HHS Public Access

Author manuscript

Vaccine. Author manuscript; available in PMC 2018 September 28.

Published in final edited form as:

Vaccine. 2018 April 25; 36(18): 2471–2479. doi:10.1016/j.vaccine.2018.03.030.

Hepatitis B vaccination coverage among adults aged ≥ 18 years traveling to a country of high or intermediate endemicity, United States, 2015

Peng-jun Lu[a,*], **Alissa C. O'Halloran**[a], **Walter W. Williams**[a], and **Noele P. Nelson**[b]

[a]Immunization Services Division, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, 1600 Clifton Road, NE, Atlanta, GA 30333, United States

[b]Division of Viral Hepatitis, National Center for HIV/AIDS, Viral Hepatitis, STD, & TB Prevention, Centers for Disease Control and Prevention, 1600 Clifton Road, NE, Atlanta, GA 30333, United States

Abstract

Background: Persons from the United States who travel to developing countries are at substantial risk for hepatitis B virus (HBV) infection. Hepatitis B vaccine has been recommended for adults at increased risk for infection, including travelers to high or intermediate hepatitis B endemic countries.

Purpose: To assess hepatitis B vaccination coverage among adults ≥ 18 years traveling to a country of high or intermediate endemicity from the United States.

Methods: Data from the 2015 National Health Interview Survey (NHIS) were analyzed to determine hepatitis B vaccination coverage (≥ 1 dose) and series completion (≥ 3 doses) among persons aged ≥ 18 years who reported traveling to a country of high or intermediate hepatitis B endemicity. Multivariable logistic regression and predictive marginal analyses were conducted to identify factors independently associated with hepatitis B vaccination.

Results: In 2015, hepatitis B vaccination coverage (≥ 1 dose) among adults aged ≥ 18 years who reported traveling to high or intermediate hepatitis B endemic countries was 38.6%, significantly higher compared with 25.9% among non-travelers. Series completion (≥ 3 doses) was 31.7% and 21.2%, respectively ($P < 0.05$). On multivariable analysis among all respondents, travel status was significantly associated with hepatitis B vaccination coverage and series completion. Other characteristics independently associated with vaccination (≥ 1 dose, and ≥ 3 doses) among travelers included age, race/ethnicity, educational level, duration of U.S. residence, number of

*Corresponding author at: National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, 1600 Clifton Road, NE, Mail Stop A19, Atlanta, GA 30333, United States. lhp8@cdc.gov (P.-j. Lu).

Conflict of Interest

All authors have no conflicts of interest to be stated.

Publisher's Disclaimer: Disclaimer

The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of CDC.

physician contacts in the past year, status of ever being tested for HIV, and healthcare personnel status.

Conclusions: Although travel to a country of high or intermediate hepatitis B endemicity was associated with higher likelihood of hepatitis B vaccination, hepatitis B vaccination coverage was low among adult travelers to these areas. Healthcare providers should ask their patients about travel plans and recommend and offer travel related vaccinations to their patients or refer them to alternate sites for vaccination.

Keywords

Hepatitis B; Hepatitis B vaccine; Vaccination; Coverage; Adults at risk; Travel status

1. Introduction

Hepatitis B is a vaccine-preventable infection caused by the hepatitis B virus (HBV) and has a worldwide distribution. It is estimated that more than 2 billion of the global population have been infected with HBV of whom, approximately 360 million are chronically infected [1]. Areas of high prevalence of hepatitis B (≥8% of the population hepatitis B surface antigen (HBsAg)-positive) include sub-Saharan Africa, South-East Asia, the Eastern Mediterranean countries, south and western Pacific islands, the interior of the Amazon basin and certain parts of the Caribbean. Areas of moderate prevalence of hepatitis B (≥2%–<8% of the population HBsAg-positive) include south-central and southwest Asia, eastern and southern Europe, Russia, and most of Central and South America. Areas of low prevalence of hepatitis (<2% of the population HBsAg-positive) include Australia, New Zealand, northern and western Europe, and North America [1].

HBV is transmitted through percutaneous or mucosal exposure to infectious blood or body fluids [1–8]. Approximately 5–10% of adults infected with HBV will develop chronic infection, and 15% of those adults will develop chronic liver disease, including cirrhosis, liver failure, and liver cancer. Hepatitis B is one of the leading causes of liver cancer in the United States [2–3]. In highly endemic areas, HBV is most commonly transmitted from mother to child at birth, or from person to person in early childhood. In countries with low HBV endemicity, sexual transmission and the use of contaminated needles, especially among injecting drug users, are the major routes of infection [1].

Persons from the United States who travel to high or intermediate HBV endemic countries are at risk for HBV infection [7,9]. Such persons include tourists, military personnel, missionaries, foreign born persons who return to their country of origin to visit friends or relatives, and others who work or study abroad in countries with high or intermediate HBV endemicity [8]. Hepatitis B remains one of the most common vaccine-preventable diseases acquired during travel [10–12].

Hepatitis B vaccines have been available for use in the United States since the early 1980s. In 1982, the Advisory Committee on Immunization Practices (ACIP) recommended hepatitis B vaccination for infants born to HBsAg-positive mothers and certain high-risk adult populations [3]. Initial strategies for preventing HBV infection focused on 3-dose

vaccination of high-risk groups: health care personnel, men who have sex with men (MSM), injection drug users (IDU) and recipients of certain blood products [3]. In 1991, the ACIP recommended that all infants be immunized with three doses of hepatitis B vaccine and the ACIP recommendation for high-risk adult populations was broadened to include international travelers to countries with high or intermediate HBV endemicity or persons working in countries with high or intermediate HBV endemicity [4]. In 2006, ACIP further expanded the adult hepatitis B vaccination recommendations to include universal vaccination of unvaccinated adults attending certain healthcare and treatment settings that serve high-risk adults including sexually transmitted disease (STD) clinics, human immunodeficiency virus (HIV) counseling and treatment centers, correctional facilities, drug-abuse treatment centers, and healthcare settings with services targeting MSM [7].

This study uses data from the 2011–2015 National Health Interview Survey (NHIS) to examine the most recent hepatitis B vacci-nation coverage and coverage trends among adults aged 18 years who reported travel to a country of high or intermediate HBV endemicity and factors associated with hepatitis B vaccination.

2. Methods

We analyzed data from the 2015 NHIS to determine hepatitis B vaccination coverage (≥1 dose) and series completion (≥3 doses) among adult travelers aged ≥ 18 years to high or intermediate HBV endemic countries. The NHIS is an annual household survey conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention [13]. The NHIS provides estimates on health indicators, health care utilization and access, and health-related behaviors for the U.S. non-institutionalized, civilian population. The NHIS sample is selected through the use of complex sampling design involving stratification, clustering, and multistage sampling with a nonzero probability of selection for each person. Face to face interviews were conducted each week throughout the year in a probability sample of households. In the sample adult core, one adult per sampled family was randomly selected and asked to complete the sample adult questionnaire. In 2015, the final response rate for the sample adult core was 55.2% [13].

Hepatitis B vaccination coverage was determined using the following sample adult core survey question: “Have you ever received hepatitis B vaccine?” An affirmative answer to this question prompted a second question concerning how many doses respondents received: “Did you receive three doses of the hepatitis B vaccine or less than three doses?” To determine travel status, respondents were asked “Have you ever traveled outside of the United States to countries other than Europe, Japan, Australia, New Zealand or Canada, since 1995?” For the purposes of this study we will refer to travelers to high or intermediate HBV endemic areas as “travelers”. Since adults aged 18–26 years might not be able to recall accurately vaccines received as infants or adolescents, sensitivity analyses were conducted to assess whether association between vaccination coverage and travel status or other factors changed when those aged 18–26 years were excluded from the analyses.

Vaccination coverage and series completion were stratified by travel status (travel to a country of high or intermediate HBV endemicity), demographic and other characteristics

(Table 1). Since persons from low HBV endemic countries who travel to high or intermediate HBV endemic countries are at increased risk for acquiring hepatitis B compared to those not traveling [4], we considered persons who traveled outside the United States to countries other than Europe, Japan, Australia, New Zealand, or Canada as having traveled to countries with high or intermediate HBV endemicity. All variables listed above in the bi-variable analysis were also included in the multivariable model. Additionally, we examined 1- and 3-dose coverage by travel status from 2011 to 2015 to assess coverage trends over years.

We used SUDAAN statistical software (Research Triangle Institute, Research Triangle Park, NC) to calculate point estimates and 95% confidence intervals (CIs) of vaccine coverage and series completion [14]. All analyses were weighted to reflect the age, sex, and race/ethnicity of the U.S. non-institutionalized, civilian population. Bi-variable analysis was conducted using Chi-square to test population distributions between travelers and non-travelers. We used t-tests to test the difference in vaccination coverage and series completion by travel status and within each demographic and other characteristic category. Logistic regression was used to determine adjusted prevalence ratios (controlling for the all of covariates listed in the table) associated with different characteristics among adult travelers. A separate logistic regression model was conducted among all persons aged ≥ 18 years including travel status as an independent variable to determine if travel status was an independent predictor of vaccination.

3. Results

Of the 32,954 respondents in the 2015 NHIS sample adult core, 35.8% (11,079) reported traveling to a country of high or intermediate HBV endemicity. Demographic characteristics of the study population are given in Table 1. Overall, 28.8% travelers aged ≥ 1 8 years were not born in the United States (Table 1). The distribution of travelers and non-travelers differed by all sociodemo-graphic and access to care characteristics except having a usual place for health care, having ever lived with a hepatitis patient, and having a chronic liver disease (Table 1).

In bivariate analysis, hepatitis B vaccination coverage (≥ 1 dose) is shown in Table 2. Overall, 38.6% of adult travelers received ≥ 1dose of vaccine compared with 25.9% among non-travelers ($p < 0.05$). Series completion (≥ 3 doses) was also higher among travelers at 31.7% compared with 21.2% among non-travelers ($p < 0.05$) (Table 2). Overall, hepatitis B vaccination coverage (≥ 1 dose) among travelers was significantly higher compared with those who were non-travelers across all socio-demographic, medical, and access-to-care characteristics except being without health insurance. Hepatitis B coverage (≥ 3 dose) among travelers was significantly higher compared with those who were non-travelers across all characteristics except being without health insurance, and identifying as being of “other” race/ethnicity (Table 2).

Among adult travelers, the following characteristics were associated with increased hepatitis B vaccination coverage on bivariate analysis: younger age (persons aged 18–25 years had the highest coverage and those aged ≥ 65 years the lowest), Asian race, having above a high

school education, being employed, increasing number of physician contacts, having medical insurance, having ever been tested for HIV, or being a HCP. Being male, Hispanic ethnicity, having been married, widowed, divorced, or separated, being born outside the United States and having lived in the United States ≥ 10 years, or having diabetes were significantly associated with a lower level of hepatitis B vaccination (Table 2).

Being younger, having above a high school education, being employed, increasing number of physician contacts, having ever been tested for HIV, or being a HCP were the common factors that were significantly associated with increased hepatitis B vaccination compared with the reference groups across travel status and number of doses received (Table 2). Being male, Hispanic ethnicity, having been married, widowed, divorced, or separated, being born outside United States and having lived in the United States ≥ 10 years, or having diabetes were the common factors that were significantly associated with decreased hepatitis B vaccination compared with the reference groups across travel status and number of doses received (Table 2). Other factors associated with hepatitis B vaccination by travel status and number of doses received are shown in Table 2.

On multivariable analysis among all respondents with travel status as an independent variable, hepatitis B coverage (1 dose) and series completion (≥ 3 doses) were higher (Prevalence Ratios (PR) 1.27 (95% confidence interval (CI) = 1.21, 1.34), 1.26 (95% CI = 1.19, 1.34), respectively, $p < 0.05$) among those who reported travel to a country with high or intermediate HBV endemicity compared with non-travelers (data not shown). On multivariable analysis among travelers, hepatitis B vaccination coverage (≥ 1 doses) and series completion (≥ 3 doses) were higher for travelers in all the younger age groups (age 18–25 years, age 26–30 years, age 31–49 years, and age 50–64 years) compared with travelers aged ≥ 65 years ($p < 0.05$) (Table 3). Other characteristics independently associated with vaccination (travelers ≥ 1 dose and ≥ 3 doses) among included age, race/ethnicity, educational level, duration of U.S. residence, number of physician contacts in the past year, status of ever being tested for HIV, and HCP status (Table 3). Other factors independently associated with hepatitis B vaccination by travel status, and number of doses received are shown in Table 3.

Overall, hepatitis B vaccination coverage (≥ 1 dose) decreased 3.9 percentage points among travelers between 2011 and 2015 (test for trend, $p < 0.05$) (Fig. 1). Hepatitis B vaccination coverage (≥ 3 dose) decreased 3.5 percentage points among travelers from between 2011 and 2015 (test for trend, $p < 0.05$). Hepatitis B vaccination coverage (≥ 1 dose) decreased 3.1 percentage points among non-travelers from between 2011 and 2015 (test for trend, $p < 0.05$). Hepatitis B vaccination coverage (≥ 3 dose) decreased 2.2 percentage points among non-travelers between 2011 and 2015 (test for trend, $p < 0.05$).

When those aged 18–26 years were excluded from the analyses, sensitivity analyses showed that 35.7% of adult travelers received ≥ 1 dose of vaccine compared with 22.8% among non-travelers ($p < 0.05$). Series completion (≥ 3 doses) was also higher among travelers at 29.3% compared with 18.6% among non-travelers ($p < 0.05$). The associations between hepatitis B vaccination and travel status or other factors did not change for both bi-variable and multivariable analyses when those aged 18–26 years were excluded from the analyses.

Additionally, association between hepatitis B vaccination and travel status between 2011 and 2015 did not change based on trend analysis when those aged 18–26 years were excluded from the analyses.

4. Discussion

This study used a representative national survey to assess hepatitis B vaccination coverage among adult travelers to countries of high or intermediate hepatitis B endemicity. Findings from this study indicated that travel status was significantly associated with hepatitis B vaccination (≥ 1 dose and ≥ 3 doses); however, hepatitis B coverage (≥ 1 doses) and series completion (≥ 3 doses) among adult travelers were low (38.6% and 31.7%, respectively). HBV infection is among the most common vaccine-preventable infections in travelers [10–12,15–17]. HBV infection during travel is associated with travel duration, the vaccination status of the traveler, and the prevalence of HBV in the destination country [18]. Additionally, specific populations of travelers may be at greater risk of HBV infection, including those visiting friends and relatives, and travelers engaging in casual sex, dental surgery, and medical procedures [18–22]. A previous study showed that travelers seeking urgent, unforeseen medical or dental care is common, which places travelers at risk of HBV infection [23]. Vaccination can reduce the risk of HBV infection among travelers [15–16].

Some factors might contribute to low hepatitis B vaccination among travelers to HBV endemic countries. Many travelers to international destinations may fail to seek travel health advice because of lack of awareness of the risk for travel associated infection and travel related vaccination recommendations [15–17]. Some travelers, such as business travelers, journalists and relief workers may be notified of travel on short notice and have little time for vaccination prior to departure, even though these travelers should be vaccinated in expectation of travel to HBV endemic areas to protect themselves [24–26]. Travelers may believe that travel of short duration, to resorts or on tours, will pose little risk of travel related diseases [24–27]. The belief that short duration travel poses little risk for HBV infection also may be likely for travelers visiting friends and relatives in endemic areas. Travelers should seek consultation about vaccinations recommended for travel at least 4–6 weeks before travel, since many travel vaccines require multiple shots and take time to become fully effective [24–27]. Allowing sufficient time for pre-travel hepatitis B vaccination is important. The standard three-dose hepatitis B vaccination regimen is administered at 0, 1, and 6 months [28]. However, even if travelers are leaving soon, a visit to a travel medicine doctor is valuable [24–27]. An accelerated schedule administered on days 0, 7, and 21–30 days (booster at 12 months) may be used for rapid protection [25,29]. Additional factors that may contribute to low vaccination coverage among adult travelers include: limited awareness among the public about adult vaccination, failure of providers to routinely assess vaccine needs of adult patients, the financial risks providers incur to stock vaccines and provide vaccination services to adults, acute medical care taking precedence over providing vaccination services, the inability to assess adult patients' vaccination status, some providers not perceiving responsibility as the vaccinator, and organizational challenges of vaccine administration [30–38].

Trend analysis from this study showed that hepatitis B vaccination coverage among travelers decreased from 2011 to 2015. The reasons for this decreased trend are unclear and further monitoring of coverage trend is necessary. Theoretically, hepatitis B vaccination coverage should increase, since the proportion of unvaccinated U.S. travelers should decline over time due to the aging cohort of persons vaccinated as infants. Universal infant vaccination and immunization of previously unvaccinated children aged 11–12 years were first recommended in 1991 and 1995, respectively [3,4]. Hepatitis B vaccination coverage for early childhood and adolescents now exceed 90% [39,40]. Thus, most younger travelers (persons aged < 26 years) would be expected to have vaccine-induced hepatitis B immunity from childhood or adolescent vaccination programs.

Higher vaccination coverage is expected among the younger adults. Age was strongly associated with reported hepatitis B vaccination among travelers. Findings from this study indicated that adults aged 18–25 and 26–30 years were approximately two to three times more likely to report receiving hepatitis B vaccination than those aged 50–64 and those aged 65 years, after controlling for other factors. Higher vaccination coverage among younger adults likely reflects the aging of the cohort of children who were vaccinated under the childhood and adolescent vaccination recommendations [39–43]. Additionally, the incidence of hepatitis B is higher among younger adults compared with older adults; higher coverage may reflect a targeted effort by healthcare providers to immunize persons perceived to have greater risk [8,44].

Hepatitis B vaccination coverage among travelers was significantly higher compared with those who were non-travelers across most socio-demographic, medical, and access-to-care characteristics. Travel status was significantly associated with hepatitis B vaccination coverage and series completion among travelers, and this association remained after controlling for other factors. This finding indicated some implementation of the ACIP recommendations for use of hepatitis vaccine among travelers [4,7]. Several other characteristics including race/ethnicity, educational level, duration of U.S. residence, number of physician contacts in the past year, status of ever being tested for HIV, and HCP status were independently associated with vaccination. These findings were similar to those from previous studies [41–43].

The findings in this study are subject to limitations. First, the determination of vaccination status in NHIS was not validated by medical records, thus, self-report of vaccination might be subject to recall bias. Adults particularly might not be able to recall accurately vaccines received as infants or adolescents and hepatitis B vaccination coverage levels might be greatly underestimated. Additional study is needed for accuracy of recall by young adults of vaccinations they may have been received as children or adolescents. The self-report accuracy of hepatitis B vaccination has been poorly studied. One study using serological data found self-report to be unreliable [45]. However, another study found patient recall nearly as sensitive and specific (hepatitis B: sensitivity 80%, specificity 100%) as the medical record [46]. One recent study indicated that adult self-reported hepatitis B vaccination status was about 73% sensitive and 67% specific [47]. The findings for hepatitis B vaccination among younger adults 18–26 years should be viewed with caution, based on comparison with estimates based on provider-reported vaccinations from the NIS-Teen [40].

Second, the 2015 NHIS data did not collect information in terms of risk behaviors which is also an indicator for hepatitis B vaccination. Thus, some people might receive vaccination because of being high-risk group, and might not be travel related. Finally, the NHIS sample excludes persons in the military and those residing in institutions, which might result in underestimation of vaccination coverage levels.

This study documents low national hepatitis B vaccination coverage among adults reporting travel to a country of high or intermediate endemicity and underscores the need to improve vaccination among travelers. To improve hepatitis B vaccination coverage and reduce the burden of travel related HBV infection in the United States, healthcare providers are encouraged to adopt strategies to identify candidates for hepatitis B vaccination, and to ensure that traveling adults, all adults at increased risk for HBV infection, or those seeking protection from HBV infection are offered hepatitis B vaccine [4,24–25,48–50]. Travelers to a country of high or intermediate hepatitis B endemicity are encouraged to schedule a visit with their doctor or a travel medicine provider 4–6 weeks before travel to discuss the need for travel-related vaccinations [24–26]. Increased vaccination coverage might be achieved by routinely assessing patients' vaccination status, using standing orders for vaccination, incorporating vaccination information into electronic medical records, using immunization information systems, and reminder-recall systems [48–50]. Further studies are needed to examine the factors and barriers contributing to low and declining hepatitis B vaccination coverage among travelers.

Acknowledgments

We thank James A. Singleton and Stacie M. Greby for their thoughtful review of the manuscript.

References

[1]. World Health Organization. Hepatitis B vaccines. WHO position paper Available at: <http://www.who.int/immunization/topics/WHO_position_paper_HepB.pdf>. [accessed March 9, 2018].

[2]. Centers for Disease Control and Prevention (CDC). Prevention and control of infections with hepatitis virus in correctional settings. MMWR 2003; 52 (RR01): 1–33.

[3]. Centers for Disease Control and Prevention (CDC). Inactivated hepatitis B vaccine. MMWR 1982; 31: 317–18. [PubMed: 6811846]

[4]. Centers for Disease Control and Prevention (CDC). Hepatitis B virus: a comprehensive strategy for eliminating transmission in the United States through universal childhood vaccination. MMWR 1991; 40 (RR-13): 1–19.

[5]. Centers for Disease Control and Prevention (CDC). Update: recommendations to prevent hepatitis B virus transmission–United States. MMWR 1995; 44: 574–75. [PubMed: 7616955]

[6]. Centers for Disease Control and Prevention (CDC). Update: recommendations to prevent hepatitis B virus transmission–United States. MMWR 1999; 48: 33–4. [PubMed: 9933127]

[7]. Centers for Disease Control and Prevention (CDC). A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2006; 55(RR-16): 1–25.

[8]. Centers for Disease Control and Prevention (CDC). Surveillance for acute viral hepatitis–United States, 2007. MMWR 2009; 58 (SS-3): 1–27.

[9]. Centers for Disease Control and Prevention (CDC). Recommended adult immunization schedule – United States, 2011. MMWR 2011; 60(4): 1–4.

[10]. Chen LH, Hill DR, Wilder-Smith A. Vaccination of travelers: how far have we come and where are we going? Expert Rev Vacc 2011 11;10(11):1609–20.

[11]. Steffen R, Amitirigala I, Mutsch M. Health risks among travelers–need for regular updates. J Travel Med 2008;15(3):145–6. May-Jun. [PubMed: 18494690]

[12]. Connor BA, Jacobs RJ, Meyerhoff AS. Hepatitis B risks and immunization coverage among American travelers. Travel Med 2006;13(5):273–80.

[13]. Centers for Disease Control and Prevention (CDC). National Health Interview Survey Available at: <ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2015/srvydesc.pdf> [accessed June 3, 2017].

[14]. Shah B, Barnwell B, Bieier G. SUDAAN User's Manual, Release 11.1 Research Triangle Park, NC: Research Triangle Institute; 2010.

[15]. Johnson DF, Leder K, Torresi J. Hepatitis B and C infection in international travelers. J Travel Med 2013;20(3):194–202. [PubMed: 23577866]

[16]. Jong EC. Risks of hepatitis A and B in the traveling public. J Travel Med 2001;8 (Suppl 1):S3–8. [PubMed: 11182611]

[17]. Steffen R, Connor BA. Vaccines in travel health: from risk assessment to priorities. J Travel Med 2005;12(1):26–35. [PubMed: 15996464]

[18]. Loscher T, Keystone JS, Steffen R. Vaccination of travelers against hepatitis A and B. J Travel Med 1999;6:107–14. [PubMed: 10381963]

[19]. Struve J, Norrbohm O, Stenbeck J, et al. Risk factors for hepatitis A, B and C virus infection among Swedish expatriates. J Infect 1995;31:205–9. [PubMed: 8586840]

[20]. Streeton CL, Zwar N. Risk of exposure to hepatitis B and other blood-borne viruses among Australians who travel abroad. J Travel Med 2006;13:345–50. [PubMed: 17107427]

[21]. Hahne S, Ramsay M, Balogun K, et al. Incidence and routes of transmission of hepatitis B virus in England and Wales, 1995–2000: implications for immunisation policy. J Clin Virol 2004;29:211–20. [PubMed: 15018847]

[22]. Sonder GJ, van Rijckevorsel GG, van den Hoek A. Risk of hepatitis B for travelers: is vaccination for all travelers really necessary? J Travel Med 2009;16:18–22. [PubMed: 19192123]

[23]. Nielsen US, Petersen E, Larsen CS. Hepatitis B immunization coverage and risk behaviour among Danish travellers: are immunization strategies based on single journey itineraries rational? J Infect 2009;59:353–9. [PubMed: 19733194]

[24]. Accelerated vaccination schedules provide protection against hepatitis A and B in last-minute travelers Available at: <http://www.medscape.com/viewarticle/491698> [accessed May 30, 2017].

[25]. Centers for Disease Control and Prevention (CDC). Travelers' health Available at: <https://wwwnc.cdc.gov/travel/yellowbook/2016/advising-travelers-with-specific-needs/last-minute-travelers> [accessed May 3, 2017].

[26]. Connor BA. Hepatitis A vaccine in the last-minute traveler. Am J Med 2005 10;118(Suppl 10A):58S–62S. [PubMed: 16271543]

[27]. De Serres G, Duval B, Shadmani R, Boulianne N, Pohani G, Naus M, et al. Ineffectiveness of the current strategy to prevent hepatitis A in travelers. J Travel Med 2002;9(1):10–6. Jan-Feb. [PubMed: 11962352]

[28]. Kim DK, Riley LE, Harriman KH, Hunter P, Bridges CB. Recommended immunization schedule for adults aged 19 years or older, United States, 2017. Advisory committee on immunization practices. Ann Intern Med 2017 2 7;166(3):209–19. [PubMed: 28166560]

[29]. Connor BA, Jacobs RJ, Meyerhoff AS. Hepatitis B risks and immunization coverage among American travelers. J Travel Med 2006;13(5):273–80. Sep-Oct. [PubMed: 16987126]

[30]. Bridges CB, Hurley LP, Williams WW, Ramakrishnan A, Dean AK, Groom AV. Meeting the challenges of immunizing adults. Am J Prev Med 2015;49(Suppl4):S455–64. [PubMed: 26382294]

[31]. Joon Lee T, Hayes S, Cummings DM, et al. Herpes zoster knowledge, prevalence, and vaccination rate by race. J Am Board Fam Med 2013;26:45–51. [PubMed: 23288280]

[32]. Johnson DR, Nichol KL, Lipczynski K. Barriers to adult immunization. Am J Med 2008;121(Suppl 2):S28–35.

[33]. Winston CA, Wortley PM, Lees KA. Factors associated with vaccination of Medicare beneficiaries in five U.S. communities: results from the racial and ethnic adult disparities in immunization initiative survey, 2003. J Am Geriatr Soc 2006;54:303–10. [PubMed: 16460383]

[34]. National Foundation for Infectious Diseases. Call to action: adult vaccination saves lives Bethesda, MD: National Foundation for Infectious Diseases; 2012 <http://www.adultvaccination.org/resources/cta-adult.pdf> [accessed May 22, 2017].

[35]. Stewart AM, Lindley MC, Chang KH, Cox MA. Vaccination benefits and cost-sharing policy for non-institutionalized adult Medicaid enrollees in the United States. Vaccine 2014;32:618–23. [PubMed: 24291539]

[36]. Hurley LP, Bridges CB, Harpaz R, et al. U.S. physician's perspective of adult vaccine delivery. Ann Intern Med 2014;160:161–70. [PubMed: 24658693]

[37]. Lu PJ, O'Halloran A, Williams WW. Impact of health insurance status on vaccination coverage among adult populations—United States, 2012. Am J Prev Med 2015;48(6):647–61. [PubMed: 25890684]

[38]. Johnson DR, Nichol KL, Lipczynski K. Barriers to adult immunization. Am J Med 2008;121(7B):S28–35.

[39]. Centers for Disease Control and Prevention (CDC). Vaccination Coverage Among Children Aged 19–35 Months — United States, 2015. MMWR 2016; 65 (39): 1065–71. [PubMed: 27711036]

[40]. Centers for Disease Control and Prevention (CDC). National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13–17 Years — United States, 2015. MMWR 2016; 65(33): 850–8. [PubMed: 27561081]

[41]. Lu PJ, Byrd KK, Murphy TV, Weinbaum C. Hepatitis B vaccination coverage among high-risk adults 18–49 years, U.S., 2009 Vaccine 2011 Sep 16;29 (40):7049–57.

[42]. Centers for Disease Control and Prevention (CDC). Hepatitis B Vaccination Among High-Risk Adolescents and Adults – San Diego, California, 1998–2001. MMWR 2002; 51(28): 618–21. [PubMed: 12236303]

[43]. Lu PJ, Byrd KK, Murphy TV. Hepatitis A vaccination coverage among adults 18–49 years traveling to a country of high or intermediate endemicity United States. Vaccine 2013;31(19): 2348–57. [PubMed: 23523408]

[44]. Centers for Disease Control and Prevention (CDC). Surveillance for Viral Hepatitis – United States, 2014 Available at: <http://www.adultvaccination.org/resources/cta-adult.pdf>. [accessed June 2, 2017].

[45]. Trevisan A, Frasson C, Morandin M, Beggio M, Bruno A, Davanzo E, et al. Immunity against infectious diseases: predictive value of self-reported history of vaccination and disease. Infect Control Hosp Epidemiol 2007;28:564–9. [PubMed: 17464916]

[46]. Stange KC, Zyzanski SJ, Smith TF, Kelly R, Langa DM, Flocke SA, et al. How valid are medical records and patient questionnaires for physician profiling and health services research? A comparison with direct observation of patients visits. Med Care 1998;36:851–67. [PubMed: 9630127]

[47]. Rolnick SJ, Parker ED, Nordin JD, et al. Self-report compared to electronic medical record across eight adult vaccines: do results vary by demographic factors? Vaccine 2013;31(37):3928–35. [PubMed: 23806243]

[48]. Guide to Community Preventive Services. Vaccination Available at <http://www.thecommunityguide.org/index.html> [accessed June 8, 2017].

[49]. Poland GA, Shefer AM, McCauley M, Webster PS, Whitely-Williams PN, Peter G, et al. Standards for adult immunization practice. Am J Prev Med 2003;25 (2):144–50. [PubMed: 12880883]

[50]. National Vaccine Advisory Committee. Recommendations from the National Vaccine Advisory Committee: standards for adult immunization practice. Public Health Rep 2014;129(2):115–23. [PubMed: 24587544]

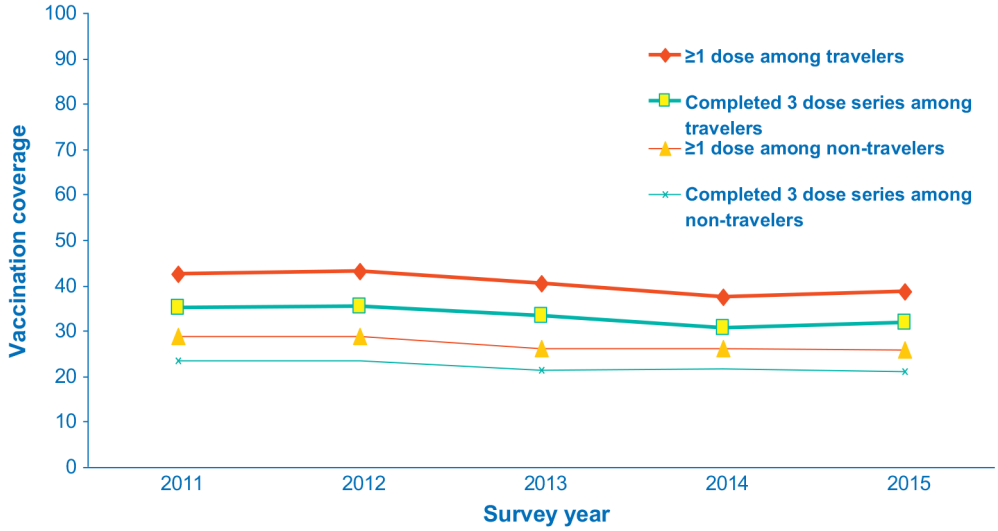

Fig. 1.
Source: National Health Interview Survey 2011–2015.

Table 1

Sample characteristics of participants aged ≥ 18 years in the United States, by travel status, demographic, medical, and access-to-care variables–NHIS 2015.

Characteristic		Traveled*		Not traveled	
		Sample	Weighted %	Sample	Weighted %
Total		11,079	100.0	21,875	100.0
Age					
	18–25	1152	12.4	2255	15.3†
	26–30	1180	10.1	1598	7.9
	31–49	4072	38.4	5993	28.4
	50–64	2690	24.9	5778	26.2
	≥65	1985	14.1	6251	22.1
Sex					
	Male	5221	50.5	9540	46.9†
	Female	5858	49.5	12,335	53.1
Race/ethnicity					
	Non-Hispanic White	6328	59.4	14,139	68.1†
	Non-Hispanic Black	950	8.0	3371	13.6
	Hispanic	2359	19.9	3110	13.2
	Asian	1216	11.0	620	2.6
	Other	226	1.7	635	2.5
Marital Status					
	Married	5826	61.9	8691	48.3†
	Widowed/divorced/separated	2180	12.6	6685	20.3
	Never married	3055	25.5	6454	31.3
Education					
	High school or less	2735	24.1	10,012	44.7†
	Some college or college graduate	6152	56.5	10,158	47.6
	Above college graduate	2159	19.4	1602	7.7
Employment status					
	Employed	7521	69.9	11,490	56.5†
	Not employed	3551	30.1	10,379	43.5
Poverty level					
	At or above poverty	9506	92.2	16,902	85.4†
	Below poverty	1106	7.8	3834	14.6
Region					
	Northeast	1827	17.0	3622	17.6†
	Midwest	1984	18.8	4965	24.5
	South	3560	34.7	7807	38.4
	West	3708	29.5	5481	19.6

Characteristic		Traveled*		Not traveled	
		Sample	Weighted %	Sample	Weighted %
US born status					
	U.S. born	7754	71.2	19,108	87.7†
	Born outside U.S. - In U.S. <10 yrs	769	6.3	395	2.0
	Born outside U.S. - In U.S. >10 yrs	2517	22.5	2333	10.3
Physician contacts within past year					
	None	1841	16.5	3889	18.8†
	1	2032	18.9	3553	16.8
	2–3	3017	28.3	5618	25.9
	4–9	2640	23.4	5428	24.0
	>10	1525	12.9	3320	14.6
Hospitalization within past year					
	Yes	794	6.7	2410	9.9†
	No	10,279	93.3	19,455	90.1
Usual place for health care					
	Yes	9476	86.3	19,027	86.2
	No	1602	13.7	2842	13.8
Health insurance					
	Yes	9999	91.7	19,393	88.5†
	No	1047	8.3	2373	11.5
Ever tested for HIV					
	Yes	4840	44.3	7641	35.4†
	No	5891	55.7	13,537	64.6
Health care personnel					
	Yes	1204	10.2	1534	7.1†
	No	9874	89.8	20,339	92.9
Ever lived with a hepatitis patient					
	Yes	466	4.0	875	3.8
	No	10,228	96.0	20,258	96.2
Persons with chronic liver disease					
	Yes	118	1.0	317	1.3
	No	10,952	99.0	21,547	98.7
Diabetes status					
	With diabetes	820	7.0	2746	11.0†
	Without diabetes	10,253	93.0	19,114	89.0

*Persons from developed countries who travel to countries with high or intermediate HBV endemicity are at substantial risk for acquiring hepatitis B. Persons who reported traveling outside the United States to countries other than Europe, Japan, Australia, New Zealand, or Canada were considered having traveled to countries with high or intermediate HBV endemicity.

†Significant difference between travelers and non-travelers (by chi-square test, $p < 0.05$).

Table 2

Hepatitis B vaccination coverage of participants aged ≥ 18 years, by travel status, demographic, medical, and access-to-care variables, United States–NHIS 2015.

Characteristic		Vaccination coverage with ≥ 1 dose among travelers[a] % (95% CI)	Vaccination coverage with ≥ 1 dose among non-travelers % (95% CI)	Vaccination coverage with ≥ 3 dose among travelers[a] % (95% CI)	Vaccination coverage with ≥ 3 dose among non-travelers % (95% CI)
Total		38.6 (37.3–40.0)	25.9 (24.9–26.9)†	31.7 (30.5–33.0)	21.2 (20.2–22.1)†
Age					
	18–25	56.9 (52.6–61.2)‡	41.1 (37.7–44.6)†,‡	48.1 (43.7–52.5)‡	34.5 (31.2–37.9)†,‡
	26–30	53.8 (49.8–57.8)‡	43.1 (39.9–46.3)†,‡	44.7 (40.8–48.7)‡	35.6 (32.3–39.0)†,‡
	31–49	40.8 (38.7–42.9)‡	28.7 (27.0–30.4)†,‡	33.6 (31.7–35.6)‡	23.2 (21.6–24.8)†,‡
	50–64	30.5 (28.1–32.9)‡	21.9 (20.3–23.5)†,‡	25.0 (22.8–27.4)‡	18.1 (16.6–19.7)†,‡
	≥65§	21.9 (19.4–24.6)	11.1 (9.9–12.4)†	17.6 (15.4–20.1)	9.0 (7.9–10.2)†
Sex					
	Male	35.4 (33.6–37.3)‡	21.3 (20.0–22.7)†,‡	28.1 (26.4–30.0)‡	16.8 (15.6–18.1)†,‡
	Female§	41.9 (40.1–43.7)	29.9 (28.6–31.2)†	35.3 (33.6–37.0)	25.0 (23.8–26.3)†
Race/ethnicity					
	Non-Hispanic White§	39.7 (37.9–41.6)	25.9 (24.8–27.1)†	33.7 (31.9–35.4)	21.6 (20.5–22.7)†
	Non-Hispanic Black	38.1 (33.8–42.7)	27.1 (25.0–29.3)†	30.9 (26.9–35.2)	21.9 (19.9–24.0)†
	Hispanic	31.9 (29.2–34.6)‡	22.8 (20.7–25.1)†,‡	23.7 (21.2–26.4)‡	17.0 (15.1–19.1)†,‡
	Asian	44.0 (40.3–47.7)‡	26.6 (21.3–32.6)†	35.4 (31.9–39.0)	21.8 (17.1–27.4)†
	Other	47.1 (37.4–57.0)	33.2 (27.8–39.0)†,‡	37.6 (26.9–49.8)	26.3 (21.2–32.1)
Marital Status					
	Married	36.4 (34.8–37.9)‡	24.8 (23.5–26.1)†,‡	30.0 (28.5–31.4)‡	20.5 (19.3–21.7)†,‡
	Widowed/divorced/ separated	30.6 (27.8–33.6)‡	19.0 (17.6–20.4)†,‡	24.3 (21.6–27.2)‡	15.2 (14.0–16.6)†,‡
	Never married§	48.4 (45.5–51.3)	32.2 (30.2–34.4)†	40.2 (37.3–43.1)	26.3 (24.4–28.3)†
Education					
	High school or less§	26.0 (23.8–28.3)	19.3 (18.0–20.5)†	18.4 (16.4–20.5)	14.9 (13.7–16.1)†
	Some college or college graduate	41.3 (39.4–43.3)‡	31.4 (30.0–32.8)†,‡	34.7 (32.8–36.6)‡	26.3 (25.0–27.6)†,‡
	Above college graduate	46.7 (43.8–49.7)‡	30.4 (27.4–33.5)†,‡	39.7 (36.9–42.7)‡	26.2 (23.4–29.3)†,‡
Employment status					
	Employed§	41.0 (39.4–42.6)	30.2 (29.0–31.5)‡	33.9 (32.4–35.5)	25.1 (23.8–26.4)†
	Not employed	33.1 (31.1–35.2)‡	20.2 (19.0–21.5)†,‡	26.7 (24.7–28.7)‡	16.2 (15.0–17.4)†,‡

Characteristic		Vaccination coverage with ≥ 1 dose among travelers[a] % (95% CI)	Vaccination coverage with ≥ 1 dose among non-travelers % (95% CI)	Vaccination coverage with ≥ 3 dose among travelers[a] % (95% CI)	Vaccination coverage with ≥ 3 dose among non-travelers % (95% CI)
Poverty level					
	At or above poverty	38.9 (37.5–40.4)	26.2 (25.1–27.3)†	32.2 (30.9–33.6)	21.6 (20.6–22.6)†
	Below poverty§	38.3 (33.8–43.0)	27.0 (24.7–29.5)†	29.0 (24.8–33.6)	21.2 (19.0–23.6)†
Region					
	Northeast§	37.8 (34.1–41.7)	23.3 (21.0–25.8)†	31.1 (27.1–35.4)	18.6 (16.5–20.9)†
	Midwest	40.8 (37.3–44.5)	28.5 (26.4–30.7)†,‡	35.5 (32.3–38.8)	24.0(21.9–26.1)†,‡
	South	36.6 (34.5–38.8)	24.6 (23.3–26.0)†	29.0 (27.2–30.9)	20.1 (18.8–21.4)†
	West	40.1 (37.9–42.4)	27.4 (25.2–29.7)†,‡	32.9 (30.9–34.9)	22.2 (20.0–24.5)†,‡
US born status					
	U.S. born§	40.8 (39.2–42.5)	26.6 (25.6–27.7)†	34.4 (32.8–36.0)	22.0 (21.0–23.0)†
	Born outside U.S. - In U.S. <10 yrs	42.1 (37.6–46.7)	22.4 (17.5–28.2)†	30.9 (26.8–35.2)	18.7 (13.7–25.1)†
	Born outside U.S. - In U.S. ≥10 yrs	31.0 (28.7–33.4)‡	20.5 (18.3–22.9)†,‡	23.6 (21.4–25.9)‡	15.0 (13.0–17.2)†,‡
Physician contacts within past year					
	None§	33.4 (30.1–36.8)	22.4 (20.4–24.6)‡	25.8 (22.9–28.9)	17.5 (15.6–19.5)†
	1	39.3 (36.5–42.2)‡	27.4 (25.2–29.8)†,‡	32.8 (30.0–35.7)‡	22.0 (20.0–24.1)†,‡
	2–3	39.3 (36.8–41.8)‡	27.0 (25.2–28.9)†,‡	31.9 (29.6–34.3)‡	22.9 (21.3–24.5)†,‡
	4–9	40.1 (37.3–43.0)‡	25.5 (23.6–27.5)†,‡	34.0 (31.2–36.9)‡	20.8 (19.0–22.7)†,‡
	>10	40.3 (37.1–43.5)‡	27.4 (25.2–29.8)†,‡	33.1 (29.9–36.4)‡	22.7(20.6–25.1)†,‡
Hospitalization within past year					
	Yes	39.5 (35.3–44.0)	25.9 (23.5–28.5)†	32.3 (28.2–36.8)	20.8 (18.5–23.3)†
	No§	38.5 (37.1–40.0)	25.9 (24.9–26.9)†	31.6 (30.3–33.0)	21.2 (20.3–22.2)†
Usual place for health care					
	Yes	38.7 (37.2–40.1)	25.8 (24.8–26.8)†	32.0 (30.7–33.4)	21.3 (20.3–22.3)†
	No§	38.5 (35.3–41.8)	26.5 (24.2–28.9)†	29.8 (26.8–33.0)	20.4 (18.3–22.7)†
Health insurance					
	Yes	39.5 (38.1–41.0)‡	26.0 (25.0–27.1)†	32.6 (31.3–34.0)‡	21.5 (20.5–22.5)†
	No§	29.2 (25.8–33.0)	25.0 (22.4–27.7)	22.1 (18.8–25.8)	19.1 (16.7–21.7)
Ever tested for HIV					
	Yes	47.9 (45.8–50.1)‡	37.2 (35.6–38.9)†,‡	40.1 (38.0–42.2)‡	30.4 (28.7–32.0)†,‡

Characteristic		Vaccination coverage with ≥ 1 dose among travelers[a] % (95% CI)	Vaccination coverage with ≥ 1 dose among non-travelers % (95% CI)	Vaccination coverage with ≥ 3 dose among travelers[a] % (95% CI)	Vaccination coverage with ≥ 3 dose among non-travelers % (95% CI)
	No[§]	31.6 (29.8–33.3)	19.7 (18.6–20.8)[†]	25.4 (23.8–27.1)	16.2 (15.2–17.3)[†]
Health care personnel					
	Yes	74.5 (71.0–77.7)[‡]	68.4 (65.1–71.6)[†,‡]	67.6 (64.0–71.0)[‡]	62.5 (59.0–65.9)[†,‡]
	No[§]	34.3 (32.9–35.8)	22.6 (21.6–23.5)[†]	27.4 (26.1–28.7)	17.9 (17.0–18.8)[†]
Ever lived with a hepatitis patient					
	Yes	44.5 (38.2–51.0)	36.2 (31.4–41.4)[‡]	35.8 (29.9–42.2)	27.7 (23.4–32.4)[†,‡]
	No[§]	38.3 (36.9–39.7)	25.2 (24.2–26.2)[†]	31.5 (30.2–32.9)	20.7 (19.8–21.7)[†]
Persons with chronic liver disease					
	Yes	37.9 (25.7–51.9)	35.0 (27.8–42.9)[‡]	27.9 (17.3–41.6)	28.6 (21.9–36.4)[‡]
	No[§]	38.7 (37.3–40.0)	25.8 (24.8–26.8)[†]	31.8 (30.5–33.0)	21.1 (20.2–22.0)[†]
Diabetes status					
	With diabetes	29.7 (25.7–34.1)[‡]	19.6 (17.6–21.8)[†,‡]	23.2 (19.2–27.6)[‡]	15.4 (13.6–17.5)[†,‡]
	Without diabetes[§]	39.3 (37.9–40.8)	26.7 (25.7–27.7)[†]	32.4 (31.0–33.7)	21.9 (20.9–22.9)[†]

[*] Persons from developed countries who travel to countries with high or intermediate HBV endemicity are at substantial risk for acquiring hepatitis B. Persons who reported traveling outside the United States to countries other than Europe, Japan, Australia, New Zealand, or Canada were considered having traveled to countries with high or intermediate HBV endemicity.

[†] $p < 0.05$ by t test for comparisons between travelers and non-travelers within each level of each characteristic.

[‡] $p < 0.05$ by t test for comparisons within each variable with the indicated reference level.

[§] Reference level.

Table 3

Multivariable logistic regression analyses of persons ≥ 18 years who reported receiving hepatitis B vaccination, by travel status, demographic, medical, and access-to-care variables, United States – NHIS 2015.

Characteristic		Prevalence ratio (PR) with ≥1 dose among travelers* PR (95% CI)	Prevalence ratio (PR) with ≥1 dose among non-travelers PR (95% CI)	Prevalence ratio (PR) with ≥3 dose among travelers* PR (95% CI)	Prevalence ratio (PR) with ≥3 dose among non-travelers PR (95% CI)
Age					
	18–25	2.65 (2.25, 3.13)†	3.64 (3.12, 4.26)†	2.82 (2.34, 3.41)†	3.88 (3.24, 4.63)†
	26–30	2.26 (1.94, 2.64)†	3.30 (2.82, 3.86)†	2.29 (1.89, 2.77)†	3.40 (2.79, 4.15)†
	31–49	1.67 (1.43, 1.96)†	2.03 (1.75, 2.36)†	1.69 (1.42, 2.02)†	2.06 (1.73, 2.46)†
	50–64	1.29 (1.11, 1.50)†	1.54 (1.34, 1.77)†	1.30 (1.09, 1.55)†	1.61 (1.36, 1.90)†
	≥65§	Reference	Reference	Reference	Reference
Sex					
	Male	0.95 (0.89, 1.01)	0.83 (0.77, 0.89)†	0.92 (0.85, 0.99)†	0.80 (0.73, 0.88)†
	Female§	Reference	Reference	Reference	Reference
Race/ethnicity					
	Non-Hispanic White§	Reference	Reference	Reference	Reference
	Non-Hispanic Black	0.84 (0.75, 0.96)†	0.89 (0.81, 0.99)†	0.84 (0.73, 0.96)†	0.87 (0.77, 0.97)†
	Hispanic	0.88 (0.79, 0.98)†	0.86 (0.76, 0.98)†	0.82 (0.72, 0.94)†	0.81 (0.69, 0.93)†
	Asian	1.11 (0.99, 1.25)	1.09 (0.90, 1.32)	1.10 (0.96, 1.26)	1.05 (0.84, 1.30)
	Other	1.05 (0.86, 1.30)	0.96 (0.78, 1.17)	0.97 (0.71, 1.32)	0.94 (0.75, 1.17)
Marital Status					
	Married	0.99 (0.91, 1.08)	1.12 (1.03, 1.23)†	1.00 (0.90, 1.10)	1.13 (1.03, 1.25)†
	Widowed/divorced/ Separated	0.99 (0.88, 1.11)	1.05 (0.94, 1.16)	0.95 (0.82, 1.10)	1.04 (0.93, 1.17)
	Never married§	Reference	Reference	Reference	Reference
Education					
	High school or less§	Reference	Reference	Reference	Reference
	Some college or college graduate	1.25 (1.14, 1.37)†	1.33 (1.23, 1.43)†	1.35 (1.20, 1.51)†	1.41 (1.29, 1.54)†
	Above college graduate	1.47 (1.32, 1.64)†	1.45 (1.29, 1.63)†	1.59 (1.39, 1.81)†	1.59 (1.39, 1.82)†
Employment status					
	Employed§	Reference	Reference	Reference	Reference
	Not employed	1.05 (0.97, 1.13)	1.00 (0.93, 1.08)	1.06 (0.97, 1.16)	1.00 (0.91, 1.10)
Poverty level					
	At or above poverty	1.00 (0.88, 1.13)	0.97 (0.88, 1.07)	1.06 (0.91, 1.24)	0.98 (0.87, 1.10)

Characteristic		Prevalence ratio (PR) with ≥1 dose among travelers* PR (95% CI)	Prevalence ratio (PR) with ≥1 dose among non-travelers PR (95% CI)	Prevalence ratio (PR) with ≥3 dose among travelers* PR (95% CI)	Prevalence ratio (PR) with ≥3 dose among non-travelers PR (95% CI)
	Below poverty§	Reference	Reference	Reference	Reference
Region					
	Northeast§	Reference	Reference	Reference	Reference
	Midwest	1.13 (0.99, 1.29)	1.17 (1.03, 1.32)†	1.18 (1.00, 1.39)†	1.23 (1.06, 1.42)†
	South	1.06 (0.94, 1.19)	1.03 (0.92, 1.16)	1.03 (0.88, 1.20)	1.07 (0.94, 1.22)
	West	1.09 (0.98, 1.22)	1.11 (0.98, 1.26)	1.11 (0.95, 1.29)	1.17 (1.01, 1.35)†
US born status					
	U.S. born§	Reference	Reference	Reference	Reference
	Born outside U.S. - In U.S. <10 yrs	0.88 (0.75, 1.03)	0.71 (0.57, 0.90)†	0.82 (0.69, 0.99)†	0.76 (0.59, 1.00)†
	Born outside U.S. - In U.S. ≥10 yrs	0.90 (0.82, 0.99)†	0.95 (0.84, 1.08)	0.86 (0.76, 0.97)†	0.90 (0.77, 1.05)
Physician contacts within past year					
	None§	Reference	Reference	Reference	Reference
	1	1.05 (0.93, 1.19)	1.11 (0.98, 1.25)	1.10 (0.95, 1.27)	1.08 (0.94, 1.25)
	2–3	1.07 (0.94, 1.22)	1.18 (1.06, 1.31)†	1.07 (0.93, 1.24)	1.23 (1.08, 1.39)†;
	4–9	1.15 (1.01, 1.32)†	1.18 (1.06, 1.32)†	1.20 (1.02, 1.40)†	1.18 (1.03, 1.36)†
	>10	1.13 (0.99, 1.30)	1.20 (1.06, 1.36)†	1.15 (0.98, 1.36)	1.23 (1.05, 1.43)†
Hospitalization within past year					
	Yes	1.00 (0.89, 1.12)	1.12 (1.01, 1.24)†	0.99 (0.85, 1.14)	1.12 (1.00, 1.25)
	No§	Reference	Reference	Reference	Reference
Usual place for health care					
	Yes	1.03 (0.94, 1.14)	0.98 (0.89, 1.08)	1.07 (0.95, 1.21)	1.05 (0.94, 1.18)
	No§	Reference	Reference	Reference	Reference
Health insurance					
	Yes	1.12 (0.98, 1.28)	1.03 (0.91, 1.16)	1.12 (0.95, 1.32)	1.01 (0.87, 1.17)
	No§	Reference	Reference	Reference	Reference
Ever tested for HIV					
	Yes	1.38 (1.28, 1.49)†	1.51 (1.40, 1.62)†	1.44 (1.31, 1.57)†	1.47 (1.35, 1.61)
	No§	Reference	Reference	Reference	Reference
Health care personnel					
	Yes	2.01 (1.88, 2.16)†	2.59 (2.41, 2.78)†	2.19 (2.03, 2.37)†	2.84 (2.62, 3.07)†

Characteristic		Prevalence ratio (PR) with ≥1 dose among travelers* PR (95% CI)	Prevalence ratio (PR) with ≥1 dose among non-travelers PR (95% CI)	Prevalence ratio (PR) with ≥3 dose among travelers* PR (95% CI)	Prevalence ratio (PR) with ≥3 dose among non-travelers PR (95% CI)
	No§	Reference	Reference	Reference	Reference
Ever lived with a hepatitis patient					
	Yes	1.18 (1.03, 1.34)†	1.49 (1.32, 1.70)†	1.17 (0.98, 1.39)	1.41 (1.22, 1.64)†
	No§	Reference	Reference	Reference	Reference
Persons with chronic liver disease					
	Yes	0.90 (0.58, 1.40)	0.98 (0.65, 1.48)	0.89 (0.52, 1.50)	0.98 (0.60, 1.60)
	No§	Reference	Reference	Reference	Reference
Diabetes status					
	With diabetes	1.03 (0.90, 1.19)	1.10 (0.99, 1.22)	0.99 (0.82, 1.20)	1.06 (0.94, 1.21)
	Without diabetes§	Reference	Reference	Reference	Reference

*Persons from developed countries who travel to countries with high or intermediate HBV endemicity are at substantial risk for acquiring hepatitis B. Persons who reported traveling outside the United States to countries other than Europe, Japan, Australia, New Zealand, or Canada were considered having traveled to countries with high or intermediate HBV endemicity.

†$p < 0.05$ by t test for comparisons within each covariate category with the indicated reference level.

§Reference level.