex with men may also engage in sex with women to identify with acceptable gender roles and uphold a sense of masculinity (or *machismo*) in Hispanic Puerto Rican culture (40). Therefore while HIV prevention services may target popular locations known for attracting homosexual men, these efforts may neglect the diversity of men who have sex with men who do not identify as gay and/or self-identify as heterosexual or bisexual (39). With this in consideration, research and prevention interventions must account for varying gay and non-gay sexual identities that could play a part in prevention-seeking behaviors.

Stigma associated with homosexual behavior may also contribute to MSM not seeking out prevention services, HIV testing, or needed treatment from their health care provider. Even those attending medical consultations may choose to not disclose their sexual orientation or sexual behavior to their provider out of fear of mistreatment or discrimination, or their provider may choose to not ask about these risk factors, resulting in missed opportunities for testing and primary prevention (41-43).

In Puerto Rico, stigma against homosexuality also likely discourages men to discuss their sexual practices in fear of discrimination. This lack of openness about sexual behaviors may negatively hinder the ability of men to have conversations about condom use or HIV status with

partners, seek services like HIV testing in facilities where they may be recognized, or disclose their sexual behavior or HIV status to physicians that provide health-related services (32, 41, 44). Recent literature on stigma and patient-provider relationships with people living with HIV/AIDS in Puerto Rico also found high levels of stigma and emphasized the role of religion in conversations about prevention and treatment between patients and their providers (32). Therefore, stigma and discrimination associated with both HIV/AIDS and engaging in homosexual behavior may dually affect health-care seeking behaviors and testing practices in which MSM choose to participate in Puerto Rico.

Other challenges that may thwart efforts to provide HIV prevention to MSM in Puerto Rico include that the primary language is Spanish, yet many health education programs or research tools found to be effective are not translated into Spanish nor tailored to the Hispanic community, moreover to the Hispanic MSM community in Puerto Rico (45). This lack of relevant resources could lead to low knowledge about HIV and low perceived risk, which in turn, could decrease HIV testing behaviors (28, 46).

Complex and dynamic factors that incorporate culture, religion, sexual identity, access to resources, and many other determinants confront both public health entities and the Hispanic MSM community in Puerto Rico that aim to decrease HIV prevalence and incidence rates in this region. While challenging, these complex issues must first be acknowledged and understood, as a context for developing effective HIV prevention strategies for MSM in Puerto Rico.

Summary

The large burden of HIV infection in Hispanics—and predominantly in Hispanic MSM—warrants further research to explore specific factors associated with HIV infection and prevention practices in this ethnic group. With at least one in five Hispanic MSM living with an undiagnosed HIV infection in the U.S., initiatives to understand HIV testing behaviors among Hispanic MSM are much needed. Previous studies have also encouraged future research to study issues surrounding HIV testing specific to subpopulations or geographic regions to which

Hispanic MSM belong, as the diversity of the Hispanic community could reveal important differences in how to approach HIV testing and linkage to care services in distinct subgroups or geographic locations (9).

For MSM in Puerto Rico, there has been a lack of information collected and analyzed on this group, as the epidemic has historically focused on injection drug users. Current research on HIV testing in this population has been limited in scope, as it has only incorporated qualitative research approaches and only been applied to the context of the medical field. Main findings of these studies have discussed the relevance of HIV/AIDS-related stigma in the patient-provider relationship but has not focused specifically on men who have sex with men (32). Therefore, research that uses quantitative data and considers other factors such as behavioral risk factors that establish the need for recent HIV testing must be explored. As HIV cases are increasing for MSM on the island yet testing practices appear to be decreasing, understanding current testing practices and risks behaviors as well as identifying barriers and contextual factors associated with HIV testing is critical to developing targeted prevention strategies that will reduce HIV transmission among this population at increased risk.

To our knowledge, the only current quantitative data on HIV testing practices specifically among MSM in Puerto Rico are collected through the National HIV Behavioral Surveillance system at CDC (47). To date, there have not been specific analyses on predictors of HIV testing within this subpopulation in Puerto Rico, therefore this analysis will provide insight about factors associated with not receiving an HIV test in the last 12 months as recommended by the CDC, using the most recent NHBS-MSM3 cycle. Overall, this study aims to inform national, regional, and local health systems about HIV-related outcomes among MSM in Puerto Rico in order to better describe the epidemic and tailor prevention efforts for this population.

CHAPTER II: A MANUSCRIPT

INTRODUCTION

In the United States, approximately 1.1 million individuals are currently living with the human immunodeficiency virus (HIV) and nearly 50,000 individuals are newly infected with the virus each year (1, 2). The majority of current and new infections are concentrated in high-risk populations, especially men who have sex with men (MSM). While MSM total to 4% of the U.S male population, they represent over half of all individuals living with an HIV infection in the country (1, 5). In 2008, HIV prevalence among MSM was 19%, demonstrating that MSM remain one of the most at-risk groups in the United States (6). From 2008 to 2010, new HIV infections in MSM rose by 12%, with male-to-male sexual transmission accounting for 63% of new HIV infections (2).

Significant racial disparities in HIV infection exist in the U.S., with blacks and Hispanics sharing a disproportionate burden of HIV cases. While Hispanics make up about 16% of the total U.S. population, they accounted for 21% of new HIV infections in 2010 (2). Hispanic MSM are at particularly high risk for acquiring HIV/AIDS. Fifty-seven percent (57%) of infections among all Hispanics were attributed to male-to-male sexual transmission in 2009 (7). Hispanic men experience nearly three times the rate of new HIV infections compared to white men, and male-to-male sexual contact represents close to 80% of incident infections among Hispanic men (2, 6, 8). The large burden of HIV infection in Hispanics—and predominantly in Hispanic MSM—warrants further research to explore specific factors associated with HIV infection and prevention practices among MSM in this ethnic group.

While many studies have investigated the HIV epidemic among Hispanic MSM in the U.S. mainland, limited research has been done to understand the epidemic among MSM in U.S. dependent areas such as Puerto Rico. In 2006, the HIV incidence rate for males in Puerto Rico was 45.0 per 100,000 population, almost twice that of mainland U.S. males and 1.5 times that of mainland U.S. Hispanic males (10). Recent literature has encouraged future analyses of

Hispanics to consider geographic differences in assessing HIV risk and testing behaviors (9). Therefore, greater understanding is needed to identify factors associated with this increased risk of HIV infection specifically among males in Puerto Rico.

Research on HIV in Puerto Rico has traditionally focused on injection drug use (IDU) which accounts for 40% of prevalent HIV cases among males in the country (10). However, male-to-male sexual contact follows closely, estimated to account for 30% of prevalent cases among men (10). Little has been published about the epidemic among MSM, though case surveillance data has shown that from 2005 to 2007, HIV cases due to IDU decreased by 3.4% while cases due to male-to-male sexual contact increased by 9.1% (11, 12). Data from the National HIV Behavioral Surveillance (NHBS) system for Puerto Rico report that from the NHBS-MSM1 cycle in 2005 to the NHBS-MSM2 cycle in 2008, unprotected anal intercourse (UAI) increased from 43% to 63% and from 23% to 42% for main and casual male partners respectively, while HIV testing in the past 12 months decreased from 79% to 52% (14, 15).

Alongside decreasing HIV testing practices, the latest NHBS report noted that 72% of MSM in Puerto Rico who had a positive HIV test at their NHBS study visit were unaware of their HIV infection, suggesting that initiatives to increase regular testing practices and eliminate structural and cultural barriers to HIV testing may be greatly needed (6). Current recommendations from the Centers of Disease Control and Prevention (CDC) propose HIV testing every 12 months for sexually active MSM and perhaps even more frequent testing for MSM engaging in high-risk sexual behaviors (23-25). With a high percentage of unaware infections and only about half of respondents reporting receiving an HIV test in the last year, additional research is still needed to identify gaps in current testing practices as well as understand the factors that influence HIV testing uptake in this population.

Important characteristics of Hispanic culture and Judeo-Christian religion may further contribute to HIV risk and prevention efforts for MSM in Puerto Rico (32). Stigma and discrimination associated with homosexuality and bisexuality may affect the testing and risk

behaviors in which MSM in Puerto Rico engage, and will therefore be considered in this analysis (44).

Overall, this study seeks to identify predictors of not HIV testing in the last 12 months among MSM in Puerto Rico. We aim to inform national, regional, and local health systems about HIV-related outcomes among MSM in Puerto Rico in order to better describe the epidemic and tailor prevention efforts for this population.

METHODS

Study design and setting

This study utilized a cross-sectional study design as part of the National HIV Behavioral Surveillance system at the Centers for Disease Control and Prevention. The data came from the the third round of the NHBS study conducted in 2011 among MSM in the United States and Puerto Rico, referred to as NHBS-MSM3. The study site of interest was the metropolitan statistical area (MSA) of San Juan, Puerto Rico, with research operations carried out by NHBS staff and the Department of Health in Puerto Rico.

Sampling Design and Formative Research

Subjects were recruited using venue-based sampling, a version of time-location sampling that is commonly used to study hard-to-reach populations (48). This sampling method requires identifying venues commonly visited by MSM and determining the best day-time periods to sample the population at the chosen venues (called Venue Day-Time periods, or VDTs) each month (14). Formative research was conducted by local NHBS staff in 2010 to identify an exhaustive list of San Juan venues that MSM frequented (49). Venues represented bars, dance clubs, social organization events, sex establishments, restaurants, street locations, retail businesses, parks or beaches, fitness clubs, gay pride or similar events, or other popular locations where MSM spend time. The formative research included key informant interviews, focus groups, and street-side surveys in order to identify ideal venues that would both allow for a sufficient amount of MSM to be potentially recruited as well as represent the broad diversity of the MSM population.

Recruitment

Staff recruiters at the venue locations followed a detailed protocol in order to engage male venue attendees into the screening process. Males who crossed a designated boundary and

were perceived as eligible were then approached by a recruiter who introduced himself, informed the male passer-byer about the study, and provided the option for the individual to participate. If an individual accepted the invitation to participate, the recruiter then escorted the male participant to a nearby private location where an NHBS interviewer conducted the official eligibility screening and the informed consent process with the participant. If still eligible and willing to consent to the survey, the participant then completed the survey interview and had the option to also participate in the HIV testing procedures. Men were considered eligible according to the following criteria:

- Has not participated previously in NHBS-MSM3
- Is at least 18 years of age
- Was male sex at birth and self-identifies as male (not transgender)
- Has ever had oral or anal sex with another man
- Is a resident of the San Juan, Puerto Rico MSA
- Is able to complete the interview in English or Spanish

Data collection

Trained interviewers used handheld computers to administer a questionnaire that included questions about demographics, sexual risk behaviors, use of prevention services, HIV/STI testing history, alcohol and drug use, health conditions, and other issues related to HIV/AIDS. Anonymous HIV testing was offered to all participants regardless of self-reported HIV infection status. Blood or oral specimens were collected for either conventional laboratory testing or rapid testing in the field followed by laboratory confirmation. HIV-positive individuals were linked to care. Participants were compensated $25 in cash if they completed the survey interview and $50 in cash if they completed both the survey interview and the HIV test.

Ethical Considerations

Activities for NHBS-MSM3 were approved by the CDC as non-engaged research and by the Institutional Review Boards (IRB) at the Ministry of Health in Puerto Rico and the University of Puerto Rico-San Juan to conduct the NHBS-MSM3 study. The data provided for this analysis was unlinked and anonymous and accessible only through data secure servers physically located at the CDC. Therefore the Emory IRB provided written agreement via email supporting that this analysis was exempt.

In addition to data quality assurance taking place during interviews and recruitment events, each project site had a principal investigator, project coordinator, and field supervisor that were required to oversee data collection and monitor study staff performance to ensure the safety, security, reliability, and confidentially of NHBS data and study activities. The responsibilities of the NHBS-MSM3 staff and standardized study procedures were outlined in the NHBS-MSM3 Operations Manual and Protocol and ongoing training documents in order to uphold the highest standards of client confidentiality and data security. The standardized questionnaire and in-depth training of interviewers contributed to ensuring data quality and consistency. Prior to data analyses, any further data cleaning and de-identification of the data was performed by NHBS data analysts.

Data Analysis

Study subjects

The target sample size for this study was 500 eligible males who reported having sex with another man in the last 12 months. A total of 668 males were approached by recruiters to determine their eligibility to enroll in the study. Of these, 395 (59.1%) males were eligible to participate. Of those eligible, 364 male participants consented to the study and had valid responses for the survey and testing study components.

This data analysis aimed to identify factors associated with not receiving an HIV test in the last 12 months among MSM in Puerto Rico. Therefore, five (5) respondents who did not

provide a valid answer or had missing data for the outcome variable of interest were not included. Of note, one participant who was unaware HIV-positive was excluded from this analysis because he had missing data for the outcome variable of HIV testing in the last 12 months. In addition, because annual HIV testing has been considered as a form of HIV prevention for those who report being HIV-negative or do not know their HIV status, nine (9) individuals who self-reported being HIV-positive and were confirmed HIV-positive through NHBS HIV testing were not included in this analysis. Twenty-four (24) participants who reported being HIV-negative or of unknown HIV status but tested positive for HIV at the NHBS event were considered unaware HIV-positives and were included in this analysis. Combining these 24 unaware HIV-positive participants with the nine self-reported HIV-positive participants and the one unaware HIV-positive participant who did not answer the outcome variable, the estimated HIV prevalence was 9%. After these considerations, the final sample size for this analysis consisted of 350 subjects (n=350).

Measures

The main outcome variable of not receiving an HIV test in last 12 months was dichotomized as a yes/no binary variable. Factors related to HIV testing were procured through the literature on this topic. Predictor variables that were considered included: age, education, type of health insurance, income, employment status, sexual identity (homosexual, heterosexual, bisexual), recruitment venue, visited health care provider in the last 12 months, diagnosed with an STI in the last 12 months (any, syphilis, chlamydia, gonorrhea, other), age of sexual debut, age of sexual debut with a male, number of male partners in the last 12 months, UAI with a male in the last 12 months, having a female partner in the last 12 months, use of internet to meet friends or sexual partners, incarceration, non-injection drug use, injection drug use, current alcohol use (at least one alcoholic beverage in last 30 days), current heavy alcohol use (two or more alcoholic beverages per day on average in last 30 days), and current binge alcohol use (more than five alcoholic beverages at one sitting in last 30 days), alcohol or drug use during last sexual

encounter, partnership type of last male sexual partner (main, casual, exchange), age of last male sexual partner, HIV status of last male sexual partner, disclosure of being attracted to or having sex with men to various types of individuals (anyone, gay friends, non-gay friends, family, spouse/partner, and/or health care provider), experience of discrimination in last 12 months (any, through verbal insults, poorer services, unfair treatment at work/school, lower health care, and/or physically injured), and perceived stigma of gays and bisexuals.

Other variables reflecting the use of prevention services were described but not considered predictors in the HIV testing multivariate analysis due to the possible overlapping reach of prevention services. These included if participants were tested for syphilis in the last 12 months, received free condoms in the last 12 months, received an individual or group HIV prevention intervention, and participated in an alcohol or drug treatment program.

Modeling Strategy

Descriptive, bivariate, and multivariate analyses were carried out to consider the associations between the predictor variables and the outcome of not HIV testing in the last 12 months. An additional bivariate analysis was also carried out to consider the relationship between prevention services and HIV testing. SAS 9.3 software was used to conduct the described data analyses.

Literature on venue-based sampling supports the practice of weighting observations based on the counts of men frequenting the venues during the randomly assigned VDTs in order to take into consideration bias from the convenient sampling design (48, 50, 51). However, due to limited resources, current changes on weighting procedures for NHBS data, and difficulty in collecting this information accurately at the field locations, weighting was not performed for this analysis. Since the design of this study was cross-sectional and the outcome variable was binary, this analysis used logistic regression methods based on the binomial distribution and reported adjusted odds ratios (ORs) as the measures of association.

For the univariate analyses, crude counts and prevalence percentages were reported for each independent variable. In the bivariate analysis for HIV testing, chi-square tests were performed and 95% confidence intervals and p-values were reported. For variables that observed small cell counts below 5, Fisher's exact tests were performed in place of approximated chi-square tests. Because the number of potential predictor variables exceeded an appropriate number to run the multivariate model, a method for starting with a more parsimonious multivariate model was required. Variables that showed significance at the 0.10 alpha level during the bivariate analyses were considered in the multivariate regression model. An alpha level of 0.10 was chosen as a conservative threshold in order to include the variables most likely to have an association with the outcome and avoid excluding potentially relevant factors.

In addition to variables significantly associated with the outcome at the bivariate level, age, education, and health insurance were retained in the model based on existing literature supporting their association with HIV testing. All two-way interaction terms between the remaining independent variables were also considered in the initial model. Multicollinearity was then assessed using the collinearity macro for logistic regression and thresholds of 30 for the conditional index (CI) and 0.50 for variance decomposition proportions (VDPs). Subsequently, the remaining interaction terms were evaluated by conducting an overall Likelihood Ratio test, and then performing backwards elimination to drop non-significant interaction terms. Confounding was then assessed through considering all possible model combinations and Hosmer-Lemeshow goodness-of-fit tests were carried out to determine model fit for the possible models, which led to the selection of the final model. Adjusted odds ratios (AORs) along with 95% confidence intervals and their corresponding p-values were reported for the final model.

RESULTS

Demographics

Crude counts and percentages for the descriptive analysis on the study population are presented in Tables 1.1-1.4. Overall, the median age of participants was 30 years old, ranging from 18 to 73 years, and the largest age group represented was 30-39 year olds. Almost all (97%) had at least graduated from high school. The majority of participants (77%) currently had some form of health insurance, with nearly half (48%) using private health insurance. Fifty-five percent (55%) had an annual income of $19,999 or less and 72% were employed either part- or full-time. Most participants were recruited from bars (49%) or dance clubs (27%), and self-identified as homosexual (85%) or bisexual (14%).

Testing, STI History, and Use of Prevention Services

Overall, 77% of the sample reported being HIV-negative and about 23% reported unknown HIV status. Twenty-four (24) participants who reported negative or unknown HIV status tested positive for HIV at the NHBS event. These individuals were considered unaware HIV-positives and totaled to 7% of the study sample for this analysis. Fifty-eight percent (58%) of those considered unaware HIV-positive had not received an HIV test in the last year (not shown in table).

Overall, 53% of participants had not received an HIV test in the last 12 months, including 19% of participants who had never received an HIV test in their lifetime. The main reasons for not receiving an HIV test in the last year included that the participant thought he was at low risk for HIV, was afraid of finding out that he had HIV, or did not have time. Visiting a health care provider was generally common, with 72% having visited a health care provider in the last year. Prevalence of a sexually transmitted infection (STI) diagnosis in the last 12 months was at 5%, with more cases of syphilis reported than any other STI. Prevention services such as annual testing for syphilis and individual or group prevention interventions had reached about a fourth of

all MSM interviewed, and free condom distribution activities had reached two-thirds of the participants.

Risk Behaviors

About 33% of respondents had their sexual debut with a male before the age of 15 years. Six percent (6%) reported having no sexual partners in the last year, 34% reported having one partner in the last year, and over half of the sample (59%) reported having at least 2 male sexual partners, with 25% reporting 4 or more male partners in the last year. UAI with a male partner was also common with 58% reporting male UAI in the last 12 months. Sixty-percent (60%) of most recent male partners were considered casual while 37% were main partners and about 3% were exchange partners. The HIV status of the respondents' last male partner included 3% known to be HIV-positive, 45% HIV-negative, and about 52% of unknown HIV status.

Approximately 20% of participants engaged in sex with a female in the last year. The majority of participants reported current, heavy, and binge drinking, with 65% reporting binge drinking in the last 30 days. Twenty-six percent (26%) reported using non-injection drugs in the last year. A third (31%) reported drinking or using drugs during the last sexual encounter.

Social Risks

Ninety-percent (90%) of our sample had told someone that they were attracted to or had sex with men, with a large majority of individuals telling other gay friends (87%), non-gay friends (76%), and family (71%). In contrast, 48% had told a health care provider that they were attracted to or had sex with men. About 37% reported having experienced some form of discrimination for their sexual identity in the last 12 months. This was mainly represented through verbal name-calling (21%) and unfair treatment at work or school (20%), though 5% said they had been physically attacked or injured because of their sexual identity. Three percent (3%) reported having been denied or given lower health care due to their sexual identity. One in three participants also said they perceived stigma of gays and bisexuals.

Bivariate Results

Results for the bivariate analyses among HIV-negative participants are reported in Tables 2.1-2.2. Participants who had a fewer number of male sexual partners in the last year (OR (1vs. ≥4)=2.9; 95% CI: 1.6, 5.0) and had not told a health care provider that they are attracted to or have sex with men (OR=2.1; 95% CI: 1.4, 3.2) were significantly more likely to have not received an HIV test in the last year. Specifically, 66% of those with one male sex partner in the last year had not received an annual HIV test compared 40% of those who had four or more partners. Sixty-two percent (62%) of those who had not told a health care provider about male-male attraction/sex were not tested for HIV in the last year compared to 44% of those who had told their provider. Those who used non-injection drugs in the last 12 months (OR=0.5; 95% CI: 0.3, 0.9) and visited a health care provider in the last 12 months (OR=0.5; 95% CI: 0.3, 0.8) were significantly less likely to have not received an HIV test in the last year. Age, education, and type of health insurance were also included in the analysis based on previous research demonstrating strong associations between these factors and HIV testing behaviors, though they were not found significant at the bivariate level in this study (p=0.34; p=0.48; p=0.42, respectively).

Multivariate Results

The final multivariate logistic regression model shown in Table 3 included age, education, and type of health insurance based on a priori criteria, as well as the number of male partners in the last 12 months and having told a health provider that they were attracted to or had sex with men. In the analysis, the number of male partners in the last 12 months and disclosure of male-male sex to a health care provider were both found to be significantly associated with not HIV testing in the last 12 months, with participants who had fewer recent sex partners and did not disclose male-male sex to a health provider having increased odds of not receiving an HIV test in the last year (AOR(1 vs. ≥4)=2.7, 95% CI: 1.5, 5.0); AOR=2.0, 95% CI: 1.3, 3.2, respectively).

Goodness-of-fit tests for the final model with these five predictors demonstrated good model fit, accounting for most of the variance in the outcome (χ^2=5.02, p=0.76). Though having visited a medical provider in last 12 months and non-injection drug use were significant at the bivariate level, they were not found to be significantly associated with HIV testing after controlling for the other variables. Removing them as independent variables in the model did not compromise model fit or the associations of other remaining variables with HIV testing, and therefore a more parsimonious model with equal fit was selected as the final model.

Associations with the Use of Prevention Services

An additional analysis considering the use of prevention services was conducted to better understand potential associations between prevention efforts and recent HIV testing. These results are illustrated in Table 4. Prevention services including having been tested for syphilis in the last 12 months, received free condoms in the last 12 months, and received a group or individual HIV prevention intervention were significantly associated with having had an HIV test in the last 12 months when assessed independently ($p<0.01$ for each association). Having participated in an alcohol or drug treatment program was not significantly associated with recent HIV testing. Some overlap between prevention services was observed, with about 77% of those getting tested for syphilis in the last year, 54% of those receiving free condoms in the last year, and about 70% of those receiving either an individual or group prevention intervention in the last year also receiving an HIV test in the last 12 months. However, those who received recent prevention services did not always receive a recent HIV test. About one in four participants were tested for syphilis in the last year, yet of those, 23% were not tested for HIV in the last year. While 69% of participants received free condoms in the last year, 46% of these participants did not receive an HIV test in the last year. Finally, prevention interventions either at the individual or group level reached 26% of MSM participants, though 30% of those who had engaged in one of these prevention interventions had not received an HIV test in the last year.

DISCUSSION

The main aims of this study were to identify demographic and behavioral risk factors associated with not receiving an annual HIV test among MSM in Puerto Rico. It is predicted that MSM in Puerto Rico may face barriers to HIV prevention services including HIV testing as the epidemic in Puerto Rico has been most concentrated in injection drug users and cultural stigma against homosexuality may both increase high-risk behaviors while limiting the ability for MSM to comfortably engage with opportunities for prevention (10, 11, 32, 44). Previous data have shown that risk behaviors including UAI as well as HIV cases have been increasing in this population over the past several years, while annual HIV testing as recommended by CDC has been decreasing (14, 15). In addition, high percentages of unaware infection among Hispanic MSM and MSM specifically in Puerto Rico suggest a need to better understand testing practices in this population in an effort to prevent unaware HIV infection and increase future testing practices (6, 14). Few national-level analyses have been conducted specifically with this population to inform national, regional, and local health systems about HIV-related outcomes for MSM in this context.

Our analysis supports that MSM in Puerto Rico continue to engage in high-risk behaviors, including UAI, young age of sexual debut, having multiple recent partners, and binge alcohol use. This was consistent with findings from previous NHBS surveillance reports. These results also had some consistencies with a population-based study by Colón-Lopez et al. that reported about 40% of MSM with an age of sexual debut before the age of 15 as well as large percentages of MSM reporting alcohol and drug use and having had at least 10 lifetime sex partners (11). Though we did not consider lifetime partners, we did find that more than half of MSM interviewed had 2 or more male sex partners in the last year. Our results disagreed with this particular study in findings of recent vaginal sex however, as our study found 20% of participants having had a female sex partner in the last year in contrast to 80% reported in the Colon-Lopez et al. study (11). Compared to surveillance data on MSM in Puerto Rico from 2005 and 2008, reported UAI with a male partner appears to have increased over the years, from 29%

to 54% to 58%, though sex with a female in the last year has remained relatively constant ranging between 14% and 21% (14, 15). Casual sex and binge alcohol use have stayed consistently high, with between 51- 61% and 61-65% of MSM engaging in the behaviors, respectively, over the 6-year period (14, 15).

This analysis found that 73% of those who tested positive during their study visit were not aware of their positive HIV status, consistent with 72% reported in 2008 (6). The level of unaware HIV infection specifically among MSM in Puerto Rico surpasses the estimates of unaware infection among both the Hispanic MSM population and the general MSM population in the U.S. estimated at 46% and 44% respectively (6). Of those unaware of their infection in Puerto Rico, 58% had received an HIV test in the last year which was slightly higher than that estimated for the MSM population overall in the U.S. in 2008 (6).

Our study determined that of all MSM participants in Puerto Rico who reported negative or unknown HIV status, 53% of participants had not received an HIV test in the last 12 months, including 19% who reported never having received an HIV test in their lifetime. Since 2008, this is a slight 5% increase in not HIV testing in last 12 months and a slight 6% increase in never HIV testing for MSM on the island (14). These were also worse compared to estimates for the general U.S. MSM population as well as the U.S. Hispanic MSM population, both estimated at 38% having not tested in the last 12 months, and 10-11% having never tested for HIV (14). Preliminary analyses of the NHBS-MSM3 study in 21 U.S. cities indicate that HIV testing rates are generally increasing across each study site except Puerto Rico where HIV testing rates are remaining stable (52). Given the high prevalence of risk behaviors and unaware HIV infection among MSM in Puerto Rico, yet more than half of these men not receiving a HIV test in the last year and HIV testing rates showing no increase compared to other parts of the U.S., initiatives to understand and improve regular HIV testing for MSM in Puerto Rico are needed to avert new cases of unaware HIV infection and prevent the spread of HIV in this population.

One important study result was that having fewer male sexual partners in the last year was strongly associated with not having received an HIV test in the last 12 months after adjusting

for age, education, health insurance, and having disclosed male-male attraction/sex to a health care provider. The number of sexual partners has been previously noted in the literature as a significant predictor of HIV risk and hence a strategic point of intervention, as those who have multiple partners may be exposed to different, concurrent sexual networks (53, 54). While it is encouraging that a large percentage of MSM in Puerto Rico who had multiple partners did receive an HIV test in the last 12 months, it still remains that about 40% of those with four or more sexual partners did not receive a recent HIV test. Since these are individuals at high risk for HIV transmission, it is particularly important to communicate not only the increased risk of HIV when engaging in sex with multiple partners, but the need for regular testing in order to establish a timely diagnosis and prevent transmission to other partners.

While many HIV interventions have focused on reducing the number of sex partners for MSM, a growing body of literature reveals that many MSM may be contracting HIV through main partnerships (55, 56). In one study, it was estimated that about 68% of HIV transmissions among MSM were from main sex partners and this was attributed to the higher number of sex acts, more frequent receptive anal sex, and lower condom use during anal sex for main partnerships (55). In our study, men who had just one male sexual partner in the last year were more likely to have not received a recent HIV test than those with multiple partners. Individuals who have one main partner may perceive themselves to be at low risk for HIV and hence not seek regular HIV testing, leading to possible unaware infection. This may be true for Hispanics for whom low perceived risk of HIV has been associated with low testing rates and lack of intention to test in the future (46). Twenty-six percent (26%) of MSM in our study reported not getting HIV tested because they thought they were at low risk for getting HIV, yet 30% did report being afraid to find out they were HIV-positive as their main reason for not HIV testing in the last year. While these data may provide inconclusive answers about risk perception in this population, it has been documented that 67% of MSM in Puerto Rico have engaged in anal sex with a main male partner and 63% of these had unprotected anal sex within a main partnership (14). If indeed a high percentage of HIV transmissions is occurring between main partners in Puerto Rico as

observed in other studies of MSM, it is of great concern that this group was also the least likely to receive a recent HIV test in our study. Future research should consider HIV risk for MSM with only one sexual partner and the implications this may have for prevention-seeking behaviors such as annual HIV testing among MSM in Puerto Rico.

Another important finding of this analysis was that not having told a health provider about being attracted to or having sex with men was also significantly associated with not receiving an HIV test in the last 12 months after controlling for potential confounding. In total, less than half (48%) reported disclosing this information to their health care provider. Disclosure of male-to-male sexual behavior and its association with HIV testing has been discussed previously in the literature, emphasizing that physicians should actively inquire about male-male sex in order to increase the offering of HIV tests to MSM (57). One recent study found that Hispanic men are significantly less likely to disclose their same-sex attraction to health care providers than White men (41). Our results support that disclosure of same sex behavior is vital for physicians and their patients to openly discuss risks for HIV/STDs and these conversations can present a key opportunity for providers to initiate HIV testing. Therefore, future research and prevention efforts that further explore patient-provider interactions and barriers to the disclosure of male-male sex behavior for Hispanic MSM in Puerto Rico are warranted.

Issues of stigma and discrimination against homosexuality in traditional Puerto Rican culture may further hinder the ability of MSM to disclose their sexual orientation to their health care providers, or conversely, may lead health care providers to avoid asking their patients about sexual behaviors that are not considered mainstream. Our finding of low disclosure of male-male sex to providers and its association with not HIV testing supports that conversations about sexual behavior at the patient-provider level are essential for HIV prevention. In our study, we found that over a third (37%) had experienced some form of discrimination in the last 12 months, which was manifested mostly through verbal name-calling and unfair treatment at work or school. An encouraging finding may be that few individuals reported being denied or given lower health care because of sexual identity in past 12 months, however this may also be related to the low level of

outness with health care providers in general and does not reflect previous experiences with discrimination in the health care setting that may have occurred more than 12 months prior. Future interventions that aim to increase HIV testing should focus on reducing stigma and discrimination at the patient-provider level by both empowering MSM to discuss their sexual behavior with their physicians and training physicians in Puerto Rico on how to comfortably and sensitively discuss issues of sexual behavior with MSM. Curricula on cultural competency for health care providers working with MSM populations have been developed by the Fenway Institute and the Desmond Tutu HIV Foundation and could be applied and tailored to those working with the Hispanic MSM population in Puerto Rico (58, 59). Health care providers should also remain updated on current testing and counseling recommendations for MSM in order to ensure appropriate risk counseling and regular annual or more frequent HIV testing for this at-risk group.

Our study also explored the associations between prevention services and HIV testing. Almost all prevention variables were significantly associated with HIV testing, indicating substantial overlap of prevention services with HIV testing. However, it is important to note that large percentages of those who participated in prevention programs in the last year had still not received a recent HIV test. For example, 23% of those who received a syphilis test in the last year, 46% of those who received free condoms in the last year, and 30% of those who received either a group or individual HIV prevention intervention in the last year did not receive an HIV test in the last year. Integrating testing and prevention services into a comprehensive HIV prevention package in the future is greatly needed to achieve effective HIV prevention.

This study does not come without several limitations. First, this study was based on a convenience sample that used venue-based sampling to recruit eligible participants which can introduce sampling bias and limit the generalizability of study findings. These data were not weighted and are not representative of all Hispanic MSM in Puerto Rico. Participation bias could have also been introduced during recruitment if the male passer-byers who refused to participate in the survey or testing components were intrinsically different in demographics or risk behaviors

from those who did choose to participate in the study. Furthermore, because the questionnaire was delivered by an in-person interviewer, the study may have been subject to social desirability bias, as sexual and other risk behaviors may have been under-reported while positive prevention behaviors such as HIV testing may have been over-reported. In addition, social desirability bias may have resulted in an underestimate of the number of participants who reported previously testing positive for HIV infection, which could have resulted in individuals being considered HIV-positive unaware and thereby included in this analysis, rather than being excluded as known HIV-positives. We did not have data on preferred language or level of acculturation, and therefore could not address how acculturation may influence HIV risk and prevention in this group of men. Despite these limitations, a major strength of this study was that it used data from the NHBS system which is the only existing dataset of its scale that can provide national-level, high-quality information on the MSM population in Puerto Rico.

In conclusion, this study has led to important insights for future HIV prevention efforts focusing on HIV testing for MSM in Puerto Rico. Having multiple sex partners remains a key behavioral factor that should be addressed in HIV testing programs in this region, though future interventions should also consider the importance of annual HIV testing among those with only one sex partner as this group was more likely to have not received an annual HIV test and may still be at high risk for acquiring HIV. In addition, disclosure of male-male sex between MSM patients and their health care providers will be essential to overcome barriers to HIV testing in this population. Stigma and discrimination against homosexuality in Puerto Rican culture may create obstacles for both MSM and physicians to openly discuss sexual risk behaviors and opportunities for HIV testing. Future research is needed to explore the impact that these cultural values may have on the ability of MSM to disclose same-sex behavior in the clinical setting. Understanding and incorporating these identified factors into future HIV testing efforts will offer a more targeted prevention strategy to reduce unaware HIV infection and improve recent HIV testing rates for MSM in Puerto Rico.

CHAPTER III: CONCLUSIONS

In the United States, the HIV epidemic has been primarily concentrated in high-risk populations including men who have sex with men. Hispanic men in particular experience nearly three times the rate of new HIV infections compared to white men and male-to-male sexual contact represents close to 80% of incident infections among Hispanic men (2, 6, 8). Several studies have investigated the HIV epidemic among Hispanic MSM in the U.S. mainland, however limited research has been conducted to understand the epidemic among MSM in U.S. dependent areas such as Puerto Rico where the HIV incidence rate for males is nearly twice that of mainland U.S. males and 1.5 times that of mainland U.S. Hispanic males (10).

While injection drug use has been the focus of HIV research and interventions in Puerto Rico over the last decade, male-to-male sexual contact accounts for 30% of prevalent HIV cases among men living on the island (10). Recent data from the National HIV Behavioral Surveillance system has shown that from 2005 to 2008, unprotected anal sex among MSM in Puerto Rico has increased by about 20% for both main and casual sex partners while HIV testing in the last 12 months as recommended by the CDC has decreased by over 25% (14, 15). In addition, according to the 2008 NHBS cycle, 72% of MSM in Puerto Rico were unaware of their HIV infection (14). Issues of stigma and discrimination associated with homosexuality in traditional Hispanic culture and Judeo-Christian religion may further contribute to HIV risk or act as barriers to HIV testing practices for MSM in this region (32, 44). With a high percentage of unaware infections and over half of respondents not receiving an HIV test in the last year, research to understand the factors that influence HIV testing and identify gaps in current HIV testing practices is warranted.

This study aimed to identify factors associated with not HIV testing in the last 12 months among MSM in Puerto Rico in an effort to inform national, regional, and local health systems about HIV-related outcomes and tailor prevention strategies for this population. We used the most recent available data from the third NHBS cycle with MSM in 2011 that used venue-based sampling to recruit the study population. We performed descriptive and bivariate analyses as

well as a multivariate logistic regression analysis to determine key predictors of the outcome of interest. At the bivariate level, factors significantly associated with not HIV testing in the last year included having fewer male partners in the last 12 months, not having visited a medical provider in the last 12 months, not having told a health provider that they were attracted to or had sex with men, and not having used non-injection drugs in the last year. These variables were considered at the multivariate level. The final logistic regression model included age, education, and type of health insurance (selected to be in the model a priori), as well as the number of male partners in the last 12 months and having told a health provider that they were attracted to or had sex with men. Both of these variables were significantly associated with the outcome of not HIV testing in the last 12 months after controlling for potential confounding and the final model demonstrated good model fit.

Public Health Implications

Our study reveals crucial information about factors associated with not HIV testing in the last 12 months as recommended for MSM in Puerto Rico to prevent HIV transmission. Though not included in the final model, having visited a health care provider in the last year was bivariately associated with HIV testing indicating that access to and use of health care services may be important to consider in general for HIV testing interventions in Puerto Rico. If MSM do not regularly seek health care such as annual check-ups with a health care provider, they may also be missing a key opportunity to be offered an HIV test. Twenty-eight percent (28%) of our sample did not visit a health provider in the last year. Therefore, there may be a need to encourage regular health visits with a physician in order to better support HIV prevention interventions in Puerto Rico. Common obstacles to accessing annual health care for MSM in Puerto Rico could include a lack of health insurance or high clinical costs. Fifty-eight percent (58%) of those who had access only to public health insurance and 57% of those who had no health insurance had not been HIV tested in the last year, compared to 49% of those with private insurance; hence health insurance and type may further impact decisions about accessing health

services. Additionally, a lack of comfort or fear of discrimination in health care settings may affect the ability of MSM to regularly access health care services that could lead to annual HIV testing.

Non-injection drug use was also associated with HIV testing at the bivariate level. This association has not been commonly found in the literature as being positively correlated with HIV testing. Our hypothesis is that since the HIV epidemic has largely focused on male injection drug users in Puerto Rico, current interventions or health care settings that incorporate HIV testing and target drug users as a high-risk population may be capturing non-injection drug users as well. Other explanations could include that men who engage in both injection drug use and non-injection drug use felt more comfortable reporting only non-injection drug use, yet they may have been targeted with HIV prevention and testing opportunities as injection drug users in Puerto Rico. Lastly, it is possible that those who do engage in non-injection drug use may perceive their risk for HIV to be higher in general, either from drug use or other high-risk behaviors, therefore leading these individuals to test more regularly. Further research on non-injection drug use and the use of prevention services including HIV testing among MSM in Puerto Rico could reveal more information that would better explain this association.

Our analysis had several important results at the multivariate level as well, one of which highlights the impact of multiple sexual partnerships on HIV testing. A higher number of sex partners has been well documented in the literature as a key risk factor for HIV infection, leading to the reduction of multiple partnerships as a strategic point of intervention (53, 54). In our analysis, having fewer male sex partners in the last year was significantly associated with not receiving a recent HIV test. We predict that MSM who engage in multiple partnerships in Puerto Rico recognize the risk associated with those behaviors and hence may perceive a greater need to get HIV tested regularly. However, while it is encouraging that a larger percentage of MSM in our study who had multiple partners were HIV tested in the last 12 months, it is still important to note that about 40% of those with four or more sexual partners did not receive a recent HIV test in the last year. These individuals may be at higher risk for contracting HIV due to the interplay

of a high number of sexual contacts, sexual networks, and concurrency that takes place with multiple partnerships. Undiagnosed infection in this population would therefore have serious implications for this group of MSM, as those who have multiple sex partners and are unaware of their HIV infection may not use condoms or other risk reducing behaviors since they do not know they are HIV-positive. Yet, they are potentially engaging in unprotected sex with multiple individuals, possibly at the same time. Identifying HIV infection in this group of MSM is critical to preventing HIV transmission and therefore regular HIV testing remains greatly needed for those in multiple sexual partnerships in order to prevent unaware infection and HIV transmission to other partners.

Another important consideration for the association between the number of sex partners and HIV testing for MSM in Puerto Rico underscores the lack of HIV testing among those with one main sexual partnership in the last year. While there is a need for HIV interventions to focus on reducing the number of sex partners among MSM, a growing body of literature reveals that many MSM may be contracting HIV through a main partnership, as the high number of unprotected anal sex acts may place main partners at greater risk for transmission (55, 56). The implications of applying this hypothesis to the MSM population in Puerto Rico could be disconcerting if a large percentage of HIV transmissions were to be occurring within main partnerships. Men who only had one partner in the last year had nearly three times the odds of not receiving an annual HIV test compared to men with four or more partners in the last year in our study, with similar associations observed in comparison to those with two or three partners. It may be that MSM in Puerto Rico who have one main sex partner perceive themselves to be at low risk for HIV and hence do not seek HIV testing annually. However, they may be more likely to engage in high sexual risk behaviors including unprotected anal sex with a main partner, and consequently place themselves at higher risk of contracting HIV if their partner was infected. Low HIV testing rates in this particular group of men could, in turn, correspond to HIV transmission through undiagnosed infections. As discussed previously, these undiagnosed infections could further facilitate the spread of HIV as those unaware of their HIV infection may

have increased viral loads and continue to carry out high-risk sexual behaviors that they would otherwise avoid if aware of their condition. More research is needed, however, to determine to what extent HIV transmission is occurring within main sex partnerships of MSM in Puerto Rico and whether HIV prevention interventions directly targeting this subpopulation would be a well-aimed approach. Nevertheless, given the low testing rates for those with one sex partner in the last year that were found, current HIV prevention programs should consider this population to still be at-risk for HIV and therefore address risk perceptions and testing practices in this subgroup. Potential future interventions could include couples' HIV testing and counseling (CVCT) which has been utilized in other parts of the U.S. to facilitate partners' risk assessment and provide mutual testing opportunities for MSM in main partnerships, though the acceptability of this type of intervention among MSM in Puerto Rico would need to be assessed to determine if this would be a feasible intervention in this region (60).

Our study also found that not having told a health provider about being attracted to or having sex with men was significantly associated with not HIV testing in the last 12 months after controlling for potential confounding. Disclosure of male-to-male sexual behavior and its association with HIV testing has been discussed previously in the literature, and most studies have recommended that physicians actively ask about male-male sex behavior during clinic visits in order to increase HIV screenings for MSM (41, 57). Our results note that first, from a public health perspective, the clinical setting may be a key physical space in which HIV testing is available yet may not currently be utilized to its full potential if testing is not being administered to all MSM receiving recent health care services. Second, our results support that the disclosure of same-sex behavior in the clinical setting is vital for physicians and their patients to openly discuss risks for HIV/STDs and that this disclosure can present a key opportunity to initiate HIV testing, as those who had not told their doctor about same-sex behavior had twice the odds of not getting HIV tested in the last year compared to those who had told their provider. Based on these results, it follows that building a strong patient-provider relationship in which this disclosure can occur safely may be very important in increasing testing rates for MSM in Puerto Rico.

Another recent study found that Hispanic men are significantly less likely to disclose their same-sex attraction to health care providers than White men (41). This research may indicate that there are significant obstacles that Hispanic MSM face in discussing these critical issues with their providers. In considering the cultural context, potential stigma against homosexuality may be a concern for both the patient and the provider. Though few individuals in our study reported that they had been given poorer health care services based on their sexual orientation, this may also be because men do not disclose information about their sexual orientation with their providers in order to avoid any stigma or poorer treatment. Therefore, concerns about homophobia or perceptions of masculinity in traditional Puerto Rican culture may further hinder the ability of MSM to disclose their sexual orientation to their health care provider, or conversely, may lead health care providers to neglect to ask their patients about same-sex behaviors. While issues of stigma and discrimination have been explored in the clinical setting for people living with HIV/AIDS in Puerto Rico, little to no information has explored how stigma and discrimination specifically against homosexuality may affect patient-provider communication, particularly the disclosure of male-male sex behavior, risk assessment, and options for HIV testing. With cultural stigma against both HIV/AIDS and homosexuality, there may also be a dynamic overlap in the experience of disclosing sexual orientation to a provider, requesting or accepting an HIV test, and fear of finding out if the patient is HIV-positive. Future research on the barriers to disclosing male-male sex at the patient-provider level is necessary to target the exact issues that MSM are facing and better understand if and how stigma against homosexuality and/or HIV/AIDS may be affecting this process and impeding the ability of MSM to receive recent HIV testing. Furthermore, this future research should not only identify barriers, but explore key facilitators that could promote this disclosure and the uptake of HIV testing in the clinical setting.

Our study also explored the associations between prevention services and HIV testing. Substantial overlap between prevention services and HIV testing was observed, with nearly all prevention variables being highly significantly associated with HIV testing. However, regardless

of these associations, large percentages of those who received a prevention service in the last year had still not received an annual HIV test. Specifically, 23% of those who received a syphilis test, 46% of those who received free condoms, and 30% of those who received either a group or individual HIV prevention intervention in the last year did not receive an annual HIV test. To achieve effective HIV prevention, testing and prevention services should be integrated such that individuals who receive any prevention service, particularly STI testing, should also receive an HIV test as part of a comprehensive HIV prevention package. The proportion of men who had participated in any of these prevention opportunities was slightly greater than those at other NHBS sites across the U.S., suggesting that these initiatives do have the potential to reach MSM in Puerto Rico and should be utilized to increase HIV testing rates (14). These findings support that incorporating HIV testing into existing prevention efforts that are already reaching MSM groups may be a feasible option to more effectively promote regular HIV testing practices.

Strengths and Limitations

Our findings do not come without several limitations. First, this study was a convenience sample that used venue-based sampling (VBS) to recruit eligible participants, which can introduce sampling bias. VBS is commonly utilized to access hard-to-reach groups including MSM, as a gold standard for recruiting a representative sample of a hard-to-reach population does not currently exist. To reduce this sampling bias, data can be weighted to account for the frequency of MSM who pass by a venue at a given time or by the probability of being identified and recruited to participate in the study using data collected at the venues (48, 50, 51). Unfortunately, at the time of this analysis the information needed to calculate these weights was not available for NHBS-MSM3 in Puerto Rico, therefore weighting was not possible. Using VBS limits the generalizability of study findings, therefore study results can only be generalized to the population of MSM that attend the venues where the study took place and at the time of implementation.

Participation bias could have also been introduced if at the venues the male passer-byers who refused to participate in the survey or testing components were intrinsically different in demographics or risk behaviors from those who did choose to participate in the study. Furthermore, because the questionnaire was delivered by an in-person interviewer, the study may have been subject to social desirability bias, as sexual and other risk behaviors may have been under-reported while positive prevention behaviors may have been over-reported.

Despite these limitations, this study had several strengths that further support the conclusions of this analysis. First, NHBS is the only existing dataset of its scale that can provide high-quality data on the MSM population in Puerto Rico. In addition, while the study used venue-based sampling which is subject to the limitations aforementioned, this sampling strategy has demonstrated previous success in recruiting large and diverse samples of hard-to-reach populations including MSM. Furthermore, both NHBS-MSM1 and NHBS-MSM2 cycles used VBS to recruit participants, lending to feasible comparisons between cycles over time. Extensive formative research took place prior to study implementation in order to reduce potential participation bias by identifying highly frequented and diverse locations and times for recruitment. Lastly, the study also aimed to reduce social desirability bias by conducting interviews in private spaces, clearly explaining the confidentiality of the study to participants, as well as providing significant training to interviewers on how to build positive rapport with the subjects so that they felt comfortable to provide honest and valid information.

Future Directions

In looking forward, existing HIV prevention services must integrate HIV testing into their current operations so that all MSM reached with any kind of prevention services is offered an HIV test as part of a comprehensive approach to HIV prevention.

Future HIV prevention efforts for MSM in Puerto Rico should also focus on both increasing testing rates for those who have multiple sex partners as they are at higher risk for HIV and are not all getting tested annually, as well as for those in main partnerships who may still be

at-risk for HIV yet are currently not testing annually due to low perceived risk for HIV infection. Additional research that evaluates the extent to which HIV may be transmitted through main partnerships among MSM in Puerto Rico could be useful to know if targeting this group with HIV testing campaigns would be a strategic intervention, and existing programs should still address issues of risk perception and aim to increase HIV testing rates for MSM with fewer partners. To further target men in main partnerships, possible interventions could include couples' testing and counseling in order to provide testing opportunities that take into consideration the context of the relationship, though the feasibility and reach of this intervention in Puerto Rico would be important to consider prior to implementation.

Additionally, future prevention initiatives should strongly focus on barriers for MSM in disclosing male-male sexual contact to their health care provider, as this patient-provider interaction appears to be an important component in whether or not an individual has received an annual HIV test. These barriers could range from a patient's fear of discrimination when disclosing his sexual orientation in the clinical setting to a physician's lack of training and experience in addressing sexual health issues for MSM or HIV generally. Future interventions that aim to increase HIV testing rates among MSM should focus on these issues through the following approaches. First, programs can aim to reduce stigma and discrimination at the patient-provider level by encouraging MSM to discuss their sexual behavior with their physicians or even ask directly for an HIV test as a means of protecting one's own health. Secondly, training physicians in Puerto Rico on how to comfortably and sensitively discuss issues of sexual behavior and HIV risks with MSM will be needed to increase knowledge and awareness of these issues and alleviate concerns about working with the MSM population. Sensitivity training for physicians may be an important intervention strategy in order to better equip medical providers with the information and experience they need to better address sexual health issues for MSM, recommend risk-reduction strategies against HIV/AIDS, as well as eliminate potential discrimination at the patient-provider level. The Fenway Institute at Fenway Health and the Desmond Tutu HIV Foundation have produced guides for health care providers to learn how to discuss sexual health

issues with MSM and may serve as tools for cultural competency for physicians that work with MSM in Puerto Rico. Health care providers should also remain updated on current testing recommendations for MSM in order to ensure proper risk counseling and regular annual or more frequent HIV testing for this at-risk group. Further research on the cultural context of accessing health care and disclosing male-to-male sexual behaviors to health care providers specifically among MSM in Puerto Rico may significantly contribute to developing better targeted strategies for overcoming these barriers and increasing HIV testing rates in this population.

Final Comments

In conclusion, this study has revealed important findings to guide future HIV prevention efforts for HIV testing among MSM in Puerto Rico. Key behavioral factors including having multiple sex partners should continue to be addressed in HIV testing programs in Puerto Rico. Future interventions should also concentrate on promoting annual HIV testing among those with fewer sex partners as this group of MSM had low testing rates yet may still be engaging in high-risk sex. Disclosure of male-male sex between MSM patients and their health care providers was also identified as an important barrier to recent HIV testing in this population. Issues of stigma and discrimination against homosexuality in Puerto Rican culture may further inhibit MSM and physicians from openly discussing sexual risk behaviors and initiating HIV testing. Integrating these identified factors in future HIV testing strategies will be important to reducing unaware HIV infection and improving annual HIV testing rates for MSM in Puerto Rico.

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Table 1.1—Number* and percentage of participants who self-reported negative or unknown HIV status, by selected demographic characteristics — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011

	Total (N= 350)	
Characteristic	**n**	**%**
Age (yrs)		
18-19	27	7.7
20-24	85	24.3
25-29	62	17.7
30-39	96	27.4
40-49	56	16.0
≥50	24	6.9
Education		
< High school graduate	12	3.4
High school diploma or GED	78	22.3
Some college or technical college	108	30.9
College or higher education	152	43.4
Type of health insurance		
None	79	22.6
Private only[§]	168	48.0
Public only[¶]	62	17.7
Other/multiple	41	11.7
Annual household income**		
≤$19,999	189	54.6
$20,000 to $39,999	99	28.6
$40,000 to $74,999	41	11.9
≥$75,000	17	4.9
Employment status		
Employed (part- or full-time)	253	72.3
Full-time student	38	10.9
Unemployed	42	12.0
Other	17	4.9
Sexual identity		
Homosexual	296	84.6
Heterosexual	__[††]	__[††]
Bisexual	50	14.3
Recruitment venue		
Bar	173	49.4
Café or restaurant	23	6.6
Dance club	96	27.4
Social organization	13	3.7
Sex establishment or environment	8	2.3
Other	37	10.6
Total	**350**	**100.0**

Abbreviations: GED = general educational development; HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

[§] Coverage through private insurance policies or employer, TRICARE, CHAMPUS, or membership in a health maintenance organization.

[¶] Coverage through Medicare, Medicaid, or Veterans Administration.

** Annual household income was collected from participants in ranges. These ranges were combined into four categories (ie. ≤$19,999, $20,000-$39,000, $40,000-74,999, and ≥$75,000) to allow for comparisons to NHBS surveillance data for the total men surveyed during the third NHBS MSM cycle.

[††] Suppressed because the number or numerator was less than 5.

Table 1.2—Number* and percentage of participants who self-reported negative or unknown HIV status, by selected testing and prevention characteristics — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011

	Total (N= 350)	
Characteristic	**n**	**%**
Self-reported HIV status		
Unknown, never tested	66	18.9
Unknown, never obtained test results	14	4.0
HIV-negative	270	77.1
HIV test results[†]		
HIV-negative	326	93.1
HIV-positive, unaware	24	6.9
Most recent HIV test		
Never	66	18.9
Greater than 12 months ago	121	34.6
Less than or equal to 12 months ago	163	46.6
Reasons for not HIV testing		
Thought you were at low risk for HIV	48	25.7
Was afraid of finding out that you had HIV	57	30.5
Did not have time	49	26.2
Other reason	10	5.4
No particular reason	23	12.3
Visited health care provider in the last 12 months	253	72.3
Diagnosed with sexually transmitted infection (STI) in last 12 mo.	18	5.1
Syphilis diagnosed in last 12 mo. [§]	7	2.0
Tested for syphilis in last 12 mo.	94	27.0
Received free condoms in last 12 mo.	240	68.6
Received either individual or group-level HIV prevention intervention in last 12 months	90	25.7
Participated in alcohol or drug treatment program		
Never	342	97.7
>12 mo. before interview	—[¶]	—[¶]
≤12 mo. before interview	—[¶]	—[¶]
Total	**350**	**100.0**

Abbreviations: GED = general educational development; HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

[†] HIV-negative participants had self-reported being HIV-negative during the survey and had a confirmed negative HIV test. Unaware HIV-positive participants had self-reported being HIV-negative but had a confirmed HIV-positive test result. One unaware HIV-positive participant was not included in this analysis due to missing values for the outcome variable of interest.

[§] Diagnoses for gonorrhea, chlamydia, and other STIs were not reported due to small counts below 5.

[¶] Suppressed because the number or numerator was less than 5.

Table 1.3—Number* and percentage of participants who self-reported negative or unknown HIV status, by selected risk behaviors — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011

	Total (N= 350)	
Characteristic	**n**	**%**
Age of sexual debut <15 years	133	38.1
Age of sexual debut with a male <15 years	116	33.3
Number of male partners in past 12 months		
0	22	6.3
1	119	34.3
2	65	18.7
3	51	14.7
≥ 4	90	25.9
Unprotected anal sex with male partner in past 12 months[†]	201	57.9
Female partner in the past 12 months	28	20.7
Use internet to meet men for friendship or sex	215	61.4
Ever incarceration	12	3.4
Incarceration in last 12 months	6	1.7
Non-injection drug use in last 12 months	89	25.5
Ever injection drug use	0	0.0
Current alcohol use[¶]	284	95.6
Current heavy alcohol use[¶]	246	86.9
Current binge alcohol use[¶]	186	65.5
Alcohol or drugs before or during last male sexual encounter	100	30.8
Last male partner type[§]		
Main	76	36.5
Casual	126	60.6
Exchange	6	2.9
Last male partner age		
Same	40	12.3
Younger	141	43.4
Older	144	44.3
Last male partner HIV status		
HIV-negative	147	45.4
HIV-positive	10	3.1
Unknown	167	51.5
Total	**350**	**100.0**

Abbreviations: HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

[†] Neither the participant nor his partner used a condom.

[§] A main partner was a man with whom the participant had sex and to whom he felt most committed (e.g., boyfriend, spouse, significant other, or life partner). A casual partner was a man with whom the participant had sex but to whom he did not feel committed or he didn't know very well. An exchange partner was a man with whom the participant had sex in exchange for something (e.g., money or drugs).

[¶] Alcoholic beverage was defined as a 12-oz beer, 5-oz glass of wine, or 1.5 shot of liquor. Participants who drank at least one alcoholic beverage during the past 30 days were considered "current." Participants who drank on average more than two alcoholic beverages per day in the 30 days before the interview were considered "heavy." Participants who drank more than five alcoholic beverages at one sitting in the 30 days before the interview were considered "binge."

** Suppressed because the number or numerator was less than 5.

Table 1.4—Number* and percentage of participants who self-reported negative or unknown HIV status, by selected social risk factors — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011

	Total (N= 350)	
Characteristic	**n**	**%**
Told anyone that they are attracted to or have sex with men	316	90.3
Told gay, lesbian, or bisexual friends that they are attracted to or have sex with men	304	86.9
Told other friends not gay, lesbian, or bisexual friends that they are attracted to or have sex with men	266	76.0
Told family that they are attracted to or have sex with men	250	71.4
Told spouse/partner that they are attracted to or have sex with men†	0	0.0
Told health care provider that they are attracted to or have sex with men	168	48.0
Experienced any discrimination for sexual identity in last 12 months	130	37.1
Experienced verbal name-calling or insults because of sexual identity in last 12 months	73	20.9
Experienced poorer services in stores or restaurants because of sexual identity in last 12 months	47	13.4
Experienced unfair treatment at work or school because of sexual identity in last 12 months	70	20.0
Was denied or given lower health care because of sexual identity in last 12 months	12	3.4
Was physically attacked or injured because of sexual identity in last 12 months	17	4.9
Perceived stigma of gays and bisexuals	93	33.2
Total	**350**	**100.0**

Abbreviations: HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

† A total of 35 participants responded to this question.

Table 2.1—Factors associated with not HIV testing in the last 12 months, by demographic and other characteristics — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011*

	No HIV test in last 12 months (N=187)		OR	95% CI		P-value
Characteristic	**n**	**%**		**Lower**	**Upper**	
Age (yrs)						0.34
18-19	18	66.7	1.8	0.7	4.5	
20-24	33	53.2	0.9	0.4	1.7	
25-29	42	49.4	Referent			
30-39	46	47.9	0.8	0.4	1.5	
40-49	32	57.1	1.2	0.6	2.4	
≥50	16	66.7	1.8	0.7	4.7	
Education						0.48†
< High school graduate	8	66.7	1.5	0.4	5.3	
High school diploma or GED	45	57.7	Referent			
Some college or technical college	59	54.6	0.9	0.5	1.6	
College or higher education	75	49.3	0.7	0.4	1.2	
Type of health insurance						0.42
None	45	57.0	Referent			
Private only§	82	48.8	0.7	0.4	1.2	
Public only¶	36	58.1	1.0	0.5	2.1	
Other/multiple	24	58.5	1.1	0.5	2.3	
Annual household income**						0.45
≤$19,999	105	55.6	Referent			
$20,000 to $39,999	52	52.5	0.9	0.5	1.4	
$40,000 to $74,999	22	53.7	0.9	0.5	1.8	
≥$75,000	6	35.3	0.4	0.2	1.2	
Employment status						0.57
Employed (part- or full-time)	136	53.8	Referent			
Full-time student	23	60.5	1.3	0.7	2.6	
Unemployed	21	50.0	0.9	0.4	1.7	
Other	7	41.2	0.6	0.2	1.6	

Table 2.1—Factors associated with not HIV testing in the last 12 months, by demographic and other characteristics — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011*

	No HIV test in last 12 months (N=187)		OR	95% CI		P-value
Characteristic	**n**	**%**		**Lower**	**Upper**	
(continued)						
Sexual identity						0.58†
Homosexual	159	53.7	Referent			
Heterosexual	__††	__††	__††	__††	__††	
Bisexual	27	54.0	1.0	0.6	1.8	

Abbreviations: GED = general educational development; HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

† Fisher's exact test was performed to calculate p-value due to small cell counts below 5.

§ Coverage through private insurance policies or employer, TRICARE, CHAMPUS, or membership in a health maintenance organization.

¶ Coverage though Medicare, Medicaid, or Veterans Administration.

** Annual household income was collected from participants in ranges. These ranges were combined into four categories (ie. ≤$19,999, $20,000-$39,000, $40,000-74,999, and ≥$75,000) to allow for comparisons to NHBS surveillance data for the total men surveyed during the third NHBS MSM cycle. Income was not adjusted for household size because most of the participants had a household size of one.

†† Suppressed because the number or numerator was less than 5.

Table 2.2—Factors associated with not HIV testing in the last 12 months, by selected risk and health-related behaviors — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011*

	No HIV test in past 12 months (N=187)		OR	95% CI		P-value
Characteristic	**n**	**%**		**Lower**	**Upper**	
Number of male partners in last 12 months						**< 0.01**
0	17	77.3	5.1	1.7	15.1	
1	78	65.6	2.9	1.6	5.0	
2	27	41.5	1.1	0.6	2.0	
3	28	54.9	1.8	0.9	3.7	
≥ 4	36	40.0	Referent			
Unprotected anal sex with male partner in last 12 mo.†						0.41
No	82	56.2	Referent			
Yes	104	51.7	0.8	0.5	1.3	
Use internet to meet men for friendship or sex						0.53
No	75	55.6	Referent			
Yes	112	52.1	0.9	0.6	1.3	
Non-injection drug use in last 12 mo.						**0.01**
No	150	57.7	Referent			
Yes	37	41.6	0.5	0.3	0.9	
Current binge alcohol use§						0.32
No	54	55.1	Referent			
Yes	91	48.9	0.8	0.5	1.3	
Alcohol or drugs before or during last male sexual encounter						0.81
No	118	52.4	Referent			
Yes	51	51.0	0.9	0.6	1.5	
Last male partner type§						0.55¶
Main	32	42.1	Referent			
Casual	57	45.2	1.1	0.6	2.0	
Exchange	—††	—††	—††	—††	—††	
Last male partner HIV status						0.18¶
HIV-negative	68	46.3	Referent			
HIV-positive	6	60.0	1.7	0.5	6.4	
Unknown	94	56.3	1.5	1.0	2.3	

Table 2.2—Factors associated with not HIV testing in the last 12 months, by selected risk and health-related behaviors — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011*

	No HIV test in past 12 months (N=187)		OR	95% CI		P-value
Characteristic	**n**	**%**		**Lower**	**Upper**	
(continued)						
Visited health care provider in last 12 months						**0.01**
No	63	65.0	Referent			
Yes	124	49.0	0.5	0.3	0.8	
Diagnosed with sexually transmitted infection (STI) in last 12 mo.						0.50
No	176	53.0	Referent			
Yes	11	61.1	1.4	0.5	3.7	
Told health care provider that they are attracted to or have sex with men						**< 0.01**
No	113	62.1	2.1	1.4	3.2	
Yes	74	44.1	Referent			
Was denied or given lower health care because of sexual identity in last 12 months						0.73
No	180	53.3	Referent			
Yes	7	58.3	1.2	0.4	3.9	
Experienced any discrimination for sexual identity in last 12 mo.						0.57
No	115	52.3	Referent			
Yes	72	55.4	1.1	0.7	1.8	
Perceived stigma of gays and bisexuals						0.58
No	98	52.4	Referent			
Yes	52	55.9	1.2	0.7	1.9	

Abbreviations: GED = general educational development; HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

† Neither the participant nor his partner used a condom.

§ A main partner was a man with whom the participant had sex and to whom he felt most committed (e.g., boyfriend, spouse, significant other, or life partner). A casual partner was a man with whom the participant had sex but to whom he did not feel committed or whom he didn't know very well. An exchange partner was a man with whom the participant had sex in exchange for something such as money or drugs.

¶ Fisher's exact test was performed to calculate p-value due to small cell counts below 5.

** Alcoholic beverage was defined as a 12-oz beer, 5-oz glass of wine, or 1.5 shot of liquor. Participants who drank at least one alcoholic beverage during the past 30 days were considered "current." Participants who drank on average more than two alcoholic beverages per day in the 30 days before the interview were considered "heavy." Participants who drank more than five alcoholic beverages at one sitting in the 30 days before the interview were considered "binge."

†† Suppressed because the number or numerator was less than 5.

Table 3—Multivariate logistic regression model for not HIV testing in the last 12 months — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011*

Characteristic	AOR	95% CI		P-value
		Lower	Upper	
Age (yrs)				0.55
18-19	1.2	0.4	3.5	
20-24	0.7	0.3	1.4	
25-29	Referent			
30-39	0.7	0.4	1.5	
40-49	0.9	0.4	1.9	
≥50	1.5	0.5	4.4	
Education				0.82
< High school graduate	1.2	0.3	4.5	
High school diploma or GED	Referent			
Some college or technical college	1.0	0.5	1.9	
College or higher education	0.8	0.4	1.5	
Type of health insurance				
None	Referent			0.44
Private only†	0.7	0.4	1.3	
Public only§	1.2	0.6	2.4	
Other/multiple	1.1	0.5	2.6	
Told health care provider that they are attracted to or have sex with men				< 0.01
No	2.0	1.3	3.2	
Yes	Referent			
Number of male partners in past 12 months				< 0.01
0	4.1	1.3	12.7	
1	2.7	1.5	5.0	
2	0.8	0.4	1.7	
3	1.6	0.8	3.4	
≥ 4	Referent			

Abbreviations: GED = general educational development; HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

† Coverage through private insurance policies or employer, TRICARE, CHAMPUS, or health maintenance organization.

§ Coverage though Medicare, Medicaid, or Veterans Administration.

Table 4—Associations between the use of prevention services and not HIV testing in the last 12 months — Puerto Rico, National HIV Behavioral Surveillance System: Men Who Have Sex with Men, 2011*

	No HIV test in past 12 months (N=187)		OR	95% CI		P-value
Characteristic	**n**	**%**		**Lower**	**Upper**	
Tested for syphilis in past 12 months						< 0.01
No	163	64.2	Referent			
Yes	22	23.4	0.2	0.1	0.3	
Received free condoms in past 12 months						< 0.01
No	77	70.0	Referent			
Yes	110	45.8	0.4	0.2	0.6	
Received either individual or group-level HIV prevention intervention[†§]						< 0.01
No	160	61.5	Referent			
Yes	27	30.0	0.3	0.2	0.4	
Participated in alcohol or drug treatment program[¶]						1.00[††]
Never	183	53.5	Referent			
>12 mo. before interview	—[**]	—[**]	—[**]	—[**]	—[**]	
≤12 mo. before interview	—[**]	—[**]	—[**]	—[**]	—[**]	

Abbreviations: HIV = human immunodeficiency virus

* Numbers might not add to totals because of missing or unknown data.

[†] One-on-one conversation with an outreach worker, a counselor, or a prevention program worker about ways to protect against HIV or other sexually transmitted diseases.

[§] Small-group discussion about ways to protect against HIV or other sexually transmitted diseases.

[¶] Length of time since participating in an alcohol or drug treatment program.

[**] Suppressed because the number or numerator was less than 5.

[††] Fisher's exact test was used due to having at least one cell count less than 5.

APPENDIX A: SAS Code

```
************************************************************
************************************************************
Program: PR MSM3_Data Analysis for Thesis
Date: 12/27/2012
Programmer: Johanna Chapin
Details: This dataset contains all the work Johanna has done
to clean data, exclude ineligibles, create new variables
and conduct HIV testing analysis for Puerto Rico MSM3;
************************************************************
************************************************************;

OPTIONS  NOFMTERR  ;
libname pr '\\cdc\project\NCHHSTP_BCSB_Data\BST_OTHER\Johanna Chapin';

libname library '\\cdc\project\NCHHSTP_BCSB_Data\BST_OTHER\Johanna
Chapin\Limited data for MSM3\Formats\';

%include '\\cdc\project\NCHHSTP_BCSB_Data\BST_OTHER\Johanna
Chapin\Limited data for MSM3\PR MSM3_formats.sas';

proc contents data=pr.msm3_limited_rev (read='JC9999');
run;
proc freq data=pr.msm3_limited_rev(read='JC9999');
tables e_part age cityname e_city gender birthsex e_evrmsm e_able
e_ablea consenta consentb hivcnstb validity td_hivrslt el_msm cycle;
run;

************************************************
EXCLUDE INELIGIBLES, NON-CONSENTERS, and INVALIDS
************************************************;
*Consent;
data work.msm3_PR; **n=371;
      set pr.msm3_limited_rev (read='JC9999');
      if el_msm=1 and consenta=1 and complete=1 and (consentb=1 or
      hivcnstb=1);
run;

*Validity/completion;
data work.msm3_PR2; **n=364;
      set work.msm3_PR;
      if td_hivrslt in (0,1) and validity in (1,2);
run;

************
EXPLORATORY
************;
proc freq data=work.msm3_PR2;
tables age school hhincom depend empstat hispanic hisptypa hisptypb
      hisptypc hisptypd hisptype _raceomb currhlth typ_insa typ_insb
      typ_insc typ_insd typ_inse typ_insf typ_insg identity out_gi
      out_gia out_gib out_gic out_gid out_gie evertest evrpos
      td_hivrslt rcntrslt venue ;
run;

proc freq data=work.msm3_PR2;
```

```
tables      m_fdebut m_mdebut m_fever m_mever m_msx12 m_mlpty m_mlkno
            m_mlhiv m_mlra M_FSX12 alc30 ALCMAVG ALC5
            alc30*ALCMAVG*ALC5 RCNTRSLT/list;
run;

*****************************************
      CREATING NEW VARIABLES/DATASET
*****************************************;

data work.msm3_PR3a;
      set work.msm3_PR2;

******************
DEMOGRAPHICS/STATUS
******************;

*Age;
       if age in (18 19) then _agecat=1;
else if age in (20 21 22 23 24) then _agecat=2;
else if age in (25 26 27 28 29) then _agecat=3;
else if age in (30 31 32 33 34 35 36 37 38 39) then _agecat=4;
else if age in (40 41 42 43 44 45 46 47 48 49) then _agecat=5;
else if age ge 50 then _agecat=6;
else __agecat=.;

*Age-3 level;
       if age in (18 19 20 21 22 23 24) then _agecat3=1;
else if age in (25 26 27 28 29 30 31 32 33 34) then _agecat3=2;
else if age ge 35 then _agecat3=3;
else __agecat3=.;
*Note: Tried different categories for age, school, income, _mpartcat,
and others, but only am presenting the code for the categories I chose
to model in the end;

*School;
      if school in (0 1 2) then _schoolcat=1; *never attended school,
grades 1-8, grades 9-11;
else if school =3 then _schoolcat=2; *grade 12 or ged;
else if school =4 then _schoolcat=3; *some college/associates;
else if school in (5 6) then _schoolcat=4;  *bachelor's degree, any
post grad studies;
else _schoolcat=.;

      *School--3levels;
      if school in (0 1 2 3) then _school3=1; *high school or less;
      else if school =4 then _school3=2;  *some college/associates;
      else if school in (5 6)then _school3=3;   *bachelor's degree, any
post grad studies;
      else _school3=.;

*recoding currhlth;
if currhlth=1 then _currhlthcat=1;
      else if currhlth=0 then _currhlthcat=2;
      else _currhlthcat=.;
if currhlth in (.D,.R,.S,.) then do;_insutot= .U; _insux=.U; end;
else if currhlth=1 then do;
      if typ_insa=.R then _insux=4; **one obs that has current health
insurance, but no specified type, place in other;
```

```
      _insutot=
sum(typ_insa,typ_insb,typ_insc,typ_insd,typ_inse,typ_insf,typ_insg);
           if _insutot=0 and typ_insa=0   then _insux=1;*none;
      else if _insutot=1 and typ_insa=1   then _insux=2;*private only;
      else if _insutot=1 and typ_insb=1   then _insux=3;*Medicaid/Publ;
      else if _insutot=1 and typ_insc=1   then _insux=3;*Medicare/Publ;
      else if _insutot=1 and typ_insd=1   then _insux=3;*some other
      govt plan -- public only;
      else if _insutot=1 and typ_inse=1   then _insux=2*tricare/champus
      -- private only;
      else if _insutot=1 and typ_insf=1   then _insux=3;*VA coverage --
      public only;
      else if _insutot=1 and typ_insg=1   then _insux=4;*other;
      else if _insutot gt 1                     then _insux=4;
      *multiple;
      else if typ_insa=.R                       then _insux=4;**one obs
      that has current health insurance, but no specified type so
      considered other here;
      else                                                _insux=.U;
end;
else if currhlth =0 then do; _insutot=0; _insux=1;  end;
label _insux='F: Mutually exclusive insurance';
drop _insutot;
* In MSM2 (Finlayson, HIV Risk, 2008), categorized accordingly: none,
private only (e.g., health insurance obtained through a private
insurance policy or employer, TRICARE, CHAMPUS, or membership in a
health maintenance organization), public only (e.g., Medicare,
Medicaid, or Veterans Administration coverage), or other coverage;

*Income;
      if hhincom in (0 1 2 3 4) then _hhincomcat=1;   *0-19,999;
else if hhincom in (5 6 7 8) then _hhincomcat=2;  *20,000-39,999;
else if hhincom in (9 10 11) then _hhincomcat=3; *40,000-64,999;
else if hhincom =12 then _hhincomcat=4;           *75,000+;
else _hhincomcat=.;

*Poverty;
      if hhincom=.D or hhincom=.R or depend=.S or depend=.R       then
_poverty=.;
else if hhincom in (0,1)                                  then _poverty=1;
else if hhincom in (0,1,2)             and depend >1  then _poverty=1;
else if hhincom in (0,1,2,3)           and depend >2  then _poverty=1;
else if hhincom in (0,1,2,3,4)         and depend >3  then _poverty=1;
else if hhincom in (0,1,2,3,4,5)       and depend >6  then _poverty=1;
else if hhincom in (0,1,2,3,4,5,6)     and depend >8  then _poverty=1;
else if hhincom in (0,1,2,3,4,5,6,7)   and depend >11 then _poverty=1;
else if hhincom in (0,1,2,3,4,5,6,7,8) and depend >18 then _poverty=1;
else _poverty=2;

*Employment Status;
       if empstat in (1 2) then _empcat=1; *employed part or full;
else if empstat in (3 5 6 8)   then _empcat=4; *homemaker, retired,
disabled, other into other;
else if empstat =4 then _empcat=2;*student;
else if empstat =7 then _empcat=3;*unemployed;
else  _empcat=.;

*Sexual Orientation --> used identity --> reference=1, homosexual;
```

```
*Told anyone attracted to;
      *combined gay-identified and non-gay identified (6)...no overlap
btw these gay/nongay;
if out_gi in (.D,.R,.S,.) or out_ngi in (.D,.R,.S,.) then _out=.;
if out_gi =1 or out_ngi=1 then _out=1;
else if out_gi=0 or out_ngi=0 then _out=2;

if _out=1 then do;
            if out_gia=1 or out_ngia=1 then _outa=1; *Gay, lesbian, or
            bisexual friends;
      else if out_gia=0 or out_ngia=0 then _outa=2;
      else _outa=.;
            if out_gib=1 or out_ngib=1 then _outb=1; *Friends who are
            not gay, lesbian, or bisexual;
      else if out_gib=0 or out_ngib=0 then _outb=2;
      else _outb=.;
            if out_gic=1 or out_ngic=1 then _outc=1; *Family members;
      else if out_gic=0 or out_ngic=0 then _outc=2;
      else _outc=.;
            if out_gid=1 or out_ngid=1 then _outd=1; *Spouse or
            partner;
      else if out_gid=0 or out_ngid=0 then _outd=2;
      else _outd=.;
            if out_gie=1 or out_ngie=1 then _oute=1; *Health care
            provider;
      else if out_gie=0 or out_ngie=0 then _oute=2;
      else _oute=.;
      end;
if _out=2 then _outa=2;
if _out=2 then _outb=2;
if _out=2 then _outc=2;
if _out=2 then _outd=2;
if _out=2 then _oute=2;

*Venue;
if cycle=1 then do;
                  _ventype=upcase(substr(venue,1,1));
            if _ventype notin ('B' 'C' 'D' 'E' 'F' 'G' 'O' 'P' 'R' 'S'
'V' 'X' 'Z') then _ventype='U';
             end;
else _ventype=.;
label  _ventype = "Venue type";

*VENCAT;
      if _ventype='B' then _vencat=1;*bar;
else if _ventype='C' then _vencat=2; *cafe;
else if _ventype='D' then _vencat=3; *dance;
else if _ventype='O' then _vencat=4; *social org;
else if _ventype='X' then _vencat=5; *sex estab;
else if _ventype='Z' then _vencat=6; *other;
else _vencat=.;

*Self-reported HIV status;
if evertest=1 then do;
      if rcntrslt=1 then _hivstat= 0; *negative;
            else if rcntrslt=2 or (EVRPOS=1 and rcntrslt in (3,4))
then _hivstat=1; *positive, (everpos and rcnrslt never obtained or
indeterm);
```

```
            else if rcntrslt=3 then _hivstat= 2; *tested but no result
received;
            else if rcntrslt=4 then _hivstat= 3; *tested and
indeterminant;
            else                    _hivstat=.; *;
            end;

else if evertest=0 then _hivstat=4; *untested;
else                    _hivstat=.;

*HIVSTATCAT --> no indeterminants;
      if _hivstat=0 then _hivstatcat=2; *negative **referent**;
else if _hivstat=1 then _hivstatcat=1; *positive;
else if _hivstat=2 then _hivstatcat=3; *no results;
else _hivstatcat=.;

**EVER HIV tested;
if evertest=0 then _evertest=2; *never tested  **referent**;
else if evertest=1 then _evertest=1; *tested, ever;
else _evertest=.;

*HIV test results--awareness;
if td_hivrslt=1 then do;
      if _hivstat ne 1 then _hivunaware=1; *HIV pos, unaware;
      else _hivunaware=2;                  *HIV pos, aware;
      end;
else if td_hivrslt=0 then _hivunaware=3;  *HIV neg;
else _hivunaware=.;

*HIVRSLTCAT;
      if td_hivrslt=1 then _hivrsltcat=1; *positive;
else if td_hivrslt=0 then _hivrsltcat=2; *neg **referent**;
else _hivrsltcat=.;

**************
RISK BEHAVIORS
**************;

*Age of sexual debut;

**Male only debut;
      if m_mdebut = 0 then m_mdebut=.;  *excluding 0 values in order to
get unskewed mean/med;

      if m_mdebut > 0 and m_mdebut <15 then m_mdebut2=1;
else if m_mdebut ge 15 and m_mdebut le 24 then m_mdebut2=2;
else if m_mdebut ge 25 and m_mdebut le 34 then m_mdebut2=3;
else if m_mdebut ge 35 and m_mdebut le 49 then m_mdebut2=4;
else if m_mdebut ge 50 then m_mdebut2=5;
else m_mdebut2=.;

      if m_mdebut > 0 and m_mdebut < 15 then m_mdebut2a=1; *>=15, <15;
else if m_mdebut ge 15 then m_mdebut2a=2;
else m_mdebut2a=.;

**Female only debut;
      if m_fdebut = 0 then m_fdebut=.;    *excluding 0 values in order
to get unskewed mean/med;
```

```
      if m_fdebut > 0 and m_fdebut <15 then m_fdebut2=1;
else if m_fdebut ge 15 and m_fdebut le 24 then m_fdebut2=2;
else if m_fdebut ge 25 and m_fdebut le 34 then m_fdebut2=3;
else if m_fdebut ge 35 and m_fdebut le 49 then m_fdebut2=4;
else if m_fdebut ge 50 then m_fdebut2=5;
else m_fdebut2=.;

      if m_fdebut > 0 and m_fdebut < 15 then m_fdebut2a=1;  *>=15, <15;
else if m_fdebut ge 15 then m_fdebut2a=2;
else m_fdebut2a=.;

**Either male or female debut ;
      if m_fdebut > 0 and m_fdebut < 15 then agedeb=1;
else if m_mdebut > 0 and m_mdebut <15 then agedeb=1;
else if m_fdebut ge 15 or m_mdebut ge 15 then agedeb=2;
else agedeb=.;

      if m_fdebut > 0 and m_fdebut < 15 then agedeb2=1;
else if m_mdebut >0 and m_mdebut <15 then agedeb2=1;
else if m_fdebut ge 15 and m_fdebut le 24 then agedeb2=2;
else if m_mdebut ge 15 and m_mdebut le 24 then agedeb2=2;
else if m_fdebut ge 25 and m_fdebut le 34 then agedeb2=3;
else if m_mdebut ge 25 and m_mdebut le 34 then agedeb2=3;
else if m_fdebut ge 35 and m_fdebut le 49 then agedeb2=4;
else if m_mdebut ge 35 and m_mdebut le 49 then agedeb2=4;
else if m_fdebut ge 50 then agedeb2=5;
else if m_mdebut ge 50 then agedeb2=5;
else agedeb2=.;

**mean/median;
      if m_fdebut > 0 and m_fdebut < m_mdebut then agedeb3=m_fdebut;
else if m_mdebut > 0 and m_mdebut < m_fdebut then agedeb3=m_mdebut;
else if m_fdebut in (.,.S,.D,.R) and m_mdebut >0 then agedeb3=m_mdebut;
else if m_mdebut in (.,.S,.D,.R) and m_fdebut >0 then agedeb3=m_fdebut;
else if m_fdebut > 0 and m_mdebut >0 and m_mdebut = m_fdebut then
agedeb3=m_mdebut;
else agedeb3=.;

*# of male partner in last 12mo;
if m_msx12=0 then _mpartcat=1;
else if m_msx12=1 then _mpartcat=2;
else if m_msx12=2 then _mpartcat=3;
else if m_msx12=3 then _mpartcat=4;
else if m_msx12 ge 4 then _mpartcat=5;
else _mpartcat=.;

      *# of male partner in last 12mo--4 level;
      if m_msx12=0 then _mpartcat4=0;
      else if m_msx12=1 then _mpartcat4=1;
      else if m_msx12 in (2,3) then _mpartcat4=2;
      else if m_msx12 ge 4 then _mpartcat4=3;
      else _mpartcat4=.;

*Unprotected anal sex with male partner in past 12 mo;
*****************************************************************;
**** (((((((MALE PARTICIPANT - MALE PARTNER: M-M)))))))))))*********
                  ***(((No. main partners)))***;
*****************************************************************;
```

```
M_MEVER=e_evrmsm;

       if gender =1 and (m_mever=0 or m_msx12=0)      then _m_m_m_n= 0;
else if gender =1  and m_mever=1 then do;

       if m_msx12 >1 and m_mmsx>=1              then _m_m_m_n= m_mmsx;
else if m_msx12= 1 and m_m1sx= 1                then _m_m_m_n= 1;
else if m_msx12> 0 and m_mmsx=.D or m_m1sx=.D   then _m_m_m_n=.U;
else if m_msx12> 0 and m_mmsx=.R or m_m1sx=.R   then _m_m_m_n=.U;
else if m_msx12> 0 and m_mmsx= 0 or m_m1sx= 2   then _m_m_m_n= 0;
else
_m_m_m_n=.U;
end;
else
_m_m_m_n=.U;

***(((No. casual partners)))***;
       if gender =1 and (m_mever=0 or m_msx12=0)      then _m_m_c_n= 0;
else if gender =1 and m_mever=1 then do;

       if m_msx12 >1 and m_mcsx>=1                    then _m_m_c_n=
m_mcsx;
else if m_msx12 =1 and m_m1sx= 2                      then _m_m_c_n= 1;
else if m_msx12=m_mmsx                                then _m_m_c_n= 0;
else if m_msx12 >0 and m_mcsx=.D or m_m1sx=.D   then _m_m_c_n=.U;
else if m_msx12 >0 and m_mcsx=.R or m_m1sx=.R   then _m_m_c_n=.U;
else if m_msx12 >0 and m_mcsx= 0 or m_m1sx= 1   then _m_m_c_n= 0;
else
       _m_m_c_n=.U;
end;
else
_m_m_c_n=.U;

********* ((((((((((((MALE=MALE: ANAL SEX))))))))))))))))))********;
            ***(((No. main anal sex partner)))***;
       if _m_m_m_n= 0                                 then _m_m_mas_n= 0;
else if _m_m_m_n=.U                                   then _m_m_mas_n=.U;

else if gender=1 and _m_m_m_n>=1 then do;
       if m_mmas>=1 or m_mm1as= 1 then _m_m_mas_n =
max(m_mmas,m_mm1as);
else if m_mmas=.D or m_mm1as=.D then _m_m_mas_n =.U;
else if m_mmas=.R or m_mm1as=.R then _m_m_mas_n =.U;
else if m_mmas= 0 or m_mm1as= 0 then _m_m_mas_n = 0;
else                                                   _m_m_mas_n =.U;
end;

***(((No. casual anal sex partner)))***;
       if _m_m_c_n= 0                                 then _m_m_cas_n= 0;
else if _m_m_c_n=.U                                   then _m_m_cas_n=.U;
else if gender=1 and _m_m_c_n>=1 then do;
       if m_moas>=1 or m_mo1as= 1 then _m_m_cas_n =
max(m_moas,m_mo1as);
else if m_moas= 0 or m_mo1as= 0 then _m_m_cas_n = 0;
else if m_moas=.D or m_mo1as=.D then _m_m_cas_n =.U;
else if m_moas=.R or m_mo1as=.R then _m_m_cas_n =.U;
else                                                   _m_m_cas_n =.U; end;

***(((Had an anal sex partner)))***;
```

```
       if _m_m_mas_n>=1 or  _m_m_cas_n>=1 then _m_m_as= 1;
else if _m_m_mas_n= 0 and _m_m_cas_n= 0 then _m_m_as= 0;
else if _m_m_mas_n=.U or  _m_m_cas_n=.U then _m_m_as=.U;
else
_m_m_as=.U;

*************(((((((((((MALE=MALE:  UNPROTECTED ANAL
SEX))))))))))))))))*************************;
***(((No. main unprotected anal sex partner)))***;
     if _m_m_mas_n= 0                    then _m_m_muas_n= 0;
else if _m_m_mas_n=.U                    then _m_m_muas_n=.U;
else if _m_m_mas_n >=1 and gender=1 then do;

       if m_mmuas>=1 or m_mm1uas>=1       then _m_m_muas_n=
max(m_mmuas,m_mm1uas);
else if m_mmuas= 0 or m_mm1uas= 0   then _m_m_muas_n= 0;
else if m_mmuas=.D or m_mm1uas=.D   then _m_m_muas_n=.U;
else if m_mmuas=.R or m_mm1uas=.R   then _m_m_muas_n=.U;
else                                                 _m_m_muas_n=.U;
end;

***(((No. casual unprotected anal sex partner)))***;
       if _m_m_cas_n= 0                  then _m_m_cuas_n= 0;
else if _m_m_cas_n=.U                    then _m_m_cuas_n=.U;
else if _m_m_cas_n >=1 and gender=1 then do;

       if m_mouas >=1 or m_mo1uas >=1 then _m_m_cuas_n=
max(m_mouas,m_mo1uas);
else if m_mouas = 0 or m_mo1uas = 0 then _m_m_cuas_n= 0;
else if m_mouas =.D or m_mo1uas =.D then _m_m_cuas_n=.U;
else if m_mouas =.R or m_mo1uas =.R then _m_m_cuas_n=.U;
else                                                 _m_m_cuas_n=.U;
end;

***(((Had an unprotected anal sex partner)))***;
       if _m_m_muas_n>=1 or  _m_m_cuas_n>=1  then _m_m_uas= 1;
else if _m_m_muas_n= 0 and _m_m_cuas_n= 0  then _m_m_uas= 2; *coded
with 2 bc going to use sudaan;
else if _m_m_muas_n=.U or  _m_m_cuas_n=.U  then _m_m_uas=.U;
else
_m_m_uas=.U;


*Last male partner type ... include exchange as separate...but no way
to get main and casual together...
      *For main/casual, use m_mlpty ... for exchange, use m_mleg and
m_mler;
      if m_mleg=1 or m_mler=1 then _parttypcat=3; *exchange;
else if m_mlpty=1 then _parttypcat=1;                        *main;
else if m_mlpty=2 then _parttypcat=2;                        *casual;
else _parttypcat=.;

*Age of last male partner;
      *Used m_mlra...categorized as younger, older, same;
if m_mlra=0 then _partage=2;                *younger;
else if m_mlra=1 then _partage=3;   *older;
else if m_mlra=2 then _partage=1;   *same;
else _partage=.;
```

```
*Last male partner serostatus;
if m_mlkno =0 then _parthivstat = 3;      *no, didn't know;
else if m_mlkno =1 and m_mlhiv=1 then _parthivstat=1; *know, negative;
else if m_mlkno =1 and m_mlhiv=2 then _parthivstat=2; *know, positive;
else if m_mlkno =1 and m_mlhiv=3 then _parthivstat=3; *know,
indeterminant;
else _parthivstat=.;

*Number of female partners in last 12 mo;
if m_fsx12 ge 1 then _fpartcat=1;
else if m_fsx12=0 then _fpartcat=2;
else _fpartcat=.;

*Alcohol use;
if alc30 ge 1 and alc30 le 30 then alc_curr=1; *if drank at least once
in last 30 days, then 'current';
else if alc30=0 then alc_curr=2;
else alc_curr=.;

if alcmavg > 2 then alc_hvy=1;      *if drank on average more than two
drinks/day in last 30 days then 'heavy';
else if alcmavg in (1,2) then alc_hvy=2; * just one drink;
else alc_hvy=.;

if alc5 ge 1 then alc_bng=1; *if drank more than five alcoholic bevs at
one sitting then 'binge';
else if alc5 = 0 then alc_bng=2;
else alc_bng=.;

*Alcohol or drugs before or during last sex;
if m_mlhi in (1,2,3) then _lsalcdrg=1;
else if m_mlhi =4 then _lsalcdrg=2;
else _lsalcdrg=.;

*Non-injection drug use;
      if niuse12 = 1 then _ninjuse=1;
else if niuse12 = 0 then _ninjuse=2;
else _ninjuse=.;

*Injection drug use;
      if evrinj = 1 then _everinjuse=1;
else if evrinj = 0 then _everinjuse=2;
else _everinjuse=.;

      if linj12 = 1 then _injuse12=1;
else if linj12 = 0 then _injuse12=2;
else _injuse12=.;

*Incarceration;
      if evheld = 1 then _everincar=1;
else if evheld = 0 then _everincar=2;
else _everincar=.;

if evheld=1 then do;
      if held12m=1 then _incar12=1;
      else if held12m=0 then _incar12=2;
      end;
else if evheld=0 then _incar12=2;
else _incar12=.;
```

```
*Use internet to meet men for friendship or sex;
if m_mint ge 1 then _minternet=1;
else if m_mint =0 then _minternet=2;
else _minternet=.;

*Experience discrimination for sexual identity in last 12 months --> no
missing, no need to play within _discrim --> gay and non-gay mutually
exclusive so no overlap;
      if    disc_gia=1 or disc_gib=1 or disc_gic=1 or disc_gid=1 or
disc_gie=1 or disc_nga=1 or disc_ngb=1 or disc_ngc=1 or disc_ngd=1 or
disc_nge=1 then _discrim=1;
else if disc_gia=0 and disc_gib=0 and disc_gic=0 and disc_gid=0 and
disc_gie=0 then _discrim=2;
else if disc_nga=0 and disc_ngb=0 and disc_ngc=0 and disc_ngd=0 and
disc_nge=0 then _discrim=2;
else _discrim=.;

      if disc_gia=1 or disc_nga=1 then _disca=1; *Verbal discrim ;
else if disc_gia=0 or disc_nga=0 then _disca=2;
else _disca=.;
      if disc_gib=1 or disc_ngb=1 then _discb=1; *poorer services ;
else if disc_gib=0 or disc_ngb=0 then _discb=2;
else _discb=.;
      if disc_gic=1 or disc_ngc=1 then _discc=1; *treated unfairly ;
else if disc_gic=0 or disc_ngc=0 then _discc=2;
else _discc=.;
      if disc_gid=1 or disc_ngd=1 then _discd=1;  lower health care;
else if disc_gid=0 or disc_ngd=0 then _discd=2;
else _discd=.;
      if disc_gie=1 or disc_nge=1 then _disce=1; *physically attacked;
else if disc_gie=0 or disc_nge=0 then _disce=2;
else _disce=.;

*Perceived stigma of gays and bisexuals;
if tol_gi=1 or tol_gi=2 or tol_ng=1 or tol_ng=2 then _stigma=2;
*strongly agree or agree;
else if tol_gi=4 or tol_gi=5 or tol_ng=4 or tol_ng=5 then _stigma=1;
*strongly disagree or disagree;
else _stigma=.; *neither agree nor disagree, don't know, refuse,
missing;

*Most recent HIV test (never, >12mo, <12mo);
_idate_yr=year(idate);
_idate_mo=month(idate);
_yearsslt=_idate_yr-rcntsty;
_mosbtn=_idate_mo-rcntstm;
_monthsslt=(_yearsslt*12)+ _mosbtn;

_mostrcntest12=.X;
      if EVERTEST=0           then _mostrcntest12= 3; *never;
else  if EVERTEST=1           then do;
            if 0 =< _monthsslt <=12            then _mostrcntest12= 1;
      else if _monthsslt >12                   then _mostrcntest12= 2;
*tested >12mo;
      else if (_monthsslt=. and C_RCNTST=1) or (RCNTSTY=_idate_yr and
RCNTSTY>1000)                                  then _mostrcntest12= 1;
*tested in same calendar year or confirmed tested in past 12 mos;
```

```
      else if _monthsslt= . and  (_idate_yr-RCNTSTY>=2)
                                                then _mostrcntest12= 2;
*tested over two calendar years ago;
      else if _monthsslt= . and C_RCNTST=0      then _mostrcntest12= 2;
*confirmed tested over 12 mos ago;
      else if _monthsslt= . and  (TST1STY=_idate_yr and TST1STY>1000)
                                                then _mostrcntest12= 1;
*first test was in same calendar year;
else _mostrcntest12=.U;
end;
else if EVERTEST in (.,.D,.R,.S)                then _mostrcntest12=.U;

*HIV test in last 12 months;
_idate_yr=year(idate);
_idate_mo=month(idate);
_yearsslt=_idate_yr-rcntsty;
_mosbtn=_idate_mo-rcntstm;
_monthsslt=(_yearsslt*12)+ _mosbtn;

_lasthivtest12=.X;
            if EVERTEST=0                       then _lasthivtest12= 2;
else  if EVERTEST=1              then do;
            if 0 =< _monthsslt <=12             then _lasthivtest12= 1;
      else if _monthsslt >12                    then _lasthivtest12= 2;
      else if (_monthsslt=. and C_RCNTST=1) or (RCNTSTY=_idate_yr and
RCNTSTY>1000)                                   then _lasthivtest12= 1;
*tested in same calendar year or confirmed tested in past 12 mos;
      else if _monthsslt= . and (_idate_yr-RCNTSTY>=2)
                                                then _lasthivtest12= 2;
*tested over two calendar years ago;
      else if _monthsslt= . and C_RCNTST=0      then _lasthivtest12= 2;
*confirmed tested over 12 mos ago;
      else if _monthsslt= . and  (TST1STY=_idate_yr and TST1STY>1000)
                                                then _lasthivtest12= 1;
*first test was in same calendar year;
else _lasthivtest12=.U;
end;
else if EVERTEST in (.,.D,.R,.S)                then _lasthivtest12=.U;

**Opposite HIV test coding;
_nlasthivtest12=.X;
      if EVERTEST=0                         then _nlasthivtest12= 1;
else  if EVERTEST=1               then do;
            if 0 =< _monthsslt <=12         then _nlasthivtest12= 2;
      else if _monthsslt >12                then _nlasthivtest12= 1;
      else if (_monthsslt=. and C_RCNTST=1) or (RCNTSTY=_idate_yr and
RCNTSTY>1000)                               then _nlasthivtest12= 2;
*tested in same calendar year or confirmed tested in past 12 mos;
      else if _monthsslt= . and  (_idate_yr-RCNTSTY>=2)
                                            then _nlasthivtest12= 1;
*tested over two calendar years ago;
      else if _monthsslt= . and C_RCNTST=0 then _nlasthivtest12= 1;
*confirmed tested over 12 mos ago;
      else if _monthsslt= . and  (TST1STY=_idate_yr and TST1STY>1000)
                                            then _nlasthivtest12= 2;
*first test was in same calendar year;
else _nlasthivtest12=.U;
end;
else if EVERTEST in (.,.D,.R,.S)          then _nlasthivtest12=.U;
```

```
************************
****OUTCOME VARIABLE****
************************;
_ntst12=_nlasthivtest12;
************************;

*Visited health care provider during preceding year;
      if vsitmd12 = 1 then _vstmd12 =1;
else if vsitmd12  = 0 then _vstmd12 =2;
else _vstmd12 =.;

*Ever diagnosed with STI;
      if gonorr=1 or chlamyd=1 or syphilis=1 or othsti=1 then
_posstd=1;
else if gonorr=0 and chlamyd=0 and syphilis=0 and othsti=0 then
_posstd=2;
else _posstd=.;

*Syphilis;
      if syphilis = 1 then _syph=1;
else if syphilis = 0 then _syph=2;
else _syph=.;

*Gonorrhea;
      if gonorr = 1 then _gonorr=1;
else if gonorr = 0 then _gonorr=2;
else _gonorr=.;

*Chlamydia;
      if chlamyd = 1 then _chlamyd=1;
else if chlamyd = 0 then _chlamyd=2;
else _chlamyd=.;

*Other STI;
      if othsti = 1 then _othsti =1;
else if othsti  = 0 then _othsti =2;
else _othsti =.;
*************************
USE OF PREVENTION SERVICES
*************************;

*Tested for syphilis in past 12 mo;
if stdtest=1 then do;
      if tstsyph=1 then _testsyph=1;
      else if tstsyph=0 then _testsyph=2;
      else _testsyph=.;
      end;
else if stdtest=0 then _testsyph=2;
else _testsyph=.;

*Received free condoms in past 12 months;
      if cond12= 1 then _cond12 =1;
else if cond12  = 0 then _cond12 =2;
else _cond12 =.;

*Received individual HIV prevention intervention;
      if talkhiv= 1 then _previntind =1;
else if talkhiv  = 0 then _previntind =2;
```

```
else _previntind =.;

*Received group-level HIV prevention intervention;
      if group12= 1 then _previntgrp =1;
else if group12  = 0 then _previntgrp =2;
else _previntgrp =.;

*Received individual or group-level HIV prevention intervention;
if TALKHIV=1 or GROUP12=1 then _prevint=1;
else if TALKHIV=0 and GROUP12=0 then _prevint=2;
else if TALKHIV in (.S,.D,.R,.) and GROUP12=0 then _prevint=2;
else if TALKHIV=0 and GROUP12 in (.S,.D,.R,.) then _prevint=2;
else _prevint=.;

*Participated in alcohol or drug treatment program;
if altx=1 or dgtx=1 then do;
      if altx12m=1 or dgtx12m=1 then _aldgtxcat=1;*yes, in last 12 mo;
      else if altx12m in (.S, 0) and dgtx12m=0 then _aldgtxcat=2; *yes,
but > 12 mo ago;
      else if altx12m=0 and dgtx12m in (.S,0) then _aldgtxcat=2; *yes,
but > 12 mo ago;
      else _aldgtxcat=.;
      end;
else if altx=0 and dgtx=0 then _aldgtxcat=3;          *never;
else _aldgtxcat=.;

*Participated in JUST alcohol treatment program;
if altx=1 then do;
      if altx12m=1 then _altxcat=1;       *yes, and in last 12 mo;
      else if altx12m=0 then _altxcat=2;  *yes, but > 12 mo ago;
      else _altxcat=.;
      end;
else if altx=0 then _altxcat=3;           *never;
else if altx=.S then _altxcat=.;
else _altxcat=.;

*****************************************************
***  CREATING INTERACTION TERMS , RECODE 0/1 VARS ***
*****************************************************

**out--not told health care provider=1;
if _oute=2 then  _oute2=1;
else if _oute=1 then _oute2=0;
else  _oute2=.;

*Neg vs. Unaware comparison;
if _hivrsltcat=2 then _negunawarecat=1; *negative;
else if _hivrsltcat=1 and _hivunaware=1 then _negunawarecat=2;
*positive unaware;
else _negunawarecat=.;

_ageschool=_agecat*_schoolcat ;
_ageinsux=_agecat*_insux ;
_agemd=_agecat*vsitmd12 ;
_ageoute=_agecat*_oute2;
_agempart=_agecat*_mpartcat ;
_ageniuse=_agecat*niuse12 ;
_schoolinsux=_schoolcat*_insux ;
_schoolmd=_schoolcat*vsitmd12 ;
```

```
_schooloute=_schoolcat*_oute2;
_schoolmpart=_schoolcat*_mpartcat ;
_schoolniuse=_schoolcat*niuse12 ;
_insuxmd=_insux*vsitmd12 ;
_insuxoute=_insux*_oute2;
_insuxmpart=_insux*_mpartcat;
_insuxniuse=_insux*niuse12 ;
_mdoute=vsitmd12*_oute2;
_mdmpart=vsitmd12*_mpartcat ;
_mdniuse=vsitmd12*niuse12 ;
_outempart=_oute2*_mpartcat ;
_outeniuse=_oute2*niuse12 ;
_mpartniuse=_mpartcat*niuse12 ;

*************************************************************;
***  RESTRICTING DATASET TO ANSWERING HIV TEST QUESTION  ***;
*************************************************************;

if _ntst12 in (.,.U,.X) then delete;
run;

*******************************************************;
***CREATING ANALYSIS DATASETS FOR NEGATIVES & UNAWARES***;
*******************************************************;
*for HIV testing among negatives and unawares;
data work.msm3_PR3;
      set work.msm3_PR3a;
      if _hivunaware=2 then delete;
run;

proc contents data=work.msm3_PR3;
run;

**TOTAL observations for analysis, n=350**;
*****************************************************
***************  Variable checks  *******************
*****************************************************;

*Dems;
proc freq data=work.msm3_PR3;
tables      age*_agecat _agecat school school*_schoolcat*_schooltri
            _schoolcat _schooltri hhincom*_hhincomcat _hhincomcat
            hhincom*depend*_poverty _poverty empstat*_empcat _empcat

            currhlth typ_insa typ_insb typ_insc typ_insd typ_inse
            typ_insf typ_insg
            currhlth*typ_insa*typ_insb*typ_insc*typ_insd*typ_inse*typ_i
            nsf*typ_insg
            typ_insa*typ_insb*typ_insc*typ_insd*typ_inse*typ_insf*typ_i
            nsg*_insux _insux currhlth*_currhlthcat

            identity out_gi*out_ngi*_out  out_gia*out_ngia*_outa
            out_gib*out_ngib*_outb
            out_gic*out_ngic*_outc out_gid*out_ngid*_outd
            out_gie*out_ngie*_oute
            _out _outa _outb _outc _outd _oute  _ventype*_vencat
            _ventype
```

```
            evertest*evrpos*rcntrslt*_hivstat td_hivrslt*_hivstat
            td_hivrslt*_hivstat*_hivunaware
            rcntrslt td_hivrslt _hivunaware _evertest
            td_hivrslt*_hivrsltcat _hivrsltcat
            _hivstat*_hivstatcat _hivstat _hivstatcat       /list ;
run;

proc univariate data=work.msm3_PR3;
var   age ;
histogram age/normal;  *skewed to the right a bit...kurtosis=0.68,
skewness=0.99...categorize for NHBS comparison;
run;

*Risk behaviors;
proc freq data=work.msm3_PR3;
tables      m_fdebut*m_mdebut*agedeb m_fdebut*m_mdebut*agedeb2
            m_fdebut*m_mdebut*agedeb3 m_mdebut*agedeb2
            agedeb agedeb2 m_mdebut*m_mdebut2 m_fdebut*m_fdebut2
            m_mdebut2 m_fdebut2 m_fdebut*m_fdebuta m_fdebut2a
            m_mdebut*m_mdebuta m_mdebut2a


            _mpartcat _m_m_uas m_mlpty*m_mleg*m_mler
            m_mlpty*m_mleg*m_mler*_parttypcat _parttypcat
            m_mlra*_partage _partage m_mlhiv*m_mlkno*_parthivstat
            _parthivstat m_fsx12*_fpartcat _fpartcat m_msx12*_mpartcat

            E_EVRMSM*m_mever  m_mmas m_moas m_mmuas m_mouas
            m_msx12*m_mmuas*m_mouas m_msx12*M_MMAS*M_MoAS _m_m_uas

            alc30*alc_curr alcmavg*alc_hvy alc5*alc_bng alc_curr
            alc_hvy alc_bng alc_curr*alc_hvy*alc_bng
            m_mlhi*_lsalcdrg _lsalcdrg niuse12*_ninjuse _ninjuse
            evrinj*_everinjuse _everinjuse linj12*_injuse12 _injuse12

            evheld*_everincar _everincar held12m*_incar12 _incar12
            m_mint*_minternet _minternet vsitmd12*_vstmd12 _vstmd12
            _posstd _syph _gonorr _chlamyd _othsti

            disc_gia*disc_gib*disc_gic*disc_gid*disc_gie*disc_nga*disc_
            ngb*disc_ngc*disc_ngd*disc_nge _discrim
            disc_gia*disc_nga*_disca _ntst12*disc_gib*_discb
            disc_ngb*_discb disc_gic*disc_ngc*_discc
            disc_gid*disc_ngd*_discd disc_gie*disc_nge*_disce
            _disca _discb _discc _discd _disce tol_gi*tol_ng*_stigma
            _stigma

            evertest*_monthsslt*c_rcntst*rcntsty*_idate_yr*tst1sty*_mos
            trcntest12
            evertest*_monthsslt*c_rcntst*rcntsty*_idate_yr*tst1sty*_las
            thivtest12 _mostrcntest12 _lasthivtest12 _nlasthivtest12
            _ntst12*_nlasthivtest12*_lasthivtest12 _ntst12 rent12m
            /list;
run;

proc univariate data=work.msm3_PR3;
var   agedeb3 m_mdebut m_fdebut m_msx12;
run;
```

```
*Use of prevention services;
proc freq data=work.msm3_PR3;
tables  _testsyph cond12*_cond12 _cond12 talkhiv*_previntind
        _previntind group12*_previntgrp _previntgrp
        _previnт*_previntind*_previntgrp _previnт
        altx*dgtx*altx12m*dgtx12m*_aldgtxcat _aldgtxcat
        altx*altx12m*_altxcat _altxcat*_aldgtxcat _altxcat  /list;
run;

************************************************
Table 1--Descriptive Total: Negatives & Unawares;
************************************************;

*Dems/Out/Testing;
proc freq data=work.msm3_PR3;
tables      _agecat _agecat3 _schoolcat currhlth _insux _hhincomcat
            _poverty _empcat  identity _ventype
            _out _outa _outb _outc _outd _oute _evertest
            _hivstatcat _hivunaware _mostrcntest12 _ntst12 rent12m
      /list ;
run;


proc univariate data=work.msm3_PR3;
var   age;
histogram age /normal;  *skewed to the right a
bit...kurtosis=0.68045655, skewness=0.99371685;
run;

*Risk behaviors;
proc freq data=work.msm3_PR3;
tables      agedeb m_mdebut2 m_fdebut2 m_mdebut2a m_fdebut2a
            _mpartcat _m_m_uas _parttypcat _partage _parthivstat
            _parteth _fpartcat
            alc_curr alc_hvy alc_bng _lsalcdrg _ninjuse _everinjuse
            _injuse12 linj12 _everincar _incar12 _minternet
            _discrim _disca _discb _discc _discd _disce _stigma
            _vstmd12 _posstd _syph _gonorr _chlamyd _othsti /list;
run;

proc univariate data=work.msm3_PR3;
var   m_msx12;
histogram m_msx12 /normal;
run;

*Use of prevention services;
proc freq data=work.msm3_PR3;
tables  _testsyph _cond12 _previntind _previntgrp _previnт
      _aldgtxcat _altxcat     /list;
run;

*Not testing for multiple partners--44.2%;
proc freq data=work.msm3_PR3;
tables  _ntst12;
where   _mpartcat ge 3;
run;

*Not testing for unawares--58.3%;
proc freq data=work.msm3_PR3;
```

```
tables  _ntst12;
where   _hivunaware =1;
run;


*****************************************************************
*                  TABLE 2: BIVARIATE ANALYSES                  *
*****************************************************************;

*****************************************************************
***************  No HIV test in last 12 months  ***************
***************  Negatives and Unawares (N=350) ***************
***************       Bivariate Analysis        ***************
*****************************************************************;

*Dems;
proc freq data=work.msm3_PR3;
tables      _ntst12*_agecat _ntst12*_schoolcat _ntst12*_currhlthcat
            _ntst12*_insux _ntst12*_hhincomcat _ntst12*_poverty
            _ntst12*_empcat _ntst12*identity _ntst12*_out _ntst12*_outa
            _ntst12*_outb _ntst12*_outc _ntst12*_outd _ntst12*_oute
            _ntst12*_ventype
            _ntst12*_hivrsltcat _ntst12*_hivstatcat _ntst12*_hivunaware
/chisq fisher;
run;

*Risks;
proc freq data=work.msm3_PR3;
tables      _ntst12*agedeb _ntst12*m_mdebut2a _ntst12*m_fdebut2a
            _ntst12*_m_m_uas _ntst12*_mpartcat _ntst12*_parttypcat
            _ntst12*_partage _ntst12*_parthivstat _ntst12*_fpartcat

            _ntst12*alc_curr _ntst12*alc_hvy _ntst12*alc_bng
            _ntst12*_lsalcdrg _ntst12*_ninjuse _ntst12*_everinjuse
            _ntst12*_injuse12 _ntst12*_everincar _ntst12*_incar12
            _ntst12*_minternet

            _ntst12*_discrim _ntst12*_disca _ntst12*_discb
            _ntst12*_discc _ntst12*_discd _ntst12*_disce
            _ntst12*_stigma _ntst12*rent12m

            _ntst12*_vstmd12 _ntst12*_posstd _ntst12*_syph
            _ntst12*_gonorr _ntst12*_chlamyd _ntst12*_othsti
/chisq fisher;
run;

*****************************************************************
*******************  Bivariate ORs  *************************
*****************************************************************;

*Dems;
proc logistic data=work.msm3_PR3;
      class _agecat  (ref='3')/ param=ref;
      model _ntst12 =  _agecat  ;
      run;

proc logistic data=work.msm3_PR3;
      class _schoolcat (ref='2')/ param=ref;
      model _ntst12 =  _schoolcat ;
```

```
      run;

proc logistic data=work.msm3_PR3;
      class _currhlthcat  (ref='2')/ param=ref;
      model _ntst12 =  _currhlthcat ;
      run;

proc logistic data=work.msm3_PR3;
      class _insux (ref='1')/ param=ref;
      model _ntst12 =  _insux ;
      run;

proc logistic data=work.msm3_PR3;
      class _hhincomcat (ref='1')/ param=ref;
      model _ntst12 =  _hhincomcat;
      run;

proc logistic data=work.msm3_PR3;
      class _poverty (ref='2')/ param=ref;
      model _ntst12 =  _poverty ;
      run;

proc logistic data=work.msm3_PR3;
      class _empcat (ref='1')/ param=ref;
      model _ntst12 =  _empcat;
      run;

proc logistic data=work.msm3_PR3;
      class identity (ref='2')/ param=ref;
      model _ntst12 =  identity ;
      run;

proc logistic data=work.msm3_PR3;
      class _out (ref='2')/ param=ref;
      model _ntst12 =  _out ;
      run;

proc logistic data=work.msm3_PR3;
      class _outa (ref='2')/ param=ref;
      model _ntst12 =  _outa ;
      run;

proc logistic data=work.msm3_PR3;
      class _outb (ref='2')/ param=ref;
      model _ntst12 =  _outb ;
      run;

proc logistic data=work.msm3_PR3;
      class _outc (ref='2')/ param=ref;
      model _ntst12 =  _outc ;
      run;

proc logistic data=work.msm3_PR3 ;
      class _oute (ref='1')/ param=ref; *ref=yes told;
      model _ntst12 =  _oute;
      run;

proc logistic data=work.msm3_PR3;
      class _vencat (ref='1')/ param=ref;;
```

```
      model _ntst12 =  _vencat ;
      run;

*Risks;
proc logistic data=work.msm3_PR3;
      class agedeb (ref='1')/ param=ref;
      model _ntst12 =  agedeb;
      run;

proc logistic data=work.msm3_PR3 ;
      class m_mdebut2a (ref='1')/ param=ref;
      model _ntst12 =  m_mdebut2a;
      run;

proc logistic data=work.msm3_PR3 ;
      class m_fdebut2a (ref='1')/ param=ref;
      model _ntst12 =  m_fdebut2a;
      run;

proc logistic data=work.msm3_PR3 ;
      class _mpartcat (ref='5')/ param=ref; *ref=4+ partners;
      model _ntst12 =  _mpartcat;
      run;

proc logistic data=work.msm3_PR3 ;
      class _m_m_uas (ref='2')/ param=ref;
      model _ntst12 =  _m_m_uas;
      run;

proc logistic data=work.msm3_PR3 ;
      class _parttypcat (ref='1')/ param=ref;
      model _ntst12 =  _parttypcat;
      run;

proc logistic data=work.msm3_PR3 ;
      class _partage (ref='1')/ param=ref;
      model _ntst12 =  _partage;
      run;

proc logistic data=work.msm3_PR3 ;
      class _parthivstat (ref='1')/ param=ref;
      model _ntst12 =  _parthivstat;
      run;

proc logistic data=work.msm3_PR3 ;
      class _fpartcat (ref='2')/ param=ref;
      model _ntst12 =  _fpartcat;
      run;

proc logistic data=work.msm3_PR3 ;
      class alc_curr (ref='2')/ param=ref;
      model _ntst12 =  alc_curr;
      run;

proc logistic data=work.msm3_PR3 ;
      class alc_hvy (ref='2')/ param=ref;
      model _ntst12 =  alc_hvy;
      run;
```

```
proc logistic data=work.msm3_PR3 ;
      class alc_bng (ref='2')/ param=ref;
      model _ntst12 =  alc_bng;
      run;

proc logistic data=work.msm3_PR3 ;
      class _lsalcdrg(ref='2')/ param=ref;
      model _ntst12 =  _lsalcdrg;
      run;

proc logistic data=work.msm3_PR3 ;
      class _ninjuse (ref='2')/ param=ref;
      model _ntst12 =  _ninjuse;
      run;

proc logistic data=work.msm3_PR3 ;
      class _everincar(ref='2')/ param=ref;
      model _ntst12 = _everincar;
      run;

proc logistic data=work.msm3_PR3 ;
      class _incar12 (ref='2')/ param=ref;
      model _ntst12 =  _incar12;
      run;

proc logistic data=work.msm3_PR3 ;
      class _minternet (ref='2')/ param=ref;
      model _ntst12 =  _minternet;
      run;

proc logistic data=work.msm3_PR3 ;
      class _discrim (ref='2')/ param=ref;
      model _ntst12 =  _discrim;
      run;

proc logistic data=work.msm3_PR3 ;
      class _disca (ref='2')/ param=ref;
      model _ntst12 =  _disca;
      run;

proc logistic data=work.msm3_PR3 ;
      class _discb (ref='2')/ param=ref;
      model _ntst12 =  _discb;
      run;

proc logistic data=work.msm3_PR3 ;
      class _discc (ref='2')/ param=ref;
      model _ntst12 =  _discc;
      run;

proc logistic data=work.msm3_PR3 ;
      class _discd (ref='2')/ param=ref;
      model _ntst12 =  _discd;
      run;

proc logistic data=work.msm3_PR3 ;
      class _disce (ref='2')/ param=ref;
      model _ntst12 =  _disce;
      run;
```

```
proc logistic data=work.msm3_PR3 ;
      class _stigma (ref='2')/ param=ref;
      model _ntst12 =  _stigma;
      run;

proc logistic data=work.msm3_PR3;
      class _vstmd12(ref='2')/ param=ref;
      model _ntst12 =  _vstmd12;
      run;

proc logistic data=work.msm3_PR3 ;
      class _posstd(ref='2')/ param=ref;
      model _ntst12 =  _posstd;
      run;

proc logistic data=work.msm3_PR3 ;
      class _syph (ref='2')/ param=ref;
      model _ntst12 =  _syph;
      run;

proc logistic data=work.msm3_PR3 ;
      class _gonorr(ref='2')/ param=ref;
      model _ntst12 =  _gonorr;
      run;

proc logistic data=work.msm3_PR3 ;
      class _chlamyd(ref='2')/ param=ref;
      model _ntst12 =  _chlamyd;
      run;

proc logistic data=work.msm3_PR3 ;
      class _othsti(ref='2')/ param=ref;
      model _ntst12 =  _othsti;
      run;

*********************************************************************
*****************   TABLE 3: MULTIVARIATE ANALYSIS  *****************
*********************************************************************;

*********************************************************************
*** ASSESSING COLLINEARITY : INCLUDING ALL 2-WAY INTERACTION TERMS ***
*********************************************************************;

*SAS macro;
%include '\\cdc\project\NCHHSTP_BCSB_Data\BST_OTHER\Johanna
Chapin\Limited data for MSM3\collin_2011.sas';

proc logistic data=work.msm3_PR3 covout outest=thesis;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 = _agecat _schoolcat _insux _mpartcat vsitmd12
                      _oute2 niuse12

      _ageschool _ageinsux _agemd _ageoute _agempart _ageniuse
      _schoolinsux _schoolmd _schooloute _schoolmpart _schoolniuse
      _insuxmd _insuxoute _insuxmpart _insuxniuse
      _mdoute _mdmpart _mdniuse
      _outempart _outeniuse
```

```
      _mpartniuse                    /link=glogit;
run;
%collin (covdsn=thesis, output=thesisout);
*Highest CI at   106.925...high VDPs above >0.05 only for _mpartcat, no
other variable with high VDP
Therefore conclude that there is no collinearity problem...
...move onto interaction assessment;

*********************************
*****  TESTING INTERACTIONS  *****
*********************************;

proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _mpartcat vsitmd12
                       _oute2 niuse12

      _ageschool _ageinsux _agemd _ageoute _agempart _ageniuse
      _schoolinsux _schoolmd _schooloute _schoolmpart _schoolniuse
      _insuxmd _insuxoute _insuxmpart _insuxniuse
      _mdoute _mdmpart _mdniuse
      _outempart _outeniuse
      _mpartniuse ;
run;

proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _mpartcat vsitmd12
                       _oute2 niuse12;
run;

*Chunk test:  LRR=   433.459 (18 df) - LRF= 421.560 (39 df)= 11.32 ...
Xsq with 21 df ~ p=0.96--> Not significant
*Still do BW elimination to see if any significant terms;

*Drop   _ageinsux from full interaction model above (0.9949, least
significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                       _oute2 niuse12

      _ageschool _agemd _ageoute _agempart _ageniuse
      _schoolinsux _schoolmd _schooloute _schoolmpart _schoolniuse
      _insuxmd _insuxoute _insuxmpart _insuxniuse
      _mdoute _mdmpart _mdniuse
      _outempart _outeniuse
      _mpartniuse ;
run;

*Drop    _schoolinsux (0.9381, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                       _oute2 niuse12
```

```
                        _ageschool _agemd _ageoute _agempart _ageniuse
                        _schoolmd _schooloute _schoolmpart _schoolniuse
                        _insuxmd _insuxoute _insuxmpart _insuxniuse
                        _mdoute _mdmpart _mdniuse
                        _outempart _outeniuse
                        _mpartniuse ;
run;

*Drop    _outeniuse ( 0.9358, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _agempart _ageniuse
                        _schoolmd _schooloute _schoolmpart _schoolniuse
                        _insuxmd _insuxoute _insuxmpart _insuxniuse
                        _mdoute _mdmpart _mdniuse
                        _outempart
                        _mpartniuse ;
run;

*Drop    _schoolmpart  (0.9299, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _agempart _ageniuse
                        _schoolmd _schooloute _schoolniuse
                        _insuxmd _insuxoute _insuxmpart _insuxniuse
                        _mdoute _mdmpart _mdniuse
                        _outempart
                        _mpartniuse ;
run;

*Drop    _insuxmd  (0.8584, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _agempart _ageniuse
                        _schoolmd _schooloute _schoolniuse
                        _insuxoute _insuxmpart _insuxniuse
                        _mdoute _mdmpart _mdniuse
                        _outempart
                        _mpartniuse ;
run;

*Drop    _insuxoute ( 0.7337, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
```

```
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _agempart _ageniuse
                        _schoolmd _schooloute _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute _mdmpart _mdniuse
                        _outempart
                        _mpartniuse ;
run;

*Drop    _mdmpart ( 0.7337, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _agempart _ageniuse
                        _schoolmd _schooloute _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute _mdniuse
                        _outempart
                        _mpartniuse ;
run;

*Drop   _outempart ( 0.7153, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _agempart _ageniuse
                        _schoolmd _schooloute _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute _mdniuse
                        _mpartniuse ;
run;

*Drop   _agempart ( 0.6958, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _ageniuse
                        _schoolmd _schooloute _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute _mdniuse
                        _mpartniuse ;
run;

*Drop   _schooloute ( 0.6574, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12
```

```
                        _ageschool _agemd _ageoute _ageniuse
                        _schoolmd _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute _mdniuse
                        _mpartniuse ;
run;

*Drop   _mdniuse ( 0.6264, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute _ageniuse
                        _schoolmd _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute
                        _mpartniuse ;
run;

*Drop    _ageniuse ( 0.6136, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute
                        _schoolmd _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute
                        _mpartniuse ;
run;

*Drop    _mpartniuse( 0.6206, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageschool _agemd _ageoute
                        _schoolmd _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute ;
run;

*Drop   _ageschool ( 0.5529, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _agemd _ageoute
                        _schoolmd _schoolniuse
                        _insuxmpart _insuxniuse
```

```
                        _mdoute ;
run;

*Drop  _schoolmd (0.4671, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _agemd _ageoute
                        _schoolniuse
                        _insuxmpart _insuxniuse
                        _mdoute ;
run;

*Drop  _mdoute ( 0.4401, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _agemd _ageoute
                        _schoolniuse
                        _insuxmpart _insuxniuse ;
run;

*Drop  _agemd ( 0.4589, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageoute
                        _schoolniuse
                        _insuxmpart _insuxniuse ;
run;

*Drop  _insuxniuse ( 0.2953, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
      _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _ageoute
                        _schoolniuse
                        _insuxmpart ;
run;

*Drop  _schoolniuse( 0.1165, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12
```

```
                        _ageoute
                        _insuxmpart ;
run;

*Drop  _ageoute  ( 0.1218, least significant);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                        _insuxmpart ;
run;

*Drop  _insuxmpart  (0.0988, least significant);

******AT THIS POINT, ALL INTERACTIONS ARE DROPPED...BACK TO NO
INTERACTION MODEL*****;

*****GOLD STANDARD, no interactions*****;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12 ;
run;

**Tried BW elimination function to check manual BW elimination;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12

                  _ageinsux _agemd _ageoute _agempart _ageniuse
                  _schoolinsux _schoolmd _schooloute _schoolniuse
                  _insuxmd _insuxoute _insuxmpart _insuxniuse
                  _mdoute _mdmpart _mdniuse
                  _outempart _outeniuse
                  _mpartniuse
      /selection=backward;
run;
***left _mpartcat, ageoute, schooloute --> close, would have to add age
and school and oute as well as insurance...once you do this, you get
same model + the two interaction terms;

proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat _oute2
                        _ageoute _schooloute;
run;

proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _mpartcat _oute2;
run;
```

```
*Chunk test: 438.813 (16df) -   436.288 (18 df) = 4.217 w/ 2df, p=.13,
so not significant anymore once other necessary (a priori) variables
are added to the model...stick with gold standard to start.

*************************************************************************
******************  MODEL SELECTION ********************************
*************  STARTING WITH GOLD STANDARD ***************************
*******  TRYING FORWARD SELECTION / ALL POSSIBLE COMBINATIONS  ********
*************************************************************************;

*********************
***GOLD STANDARD;
*********************
-->  age/school/insux not sign, oute sign, mpart sign, niuse not sign,
visit not sign;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat _oute2
                        niuse12 vsitmd12/;
run;

*********************
***Forward Selection;
*********************

*Add _oute2 (most significant in gold standard at p=0.005)
      --> now p= 0.0016, stays sign...doesnt change other ORs much;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _oute2 /;
run;

*Add _mpartcat (second most significant in gold standard at p= 0.006)
      --> p=0.0006, oute2 stays sign too...doesnt change other ORs
much;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux  _oute2 _mpartcat /;
run;

**Add niuse12 (not significant in gold standard)--> p=0.18, not
significant;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux  _oute2 _mpartcat
                        niuse12/;
run;

**Add vsitmd12 without niuse12 (not significant in gold standard)-->
p=0.10, still not significant;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _oute2 _mpartcat
                        _vstmd12/;
```

```
run;

****************************************
All possible combos--Change in Estimates
****************************************

*Gold Standard;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='2') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12/lackfit;
run;

*Drop one var;
*Model 2: Drop visitmd  ;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _oute2 _mpartcat
                        niuse12/lackfit;
run;

*Model 3: Drop niuse ;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _oute2 _mpartcat
                        vsitmd12 /lackfit;
run;

*Model 4: Drop mpart  ;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _oute2 niuse12
                        vsitmd12 /lackfit;
run;

*Model 5: Drop oute  ;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat niuse12
                        vsitmd12 /lackfit;
run;

**Drop two vars;
*Model 6: drop visitmd, niuse ;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _oute2 _mpartcat
/lackfit;
run;

*Model 7: drop visitmd, mpart;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
```

```
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _oute2 niuse12
/lackfit;
run;

*Model 8: drop visitmd, out;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _mpartcat niuse12
/lackfit;
run;

*Model 9: drop niuse, mpartl
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _oute2 vsitmd12
/lackfit;
run;

*Model 10: drop niuse, out;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _mpartcat vsitmd12
/lackfit;
run;

*Model 11: drop  mpart, out;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux niuse12 vsitmd12
/lackfit;
run;

**One var only;
*Model 12: VisitMD only;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux vsitmd12/lackfit;
run;

*Model 13: NI Use only;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux niuse12 /lackfit;
run;

*Model 14: MPartners only;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _mpartcat/lackfit;
run;
```

```
*Model 15: Out only;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _oute2/lackfit;
run;

*Model 16: No covariates;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux/lackfit;
run;


*********************************************************************
************  H-L GOODNESS OF FIT TO HELP FINAL MODEL DECISION  *******
*********************************************************************;

*Gold Standard -->   Chi-sq= 5.0738  (8 df), p= 0.7497 (not
significant, great fit..but some low bin values);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _mpartcat vsitmd12
                        _oute2 niuse12/lackfit;
run;

*Basic -->   Chi-sq=  0.8302  (8 df), p=  0.9971 (not significant,
great fit);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux/lackfit;
run;

*Basic + _oute2 -->   Chi-sq=9.8597   (8 df), p=0.2750 (not
significant, but not great fit);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _oute2/lackfit;
run;

*Basic + _mpartcat -->   Chi-sq=6.8942 (8 df), p=0.5481 (not
significant, okay fit);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _mpartcat/lackfit;
run;

*Basic + niuse12 -->   Chi-sq= 4.3205 (8 df), p= 0.8271 (not
significant, good fit);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux niuse12/lackfit;
run;
```

```
*Basic + vsitmd12 -->   Chi-sq=3.9078  (8 df), p=0.8653 (not
significant, good fit);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux vsitmd12/lackfit;
run;

*********************************************************************
********************   FINAL MODEL   ****************************
*********************************************************************
*Basic + _oute2 + _mpartcat-->   Chi-sq=5.0189  (8 df), p= 0.7556 (not
significant, great fit);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _oute2 _mpartcat
/lackfit;
run;

**This model doesn't compromise model fit compared to gold standard, it
allows for both significant terms to stay in the adjusted model, and
associations between age/school/insurance and testing stay similar and
insignificant...chose this as final model;
*********************************************************************
*********************************************************************

*Basic + _oute2 + _mpartcat + niuse12
      -->   p=  0.9649 (not significant, good fit...but very low bin
values);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _oute2 _mpartcat
                        niuse12/lackfit;
run;

*Basic + _oute2 + _mpartcat + vsitmd12
      -->   Chi-sq=15.1694  (8 df), p= 0.6430 (not significant, good
fit...but low bin values);
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =   _agecat _schoolcat _insux _oute2 _mpartcat
                        vsitmd12/lackfit;
run;

*Tried running exact binomial regression on final model but didn't have
enough memory;
proc logistic data=work.msm3_PR3 ;
      class _agecat (ref='3') _schoolcat(ref='2') _insux(ref='1')
            _mpartcat (ref='5') / param=ref;
      model _ntst12 =  _agecat _schoolcat _insux _oute2 _mpartcat
      /lackfit;
      exact _agecat _schoolcat _insux _oute2 _mpartcat /estimate=both;
run;
```

```
*********************************************
*     TABLE 4: Bivariate looking at          *
Prev Services and Not HIV testing in last year
*********************************************;

*Prevention Use;
proc freq data=work.msm3_PR3;
tables      _ntst12*_testsyph _ntst12*_cond12 _ntst12*_previntind
            _ntst12*_previntgrp _ntst12*_prevint
            _ntst12*_aldgtxcat _ntst12*_altxcat/chisq fisher;
run;

proc logistic data=work.msm3_PR3 ;
      class _testsyph(ref='2')/ param=ref;
      model _ntst12 =  _testsyph;
      run;

proc logistic data=work.msm3_PR3;
      class _cond12(ref='2')/ param=ref;
      model _ntst12 =  _cond12;
      run;

proc logistic data=work.msm3_PR3;
      class _previntind(ref='2')/ param=ref;
      model _ntst12 = _previntind;
      run;

proc logistic data=work.msm3_PR3;
      class _previntgrp(ref='2')/ param=ref;
      model _ntst12 =  _previntgrp;
      run;

proc logistic data=work.msm3_PR3;
      class _prevint(ref='2')/ param=ref;
      model _ntst12 =  _prevint;
      run;

proc logistic data=work.msm3_PR3;
      class _aldgtxcat(ref='3')/ param=ref;
      model _ntst12 =  _aldgtxcat;
      run;

proc logistic data=work.msm3_PR3;
      class _altxcat(ref='3')/ param=ref;
      model _ntst12 =  _altxcat;
      run;
```