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Ann Epidemiol. Author manuscript; available in PMC 2014 December 11.

Published in final edited form as:
Ann Epidemiol. 2014 June ; 24(6): 418–423. doi:10.1016/j.annepidem.2014.02.013.

Prevalence of Diagnosed Chronic Hepatitis B Infection Among U.S. Medicaid Enrollees, 2000 – 2007

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Abstract

Purpose—Few population-based studies have estimated the number of persons diagnosed with chronic hepatitis B (CHB) infection in the United States. Our objective was to estimate the prevalence of diagnosed CHB infection among persons enrolled in the U.S. Medicaid programs of

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These results were presented at the 29th International Conference on Pharmacoepidemiology and Therapeutic Risk Management in Montreal, Canada, August 25–28, 2013.

Disclosures:
Dana D. Byrne, MD: No disclosures to report.
Craig W. Newcomb, MS: No disclosures to report.
Dena M. Carbonari, MS: No disclosures to report.
Melissa S. Nezamzadeh, BA: No disclosures to report.
Kimberly B. F. Leidl, MPH: No disclosures to report.
Maximilian Herlim, MS: No disclosures to report.
Yu-Xiao Yang, MD, MSCE: No disclosures to report.
Sean Hennessy, PharmD, PhD: Dr. Hennessy has been supported by research funding provided to Penn from AstraZeneca, Bristol-Myers Squibb, and Gilead Sciences, Inc. and has served as a consultant to AstraZeneca and Bristol-Myers Squibb.
Jay R. Kostman, MD: Dr. Kostman has served as a consultant to Merck and Vertex.
Mary B. Leonard, MD, MSCE: No disclosures to report.
A. Russell Localio, PhD, JD, MPH: No disclosures to report.
Vincent Lo Re III, MD, MSCE: Dr. Lo Re has received research grant support (to Penn) from AstraZeneca, Bristol-Myers Squibb, Gilead Sciences, Inc., and Merck.

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California, Florida, New York, Ohio, and Pennsylvania between 2000 and 2007. As part of our analyses, we confirmed the accuracy of CHB diagnoses within the Medicaid database.

Methods—CHB infection was defined by the presence of two outpatient CHB diagnoses recorded more than 6 months apart. Two clinicians reviewed the medical records of a random sample of patients who met this definition to confirm the diagnosis, which enabled calculation of the positive predictive value (PPV). The period prevalence of diagnosed CHB infection among Medicaid enrollees with at least 6 months of membership from 2000–2007 was then estimated, adjusting for both the PPV and estimated sensitivity of our definition of CHB infection.

Results—The definition of CHB infection accurately identified clinician-confirmed cases (PPV, 96.3%; 95% confidence interval [CI], 87.3–99.5). Using this definition, 31,046 cases of CHB were diagnosed among 31,358,010 eligible Medicaid members from the five states (prevalence, 9.9 [95% CI, 9.8–10.0] per 10,000). Adjusting for the PPV and estimated sensitivity of our CHB definition, the prevalence of diagnosed CHB infection was 15.6 (95% CI, 15.4–15.7) per 10,000.

Conclusions—Two outpatient CHB diagnoses recorded more than 6 months apart validly identified clinician-confirmed CHB. The prevalence of diagnosed CHB infection among U.S. Medicaid enrollees was 15.6 per 10,000.

Keywords

Hepatitis B; viral hepatitis; prevalence

INTRODUCTION

Chronic hepatitis B (CHB) infection is a major global health problem, and the World Health Organization estimates that 240 million persons are affected worldwide (3.7% of the world population) [1]. After bloodborne or sexual transmission [2], progression from acute infection to CHB, defined as persistence of hepatitis B surface antigenemia for more than 6 months, is heavily influenced by the age at which infection is acquired [3, 4]. CHB develops in 90% of perinatally-acquired infections [5], in 20% to 50% of infections acquired between the age of one and five years [6, 7], and in less than 5% of adolescent- and adult-acquired infections [8]. Approximately 15–25% of CHB-infected persons will develop liver-related complications during their lifetime, which can include hepatocellular carcinoma and hepatic decompensation [3, 4].

In the United States (U.S.), the true prevalence of CHB infection remains unknown because screening for CHB is not part of routine care and because CHB serologic surveys have often excluded high-risk groups [9–11]. Published estimates of the prevalence of CHB infection in the U.S. have ranged from 55,000 to 2.2 million [9–13]. However, few population-based epidemiologic analyses have estimated the number of persons diagnosed with CHB. The Institute of Medicine recently highlighted the lack of data on screening for CHB and noted that resources being allocated for CHB surveillance, prevention, and control remain inadequate [14]. Studies that estimate the prevalence of diagnosed CHB infection can provide important information for the creation of a CHB “cascade of care,” which reports estimates of CHB infection, diagnosis, retention in care, antiviral therapy, and achievement of viral suppression. These data can help identify key gaps in the delivery of care across the

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entire continuum of CHB care that are important for the development of programs for earlier diagnosis, linkage to care, and management of infection.

The objective of this study was to estimate the prevalence of diagnosed CHB infection among patients enrolled in the U.S. Medicaid programs of California, Florida, New York, Ohio, and Pennsylvania. As part of this work, we confirmed the accuracy of CHB diagnoses within the Medicaid database.

METHODS

Study Design and Data Source

We conducted a cross-sectional study within the Medicaid populations of California, Florida, New York, Ohio, and Pennsylvania between January 1, 2000 and December 31, 2007. The Medicaid program consists of state-run programs with joint federal and state funding for hospital, medical, and outpatient care, and drug benefits for low-income and special-needs individuals [15]. The states included in this study were selected because they represent five of the largest Medicaid programs in the U.S., comprising approximately 22 million active enrollees, or almost 40% of the U.S. Medicaid population [16, 17]. Medicaid claims report demographic information, inpatient and outpatient medical diagnoses (recorded using International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] diagnosis codes), procedures (recorded with Current Procedural Terminology [CPT] codes), and dispensed medications (recorded by National Drug Codes). CPT codes for ordered laboratory tests can be identified, but the results of these tests are not recorded in the Medicaid database. Since 17% of Medicaid beneficiaries are co-enrolled in the U.S. Medicare program, we obtained Medicare data on dually-eligible persons [18]. Prior analyses of the linked Medicaid and Medicare claims indicate that the data are of high quality [19]. The study was approved by the University of Pennsylvania Institutional Review Board, and a data use agreement was obtained from the Centers for Medicare and Medicaid Services.

Study Patients

Patients with at least 6 months (180 days) of Medicaid enrollment were identified as having CHB infection if they had two outpatient CHB diagnoses recorded more than 6 months apart. We focused on outpatient diagnoses because CHB is primarily managed in the outpatient setting. The rationale for requiring a definition consisting of two CHB diagnoses recorded more than 6 months apart was because a clinical diagnosis of CHB requires evidence of persistence of infection for more than 6 months [3]. The following ICD-9-CM diagnosis codes were used to identify patients with CHB: 070.22 (chronic hepatitis B with coma), 070.23 (chronic hepatitis B + D with coma), 070.32 (chronic hepatitis B without coma), 070.33 (chronic hepatitis B + hepatitis D without coma), or V02.61 (hepatitis B carrier).

Medicaid Data Analyzed

From eligible patients who met our definition of CHB infection, we collected the following variables from the Medicaid database: age at initial diagnosis date; sex; race/ethnicity; U.S.

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state; diagnoses of select comorbidities; claims for hepatitis B-related laboratory tests (i.e., hepatitis B surface antigen [HBsAg; CPT 87340], hepatitis B e antigen [HBeAg; CPT 87350], hepatitis B DNA [CPT 87515, 87516, 87517]); and antiviral medications used to treat CHB (i.e., adefovir, emtricitabine, entecavir, interferon, lamivudine, telbivudine, or tenofovir). Diagnoses of comorbidities were determined by an outpatient or hospital-associated ICD-9-CM diagnosis recorded in the database (Appendix 1). Hepatic decompensation was defined by diagnoses of ascites, spontaneous bacterial peritonitis, variceal hemorrhage, or hepatic encephalopathy [20].

Statistical Analysis

Positive Predictive Value of CHB Definition—We determined the positive predictive value (PPV) of our CHB definition (i.e., any two outpatient CHB diagnoses recorded more than 6 months apart) compared to clinician-confirmed diagnosis. Our focus was on PPV because a high PPV provides confidence that identified diagnoses represent true cases of CHB infection. To conduct this analysis, we identified patients who met the CHB definition between January 1, 2005 and December 31, 2007 and selected a random sample of these patients. The rationale for sampling patients from the last three years of the data was to increase the likelihood of retrieving records. We restricted our sample to patients who had diagnoses recorded from outpatient hospital practices to further increase the chance of obtaining records, since such practices might be less likely to close or change addresses over time. We targeted 120 patients to allow determination of the PPV within a narrow 95% confidence interval (CI) width of ±8%, assuming a PPV of 80%. Prior studies suggested that 20% of hospital records requested for Medicaid enrollees from the five states in this study could not be retrieved [21, 22]. Since retrieval of outpatient charts might be more challenging due to variability in the records systems used by outpatient practices, we estimated that records might not be obtainable for 40% of the patients. We therefore inflated our target sample size by approximately 40% and selected a sample of 206 patients.

We requested the outpatient records of these 206 patients from the dates on which the two CHB diagnoses were recorded. If more than two outpatient diagnoses were recorded for a patient during the 2005–2007 time period, we requested records from the first and last diagnosis dates to allow for the widest possible time to capture clinical information. In collaboration with a subcontractor (Information Collection Enterprises, LLC [ICE]), we contacted outpatient practices via mail to request medical records to be used for research purposes. Practices sent photocopies of the records to ICE, which hand-redacted direct personal identifiers, scanned the redacted records, and provided them to the study team on electronic storage media. ICE re-contacted non-responding practices via mail and/or telephone to re-request records, provide copies of the regulatory approval and data use agreement (when requested), and ascertain reasons for non-shipment of records.

A single trained abstractor (M.S.N.) reviewed the records and recorded data relevant to the diagnosis of CHB onto structured forms in a Research Electronic Data Capture (REDCap) database [23]. The forms collected information from primary care physician progress notes and gastroenterologist consultations (CHB diagnoses), medication lists (antiviral drugs used to treat CHB), and laboratory results (alanine aminotransferase, aspartate aminotransferase,

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total bilirubin, HBsAg, HBeAg, and HBV DNA). Additionally, scanned copies of redacted chart information were included with the forms.

After abstraction, these forms were independently reviewed by a gastroenterologist (Y.X.Y.) and infectious diseases specialist (V.L.R.) with expertise in CHB. Each classified cases as: 1) definite, 2) possible, 3) no infection, or 4) unable to determine. Since the diagnosis of CHB is based upon the persistence of infection for more than 6 months [3], a definite diagnosis of CHB was confirmed by either: 1) the presence of any two of the following laboratory results recorded >6 months apart: positive HBsAg, positive HBeAg, or quantifiable hepatitis B DNA level, or 2) receipt of antiviral therapy for CHB. A single positive HBsAg, HBeAg, or hepatitis B DNA or a report of CHB in the assessment or plan of a physician's note or an abdominal imaging report without confirmatory laboratory data constituted a possible diagnosis of CHB. Disagreement between the specialists resulted in review by a third arbitrator (D.D.B.) to adjudicate the case.

We constructed contingency tables comparing the diagnosis of CHB identified by our definition with actual presence or absence of definite or possible infection. The PPV was determined as a point estimate with 95% CI. We adjusted our PPV by estimating the probability of a chart being obtained given patient characteristics (i.e., age at initial diagnosis, race/ethnicity, and state). Because this analysis produced a higher PPV, we used the more conservative, raw PPV estimate in subsequent prevalence calculations. Since our analysis only included subjects with CHB diagnoses, we could not calculate sensitivity, specificity, negative predictive value, or the kappa statistic of our CHB definition.

Estimates of Prevalence of CHB Diagnosis—The period prevalence of diagnosed CHB within Medicaid was estimated by dividing the number of prevalent cases who met our validated definition between January 1, 2000 and December 31, 2007 by the total number of patients with at least 6 months of Medicaid enrollment during this period. We estimated the raw prevalence of CHB diagnosis overall and by sex, age group, and race/ethnicity. We then adjusted the raw prevalence of diagnosed CHB for our observed PPV.

Further, because of the well-known problem that not all clinicians will document a diagnosis of all relevant patient conditions over repeated visits, we estimated the sensitivity of our validated CHB definition using data on patients with and without CHB diagnoses. We utilized duration of eligibility and patterns of recorded CHB diagnoses over time to arrive at an approximate probability of declaring a patient to be CHB-infected according to our definition. We also arrived at an estimate of this probability using simulations based on the same data. Details appear in Appendix 2. We could then estimate the prevalence of diagnosed CHB infection based on the prevalence of the observed CHB diagnosis in our sample and the estimated sensitivity of that definition as applied to observed diagnoses.

We conducted additional analyses where we estimated the prevalence of CHB diagnosis among Medicaid enrollees with: 1) 6 months (180 days) of enrollment and either two outpatient CHB diagnoses or one outpatient plus one inpatient CHB diagnosis recorded >6 months apart, 2) 6 months of enrollment and at least one CHB diagnosis, 3) one year (365 days) of enrollment and two outpatient chronic HBV diagnoses recorded >6 months apart, 4)

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one year of enrollment and either two outpatient CHB diagnoses or one outpatient plus one inpatient CHB diagnosis recorded >6 months apart, and 5) one year of enrollment and at least one CHB diagnosis.

Characteristics of Patients with Diagnosed CHB Infection in the Medicaid Sample—The characteristics of patients diagnosed with CHB infection were described using proportions for categorical data and means with standard deviations for continuous variables. Data were analyzed using SAS 9.2 (SAS Institute Inc., Cary, NC).

RESULTS

Positive Predictive Value of CHB Definition

Of the 206 randomly sampled patients for whom we requested two outpatient medical records, 150 (72.8%) patients had unavailable records or no relevant chart information available from both outpatient visits identified by our definition, and 20 (9.7%) additional patients had only one of the records from the two visits available, totaling 320/412 (77.7%) irretrievable or insufficient records. The lack of medical record retrieval was attributed to: no response received from provider (140/412 [34.0%] records), concern regarding patient privacy (93/412 [22.6%] records), and inability to retrieve appropriate records (87/412 [21.1%] records). Thus, 92/412 (22.3%) records were available for abstraction from 56 (27.2%) patients (36 patients had both outpatient records available; 20 had only one outpatient record available). Patients whose charts were retrieved were older, less likely to be cared for in New York, more commonly black, and less frequently Hispanic compared to those whose records were not obtained (data not shown).

After case adjudication, CHB infection was unable to be determined for 2 patients. Among those patients with an adjudicator determination of CHB infection, 52 of the 54 patients were confirmed to have CHB infection (18 definite; 34 possible), corresponding to a PPV of 96.3% (95% CI, 87.3–99.5%). The two patients adjudicated as not having confirmed CHB infection were found to have chronic hepatitis C virus infection with no evidence of CHB. The weighted PPV based on the probability of a record being found was 98.9% (95% CI, 91.4–100.0%). The overall percent agreement in cases between the two arbitrators was 90.7% (49/54).

Prevalence of CHB Diagnosis in the Medicaid Sample

A total of 31,046 Medicaid enrollees met the validated CHB definition among the 31,358,010 Medicaid enrollees from the five states with at least 180 days of enrollment (Table 1). Figure 1 reports raw estimates of the prevalence of diagnosed CHB, overall and by sex, age group, and race/ethnicity. Among the five states, the overall raw prevalence of diagnosed CHB, according to the validated definition, was 9.9 (95% CI, 9.8–10.0) per 10,000 population. The raw prevalence of CHB diagnosis was higher for men (14.0 per 10,000) than women (7.3 per 10,000), highest for age group 50–64 years (34.9 per 10,000), and substantially higher for Asians (107.9 per 10,000) and Pacific Islanders (66.4 per 10,000) than other races. There was little change in the prevalence after adjustment for the PPV of our validated definition (Table 1).

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When the prevalence of diagnosed CHB was adjusted for the estimated sensitivity of the validated definition, the prevalence of CHB infection was 16.2 (95% CI, 16.1–16.4) per 10,000. A similar estimate (15.6 [95% CI, 15.4–15.7] per 10,000) was observed after adjusting for both the sensitivity and PPV of the CHB definition (Table 1).

Results of additional analyses are reported in Table 1. When the definition of CHB infection was expanded to include any one CHB diagnosis, the number of cases increased to 90,882 of 31,358,010, corresponding to a raw prevalence of diagnosed CHB of 29.0 (95% CI 28.8–29.2) per 10,000. Prevalence estimates among patients with one year of Medicaid enrollment were similar to those with 6 months of enrollment.

Characteristics of Diagnosed CHB Patients in the Medicaid Sample

The characteristics of the patients diagnosed with CHB infection by the validated definition are presented in Table 2. Overall, between 2000 and 2007, the cohort of 31,046 CHB-infected patients had 74,032.7 person-years of follow-up (median, 2.1 years per patient) from the date at which the CHB definition was met until the last recorded Medicaid claim. These patients were predominantly male (55.4%), of Asian race (46.4%), and frequently had a history of chronic kidney disease, diabetes mellitus, myocardial infarction, and rheumatoid arthritis or other arthropathies. A total of 30.7% of the CHB-infected patients had hepatitis C coinfection; 9.0% had human immunodeficiency virus (HIV) coinfection; and 5.7% were coinfected with both hepatitis C and HIV infections. Nineteen percent had a diagnosis of hepatic decompensation recorded during the eight-year period. A CHB-related laboratory test was ordered for 12,087 (38.9%) patients. Thirty-six percent had a claim for an antiviral medication used to treat CHB (Table 2).

After CHB was initially diagnosed, the cohort of CHB-infected patients had a mean (standard deviation) of 2.4 (5.3) outpatient visits per year with a CHB diagnosis recorded. There was no difference in the mean number (standard deviation) of outpatient visits for CHB infection per year between HIV/CHB-coinfected patients and those with CHB alone (2.4 [5.0] versus 2.4 [7.7] outpatient visits with a CHB diagnosis per year).

DISCUSSION

This study demonstrated that two CHB diagnoses recorded more than 6 months apart within U.S. Medicaid data had 96.3% PPV for clinician-confirmed CHB infection. Using this definition, we found that the raw prevalence of CHB diagnosis was 9.5 per 10,000. The prevalence of diagnosed CHB was highest in Asians and Pacific Islanders, highest among persons aged 50–64 years, and higher in men. After adjustment for both the PPV and estimated sensitivity of our validated CHB definition, the prevalence of CHB infection in Medicaid was 15.6 per 10,000.

Our finding of a higher prevalence of diagnosed CHB infection in males than females and increasing prevalence with advancing age through 64 years are consistent with data from the National Health and Nutrition Examination Survey (NHANES) [9–11]. Moreover, our observation of a high prevalence of diagnosed CHB among Asians and Pacific Islanders is consistent with other recent data that suggest that Asians/Pacific Islanders account for more

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than 50% of Americans living with CHB infection [24, 25]. Further, the overall prevalence of hepatic decompensation in this study (19.2%) was similar to results of prior cohort studies that reported that 15–25% of CHB-infected patients develop decompensated cirrhosis [3, 4].

However, the prevalence of CHB infection determined within the Medicaid populations of the five states in this study (15.6 per 10,000) was lower than previously reported estimates in the general U.S. population from the NHANES (27–38 per 10,000) [9–11]. This may have been because this estimate was based on a strict definition of CHB infection that required two diagnoses recorded more than 6 months apart. A second reason for this finding might be due to the fact that persons who make up the highest CHB risk groups (e.g., Asians, foreign-born persons) are less commonly enrolled in Medicaid [12, 13]. Alternatively, the low prevalence of CHB might be due to under-diagnosis of CHB infection among Medicaid enrollees. If confirmed, efforts to enhance screening of Medicaid enrollees at-risk for CHB infection will need to be undertaken to identify these patients before long-term complications develop. The U.S. Centers for Disease Control and Prevention has published recommendations on serologic testing for the identification of persons with CHB infection [26].

The estimates of the prevalence of coinfection with HIV and hepatitis C observed in our study sample were higher than those that have been reported in other studies [27, 28]. The reasons for these findings are unclear. It is possible that the CHB-infected patients enrolled in the Medicaid programs of these states engage in activities that put them at increased risk for these other infections. Future analyses should evaluate the risk factors for HIV and hepatitis C coinfection in CHB-infected Medicaid enrollees.

Our results provide valuable data for the future development of a CHB infection “cascade of care,” as has been described for HIV infection [29, 30]. This model would show, in visual form, the numbers of CHB-infected individuals engaged in CHB care in the U.S., spanning from CHB acquisition, diagnosed infection, linkage and retention in CHB care, need for antiviral therapy, receipt of CHB treatment, and achievement of viral suppression. A CHB treatment cascade could be used to identify key deficits across the entire continuum of CHB care, such as late diagnosis, suboptimal linkage to and retention in care, insufficient use of antiviral therapy, and suboptimal adherence to therapy, all of which pose significant barriers to achieving optimal treatment outcomes. The results of this study will help to inform estimates for a number of steps along this cascade of care.

This study demonstrated that U.S. Medicaid data can be a valuable resource for future studies of CHB epidemiology. We developed and validated an ICD-9-CM diagnosis-based definition for CHB infection compared to clinician-confirmed diagnosis, enabling identification of a large and reliably diagnosed cohort of CHB-infected patients. Moreover, as shown in Table 2, Medicaid contains information on comorbidities and medications that might be potential confounding variables in CHB epidemiologic studies. Thus, Medicaid data could be used to examine associations between CHB and health outcomes of interest, identify complications associated with CHB treatment, and evaluate the safety of medications used by CHB-infected patients.

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This study has several potential limitations. First, a large proportion of outpatient records requested to permit estimation of the PPV of our ICD-9-CM diagnosis-based CHB definition were unable to be obtained; however, among patients who had available records, CHB infection was confirmed in 96.3%. Second, there is the potential that diagnoses of CHB were misclassified. However, CHB was identified using a validated definition with high PPV. Third, there is the possibility that we might have missed CHB diagnoses, but we conducted analyses to estimate the sensitivity of our CHB definition. Estimates of the prevalence of CHB infection accounted for both the PPV and estimated sensitivity of our validated CHB definition. Of course, we could not estimate the true prevalence of CHB infection because some patients might have CHB infection and are never diagnosed. Fourth, we lacked data on laboratory results (e.g., HBsAg, HBeAg, hepatitis B e antibody, hepatitis B DNA, liver aminotransferases, and hepatic synthetic function) for the overall cohort of 31,046 CHB-infected patients. The absence of such data limits the ability to further classify CHB infections and to determine the prevalence and outcomes of these subgroups. Finally, our study focused on a sample of U.S. Medicaid enrollees, and thus may not be generalizable to the entire U.S. population.

This study had a number of strengths. It validated an ICD-9-CM diagnosis-based definition for CHB infection and used this information to examine the prevalence of CHB diagnosis and infection in the U.S. Medicaid population. This study also confirmed the ability of Medicaid data to examine CHB infection for future epidemiologic studies.

In conclusion, two outpatient CHB diagnoses recorded more than 6 months apart validly identified clinician-confirmed CHB in U.S. Medicaid data. Using this definition, the prevalence of diagnosed CHB infection among U.S. Medicaid enrollees was estimated to be 15.6 per 10,000.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding: This work was supported by an investigator-initiated research grant (to the University of Pennsylvania) from Gilead Sciences, Inc.

List of Abbreviations

CHB	chronic hepatitis B
CI	confidence interval
CPT	Current Procedural Terminology
HIV	human immunodeficiency virus
HBeAg	hepatitis B e antigen
HBsAg	hepatitis B surface antigen

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ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
IQR	interquartile range
NHANES	National Health and Nutrition Examination Survey
PPV	positive predictive value
U.S	United States

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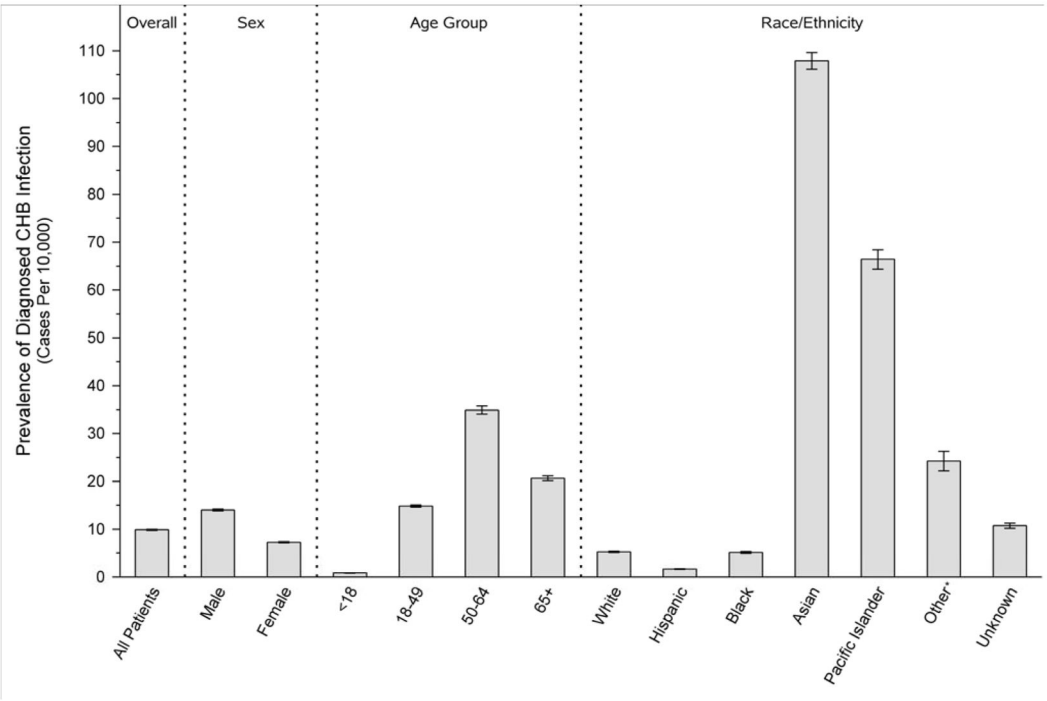

Figure 1.

Estimates (with 95% confidence intervals) of the raw prevalence of diagnosed chronic hepatitis B (CHB) infection, overall and by sex, age group, and race/ethnicity, in the U.S. Medicaid programs of California, Florida, New York, Ohio, and Pennsylvania between 2000 and 2007. For each group, bars represent the point estimate of the raw prevalence of diagnosed CHB infection, and the vertical lines represent 95% confidence intervals.

Abbreviation: CHB, chronic hepatitis B

*Other race/ethnicity defined as American Indian, Alaska native, or multiracial.

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Table 1

Prevalence of diagnosed chronic hepatitis B (CHB) infection (per 10,000) among patients enrolled in the U.S. Medicaid programs of California, Florida, New York, Ohio, and Pennsylvania between 2000 and 2007.

Definition of CHB Infection	Prevalence of Diagnosed CHB Infection (per 10,000)			
	Raw Prevalence (95% CI)	Prevalence Adjusted for PPV of CHB Definition (95% CI)*	Prevalence Adjusted for Sensitivity of CHB Definition (95% CI)†	Prevalence Adjusted for Sensitivity and PPV of CHB Definition (95% CI)‡
Among patients with 180 days of Medicaid enrollment:				
Two outpatient CHB diagnoses >6 months apart	9.9 (9.8–10.0)	9.5 (9.4–9.6)	16.2 (16.1–16.4)	15.6 (15.4–15.7)
Two outpatient CHB diagnoses >6 months apart OR one outpatient plus one inpatient CHB diagnosis >6 months apart	9.9 (9.8–10.0)	**	**	**
At least one CHB diagnosis	29.0 (28.8–29.2)	**	**	**
Among patients with 365 days of Medicaid enrollment:				
Two outpatient CHB diagnoses >6 months apart	11.5 (11.4–11.6)	11.1 (11.0–11.2)	16.4 (16.3–16.6)	15.9 (15.7–16.0)
Two outpatient CHB diagnoses >6 months apart OR one outpatient plus one inpatient CHB diagnosis >6 months apart	11.5 (11.4–11.7)	**	**	**
At least one CHB diagnosis	32.5 (32.3–32.7)	**	**	**

Abbreviations: CHB, chronic hepatitis B; CI, confidence interval; PPV, positive predictive value

*Estimate is equal to raw prevalence multiplied by positive predictive value.

†Estimate is equal to raw prevalence divided by estimated sensitivity of CHB definition.

‡Estimate is equal to raw prevalence multiplied by positive predictive value and divided by estimated sensitivity of CHB definition.

**Estimate of prevalence could not be calculated since the positive predictive value of this diagnostic coding definition was not determined.

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Table 2

Characteristics of patients diagnosed with chronic hepatitis B (CHB) infection, defined by two outpatient diagnoses recorded more than 6 months apart, who were enrolled in the U.S. Medicaid programs of California, Florida, New York, Ohio, and Pennsylvania between 2000 and 2007.

Characteristic	Chronic Hepatitis B-Infected Patients					
	Overall (n=31,046)	California (n=14,300)	Florida (n=1,710)	New York (n=13,106)	Ohio (n=1,025)	Pennsylvania (n=905)
Mean age (years, SD)	49.5 (17.0)	55.4 (16.9)	47.9 (14.8)	43.3 (15.6)	48.8 (14.4)	50.6 (14.0)
Female sex (n, %)	13,844 (44.6%)	6,641 (46.4%)	565 (33.0%)	5,929 (45.2%)	406 (39.6%)	303 (33.5%)
Race/ethnicity (n, %)						
White	5,834 (18.8%)	2,027 (14.2%)	753 (44.0%)	1,946 (14.8%)	604 (58.9%)	504 (55.7%)
Black	2,916 (9.4%)	610 (4.3%)	557 (32.6%)	1,130 (8.6%)	376 (36.7%)	243 (26.9%)
Hispanic	1,853 (5.9%)	587 (4.1%)	214 (12.5%)	995 (7.6%)	15 (1.5%)	42 (4.6%)
Asian	14,393 (46.4%)	6,302 (44.1%)	80 (4.7%)	7,889 (60.2%)	27 (2.6%)	95 (10.5%)
Native Hawaiian/Pacific Islander	4,075 (13.1%)	4,020 (28.1%)	0 (0%)	55 (0.4%)	0 (0%)	0 (0%)
Other*	527 (1.7%)	22 (0.2%)	1 (0.1%)	500 (3.8%)	2 (0.2%)	2 (0.2%)
Unknown	1,448 (4.7%)	732 (5.1%)	105 (6.1%)	591 (4.5%)	1 (0.1%)	19 (2.1%)
Follow-up (person-years)†						
Median (IQR)	2.06 (0.82–3.58)	2.00 (0.85–3.79)	2.03 (0.80–3.74)	1.89 (0.75–3.34)	2.14 (0.98–3.86)	2.73 (1.23–4.44)
Total	74,032.7	35,433.2	4,205.5	29,068.4	2,652.7	2,672.9
Medical diagnoses (n, %)‡						
Alcoholism	3,615 (11.6%)	1,606 (11.2%)	447 (26.1%)	1,021 (7.8%)	285 (27.8%)	256 (28.3%)
Depressive/Bipolar Disorders	7,407 (23.9%)	3,701 (25.9%)	808 (47.3%)	1,942 (14.8%)	548 (53.5%)	408 (45.1%)
Chronic kidney disease	12,567 (40.5%)	5,985 (41.9%)	961 (56.2%)	4,539 (34.6%)	583 (56.9%)	499 (55.1%)
Congestive heart failure	5,908 (19.0%)	3,241 (22.7%)	603 (35.3%)	1,316 (10.0%)	439 (42.8%)	309 (34.1%)
Diabetes mellitus	10,864 (34.9%)	6,209 (43.4%)	850 (49.7%)	2,861 (21.8%)	535 (52.2%)	409 (45.2%)
Hepatic decompensation	5,960 (19.2%)	3,192 (22.3%)	607 (35.5%)	1,518 (11.6%)	358 (34.9%)	285 (31.5%)
Ascites	3,365 (10.8%)	1,728 (12.1%)	375 (21.9%)	836 (6.4%)	231 (22.5%)	195 (21.5%)
Esophageal variceal hemorrhage	1,528 (4.9%)	812 (5.7%)	168 (9.8%)	376 (2.9%)	91 (8.9%)	81 (9.0%)
Hepatic encephalopathy	3,575 (11.5%)	2,080 (14.5%)	356 (20.8%)	818 (6.2%)	159 (15.5%)	162 (17.9%)
Spontaneous bacterial peritonitis	577 (1.9%)	253 (1.8%)	71 (4.2%)	136 (1.0%)	82 (8.0%)	35 (3.9%)

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Characteristic	Chronic Hepatitis B-Infected Patients					
	Overall (n=31,046)	California (n=14,300)	Florida (n=1,710)	New York (n=13,106)	Ohio (n=1,025)	Pennsylvania (n=905)
Hepatitis C virus coinfection	9,531 (30.7%)	4,950 (34.6%)	943 (55.1%)	2,572 (19.6%)	530 (51.7%)	536 (59.2%)
Human immunodeficiency virus (HIV) coinfection	2,804 (9.0%)	1,078 (7.5%)	683 (39.9%)	758 (5.8%)	138 (13.5%)	147 (16.2%)
Hepatitis C and HIV coinfection	1,765 (5.7%)	655 (4.6%)	411 (24.0%)	495 (3.8%)	88 (8.6%)	116 (12.8%)
Hepatocellular carcinoma	1,774 (5.7%)	1,120 (7.8%)	105 (6.1%)	479 (3.7%)	28 (2.7%)	42 (4.6%)
Myocardial infarction	9.464 (30.5%)	5,467 (38.2%)	799 (46.7%)	2,444 (18.6%)	438 (42.7%)	316 (34.9%)
Rheumatoid arthritis/non-specific arthropathy	7,296 (23.5%)	4,736 (33.1%)	483 (28.2%)	1,621 (12.4%)	291 (28.4%)	165 (18.2%)
Schizophrenia	740 (2.4%)	561 (3.9%)	60 (3.5%)	66 (0.5%)	39 (3.8%)	14 (1.5%)
Hepatitis B laboratory tests performed (n, %)	12,087 (38.9%)	7,193 (50.3%)	1,203 (70.4%)	2,485 (19.0%)	551 (53.8%)	655 (72.4%)
Hepatitis B surface antigen	10,740 (34.6%)	6,256 (43.7%)	1,123 (65.7%)	2,267 (17.3%)	507 (49.5%)	587 (64.9%)
Hepatitis B e antigen	5,840 (18.8%)	3,501 (24.5%)	563 (32.9%)	1,304 (9.9%)	169 (16.5%)	303 (33.5%)
Hepatitis B DNA	6,637 (21.4%)	4,048 (28.3%)	667 (39.0%)	1,368 (10.4%)	200 (19.5%)	354 (39.1%)
Antiviral medications used to treat CHB (n, %)	11,276 (36.3%)	4,475 (31.3%)	943 (55.1%)	5,327 (40.6%)	260 (25.4%)	271 (29.9%)
Adefovir	4,898 (15.8%)	1,667 (11.7%)	191 (11.2%)	2,915 (22.2%)	50 (4.9%)	75 (8.3%)
Emtricitabine	1,109 (3.6%)	442 (3.1%)	292 (17.1%)	292 (2.2%)	48 (4.7%)	35 (3.9%)
Entecavir	2,135 (6.9%)	886 (6.2%)	82 (4.8%)	1,100 (8.4%)	29 (2.8%)	38 (4.2%)
Standard or pegylated interferon	6,991 (22.5%)	2,895 (20.2%)	774 (45.3%)	3,066 (23.4%)	190 (18.5%)	185 (20.4%)
Lamivudine	7,110 (22.9%)	2,650 (18.5%)	359 (21.0%)	3,757 (28.7%)	106 (10.3%)	119 (13.1%)
Telbivudine	335 (1.1%)	100 (0.7%)	7 (0.4%)	226 (1.7%)	1 (0.1%)	1 (0.1%)
Tenofovir	1,923 (6.2%)	791 (5.5%)	478 (28.0%)	504 (3.8%)	85 (8.3%)	65 (7.2%)

Abbreviations: CHB, chronic hepatitis B; HIV, human immunodeficiency virus; IQR, interquartile range

*Other race/ethnicity defined as American Indian, Alaska native, or multiracial.

†Follow-up was determined from the date at which the CHB definition was met until the last recorded Medicaid claim.

‡Diagnoses determined by an outpatient or hospital-associated diagnosis.