Two Decades After Vaccine License: Hepatitis B Immunization and Infection Among Young Men Who Have Sex With Men

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ABSTRACT

Objectives. This study investigated hepatitis B immunization coverage and the extent of hepatitis B virus (HBV) infection among young men who have sex with men (MSM), a group for whom hepatitis B vaccine has been recommended since 1982.

Methods. We analyzed data from 3432 MSM, aged 15 to 22 years, randomly sampled at 194 gay-identified venues in 7 US metropolitan areas from 1994 through 1998. Participants were interviewed, counseled, and tested for serologic markers of HBV infection.

Results. Immunization coverage was 9% and the prevalence of markers of HBV infection was 11%. HBV infection ranged from 2% among 15-year-olds to 17% among 22-year-olds. Among participants susceptible to HBV infection, 96% used a regular source of health care or accessed the health care system for HIV or sexually transmitted disease testing.

Conclusions. Despite the availability of an effective vaccine for nearly 2 decades, our findings suggest that few adolescent and young adult MSM in the United States are vaccinated against hepatitis B. Health care providers should intensify their efforts to identify and vaccinate young MSM who are susceptible to HBV. (*Am J Public Health.* 2001; 91:965–971)

The acute and chronic consequences of hepatitis B virus (HBV) infection are a considerable public health problem in the United States. Between 1976 and 1994, approximately 300 000 persons were infected annually with HBV.[1] Among the estimated 1 million persons chronically infected with HBV, chronic liver disease and primary hepatocellular carcinoma cause an estimated 5000 deaths annually.[2]

In 1982, a safe and effective vaccine against hepatitis B was licensed in the United States.[3] The national hepatitis B prevention strategy adopted in 1985 focused on vaccinating persons at high risk for infection, such as men who have sex with men (MSM), injection drug users, and health care workers.[3–5] In the decade after licensing, however, few high-risk persons other than health care workers were vaccinated.[6] In 1991, a comprehensive strategy of childhood vaccination was adopted to eliminate the transmission of HBV.[7] Implementation of this strategy increased vaccination coverage in children 35 months and younger from an estimated 41% in 1994 to 85% in 1997.[8] However, vaccination catch-up efforts for adolescents aged 13 to 18 years began only in 1997, and few states currently have laws requiring that children be vaccinated against hepatitis B before entering the ninth grade.[9,10] Consequently, for the next several years, many adolescents and young adults will remain at risk for HBV infection.

Of all adolescents, young MSM are at particularly high risk for hepatitis B. Several studies conducted in the late 1970s and early 1980s found that as many as 70% of adult MSM had been infected with HBV.[5] More recent reports suggest a resurgence of sexually transmitted diseases (STDs) and a high incidence of HIV infection among MSM, particularly young MSM.[11–14] However, the current epidemiology of HBV infection among young MSM is unknown. Hepatitis B vaccination coverage among young MSM is also unknown, because data are not yet available on catch-up vaccination efforts for adolescents.[10]

To gain further insight into the epidemiology of HBV infection and hepatitis B vaccine coverage, we analyzed data from the Young Men's Survey, an HIV prevalence and risk behavior survey of young MSM conducted in 7 US metropolitan areas from 1994 through 1998. Evaluating the extent of HBV infection and vaccine coverage in this young high-risk population is essential for improving the delivery of an effective vaccine that has been available for nearly 2 decades.

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Methods

Sampling Procedure

The Young Men's Survey is a cross-sectional, anonymous, sample survey of young MSM who attend venues frequented by young MSM.[14–16] The survey was conducted in the following metropolitan areas and years: Baltimore, 1996 to 1998; Dallas, 1994 to 1995; Los Angeles, 1994 to 1996; Miami, 1995 to 1996; New York City, 1997 to 1998; the San Francisco Bay Area (San Francisco, Oakland, and San Jose), 1994 to 1995; and Seattle, 1997 to 1998. Venues (e.g., dance clubs, social organizations, businesses) were identified through community informants, gay-oriented advertisements, focus groups, and extensive field observations. We constructed sampling frames of venues and specific time periods (e.g., Fridays from 10:00 PM to 2:00 AM) where a minimum of 7 eligible men might be encountered. Sampling frames did not include needle exchange sites, street locations attended predominately by sex workers, or settings in which clinical or other services are provided for HIV- or STD-infected MSM. Attendance estimates were based on field counts; the minimum of 7 eligible men was selected for cost and logistical efficiency.

Each month, 12 to 16 venues and their associated time periods were randomly selected from updated sampling frames. These venues and periods were then scheduled for sampling in the upcoming month. During sampling events, enumerators counted all men appearing to be younger than 30 years who entered defined areas (e.g., a stretch of sidewalk in front of a dance club). When not conducting interviews, recruiters consecutively approached and briefly interviewed counted men to assess their eligibility for the study. Eligibility criteria were being 15 to 22 years of age and having residence in 1 or more local counties in and around the metropolitan areas listed above. Sexual behavior and identity were not included as eligibility criteria, so that MSM who did not identify as gay or bisexual could participate.

Eligible men who wished to participate were escorted to a van, where a trained counselor obtained informed consent, administered a standardized questionnaire, obtained blood specimens, and conducted counseling for the prevention of sexually trasmitted diseases. Participants were reimbursed $40 to $50 for their time and were scheduled to receive their test results within 2 weeks. Participants who returned for their results were provided risk-reduction counseling and referrals for health care as needed. Prevention counseling included discussion of viral hepatitis and of locations and providers where participants could receive hepatitis B vaccine. Some areas (San Francisco, Miami, and Seattle) were able to refer men for free hepatitis B vaccine.

To minimize duplicate enrollments, staff asked all men who were screened whether they had already participated in the Young Men's Survey. Those who had participated earlier were not eligible. We also used the Miragen assay (Miragen, Inc, Irvine, Calif) to test specimens of suspected duplicate participants, such as those who reported the same race and date of birth as previous participants or who staff thought (by virtue of their appearance) had previously participated. The Miragen assay is an individual-specific antibody-profile assay.[17] When antibody profiles matched, specimens were considered duplicates and only data from the first record and specimen were analyzed.

The Young Men's Survey multisite protocol was approved by institutional review boards at the Centers for Disease Control and Prevention and at state and local institutions responsible for the survey.

Measures

The questionnaire collected information on sociodemographic characteristics, source of health care, and use of STD treatment, HIV testing, and hepatitis B vaccination services. Source of health care was measured with the following item: "Where do you usually go for health care? I mean the place or places you most often visit to receive health care services."

We also asked about lifetime and recent sexual behavior and about injection drug use and needle-sharing practices. From these, we constructed a risk hierarchy (low, moderate, high) based on factors known to be associated with HBV infection among MSM.[18–22] We defined low risk as having never engaged in anal sex and having 5 or fewer lifetime male sex partners. High risk was defined as having ever engaged in anal sex and meeting 1 or more of the following criteria: having had 20 or more male sex partners; having ever exchanged sex for money, food, or drugs; having, or having had, a STD; having ever engaged in anal fisting; and having ever shared needles or equipment to inject drugs. Moderate risk was defined as not belonging to either group.

Specimens were tested at local laboratories with assays licensed by the Food and Drug Administration for hepatitis B surface antigen (HBsAg) and for antibodies to hepatitis B surface (anti-HBs) and core (anti-HBc) antigens. We defined vaccine-associated immunity as the presence of anti-HBs alone among MSM who reported having received 1 or more doses of hepatitis B vaccine. HBV infection (past or current) was defined as the presence of anti-HBc or HBsAg. Susceptibility to HBV infection was defined as not having any of the 3 serologic markers. Unknown status was defined as the presence of anti-HBs alone in MSM who reported not having been vaccinated with 1 or more doses of hepatitis B vaccine.

Analytic Methods

Rates of immunization and HBV infection are reported overall and by age, race/ethnicity, metropolitan area, and risk group. All rates are based on a minimum denominator of 20. We used the χ^2 test on combined data from the 7 areas to evaluate variables associated with infection and immunization. We combined the data because we found, using the Breslow–Day test,[23] that associations were homogeneous across metropolitan areas. Because of the substantial literature on behavioral risk factors associated with HBV infection among MSM, we evaluated HBV infection by a single risk hierarchy rather than by multiple risk behaviors.[18–22]

We used logistic regression to identify independent predictors of immunization.[24] We entered into the model all variables that were found to be associated or that we reasoned could be associated with immunization. The full model was then reduced by the stepwise elimination of the least significant variables. Variables were removed from models only if there were no substantive changes in remaining regression coefficients. The final model had no evidence of collinearity and had a nonsignificant goodness-of-fit result ($P = .63$), suggesting adequate fit.[24,25] All analyses were performed with SAS version 6 (SAS Institute, Inc, Cary, NC).

Results

Sampling Outcomes

During 1592 sampling events in the 7 areas, the Young Men's Survey staff counted 38 622 men who appeared to be younger than 30 years. Of these, 23 881 (62%) were approached, 21 096 (88% of those approached) completed their brief eligibility interview, and 6866 (33% of those who completed the eligibility interview) were eligible for the Young Men's Survey. Of these eligible men, 4274 (62%) agreed to participate.

Of the 4274 participants, 162 (4%) were confirmed duplicates and were removed from analyses. An additional 43 participants (1%) were judged by interviewers to have reported invalid data. Of the remaining 4069, 3% reported never having had sex, 11% reported never having had sex with men, and 1% had

TABLE 1—Sampling Outcomes and Demographic Characteristics of Participants, by Metropolitan Area

Sampling Outcomes	Baltimore	Dallas	Los Angeles	Miami	New York	San Francisco	Seattle	All
Survey period	1996–1998	1994–1995	1994–1996	1995–1996	1997–1998	1994–1995	1997–1998	1994–1998
Enrolled, n	342	521	504	481	537	683	364	3432
Participation rate, %[a]	57	51	57	75	64	74	61	62
Race/ethnicity, %								
Asian	3	2	6	2	2	16	7	6
Black	38	15	8	16	24	15	8	17
Hispanic	3	19	40	60	41	27	3	30
White	49	59	29	18	11	31	64	35
Mixed	6	3	10	2	17	10	13	9
Other	2	2	7	2	6	1	4	3
Age, y, %								
15–19	38	36	49	43	57	41	48	45
20–22	62	64	51	57	43	59	52	55

[a]Among men who were determined to be eligible.

missing or incomplete hepatitis B laboratory data.

We limited our analyses to the remaining 3432 MSM. Participants were recruited at 194 venues in the 7 areas: 30% at street locations, 28% at dance clubs, 12% at bars, 10% at social organizations (e.g., gay–lesbian youth organizations), 9% at businesses (e.g., restaurants, cafés, bookstores, athletic clubs), 5% at parks and beaches, 3% at gay pride events, and 3% at adult bookstores and bathhouses.

Eligible participation rates ranged from 51% to 75% in the 7 areas (Table 1). Young men aged 15 to 19 years were significantly more likely to participate than men aged 20 to 22 years (69% vs 57%, $P=.001$). Compared with men of all other races or ethnicity, men of mixed race were more likely to participate (77% vs 61%, $P=.001$) and Asian men were less likely to participate (52% vs 63%, $P=.001$).

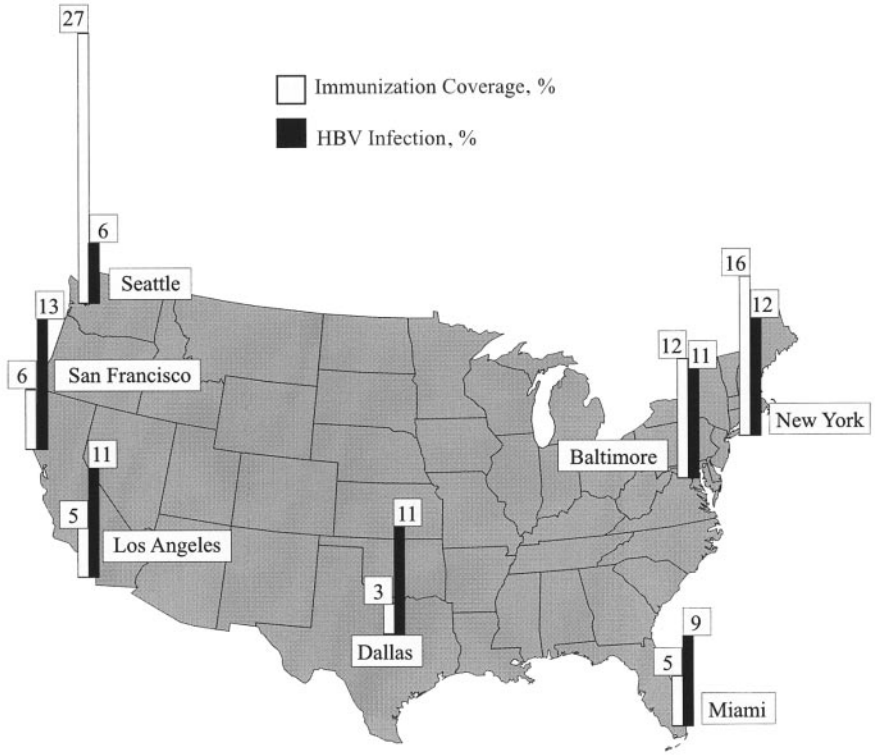


FIGURE 1—Hepatitis B immunization coverage and prevalence of hepatitis B virus (HBV) infection among 3432 young men who have sex with men sampled in 7 US metropolitan areas from 1994 to 1998.

Sociodemographic Characteristics

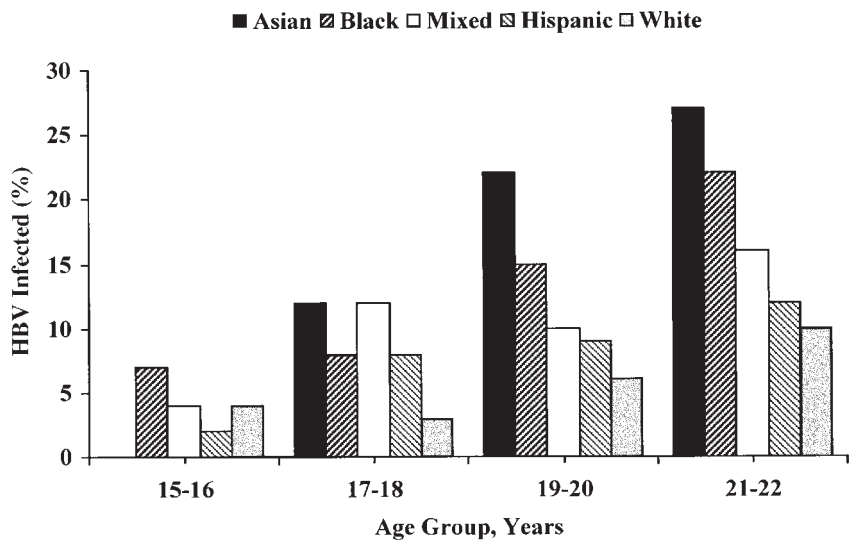
Participants generally reflected the underlying racial and ethnic patterns of the areas in which they resided (Table 1). Nearly half (45%) were younger than 20 years, half were still in school, and the parents of over half (59%) had attended or graduated from college. Although 96% were currently domiciled (living alone or with friends, relatives, or other persons), 35% reported having ever run away from home. Most (65%) were employed part-time or full-time; 26% were seeking employment.

Immunization Coverage and Prevalence of HBV Infection and Risk Behavior

Of all participants, 9% had been immunized against hepatitis B and 11% had evidence of HBV infection. Seventy-seven percent of participants were susceptible to infection and the status of 3% was unknown. Immunization and HBV infection prevalence rates varied by metropolitan area (Figure 1). By the risk hierarchy, 10% of all participants were classified as low risk, 54% as moderate risk, and 36% as high risk. Of those at high risk, 13% reported ever having injected drugs and 6% reported ever sharing needles or "works." Of those susceptible to HBV infection, 86% reported ever having engaged in anal sex, 72% had had anal sex in the past 6 months, 44% had had 6 or more lifetime male partners, and 6% reported ever having injected drugs.

Factors Associated With HBV Infection

The prevalence of HBV infection ranged from 2% among MSM aged 15 years to 17% among those aged 22 years ($P=.001$). Prevalence of HBV infection, which increased by



Note. HBV prevalence among Asians aged 15 to 16 years was not calculated because only 2 participants were in this age and race category.

FIGURE 2—Prevalence of hepatitis B virus (HBV) infection among 3432 young men who have sex with men sampled in 7 US metropolitan areas from 1994 to 1998, by age group and race/ethnicity.

age for all racial/ethnic groups (Figure 2), was 22% among Asians, 15% among Blacks, 12% among mixed-race subjects, 10% among Hispanics, and 7% among Whites ($P=.001$). HBV prevalence also varied significantly by risk hierarchy, ranging from 4% among MSM at low risk to 7% among those at moderate risk and 18% among those at high risk ($P=.001$).

Health Care Use

Ninety percent of participants and 88% of those susceptible to HBV infection reported using a regular source of health care. By provider type, 43% of participants used a hospital, school, or community clinic; 39% a private physician; 19% a health maintenance organization; 12% a health department clinic; and 18% another type of provider (more than 1 source could be given). Sixty-five percent of all participants (63% of those susceptible) had been previously tested for HIV infection, and 13% (12% of those susceptible) had been previously diagnosed with an STD. Of susceptible MSM who had used HIV testing services, 62% had been tested at least twice. Ninety-six percent of those susceptible to HBV infection reported using a regular source of health care, having been tested for HIV, or having been diagnosed with an STD. Of participants who reported having never been vaccinated against hepatitis B, 73% reported not knowing about the vaccine and 9% believed that they were at low risk for HBV infection.

Factors Associated With Immunization

Immunization against hepatitis B was associated with several sociodemographic and health care variables (Table 2). Participants from Seattle (1997–1998), New York (1997–1998), and Baltimore (1996–1998), had 12, 7, and 5 times greater odds of being immunized (respectively) than did participants from Dallas (1994–1995). Other variables associated with immunization included using a regular source of health care, being younger, being in school, having informed others about being sexually attracted to men, having been tested for HIV infection, and having tested HIV negative. Variables not associated with immunization included race/ethnicity, sexual and drug-use behaviors, having had an STD, and having received medical care for HIV infection.

Discussion

Despite the availability for nearly 2 decades of an effective vaccine, our findings suggest that few adolescent and young adult MSM in the United States are vaccinated against hepatitis B. As a consequence, nearly 1 in 5 MSM in our sample acquired HBV by age 22. The prevalence of infection increased significantly by age and risk behavior, corroborating findings that sexual behavior is the predominant mode of HBV transmission among MSM.[18–22] As reported for the general population, rates of HBV infection were higher for MSM of Asian, Black, or mixed race than for White MSM.[26]

As we expected, young MSM who used a regular source of health care were more likely to have been immunized than those who did not have a regular source of health care or did not use health care services. However, even though 9 of 10 young MSM reported using a regular source of health care, only 1 in 10 had been immunized. Of MSM susceptible to HBV infection, most were unaware of hepatitis B vaccine and engaged in risk behaviors that could lead to infection, yet nearly 9 in 10 reported using a regular source of health care. These and other data suggest that many providers miss opportunities to inform and vaccinate persons at risk for hepatitis B.[6,27–30]

Providing vaccinations in HIV–STD diagnostic and treatment settings may prevent many HBV infections among young MSM.[31] We found that of participants with a past STD, fewer than 1 in 10 had been immunized, and many who were susceptible to HBV infection reported a previous STD. Although the integration of hepatitis B prevention within STD programs has been successfully demonstrated, very few programs provide hepatitis B vaccine.[32–36] We also found that nearly two thirds of susceptible MSM had been tested for HIV infection, and most of these men had been tested at least twice. These and other data suggest that many MSM are regularly tested for HIV, thus providing repeat opportunities for hepatitis B vaccination.[37–39] Although we did find that participants who had been tested for HIV were more likely to have been vaccinated than those who had not, this association probably represents a marker for better health maintenance behavior rather than an indicator of referral or vaccination practices. Federal HIV counseling and testing guidelines do not specifically address hepatitis B prevention, and, as practiced in public health settings, HIV counseling does not usually include any consideration of hepatitis B prevention.[40,41]

Health care providers should routinely identify and vaccinate or refer for vaccination persons at risk for HBV infection.[6,42–44] Our finding that the prevalence of HBV infection increased from 2% among 15-year-olds to 17% among 22-year-olds underscores the need for providers to identify and vaccinate MSM as early as possible. Identifying vaccine candidates, however, can be challenging, because many gay and bisexual youths do not report their sexual orientation to their providers.[45,46] We found that young MSM who acknowledged

TABLE 2—Factors Associated With Hepatitis B Immunization Among 3432 Young Men Who Have Sex With Men Sampled in 7 US Metropolitan Areas, 1994–1998

Characteristic	No.	% Immunized	Adjusted OR[a]	95% CI
Demographics				
Residence				
Dallas	521	2.5	1.0	. . .
Los Angeles	504	4.6	1.6	0.8, 3.4
Miami	481	5.4	2.4	1.2, 4.9
San Francisco	683	5.7	2.3	1.2, 4.5
Baltimore	342	12.0	5.2	2.7, 10.0
New York	537	15.8	7.4	4.0, 13.8
Seattle	364	26.6	12.1	6.6, 22.1
Race/ethnicity				
Hispanic	1015	7.2	. . .	. . .
Asian	201	8.0	. . .	. . .
Black	578	8.3	. . .	. . .
White	1215	11.1	. . .	. . .
Mixed	302	11.6	. . .	. . .
Other	118	14.4	. . .	. . .
Age group, y				
20–22	1899	7.3	1.0	. . .
15–19	1533	12.1	1.6	1.3, 2.2
Currently in school				
No	1720	7.3	1.0	. . .
Yes	1712	12.0	1.5	1.2, 2.0
Informing others of sexual orientation[b]	. . .	. . .	1.1	1.0, 1.2
Risk Behavior[c]				
Lifetime partners				
1–5	1488	8.7	. . .	. . .
6–19	1078	10.1	. . .	. . .
≥20	866	9.9	. . .	. . .
Anal sex—ever				
No	449	8.5	. . .	. . .
Yes	2983	9.6	. . .	. . .
Anal sex—past 6 mo				
None or protected	2039	9.4	. . .	. . .
Unprotected	1393	9.5	. . .	. . .
Injected drugs—ever				
No	3192	9.2	. . .	. . .
Yes	240	12.1	. . .	. . .
Health Care				
Regular source				
No	355	2.5	1.0	. . .
Yes	3077	10.3	4.1	2.0, 8.1
Diagnosis of STD—ever				
No	2974	9.5	. . .	. . .
Yes	458	8.7	. . .	. . .
Tested for HIV				
No	1196	7.1	1.0	. . .
Yes	2236	10.7	1.7	1.3, 2.2
HIV status				
Positive	246	5.3	1.0	. . .
Negative	3186	9.8	1.9	1.0, 3.4
Receiving care for HIV infection				
No	3394	9.4	. . .	. . .
Yes	38	13.2	. . .	. . .

Note. OR = odds ratio; CI = confidence interval; STD = sexually transmitted disease.
[a]Adjusted odds ratios are reported for those variables that remained in the final logistic regression model. All other variables listed were entered into the full model but were removed in the variable-reduction procedure as described in the Methods section.
[b]Measured on a 7-point scale: not "out" to anyone (1) to "out" to everyone (7).
[c]Sex with other men only.

their sexual orientation to others were more likely to have been immunized. Although this association could be a marker for better health maintenance behavior, it may also indicate that providers who were aware of their patients' risks were more likely to prescribe vaccine. Providers can obtain accurate sexual histories to help identify, inform, and vaccinate young MSM by creating environments in which gay youths feel welcome and safe.[45,47] Vaccination practices may be improved by using standing orders for nonphysicians to administer vaccines, instituting provider reminder and patient reminder or recall systems, and periodically assessing immunization coverage.[48]

We were encouraged by our finding of higher hepatitis B immunization rates among MSM who were younger, who were in school, and who resided in Baltimore (1996–1998), New York (1997–1998), or Seattle (1997–1998). Higher immunization rates in these metropolitan areas than in Dallas (sampled in 1994–1995) might be attributable to expanded Vaccine for Children program coverage for adolescents aged 11 to 12 years (initiated in 1994) and for all adolescents younger than 19 years (initiated in 1997).[9,49] Higher immunization rates could also be attributable to improvement in provider practices and increases in school-based vaccination requirements or programs.[50,51] In Seattle, for example, hepatitis B vaccine was made available in all high school health clinics in 1995 (H. Thiede, DVM, MPH, Public Health—Seattle and King County, oral communication, December 1999).

Our reported immunization coverage should be considered a minimum estimate, for 2 reasons. First, vaccine-induced anti-HBs may have waned below detectable levels among some men who reported being vaccinated. However, significant underestimation attributed to waning immunity is unlikely because of the young age and presumed healthy status of the Young Men's Survey participants (7% were HIV infected). Second, some men who did not report being vaccinated but who were positive for anti-HBs alone may also have been vaccinated. Anti-HBs alone (without a vaccination history), however, may represent a false result, very low exposure to HBV without infection, or HBV infection with loss of anti-HBc.[52,53] Defining vaccine-associated immunity by the presence of anti-HBs alone would have raised our reported immunization coverage from 9% to 12%.

Several reports assert that most high-risk persons are difficult to reach with prevention services and acquire HBV infection before they access health care.[5,54–56] Our data suggest that this is not true for young MSM. We conclude that the ongoing failure to prevent HBV infections among young MSM results, in part, from missed vaccination opportunities in the health care and HIV–STD prevention systems. A comprehensive strategy to eliminate HBV transmission in the United States must address these missed opportunities. Despite advances in increasing hepatitis B vaccination coverage among children, universal infant vaccination will not eliminate the acute and chronic consequences

of HBV infection for more than 20 years. By improving immunization practices and integrating HBV prevention into HIV–STD prevention programs, we can prevent many infections now. □

Contributors

D. A. MacKellar contributed to the design of the study and led the conception, design, and writing of the paper. L. A. Valleroy and R. S. Janssen contributed to the conception and design of the study and assisted in the interpretation and analysis of data. G. M. Secura contributed to the national coordination of the study and assisted in the management and analysis of data. W. McFarland, D. Shehan, W. Ford, M. LaLota, D. D. Celentano, B. A. Koblin and L. V. Torian, and H. Thiede were responsible for the scientific and operational oversight of the studies conducted in San Francisco, Dallas, Los Angeles, Miami, Baltimore, New York City, and Seattle, respectively; they also contributed to the interpretation and analysis of data. All authors reviewed and edited the final version of the manuscript.

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References

1. Coleman PJ, McQuillan GM, Moyer LA, Lambert SB, Margolis HS. Incidence of hepatitis B virus infection in the United States, 1976–1994: estimates from the National Health and Nutrition Examination Surveys. *J Infect Dis.* 1998; 178:954–959.
2. Margolis HS, Coleman PJ, Brown RE, Mast EE, Sheingold SH, Arevalo JA. Prevention of hepatitis B virus transmission by immunization: an economic analysis of current recommendations. *JAMA.* 1995;274:1201–1208.
3. Advisory Committee on Immunization Practices. Recommendations for protection against viral hepatitis. *MMWR Morb Mortal Wkly Rep.* 1985;34:313–324, 329–335.
4. Centers for Disease Control and Prevention. Update on hepatitis B prevention. *MMWR Morb Mortal Wkly Rep.* 1987;36:353–360, 366.
5. Goilav C, Piot P. Vaccination against hepatitis B in homosexual men: a review. *Am J Med.* 1989; 87(suppl 3A):21S–25S.
6. Alter MJ, Hadler SC, Margolis HS, et al. The changing epidemiology of hepatitis B in the United States: need for alternative vaccination strategies. *JAMA.* 1990;263:1218–1222.
7. Centers for Disease Control and Prevention. Hepatitis B virus: a comprehensive strategy for eliminating transmission in the United States through universal childhood vaccination. Recommendations of the Immunization Practices Advisory Committee (ACIP). *MMWR Morb Mortal Wkly Rep.* 1991;40(RR-13):1–25.
8. Yusuf HR, Coronado VG, Averhoff FA, et al. Progress in coverage with hepatitis B vaccine among US children, 1994–1997. *Am J Public Health.* 1999;89:1684–1689.
9. Centers for Disease Control and Prevention. Update: recommendations to prevent hepatitis B virus transmission—United States. *MMWR Morb Mortal Wkly Rep.* 1999;48:33–34.
10. Mast EE, Mahoney FJ, Alter MJ, Margolis HS. Progress toward elimination of hepatitis B virus transmission in the United States. *Vaccine.* 1998; 16 (suppl):S48–S51.
11. Centers for Disease Control and Prevention. Increases in unsafe sex and rectal gonorrhea among men who have sex with men—San Francisco, California, 1994–1997. *MMWR Morb Mortal Wkly Rep.* 1999;48:45–48.
12. Willams LA, Klausner JD, Whittington WLH, Handsfield HH, Celum C, Holmes KK. Elimination and reintroduction of primary and secondary syphilis. *Am J Public Health.* 1999;89: 1093–1097.
13. Weinstock H, Sweeny S, Satten GA, Gwinn M, for the STD Clinic HIV Seroincidence Study Group. HIV seroincidence and risk factors among patients repeatedly tested for HIV attending sexually transmitted disease clinics in the United States. *J Acquir Immune Defic Syndr Hum Retrovirol.* 1998;19:506–512.
14. Valleroy LA, MacKellar DA, Karon JM, et al. HIV prevalence and associated risks in young men who have sex with men. *JAMA.* 2000;284: 198–204.
15. Kalton G. Sampling considerations in research on HIV risk and illness. In: Ostrow DG, Kessler RC, eds. *Methodological Issues in AIDS Behavioral Research*. New York, NY: Plenum Press; 1993:53–74.
16. MacKellar DA, Valleroy LA, Karon J, Lemp G, Janssen R. The Young Men's Survey: methods for estimating HIV seroprevalence and risk factors among young men who have sex with men. *Public Health Rep.* 1996;111(suppl 1):138–144.
17. Unger TF, Strauss A. Individual-specific antibody profiles as a means of newborn infant identification. *J Perinatol.* 1995;15:152–154.
18. Osmond DH, Charlebois E, Sheppard HW, et al. Comparison of risk factors for hepatitis C and hepatitis B virus infection in homosexual men. *J Infect Dis.* 1993;167:66–71.
19. Koziol DE, Saah AJ, Odaka N, Muñoz A. A comparison of risk factors for human immunodeficiency virus and hepatitis B virus infections in homosexual men. *Ann Epidemiol.* 1993;3: 434–441.
20. Kingsley LA, Rinaldo CR, Lyter DW, Valdiserri RO, Belle SH, Ho M. Sexual transmission efficiency of hepatitis B virus and human immunodeficiency virus among homosexual men. *JAMA.* 1990;264:230–234.
21. Schreeder MT, Thompson SE, Hadler SC, et al. Hepatitis B in homosexual men: prevalence of infection and factors related to transmission. *J Infect Dis*. 1982;146:7–15.
22. Szmuness W, Much MI, Prince AM, et al. On the role of sexual behavior in the spread of hepatitis B infection. *Ann Intern Med.* 1975;83: 489–495.
23. Breslow NE, Day NE. *Statistical Methods in Cancer Research*. *The Analysis of Case Control Studies.* Lyon, France: International Agency for Research on Cancer; 1980.
24. Hosmer DW, Lemeshow S. *Applied Logistic Regression*. New York, NY: John Wiley & Sons; 1989.
25. Davis CE, Hyde JE, Bangdiwala SI, Nelson JJ. An example of dependencies among variables in a conditional logistic regression. In: Moolgavkar SH, Prentice RL, eds. *Modern Statistical Methods in Chronic Disease Epidemiology.* New York, NY: John Wiley & Sons; 1986: 140–147.
26. McQuillan GM, Coleman PJ, Kruszon-Moran D, Moyer LA, Lambert SB, Margolis HS. Prevalence of hepatitis B virus infection in the United States: the National Health and Nutrition Examination Surveys, 1976 through 1994. *Am J Public Health.* 1999;89:14–18.
27. Weinberg M, Gunn R, Gonzales P, Lopez-Devereaux D, Murray P, Hodgson W. PN and case management for sex and needle-sharing partners of persons with chronic hepatitis B virus infection, San Diego, CA [abstract]. In: *Program and Abstracts of the 1998 National STD Prevention Conference.* Atlanta, Ga: Centers for Disease Control and Prevention; 1998:129.
28. Centers for Disease Control and Prevention. Undervaccination for hepatitis B among young men who have sex with men—San Francisco and Berkeley, California, 1992–1993. *MMWR Morb Mortal Wkly Rep.* 1996;45:215–217.
29. Rabeneck L, Risser JMH, Murray NGB, McCabe BK, Lacke CE, Lucco LJ. Failure of providers to vaccinate HIV-infected men against hepatitis B: a missed opportunity. *Am J Gastroenterol.* 1993;88:2015–2018.
30. McCusker J, Hill EM, Mayer KH. Awareness

and use of hepatitis B vaccine among homosexual male clients of a Boston community health center. *Public Health Rep.* 1990;105: 59–64.

31. Jones TS, Alter MJ, Margolis HS. One stop shopping: integrating prevention services for viral hepatitis. Paper presented at: 10th International Symposium on Viral Hepatitis and Liver Disease; April 2000; Atlanta, Ga.
32. Margolis HS, Moyer LA, Cookson S, Gunn R, O'Neill S. Overview of hepatitis B vaccination in high risk populations [abstract]. In: *Program and Abstracts of the 1998 National STD Prevention Conference.* Atlanta, Ga: Centers for Disease Control and Prevention; 1998:128.
33. Moyer LA, Margolis H. Survey of hepatitis B vaccination policies and practices in the STD setting [abstract]. In: *Program and Abstracts of the 1998 National STD Prevention Conference.* Atlanta, Ga: Centers for Disease Control and Prevention; 1998:128.
34. Weinstock HS, Bolan G, Moran JS, Peterman TA, Polish L, Reingold AL. Routine hepatitis B vaccination in a clinic for sexually transmitted diseases. *Am J Public Health.* 1995;85:846–849.
35. O'Neill A, Gunn R, Murray P, Hodgson W, Mast E, Margolis H. Implementing hepatitis B vaccine to high-risk adolescents and adults in a public health STD clinic [abstract]. In: *Program and Abstracts of the 1998 National STD Prevention Conference.* Atlanta, Ga: Centers for Disease Control and Prevention; 1998:129.
36. Asbel L. Hodges V, Abakporo E, Goldberg M. Hepatitis vaccination in a busy inner city STD clinic [abstract]. In: *Program and Abstracts of the 1998 National STD Prevention Conference.* Atlanta, Ga: Centers for Disease Control and Prevention; 1998:184.
37. Kalichman SC, Shaper PE, Belcher L, et al. It's like a regular part of gay life: repeat HIV antibody testing among gay and bisexual men. *AIDS Educ Prev.* 1997;9(suppl B):41–51.
38. McFarland W, Fischer-Ponce L, Katz MH. Repeat negative human immunodeficiency virus (HIV) testing in San Francisco: magnitude and characteristics. *Am J Epidemiol.* 1995;142: 719–723.
39. Phillips KA, Paul J, Kegeles S, Stall R, Hoff C, Coates TJ. Predictors of repeat HIV testing among gay and bisexual men. *AIDS.* 1995;9: 769–775.
40. *HIV Counseling, Testing and Referral: Standards and Guidelines, May 1994.* Washington, DC: Centers for Disease Control and Prevention; 1996. Publication 738-953/40040.
41. Sikkema KJ, Bissett RT. Concepts, goals, and techniques of counseling: review and implications for HIV counseling and testing. *AIDS Educ Prev.* 1997;9(suppl B):14–26.
42. Centers for Disease Control and Prevention. Immunization of adolescents. Recommendations of the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, the American Academy of Family Physicians, and the American Medical Association. *MMWR Morb Mortal Wkly Rep.* 1996; 45(RR-13):1–16.
43. Centers for Disease Control and Prevention. Update on adult immunization recommendations of the Immunization Practices Advisory Committee (ACIP). *MMWR Morb Mortal Wkly Rep.* 1991;40(RR-12):1–52.
44. Centers for Disease Control and Prevention. Public health burden of vaccine-preventable diseases among adults: standards for adult immunization practice. *MMWR Morb Mortal Wkly Rep.* 1990;39:725–729.
45. Ryan C, Futterman D. *Lesbian & Gay Youth Care and Counseling: The First Comprehensive Guide to Health & Mental Health Care.* New York, NY: Columbia University Press; 1998.
46. Dardick L, Grady K. Openness between gay persons and health professionals. *Ann Intern Med.* 1980;93:115–119.
47. Kripke CC, Vaias L, Elliot A. The importance of taking a sensitive sexual history. *JAMA.* 1994;271:713.
48. Centers for Disease Control and Prevention. Vaccine-preventable diseases: improving vaccination coverage in children, adolescents, and adults. A report on recommendations of the Task Force on Community Preventive Services. *MMWR Morb Mortal Wkly Rep.* 1999; 48(RR-8):1–15.
49. Centers for Disease Control and Prevention. Update: recommendations to prevent hepatitis B virus transmission—United States. *MMWR Morb Mortal Wkly Rep.* 1995;44: 574–575.
50. Centers for Disease Control and Prevention. Vaccination coverage among adolescents 1 year before the institution of a seventh grade school entry vaccination requirement—San Diego, California, 1998. *MMWR Morb Mortal Wkly Rep.* 2000;49:101–111.
51. Centers for Disease Control and Prevention. Hepatitis B vaccination of adolescents—California, Louisiana, and Oregon, 1992–1994. *MMWR Morb Mortal Wkly Rep.* 1994;43: 605–609.
52. Sherker AH, Robinson WS. Hepatitis B and hepatitis D (delta agent). In: Hoeprich PD, Jordan MC, Ronald AR, eds. *Infectious Diseases.* 5th ed. Philadelphia, Pa: J. B. Lippincott; 1994: 801–814.
53. Dienstag JL, Ryan DM. Occupational exposure to hepatitis B virus in hospital personnel: infection or immunization? *Am J Epidemiol.* 1982; 115:26–39.
54. Shapiro CN. Epidemiology of hepatitis B. *Pediatr Infect Dis J.* 1993;12:433–437.
55. Kane MA, Alter MJ, Hadler SC, Margolis HS. Hepatitis B infection in the United States: recent trends and future strategies for control. *Am J Med.* 1989;87(suppl 3A):11S–13S.
56. Hollinger FB and the North American Regional Study Group. Controlling hepatitis B virus transmission in North America. *Vaccine.* 1990; 8(suppl):S122–S128.