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Baseline hepatitis B vaccination coverage among persons with diabetes before implementing a U.S. recommendation for vaccination

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Abstract

Background: Recent data suggest that adults with diabetes are at increased risk of incident hepatitis B infection and may suffer increased morbidity or mortality from chronic hepatitis B infection. In October 2011, the Advisory Committee on Immunization Practices (ACIP) recommended hepatitis B vaccination (HepB) for persons with diabetes aged 19–59 years and stated that persons with diabetes aged 60 years and older should be considered for vaccination.

Objective: To determine HepB coverage among persons with diabetes aged ≥19 years prior to implementation of the new ACIP recommendation and to determine predictors for vaccination.

Methods: We used the 2009 National Health Interview Survey to determine weighted proportions of self-reported HepB coverage (≥1 and ≥3 doses) among persons with diabetes aged ≥19 years. A multivariable logistic regression analysis was performed to determine factors independently associated with vaccination.

Results: Overall, 19.5% (95% CI: 17.4–21.6%) and 16.6% (14.7–18.6%) of persons with diabetes, aged ≥19 years, reported receiving ≥1 and ≥3 doses of HepB, respectively, compared with 30.3% (29.4–31.3%) and 26.5% (25.5–27.4%) among persons without diabetes. While unadjusted HepB coverage was higher among persons without diabetes, diabetes status was not associated with ≥1 or ≥3 dose vaccination. Among persons with diabetes, being a healthcare provider (OR 4.2, 2.5–7.0), ever tested for HIV (OR 2.6, 1.8–3.6), high-risk behaviors (OR 1.8, 1.0–3.4, *P*-value = 0.053) and having some college education (OR 1.7, 1.2–2.4) were all independently associated with vaccination.

Conclusion: HepB coverage among persons with diabetes is low. These data can be used to provide a baseline for measuring future progress toward vaccination of persons with diabetes.

Keywords

Hepatitis B vaccination; Diabetes; Vaccination

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1. Introduction

Recent evidence suggests that persons with diabetes may be at increased risk of hepatitis B infection. One population based study that examined acute hepatitis B cases and diabetes data from eight Emerging Infections Program (EIP) surveillance sites estimated hepatitis B incidence, in persons aged 23–59 years, to be approximately two times higher in persons with diabetes compared to those without when the analysis was restricted to persons without high risk behavior [1]. A similar trend was seen among persons 60 years of age and older, although the difference was not statistically significant.

Hepatitis B prevalence has also been found to be higher among persons with diabetes. A study which examined hepatitis B serology data from the National Health and Nutrition Examination Survey, a nationally representative survey of the U.S. non-institutional population, found the overall prevalence of past or current HBV infection was statistically higher among persons with diabetes at 8.3% compared to 5.2% among persons without diabetes [2]. Results, however, did not adjust for potential confounders and may have underestimated the risk of HBV infection among persons with diabetes. Another study that looked at national hospitalization data from the Nationwide Inpatient Sample found that hepatitis B-associated hospitalizations were three times higher among persons with diabetes than those without [3].

Increased risk of hepatitis B infection among persons with diabetes may, in part, be caused by HBV exposure during routine diabetes care. Reuse of fingerstick devices meant for individual use on multiple persons and shared use of blood glucose monitoring equipment have led to multiple HBV outbreaks in the past several years [4]. Studies have shown that potential HBV exposure during routine diabetes care is prevalent in a number of different settings such as physician offices, health fairs, schools, and hospitals. For example, blood is often detectable on hospital glucose meters [5] and hospitals frequently conduct large numbers of sequential tests, using glucose meters, on multiple patients [6]. Because HBV is environmentally stable on surfaces, for at least 7 days [7], there may be risk of HBV transmission for persons receiving monitoring with a shared meter in multiple settings both within and outside of healthcare settings.

Hepatitis B infection can be prevented through the 3-dose hepatitis B vaccination (HepB). In October 2011, the Advisory Committee on Immunization Practices (ACIP) recommended HepB for persons with diabetes aged 19–59 years and stated that HepB should be considered for persons with diabetes 60 years of age and older [8]. We analyzed data from the 2009 National Health Interview Survey to estimate baseline HepB vaccination coverage (≥1 and ≥3 dose coverage) among persons with diabetes prior to the implementation of the new ACIP recommendation and to identify significant correlates of vaccination status from three main categories: demographic characteristics, access to care variables and additional indications for HBV vaccination.

2. Methods

We used the 2009 National Health Interview Survey (NHIS) to estimate the weighted proportion of self-reported ≥1 and ≥3 dose HepB coverage among persons with diabetes ≥19 years. The NHIS is an annual cross-sectional household interview survey of the civilian non-institutionalized U.S. population. The survey is conducted by the Bureau of the Census for the CDC. The objective of the NHIS is to collect information on health behaviors, health indicators, and healthcare utilization and access in the adult non-institutionalized population. Details on the NHIS design and sampling procedures have been previously described [9]. In 2009, the final response rate for the core survey sample of adults was 65.4% [9].

Vaccination coverage was estimated and stratified by three main categories of variables: demographic characteristics (age group, sex, race/ethnicity, poverty level and education level); access to care variables (insurance status, number of physician visits in past year and place of usual healthcare); additional indications for HepB vaccination (persons with kidney disease, persons with chronic liver disease (CLD), healthcare workers, and persons with high-risk behaviors for incident HBV infection). Lastly, we also stratified coverage by whether a person had ever been tested for HIV.

A person with diabetes was defined as a person who responded “yes” to the following question: Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes? Persons who responded that they were borderline diabetic were considered non-diabetic. A person was considered to be vaccinated with ≥1 or ≥3 of HepB if they responded “yes” to the following questions: Have you ever received the hepatitis B vaccine? Did you receive at least 3 doses of the hepatitis B vaccine, or less than 3 doses? A person with CLD was defined as a person who responded “yes” to the following question: Has a doctor or other health professional ever told you that you had any kind of chronic, or long-term liver condition? A person with kidney disease was defined as a person who responded “yes” to the following question: During the past 12 months, have you been told by a doctor or other health professional that you had weak or failing kidneys? Individuals with high-risk behaviors were defined as persons who considered themselves at high risk for HIV infection, or reported having a sexually transmitted disease other than HIV/AIDS during the previous 5 years, or reported *any* one of the following risk factors: male sex with men, injection of street drugs, ever traded sex for money or drugs, HIV positive, ever had sex with someone with any of aforementioned risk factors, and hemophilia with receipt of clotting factor concentrates. Hemophilia is not a risk behavior for transmission of HBV, however, we were unable to exclude this group due to the format of the survey question.

Subjects were divided into 5 year age groups starting at age 40 to age 70. Persons ≥70 years were placed into one group. Persons 19–39 years of age were combined into one group because of the small numbers of persons with diabetes among these ages. All “don’t know,” “refused,” “not ascertained” or missing responses (less than 8% of responses) were excluded from the analysis.

We used STATA, release 11 (College Station, TX: StataCorp LP) statistical software to calculate point estimates and 95% confidence intervals of ≥1 and ≥3 dose HepB coverage. All analyses were weighted to reflect the age, sex, and race/ethnicity of the U.S. non-institutionalized civilian population. The association between vaccination coverage (≥1 and ≥3 dose), both by and within diabetes status, and demographic characteristics, access to care variables and additional indications for HBV vaccination was tested using Wald chi-square tests. A multivariable logistic regression analysis was performed to determine independent predictors of vaccination, among persons with diabetes, and to determine the adjusted vaccination coverage (i.e. predictive margins). All variables from the bivariate analysis were included in the regression model. A separate logistic regression model, which included diabetes status as an independent variable, was conducted to determine if diabetes status was a predictor of vaccination. A two-sided significance level of 0.05 was used for all statistical tests.

3. Results

A total of 25,179 adults aged ≥19 years were included in the study, of which 2511 (9.3% weighted) had known diabetes. Approximately 26% of persons with diabetes were aged ≥70 years, 49% were female, and 65% were white, non-Hispanic. The majority of persons with diabetes were insured (85%), lived at or above the poverty level (86%) and had less than a high school education (44%). Persons with and without diabetes differed among most sociodemographic factors and other characteristics (Table 1).

3.1. HepB vaccination coverage among persons with diabetes

Overall, 19.5% (95% CI: 17.4–21.6%) of all persons with diabetes reported receiving ≥1 dose of HepB and 16.6% (14.7–18.6%) received ≥3 doses compared with 30.3% (29.4–31.3%) and 26.5% (25.5–27.4%) among persons without diabetes (both *P*-values <0.05), Table 2. Of those persons with diabetes who began the HepB series, 85.1% (81.0–89.2%) completed the 3 dose series. Among persons with diabetes 19–59 years of age (for whom HepB was recommended in 2011) 27.0% (23.5–30.5%) and 23.1% (19.8–26.4%) received ≥1 and ≥3 doses, respectively compared with 35.4% (34.2–36.5%) and 30.9% (29.8–32.1%) among persons without diabetes (both *P*-values <0.05). Among persons with diabetes 60 years and older 12.0% (9.9–14.2%) and 10.2% (8.1–12.3%) reported receiving ≥1 and ≥3 doses, respectively, compared with 12.8% (11.7–13.9%) and 10.9% (9.9–11.9%) among persons without diabetes (both *P*-values >0.05). Data not shown.

3.2. Bivariate analysis: characteristics associated with HepB vaccination among persons with diabetes

Persons with diabetes within all age groups had lower ≥1 dose coverage than persons with diabetes aged 19–39 years (all *P*-values <0.05)—the exception was persons aged 40–44 years who had coverage that had overlapping confidence intervals with persons aged 19–39 years. Lower ≥3 dose coverage was seen among persons with diabetes 60–64, 65–70 and ≥70 years compared with persons 19–39 years (all *P*-values <0.05). Among persons with diabetes, there was no significant difference in ≥1 or ≥3 dose coverage by sex, race and ethnicity, poverty level, insurance status, number of physician visits, place of usual

healthcare, kidney disease, or chronic liver disease. Among persons with diabetes, persons with above a high school education, persons ever tested for HIV, persons with high-risk behavior and healthcare providers had higher ≥1 and ≥3 dose coverage compared to persons with diabetes without these characteristics (all *P*-values <0.05) (Table 2). Results of the bivariate analysis by diabetes status are listed in Table 2.

3.3. Multivariate logistic regression: characteristics associated with HepB vaccination among persons with diabetes

Odds of ≥1 dose vaccination decreased as age increased with persons ≥70 years having the lowest odds of vaccination (OR 0.18; 95% CI: 0.10–0.33, persons 19–39 years as referent). Odds of vacci-nation did not differ by sex or race/ethnicity. Among persons with diabetes, being a healthcare provider (OR 4.2, 2.5–7.0), ever having been tested for HIV (OR 2.6, 1.8–3.6), having high-risk behaviors (OR 1.8, 1.0–3.4, *P*-value = 0.053) and having some college education (OR 1.7, 1.2–2.4) were all independently associated with vacci-nation. Having ten or more healthcare visits in the previous year was also predictive of vaccination among persons with diabetes. Poverty level, insurance status, place of usual healthcare, chronic liver disease and kidney disease were not associated with vacci-nation. The same trends were seen in the multivariable analysis of ≥3 dose coverage except that high risk behavior and having ten or more healthcare visits were not associated with series completion (Table 3). When diabetes status was included as an independent variable within the logistic regression model, diabetes status was not associated with ≥1 or ≥3 dose vaccination. Data not shown.

4. Discussion

We used a national database to determine baseline hepatitis B vaccination coverage among persons with diabetes, prior to implementing a new ACIP recommendation for HepB vaccination for persons with diabetes 19–59 years of age and consideration for vaccination of persons with diabetes aged ≥60 years. HepB coverage was low among adults with diabetes aged 19–59 years at approximately 27% and 23% for ≥1 and ≥3 doses, respectively. Twelve percent and 10% of persons with diabetes aged 60 years and older reported receiving ≥1 and ≥3 doses, respectively. Although unadjusted vaccination coverage was higher among person without diabetes, within the aforementioned age groups, diabetes status was not associated with ≥1 or ≥3 dose HepB vaccination.

Unadjusted coverage was higher among persons without diabetes within several sociodemographic and other categories. This disparity was likely due to differences in the age distribution between the two groups; the diabetic sample had larger numbers of older persons and older age was associated with decreased coverage. Higher coverage among younger adults likely reflects the aging of children who were vaccinated under childhood HepB vaccination recommendations.

We found some predictors of vaccination (e.g. high-risk behavior, education, ever tested for HIV) to be consistent with other studies [10]. Persons with diabetes and high-risk behaviors and those ever tested for HIV were more likely to be vaccinated. This is likely because providers consider these groups to be high risk for incident infection and target them for

vaccination. In addition, persons with high-risk behavior were recommended for vaccination as early as 1982 [16]. Being a healthcare worker was also predictive of vaccination; healthcare occupation is another group with a longstanding recommendation for vaccination [11]. Even with previous vaccination recommendations coverage among these groups was low.

Although low HepB coverage among persons with diabetes was to be expected prior to the new ACIP recommendation, coverage was also low among some groups with diabetes who fell under previous ACIP recommendations for vaccination of persons with chronic kidney or liver disease, high-risk behavior and for health-care providers. While high-risk behavior and being a healthcare provider were both predictors of vaccination, kidney and chronic liver disease were not associated with vaccination. Failure to target persons with kidney and chronic liver disease for vaccination may have contributed to low coverage among persons with diabetes; 40% of all persons with diabetes have some stage of chronic kidney disease [12] and an estimated 40–70% have non-alcoholic liver steatosis, a condition which can lead to liver fibrosis, cirrhosis and liver cancer [13]. The new recommendation prompts providers to vaccinate persons with diabetes early in their diagnosis which may be prior to development of chronic kidney disease (when sero-protection rates from HepB vaccination decline dramatically) or chronic liver disease.

While baseline HepB coverage among persons with diabetes is low, there are existing platforms for providing vaccinations for this population. Persons with diabetes are recommended for influenza and pneumococcal vaccines. Influenza and pneumococcal coverage, among persons with diabetes, is twice as high as among persons without diabetes (57% and 46% among persons with diabetes compared with 33% and 19% among persons without diabetes for influenza and pneumococcal vaccination coverage, respectively) (CDC unpublished data, 2009). While both estimates are below the Healthy People 2010 goals for vaccination of persons with diabetes, they demonstrate that there is an existing platform for vaccination of persons with diabetes which can be used for hepatitis B vaccination.

Our data showed that over 70% of persons with diabetes were seen by a healthcare provider four or more times in the previous year. There are, therefore, multiple opportunities to vaccinate persons with diabetes. In addition, since there is no apparent effect on the immunogenicity of the 3 dose hepatitis B vaccination series, when the spacing of the series is longer than the recommended intervals the hepatitis B vaccination schedule can be accommodated by intermittent healthcare visits. When the HepB series is interrupted it does not need to be restarted although minimum spacing (minimum of 4 weeks between the first and second dose, 8 weeks between the second and third dose and a minimum of 16 weeks between the first and third dose) between doses is required [14]. In addition to traditional vaccination settings such as primary care offices, complimentary vaccination venues such as pharmacies may be used to vaccinate persons with diabetes. The Guide to Community Preventive Services recommends using standing orders for vaccination and reminder-recall systems to increase vaccination [15]. These systems should work particularly well with diabetic populations who have frequent contact with the healthcare system.

The findings of this study are subject to limitations. Data for this study were collected by self report; vaccination status and health outcomes (e.g. kidney and CLD) were not verified by medical records. Although we are not aware of validity studies of self-report vaccination among persons with diabetes, one study showed that the sensitivity and specificity of self-reported diabetes was 66% and 97%, respectively [16]. We, therefore, were likely to have underestimated the number of persons with diabetes. NHIS excluded all institutionalized persons (including persons in long-term care facilities) for whom both the risk for HBV infection and vaccination coverage might differ from among the rest of the population. Also, the survey question for kidney disease did not distinguish the stage of disease; reported cases could have been mild or transient, in which case, they would not fall under the previous vaccination recommendations.

In 2009, prior to enactment of the 2011 ACIP recommendation for hepatitis B vaccination of persons with diabetes 19–59 years of age and consideration of vaccination for persons with diabetes aged ≥60 years, hepatitis B vaccination coverage among persons with diabetes was low. HepB coverage among adults with diabetes aged 19–59 years was 27% and 23% for ≥1 and ≥3 doses, respectively. Twelve percent and 10% of persons with diabetes aged 60 years and older reported receiving ≥1 and ≥3 doses, respectively. There are multiple opportunities and existing platforms for vaccinating persons with diabetes. These data can be used to measure progress toward hepatitis B vaccination of persons with diabetes as the new ACIP recommendation is implemented.

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Table 1

Sample characteristics of adults ≥19 years by diabetes status, demographics and access-to-care variables, National Health Interview Survey, 2009.

Characteristic	All adults		Persons with diabetes		Persons without diabetes	
	Sample (*n*)	Weighted %	Sample (*n*)	Weighted %	Sample (*n*)	Weighted %
Total	25,179	100	2511	9.3	22,668	90.7
Age (years)						
19–39	8841	37.0	206	8.7	8635	39.9[a]
40–44	2284	9.4	137	7.1	2147	9.6[a]
45–49	2423	10.3	192	9.0	2231	10.4
50–54	2403	10.0	283	12.6	2120	9.7[a]
55–59	2137	8.5	307	12.6	1830	8.1[a]
60–64	1931	7.5	339	13.9	1592	6.9[a]
65–69	1536	5.2	314	10.5	1222	4.7[a]
≥70	3624	12.1	733	25.6	2891	10.7[a]
Sex						
Male	11,059	48.0	1122	51.1	9937	47.7[a]
Female	14,120	52.0	1389	48.9	12,731	52.3[a]
Race/ethnicity						
White, non-Hispanic	14,843	69.1	1333	65.0	13,510	69.5[a]
Black, non-Hispanic	3965	11.5	559	15.5	3406	11.0[a]
Other, non-Hispanic[b]	1795	6.0	150	5.7	1645	6.1
Hispanic	4530	13.4	464	13.8	4066	13.4
Education						
High school or less	11,032	42.1	1429	55.9	9603	40.6[a]
Some college and above	14,035	57.9	1067	44.1	12,968	59.4[a]
Poverty level						
Below	3843	12.9	447	14.4	3396	12.8

Characteristic	All adults		Persons with diabetes		Persons without diabetes	
	Sample (*n*)	Weighted %	Sample (*n*)	Weighted %	Sample (*n*)	Weighted %
At or above	18,472	87.1	1746	85.6	16,726	87.2
Insured						
No	4543	17.5	228	9.7	4315	18.3[a]
Yes	20,586	82.5	2280	90.3	18,306	81.7[a]
Number of physician visits[c]						
None	4757	18.9	116	4.9	4641	20.3[a]
1	4056	16.4	161	6.1	3895	17.4[a]
2–3	6324	26.1	431	17.3	5893	30.0[a]
4–9	6285	24.4	103S	41.3	5250	22.7[a]
≥10	3664	14.2	752	30.5	2912	12.6[a]
Usual place of care						
None	3151	12.7	85	4.3	3066	13.6[a]
Clinic or health center	4787	17.8	506	18.5	4281	17.8
Doctor’s office or HMO[d]	16,294	66.5	1826	73.7	14,468	65.8[a]
Some other place[e]	833	2.9	93	3.5	740	2.8
Ever tested HIV						
No	14,343	60.4	1599	67.7	12,744	59.7[a]
Yes	10,274	39.6	831	32.3	9443	40.3[a]
Indicated for HepB[f]						
Has kidney disease	558	2.0	202	7.6	356	1.4[a]
Has chronic liver disease	320	1.2	66	2.4	254	1.0[a]
Has high-risk behavior[g]	1366	5.1	101	3.8	1265	5.2[a]
Is a healthcare provider	2137	8.4	167	5.6	1970	8.8[a]
Not indicated for HepB						

Characteristic	All adults		Persons with diabetes		Persons without diabetes	
	Sample (*n*)	Weighted %	Sample (*n*)	Weighted %	Sample (*n*)	Weighted %
No kidney disease	24,612	98.0	2309	92.4	22,303	98.6[a]
No chronic liver disease	24,828	98.8	2444	97.6	22,384	99.0[a]
No high-risk behavior[g]	23,813	94.9	2410	96.2	21,403	94.8[a]
Is not a healthcare provider	23,015	91.6	2344	94.4	20,671	91.3[a]

[a]Wald chi-square *P*-value for difference between persons with and without diabetes of <0.05.

[b]"Other" includes American Indian/Alaska Native, Asian and multiracial persons.

[c]Includes visits to non-physician healthcare providers.

[d]Health Maintenance Organization.

[e]Includes responses of "some other place" and hospital ER and hospital outpatient departments.

[f]HepB indicates hepatitis B vaccine.

[g]High-risk behaviors includes persons who considered themselves at high risk for HIV infection, persons who reported having a sexually transmitted disease other then HIV/AIDS during the previous 5 years, and persons who reported any one of the following risk factors: hemophilia with receipt of clotting factor concentrates, men who have sex with men, injecting street drugs, trading sex for money or drugs, testing positive for HIV, or having sex with someone with any of these risk factors. Percentages were rounded to the nearest one-tenth decimal place.

Table 2

Proportion of adults with diabetes aged ≥19 years who received ≥1 and ≥3 doses of hepatitis B vaccine by, demographics and access-to-care variables, National Health Interview Survey, 2009.

Characteristic	≥1 dose HepB coverage				≥3 dose HepB coverage			
	Diabetes		Non-diabetes		Diabetes		Non-diabetes	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Total	19.5	17.4–21.6	30.3	29.4–31.3[b]	16.6	14.7–18.6	26.5	25.5–27.4[b]
Age (years)								
19–39[C]	38.5	29.9–47.1	44.9	43.3–46.6[b]	29.7	22.2–37.2	39.6	37.9–41.3[b]
40–44	27.9	18.5–37.2	31.5	28.9–34.1[a]	23.2	14.8–31.7	27.7	25.1–30.2[a]
45–49	23.0	15.9–30.2[a]	26.1	23.6–28.5[a]	20.3	13.3–27.2	22.2	19.8–24.5[a]
50–54	26.3	18.5–34.2[a]	22.2	20.0–24.2[a]	22.4	14.9–29.9	19.4	17.4–21.4[a]
55–59	22.2	17.0–27.4[a]	20.6	18.1–23.0[a]	21.0	15.9–26.2	17.0	14.7–19.2[a]
60–64	18.9	13.8–24.0[a]	19.2	16.7–21.7[a]	16.8	11.8–21.7[a]	16.6	14.2–19.0[a]
65–69	12.2	7.2–17.2[a]	17.3	14.5–20.0[a]	10.4	5.6–15.2[a]	15.1	12.6–17.7[a]
≥70	8.3	5.7–10.8[a]	6.7	5.6–7.7[a]	6.5	4.2–8.8[a]	5.4	4.4–6.3[a]
Sex								
Male	18.1	14.7–21.5	26.3	25.1–27.5[b]	14.9	11.8–18.0	22.8	21.6–24.0[b]
Female	21.0	18.3–23.7	34.0	32.7–35.3[a,b]	18.4	15.8–21.0	29.8	28.5–31.0[a,b]
Race/ethnicity								
White, non-Hispanic[c]	19.1	16.5–21.8	29.9	28.8–31.0[b]	16.8	14.3–19.3	26.3	25.1–27.4[b]
Black, non-Hispanic	21.1	16.7–25.5	33.9	31.4–36.5[a,b]	17.3	13.1–21.5	29.9	27.5–32.3[a,b]
Other, non-Hispanic[d]	23.6	15.8–31.5	36.1	32.8–39.3[a,b]	19.3	12.4–26.3	31.2	28.1–34.3[a,b]
Hispanic	19.9	13.0–22.9	27.0	24.8–29.2[a,b]	14.1	10.0–18.2	22.4	20.2–24.7[a,b]
Education								
High school or less	14.2	11.9–16.5	20.7	19.5–21.8[b]	11.9	9.8–14.1	17.4	16.3–18.5[b]

Characteristic	≥1 dose HepB coverage				≥3 dose HepB coverage			
	Diabetes		Non-diabetes		Diabetes		Non-diabetes	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Some college and above	26.4	22.8–30.0[a]	37.0	35.7–38.3[a,b]	22.7	19.4–26.0[a]	32.7	31.4–34.0[a,b]
Poverty level								
Below	20.3	14.9–25.7	32.8	30.2–35.3[b]	15.4	10.7–20.0	28.8	26.4–31.l[b]
At or above	20.5	17.9–23.0	30.9	30.0–32.0[b]	17.7	15.3–20.2	27.1	26.0–28.l[b]
Insured								
No	19.4	12.8–25.9	29.5	27.4–31.6[b]	15.5	9.9–21.1	25.0	23.0–27.0[b]
Yes	19.5	17.3–21.8	30.5	29.5–31.5[b]	16.7	14.6–18.9	26.8	25.8–27.8[b]
Number of physician visits[e]								
None[c]	16.7	5.1–28.3	25.4	23.7–27.1	14.5	4.3–24.7	21.6	19.9–23.2
1	17.8	11.0–24.6	31.3	29.3–33.3[a,b]	14.2	7.5–20.9	27.1	25.2–29.0[a,b]
2–3	16.8	12.2–21.5	31.7	30.0–33.4[a,b]	15.1	10.5–19.6	27.7	26.0–29.3[a,b]
4–9	18.2	15.2–21.2	32.0	30.2–33.7[a,b]	15.7	12.8–18.6	28.1	26.4–29.8[a,b]
≥10	23.9	19.9–27.9	31.5	29.2–33.8[a,b]	19.7	15.9–23.6	28.3	26.0–30.6[a,b]
Usual place of care								
None[c]	26.7	12.2–41.3	27.5	25.3–29.8	22.5	9.5–35.6	23.0	20.7–25.3
Clinic or health center	16.0	12.7–20.9	34.9	32.7–37.1[a,b]	13.6	9.8–17.4	30.6	28.3–32.9[a,b]
Doctor’s office or HMO[f]	19.8	17.2–22.4	29.6	28.5–30.7[b]	17.0	14.6–19.3	26.0	24.9–27.1[a,b]
Some other place[g]	18.6	9.3–27.9	31.7	27.0–36.4[b]	18.0	8.8–27.3	28.2	23.6–32.7[a,b]
Ever tested HIV								
No	12.0	9.6–14.4	22.8	21.7–24.0[b]	10.4	8.2–12.6	19.6	18.5–20.7[b]
Yes	35.9	31.4–40.4[a]	41.8	40.3–43.2[a,b]	30.1	25.9–34.3[a]	36.9	35.4–38.2[a,b]
Kidney disease								
No	19.2	17.1–21.3	30.4	29.5–31.5[b]	16.4	14.5–18.4	26.6	25.6–27.6[b]

Characteristic	≥1 dose HepB coverage				≥3 dose HepB coverage			
	Diabetes		Non-diabetes		Diabetes		Non-diabetes	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Yes	24.1	16.1−32.1	19.7	14.6−24.8[a]	19.1	11.7−26.5	17.4	12.6−22.2[a]
Chronic liver disease								
No	19.2	17.2−21.4	30.2	29.2−31.2[b]	16.5	14.5−18.5	26.4	25.5−27.4[b]
Yes	31.1	16.8−45.5	41.6	33.0−50.2[a]	23.8	11.1−36.5	31.3	23.5−39.0
High-risk behavior[h]								
No	18.6	16.5−20.7	29.6	28.6−30.1[b]	16.2	14.2−18.1	25.8	24.8−26.8[b]
Yes	42.9	30.9−55.0[a]	44.1	40.4−47.8[a]	28.3	18.6−38.1[a]	38.9	35.3−42.5[a,b]
Healthcare provider								
No	17.4	15.3−19.6	26.7	25.8−27.7[b]	14.6	12.6−16.6	23.1	22.2−24.0[b]
Yes	55.5	45.6−65.3[a]	68.4	65.5−71.4[a,b]	50.7	40.8−60.7[a]	61.9	58.9−64.8[a,b]

[a] Wald chi-square test *P*-value < 0.05, for comparison for each level of characteristic within diabetes status.

[b] Wald chi-square test *P*-value < 0.05, for comparison of persons with and without diabetes for each level of characteristic

[c] Referent.

[d] "Other" includes American Indian/Alaska Native, Asian and multiracial persons.

[e] Includes visits to non-physician healthcare providers.

[f] Health Maintenance Organization.

[g] Includes responses of "some other place" and hospital ER and hospital outpatient departments.

[h] High-risk behaviors includes persons who considered themselves at high risk for HIV infection, persons who reported having a sexually transmitted disease other then HIV/AIDS during the previous 5 years, and persons who reported any one of the following risk factors: hemophilia with receipt of clotting factor concentrates, men who have sex with men, injecting street drugs, trading sex for money or drugs, testing positive for HIV, or having sex with someone with any of these risk factors.

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Table 3

Multivariable logistic regression and adjusted hepatitis B vaccination coverage (≥1 dose and ≥3 dose) among persons with diabetes aged ≥19 years, by characteristic, National Health Interview Survey, 2009.

	≥1 dose				≥3 dose			
	Adjusted coverage		Adjusted odds ratio		Adjusted coverage		Adjusted odds ratio	
	%	(95% CI)	aOR	*P*- value	%	(95% CI)	aOR	*P*- value
Age (years)								
19–39	34.5	26.5−42.6	Referent	-	26.2	18.4−34.0	Referent	
40–44	28.1	19.8−36.4	0.71	0.267	23.6	15.8−31.4	0.85	0.616
45–49	21.7	15.2−28.2	0.48	0.015	19.4	12.9−25.8	0.65	0.168
50–54	23.9	15.6−32.3	0.56	0.050	20.1	11.7−28.6	0.68	0.227
55–59	244	18.9−30.0	0.57	0.032	23.2	17.6−28.8	0.83	0.525
60–64	18.4	13.3−23.4	0.38	0.001	15.8	10.9−20.7	0.49	0.027
65–69	14.7	9.1−20.2	0.28	0.000	13.0	7.4−18.7	0.38	0.012
≥70	10.3;	6.7−13.9	0.18	0.000	8.0	4.7−11.4	0.21	0.000
Sex								
Male	20.2	16.8−23.4	Referent		16.5	13.1−19.8	Referent	
Female	22.3	18.5−24.0	1.08	0.638	18.8	16.1−21.5	1.20	0.316
Race and ethnicity								
White, non-Hispanic	21.6	18.8−24.4	Referent		18.8	16.0−21.5	Referent	
Black, non-Hispanic	19.0	14.5−23.5	0.82	0.371	15.2	11.0−19.5	0.75	0.216
Other, non-Hispanic[a]	22.8	14.4−31.2	1.08	0.784	19.4	10.7−27.1	1.05	0.880
Hispanic	17.9	13.8−21.9	0.75	0.142	14.5	10.6−18.5	0.70	0.089
Education								
High school or less	17.1	14.3−20.0	Referent		14.6	11.8−17.4	Referent	
Some college and above	24.5	21.1−27.8	1.69	0.002	20.7	17.4−24.0	1.62	0.008
Poverty level								
Below	18.4	14.0−22.8	Referent		14.5	10.2−18.8	Referent	
At or above	2.1,1	18.9−23.4	1.23	0.283	18.2	15.8−20.5	1.37	0.152
Insured								
No	16.6	10.6−22.6	Referent		13.1	7.7−18.6	Referent	

	≥1 dose				≥3 dose			
	Adjusted coverage		Adjusted odds ratio		Adjusted coverage		Adjusted odds ratio	
	%	(95% CI)	aOR	*P*- value	%	(95% CI)	aOR	*P*- value
Yes	21.3	18.9−23.7	1.45	0.214	18.2	15.8−20.7	1.57	0.158
Number of physician visits[b]								
None	11.9	3.6−20.1	Referent		10.5	2.6−18.5	Referent	
1	19.5	12.6−26.5	2.00	0.195	15.7	8.4−22.9	1.68	0.366
2–3	19.6	14.4−24.9	2.02	0.167	17.3	12.1−22.5	1.93	0.216
4–9		16.0−22.6	1.97	0.162	16.5	13.3−19.7	1.81	0.239
≥10	25.3	21.2−29.3	2.99	0.027	21.1	17.0−25.2	2.58	0.068
Place of usual healthcare								
None	28.4	13.5−43.3	Referent		26.6	11.7−41.4	Referent	
Clinic or health center	19.6	15.8−23.4	0.55	0.205	16.2	12.4−20.0	0.48	0.121
Doctor’s office or HMO[C]	20.7	18.2−21.2	0.60	0.275	17.4	15.0−19.8	0.53	0.176
Some other place[d]	16.0	7.1−24.9	0.41	0.139	16.3	6.7−26.0	0.48	0.236
Ever tested HIV								
No	15.3	12.4−18.3	Referent		12.8	9.9−15.8	Referent	
Yes	29.4	25.5−33.3	2.56	0.000	25.3	21.4−29.3	2.52	0.000
Kidney disease								
No	20.3	18.3−22.4	Referent		17.4	15.4−19.4	Referent	
Yes	25.7	16.6−34.8	1.45	0.214	19.9	10.4−29.4	1.21	0.583
Chronic liver disease								
No.	20.7	18.7−22.8	Referent		17.7	15.6−19.8	Referent	
Yes	20.1	9.7−30.5	0.95	0.905	14.6	6.6−22.5	0.76	0.483
High-risk behavior[e]								
No	20.2	18.1−22.4	Referent		17.5	15.3−19.7	Referent	
Yes	29.5	19.4−39.6	1.83	0.053	18.9	11.1−26.8	1.12	0.724
Healthcare provider								
No	19.0	16.8−21.2	Referent		16.0	13.8−18.2	Referent	
Yes	44.2	34.3−54.2	4.21	0.000	38.7	28.8−48.6	3.94	0.000

[a] “Other” includes American Indian/Alaska Native, Asian and multiracial persons.

[b] Includes visits to non-physician healthcare providers.

[c] Health Maintenance Organization.

[d] Includes responses of “some other place” and hospital ER and hospital outpatient departments.

[e] High-risk behaviors includes persons who considered themselves at high risk for HIV infection, persons who reported having a sexually transmitted disease other then HIV/AIDS during the previous 5 years, and persons who reported any one of the following risk factors: hemophilia with receipt of clotting factor concentrates, men who have sex with men, injecting street drugs, trading sex for money or drugs, testing positive for HIV, or having sex with someone with any of these risk factors.