

The Hepatitis B Care Cascade Using Administrative Claims Data, 2016

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Hepatitis B virus (HBV) infection remains a major public health issue.¹ After exposure to HBV, patients will develop symptomatic or asymptomatic acute HBV infection, and although many patients resolve their acute infection within 6 months, some will develop chronic hepatitis B (CHB). In the United States, an estimated 840,000 adults were living with CHB in 2016.² Approximately 1 in 4 persons living with CHB will die prematurely from liver cirrhosis, hepatocellular carcinoma (HCC), or liver failure.³

CHB disproportionately affects certain populations. About 70% of persons with CHB are non-US-born, and non-US-born persons primarily reside in the Western and Eastern United States⁴; other high-burden populations include men who have sex with men, people who inject drugs or are incarcerated, and sexual and household contacts of HBV-infected persons.⁵ Current guidelines recommend hepatitis B screening for high-risk groups.⁶⁻⁸ Although not all patients with CHB require treatment, all should be evaluated at least every 12 months for treatment eligibility and complications of liver disease and treatment through routine laboratory assessments of liver function tests and HBV viral load.⁷ It is estimated that 20% to 40% of patients with CHB should be treated with antiviral therapy.⁹ Only 30% of persons with CHB in the United States were aware of their diagnosis in 2016, and fewer than 10% were receiving recommended care and treatment in 2011.^{9,10} For patients with CHB who are eligible for antiviral treatment, lifelong therapy is usually indicated.⁷

Prior studies have used claims data to study hepatitis B and liver cirrhosis,¹¹ hepatitis B testing and antiviral treatment rates during pregnancy,^{12,13} and the proportion of pregnant women receiving hepatitis B care and treatment.¹³ We are not aware of previous studies using claims data to describe the CHB care continuum, from diagnosis to linkage to care and treatment among adults.

As a first step to address gaps in the CHB care continuum for adults, we used commercial claims data to describe CHB diagnoses by year and the proportion linked to care with antiviral prescription claims.

ABSTRACT

OBJECTIVES: Monitoring care and treatment for persons with chronic hepatitis B (CHB) is essential for demonstrating progress in achieving national elimination goals. We sought to evaluate insurance claims data as a source for monitoring progression along the CHB care cascade.

STUDY DESIGN: Longitudinal evaluation from diagnosis to treatment among commercially insured enrollees with CHB.

METHODS: We used standardized procedure and diagnosis codes to identify enrollees (≥ 18 years) with CHB in large insurance claims databases to describe the CHB care cascade from 2008 to 2016. Linkage to care was defined as procedure codes for liver fibrosis assessment (alanine aminotransferase in conjunction with either hepatitis B virus DNA or hepatitis B e-antigen) more than 12 months after CHB diagnosis. Treatment was defined as a claim for any CHB prescription. We analyzed factors associated with linkage to care and treatment using unadjusted logistic regression and evaluated rates of diagnosis, linkage to care, and treatment over time.

RESULTS: Of 16,644 individuals with CHB, 6004 (36%) were linked to care and 2926 (18%) were treated. Persons coinfecting with HIV (odds ratio [OR], 0.46; 95% CI, 0.36-0.59) or hepatitis C (OR, 0.50; 95% CI, 0.34-0.73) were less likely to be linked to care, and persons coinfecting with HIV (OR, 0.29; 95% CI, 0.19-0.44) were less likely to be treated. From 2009 to 2015, there was a significant decrease in CHB diagnoses but no change in the proportion linked to care and treatment.

CONCLUSIONS: We identified gaps in linkage to care and treatment in commercially insured adults with CHB.

Am J Manag Care. 2020;26(8):331-338. doi:10.37765/ajmc.2020.44069

TAKEAWAY POINTS

Only one-third of commercially insured enrollees diagnosed with chronic hepatitis B (CHB) were linked to recommended care, highlighting the need for targeted interventions to improve linkage to care.

- ▶ Researchers can monitor the CHB care cascade using administrative health care data to identify potential targets for public health intervention to achieve elimination goals.
- ▶ This is the first study to describe the CHB care cascade among commercially insured enrollees from a large, nationally representative claims database.
- ▶ Analyses identified associated factors affecting progression along the care cascade.

Revision, Clinical Modification (ICD-10-CM) diagnosis codes associated with each cascade step (Table 1).

CHB is a lifelong disease and is clinically distinct from acute hepatitis B; as a result, providers would place a diagnosis claim for CHB during each encounter in which they evaluate a patient with CHB. To identify unique CHB diagnoses, we defined CHB as at least 2 CHB ICD-9-CM/ICD-10-CM diagnosis codes entered on service dates at least 2 weeks apart.

METHODS

Data Source and Study Population

We obtained deidentified demographic, enrollment, and insurance claims data from Truven Health's MarketScan Commercial Claims and Encounters insurance claims database, for adults 18 years and older with employer health plans. This database includes claims for millions of persons with private insurance who are younger than 65 years. A unique enrollee identification number allows linkage of medical claims with outpatient pharmacy claims data. This secondary analysis of deidentified insurance claims data did not require institutional review board approval.

CHB Care Continuum Description and Statistical Analysis

To evaluate CHB diagnosis, care, and treatment, we searched both inpatient and outpatient insurance claims for Current Procedural Terminology (CPT) codes for laboratory tests and *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* and *International Classification of Diseases, Tenth*

This inclusion definition was used to validate diagnoses of chronic hepatitis C virus (HCV) infections previously.¹⁴ Inclusion criteria required continuous enrollment 6 months before and 12 months after the first diagnosis claim for CHB between January 1, 2008, and December 31, 2016.

Linkage to care is the process of ensuring that patients with CHB are receiving hepatitis B–directed care. Hepatitis B–directed care is defined as the periodic assessment of liver inflammation (alanine aminotransferase [ALT]) and viral replication (HBV DNA or hepatitis B e-antigen [HBeAg]) to evaluate disease progression and treatment eligibility, and patients should be evaluated at least every 12 months.⁷ We defined linkage to hepatitis B–directed care as an ALT test in conjunction with either an HBV DNA or HBeAg test at least 12 months after the date of CHB diagnosis code used to include the patient in the analysis and calculated the proportion of persons with CHB linked to care. The year of linkage to care was defined as the year of the CPT test code for HBV DNA or HBeAg. Next, we described hepatitis B antiviral treatment claims among all persons diagnosed with CHB with pharmacy claims. Persons requiring antiviral treatment for CHB typically require lifelong

TABLE 1. Procedure^a and Diagnosis^b Codes Used to Identify CHB Diagnosis, Care, and Treatment

	Test or condition	Code number	Code description
Diagnostic codes used to identify CHB cases	CHB ^b	070.22	Chronic viral hepatitis with hepatic coma without hepatitis delta
		070.23	Chronic viral hepatitis B with hepatic coma with hepatitis delta
		070.32	Chronic viral hepatitis B without mention of hepatic coma without mention of hepatitis delta
		070.33	Chronic viral hepatitis B without mention of hepatic coma with hepatitis delta
		V02.61	Carrier of viral hepatitis B
		B18.0	Chronic viral hepatitis B with delta-agent
		B18.1	Chronic viral hepatitis B without delta-agent
		Z22.51	Carrier or suspected carrier of hepatitis B
	ALT test ^a	80076	Hepatic function panel
		84460	Alanine aminotransferase
	HBV DNA test ^a	87515	Hepatitis B virus detection by nucleic acid using direct probe technique
		87516	Hepatitis B virus DNA, qualitative, real-time PCR
		87517	Hepatitis B virus DNA, quantitative, real-time PCR
	HBeAg test ^a	87350	Hepatitis B e-antigen

(continued)

TABLE 1. (Continued) Procedure^a and Diagnosis^b Codes Used to Identify CHB Diagnosis, Care, and Treatment

	Test or condition	Code number	Code description
Diagnostic definitions and codes used to identify other clinical characteristics	HIV ^b	795.71	Nonspecific serologic evidence of HIV
		R75	Inconclusive laboratory evidence of HIV
		V08	Asymptomatic HIV infection status
		Z21	Asymptomatic HIV infection status
		42	HIV disease
		B20	HIV disease
		79.53	HIV, type 2
		B9735	HIV, type 2 as the cause of diseases classified elsewhere
	HCV definition	HCV RNA test followed by ≥2 chronic HCV codes on different service dates	
	HCV RNA ^a	87520	Infectious agent detection by nucleic acid (DNA or RNA); hepatitis C, direct probe technique
		87521	Infectious agent detection by nucleic acid (DNA or RNA); hepatitis C, amplified probe technique
		87522	Infectious agent detection by nucleic acid (DNA or RNA); hepatitis C, quantification
	HCV ^b	070.44	Chronic hepatitis C with hepatic coma
		070.54	Chronic hepatitis C without mention of hepatic coma
		B18.2	Chronic viral hepatitis C
		Z22.52	Carrier of viral hepatitis C
	HCC definition	Any HCC diagnostic code	
	HCC ^b	C220	Liver cell carcinoma
		C227	Other specified carcinomas of liver
		155.0	Malignant neoplasm of liver, primary
		C22.8	Malignant neoplasm of liver, primary, unspecified as to type
	Liver cirrhosis definition	Any liver cirrhosis diagnostic code	
	Cirrhosis ^b	5712	Alcoholic cirrhosis of liver
		5715	Cirrhosis of liver without mention of alcohol
		5716	Biliary cirrhosis
		K7030	Alcoholic cirrhosis of liver without ascites
		K7031	Alcoholic cirrhosis of liver with ascites
		K703	(Nonbillable Dx) Alcoholic cirrhosis liver
		K717	Toxic liver disease with fibrosis and cirrhosis of liver
		K743	Primary biliary cirrhosis
		K744	Secondary biliary cirrhosis
		K745	Biliary cirrhosis, unspecified
K7460		Unspecified cirrhosis of liver	
K7469		Other cirrhosis of liver	
K746		(Nonbillable Dx) Liver cirrhosis not elsewhere classifiable and not otherwise specified	
K74		(Nonbillable Dx) Fibrosis and cirrhosis liver	

ALT, alanine aminotransferase; CHB, chronic hepatitis B; Dx, diagnosis; HBeAg, hepatitis B e-antigen; HBV, hepatitis B virus; HCC, hepatocellular carcinoma; HCV, hepatitis C virus; PCR, polymerase chain reaction.

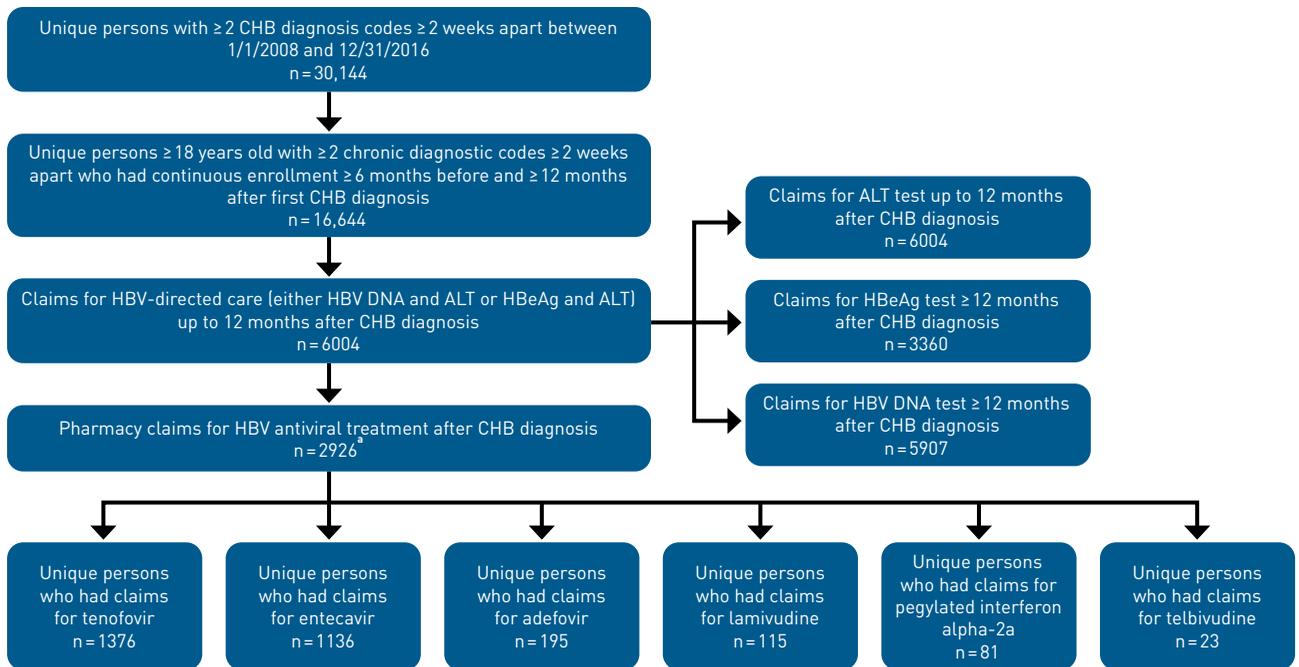
^aCurrent Procedural Terminology or Healthcare Common Procedure Coding System.

^bInternational Classification of Diseases, Ninth Revision, Clinical Modification or International Classification of Diseases, Tenth Revision, Clinical Modification.

treatment.⁷ We calculated the proportion of persons with CHB with antiviral prescription claims, defined as at least 1 claim for antiviral treatment (tenofovir, entecavir, lamivudine, adefovir, telbivudine, or pegylated interferon alpha-2a) at the time of or after the CHB

diagnosis date. We performed descriptive statistical analysis and unadjusted logistic regression analysis that evaluated differences in demographic and clinical characteristics between adults with CHB who did or did not receive hepatitis B care and treatment.

FIGURE 1. Adults With CHB With Commercial Insurance Diagnosed, Linked to Care, and Antiviral Treatment Claims, 2008-2016



ALT, alanine aminotransferase; CHB, chronic hepatitis B; HBV, hepatitis B virus; HBeAg, hepatitis B e-antigen.
*16,572 with prescription claims available for analysis.

Clinical characteristics included diagnosis of HIV, HCV infection, HCC, and liver cirrhosis (Table 1).

Next, we calculated the rates of CHB diagnosis and the proportion of persons with CHB who were linked to care and treatment over time, and we evaluated for statistical significance using the Cochran-Armitage test for trend. The trend analysis includes data points from 2009 through 2015. We did not include data points from 2008 because we defined linkage to care as ALT in conjunction with either HBV DNA or HBeAg with CPT codes at least 12 months after the chronic hepatitis B diagnosis code; thus, the earliest time point included was 2009. We also did not include data points from 2016 due to incomplete data for that year. Analyses were completed using SAS version 9.4 (SAS Institute). We considered *P* values < .05 to be statistically significant.

RESULTS

There were 16,644 unique adults meeting inclusion criteria for CHB (Figure 1). The median age was 45 years (range, 18-64 years), with 84% of persons aged 30 to 59 years, 55% male, 95% living in urban locations, and 43% from the West region (Table 2). Regarding coinfection, 377 (2.3%) had HIV and 159 (1.0%) had HCV infection diagnoses. There were 98 (0.6%) with liver cirrhosis and 3 (< 0.1%) with HCC.

There were 6004 (36%) persons linked to hepatitis B–directed care (Figure 1). Persons linked to care were more likely to be

younger than 60 years (odds ratios [ORs], 1.50-2.19) and living in the Northeast (OR, 1.27; 95% CI, 1.15-1.41), North Central/Midwest (OR, 1.51; 95% CI, 1.35-1.69) or West (OR, 1.66; 95% CI, 1.53-1.80) regions of the United States (Table 3). Persons linked to care were less likely to be coinfecting with HIV (OR, 0.46; 95% CI, 0.36-0.59) or HCV (OR, 0.50; 95% CI, 0.34-0.73) (Table 3).

There were 16,572 of 16,644 (99.6%) persons with prescription claims data available, and 2926 (18%) persons had antiviral prescription claims (Figure 1). The most common antiviral prescription claims were for tenofovir (47%) and entecavir (39%) (Figure 1). Persons with hepatitis B antiviral prescription claims were more likely to be male (OR, 1.36; 95% CI, 1.26-1.48), older than 30 years (OR, 1.18; 95% CI, 1.01-1.38), or living in the South region of the United States (Table 3). Persons coinfecting with HIV were less likely (OR, 0.29; 95% CI, 0.19-0.44) to have antiviral prescription claims (Table 3). There were 29 (30%) of 98 adults with CHB and liver cirrhosis who had hepatitis B antiviral prescription claims, and persons with cirrhosis were more likely (OR, 1.98; 95% CI, 1.28-3.06) to have prescription claims (Table 3).

The rates of persons receiving a CHB diagnosis decreased (*P* = .03) over time from 93 per 100,000 persons in 2009 to 55 per 100,000 persons in 2015 (Figure 2 [A]). The proportion of persons with CHB who were identified as being linked to care did not change over time (*P* = .25), and the proportion of persons with antiviral treatment claims increased, although not significantly (*P* = .15), from 13% in 2009 to 17% in 2015 (Figure 2 [B]).

TABLE 2. Demographic and Clinical Characteristics for Adults With Chronic Hepatitis B With Commercial Insurance, 2008-2016 (N = 16,664)

Demographic characteristics	Category	n	Proportion	95% CI
Gender	Male	9220	55.3%	54.6-56.2
	Female	7424	44.6%	43.9-45.4
Age group in years	18-29	1307	7.8%	7.4-8.3
	30-59	14,002	84.0%	83.6-84.7
	≥ 60	1335	8.0%	7.6-8.4
Region	Northeast	3080	18.5%	17.9-19.1
	North Central/ Midwest	2064	12.4%	11.9-12.9
	South	4318	25.9%	25.3-26.6
	West	7152	43.0%	42.2-43.7
	Unknown	30	0.2%	0.12-0.24
Urbanicity	Nonurban	838	5.0%	4.7-5.4
	Urban	15,806	94.9%	94.6-95.3
Other clinical characteristics				
HIV	Yes	377	2.3%	2.1-2.5
	No	16,267	97.6%	97.5-98.0
HCV	Yes	159	1.0%	0.8-1.1
	No	16,485	98.9%	98.9-99.2
Cirrhosis	Yes	98	0.6%	0.5-0.7
	No	16,546	99.3%	99.3-99.5
HCC	Yes	3	0.1%	0.0000-0.0004
	No	16,641	99.9%	99.9-100.0

HCC, hepatocellular carcinoma; HCV, hepatitis C virus.

DISCUSSION

We evaluated the hepatitis B care continuum among adults diagnosed with CHB using a large commercial claims database. The results of our study showed a gap in linkage to care among adults with CHB, given that all such adults should be linked to care but only 36% had claims suggesting hepatitis B–directed linkage to care. This analysis showed that 18% of patients with CHB had antiviral treatment claims. Not all patients with CHB require antiviral treatment, but all require routine monitoring of liver function tests and HBV viral load at least every 12 months. Because experts estimate that up to 40% of patients with CHB are clinically indicated to receive treatment, our results may signal undertreatment among commercially insured patients.⁹ Our approach demonstrates the utility of claims data to monitor and assess patients engaged along the care continuum among commercially insured adults with chronic hepatitis B.

Without a national system to monitor population health, we need to leverage existing databases to assist in identifying gaps in the care continuum, and then to design interventions to improve engagement. Commercial claims databases provide a useful tool to monitor patient engagement in the care continuum among persons with commercial insurance. Truven Health's MarketScan database has been used to monitor the hepatitis B care cascade for pregnant women.¹³ This

approach demonstrated the value of utilizing large claims databases, and it identified gaps in hepatitis B testing, linkage to care, and treatment in pregnant women with commercial insurance.¹³ Further, this approach can be used over time to assess trends and progress in hepatitis B prevention. Regarding the estimation of a national care continuum for adults with CHB, the most recent estimate is quite dated (ie, from 2011).⁹ Our analysis presents a care continuum for commercially insured adults with CHB as of 2016. Despite signs of improvement over time in linkage to hepatitis B care and treatment, we identified significant gaps representing an unmet need.

Although not all patients with CHB require treatment, all should be evaluated for HCC and treatment eligibility through history, physical exam, and laboratory assessment at least annually.^{7,15} Adults with CHB who are linked to care achieve significant reductions in HBV-associated morbidity and mortality.^{16,17} However, study findings suggest that fewer than 40% are linked to hepatitis B–directed care as determined by regular HBV DNA assessments.^{18,19} Using commercial claims data, we previously showed that 60% of pregnant women with CHB did not receive hepatitis B–directed care.¹³ Data from this study showed that, similarly, more than 64% of adults with CHB were not linked to hepatitis B–directed care. Our analysis identified factors associated with not being linked to care, which included coinfection with HIV or HCV. These patients may not routinely receive hepatitis B–directed care because HIV-infected persons may be treated with hepatitis B antiviral–containing antiretroviral treatment, thus not meeting our definition of hepatitis B–directed care. Patients coinfecting with HCV should also receive HBV DNA monitoring because of the potential for reactivation of hepatitis B among patients coinfecting with HCV receiving direct-acting antivirals.²⁰ Thus, it is imperative that patients with HCV/HBV coinfection be linked to hepatitis B–directed care.⁷ Our regional analysis suggests that persons from the South were less likely to be linked to care compared with those from other regions, which could be related to fewer non-US-born persons residing in the South.

It has been suggested that fewer than 15% of adults with CHB eligible to receive treatment are being treated,⁹ which may be due to lack of health insurance or access to health care resources. Thus, it is interesting to analyze the proportion of persons with commercial insurance receiving antiviral treatment for CHB. We previously showed that 15% of commercially insured pregnant women with CHB received antiviral prescription claims.¹³ This analysis showed that 18% of commercially insured adults with CHB received antiviral prescription claims. These estimates are closer to the estimated 20% to 40% of persons with CHB who are clinically indicated to receive treatment, but they are still suboptimal. Other than access to health care, other barriers to treatment may include knowledge about CHB or treatment guidelines, cultural barriers, and complexities in navigating the health system.²¹ All adults with liver cirrhosis are eligible for treatment; however, our data showed that only 30% of adults with CHB and liver cirrhosis had antiviral prescription claims. Fortunately, our analysis showed that persons with liver cirrhosis were more likely to have antiviral prescription claims;

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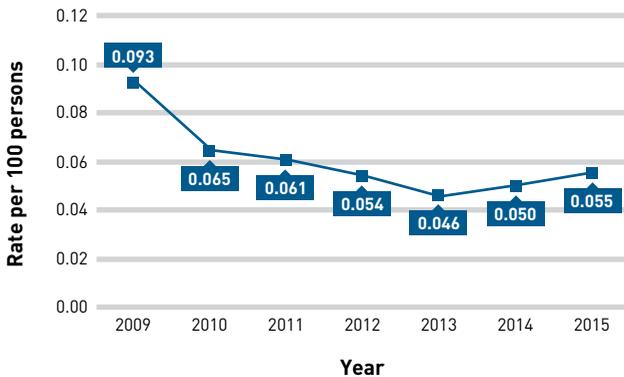
TABLE 3. Univariate (A) and Multivariate (B) Analysis of Demographic and Clinical Factors Associated With Linkage to Care and Treatment Among Adults With Chronic Hepatitis B With Commercial Insurance, 2008-2016

A. Univariate analysis											
Characteristics	Category	Linked to care					Treated				
		Yes		No		P	Yes		No		P
		n = 6004	Row %	n = 10,640	Row %		n = 2926	Row %	n = 13,718	Row %	
Gender	Male	3273	35.5	5947	64.5	.0478	1802	19.5	7418	80.5	<.001
	Female	2731	36.8	4693	63.2		1124	15.1	6300	84.9	
Age group in years	18-29	296	22.6	1011	77.4	<.001	201	15.4	1106	84.6	<.001
	30-59	5047	36.0	8955	64.0		2442	17.4	11560	82.6	
	≥ 60	661	49.5	674	50.5		283	21.2	1052	78.8	
Region	Northeast	1057	34.3	2023	65.7	<.001	492	16.0	2588	84.0	<.001
	North Central/Midwest	789	38.2	1275	61.8		311	15.1	1753	84.9	
	South	1256	29.1	3062	70.9		899	20.8	3419	79.2	
	West	2893	40.5	4259	59.5		1221	17.1	5931	82.9	
	Unknown	9	30.0	21	70.0		3	10.0	27	90.0	
Urbanicity	Nonurban	291	34.7	547	65.3	.0027	146	17.4	692	82.6	.0139
	Urban	5713	36.1	10,093	63.9		2780	17.6	13,026	82.4	
Other clinical characteristics											
HIV	Yes	92	24.4	285	75.6	<.001	22	5.8	355	94.2	<.001
	No	5912	36.3	10,355	63.7		2904	17.9	13,363	82.1	
HCV	Yes	42	83.7	117	16.3	.0108	42	29.6	117	70.4	.0033
	No	5962	35.8	10,523	64.2		2884	17.5	13,601	82.5	
Cirrhosis	Yes	82	26.4	16	73.6	<.001	29	26.4	69	73.6	.0017
	No	5922	36.2	10,624	63.8		2897	17.5	13,649	82.5	
HCC	Yes	2	66.7	1	33.3	.27	0	0.0	3	100.0	.42
	No	6002	36.1	10,639	63.9		2926	17.6	13,715	82.4	
B. Multivariate analysis											
Characteristics		Linked to care				Treated					
		Unadjusted OR		Unadjusted 95% CI		Unadjusted OR		Unadjusted 95% CI			
Gender	Male	0.95		0.89-1.01		1.36		1.26-1.48			
	≥ 60 (reference)										
Age group in years	18-29	1.85		1.57-2.19		1.22		1.00-1.50			
	30-59	1.71		1.50-1.94		1.18		1.01-1.38			
Region	South (reference)										
	Northeast	1.27		1.15-1.41		0.72		0.64-0.82			
	North Central/Midwest	1.51		1.35-1.69		0.68		0.59-0.78			
	West	1.66		1.53-1.80		0.78		0.71-0.86			
	Unknown	1.05		0.48-2.29		0.42		0.13-1.40			
Urbanicity	Nonurban (reference)										
	Urban	1.06		0.92-1.23		1.01		0.84-1.22			
Other clinical characteristics	HIV	0.46		0.36-0.59		0.29		0.19-0.44			
	HCV	0.50		0.34-0.73		0.83		0.54-1.29			
	Cirrhosis	0.82		0.53-1.26		1.98		1.28-3.06			
	HCC	N/A		N/A		N/A		N/A			

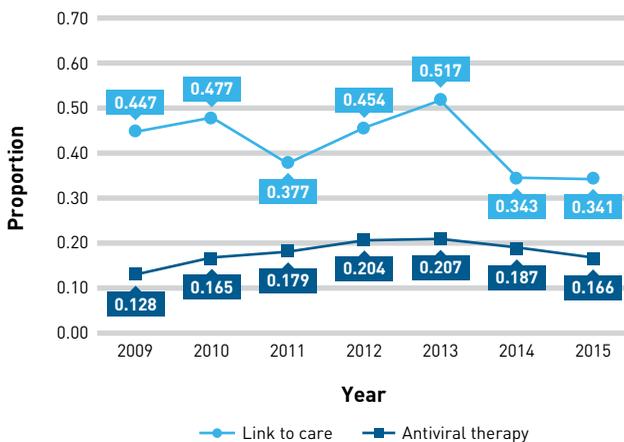
HCC, hepatocellular carcinoma; HCV, hepatitis C virus; N/A, not enough data to analyze; OR, odds ratio.

FIGURE 2. Rates of (A) Chronic Hepatitis B Diagnosis and (B) Linkage to Care and Antiviral Treatment, Among Adults With Commercial Insurance, 2009–2015

A. Trends in rates of chronic hepatitis B cases per 100 persons (MarketScan 2009–2015)



B. Proportion of chronic hepatitis B cases linked to care and prescribed antiviral therapy (MarketScan 2009–2015)



however, factors associated with not receiving a prescription claim included female gender; being aged 60 years and older; residing in the Northeast, North Central/Midwest, and Western regions of the United States compared with the Southern region; and coinfection with HIV. It is possible that persons with HIV/HBV coinfection are already prescribed antiretroviral treatment that contains hepatitis B antivirals (ie, tenofovir), which were not captured in our analysis.²² Our analysis may have identified a disparity among women where women were less likely to be treated compared with men. The association with age may be a confounder because the database included only employer-based plans, and persons 60 years and older may not be adequately represented. The regional associations are interesting because these same regions were associated with linkage to care but not treatment. It may be that providers in those regions are more selective about whom they decide to treat.

Our trend analysis showed that rates of linkage to care and treatment have not been improving over time. This gap could be addressed through education of patients and providers, the use of culturally and linguistically competent peer navigators to facilitate the continuity of care, and use of clinical decision support in the electronic health record to prompt providers to order hepatitis B–related tests.^{23,24} Patient education has shown success by facilitating increased hepatitis B testing and linkage to care in hard-to-reach populations.^{24,25} In addition, provider education can facilitate the following of appropriate clinical management standards.²⁶ Also, coordination of care through peer or patient navigators has been shown to increase linkage to care for adults with CHB.^{24,27} Furthermore, utilization of health information technology has potential to increase hepatitis B testing and linkage to care through provider alerts or standing orders regarding follow-up laboratory testing (linkage); this could be helpful because 64% of patients with CHB were not linked and many of these patients would return to care within the same health system for another medical reason at some point in the future.^{28,29}

Limitations

Use of a commercial claims database is a valuable tool to evaluate interventions using the electronic health record to improve the hepatitis B care continuum; however, our analysis was subject to at least 5 limitations. First, we used a convenience sample of a commercially insured claims database that does not include adults without insurance and therefore does not represent the general US population. As a result, our estimate represents a best-case scenario because the sample included patients with access to health care and thus may overestimate the real-world proportion of patients who are living with CHB and linked to HBV-directed care and treatment. The hepatitis B care continuum among under- or uninsured adults still needs to be characterized to better target public health interventions. Second, there was potential for misclassification of CHB diagnosis. We included a broad set of codes to cover all potential hepatitis B diagnoses, which contained the need for 2 codes entered on dates at least 2 weeks apart; however, codes may have not equated to actual HBV infection, as we were unable to confirm infection status with laboratory results or medical record review. Third, although not all adults had prescription claims data available for analysis, which may have led to an underestimated proportion of adults receiving antiviral treatment, 99.5% of persons in our CHB cohort had prescription claims. Fourth, we were not able to ascertain the proportion of adults who would have been eligible for treatment, such as those with elevated HBV DNA greater than 20,000 IU/mL and elevated ALT, because we did not have laboratory results. In addition, because we defined linkage to care as having 1 ALT test and either HBV DNA or HBeAg, we were unable to assess continued follow-up care beyond the initial step of linkage to care. However, we did evaluate the proportion of persons with cirrhosis who were prescribed treatment, and all persons with liver cirrhosis are eligible for treatment. Fifth, there was potential for selection

bias as the CHB diagnosis rates were substantially higher in 2008 and we did not include data from 2016 in our trend analysis due to incomplete data. To limit the potential for this bias, we did not include data from 2009 or 2016 in our trend analysis.

CONCLUSIONS

Commercial claims data can be used to monitor and evaluate the hepatitis B care continuum among commercially insured adults. Our data identified gaps in the hepatitis B care continuum among adults with CHB, which highlight potential targets for public health interventions to decrease hepatitis B–associated morbidity and mortality among adults living with CHB. ■

Acknowledgments

The authors have no conflicts to declare. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

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Source of Funding: This study was supported by the CDC; authors of this publication are employed by the CDC. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Disclosures: The authors report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (AMH, AO, NPN, WWT); analysis and interpretation of data (AMH, AO, NPN, WWT); drafting of the manuscript (AMH, AO, NPN, WWT); critical revision of the manuscript for important intellectual content (AMH, AO, NPN, WWT); statistical analysis (AMH, AO, NPN, WWT); administrative, technical, or logistic support (AMH, AO, NPN, WWT); and supervision (AMH).

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