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Jonathan E. Matthews Date

PREVALENCE OF AND FACTORS ASSOCIATED WITH SELF-REPORTED HEPATITIS B VACCINATION AMONG HIV-NEGATIVE MSM PARTICIPATING IN AN ONLINE SEXUAL HEALTH SURVEY

By

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Master of Public Health

Epidemiology

_____

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Epidemiology
2011

Abstract

PREVALENCE OF AND FACTORS ASSOCIATED WITH SELF-REPORTED HEPATITIS B VACCINATION AMONG HIV-NEGATIVE MSM PARTICIPATING IN AN ONLINE SEXUAL HEALTH SURVEY

By Jonathan E. Matthews

Objective: We evaluated the prevalence of self-reported hepatitis B vaccination among HIV-negative men who have sex with men (MSM) in the United States. We also sought to describe demographic and behavioral factors associated with vaccination. We also sought to understand why men who reported not being vaccinated against hepatitis B had not been vaccinated.

Methods: Between October and December 2010, data were collected in an online survey from MSM over the age of 18 who reported being interested in men on the social networking Internet sites Facebook and Black Gay Chat. Bivariate analysis and multivariate logistic regression were employed to determine which factors were significantly associated with self-reported receipt of hepatitis B vaccination. Descriptive statistics were compiled to characterize why some men remained unvaccinated.

Results: Of 1,052 adult MSM who were HIV-negative or who did not know their HIV status and who reported knowing whether they had ever received a hepatitis B vaccine, 679 (64.5%) reported being vaccinated against hepatitis B. Multivariate logistic regression modeling indicated that older age, higher education attainment, having ever been tested for hepatitis B, and provider-recommended vaccination in the last year were significantly associated with receipt of vaccination. Nearly 90% of unvaccinated men reported not being vaccinated because they were never offered a vaccine for hepatitis B, were not aware that a vaccine exists, or did not perceive themselves to be at increased risk of infection.

Conclusions: A substantial proportion of hepatitis B-negative MSM in the United States remain unvaccinated against hepatitis B. Although provider-recommended vaccination is strongly associated with receipt of vaccination among these men, earlier studies suggest that offering of hepatitis vaccination is higher when providers know that male patients have male sex partners, and that only about half of MSM disclose their male sex partners to providers. Providers should ask men who they suspect engage in male-male sexual behavior to share such behavior with them, and then proceed to vaccinate all susceptible men. In particular, healthcare providers and health promotion specialists should focus their immunization efforts toward older and more socioeconomically disadvantaged MSM.

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Acknowledgments

I would like to thank my thesis advisor, **Dr. Patrick Sullivan**, who helped me to develop and revise my thesis concept many times throughout the planning process. Your expansive subject matter expertise in general epidemiology and in issues facing men who have sex with men (MSM) was invaluable to me as I executed my analysis and drafted my manuscript.

I would also like to thank **Dr. Rob Stephenson**, who allowed me to explore my thesis concept in the context of a web-based sexual health survey that he developed to target adult MSM living in the United States.

My gratitude also goes out to my friends, as well as my coworkers in the Hubert Department of Global Health, for their encouragement throughout the entire thesis writing process.

Finally, I would like to thank my family for supporting me, not only as I wrote my thesis but also as I progressed through grade school, undergraduate, and graduate level education to achieve a master's degree in public health.

Mom, Dad, Papa, Nannie, and Granny*—the faith that you had in me, your constant reminders that* "I could do anything I set my mind to," *and your ceaseless commitment to watch after Elizabeth, Christopher and I, and to bring us up to live lives of thoughtfulness and compassion toward others—is something that has, does, and will continue to inspire me for the rest of my life. Thank you.*

This thesis is dedicated to the memory of my grandfather, **James Harden** (June 27, 1928-October 1, 1997).

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Introduction

By engaging in high risk sexual behaviors, men who have sex with men (MSM) are at an increased risk of contracting HIV and other sexually transmitted infections (STIs). During the early 1980s, at a time when empirical evidence began to accumulate that indicated that the human immunodeficiency virus was transmitted via sexual contact, researchers noted significant declines in the prevalence of high-risk sexual behaviors, including unprotected anal intercourse and anilingus, as well as in the number of casual sex partners and frequency of sexual contact reported by MSM (1). As a result, the HIV incidence rate among MSM was reduced by more than three-fold by 1989 in many large cities throughout the United States, including Pittsburgh, PA; Baltimore, MD; Washington, DC; Chicago, IL; Los Angeles, CA; and San Francisco, CA (2). More pronounced decreases were observed in the reported incidence rate of syphilis throughout the 1990s (3).

Unfortunately, however, the reduction in the burden of HIV and other sexually transmitted infections among MSM was not sustained. In an analysis of country-specific HIV notification rates among MSM, Sullivan et al showed that whereas rates in the United States decreased by nearly 3 percent annually from 1996 to 2000, they subsequently increased by more than 2 percent annually from 2000 to 2005 (4). Syphilis incidence rates in 2005 (5 cases per 100,000 men) exceeded those observed in 1996 (4.5 cases per 100,000 men) despite having declined to a rate of 2.5 cases per 100,000 men in 2000; in addition, the ratio of males to females infected with syphilis increased more than six-fold from 1.2:1 in 1996 to nearly 8:1 in 2005, suggesting that the burden of syphilis increased among MSM during this period (4). Sentinel surveillance of gonorrhea in the

United States also indicated that the burden of urethral gonorrhea associated with male-male sexual contact increased nearly threefold during 1996 to 2005, from 8% in 1996 to 22% in 2005 (5).

A number of demographic, social and behavioral considerations may account increases in HIV and STI incidence in recent years. As improved HIV treatment regimens have become more widely available and mortality rates due to AIDS have declined, younger MSM have less personal experience with knowing a person with AIDS, and an increasing number of MSM are living with HIV – and capable of onward HIV transmission (6). Furthermore, community-adopted harm-reduction approaches such as serosorting have unclear benefit given lack of accurate knowledge of HIV serostatus (7). In today's digital era, the Internet has – by virtue of its relative anonymity – become a preferred means by which MSM solicit sexual partners (8), and men who meet sex partners online are more likely to report high-risk sex. Regardless of the complex reasons, it is clear that there is a resurgent epidemic of HIV and other sexually transmitted infections across the United States.

In the United States, the Centers for Disease Control and Prevention (CDC) recommends that all MSM should be tested annually for HIV unless they have previously tested positive for infection with the virus (9). In addition, annual testing for syphilis and gonorrhea is also recommended in order to evaluate MSM for the presence of both new and recurrent infections (9). Surveillance of MSM conducted in the United States between November 2003 and April 2005 indicated that more than 90% reported ever been tested for HIV; of those ever tested for HIV, 3 out of 4 reported being tested in the past year (10). However, only 43% of those surveyed had been tested for an STI in the

past year (10). Recently, few studies with national scope have examined the prevalence of STI screening in MSM. However, results from a 2009 web-based survey of MSM who use the social networking Internet site MySpace suggest that there has been little, if any, improvement, in STI screening rates over the last several years: only 46% of respondents who sought medical treatment in the past year reported being tested for an STI (Personal communication, Patrick Sullivan, Emory University, March 18, 2011).

As part of their sexually transmitted disease treatment guidelines, the CDC recommends that all MSM with multiple sex partners should be vaccinated against hepatitis B (11). A hepatitis B vaccine has been available in the United States since its licensure in 1981, and vaccination has been recommended for MSM, as well as other high-risk adults, healthcare workers, and infants born to hepatitis B-positive mothers since 1982 (12). Vaccine recommendations were expanded in 1991 to cover all infants, as well as adolescents who engage in high-risk sexual and non-sexual behaviors (13), and by 1997, all children under the age of 18 (14). The hepatitis B vaccine is generally administered as a series of 3 injections, with the second and third dose given at least 1 month and 6 months, respectively, following administration of the first dose (11). (In infants, the first dose of hepatitis B vaccine is generally administered at birth (15).) Hepatitis B vaccine is not administered to individuals who have serological evidence of previous infection.

Although heterosexual contact remains the primary mode of transmission of hepatitis B among adults, the disease burden associated with male-male sexual contact is substantial: as of 2005, one in four incident cases of hepatitis B were reported in MSM (11). The prevalence of hepatitis B infection among MSM has been significantly reduced

in part due to the development of a hepatitis B vaccine: in the 1970s, 3 in 5 MSM had serologic evidence of prior infection (16, 17); since 1981, when the hepatitis B vaccine was licensed, less than 1 in 3 MSM have ever been infected with hepatitis B (18-24). Despite substantial reductions in the prevalence of infection, nationally representative surveys have indicated that fewer than 1 in 5 young MSM have serologic evidence of vaccination against hepatitis B (21, 22). By contrast, self-reported hepatitis B vaccination rates are often much higher: Sanchez et al reported in 2006 that 53% of MSM interviewed for the National HIV Behavioral Surveillance System had self-reported ever been vaccinated against hepatitis A or B (10). Self-reported vaccination rates among MSM in select cities across the United States have been much more variable, ranging from 16 to 70% (18, 22-27).

A number of recent studies have presented analyses that describe demographic and behavioral factors associated with receipt of hepatitis B vaccination among MSM. However, many of these studies are from limited geographic areas, from restricted age groups, or are confined to respondents from urban areas. Thus, the results of past studies may not be reflective of patterns of self-reported vaccination in MSM across the United States. Multisite studies of self-reported hepatitis B vaccination prevalence and factors associated with vaccination have been conducted in younger MSM in larger US cities (21, 22). In addition, a number of previous studies have not evaluated the statistical significance of covariates in the context of a multivariate model (18, 23, 27).

To address these gaps in previous studies, we used data from a national survey of MSM to describe the prevalence of hepatitis B vaccination in HIV-negative, internet-using MSM. Using logistic regression models, we evaluated factors associated with

receipt of self-reported vaccination among these men. In addition, we described self-reported reasons for lack of vaccination among MSM who were not vaccinated against hepatitis B.

Methods

We recruited men to a web-based sexual health survey through banner ad recruitment. We displayed banner advertisements for a Men's Health Survey (**Appendix A**) to men living in the United States who reported being interested in men on the social networking Internet site Facebook (http://www.facebook.com), and to members of the site Black Gay Chat (http://www.bgclive.com) from October 28 to December 12, 2010. Men who clicked through the banner advertisement were forwarded to a web page with a series of screening questions. Individuals were eligible for participation in the survey if they were male and 18 years of age or older. All female respondents, as well as those male respondents who were under 18 years of age or who did not specify their age, were screened out of our study and were not presented with any additional study-related questions. Study participants were asked a series of questions (**Appendix B**) related to demographic characteristics (race and ethnicity; educational, employment and insurance status; state of residence); experiences as a gay or bisexual man; lifetime history of sexual partners; characteristics of the participant's most recent male sex partner (MRMSP) [including demographic characteristics and information on the partner's HIV status]; sexual (oral and anal intercourse; condom use) and non-sexual (drug use) risk behaviors engaged in at last sex with the MRMSP; HIV knowledge, testing behaviors and status; interaction with a healthcare provider in the last 12 months; and hepatitis B diagnosis, testing and vaccination status.

To facilitate uniformity among all responses, participants were asked to choose between a series of predefined choices when answering each question. Questions pertaining to ethnicity, anal intercourse at last sex, drug use at last sex, HIV testing status,

interaction with a healthcare provider in the last 12 months, and hepatitis B diagnosis, testing and vaccination status each had two responses. Questions pertaining to race, insurance status, state of residence, and lifetime history of sexual partners each had three or more categorical responses. Questions pertaining to educational status and condom use each had a series of ordinal responses. Participants were allowed to skip any question they did not feel comfortable answering, and most questions also allowed participants to indicate that they did not know the answer, or that they preferred not to answer.

In this study, we were interested in determining the prevalence of and factors associated with receipt of hepatitis B vaccination in MSM. Therefore, participants were excluded from our analysis if they reported having sex with only women, reported never having sex, or did not specify a history of sexual partners. In particular, we were interested in evaluating the extent of hepatitis B vaccination delivery to HIV-negative MSM. Therefore, MSM who did not specify or know whether they had ever been tested for HIV, as well as men who knowingly did not specify their HIV status, were excluded from our analysis. In addition, HIV-positive men were also excluded.

Participants who remained in our analyzed study population were included in univariate analysis of all independent predictors. To assess hepatitis B vaccination coverage, participants were asked “Have you ever had a vaccine for hepatitis?” and “What type(s) of hepatitis vaccine have you had?” Individuals could choose from “Hepatitis A vaccine,” “Hepatitis B vaccine,” “Hepatitis A and B vaccine” or “I’m not sure which Hepatitis vaccine I got.” Respondents who reported receiving “‘Hepatitis B vaccine’ or ‘Hepatitis A and B vaccine’” were classified as having received a vaccine for hepatitis B. Respondents who reported, “I’m not sure which Hepatitis vaccine I got,”

were excluded from the analysis. In this study, we evaluated the association of age, race/ethnicity, educational and insurance status, state of residence, lifetime history of sexual partners, anal intercourse, condom and drug use engaged in at last sex with the MRMSP, HIV testing behavior and status, interaction with a healthcare provider in the last 12 months, and hepatitis B diagnosis and testing status with hepatitis B vaccination among MSM using chi-square tests of general association and multivariate odds ratios.

When appropriate, responses to related questions were combined or redefined in ways that would facilitate ease of analysis while also maintaining their interpretability. For example, a variable was created to indicate whether a participant had engaged in unprotected anal intercourse at last sex with their MRMSP using self-reported information on the participant's history of insertive and receptive anal intercourse at last sex as well as the participant's frequency of condom use when engaging in the above activities. Individuals who engaged in either insertive or receptive anal intercourse at last sex (or both) with their MRMSP and who had not "used a condom the whole time" were determined to have engaged in unprotected anal intercourse. Conversely, individuals who "used a condom the whole time" during insertive or receptive anal intercourse at last sex with their MRMSP were determined to not have engaged in unprotected anal intercourse. Estimated logit plots were used to evaluate whether age should be considered as a continuous variable (as originally specified) or as a categorical variable in our analysis. Race (originally specified as a 6-level categorical variable – Asian/Pacific Islander, Black/African-American, White/Caucasian, Native American/Alaska Native, Multi-Racial, and Other) and ethnicity (originally specified as a dichotomous variable, Hispanic versus non-Hispanic) were combined to create a 7-level categorical

race/ethnicity variable (Hispanic versus all non-Hispanic races [6]). Insurance status was re-coded to create an additional response category – "more than 1" – to account for individuals who selected more than one type of insurance coverage.

Existing variables and response types were also aggregated when a small number of respondents for a given response type precluded analysis of the associated variable. For example, multiple non-Hispanic races, including Asian/Pacific Islander, Native American/Alaska Native, Multi-Racial and Other, were combined into a single "non-Hispanic other" category. Individuals who reported having received a high school or General Equivalency diploma or who reported completing "some high school [or] less than high school" or who "never attended school" were grouped into a single category – "high school or less." Individuals who reported being insured under Medicaid or Medicare were defined as having "public" health insurance, and individuals who reported being insured by the United States Military ("Tricare/Champus"), the United States Veterans' Administration, some other or more than one form of health insurance were defined as having "other" health insurance. Based on their self-reported state of residence, participants were placed in one of four US Census regions: Midwest, Northeast, South or West (28).

Because individuals who are hepatitis B-positive are not recommended for vaccination, individuals who reported having received a positive test result for hepatitis antibodies were excluded from bivariate analysis of all independent predictors given a participant's hepatitis B vaccination status. Bivariate analysis was performed among all hepatitis B-negative participants to determine which covariates would be included in a subsequent logistic regression model of demographic and behavioral characteristics and

risk factors significantly associated with receipt of hepatitis B vaccination. All respondents who reported ever being told by a healthcare provider that they had hepatitis B or who were missing information on statistically significant covariates were excluded from the model. All variables with bivariate chi-square p-values of less than 0.20 were entered into the initial multivariable model. The final main effects were determined using a backward selection algorithm wherein all variables not significant at a 5% alpha level were removed from the model. Once a no-interaction model containing all significant independent covariates was developed, the presence of pairwise statistical interaction was evaluated using a forward selection algorithm. We employed a Bonferroni-type correction in order to set the overall type I error rate for interactions at 5%.

In addition to determining which factors were significantly associated with receipt of hepatitis B vaccination among HIV-negative MSM, we were also interested in describing self-reported reasons why unvaccinated MSM were not vaccinated against hepatitis B. As they completed the survey, participants who had never been vaccinated against hepatitis B were asked to endorse all the reasons to explain why they had never been vaccinated, as well as one “main” reason for lack of vaccination (for those participants who selected multiple reasons). Responses to this question were adapted from a study of viral hepatitis infection and vaccination among MSM that was conducted by Diamond et al on behalf of the US Young Men’s Survey team (20). For purposes of analysis, we re-coded these variables in such a way that all persons had a “main” reason for not being vaccinated against hepatitis B.

All analyses were performed using SAS 9.2. The present study received exempt approval from Emory IRB (IRB00044470).

Results

Figure 1 describes the mechanism by which we determined participant eligibility for inclusion into our study and subsequent analysis. 2,102 individuals completed the screening questionnaire; however, 17 individuals were deemed ineligible because they were female, under 18 years of age or because they did not specify their age. 2,085 men 18 years of age or older were eligible to participate in our study.

134 participants (6.4%) who completed our questionnaire were excluded from analysis because they reported having sex with only women, reported never having sex, or did not specify a history of sexual partners. 39 individuals (1.9%) were also excluded because they either did not specify or know whether they had ever been tested for HIV, or because they were tested for HIV but did not respond to the corresponding question regarding their serostatus. In addition, 190 individuals (9.1%) reported testing positive for HIV. Finally, 670 individuals (32.1%) were excluded because they did not know or specify whether they had ever been tested for or vaccinated against hepatitis B. Thus, of 2,085 men 18 years of age or older who were eligible to complete our survey, 1,052 (50.5%) were included in our analyzed study population. Their responses were included in univariate analysis of all independent predictors.

Table 1 describes the demographic and behavioral characteristics of the study population. Half of all participants were under the age of 26, the youngest participant was 18 years old and the oldest participant was 73 years old. We evaluated the appropriateness of defining categories for age using estimated logit plots. After examining the distribution of estimated logits by age among vaccinated individuals, we

determined that it was appropriate to divide age into three categories – 18-19, 20-31, and >31 – because the trends in estimated logits across these intervals appeared to be non-linear. More than 60% of the study population was non-Hispanic white, one fifth was non-Hispanic black, and 1 in every 10 participants was Hispanic. Study participants were generally well educated: approximately 80% reported at least having received an Associate's degree, attended technical school or completed some college coursework. More than half of all participants were insured by a private insurance company or a health maintenance organization. Unprotected anal intercourse at last sex with the MRMSP was common among study participants; however, few participants reported drug use at last sex with their MRMSP. More than 80% of all participants reported visiting a healthcare provider in the past year, but only one sixth of all participants reported that their healthcare provider recommended a hepatitis B vaccine during a recent visit.

Although nearly 75% of all participants reported ever being tested for hepatitis B, only 64.5% reported ever being vaccinated against the virus. 50 (4.8%) of all participants in our study reported they had ever been told by a healthcare provider that they were hepatitis B-positive. **Table 2** describes the bivariate association of each independent variable with vaccination status among the 1,002 hepatitis B-negative men in our study population. The odds of vaccination were approximately 50% lower for men aged greater than 31, as compared to men aged 18-19 years. More educational attainment was associated with higher odds of vaccination: when compared to men with a high school education or less, the odds of vaccination were nearly twice as great for men who reported graduating from college, and were 60% higher for men who reported having

received an Associate's degree, attended technical school or completed some college coursework.

Providers may screen their patients for hepatitis B antibodies in order to determine whether they are eligible to be vaccinated against the virus; hepatitis B testing was strongly associated with vaccination, as the odds of vaccination were 3.6 times higher among men who had ever been tested for Hepatitis B, when compared to men who had never been tested. Although drug use at last sex was rare among all participants in our study, it remained associated with hepatitis B vaccination: the odds of vaccination were 50% lower among men who used drugs at last sex with their MRMSP, when compared to men who did not use drugs at last sex. Having been seen by a healthcare provider in the last year was also associated with hepatitis B vaccination, especially when the provider knew that the respondent had sex with men and when the provider recommended that the individual be vaccinated against hepatitis B. The odds of vaccination were 80% greater among men whose providers knew they had sex with men, when compared to men whose providers were unaware of their patient's male-male sexual behavior. The odds of vaccination were nearly five times higher among men whose providers recommended that they receive a vaccine for hepatitis B, when compared to individuals whose providers did not recommend vaccination.

Table 3 presents the independent variables that remained associated with hepatitis B vaccination in the multivariable logistic regression model: age, having been tested for hepatitis B, education, and having a provider recommendation for vaccination were all associated with altered odds of vaccination. (63 respondents who either reported being infected with hepatitis B [n=50] or who were missing information on statistically

significant covariates [n=13] were excluded from the model.) The odds of vaccination among MSM increased as men reported completing successively higher levels of education: receiving an Associate's degree, completing some college coursework, or having attended technical school was associated with a two-fold increase in the odds of vaccination, when compared to men with a high school education or less. By contrast, completing a college education was associated with a three-fold increase in the odds of vaccination. The odds of vaccination were 4 times greater among men whose healthcare provider recommended a vaccine for hepatitis B at a visit in the last year, when compared to men whose providers did not recommend vaccination.

One significant interaction was identified: age interacted significantly with having been screened for antibodies to hepatitis B. This interaction is depicted graphically in **Figure 2**. Older men were consistently less likely to be vaccinated against hepatitis B than younger men. However, there was a negative association between hepatitis B screening and vaccination status among men between the ages of 20 and 31; men who had ever been tested for hepatitis B were less likely to be vaccinated than men of the same age who had never been tested. The direction of the association between hepatitis B screening and vaccination status among men over the age of 31 was reversed, as men were less likely to be vaccinated if they had never been tested for hepatitis than if they had ever been tested. The disparity in the odds of vaccination between men on the basis of their hepatitis B screening status decreased with age. Men between the ages of 20 and 31 who had ever been tested for hepatitis B were 40% less likely to be vaccinated than men of the same age who had never been tested, when compared to men 18 or 19 years of age; men older than 31 who had never been tested for hepatitis B were 20% less likely to

be vaccinated than men of a similar age who had ever been tested, when compared to men 18 or 19 years of age.

Table 4 describes the reasons why HIV-negative men who reported they were not vaccinated against hepatitis B had never been vaccinated. More than half of these men reported that they had never been offered a vaccine by a healthcare provider, and 1 in 5 did not know they were eligible to be vaccinated. Approximately one third of men were not aware that a hepatitis B vaccine was available and one quarter did not perceive themselves to be at increased risk of infection with hepatitis B. Overall, 90% of unvaccinated men reported one of the above reasons as the main reason why they had never been vaccinated against hepatitis B. Main reasons for not being vaccinated were generally similar to the reasons identified when men could endorse multiple reasons for never having been vaccinated (**Table 4**).

Discussion

We found that nearly two thirds of HIV-negative participants who participated in a web-based sexual health survey of MSM between October and December 2010 reported ever being vaccinated against hepatitis B. Educational status and provider-based recommendation of vaccination were significantly associated with self-reported receipt of vaccination. In addition, significant statistical interaction was observed between age and hepatitis B screening status, although the odds of vaccination consistently decreased with increasing age. Men between the ages of 20 and 31 were more likely to be vaccinated if they had never been tested than if they had ever been tested, whereas men over the age of 31 were more likely to be vaccinated if they had ever been vaccinated than if they had never been vaccinated. Based on these data, additional efforts are needed to improve hepatitis B vaccination rates in MSM. Understanding which factors are associated with vaccination will help clinicians and health promotion specialists tailor their immunization campaigns in a targeted effort to reach presently underserved segments of the population.

Previous studies of hepatitis B vaccination in MSM in the United States have estimated that the self-reported prevalence of vaccination is between 16% and 70% (18, 20, 22-27). Although the results from our web-based survey approach the upper bound for the previously described, self-reported prevalence of vaccination in this population, it should be noted that a majority of other studies (18, 22, 23, 27) found that no more than 40% of MSM had been vaccinated against hepatitis B. Furthermore, the high prevalence of vaccination reported by Siconolfi et al (24) in 2009 – 70% – may not be representative of all MSM in the United States because the authors solicited participation from

individuals who were presumed to be more likely to be cognizant of their overall health and to seek to remain healthy.

Nevertheless, it is not implausible that we measured such a high prevalence of hepatitis B vaccination in our study population, given the demographics of our respondents. A hepatitis B vaccine was licensed in the United States in 1981 and universal infant vaccination recommendations have been in force since 1991 (13). Therefore, men who are younger than 30 years of age, and especially those between the ages of 18 and 20, are much more likely to have been vaccinated against hepatitis B. Many prior studies have reported prevalences of vaccination in populations of MSM that were much older than the population surveyed in our study (18, 23-26). Thus, differences in vaccination prevalence may represent a cohort effect, because the predominately older men in these studies may not have been required to receive hepatitis B vaccination in order to begin or continue attending grade school.

Although serological prevalence of hepatitis B vaccination on the basis of persistent hepatitis B surface antibody is generally lower than self-reported prevalence of vaccination (19-22), it remains feasible that 64.5% of men surveyed in our study could actually have been vaccinated against the virus. Many prior estimates of vaccination prevalence that were based on serological evidence were presented following studies that were conducted more than 10 years ago (19-23, 25-27). Antibody levels decline over time and levels indicative of vaccination may have been below the limit of detection in men who were vaccinated in the early 1980s, shortly after the licensure of a hepatitis B vaccine in the United States in 1981. Such estimates should therefore be interpreted as lower limits for vaccination prevalence.

Each of the factors significantly associated with hepatitis B vaccination among MSM in our study – age (18, 21, 22, 24, 26), educational status (21, 22), hepatitis B testing status (27) and history of provider recommendation of vaccination (18) – have also been found to be associated with vaccination in prior studies of MSM in the United States . In our study, we found that the odds of vaccination decreased with increasing age; however, men in their twenties and early thirties were more likely to be vaccinated if they had never been tested for hepatitis B, whereas older men were more likely to be vaccinated if they had ever been tested. Previous studies, however, have generally been conducted only in urban areas, and have not included respondents from throughout the United States. The Young Men's Survey studies did include multiple US cities, but did not include rural areas. Furthermore, the YMS surveys enrolled only younger MSM (under the age of 30) (19-22). However, most studies that were conducted more than 10 years ago in select United States cities, as well as over the Internet, examined self-reported hepatitis B vaccination prevalence in older MSM: most of their respondent profiles indicated a mean or median age of 30 years of age or older (23, 25, 26). More recently, studies of vaccine prevalence among MSM have also been more likely to have older MSM respondents (18, 24). A 2009 study by Gilbert et al reported a significant bivariate association between age and hepatitis B vaccination, but did not control for associations with other variables (18).

We also found that men with higher levels of education were more likely to be vaccinated against hepatitis B. MacKellar et al reported a significant association between education and higher odds of vaccination in a model that also included age, city of residence, HIV testing status and diagnoses, the degree to which a man had ever told

others that he was homosexual or bisexual, and whether he had a relationship with a healthcare provider. However, with respect to education, MacKellar et al modeled vaccination status as a function of a young man's current educational status (21). As a result, it was not possible to assess the degree to which a man's level of education may simultaneously influence both his perception of infection risk associated with his sexual behavior and his likelihood of accepting vaccination. Also, the results of MacKellar et al were not directly comparable with ours. Weinbaum et al also reported a significant association between education and higher odds of vaccination in a model that included age, race, city of residence and whether a man had a regular source of healthcare (22); however, they did not provide quantitative estimates of the association of education and receipt of vaccination.

We found that the odds of vaccination were more than four times higher among men whose healthcare providers recommended vaccination, when compared to men whose providers did not recommend vaccination. A 2009 study by Gilbert et al found that the odds of vaccination were nearly 18 times higher among men whose providers recommended hepatitis B vaccination, when compared to men whose providers did not recommend vaccination (18); however, the bivariate association that they reported did not simultaneously control for the effects of confounding factors, as did our analysis.

Our study furthers knowledge of hepatitis B vaccination prevalence among HIV-negative MSM and factors significantly associated with vaccination because our study included a substantial number of African American men, who have been less represented in previous studies. We also evaluated self-reported vaccination among a group of MSM recruited from across the United States and from both urban and rural areas.

Furthermore, the authors are aware of few studies of hepatitis B vaccination prevalence (10) that examine this trend exclusively in HIV-negative individuals. In addition, we not only evaluated the relationship of covariates significantly associated with vaccination in a bivariate analysis, but we also developed a multivariable model to control for the effects of all statistically significant covariates simultaneously.

In our study, we found that while older men were consistently less likely than younger men to be vaccinated against hepatitis B, men over the age of 31 who had ever been tested for hepatitis B were more likely to be vaccinated against the virus than men of a similar age who had never been tested. Conversely, men between the ages of 20 and 31 were less likely to be vaccinated if they had ever been tested for hepatitis B than if they had never been tested. While a study of MSM living in and around Ann Arbor, MI, found that men who had been tested for hepatitis B were more than three times as likely to be vaccinated than men who had not been tested (27), this association was bivariate in nature and did not account for the effects of other confounding factors on receipt of vaccination. The authors are not aware of any hepatitis B vaccine prevalence studies in which a significant age-hepatitis B testing status interaction is present. However, the presence of such an interaction in our study seems rather intuitive. Younger men are more likely to be vaccinated against hepatitis B – despite never being tested – because universal infant vaccine recommendations have been in force in the United States since 1991 (13), and men in their twenties likely were required to be vaccinated against hepatitis B prior to entering, or during, grade school. Older men may more often, by contrast, only be vaccinated against hepatitis B after having been tested because they are

concerned that they may have been exposed to the virus and are seeking post exposure prophylaxis.

Among unvaccinated men in our study, we found that nearly 9 in 10 reported that their provider neglected to offer vaccination, that they were unaware that a vaccine exists, or that they did not perceive themselves to be at risk for hepatitis B infection, as the main reason they were never vaccinated against hepatitis B. While previous studies have not reported the primary reason for lack of vaccination in their analyses and have instead described the range of reasons MSM report why they have never been vaccinated against the virus (18, 20-23, 27), the continued opportunity for providers to more actively promote disease prevention and vaccination in their consultations is clear. More than 40% of unvaccinated respondents in our study reported that the main reason that they were not vaccinated against hepatitis B was because a vaccine was never offered to them. Encouragingly, provider-recommended vaccination is effective at encouraging MSM to be vaccinated against the virus, as evidenced by a four-fold increase in the odds of vaccination among men in our study whose providers recommended vaccination, when compared with men whose providers did not.

Providers may not recommend vaccination to all eligible MSM because they are not aware that some patients engage in male-male sexual behavior. However, if a hepatitis B-susceptible MSM shares his male-male sexual behavior with his healthcare provider, the provider may be more likely to recommend vaccination. Gilbert et al found that the odds of vaccination was more than two times higher among individuals who told their healthcare provider that they had sex with men, compared with individuals who did not (18). In addition, a 2009 web-based study of provider-recommended HIV testing

among MSM who saw a healthcare provider in the past 12 months found that men who shared their male-male sexual behavior with their providers were at least 8 times more likely to be offered HIV testing, when compared to men who did not share their homosexual behavior with their providers (29).

General delivery of health services to MSM, and especially prevention of HIV and acute hepatitis B infection, may therefore be improved if a healthcare provider knows that his patient engages in male-male sexual behavior. However, many MSM remain hesitant to disclose the fact that they have sex with other men to their providers (18, 29). Therefore, healthcare providers are encouraged to ask patients about whom they have sex with in a non-judgmental way, to include asking about male, female, or lack of any sexual partners. Providers should then screen all men who report male partners for serological evidence of past hepatitis B infection or vaccination, and offer vaccination to those men who are eligible to receive it. Providers and health promotion specialists should especially focus their efforts toward screening and vaccinating older, as well as socioeconomically disadvantaged, individuals.

There are several limitations inherent in our web-based sexual health survey of MSM in the United States. Because individuals were recruited over the Internet rather than in person, at a bar, park, or other venue by a trained interviewer, individuals who did not have access to the Internet during the study period were unable to participate and are therefore not represented in the study population. In addition, a majority of our study participants were white. However, few prevalence studies of hepatitis B vaccination in MSM have chosen minority individuals as their population of interest (30, 31). As more

than half of our study population was under the age of 30, our results have limited generalizability to older individuals.

Because our study was a cross-sectional survey of individual hepatitis B testing and vaccination status, demographic characteristics, sexual and nonsexual risk behaviors, and recent provider-participant interaction among HIV-negative MSM, it is difficult to determine with any certainty whether any of the factors significantly associated with vaccination preceded vaccination, or whether other criteria for causality might have been met. However, it is highly unlikely that a majority of men in our study were vaccinated against hepatitis B following their most recent sexual encounter. Future studies of vaccination prevalence in MSM could address the limitation of evaluating temporality in cross-sectional studies by asking participants to specify how long ago that they were vaccinated against hepatitis B.

In our study, we measured the prevalence of sexual and nonsexual risk behaviors that occurred at last sex with a study participant's MRMSP; however, as an example, a man's use of drugs at last sex with his MRMSP is not necessarily indicative of his typical drug use behavior during sex. Engaging in these high-risk sexual and nonsexual risk behaviors over long periods of time may be more significantly associated with vaccination than was engaging in these behaviors at last sex. Future studies could address this limitation by developing sexual and non-sexual risk behavior questions that incorporate an ordinal scale and evaluate whether MSM have engaged in such behaviors for much more prolonged periods of time.

Because information on the outcome of interest and potentially associated covariates was ascertained by self-report, misclassification bias is likely to have occurred. For example, individuals may not remember whether they received the hepatitis B vaccine or because they are not aware that such a vaccine exists, they may mistake other shots or vaccines for the hepatitis B vaccine. However, it is not possible to estimate whether the presence of recall bias with respect to hepatitis vaccination status led to an underestimation or overestimation of the prevalence of vaccination in this population. Although we restricted our study population to MSM who were HIV-negative or whose HIV status was unknown, it remains possible that some HIV-positive men were included in our study: these men may be so uncomfortable sharing such stigmatizing information that they instead report not being infected with HIV, or they may have been unaware of their HIV-positive status, and thus unable to report it accurately. As a result, estimates of the odds ratios that describe the relationship between covariates and hepatitis B vaccination may be higher than the true values if the prevalence of each covariate is overestimated differentially with respect to vaccination status (e.g., if respondents who specified receiving a vaccine for hepatitis B were more likely to report their HIV status).

We also excluded participants who did not know or who chose not to specify whether they had ever received a hepatitis B vaccine. If these participants had otherwise been included in our study, we would have been required to assume that they were unvaccinated; as a result, the proportion of vaccinated individuals would have been incorrectly underestimated. There is a potential for bias in the estimated odds ratios describing the bivariate association between covariates and hepatitis B vaccination; however, it is not possible to determine the magnitude or direction of such a bias without

knowing more about the true distribution of hepatitis B vaccination in this subset of the study population.

In addition, individuals may be less likely to report engaging in activities that are not perceived to be socially desirable, such as unprotected anal intercourse or drug use. The prevalences of these behaviors in the population are likely to be underestimated. However, we do not have any reason to believe that men who had been vaccinated against hepatitis B were any more or less likely than men who had never been vaccinated to underreport socially undesirable behaviors. Therefore, it remains unlikely that either unprotected anal intercourse or drug use during last sex (or both) with the MRMSP actually have a significant association with receipt of hepatitis B vaccination that was obscured by this underreporting.

Nearly one-third of HIV-negative MSM who participated in a web-based survey of their sexual and non-sexual life experiences reported never having been vaccinated against hepatitis B. Approximately 90% of these men reported not being vaccinated because they did not believe themselves to be at high risk of being infected with hepatitis B, or because they did not know about the availability of a vaccine for or were never offered vaccination against hepatitis B. As men whose providers recommended vaccination against hepatitis B were 4 times more likely to be vaccinated against the virus than men whose providers did not recommend vaccination, providers should view consultations with their male patients who have sex with men as meaningful opportunities to offer vaccination to vulnerable patients, and to inform their patients of the hepatitis infection risks associated with male-male sex. In addition, according to our

data, providers and health promotion specialists should target their vaccination campaigns toward older MSM and those MSM of lower socioeconomic status.

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Figure 1. Flow diagram illustrating derivation of study population from cohort of 2,102 men who reported being interested in men who completed an online sexual health survey, United States, October – December 2010.

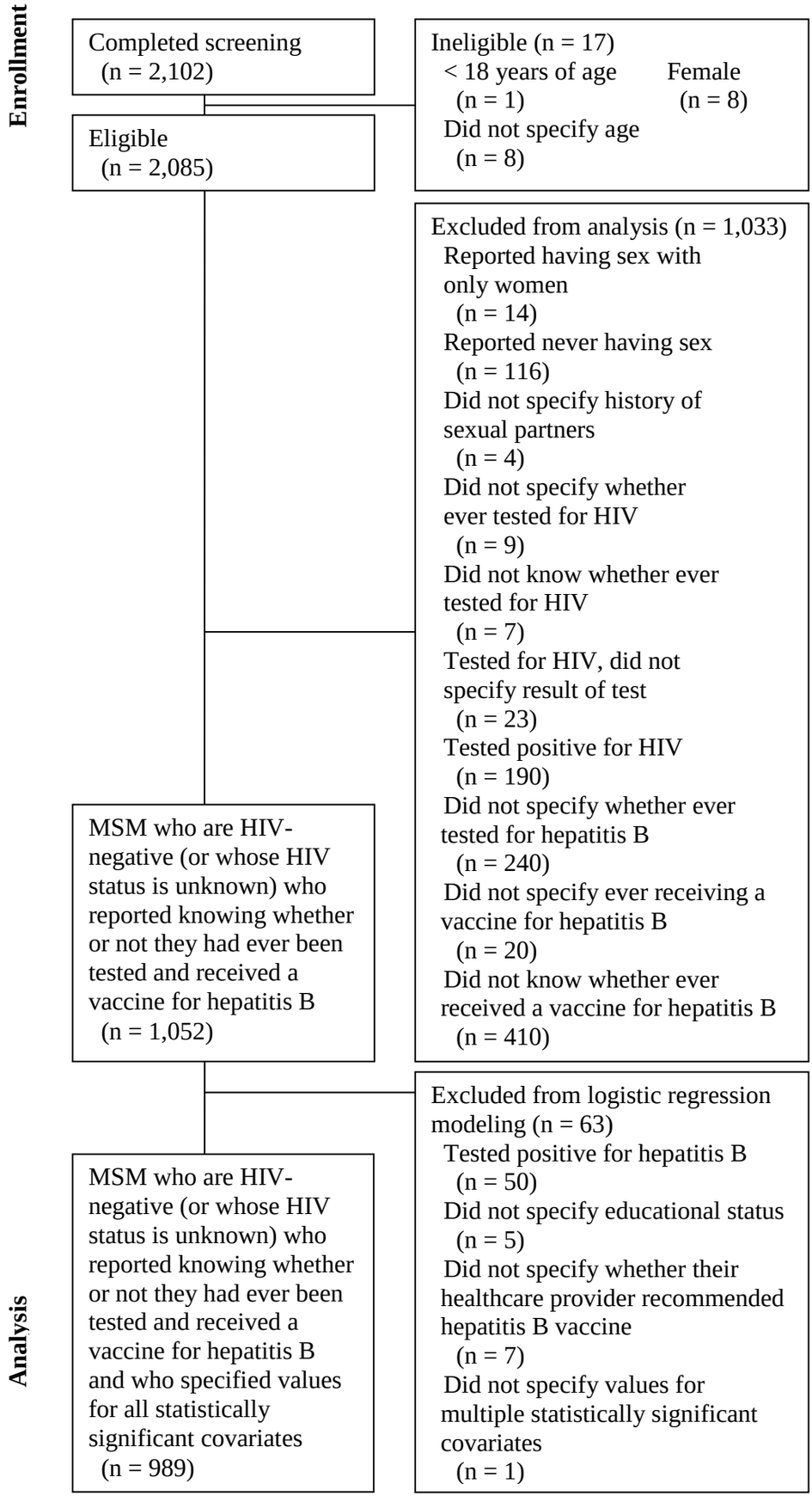


Figure 2. Graphical representation of interaction between age and self-reported hepatitis B screening status among 989 vaccinated, HIV- and hepatitis B-negative men who have sex with men, United States, October – December 2010.

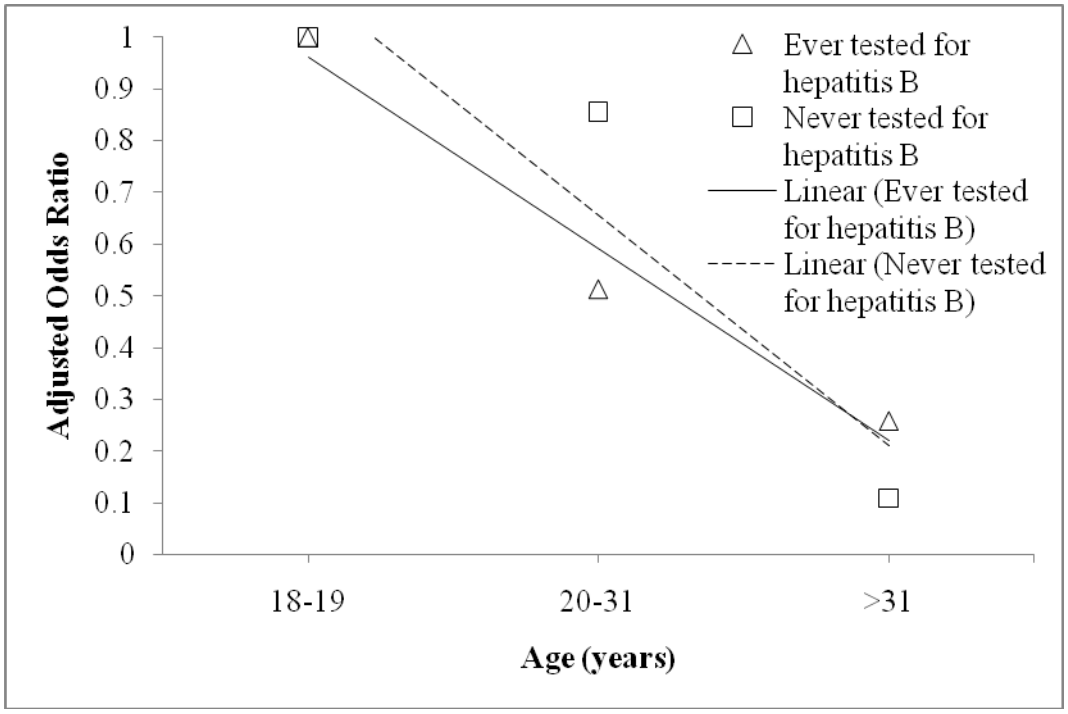


Table 1. Demographic and behavioral characteristics of 1,052 HIV-negative men who have sex with men who reported knowing whether or not they had ever been tested or received a vaccine for hepatitis B, United States, October – December 2010.

Characteristic	n (%)
Age (years)*	
>31	397 (37.7)
20-31	506 (48.1)
18-19	149 (14.2)
Race/ethnicity*,†,‡	
Hispanic	100 (9.8)
Non-Hispanic Black/African American	208 (20.3)
Non-Hispanic Other§	88 (8.6)
Non-Hispanic White/Caucasian	629 (61.4)
Educational status*,‡,‖	
College, post graduate or professional school	372 (35.6)
Some college, Associate's degree, and/or technical school	467 (44.7)
High school or less	207 (19.8)

Characteristic	n (%)
Insurance status*,‡,¶	
Private/HMO	558 (55.6)
Public	80 (8.0)
Other**	73 (7.3)
None	293 (29.2)
US Census region*,‡,††	
Midwest	217 (20.8)
Northeast	171 (16.4)
West	243 (23.3)
South	413 (39.6)
Ever tested for hepatitis B*	
Yes	787 (74.8)
Hepatitis B status*	
Told positive for hepatitis B	50 (4.8)
Vaccinated	679 (64.5)
Not vaccinated	323 (30.7)

Characteristic	n (%)
Ever tested for HIV*	
Yes	905 (86.0)
Anal intercourse at last sex*,‡,§§	
Yes, unprotected by condoms	486 (46.7)
Yes, protected by condoms	262 (25.2)
No	293 (28.2)
Drug use at last sex*,‖‖	
Yes	60 (5.8)
Ever had sex with a woman*	
Yes	456 (43.4)
Visited a healthcare provider in the last 12 months*,¶¶	
Yes	888 (84.7)
Healthcare provider aware of patient's status as a man who has sex with men at visit in last 12 months***	
Yes	490 (47.0)
Healthcare provider recommended a vaccine for hepatitis B at visit	

Characteristic	n (%)
in last 12 months*,†††	
Yes	173 (16.6)

*Chi-square p-value <0.05

†27 respondents did not specify race/ethnicity

‡Percents sum to more than 100 due to rounding

§Includes Asian/Pacific Islander, Native American/Alaska Native, multi-racial and other self-reported racial groups

||6 respondents did not specify educational status

¶48 respondents did not specify insurance status

**Includes Tricare/Champus, Veteran's Administration coverage, and other self-reported types of insurance coverage

††8 respondents did not specify state of residence

§§11 respondents did not specify having anal sex at last sex or frequency of condom use at last sex

||||14 respondents did not specify whether they used drugs at last sex

¶¶4 respondents did not specify whether they visited a healthcare provider in the last 12 months

***9 respondents did not specify whether their healthcare provider knows they have sex with men

†††8 respondents did not specify whether their healthcare provider recommended that they receive a vaccine for hepatitis B

Table 2. Demographic and behavioral characteristics of 1,002 HIV- and hepatitis B-negative men who have sex with men who reported knowing whether or not they had ever received a vaccine for hepatitis B, United States, October – December 2010.

	Ever received hepatitis B vaccination n (%)		Crude odds ratio	
Characteristic	Yes	No	(95% CI)	P-value*
Age (years)				<0.0001
>31	205 (57.6)	151 (42.4)	0.5 (0.3, 0.8)	
20-31	365 (73.4)	132 (26.6)	1.0 (0.7, 1.5)	
18-19†	109 (73.2)	40 (26.9)	Referent	
Race/ethnicity				0.2
Hispanic	67 (69.8)	29 (30.2)	1.0 (0.6, 1.7)	
Non-Hispanic Black/African American†	121 (62.1)	74 (38.0)	0.7 (0.5, 1.0)‡	
Non-Hispanic Other§	61 (72.6)	23 (27.4)	1.2 (0.7, 2.0)	
Non-Hispanic	415 (69.1)	186 (31.0)	Referent	

Characteristic	Ever received hepatitis B vaccination n (%) Yes	No	Crude odds ratio (95% CI)	P-value*
White/Caucasian†				
Missing		26		
Educational status				0.003
College, post graduate or professional school	255 (72.0)	99 (28.0)	1.9 (1.3, 2.7)	
Some college, Associate's degree, and/or technical school	305 (68.7)	139 (31.3)	1.6 (1.1, 2.2)	
High school or less	115 (58.1)	83 (41.9)	Referent	
Missing		6		
Insurance status				0.3
Private/HMO	369 (69.5)	162 (30.5)	1.2 (0.9, 1.6)	
Public	45 (59.2)	31 (40.8)	0.7 (0.4, 1.2)	

Characteristic	Ever received hepatitis B vaccination n (%) Yes	No	Crude odds ratio (95% CI)	P-value*
Other‖	42 (64.6)	23 (35.4)	0.9 (0.5, 1.6)	
None	187 (66.3)	95 (33.7)	Referent	
Missing	48			
US Census region				0.3
Midwest	140 (68.3)	65 (31.7)	1.2 (0.8, 1.7)	
Northeast	114 (69.9)	49 (30.1)	1.3 (0.9, 1.9)	
West	165 (71.4)	66 (28.6)	1.4 (1.0, 2.0)¶	
South	256 (64.5)	141 (35.5)	Referent	
Missing	6			
Ever tested for hepatitis B				<0.0001
Yes	557 (75.6)	180 (24.4)	3.6 (2.7, 4.9)	
No	122 (46.0)	143 (54.0)	Referent	
Ever tested for HIV				0.07

Characteristic	Ever received hepatitis B vaccination n (%) Yes	No	Crude odds ratio (95% CI)	P-value*
Yes	591 (68.9)	267 (31.1)	1.4 (1.0, 2.0)**	
No	88 (61.1)	56 (38.9)	Referent	
Anal intercourse at last sex				0.2
Yes, unprotected by condoms	321 (69.0)	144 (31.0)	1.3 (1.0, 1.8)††	
Yes, protected by condoms	176 (69.8)	76 (30.2)	1.4 (0.9, 1.9)	
No	173 (63.1)	101 (36.9)	Referent	
Missing	11			
Drug use at last sex				0.02
Yes†	31 (53.5)	27 (46.6)	0.5 (0.3, 0.9)	
No	638 (68.6)	292 (31.4)	Referent	
Missing	14			
Ever had sex with a				0.1

Characteristic	Ever received hepatitis B vaccination n (%) Yes	No	Crude odds ratio (95% CI)	P-value*
woman				
Yes	277 (65.2)	148 (34.8)	0.8 (0.6, 1.1)	
No	402 (69.7)	175 (30.3)	Referent	
Visited a healthcare provider in the last 12 months				0.04
Yes	581 (68.9)	262 (31.1)	1.4 (1.0, 2.0)‡‡	
No†	94 (60.7)	61 (39.4)	Referent	
Missing		4		
Healthcare provider aware of patient's status as a man who has sex with men at visit in last 12 months				<0.0001

Characteristic	Ever received hepatitis B vaccination n (%) Yes	No	Crude odds ratio (95% CI)	P-value*
Yes	344 (74.5)	118 (25.5)	1.8 (1.4, 2.4)	
No	329 (61.8)	203 (38.2)	Referent	
Missing	8			
Healthcare provider recommended a vaccine for hepatitis B at visit in last 12 months				<0.0001
Yes	141 (89.2)	17 (10.8)	4.8 (2.8, 8.0)	
No	531 (63.5)	305 (36.5)	Referent	
Missing	8			

*Mantel-Haenszel chi-square

†Percents sum to more than 100 due to rounding

‡Upper bound of confidence interval is 1.03 (p = 0.07) and is rounded down to 1.0

§Includes Asian/Pacific Islander, Native American/Alaska Native, multi-racial and other self-reported racial groups

||Includes Tricare/Champus, Veteran's Administration coverage, and other self-reported types of insurance coverage

¶Lower bound of confidence interval is 0.97 (p = 0.07) and is rounded up to 1.0

**Lower bound of confidence interval is 0.98 and is rounded up to 1.0

††Lower bound of confidence interval is 0.95 (p = 0.10) and is rounded up to 1.0

‡‡Lower bound of confidence interval is 1.01 and is rounded down to 1.0

Table 3. Characteristics significantly associated with receipt of hepatitis B vaccination among 989 vaccinated, HIV- and hepatitis B-negative men who have sex with men, United States, October – December 2010.

Characteristic	Adjusted odds ratio (95% CI)
Age 20-31 vs 18-19	
Ever tested for hepatitis B	0.5 (0.3, 1.0)*
Never tested for hepatitis B	0.9 (0.5, 1.6)
Age >31 vs 18-19	
Ever tested for hepatitis B	0.3 (0.1, 0.5)
Never tested for hepatitis B	0.1 (0, 0.3)
Educational status	
College, post graduate or professional school	2.9 (1.9, 4.4)
Some college, Associate's degree, and/or technical school	2.1 (1.4, 3.1)
High school or less	Referent
Healthcare provider recommended a vaccine for hepatitis B at visit in last 12 months	
Yes	4.2 (2.4, 7.4)

Characteristic	Adjusted odds ratio (95% CI)
No	Referent

*Upper bound of confidence interval is 1.04 (p = 0.07) and is rounded down to 1.0

Table 4. Reasons for lack of hepatitis B vaccination among 323 unvaccinated, HIV- and hepatitis B-negative men who have sex with men, United States, October – December 2010.

Reason not vaccinated	Any n (%)*	Main n (%)†,‡
A vaccine was never offered to you	174 (53.9)	92 (41.8)
You didn't know there was a vaccine that prevents infection with hepatitis B	91 (28.2)	49 (22.3)
You believe yourself to be at low risk of contracting hepatitis B	80 (24.8)	43 (19.6)
You did not know you were eligible to receive a vaccine for hepatitis	68 (21.1)	13 (5.9)
A vaccine was offered to you, but you refused to receive it	12 (3.7)	8 (3.6)
There was no one assigned to you (i.e. doctor, nurse practitioner, etc) who could provide you with health care services, including immunizations	17 (5.3)	5 (2.3)
The vaccine for hepatitis B costs too much	13 (4.0)	5 (2.3)
You were unable to travel to a location that provides vaccinations because of circumstances that were out of	4 (1.2)	2 (0.9)

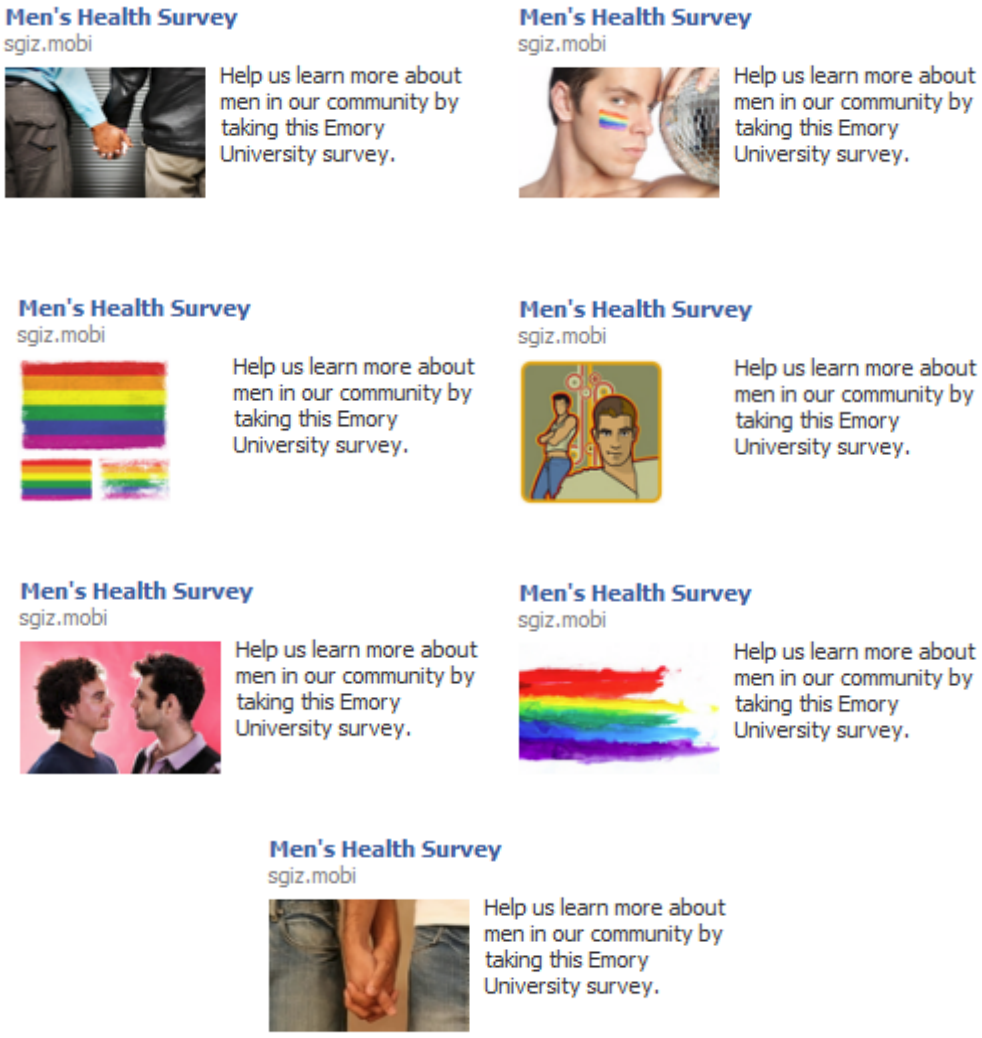
Reason not vaccinated	Any n (%)*	Main n (%)†,‡
your control (disability, live in rural area, etc)		
You were incarcerated	2 (0.6)	2 (0.9)
You believed that you may already have symptoms of hepatitis B and therefore a vaccine would not work	3 (0.9)	1 (0.5)

*Percents may sum to more than 100 because respondents could specify more than 1 reason why they were not vaccinated against hepatitis B

†Percents sum to more than 100 due to rounding

‡103 respondents not vaccinated against hepatitis B either did not specify a reason for not being vaccinated, did not know why they were not vaccinated or, if they specified more than 1 reason for not being vaccinated, did not specify a main reason

Appendix A. Banner advertisements presented to men living in the United States who reported being interested in men on the social networking Internet site Facebook and to members of the site Black Gay Chat, October – December 2010.



Appendix B. Web-based sexual health survey presented to men living in the United States who reported being interested in men on the social networking Internet site Facebook and to members of the site Black Gay Chat, October – December 2010.

Thank you for your interest in our survey. Please take note of the following information.

1. Your answers are anonymous: we don't have any information about who you are beyond the questions you answer.
2. Some questions are about sensitive topics; you can choose not to answer any question that you are not comfortable with.
3. If you have any questions or comments, you may contact the Principal Investigator, Dr. Rob Stephenson, at RBSTEPH@EMORY.EDU.

1. What is your age? _____
2. What is your sex?

   O Male

   O Female

3. Do you consider yourself to be Hispanic or Latino?

    O Yes

    O No

    O Don't Know

    O Prefer not to answer

4. Which racial group do you consider yourself to be in?

    O Asian/Pacific Islander

    O Black/African-American

    O White/Caucasian

    O Native American/Alaska Native

    O Multi-Racial

    You indicated that you are multi-racial. Please check all the racial groups you consider yourself to be in.

        O Asian/Pacific Islander

        O Black/African-American

        O White/Caucasian

        O American Indian/Alaskan Native

        O Other: _____

    O Prefer not to answer

    O Other: _____

5. What is the highest grade in school you completed?

    O College, post graduate, or professional school

    O Some college, Associate's degree, and/or Technical school

O High school or GED

O Some high school

O Less than high school

O Never attended school

O Don't Know

6. What state do you live in? _____

7. Are you currently employed?

O Yes

O No

8. What kind of health insurance or coverage do you currently have?

[ ] Private health insurance or HMO

[ ] Medicaid

[ ] Medicare

[ ] Tricare/Champus

[ ] Veterans Administration coverage

[ ] Some other health insurance

[ ] No health insurance

[ ] Don't know

9. What is your sexual orientation?

O Homosexual/ Gay

10. Do you have any friends, colleagues or acquaintances that identify themselves as a gay or bisexual man?

O Yes

Approximately how many people do you know that identify themselves as a gay or bisexual man? _____

O No

O Heterosexual/ Straight

O Bisexual

10. Do you have any friends, colleagues or acquaintances that identify themselves as a gay or bisexual man?

O Yes

Approximately how many people do you know that identify themselves as a gay or bisexual man? _____

O No

O Unsure

O Other: _____

11. I would now like you to answer some questions about your experience about being a gay/ bisexual man:

Due to your sexual orientation were you ever made fun of as a child?	Y	N
Due to your sexual orientation did you experience violence as a child?	Y	N
Due to your sexual orientation have you experienced violence as an adult?	Y	N
Due to your sexual orientation have you ever been made fun of as an adult?	Y	N
As a child did you hear people say that gay men would grow up alone?	Y	N
As a child did you ever hear that gays are not normal?	Y	N
As a child did you ever feel that your gayness hurt your family?	Y	N
Have you ever had to pretend to be straight?	Y	N
Have you ever experienced job discrimination due to your sexual orientation?	Y	N
Have you ever had to move away from family due to your sexual orientation?	Y	N
Have you ever experienced police harassment due to your sexual orientation?	Y	N

12. I would now like you to answer some more questions about being a gay/bisexual man. Please mark how much you agree with the following statements. (SD: strongly disagree, D: disagree, N: neutral, A: agree, SA: strongly agree)

I doubt that I am homosexual but still am confused about who I am sexually. SD/D/N/A/SA

I don't act like most homosexuals do, so I doubt that I am homosexual. SD/D/N/A/SA

I have homosexual feelings but I doubt that I am homosexual. SD/D/N/A/SA

I cannot imagine sharing my homosexual feelings with anyone. SD/D/N/A/SA

I don't want people to know that I may be homosexual although I'm not sure if I am homosexual or not. SD/D/N/A/SA

I may be homosexual and I am upset about the thought of it. SD/D/N/A/SA

I dread having to deal with the fact that I may be homosexual. SD/D/N/A/SA

I'm probably homosexual even though I maintain a heterosexual image in both my personal and public life. SD/D/N/A/SA

I don't mind if homosexuals know that I have homosexual thoughts and feelings, but I don't want others to know. SD/D/N/A/SA

I tolerate rather than accept my homosexual thoughts and feelings. SD/D/N/A/SA

My homosexuality is a valid private identity that I do not want to be made public. SD/D/N/A/SA

I am definitely homosexual but I do not share that knowledge with most people. SD/D/N/A/SA

I accept but would not say that I am proud of the fact that I am

definitely homosexual. SD/D/N/A/SA

I am very proud to be gay and make it known to everyone around me. SD/D/N/A/SA

I frequently confront people about their irrational homophobic feelings. SD/D/N/A/SA

I am not about to stay hidden as gay for anyone. SD/D/N/A/SA

I am openly gay with everyone but it doesn't make me feel all that different from heterosexuals SD/D/N/A/SA

My heterosexual friends, family and associates think of me as a person who happens to be gay, rather than as a gay person. SD/D/N/A/SA

I generally feel comfortable being the only gay person in a group of heterosexuals. SD/D/N/A/SA

I am openly gay around gays and heterosexuals. SD/D/N/A/SA

13. I would now like you to answer some more questions about your experiences of race.

Due to your race were you ever made fun of as a child?	Y	N
Due to your race did you ever experience violence as a child?	Y	N
Due to your race have you ever been made fun of as an adult?	Y	N
Due to your race have you ever been treated rudely or unfairly?	Y	N
Due to your race have you ever experienced police harassment?	Y	N
Due to your race have you ever faced job discrimination?	Y	N
Due to your race have you ever felt uncomfortable in white gay spaces?	Y	N
Due to your race have you ever had difficulty in finding lovers?	Y	N
Due to your race have you ever been objectified sexually?	Y	N
Due to your race have you ever been rejected for sex?	Y	N

I would now like for you to answer some questions about your relationships.

14. In your entire life, have you ever had sex with:

    O Only women

    O Only men

    O Both men and women

    O I've never had sex

15. Are you currently in a sexual relationship?

    O Yes

    For how many months have you been in this relationship? _____

    Do you have sex with partners beside the main partner you are currently in a relationship with?

        O Yes

        Are the other partners you have sex with besides your main partner men, women or both?

            O Men

            O Women

            O Both

        O No

16. Thinking about your current main sexual relationship, is that partner a man or a woman?

    O Man

    O Woman

In the next few screens we're going to ask some questions about your most recent male sex partner – that is, the last guy you had sex with.

To make the questions easier to ask, we'd like you to enter a nickname for this partner – not his real name, but maybe his initials, a pet name you have for him, or a word that will remind you of where you met him or what you liked best about him.

17. What is a nickname for the last man you had sex with? _____

We will next ask some questions about (your last male partner).
Some questions will be about (your last male partner) in general and some will be about your relationship with (your last male partner).

18. What is (your last male partner)'s current age? *(if you are unsure of the exact age, choose an age that you think is close)* _____

    Which of the following statements about (your last male partner)'s age is most true?

    O He is more than 10 years younger than I am

    O He is 2-10 years younger than I am

    O He is within a year of my age

    O He is 2-10 years older than I am

    O He is more than 10 years older than I am

    O Don't Know

19. Is (your last male partner) Hispanic?

    O Yes

O No

O Don’t Know

20. Which race is (your last male partner)?

O Asian/Pacific Islander

O Black/African-American

O White/Caucasian

O Native American/Alaska Native

O Mixed race

You indicated that (your last male partner) is of mixed-race. Which terms describe (your last male partner)?

O Asian/Pacific Islander

O Black/African-American

O White/Caucasian

O American Indian/Alaskan Native

O Other: _____

O Don’t know

O Other: _____

21. Is (your last male partner) someone that you feel or felt committed to above all others (someone you might call your boyfriend, significant other, life partner, or husband)?

O Yes

O No

O Don’t know

22. Is (your last male partner) an exchange partner (someone who you have sex with in exchange for money, drugs, food, or something else of value)?

    O Yes

    O No

    O Don't know

23. Please rate the relationship of your relationship with (your last male partner) on a scale from 1 (weak) to 10 (strong).

24. In what year did you **first** have sex with (your last male partner)? _____

25. In what month of (year in question 24) did you **first** have sex with (your last male partner)? _____

26. In what month of 2010 did you **first** have sex with (your last male partner)?

    _____

27. Did you and (your last male partner) talk about both your HIV status and his HIV status **before you first had sex**?

    O Yes

    What was (your last male partner)'s status at that time?

        O HIV-negative

        O HIV-positive

    O No

    O Don't know

28. In what year did you **most recently** have sex with (your last male partner)?

    _____

29. In what month of (year in question 28) did you **most recently** have sex with (your last male partner)? _____

30. In what month of 2010 did you **most recently** have sex with (your last male partner)? _____

31. The last time you had sex with (your last male partner), what kinds of sex did you have? Please check all the types of sex you had.

    [ ] Oral sex (penis in the mouth)

    [ ] Anal sex (penis in the butt)

    [ ] Mutual masturbation (J/O)

    [ ] Frottage (rubbing against each other)

32. The last time you had sex with (your last male partner), did you have receptive anal sex? (this means that you were the bottom)

    O Yes

    Did (your last male partner) use a condom the last time you had receptive anal sex (when you were the bottom)?

    O (Your last male partner) did not use a condom

    O (Your last male partner) used a condom part of the time

    O (Your last male partner) used a condom the whole time

    O (Your last male partner) used a condom, but it broke

    O Don't know

    O No

    What was the main reason why a condom was not used the last time you had receptive anal sex with (your last male partner)?

O A condom wasn't available.

O A condom was available, but I didn't want to use one.

O A condom was available, but (your last male partner) didn't want to use one.

O Other reason, *please specify:* _____

O Don't know

33. The last time you had sex with (your last male partner), did you have insertive anal sex? (this means that you were the top)

O Yes

Did you use a condom the last time you had insertive anal sex with (your last male partner) (when you were the top)? *Choose one:*

O I did not use a condom

O I used a condom part of the time

O I used a condom the whole time

O I used a condom, but it broke

O Don't know

O No

What was the <u>main</u> reason why a condom was not used the last time you had insertive anal sex with (your last male partner)?

O A condom wasn't available.

O A condom was available, but I didn't want to use one.

O A condom was available, but (your last male partner) didn't want to use one.

O Other reason, *please specify:* _____

O Don't know

34. The last time you had oral sex with (your last male partner), check which of these things happened – or both.

[ ] I gave him a blow job (his penis was in my mouth)

When (your last male partner)'s penis was in your mouth, was he wearing a condom?

O Yes

O No

[ ] He gave me a blow job (my penis was in his mouth)

When your penis was in (your last male partner)'s mouth, were you wearing a condom?

O Yes

O No

We'd now like to ask some questions about the situation in which you and (your last male partner) last had sex.

35. Where were you and (your last male partner) the last time you had sex?

    O Public restroom

    O The home that (your last male partner) and I share

    O Truck stop/rest area

    O On vacation in a different city

    O Sex club

    O Sex resort

    O Circuit party or rave

    O (Your last male partner)'s home

    O My home

    O Local hotel room

    O Park

    O Car

    O Bath house

    O Other, *please specify:* _____

36. The last time you had sex with (your recent male partner) were you buzzed or drunk on alcohol?

    O Yes

    O No

    O Don't know

37. The last time you had sex with (your last male partner), were you high on drugs?

O Yes

You indicated that you were high on a drug. Please indicate which ones. *Select all that apply.*

[ ] Amphetamine, meth, speed, crystal, crank, ice – *not injected*

[ ] Amphetamine, meth, speed, crystal, crank, ice – *injected*

[ ] Downers (Valium, Ativan, Xanax)

[ ] Pain killers (Oxycontin, Percocet)

[ ] Hallucinogens such as LSD

[ ] Ecstasy

[ ] Club drugs such as GHB, ketamine

[ ] Marijuana

[ ] Poppers (amyl nitrite)

[ ] Crack – *not injected*

[ ] Crack – *injected*

[ ] Cocaine – *smoked or snorted*

[ ] Cocaine – *injected with no other drugs*

[ ] Heroin, smoked or snorted but not injected

[ ] Heroin and cocaine – *injected together (speedballs)*

[ ] Other drugs, *please specify*: _____

O No

O Don't know

38. The last time you had sex with (your last male partner), did you know his HIV status?

O Yes

What was (your last male partner)'s HIV status at that time?

O HIV-negative

O HIV-positive

O No

O Don't know

This page asks some things about the last time you had sex with (your last male partner). Think back to that time and how you might have felt just before you had sex. Then please read the questions carefully, and mark any that apply to that last time you had sex with (your last male partner).

39. Check all statements that apply to the last time you had sex with (your last male partner).

[ ] (Your last male partner) did not want to use a condom

[ ] (Your last male partner) was very, very hot and sexy

[ ] I was lonely and depressed and had sex in order to feel good

[ ] I was in love with (your last male partner)

[ ] I was feeling very, very hot and horny

[ ] I trusted (your last male partner) a lot

[ ] I had to interrupt sex in order to look for condoms

[ ] I felt like bringing up condoms would spoil a romantic, magic moment

[ ] I was having sex in a public place and was afraid of getting caught

[ ] I wanted to feel really close and connected to (your last male partner)

[ ] I was having sex with a group of people and none of them was using a condom

[ ] I or (your last male partner) was having difficulty maintaining an erection

[ ] I was afraid of losing (your last male partner)

[ ] I really wanted to please (your last male partner)

[ ] I was in a bookstore, sex club, backroom, or bathhouse and was having a really good time

[ ] (Your last male partner) asked me to trust him

[ ] I was too drunk/high to remember

[ ] I felt afraid of (your last male partner) and could not mention condoms

[ ] I felt (your last male partner) would abandon me if I asked to use condoms

I would now like to ask you about the last time you had sex with a woman.

40. How long ago was the last time you had sex with a woman?

    O In the past month

    O 2-3 months ago

    O 4-6 months ago

    O 7-12 months ago

    O More than a year ago

41. The last time you had sex with a woman, did you have vaginal sex, where you put your penis in her vagina?

    O Yes

    The last time you had vaginal sex with a woman, did you use a condom?

        O Yes, the whole time

        O Yes, part of the time

        O No, not at all

    O No

42. In the past 6 months, have you had anal sex as a top and used a condom?

    O Yes

    During the last six months when you used a condom for anal sex as a 'top' did any of the following occur, even once? (Y: yes, N: no, NS: not sure)

    Did you let a condom you were using touch sharp jewelry, fingernails or teeth? Y/N/NS

    Did you put a condom on your penis with the wrong side up and then have to flip it over before you could use it? Y/N/NS

Did you completely unroll the condom before putting it on your penis?	Y/N/NS
Did you hold the tip of the condom to leave a space, then roll it down to the base of your penis?	Y/N/NS
Did you use a dry condom? (i.e. the condom was non-lubricated and you did not add any lubricant like KY jelly)	Y/N/NS
Did you add lubricant to the condom?	Y/N/NS
Did you use an oil-based lubricant such as Vaseline, baby oil, massage oil?	Y/N/NS
Did you have any problems with losing an erection while putting on a condom?	Y/N/NS
Did you have any problems with losing your erection once the condom was on and sex had begun?	Y/N/NS
Did you start having sex without a condom and then pull out and put one on?	Y/N/NS
Did you start having sex with a condom on and then take it off before sex was over?	Y/N/NS
Did the condom you were using break during sex?	Y/N/NS
Did the condom you were using slip off during sex?	Y/N/NS
Did the condom you were using slip off after sex, as you were pulling out?	Y/N/NS
Did you have a problem with the way a condom fit or felt on	

you (for example, you felt it was too small or too large, it was the wrong shape, it caused irritation of your skin, or you/your partner couldn't feel anything with it on)? Y/N/NS

O No

43. In the past 6 months, have you had anal sex with a woman and used a condom?

O Yes

O No

44. The next set of questions asks about your HIV knowledge. For each statement, please click “True”, “False”, or “I don’t know.” If you do not know, please do not guess; instead, please click the button: “I don’t know” (T: true, F: false, DK: don’t know)

Having sex with more than one partner can increase a person’s chance of becoming infected with HIV.	T/F/DK
A person will NOT get HIV if he is taking antibiotics.	T/F/DK
A person can get HIV by sharing a glass of water with someone who has HIV.	T/F/DK
There is a female condom that can help decrease a woman’s chance of getting HIV.	T/F/DK
Coughing and sneezing DO NOT spread HIV.	T/F/DK
All pregnant women infected with HIV will have babies born with AIDS.	T/F/DK
There is a vaccine that can stop adults from getting HIV.	T/F/DK
A woman cannot get HIV if she has sex during her period.	T/F/DK
Showering, or washing one’s genitals/private parts, after sex keeps a person from getting HIV.	T/F/DK
Using Vaseline or baby oil with condoms lowers the chance of getting HIV.	T/F/DK
Pulling out the penis before a man climaxes/cums keeps his partner from getting HIV during sex.	T/F/DK
A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV.	T/F/DK

Taking a test for HIV one week after having sex will tell a person if she or he has HIV. T/F/DK

A woman can get HIV if she has anal sex with a man. T/F/DK

People are likely to get HIV by deep kissing (putting their tongue in their partner's mouth), if their partner has HIV. T/F/DK

A person can get HIV from oral sex. T/F/DK

A natural skin condom works better against HIV than does a latex condom. T/F/DK

People who have been infected with HIV quickly show serious signs of being infected T/F/DK

45. Have you ever been tested for HIV?

O Yes

46. In what year was your most recent HIV test? _____

47. In what month of (year in question 46) was your most recent HIV test?

_____

48. In what month of 2010 was your most recent HIV test? _____

49. When you got tested in (month and year in questions 46, 47 and 48), where did you get tested?

O Hospital (inpatient)

O HIV/AIDS street outreach program/Mobile Unit

O HIV counseling and testing site

O Blood bank/Plasma center

O Drug treatment program

O Correctional facility (jail or prison)

O Military

O Sexually transmitted disease clinic

O Private doctor's office (including HMO)

O Emergency room

O At home

O Community health center/public health clinic

O Other _____

50. What was the result of your most recent HIV test in (month and year in questions 46, 47 and 48)?

O Negative

O Positive

O Indeterminant/inconclusive

O Didn't get the results of my last HIV test

O Prefer not to Answer

O No

O Don't know

51. If there were a service in which you could go with your male partner and receive your HIV test results together, do you think you would use this service?

O Yes

O No

The next questions ask about if you use lubrication, or “lube”, for anal sex.

52. Have you heard of a liquid called water-based lubricant, or “lube”, that you use when you are having anal sex to make it easier to insert the penis?

    O Yes

    Did you use “lube” the last time you had anal sex with a male partner?

        O Yes

        O No

    Do you know of a place near you where you can get “lube” whenever you need it?

        O Yes

        O No

    O No

This question asks about how you would feel about two options after having an HIV test.

53. Imagine that you take an HIV rapid test in your doctor's office or in your community. After 20 minutes, the HIV counselor tells you that you have a "reactive" rapid test. She explains that this means that it's possible that you have HIV, but this result needs to be confirmed.

    Would you prefer: to have a blood specimen drawn for confirmation immediately, and come back to the same test site for your final results in one week OR to be immediately referred to an HIV doctor at a different location?

54. Imagine that you take an HIV rapid test in your doctor's office or in your community. After 20 minutes, the HIV counselor tells you that you have a "reactive" rapid test. She explains that this means that it's possible that you have HIV, but this result needs to be confirmed.

    However, imagine you also know that 2 out of 10 people (20%) with a reactive rapid test have HIV.

    Would you prefer: to be immediately referred to an HIV doctor at a different location to OR have a blood specimen drawn for confirmation immediately, and come back to the same test site for your final results in one week?

55. Imagine that you take an HIV rapid test in your doctor's office or in your community. After 20 minutes, the HIV counselor tells you that you have a "reactive" rapid test. She explains that this means that it's possible that you have HIV, but this result needs to be confirmed.

    However, imagine you also know that 5 out of 10 people (50%) with a reactive rapid test have HIV.

Would you prefer: to have a blood specimen drawn for confirmation immediately, and come back to the same test site for your final results in one week OR to be immediately referred to an HIV doctor at a different location?

56. Imagine that you take an HIV rapid test in your doctor's office or in your community. After 20 minutes, the HIV counselor tells you that you have a "reactive" rapid test. She explains that this means that it's possible that you have HIV, but this result needs to be confirmed.

    However, imagine you also know that 9 out of 10 people (90%) with a reactive rapid test have HIV.

    Would you prefer: to have a blood specimen drawn for confirmation immediately, and come back to the same test site for your final results in one week OR to be immediately referred to an HIV doctor at a different location?

57. Thinking about the last question (questions 53-56), what is the main reason you said that you would prefer to have a blood specimen drawn and return for your results next week? _____

58. Thinking about the last question (questions 53-56), is there any reason why you might have chosen to be immediately referred to an HIV doctor? _____

59. Thinking about the last question (questions 53-56), what is the main reason you said that you would prefer to be immediately referred to an HIV doctor?

    _____

60. Thinking about the last question (questions 53-56), is there any reason why you might have chosen to have blood drawn and return for your results next week?

    _____

61. Please answer the following questions about things that you might have done in the past 12 months.

In the last 12 months have any of your partners ever tried to hurt you, this includes pushing, holding you down, hitting you with his fist, kicking, attempting to strangle, attacking with a knife, gun, or other weapon?	Y	N
In the last 12 months have any of your partners ever used physical force or verbal threats to force you to have sex when you did not want to?	Y	N
In the last 12 months have you ever tried to hurt any of your partners, this includes pushing, holding him down, hitting him with your fist, kicking, attempting to strangle, attacking with a knife, gun, or other weapon?	Y	N
In the last 12 months have you ever used physical force or verbal threats to force any of your partners to have sex when they did not want to?	Y	N

Now we'll ask you some questions about health care.

62. Have you visited a doctor, nurse or health care provider in the past 12 months?

O Yes

The last time you saw a doctor, nurse or other health care provider, which type of visit was it?

O A visit because I was sick

O A regular checkup

O A visit because I needed a physical for work or school

O A visit because I wanted to get an HIV test

O A visit because I had an injury

O Some other reason (please specify): _____

When you visited a doctor, nurse or health care provider in the past 12 months, did you tell the health care provider that you have sex with men?

O Yes

O No

65. You mentioned that you have visited a health care provider in the past 12 months. Did the health care provider recommend that you get a hepatitis vaccine?

O Yes

O No

O No

63. Has a doctor or nurse ever told you that you have Hepatitis B?

O Yes

O No

Have you ever been tested for Hepatitis B?

O Yes

O No

O Don't know

O Don't know

Have you ever been tested for Hepatitis B?

O Yes

O No

O Don't know

64. A vaccine is a shot that can prevent you from getting certain infections or diseases. Hepatitis vaccine is given several times as a shot in the arm. Usually there are several months in between the shots. Have you ever had a vaccine for hepatitis?

O Yes

What type(s) of hepatitis vaccine have you had?

O Hepatitis A vaccine

O Hepatitis B vaccine

O Hepatitis A and B vaccine

O I'm not sure which Hepatitis vaccine I got

O No

Which of the following are reasons why you have not been vaccinated for Hepatitis A or Hepatitis B?

[ ] You didn't know there was a vaccine that prevents infection with Hepatitis or Hepatitis B

[ ] A vaccine was never offered to you

[ ] You believe yourself to be at low risk of contracting Hepatitis A or Hepatitis B

[ ] A vaccine was offered to you, but you refused to receive it

[ ] You believed that you may already have symptoms of Hepatitis A or Hepatitis B and therefore a vaccine would not work

[ ] The vaccines for Hepatitis A and Hepatitis B costs too much

[ ] You were in jail or prison

[ ] There was no one assigned to you (i.e. doctor, nurse practitioner, etc) who could provide you with health care services, including immunizations

[ ] You were unable to travel to a location that provides vaccinations because of circumstances that were out of your control (disability, live in rural area, etc)

[ ] You did not know you were eligible to receive a vaccine for hepatitis

[ ] You don’t know why you were not vaccinated

66. You mentioned more than one reason you didn’t get a hepatitis vaccine. Of these reasons, which was the main reason you didn’t get a vaccine?

[ ] You didn't know there was a vaccine that prevents infection with Hepatitis or Hepatitis B

[ ] A vaccine was never offered to you

[ ] You believe yourself to be at low risk of contracting Hepatitis A or Hepatitis B

[ ] A vaccine was offered to you, but you refused to receive it

[ ] You believed that you may already have symptoms of Hepatitis A or Hepatitis B and therefore a vaccine would not work

[ ] The vaccines for Hepatitis A and Hepatitis B costs too much

[ ] You were in jail or prison

[ ] There was no one assigned to you (i.e. doctor, nurse practitioner, etc) who could provide you with health care services, including immunizations

[ ] You were unable to travel to a location that provides vaccinations because of circumstances that were out of your control (disability, live in rural area, etc)

[ ] You did not know you were eligible to receive a vaccine for hepatitis

[ ] You don’t know why you were not vaccinated

O Don’t know

67. Please say how much you agree or disagree with the following statements. (SA: strongly agree, A: agree, N: neither agree or disagree, D: disagree, SD: strongly disagree)

Contracting HIV would be very serious to me	SA/A/N/D/SD
The thought of contracting HIV scares me	SA/A/N/D/SD
When I think about contracting HIV I feel nauseous	SA/A/N/D/SD
If I contracted HIV my career would be endangered	SA/A/N/D/SD
When I think about contracting HIV it makes me very anxious	SA/A/N/D/SD
Contracting HIV would jeopardize my relationship with my partner	SA/A/N/D/SD
Contracting HIV would jeopardize my relationship with my family	SA/A/N/D/SD
My views of myself would change dramatically if I contracted HIV	SA/A/N/D/SD
My financial security would be greatly endangered if I contracted HIV	SA/A/N/D/SD
Contracting HIV would be more serious than other diseases	SA/A/N/D/SD
If I contracted HIV, my whole life would change	SA/A/N/D/SD
Thinking about contracting HIV stops me from sleeping	SA/A/N/D/SD
Thinking about contracting HIV stops me from enjoying sex with my partner(s)	SA/A/N/D/SD

68. How serious would it be for YOU if:

YOU contracted HIV?

- O Not at all serious
- O A little serious
- O Somewhat serious
- O Serious
- O Very serious

YOUR PARTNER contracted HIV?

- O Not at all serious
- O A little serious
- O Somewhat serious
- O Serious
- O Very serious

Thank you for taking our survey. Your response is very important to us.

If you have questions or comments, you may contact the Principal Investigator, Dr. Rob Stephenson of Emory University at RBSTEPH@EMORY.EDU.

To find an HIV testing location near you, please visit:

www.hivtest.org

To get more information about HIV, please visit:

www.cdc.gov/hiv

Otherwise, you can close your browser.

Appendix C. SAS code written to generate final dataset, figures, tables, and logistic regression models for thesis.

```
OPTIONS NOFMTERR;

LIBNAME THESIS "H:\PERSONAL FILES\THESIS\";

%INCLUDE "H:\PERSONAL FILES\THESIS\AFRICA IMPORT FROM SPSS.SAS";
%INCLUDE "H:\PERSONAL FILES\THESIS\REPVAXYN.SAS";
%INCLUDE "H:\PERSONAL FILES\THESIS\REPVAXTYPE.SAS";
%INCLUDE "H:\PERSONAL FILES\THESIS\PROVIDER.SAS";
%INCLUDE "H:\PERSONAL FILES\THESIS\WHYNOTVAX.SAS";
%INCLUDE "H:\PERSONAL FILES\THESIS\EVERTESTHEPB.SAS";

PROC SORT DATA=WORK.USAFRICA;
	BY VRID;
RUN;

PROC SORT DATA=REPVAXYN;
	BY VRID;
RUN;

DATA WORK.USAFRICA1;
	MERGE USAFRICA REPVAXYN;
		BY VRID;
RUN;

PROC SORT DATA=REPVAXTYPE;
	BY VRID;
RUN;

DATA WORK.USAFRICA2;
	MERGE USAFRICA1 REPVAXTYPE;
		BY VRID;
RUN;

PROC SORT DATA=REPLPROV;
	BY VRID;
RUN;

DATA WORK.USAFRICA3;
	MERGE USAFRICA2 REPLPROV;
		BY VRID;
RUN;
```

```
PROC SORT DATA=WHYNOTVAX;
	BY VRID;
RUN;

DATA WORK.USAFRICA4;
	MERGE USAFRICA3 WHYNOTVAX;
		BY VRID;
RUN;

PROC SORT DATA=EVERTESTHEPB;
	BY VRID;
RUN;

DATA WORK.USAFRICA5;
	MERGE USAFRICA4 EVERTESTHEPB;
		BY VRID;
RUN;

DATA WORK.USAFRICA5;
	SET WORK.USAFRICA5;
		IF VRID=4392 THEN DELETE;
RUN;

DATA THESIS.USAFRICA;
	SET WORK.USAFRICA5;
RUN;

DATA SUBSET;
	SET THESIS.USAFRICA
	 (KEEP=VRID
			VAR83
			VAR73
			VAR47
			VAR5
			VAR122
			VAR123
			VAR123O13OTHR
			VAR126
			VAR128
			VAR138O122
			VAR138O123
			VAR138O124
			VAR138O125
			VAR138O126
			VAR138O127
			VAR138O128
```

```
                    VAR138O128OTHR
                    VAR138O130
                    VAR66
                    VAX_YN_XLS
                    VAXTYPE_XLS
                    DR_VISIT_12M_XLS
                    DR_KNOWS_MSM_XLS
                    DR_REC_HEPVAX_XLS
                    DIDNTKNOWWASVAX
                    VAXNOTOFFER
                    LOWRISK
                    REFUSEDVAX
                    MAYHAVESYM
                    EXPENSIVE
                    JAILED
                    NODOC
                    NOTRAV
                    NOTELIG
                    IDKWHYNOT
                    MAINREASON
                    VAR295O743
                    VAR275
                    VAR276
                    VAR278
                    VAR279
                    VAR283
                    VAR284
                    EVERTEST_HEPB
                    TOLDHAVEHEPB);
RUN;

DATA SUBSET;
        SET SUBSET;
                RENAME      VAR83 =SEX
                            VAR73 =STATUS
                            VAR47 =PARTTYPE
                            VAR5  =AGE
                            VAR122=HISP
                            VAR123=RACE
                            VAR123O13OTHR=RACE_OTHER
                            VAR126=EDUC
                            VAR128=STATE
                            VAR138O122=INSUR_NONE
                            VAR138O123=INSUR_PRIV
                            VAR138O124=INSUR_MEDICAID
                            VAR138O125=INSUR_MEDICARE
```

```
                                VAR138O126=INSUR_TRICARE
                                VAR138O127=INSUR_VA
                                VAR138O128=INSUR_OTHER
                                VAR138O128OTHR=INSUR_OTHER_CHAR
                                VAR138O130=INSUR_IDK
                                VAR66=HIVTEST_EVER_YN
                                VAR295O743=ANALSEXLS
                                VAR275=ANALSEXLS_REC
                                VAR276=ANALSEXLS_REC_CONDPERC
                                VAR278=ANALSEXLS_INS
                                VAR279=ANALSEXLS_INS_CONDPERC
                                VAR283=ALCOHOLLS
                                VAR284=DRUGSLS;
RUN;

PROC FREQ DATA=SUBSET; * look at distribution of age variable, only interested in
respondents > 18 years old ;
        TABLES AGE/LIST MISSING;
RUN;

DATA EIGHTEEN; * remove respondents younger than 18 years of age and those
                        individuals missing a value for age ;
        SET SUBSET;
                IF AGE LT 18 THEN DELETE;
                IF AGE EQ . THEN DELETE;
RUN;

PROC FREQ DATA=EIGHTEEN;
        TABLES AGE /LIST MISSING;
RUN;

PROC FREQ DATA=EIGHTEEN; * look at distribution of sex variable, only interested
                                        in male respondents ;
        TABLES SEX;
RUN;

PROC FREQ DATA=EIGHTEEN;
        TABLES SEX;
                FORMAT SEX X;
RUN;

DATA MALES; * remove female respondents ;
        SET EIGHTEEN;
                IF SEX NE 1 THEN DELETE;
RUN;
```

```
PROC FREQ DATA=MALES;
        TABLES SEX;
                FORMAT SEX X;
RUN;

PROC FREQ DATA=MALES; * look at distribution of partner type variable, only
                                interested in MSM respondents ;
        TABLES PARTTYPE;
RUN;

PROC FREQ DATA=MALES;
        TABLES PARTTYPE;
                FORMAT PARTTYPE X;
RUN;

DATA MSM; * remove all male respondents who have only had sex with women or who
                have never had sex (non-MSM) ;
        SET MALES;
                IF PARTTYPE IN(1 4 .) THEN DELETE;
RUN;

PROC FREQ DATA=MSM;
        TABLES PARTTYPE;
                FORMAT PARTTYPE X;
RUN;

PROC FREQ DATA=MSM; * look at distribution of HIV status, only interested in HIV-
                                negative or self reported unknown status ;
        TABLES HIVTEST_EVER_YN*STATUS/LIST MISSING;
RUN;

PROC FREQ DATA=MSM;
        TABLES HIVTEST_EVER_YN*STATUS/LIST MISSING;
                FORMAT HIVTEST_EVER_YN X STATUS X;
RUN;

DATA MSM; * clean ever test for HIV YN and HIV status variables ;
        SET MSM;
                IF HIVTEST_EVER_YN=9 THEN HIVTEST_EVER_YN=.;

                IF HIVTEST_EVER_YN=. AND STATUS IN(0 1 2 3 7) THEN
                STATUS=.;

                IF STATUS=7 THEN STATUS=.;
RUN;
```

```
PROC FREQ DATA=MSM; * check distribution of ever test for HIV YN and HIV status
                                variables to ensure proper cleaning ;
        TABLES HIVTEST_EVER_YN*STATUS/LIST MISSING;
                FORMAT HIVTEST_EVER_YN X STATUS X;
RUN;

DATA MSM_EXCLPOS; * remove all respondents who did not answer question for ever
                            receiving HIV test (should not have been          ;
SET MSM;                    * presented with status question) as well as respondents who
                            did not answer or who preferred not to answer status q ;
                IF HIVTEST_EVER_YN=1 AND STATUS=. THEN DELETE;
                IF HIVTEST_EVER_YN=. THEN DELETE;
                IF STATUS EQ 1 THEN DELETE;
RUN;

PROC FREQ DATA=MSM_exclpos;
        TABLES HIVTEST_EVER_YN*STATUS/LIST MISSING;
                FORMAT HIVTEST_EVER_YN X STATUS X;
RUN;

PROC FREQ DATA=MSM_EXCLPOS; * check distribution of other race variable to
                                        determine whether Hispanic YN, race, or
                                        other race variables ;
        TABLES VRID*HISP*RACE*RACE_OTHER/LIST; *need cleaning ;
RUN;

PROC FREQ DATA=MSM_EXCLPOS;
        TABLES VRID*HISP*RACE*RACE_OTHER/LIST;
                FORMAT VRID X HISP X RACE X RACE_OTHER X;
RUN;

DATA RACE_CLEAN;
        SET MSM_EXCLPOS;

/* RACE_OTHER HISPANIC OR LATINO */

        IF VRID IN(26 34 37 62 255 351 709 963 1073 1085 1089 1131 1387 1525 1544
                        1553 1626 1645 1653 1682 1702 2918 3037 3068 3139 3149 3487
                        3526 3657 3778 3816 3831 4336) THEN DO;
                RACE=.;
                RACE_OTHER='';
        END;

        IF VRID=2765 THEN DO;
                HISP=1;
      RACE=3;
```

```
        RACE_OTHER='';
    END;

    *RACE_OTHER = PORTUGUESE BUT HISP = 0;

    IF VRID=2577 THEN DO;
        HISP=1;
    END;

/* RACE CAN BE IMPUTED FROM RACE_OTHER */
    IF VRID=2984 THEN RACE=2;
    IF VRID=410 THEN RACE=3;
    IF VRID IN(866 1115 1654 1816 3933 4262) THEN RACE=5;
    IF VRID IN(410 866 1115 1654 1816 2984 3933 4262) THEN
RACE_OTHER='';

/* RACE_OTHER NONSENSICAL */
    IF VRID IN(55 78 199 233 508 659 1636 1929 2075 2888 4341) THEN DO;
        RACE=.;
        RACE_OTHER='';
    END;

    IF RACE=7 THEN RACE=.;

RUN;

PROC FREQ DATA=RACE_CLEAN; * check distributions of Hispanic YN, race, and
                             other race variables to determine whether
                             cleaned properly ;
    TABLES VRID*HISP*RACE*RACE_OTHER/LIST;
RUN;

PROC FORMAT;
VALUE NEW_RACE 1='HISPANIC'
               2='NON-HISPANIC BLACK/AFRICAN-AMERICAN'
               4='NON-HISPANIC WHITE/CAUCASIAN'
               3='NON-HISPANIC OTHER';
RUN;

DATA NEW_RACE; * grouping Hispanic YN and race combinations according to above
                 categories ;
    SET RACE_CLEAN;
        IF HISP=1 THEN NEW_RACE = 1;
        IF HISP=0 AND RACE=2 THEN NEW_RACE = 2;
        IF HISP=0 AND RACE=3 THEN NEW_RACE = 4;
        IF HISP=0 AND RACE IN (1 4 5 6) THEN NEW_RACE = 3;
```

```
                    FORMAT NEW_RACE NEW_RACE.;
RUN;

PROC FREQ DATA=NEW_RACE; * check distribution of newly created race/ethnicity
                           variable ;
        TABLES NEW_RACE*HISP*RACE/LIST MISSING;
RUN;

PROC FREQ DATA=NEW_RACE; * check distribution of drugs at last sex variable ;
        TABLES DRUGSLS;
RUN;

PROC FREQ DATA=NEW_RACE;
        TABLES DRUGSLS;
                FORMAT DRUGSLS X;
RUN;

DATA CLEAN_DRUGSLS; * set all responses to drugs at last sex = missing if didn't
know ;
        SET NEW_RACE;
                IF DRUGSLS=9 THEN DRUGSLS=.;
RUN;

PROC FREQ DATA=CLEAN_DRUGSLS; * check distribution of drugs at last sex
                                variable to determine if cleaned properly ;
        TABLES DRUGSLS;
RUN;

PROC FREQ DATA=CLEAN_DRUGSLS; * check distribution of anal sex variables ;
        TABLES ANALSEXLS_REC ANALSEXLS_INS;
RUN;

PROC FREQ DATA=CLEAN_DRUGSLS;
        TABLES ANALSEXLS_REC ANALSEXLS_INS;
                FORMAT ANALSEXLS_REC X ANALSEXLS_INS X;
RUN;

DATA RECODE_ASLS_REC_INS; * set all responses to receptive and/or insertive anal
                            sex at last sex= missing if didn't know ;
        SET CLEAN_DRUGSLS;

                IF ANALSEXLS_REC=9 THEN ANALSEXLS_REC=.;
                IF ANALSEXLS_INS=9 THEN ANALSEXLS_INS=.;

RUN;
```

```
PROC FREQ DATA=RECODE_ASLS_REC_INS; * check distribution of anal sex
                                      variables ;
        TABLES
        ANALSEXLS*ANALSEXLS_REC*ANALSEXLS_REC_CONDPERC*ANAL
        SEXLS_INS*ANALSEXLS_INS_CONDPERC/LIST;
RUN;

PROC FREQ DATA=RECODE_ASLS_REC_INS;
        TABLES
        ANALSEXLS*ANALSEXLS_REC*ANALSEXLS_REC_CONDPERC*ANAL
        SEXLS_INS*ANALSEXLS_INS_CONDPERC/LIST;
                FORMAT ANALSEXLS X ANALSEXLS_REC X
                ANALSEXLS_REC_CONDPERC X ANALSEXLS_INS X
                ANALSEXLS_INS_CONDPERC X;
RUN;

DATA COND_ANAL; * create new variable for condom use the whole time at last anal
                  sex ;
        SET RECODE_ASLS_REC_INS;

                IF ANALSEXLS=1 AND (ANALSEXLS_REC=0 AND
                ANALSEXLS_INS=0) THEN ANALSEXLS=0;

                IF ANALSEXLS=0 THEN DO;
                        ANALSEXLS_REC=.;
                        ANALSEXLS_INS=.;
                        ANALSEXLS_REC_CONDPERC=.;
                        ANALSEXLS_INS_CONDPERC=.;
                END;

                IF ANALSEXLS=1 AND (ANALSEXLS_REC=. AND
                ANALSEXLS_INS=0) OR (ANALSEXLS_REC=0 AND
                ANALSEXLS_INS=.) THEN ANALSEXLS_REC=1;

                IF ANALSEXLS=1 AND (ANALSEXLS_REC=1 AND
                ANALSEXLS_REC_CONDPERC EQ 3) AND (ANALSEXLS_INS=1
                AND ANALSEXLS_INS_CONDPERC EQ 3) THEN COND_ANAL=1;

                IF ANALSEXLS=1 AND (ANALSEXLS_REC=1 AND
                ANALSEXLS_REC_CONDPERC EQ 3) AND ANALSEXLS_INS=0
                THEN COND_ANAL=1;

                IF ANALSEXLS=1 AND ANALSEXLS_REC=0 AND
                (ANALSEXLS_INS = 1 AND ANALSEXLS_INS_CONDPERC EQ 3)
                THEN COND_ANAL=1;
```

```
        IF ANALSEXLS=1 AND (ANALSEXLS_REC=0 AND
        ANALSEXLS_INS=0) THEN COND_ANAL=0;
        IF ANALSEXLS=1 AND (ANALSEXLS_REC=1 AND
        ANALSEXLS_REC_CONDPERC NE 3) OR (ANALSEXLS_INS=1
        AND ANALSEXLS_INS_CONDPERC NE 3) THEN COND_ANAL=0;

        IF ANALSEXLS=1 AND (ANALSEXLS_REC=. OR ALSEXLS_INS=.)
        THEN COND_ANAL=.;

        IF ANALSEXLS=0 THEN COND_ANAL=0;

        IF ANALSEXLS=1 AND (ANALSEXLS_REC=1 AND
        ANALSEXLS_REC_CONDPERC EQ .) THEN COND_ANAL=.;

        IF ANALSEXLS=1 AND (ANALSEXLS_INS=1 AND
        ANALSEXLS_INS_CONDPERC EQ .) THEN COND_ANAL=.;

        IF ANALSEXLS=1 AND (ANALSEXLS_REC=1 AND
        ANALSEXLS_REC_CONDPERC EQ 9) THEN COND_ANAL=.;

        IF ANALSEXLS=1 AND (ANALSEXLS_INS=1 AND
        ANALSEXLS_INS_CONDPERC EQ 9) THEN COND_ANAL=.;

                FORMAT ANALSEXLS_REC_CONDPERC VAR279A.;
RUN;

PROC FREQ DATA=COND_ANAL; * check distribution of new variable to determine
                            if coded properly ;
    TABLES
    COND_ANAL*ANALSEXLS*ANALSEXLS_REC*ANALSEXLS_REC_CON
    DPERC*ANALSEXLS_INS*ANALSEXLS_INS_CONDPERC/LIST MISSING;
        FORMAT COND_ANAL X ANALSEXLS X ANALSEXLS_REC X
        ANALSEXLS_REC_CONDPERC X ANALSEXLS_INS X
        ANALSEXLS_INS_CONDPERC X;
RUN;

DATA AI_TYPE; * create new variable for unprotected anal intercourse at last sex ;
    SET COND_ANAL;
        IF ANALSEXLS=0 THEN AI_TYPE=2;
        IF ANALSEXLS=1 AND COND_ANAL=1 THEN AI_TYPE=1;
        IF ANALSEXLS=1 AND COND_ANAL=0 THEN AI_TYPE=0;
RUN;

PROC FORMAT;
VALUE AI_TYPE   2="No AI at last sex"
                1="AI at last sex, protected"
```

```
                    0="AI at last sex, unprotected (UAI)"
;
RUN;

PROC FREQ DATA=AI_TYPE; * check distribution of new variable to determine if
                                coded properly ;
        TABLES AI_TYPE*ANALSEXLS*COND_ANAL/LIST MISSING;
                FORMAT AI_TYPE AI_TYPE. ANALSEXLS X COND_ANAL X;
RUN;

PROC FREQ DATA=AI_TYPE; * check distribution of new variable to determine if
                                coded properly ;
        TABLES AI_TYPE*ANALSEXLS*COND_ANAL/LIST MISSING;
                FORMAT AI_TYPE X ANALSEXLS X COND_ANAL X;
RUN;

PROC FREQ DATA=AI_TYPE; * check distribution of alcohol use at last sex variable ;
        TABLES ALCOHOLLS;
RUN;

PROC FREQ DATA=AI_TYPE;
        TABLES ALCOHOLLS;
                FORMAT ALCOHOLLS X;
RUN;

DATA ALCOHOLLS;
        SET AI_TYPE;
                IF ALCOHOLLS=9 THEN ALCOHOLLS=.;
RUN;

PROC FREQ DATA=ALCOHOLLS; * check distribution of alcohol use at last sex
                                variable to determine if cleaned properly ;
        TABLES ALCOHOLLS;
RUN;

DATA STATES; * recode residence variable (states) into census regions ;
        SET ALCOHOLLS;
                IF STATE IN(10043 10044 10045 10046 10053 10054 10056 10058
                        10065 10067 10075 10084) THEN REGION='MW';
                IF STATE IN(10034 10049 10052 10060 10061 10063 10071 10073
                        10079) THEN REGION='NE';
                IF STATE IN(10027 10031 10035 10036 10038 10039 10047 10048
                        10051 10055 10064 10068 10074 10076 10077 10081
                        10083) THEN REGION='S';
                IF STATE IN(10028 10030 10032 10033 10041 10042 10057 10059
                        10062 10069 10078 10082 10085) THEN REGION='W';
```

```
RUN;

PROC FREQ DATA=STATES; * check distribution of region variable to determine if
                                    coded properly ;
        TABLE REGION*STATE/LIST MISSING;
RUN;

PROC FREQ DATA=STATES; * check self reported other insurance variable for entries
                                    to be recoded into defined category ;
        TABLES VRID*INSUR_OTHER_CHAR/LIST;
RUN;

DATA INSUR_OTHER_CLEAN;
        SET STATES;
                IF VRID IN(51   61   90   159  269  318  343  363  376  381
                                421  442  663  712  863  914  924  1062 1156 1265
                                1294 1314 1325 1385 1474 1502 1542 1593 1605 1654
                                1862 1871 2159 2398 2499 2521 2537 2613 2647 2654
                                2668 2803 2849 2870 2885 3006 3083 3145 3188 3511
                                3548 3579 3679 3748 3787 3833 3901 4262 4295 4391
                                113 124 162 208 417 454 581 610 616 709 814 942 964
                                1010 1599 2555 2609 2620 2631 2847 2999 3333 3572
                                3663 3696 3961 4084 4147 4233) THEN DO;
                INSUR_OTHER_CHAR='';
                INSUR_OTHER=0;
                INSUR_PRIV=1;
                END;
        IF VRID IN(353 605 1481 2382 2864 3375) THEN DO;
                INSUR_OTHER_CHAR='';
                INSUR_OTHER=0;
                INSUR_MEDICAID=1;
                END;
        IF VRID IN(1701 2338 2989 3575 4211) THEN DO;
                INSUR_OTHER_CHAR='';
                INSUR_OTHER=0;
                INSUR_NONE=1;
                END;
        IF VRID IN(1293 1408 3199 3737 1200 702) THEN DO;
                INSUR_OTHER_CHAR='';
                INSUR_OTHER=0;
                INSUR_IDK=1;
                END;
RUN;

PROC FREQ DATA=INSUR_OTHER_CLEAN;
        TABLES VRID*INSUR_OTHER_CHAR/LIST;
```

```
RUN;

DATA INSURANCE_CLEAN; * create array to count number of respondents who
                        specify >1 insurance type ;

        SET INSUR_OTHER_CLEAN;
        INSURCOUNT=0;

        ARRAY INSUR {6} INSUR_PRIV INSUR_MEDICAID INSUR_MEDICARE
        INSUR_TRICARE INSUR_VA INSUR_OTHER;

        DO I=1 TO 6;
                IF INSUR{I}=1 THEN INSURCOUNT=INSURCOUNT+1;
                IF INSUR{I}=0 THEN INSURCOUNT=INSURCOUNT+0;
END;
RUN;

PROC FREQ DATA=INSURANCE_CLEAN; * determine whether array coded properly
;
        TABLES
        INSURCOUNT*INSUR_PRIV*INSUR_MEDICAID*INSUR_MEDICARE*IN
        SUR_TRICARE*INSUR_VA*INSUR_OTHER/LIST MISSING;
RUN;

PROC FORMAT;
VALUE INSURANCE 1="PRIVATE/HMO"
                        2="MEDICAID"
                        3="MEDICARE"
                        4="TRICARE/CHAMPUS"
                        5="VA"
                        6="OTHER"
                        7="MORE THAN 1"
                        8="NONE";
RUN;

DATA INSUR_MORE1; * recode insurance variable so that each respondent appears in
                    only one insurance category ;
        SET INSURANCE_CLEAN;
                IF INSURCOUNT EQ 1 AND INSUR_PRIV=1 THEN
                INSUR_CLEAN=1;

                IF INSURCOUNT EQ 1 AND INSUR_MEDICAID=1 THEN
                INSUR_CLEAN=2;

                IF INSURCOUNT EQ 1 AND INSUR_MEDICARE=1 THEN
                INSUR_CLEAN=3;
```

```
        IF INSURCOUNT EQ 1 AND INSUR_TRICARE=1 THEN
        INSUR_CLEAN=4;

        IF INSURCOUNT EQ 1 AND INSUR_VA=1 THEN INSUR_CLEAN=5;

        IF INSURCOUNT EQ 1 AND INSUR_OTHER=1 THEN
        INSUR_CLEAN=6;

        IF INSURCOUNT GT 1 THEN INSUR_CLEAN=7;

        IF INSURCOUNT EQ 0 AND INSUR_NONE=1 THEN
        INSUR_CLEAN=8;
            FORMAT INSUR_CLEAN INSURANCE.;
RUN;

PROC FREQ DATA=INSUR_MORE1; * check distribution of new insurance variable to
                              determine if coded properly ;
    TABLES
    INSUR_CLEAN*INSURCOUNT*INSUR_PRIV*INSUR_MEDICAID*INSUR
    _MEDICARE*INSUR_TRICARE*INSUR_VA*INSUR_OTHER*INSUR_NON
    E*INSUR_IDK/LIST MISSING;
        FORMAT INSUR_CLEAN INSURANCE. INSURCOUNT X
        INSUR_PRIV X INSUR_MEDICAID X INSUR_MEDICARE X
        INSUR_TRICARE X INSUR_VA X INSUR_OTHER X INSUR_NONE
        X INSUR_IDK X;
RUN;

PROC FORMAT;
    VALUE INSURANCE_COLLAPSE 1="PRIVATE/HMO"
                             2="PUBLIC"
                             3="OTHER"
                             4="NONE";
RUN;

DATA INSUR_COLLAPSE; * collapse insurance variable into above categories ;
    SET INSURANCE_CLEAN;
        IF INSURCOUNT EQ 1 AND INSUR_PRIV=1 THEN
        INSUR_CLEAN=1;

        IF INSURCOUNT EQ 1 AND (INSUR_MEDICAID=1 OR
        INSUR_MEDICARE=1) THEN INSUR_CLEAN=2;

        IF INSURCOUNT EQ 1 AND (INSUR_TRICARE=1 OR INSUR_VA=1
        OR INSUR_OTHER=1) THEN INSUR_CLEAN=3;

        IF INSURCOUNT GT 1 THEN INSUR_CLEAN=3;
```

```
            IF INSURCOUNT EQ 0 AND INSUR_NONE=1 THEN
            INSUR_CLEAN=4;

        FORMAT INSUR_CLEAN INSURANCE_COLLAPSE.;
RUN;

PROC FREQ DATA=INSUR_COLLAPSE; * check distribution of new collapsed
                                 insurance variable to determine if coded
                                 properly ;
        TABLES
        INSUR_CLEAN*INSURCOUNT*INSUR_PRIV*INSUR_MEDICAID*INSUR
        _MEDICARE*INSUR_TRICARE*INSUR_VA*INSUR_OTHER*INSUR_NON
        E*INSUR_IDK/LIST MISSING;
            FORMAT INSUR_CLEAN INSURANCE_COLLAPSE. INSURCOUNT
            X INSUR_PRIV X INSUR_MEDICAID X INSUR_MEDICARE X
            INSUR_TRICARE X INSUR_VA X INSUR_OTHER X INSUR_NONE
            X INSUR_IDK X;
RUN;

PROC FREQ DATA=INSUR_COLLAPSE; * check distribution of education variable ;
        TABLES EDUC;
RUN;

PROC FREQ DATA=INSUR_COLLAPSE;
        TABLES EDUC;
            FORMAT EDUC X;
RUN;

DATA EDUC_COMBINE; * collapse education = high school or less into one category ;
        SET INSUR_COLLAPSE;
        EDUC_COMBINE=EDUC;
            IF EDUC_COMBINE IN(3 4 5 6) THEN EDUC_COMBINE=3;
            IF EDUC_COMBINE IN(4 5 6 9) THEN EDUC_COMBINE=.;
RUN;

PROC FORMAT;
VALUE EDUC_COMBINE 1="College, post graduate or professional school"
                   2="Some college, Associates degree, and/or Technical
                   school"
                   3="High school or less"
                   ;
RUN;

PROC FREQ DATA=EDUC_COMBINE; * check distribution of collapsed education
variable to determine if coded properly ;
        TABLES EDUC*EDUC_COMBINE/LIST MISSING;
```

```
RUN;

DATA EVERTESTHEPB_RECODE; *recode variable for ever testing for HBV (1 if
told have HBV);
        SET EDUC_COMBINE;
                IF TOLDHAVEHEPB="Yes" THEN EVERTEST_HEPB_RECODE=1;
                IF EVERTEST_HEPB="Yes" THEN EVERTEST_HEPB_RECODE=1;
                IF EVERTEST_HEPB="No" THEN EVERTEST_HEPB_RECODE=0;
RUN;

PROC FREQ DATA=EVERTESTHEPB_RECODE; * check distribution of recoded
                                                        HBV test variablew to determine
                                                        if coded properly ;
        TABLES
        EVERTEST_HEPB_RECODE*TOLDHAVEHEPB*EVERTEST_HEPB/LIST
        MISSING;
RUN;

PROC FREQ DATA=EVERTESTHEPB_RECODE; * check distribution of ever tested
                                                       for HIV YN variable ;
        TABLES HIVTEST_EVER_YN;
RUN;

DATA RECODE_DR_VISIT_VAR; * recode variables coded as text into numeric ;
        SET EVERTESTHEPB_RECODE;
                IF DR_VISIT_12M_XLS="Yes" THEN DR_VISIT_12M_RC=1;
                IF DR_VISIT_12M_XLS="No" THEN DR_VISIT_12M_RC=0;
                IF DR_KNOWS_MSM_XLS="Yes" THEN DR_KNOWS_MSM_RC=1;
                IF DR_KNOWS_MSM_XLS="No" THEN DR_KNOWS_MSM_RC=0;
                IF DR_REC_HEPVAX_XLS="Yes" THEN DR_REC_HEPVAX_RC=1;
                IF DR_REC_HEPVAX_XLS="No" THEN DR_REC_HEPVAX_RC=0;
                IF DR_VISIT_12M_RC=0 THEN DO;
                        DR_KNOWS_MSM_RC=0;
                        DR_REC_HEPVAX_RC=0;
        END;
RUN;

PROC FREQ DATA=RECODE_DR_VISIT_VAR;
        TABLES
DR_VISIT_12M_XLS*DR_VISIT_12M_RC*DR_KNOWS_MSM_XLS*DR_KNOWS
_MSM_RC*DR_REC_HEPVAX_XLS*DR_REC_HEPVAX_RC/LIST MISSING;
RUN;

DATA RECODE_PARTTYPE;
        SET RECODE_DR_VISIT_VAR;
                IF PARTTYPE=2 THEN SEXWITHF=0;
```

```
                IF PARTTYPE=3 THEN SEXWITHF=1;
RUN;

* create array to separate out individuals who report more than one reason for not being
vaccinated ;

DATA WNV_ARRAY;
        SET RECODE_PARTTYPE;
                WNV_COUNT=0;

                ARRAY WNV {10} DIDNTKNOWWASVAX
                        VAXNOTOFFER
                        LOWRISK
                        REFUSEDVAX
                        MAYHAVESYM
                        EXPENSIVE
                        JAILED
                        NODOC
                        NOTRAV
                        NOTELIG;
        DO I=1 TO 10;
                IF WNV{I} NE "" THEN WNV_COUNT=WNV_COUNT+1;
                IF WNV{I} EQ "" THEN WNV_COUNT=WNV_COUNT+0;
END;
RUN;

* check for successful creation of array ;

PROC FREQ DATA=WNV_ARRAY;
        TABLES WNV_COUNT;
RUN;

PROC FREQ DATA=WNV_ARRAY;
        TABLES
DIDNTKNOWWASVAX*VAXNOTOFFER*LOWRISK*REFUSEDVAX*MAYHAV
ESYM*EXPENSIVE*JAILED*NODOC*NOTRAV*NOTELIG*IDKWHYNOT*MAI
NREASON/LIST MISSING;
                WHERE DIDNTKNOWWASVAX EQ " and VAXNOTOFFER EQ " and
                LOWRISK EQ " and REFUSEDVAX EQ " and MAYHAVESYM EQ "
                and EXPENSIVE EQ " and JAILED EQ " and NODOC EQ " and
                NOTRAV EQ " and NOTELIG EQ " and      MAINREASON EQ ";
run;

* create new variable to define single (main) reason why not vaccinated for all
unvaccinated individuals ;
```

```
DATA WNV_CLEAN;
        SET WNV_ARRAY;
                IF WNV_COUNT EQ 1 AND DIDNTKNOWWASVAX NE "" THEN
                WNV_CLEAN=1;

                IF WNV_COUNT EQ 1 AND VAXNOTOFFER NE "" THEN
                WNV_CLEAN=2;

                IF WNV_COUNT EQ 1 AND LOWRISK NE "" THEN
                WNV_CLEAN=3;

                IF WNV_COUNT EQ 1 AND REFUSEDVAX NE "" THEN
                WNV_CLEAN=4;

                IF WNV_COUNT EQ 1 AND MAYHAVESYM NE "" THEN
                WNV_CLEAN=5;

                IF WNV_COUNT EQ 1 AND EXPENSIVE NE "" THEN
                WNV_CLEAN=6;

                IF WNV_COUNT EQ 1 AND JAILED NE "" THEN WNV_CLEAN=7;

                IF WNV_COUNT EQ 1 AND NODOC NE "" THEN WNV_CLEAN=8;

                IF WNV_COUNT EQ 1 AND NOTRAV NE "" THEN
                WNV_CLEAN=9;

                IF WNV_COUNT EQ 1 AND NOTELIG NE "" THEN
                WNV_CLEAN=10;

                IF WNV_COUNT GT 1 THEN DO;

                IF MAINREASON EQ "You didn't know there was a vaccine that
                prevents infection with Hepatitis A or Hepatitis B"  THEN
                WNV_CLEAN=1;

                IF MAINREASON EQ "A vaccine was never offered to you" THEN
                WNV_CLEAN=2;

                IF MAINREASON EQ "You believe yourself to be at low risk of
                contacting Hepatitis A or Hepatitis B" THEN WNV_CLEAN=3;

                IF MAINREASON EQ "A vaccine was offered to you, but you refused to
                receive it" THEN WNV_CLEAN=4;
```

```
            IF MAINREASON EQ "You believed that you may already have
            symptoms of Hepatitis A or Hepatitis B and therefore a vaccine would not
            work" THEN WNV_CLEAN=5;

            IF MAINREASON EQ "The vaccines for Hepatitis A and Hepatitis B cost
            too much" THEN WNV_CLEAN=6;

            IF MAINREASON EQ "You were incarcerated" THEN
            WNV_CLEAN=7;

            IF MAINREASON EQ "There was no one assigned to you (i.e. doctor,
            nurse practitioner, etc) who could provide you with health care services,
            including immunizations"  THEN WNV_CLEAN=8;

            IF MAINREASON EQ "You were unable to travel to a location that
            provides vaccinations because of circumstances that were out of your
            control (disability, live in rural area, etc)" THEN WNV_CLEAN=9;

            IF MAINREASON EQ "You did not know you were eligible to receive a
            vaccine for hepatitis" THEN WNV_CLEAN=10;
        END;
RUN;

PROC FORMAT;
VALUE WNV
1="1 You didn't know there was a vaccine that prevents infection with Hepatitis A or
Hepatitis B"
2="2 A vaccine was never offered to you"
3="3 You believe yourself to be at low risk of contacting Hepatitis A or Hepatitis B"
4="4 A vaccine was offered to you, but you refused to receive it"
5="5 You believed that you may already have symptoms of Hepatitis A or Hepatitis B
and therefore a vaccine would not work"
6="6 The vaccines for Hepatitis A and Hepatitis B cost too much"
7="7 You were incarcerated"
8="8 There was no one assigned to you (i.e. doctor, nurse practitioner, etc) who could
provide you with health care services, including immunizations"
9="9 You were unable to travel to a location that provides vaccinations because of
circumstances that were out of your control (disability, live in rural area, etc)"
10="10 You did not know you were eligible to receive a vaccine for hepatitis";
RUN;

DATA THESIS.FULL_NOCUT_MAR26;
        SET WNV_CLEAN;
RUN;
```

```
PROC FREQ DATA=WNV_CLEAN; * determine which individuals did not report ever
being tested for hepatitis B ;
        TABLES EVERTEST_HEPB_RECODE/LIST MISSING;
RUN;

DATA THESIS.FULL;
        SET WNV_CLEAN;
                IF EVERTEST_HEPB_RECODE=. THEN DELETE;
RUN;

PROC FREQ DATA=THESIS.FULL;
        TABLES VAX_YN_XLS*VAXTYPE_XLS/LIST MISSING;
RUN;

DATA HEPB; * recode hepatitis B vaccination variables to include individuals never
                vaccinated for HBV ;
        SET THESIS.FULL;
                IF VAXTYPE_XLS="Hepatitis B vaccine" OR
                VAXTYPE_XLS="Hepatitis A and B vaccine" THEN HEPBVAX=1;

                IF VAXTYPE_XLS="Hepatitis A vaccine" OR VAX_YN_XLS='No'
                THEN HEPBVAX=0;

                IF HEPBVAX=. THEN DELETE;
RUN;

PROC FREQ DATA=HEPB; * check distribution of new hepatitis B vaccination variable
                                to see if coded properly ;
        TABLES HEPBVAX*VAX_YN_XLS*VAXTYPE_XLS/LIST MISSING;
RUN;

DATA HEPBSTATUS; * create new variable to define who are infected with hepatitis B,
                        vaccinated, and susceptible ;
        SET HEPB;
                IF TOLDHAVEHEPB='Yes' THEN HEPBSTATUS=0;

                IF TOLDHAVEHEPB='No' AND HEPBVAX=1 THEN
                HEPBSTATUS=1;

                IF TOLDHAVEHEPB='No' AND HEPBVAX=0 THEN
                HEPBSTATUS=2;
                IF TOLDHAVEHEPB="Don't know" AND HEPBVAX=1 THEN
                HEPBSTATUS=1;
                IF TOLDHAVEHEPB="Don't know" AND HEPBVAX=0 THEN
                HEPBSTATUS=2;
RUN;
```

```
PROC FREQ DATA=HEPBSTATUS;
        TABLES HEPBSTATUS*TOLDHAVEHEPB*HEPBVAX/LIST MISSING;
RUN;

PROC NPAR1WAY DATA=HEPBSTATUS;
        VAR AGE;
                CLASS HEPBVAX;
RUN;

* examine estimated logit plots of hepatitis B vaccination with continuous age ;

%macro logitplot(dataset,groups,outcome,contin, continame);
proc rank data=&dataset groups=&groups out=ranks;
var &contin;
ranks bin;
run;

proc means data=ranks noprint nway;
class bin;
var &outcome &contin;
output out=bins sum(&outcome)=&outcome
                                mean (&contin)=&contin;
run;

data bins;
        set bins;
        logit=log((&outcome+1)/(_freq_ - &outcome + 1));
run;

proc gplot data=bins;
        plot logit*&contin;
        symbol h=1.5 v=dot i=none;
        title "Estimated Logit plot of &continame for &outcome";
run;
quit;
%mend;

%logitplot(hepbstatus,6,hepbvax,age, age);
%logitplot(hepbstatus,7,hepbvax,age, age);
%logitplot(hepbstatus,8,hepbvax,age, age);
%logitplot(hepbstatus,9,hepbvax,age, age);
%logitplot(hepbstatus,10,hepbvax,age, age);
%logitplot(hepbstatus,11,hepbvax,age, age);
%logitplot(hepbstatus,12,hepbvax,age, age);
%logitplot(hepbstatus,13,hepbvax,age, age);
%logitplot(hepbstatus,14,hepbvax,age, age);
```

```
%logitplot(hepbstatus,15,hepbvax,age, age);
%logitplot(hepbstatus,16,hepbvax,age, age);
%logitplot(hepbstatus,17,hepbvax,age, age);
%logitplot(hepbstatus,18,hepbvax,age, age);
%logitplot(hepbstatus,19,hepbvax,age, age);
%logitplot(hepbstatus,20,hepbvax,age, age);
%logitplot(hepbstatus,21,hepbvax,age, age);
%logitplot(hepbstatus,22,hepbvax,age, age);
%logitplot(hepbstatus,23,hepbvax,age, age);
%logitplot(hepbstatus,24,hepbvax,age, age);

DATA AGE_CATEGORICAL; /* create categorical variable for age after examining
                                        estimated logit plots */
        SET HEPBSTATUS;
                IF AGE IN(18 19) THEN AGECAT=3;
                IF 20 LE AGE LE 31 THEN AGECAT=1;
                IF AGE GT 31 THEN AGECAT=2;
run;

PROC FORMAT;
VALUE HEPB 1='1 YES' 0='2 NO';
VALUE YN   1='1 YES' 0='2 NO';
RUN;

* code to prepare Table 1 (descriptive statistics);

ODS GRAPHICS ON;
ODS PDF FILE='h:\table1.pdf';

PROC FREQ DATA=AGE_CATEGORICAL;
        TABLES AGECAT /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
        TABLES NEW_RACE /CHISQ;
                FORMAT NEW_RACE NEW_RACE.;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
        TABLES EDUC_COMBINE /CHISQ;
                FORMAT EDUC_COMBINE EDUC_COMBINE.;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
        TABLES INSUR_CLEAN /CHISQ;
                FORMAT INSUR_CLEAN INSURANCE_COLLAPSE.;
```

```
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES REGION /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES EVERTEST_HEPB_RECODE /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES HEPBSTATUS/CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES HIVTEST_EVER_YN /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES AI_TYPE /CHISQ;
		FORMAT AI_TYPE AI_TYPE.;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES DRUGSLS /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES SEXWITHF /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES DR_VISIT_12M_RC /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES DR_KNOWS_MSM_RC /CHISQ;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL;
	TABLES DR_REC_HEPVAX_RC /CHISQ;
RUN;

ODS PDF CLOSE;
ODS GRAPHICS OFF;
```

```
* code to prepare Table 2 (bivariate associations of hepatitis B vaccination with
covariates);

ODS GRAPHICS ON;
ODS PDF FILE='h:\table2.pdf';

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES AGECAT*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES AGECAT*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB.;
        WHERE AGECAT IN(1,3) AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES AGECAT*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB.;
        WHERE AGECAT IN(2,3) AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES NEW_RACE*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. NEW_RACE X;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES NEW_RACE*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. NEW_RACE X;
        WHERE NEW_RACE IN(1,4) AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES NEW_RACE*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. NEW_RACE X;
        WHERE NEW_RACE IN(2,4) AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES NEW_RACE*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. NEW_RACE X;
        WHERE NEW_RACE IN(3,4) AND HEPBSTATUS IN(1,2);
```

```
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES EDUC_COMBINE*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES EDUC_COMBINE*HEPBVAX/CMH;
                FORMAT HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2) AND EDUC_COMBINE IN(1,3);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES EDUC_COMBINE*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2) AND EDUC_COMBINE IN(2,3);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES INSUR_CLEAN*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. INSUR_CLEAN X;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES INSUR_CLEAN*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. INSUR_CLEAN X;
        WHERE HEPBSTATUS IN(1,2) AND INSUR_CLEAN IN(1,4);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES INSUR_CLEAN*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. INSUR_CLEAN X;
        WHERE HEPBSTATUS(1,2) AND INSUR_CLEAN IN(2,4);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES INSUR_CLEAN*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. INSUR_CLEAN X;
        WHERE HEPBSTATUS IN(1,2) AND INSUR_CLEAN IN(3,4);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES REGION*HEPBVAX/CHISQ CMH;
```

```
            FORMAT HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES REGION*HEPBVAX/CHISQ CMH;
            FORMAT HEPBVAX HEPB.;
        WHERE REGION IN('MW' 'S') AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES REGION*HEPBVAX/CHISQ CMH;
            FORMAT HEPBVAX HEPB.;
        WHERE REGION IN('NE' 'S') AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES REGION*HEPBVAX/CHISQ CMH;
        WHERE REGION IN('W' 'S') AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES EVERTEST_HEPB_RECODE*HEPBVAX/CHISQ CMH;
            FORMAT EVERTEST_HEPB_RECODE YN. HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES HIVTEST_EVER_YN*HEPBVAX/CHISQ CMH;
            FORMAT HIVTEST_EVER_YN YN. HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES AI_TYPE*HEPBVAX/CHISQ CMH;
            FORMAT HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES AI_TYPE*HEPBVAX/CHISQ CMH;
            FORMAT HEPBVAX HEPB.;
        WHERE AI_TYPE IN(0,2) AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
```

```
        TABLES AI_TYPE*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB.;
        WHERE AI_TYPE IN(1,2) AND HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES DRUGSLS*HEPBVAX/CHISQ CMH;
                FORMAT DRUGSLS YN. HEPBVAX HEPB.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES SEXWITHF*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. SEXWITHF YN.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES DR_VISIT_12M_RC*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. DR_VISIT_12M_RC YN.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES DR_KNOWS_MSM_RC*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. DR_KNOWS_MSM_RC YN.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES DR_REC_HEPVAX_RC*HEPBVAX/CHISQ CMH;
                FORMAT HEPBVAX HEPB. DR_REC_HEPVAX_RC YN.;
        WHERE HEPBSTATUS IN(1,2);
RUN;

ODS PDF CLOSE;
ODS GRAPHICS OFF;

* code to develop no-interaction model using backward selection algorithm ;

PROC LOGISTIC DATA=AGE_CATEGORICAL DESCENDING;
        CLASS AGECAT(REF='3') EDUC_COMBINE AI_TYPE/PARAM=REF;

        MODEL HEPBVAX=AGECAT EDUC_COMBINE
        EVERTEST_HEPB_RECODE HIVTEST_EVER_YN AI_TYPE DRUGSLS
```

```
        SEXWITHF DR_VISIT_12M_RC DR_KNOWS_MSM_RC
        DR_REC_HEPVAX_RC/SELECTION=BACKWARD CLODDS=WALD;

        WHERE HEPBSTATUS IN(1,2);
RUN;

* assess for all pairwise interactions between statistically significant covariates specified
in model above using forward selection algorithm, after applying Bonferroni correction ;

ODS GRAPHICS ON;;
ODS PDF FILE='h:\table3.pdf';

PROC LOGISTIC DATA=AGE_CATEGORICAL DESCENDING;
        CLASS AGECAT(REF='3') EDUC_COMBINE /PARAM=REF;

                MODEL HEPBVAX=AGECAT EDUC_COMBINE
                EVERTEST_HEPB_RECODE DR_REC_HEPVAX_RC
                AGECAT|EDUC_COMBINE|EVERTEST_HEPB_RECODE|DR_REC_
                HEPVAX_RC@2/INCLUDE=4 SELECTION=FORWARD
                slentry=0.0083333333;

                ODDSRATIO AGECAT /AT(EVERTEST_HEPB_RECODE=1 0)
                DIFF=REF;

                WHERE HEPBSTATUS IN(1,2);
RUN;

ODS PDF CLOSE;
ODS GRAPHICS OFF;

* determine how many individuals were excluded from above model on the basis of
missing covariates ;

PROC PRINT DATA=AGE_CATEGORICAL;
        WHERE AGECAT=. AND EDUC_COMBINE NE . AND
        EVERTEST_HEPB_RECODE NE . AND DR_REC_HEPVAX_RC NE . AND
        HEPBSTATUS GT 0;
RUN;

PROC PRINT DATA=AGE_CATEGORICAL;
        WHERE AGECAT NE . AND EDUC_COMBINE = . AND
        EVERTEST_HEPB_RECODE NE . AND DR_REC_HEPVAX_RC NE . AND
        HEPBSTATUS GT 0;
RUN;

PROC PRINT DATA=AGE_CATEGORICAL;
```

```
        WHERE AGECAT NE . AND EDUC_COMBINE NE . AND
        EVERTEST_HEPB_RECODE = . AND DR_REC_HEPVAX_RC NE . AND
        HEPBSTATUS GT 0;
RUN;

PROC PRINT DATA=AGE_CATEGORICAL;
        WHERE AGECAT NE . AND EDUC_COMBINE NE . AND
        EVERTEST_HEPB_RECODE NE . AND DR_REC_HEPVAX_RC = . AND
        HEPBSTATUS GT 0;
RUN;

PROC PRINT DATA=AGE_CATEGORICAL;
        WHERE EDUC_COMBINE = . AND HEPBSTATUS GT 0;
RUN;

PROC PRINT DATA=AGE_CATEGORICAL;
        WHERE DR_REC_HEPVAX_RC = . AND HEPBSTATUS GT 0;
RUN;

* code to create Table 4 (reasons why not vaccinated) ;

ODS GRAPHICS ON;
ODS PDF FILE='table4.pdf';

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES WNV_CLEAN/LIST;
                WHERE HEPBVAX=0 AND HEPBSTATUS = 2;
        FORMAT WNV_CLEAN WNV.;
RUN;

PROC FREQ DATA=AGE_CATEGORICAL ORDER=FORMATTED;
        TABLES DIDNTKNOWWASVAX VAXNOTOFFER LOWRISK
        REFUSEDVAX MAYHAVESYM EXPENSIVE JAILED NODOC NOTRAV
        NOTELIG/LIST MISSING;
                WHERE HEPBVAX=0 AND HEPBSTATUS = 2;
        FORMAT WNV_CLEAN WNV.;
RUN;

ODS PDF CLOSE;
ODS GRAPHICS OFF;

* verify number of non-vaccinated individuals who did not specify reasons not
vaccinated ;

PROC FREQ DATA=AGE_CATEGORICAL;
```

```
        TABLES
        WNV_COUNT*DIDNTKNOWWASVAX*VAXNOTOFFER*LOWRISK*REF
        USEDVAX*MAYHAVESYM*EXPENSIVE*JAILED*NODOC*NOTRAV*N
        OTELIG*IDKWHYNOT*MAINREASON/LIST MISSING;

                WHERE DIDNTKNOWWASVAX EQ " AND VAXNOTOFFER EQ "
                AND LOWRISK EQ " AND REFUSEDVAX EQ " AND
                MAYHAVESYM EQ " AND EXPENSIVE EQ " AND JAILED EQ "
                AND NODOC EQ " AND NOTRAV EQ " AND NOTELIG EQ "
                AND MAINREASON EQ " AND HEPBVAX=0;
RUN;

* verify number of non-vaccinated individuals with more than one reason why not
vaccinated who did not specify main reason why not vaccinated ;

PROC FREQ DATA=AGE_CATEGORICAL;
        TABLES
        WNV_COUNT*DIDNTKNOWWASVAX*VAXNOTOFFER*LOWRISK*REF
        USEDVAX*MAYHAVESYM*EXPENSIVE*JAILED*NODOC*NOTRAV*N
        OTELIG*IDKWHYNOT*MAINREASON/LIST MISSING;
                WHERE WNV_COUNT GT 1 AND HEPBVAX=0 AND
                MAINREASON=";
RUN;

* set final permanent data set ;

DATA THESIS.FINAL_MAR26;
        SET AGE_CATEGORICAL;
RUN;
```