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REVIEW

Barriers to Disease Monitoring and Liver Cancer Surveillance Among Patients with Chronic Hepatitis B in the United States

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Abstract
Chronic hepatitis B infection (CHB) is a condition that needs ongoing care such as monitoring for liver enzymes (ALT) and HBV DNA tests in treated and untreated patients, and annual imaging evaluation for liver cancer. Although follow-up care and treatment might seem straight forward, an estimated two-thirds of those who are aware of their infection are not seeing a health care provider, and more than half of those who are eligible for treatment do not receive it. This study aimed to compile and examine studies related to the barriers of disease monitoring, treatment, and liver cancer surveillance for CHB patients in the United States (US). A total of 4439 studies on monitoring and surveillance of CHB published between 2007 and 2018 were identified through a search of electronic databases. After critical assessment, the authors included 42 studies, divided into categories: 'patient-related barriers'; 'provider-related barriers'; and 'system-related barriers'. Among the patient-related barriers, one of the most frequent factors invoked in failing to have adequate surveillance was lack of patient's knowledge. In the provider-related barrier category, a lack of disease knowledge and adherence to guidelines was frequently reported. For the system-related barrier category, the only recurrent mention was a lack of clarity in guidelines or lack of guidelines from certain national institutions. This review summarizes and highlights the need for long-term disease management improvement of chronic hepatitis B infection for patients and healthcare providers that care for them.

Keywords Viral hepatitis · Disease monitoring · Hepatocellular carcinoma · Antiviral treatment · Barriers

Introduction

Chronic hepatitis B infection (CHB) is a vaccine preventable and treatable disease caused by the hepatitis B virus (HBV) and is a major cause of death from liver cancer and liver cirrhosis [1]. Once cirrhosis and/or liver cancer occur, health care and treatment costs are estimated to reach $41 billion in year 2030 in the United States [2]. Treatment with the highly effective and low resistance first line antiviral medication is as simple as taking a pill a day. Although not curative, continued suppressive therapy when indicated would prevent disease progression and greatly reduce the risk of costly disease complications. An estimated two-thirds of those who are aware of their infection are not seeing a physician [3], and more than half of those who are eligible for treatment do not receive it [4]. There are serious gaps in the real-life care of hepatitis B patients. Many CHB patients are not receiving the guideline recommended routine follow-up care such as monitoring for liver enzymes (ALT) and HBV DNA tests every 6 months, and annual imaging evaluation for hepatocellular carcinoma (HCC) (e.g., ultrasound) in cirrhotic patients in most general healthcare settings in the US [5]. A series of cohort studies and model based simulation indicate that HCC surveillance is cost-effective and associated with improved early tumor detection, curative treatment rates, and survival, when it is available to patients at risk such as CHB infected individuals [6–9]. However, the real-world utilization rate is below 20% for patient and provider related reasons [10, 11], among which are poor adherence due to health illiteracy from the patient and no disease and risk knowledge among healthcare providers. There seems to be inadequate transfer of disease knowledge to patient, which is most likely due to poor knowledge of disease risk and progression among physicians.

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This study aimed to systematically compile and examine studies related to the barriers of monitoring, treatment, and HCC surveillance for CHB patients in the US.

Methods

Studies for this review were identified via extensive searches of four bibliographic databases, Pubmed (includes MEDLINE); EMBASE (a biomedical and pharmacological bibliographic database); PsycInfo (literature related to psychology) and CINAHL (the Cumulative Index to Nursing and Allied Health Literature). A research librarian (CS) helped to design the search strategies. Individual search strategies include but are not limited to the following terms: hepatitis b; hepatocellular carcinoma; guideline adherence; monitoring and surveillance. We defined monitoring as the measurement of alanine aminotransferase (ALT) and HBV-DNA viral load via bloodwork, and the term surveillance to refer to HCC detection.

The search was limited to January 2007–June 2018 and excluded non-English language studies. Case reports and letters were also excluded. Complete search strategies for each database, including the database's native search syntax, are available upon request.

The results of the database searches were uploaded to Rayyan [12], a web-based application that facilitates screening reviewing and analyzing studies for systematic reviews. Two of the authors (SI and MT) carried out a blind review process for the inclusion and data extraction of the papers. When disagreements arose, these were resolved by consensus.

We opted for a more inclusive approach in which we initially included reviews and other background articles in order to also search any relevant bibliography. According to our inclusion criteria, the study population had to be either CHB patients or relevant members who could comment on the potential barriers of CHB patients, such as healthcare providers or community leaders, the study had to be conducted in the United States and it had to include barriers or potential barriers to either monitoring, treatment or HCC surveillance for CHB. Studies that used either t-tests or regression analysis by retrospectively looking at patient and electronic medical records to demonstrate the monitoring and surveillance were included. Studies focusing on vaccination or screening barriers for hepatitis B were excluded. Studies conducted on healthcare providers' knowledge for a variety of liver conditions were included as long as CHB was included as one of the conditions. However, we excluded those studies that reported barriers for patients with liver conditions but did not clearly separate CHB from other conditions and did not report the associated barriers strictly for CHB. We included qualitative as well as quantitative studies, in order to access as much information as possible regarding our topic of interest.

We included patient, provider and system related barriers, since this classification had been previously used in analyzing barriers of hepatitis B care [13], with some studies addressing one or all of these categories. If the barriers were concerning patients, they were assigned as patient-related barriers, and if they mentioned providers, they were included in the provider category, irrespective of the person discussing the barrier (i.e., provider, patient or community leader).

Results

The results of the search strategy and final distribution of the studies are shown in Fig. 1. The search identified 4432 papers and an additional seven references manually (total of 4439). Forty two out of 147 studies that were included for full text review were retained for final data extraction and discussion.

The barriers extracted from the studies were categorized as patient, provider and system-related barriers, with barriers to monitoring/surveillance and treatment being presented separately (see Tables 1, 2, 3). We chose to present such barriers separately due to the nature of the disease, more precisely because some individuals might only require monitoring for long periods of time before being considered for treatment.

Across the three categories of barriers, there were certain recurrent factors. Among the patient-related barriers, one of the most frequent factors invoked in failing to have adequate surveillance was lack of patient's knowledge [14, 15, 17, 19, 22, 23, 26, 30, 31], be it not knowing the risks associated with CHB, not knowing that there are effective treatments available or not knowing that CHB at present is incurable. Another commonly mentioned barrier was related to financial issues, either having no insurance or having financial difficulties that prevented individuals from paying out-of-pocket costs [3, 14, 16, 19–21, 25, 29–33, 36, 37, 39–41, 45]. Having a preference for complementary or alternative treatments for CHB was also mentioned as a patient-related barrier in several studies [15, 25, 26, 32, 39, 41, 42]. Some examples of such beliefs in and preferences for complementary and alternative treatments were taking herbal treatments that interfere with western treatments and not disclosing these herbal treatments to the physicians [25]; thinking that a change in diet and lifestyle is sufficient to manage their condition [41] or that herbal medications are a better alternative than prescription drugs [42].

In the provider-related barrier category, one of the most frequent obstacles was a lack of disease knowledge and adherence to guidelines [16, 17, 19, 23, 25, 29, 33, 42, 44, 46, 47, 49–51, 53]. Having a primary care physician (PCP)

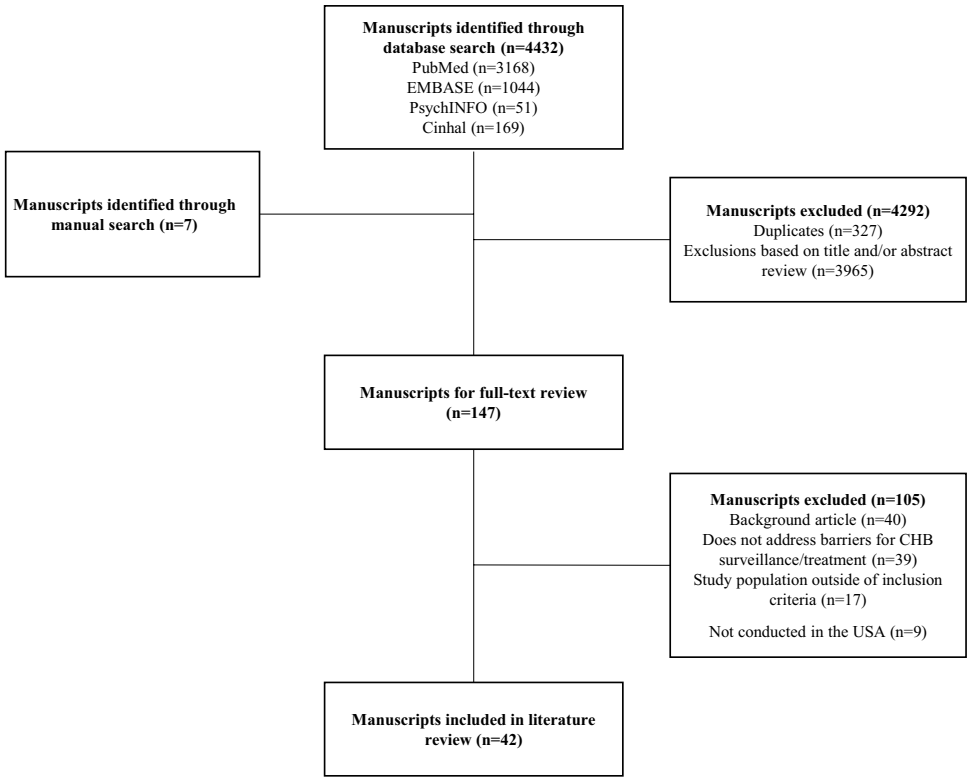

Fig. 1 Flow chart of the review study screening and selection process

or a community clinic provider also seemed to act as a barrier, as opposed to seeing a specialist or going to a university clinic [35, 40, 43, 44, 52]. Another barrier was the providers' attitude [25, 31–33, 49], illustrated by beliefs among some that HCC surveillance did not reduce all-cause mortality [49]; by attempts to cut costs for patients who were perceived as not able to afford the care [25], by beliefs among a few providers that the benefits of surveillance were uncertain [33] or by perceived lack of active listening or interest in the patient [31].

For the system-related barrier category, the only recurrent mention was a lack of clarity in guidelines or lack of guidelines from certain national institutions [16, 19, 49].

Discussion

Reviewing patient, provider and system related barriers to monitoring, treatment and HCC surveillance of CHB patients, certain patterns emerged. These were mainly: lack of knowledge, financial difficulties and a preference for alternative treatments among patients; lack of knowledge, working in community clinics or being a PCP and attitude issues among providers and a lack of clear guidelines when it comes to system related barriers. It is important to mention that while these barriers have been identified in a subset of participants, they do not reflect the entire samples included in the studies (i.e., physicians' knowledge of CHB guidelines). These identified barriers and others are not however independent of the rest—some within category or between category barriers may mutually influence one another. For instance, the preference for herbal or dietary treatments in some cases may be tied to the patients' lack of knowledge about CHB, its progression and available treatments or reasons for monitoring and surveillance. At the same time, the patients' lack of knowledge may stem from the doctors' lack of knowledge and their subsequent omission of certain important details from the patients' appointments or from the doctors' beliefs that monitoring and surveillance offer no actual benefits for patients. Similarly, the physicians' lack of knowledge, especially PCPs, may stem from the lack of sufficient specialists in certain hospitals or clinics and from a lack of clear guidelines. There are currently several formal guidelines issued with respect to CHB developed by medical societies for management and treatment (i.e., the AASLD, the APASL, the EASL, WHO guidelines) and a lack of disease management guidelines from other organizations that may be more familiar to US practitioners (e.g., the US Preventive Services Task Force). Since some of these recommendations vary, these discrepancies in recommendations may lead to confusion among practitioners and to a failure to enforce the guidelines appropriately.

Given that many diagnosed CHB patients are currently not getting adequate monitoring and treatment [11], and that this lack of proactive health behavior can lead to potentially preventable liver cancer in about 25% of patients [1],

Table 1 Patient-related barriers to CHB monitoring, surveillance and treatment

References	Method	Study population	Sample size	Region in US	Patient-related barriers
Barriers to monitoring and surveillance					
Blanas et al. [14]	Focus groups	West African immigrant community organization leaders, community health workers, and experts in the field of viral hepatitis	39	New York	Lack of knowledge leading to fatalism Stigma Concerns regarding the confidential nature of health services Fear of costs Fear of deportation Lack of overt symptoms
Burke et al. [15]	Focus groups	Cambodian people	97	Seattle area	Preferences for alternative treatment Lack of knowledge regarding HBV
Burman et al. [16]	Cross-sectional survey on providers and retrospective evaluation of electronic patient records	Providers and CHB patients	148 providers; 1727 chronic hepatitis B patients	San Francisco area	Financial barriers Race other than Asian
Chao et al. [17]	Telephone interviews following a 1-day clinic including screening and seminars	Adult population	476 (13 of whom tested positive but did not see a physician within a year)	San Francisco Bay area	Lack of knowledge about importance of physician visits Lack of a physician Lack of time
Dam et al. [18]	Survey	Vietnamese Americans coming for a routine medical visit	170	Chicago, IL	Stigma
Fitzgerald et al. [19]	Cross-sectional survey	PCPs	109	NYC regions with highest number of African or Chinese-born individuals	Lack of patients' awareness of hepatitis and liver cancer risk Lack of insurance or cost to patients
Goldberg et al. [20]	Quantitative analysis based on the Truven health analytics databases	Chronic non-cirrhotic CHB patients	4576	Ann Arbor, MI, USA	Lower number of physician visits Non-PPO or POS commercial health insurance Rural status Presence of metabolic syndrome
Greene et al. [21]	Quantitative analysis based on the CDC racial and ethnic Approaches to community health (REACH)	Foreign-born individuals	31,031 out of whom 1285 reported HBV infection	US general	Ethnicity other than Vietnamese Lack of insurance
Ha et al. [22]	Cross-sectional study & phone follow-up	Vietnamese Americans	717	Northern California (Santa Clara County) & Southern California (Orange County)	Lack of knowledge regarding the existence of effective therapies for HBV

Table 1 (continued)

References	Method	Study population	Sample size	Region in US	Patient-related barriers
Han et al. [23]	Semi-structured interviews	PCPs	20	New York, NY	Lack of time Low patient priority for follow-up due to asymptomatic nature of disease- Miscommunication and language issues Healthcare costs & lack of insurance Cultural beliefs Lack of patients' knowledge Fear of illness
Hann et al. [24]	Industry-sponsored survey	CHB patients	258	7 major US cities	Asian race associated with lower severity of symptoms, lower impact on faily life, difficulties in finding certain healthcare providers, beliefs of not being well informed of test results, lack of confidence in doctor's knowledge, and more acceptance of CHB
Hu et al. [3]	REACH U.S. survey via telephone interviews, self-administered questionnaire mailing and in-person interviews	Minority individuals: African American, Hispanic, APIs, American Indian/Alaska natives	53,896	28 communities in 17 states	Lack of health insurance Female gender US-born
Hwang et al. [25]	Focus groups	PCPs (internal medicine, family and general practice), specialists (hepatologists and gastroenterologists), and other providers (pediatricians, obstetrician/gynecologists, other surgeons, and acupuncturists)	23	Houston, TX	Financial barriers Preference for complementary and alternative medicine
Hwang et al. [26]	Focus groups	Chinese, Korean and Vietnamese community members (leaders, members, less-acculturated members)	113	Houston, TX	Lack of knowledge (e.g., beliefs that HBV is curable) Preference for complementary and alternative medicine
Juday et al. [27]	Retrospective cohort study using health care claims data from the Ingenix LabRx dataset	Patients 18–65 years of age who have had at least one positive hepatitis B surface antigen (HBsAg) test and at least 12 months of continuous enrollment after initial diagnosis	1,168	USA (Northeast, South, Midwest, West regions)	Less comorbidity Female gender Midwest region

Table 1 (continued)

References	Method	Study population	Sample size	Region in US	Patient-related barriers
Jung et al. [28]	Quantitative analysis of data from electronic medical records and patient charts (regression analysis)	Adult CHB patients	1231 patients (HBV evaluation)	four facilities affiliated with the Los Angeles County Department of Health Services (LADHS)	Male sex Shorter duration of HBV infection Fewer visits to gastroenterology clinic More recent health-care contact
Khalili et al. [29]	Cross-sectional survey	Primary care and specialty providers	109	San Francisco safety net healthcare system	Difficulty accessing specialty care Financial barriers;
Kue and Thorburn [30]	Semi-structured interviews	Hmong population	83 (out of which 7 were hepatitis B positive)	Oregon	Lack of knowledge Lack of health insurance Belief that illness is not serious Symptoms of depression Cost of treatment Effects of cancer treatment
Lee et al. [31]	Semi-structured face-to-face interviews	Korean American HBV patients & key informants (community health leaders)	12 Korean Americans; 9 key informants	US general	Belief that illness is not serious Lack of knowledge -Stigma Lack of health insurance Difficulties in making appointments Language barriers
Lee et al. [32]	Individual interviews & focus groups	Cambodian America & Korean American community health leaders	9 Korean Americans; 14 Cambodian Americans	US general	Belief that illness is not serious Difficulties in understanding medical terminology Difficulties in making appointments Language Preference for alternative medicine For Cambodian Americans, lack of transportation and the need for co-payments For Korean Americans, lack of insurance Resorting to home or traditional remedies first
McGowan et al. [33]	Survey	PCPs	391	North Carolina	Poor adherence Financial constraints Lack of insurance and insurance constraints on coverage

Table 1 (continued)

References	Method	Study population	Sample size	Region in US	Patient-related barriers
Sarkar et al. [34]	Retrospective cohort study	HBV-infected Asian Americans	1646 active patients; 1431 patients with follow-up throughout the year	San Francisco safety net healthcare system	No presence of cirrhosis Not attending a liver clinic Not testing for HBeAg
Wang et al. [35]	Retrospective medical chart review	CHB patients with and without cirrhosis	1329	San Francisco Bay Area	Having no cirrhosis
Widjaja et al. [36]	Retrospective review of patient medical records	CHB patients	167	South Bronx, NY	Lack of insurance
Xu et al. [37]	Screening events with initial survey and lectures, and follow-up (for HBV positive individuals) via letters and subsequently telephone	Asian American adults	7,387	Los Angeles County	Lack of medical insurance or financial means Lack of interest in monitoring illness Lack of time
Barriers to treatment					
Chotiyaputta et al. [38]	Self-reported questionnaire, assessment of patients' medication adherence and evaluation of medical records	Adult CHB patients	111	University of Michigan Health System	Forgetfulness Travelling away from home
Fitzgerald et al. [19]	Cross-sectional survey	PCPs	109	NYC regions with highest number of African or Chinese-born individuals	Lack of patients' awareness of hepatitis and liver cancer risk Lack of insurance of cost to patients
Hann et al. [24]	Industry-sponsored survey	CHB patients	258	7 major US cities	Asian race Not being under the care of a physician Lack of insurance Lower education level Unemployment Lower income Lower reports of symtpoms
Jung et al.* [28]	Quantitative analysis of data from electronic medical records and patient charts (regression analysis)	Adult CHB patients	691 patients (HBV treatment)	Four facilities affiliated with the Los Angeles County Department of Health Services (LADHS)	HIV negative status Not having received a liver biopsy No HBeAg or HBV-DNA testing Shorter duration of HBV infection Fewer visits to gastroenterology clinic Less recent health-care contact

Table 1 (continued)

References	Method	Study population	Sample size	Region in US	Patient-related barriers
Malespin et al. [39]	Retrospective systematic review of patient data	CHB patients	69	Chinatown Internal Medicine practice in Chicago, IL	Concerns over long-term safety Cost of medical care associated with treatment Preference for herbal therapy Patient relocation Financial hardship Anticipation of pregnancy
Nguyen et al. [40]	Retrospective analysis of patient data	CHB patients	1402	San Francisco Bay area	Financial difficulty Patient preference Younger age; female sex; lower HBV DNA & ALT levels
Tokes et al. [41]	Face-to-face structured survey	CHB patients from Chinese, Korean, and Vietnamese communities	252	New York metropolitan, San Francisco/Bay, and Los Angeles/Orange County areas	Out-of-pocket costs Concerns over medication side-effects and long-term efficacy among a minority of participants Beliefs that lifestyle and diet are sufficient to manage CHB
Upadhyaya et al. [42]	Survey (via telephone for Asian Americans; online for PCPs)	Asian Americans; PCPs	610 Asian Americans; 393 physicians	Asian Americans from New York, Pennsylvania, Washington, DC, California, Connecticut, Massachusetts, Nevada, Oregon, Virginia, Texas, Minnesota, and Illinois; PCPs from New York/northern New Jersey/Long Island, Los Angeles/Riverside/Orange County, San Francisco/Oakland/San Jose, Chicago/Gary/Kenosha, Houston/Galveston/Brazoria, Washington, DC/Baltimore, Seattle/Tacoma/Bremerton, and Honolulu	Belief among half of participants that there is no effective drug to treat CHB Concerns over adverse effects associated with long-term treatment Preference for herbal treatment among one-fifth
Vu et al. [43]	Retrospective cohort study	Treatment-eligible patients with CHB	608	Community GI clinic and academic liver clinic in the San Francisco Bay area	Being female, younger, not having cirrhosis, having lower baseline ALT and lower HBV DNA
Widjaja et al. [36]	Retrospective review of patient medical records	CHB patients	167	South Bronx, NY	Lack of insurance Consumption of injection drugs Heavy alcohol use
Wu et al. [44]	Retrospective review of patient charts	CHB patients	962	Research patient data registry at partners healthcare	Younger age Being an inactive carrier

Table 1 (continued)

References	Method	Study population	Sample size	Region in US	Patient-related barriers
Zhang et al. [45]	Retrospective cohort study	CHB patients	612	California, San Francisco Bay Area	Financial difficulties Pregnancy or future pregnancy Lower ALT levels

HBV hepatitis B virus, *CHB*, chronic hepatitis B, *PCPs* primary care physicians, *PPO* preferred provider organization, *POS* point of service, *ALT* alanine aminotransferase

further measures need to be taken to address these barriers and thus increase monitoring and surveillance. Despite the fact that most interventions have little to no effect on increasing screening uptake for a variety of conditions [55, 56], being able to know the potential barriers that might affect monitoring and surveillance among patients may lead to a better understanding of how to design such interventions or better yet how to more rapidly identify and address such barriers individually.

While systematic reviews have been conducted for other regions, such as Europe [57], there are differences in monitoring and surveillance uptake rates between Europe and North America, which may raise the possibility of different barriers or more barriers in the US compared to other regions [11]. In Europe, the systematic review study [57] found barriers in the care and treatment (combined) of CHB such as having an immigrant status or lack of knowledge. This review fleshes out findings in terms of monitoring, treatment, and surveillance separately, and tries to go beyond immigrant status, by looking at cultural or attitudinal variables, at affordability of care for people or at system-related barriers which might partially explain providers' decisions.

Some of the barriers included in this review come from retrospective studies based on regression analyses. These barriers were not directly identified by participants but inferred as barriers due to predicting lack of adequate surveillance or their opposites predicting adequate surveillance. Moreover, the ability to predict an outcome does not mean that the variable is the actual cause of that outcome and thus is necessarily a barrier. For example, being treated by a PCP as opposed to a specialist has been found to predict lower monitoring and HCC surveillance rates. However, this cannot be attributed to being a PCP in and of itself, but more likely to the fact that PCPs have less specific training in CHB, that they see patients with a wider variety of conditions and that CHB is rarer in their practice compared to specialists such as gastroenterologists or hepatologists. Similarly, some studies have found that having cirrhosis is a predictor of optimal surveillance rates [35]. This of course does not mean that patients should increase cirrhosis rates in order to receive better care, but that patients with a more severe status are monitored and treated more thoroughly by their physicians since their risk of developing HCC is also higher, as per the guidelines. While we searched four different databases for studies on barriers in the US, this is not a comprehensive review of all published work, nor did our study include unpublished work which may have contained elements not presented in this paper.

Understanding which the most frequently mentioned barriers in the literature are may help guide future research efforts which explore gaps, help providers address common barriers in their practice to obtain higher adherence rates, guide future overarching efforts of establishing national

Table 2 Provider-related barriers to CHB monitoring, surveillance and treatment

References	Method	Study population	Sample size	Region in US	Provider-related barriers
Barriers to monitoring and surveillance					
Bharadwaj and Gohel [46]	Survey questionnaire	Physician (residents and fellows)	177	Cleveland Clinic, Metro health Hospital and Fairview Hospital (Ohio)	Inconsistent surveillance methods Lack of adherence to AASLD guidelines
Burman et al. [16]	Cross-sectional survey on providers and retrospective evaluation of electronic medical records	Providers and CHB patients	148 providers; 1727 chronic hepatitis B patients	San Francisco Bay area	Difficulty accessing specialty care resources Lack of awareness of AASLD guidelines Older provider age
Chao et al. [17]	Telephone interviews following a 1-day clinic including screening and seminars	Adult population	476 (13 of which tested positive but did not see a physician)	San Francisco Bay area	Lack of adherence of HBV guidelines
Chao et al. [47]	Survey	Physicians (interns, second-year residents, chief residents, attending physicians)	219	Santa Clara County	Lack of knowledge
Chaudhary et al. [48]	Simulation center study with an illiterate CHB patient case study	Second-year fellows from NYC	12	New York City GI training programs (Cornell University, Columbia University, Mount Sinai Hospital, and New York University School of Medicine programs)	Failure to recognize and address patient's literacy level
Dalton-Fitzgerald et al. [49]	Web-based survey	PCPs (who reported seeing at least 1 patient with cirrhosis per week)	77	The Parkland Health and Hospital System, Dallas County	Not updated on current guidelines Difficulties with effective communication with patients about HCC surveillance More important issues to manage Problems identifying at-risk population Radiologic capacity -Male physicians Provider type (other than midlevel)
Ferrante et al. [50]	Survey	Family physicians	217	Seven counties within north and central New Jersey	Lack of knowledge of and lack of adherence to guidelines Male physicians Single practice
Fitzgerald et al. [19]	Cross-sectional survey	PCPs	109	NYC regions with highest number of African or Chinese-born individuals	Lack of knowledge regarding guidelines for HBV surveillance

Table 2 (continued)

References	Method	Study population	Sample size	Region in US	Provider-related barriers
Goldberg et al. [20]	Quantitative analysis based on the Truven Health Analytics databases	Chronic non-cirrhotic CHB patients	4576	Ann Arbor, MI, USA	Diagnosis and care by a non-gastroenterologist
Han et al. [23]	Semi-structured interviews	PCPs	20	New York, NY	Lack of time Lack of knowledge
Hwang et al. [25]	Focus groups	Primary care providers (internal medicine, family and general practice), specialists (hepatologists and gastroenterologists), and other providers (pediatricians, obstetrician/gynecologists, other surgeons, and acupuncturists)	23	Houston, TX	Lack of knowledge Language barriers and cultural differences Perceptions regarding patients' affordability of care
Khalili et al. [29]	Cross-sectional survey	Primary care and specialty providers	109	San Francisco safety net healthcare system	Unfamiliarity with AASLD guidelines Lack of knowledge Having less than 25% Asian patients
Lee et al. [31]	Semi-structured face-to-face interviews	Korean American CHB patients & key informants (community health leaders)	12 Korean Americans; 9 key informants	US general	Health care providers' attitude
Lee et al. [32]	Individual interviews & focus groups	Cambodian American (CA) & Korean American (KA) community health leaders	9 KAs; 14 CAs	US general	Healthcare providers' attitude
McGowan et al. [33]	Survey	PCPs	391	North Carolina	Lack of awareness of and adherence to guidelines Beliefs that surveillance has no benefits Perceptions regarding patients' affordability of care
Mukhtar et al. [51]	Survey	PCPs	277	San Francisco	Unfamiliarity with AASLD guidelines Lack of knowledge Not speaking an Asian language Older age Serving a patient panel with less than 25% of patients speaking English as a second language Practicing within the safety net setting

Table 2 (continued)

References	Method	Study population	Sample size	Region in US	Provider-related barriers
Sarkar et al. [52]	Retrospective electronic medical records study	CHB patients followed in the Kaiser Permanente Medical Care Program	12,016	San Francisco and Sacramento Greater Metropolitan areas	Provider type—patients treated by specialists received more frequent monitoring than those seen by PCPs
Sharma et al. [53]	Survey including 12 clinical scenarios	Gastroenterologists (GIs)	160	Attending the William Steinberg Board Review in Gastroenterology, or the Mayo Clinic Gastroenterology and Hepatology Board Review	Lack of knowledge of AASLD guidelines regarding scenarios on HCC screening in HBV patients Belief that surveillance can prevent only a minority of HCC deaths
Upadhyaya et al. [42]	Survey (via telephone for Asian Americans; online for PCPs)	Asian Americans; PCPs	610 Asian Americans; 393 physicians	Asian Americans from 14 states; PCPs from 22 cities	Lack of knowledge of and adherence to guidelines Inconsistent monitoring practice
Wang et al. [35]	Retrospective medical chart review	CHB patients with and without cirrhosis	1329	San Francisco Bay Area	Being cared for at a community clinic as opposed to an academic center Having fewer visits per year
Wu et al. [44]	Retrospective review of patient charts	CHB patients	962	Research Patient Data Registry at Partners Healthcare	Seeing a PCP as opposed to a gastroenterologist Lack of adherence to AASLD guidelines
Barriers to treatment					
Fitzgerald et al. [19]	Cross-sectional survey	PCPs	109	NYC regions with highest number of African or Chinese-born individuals	Lack of knowledge regarding benefits of antiviral treatment in improving outcomes
Mukhtar et al. [51]	Survey	PCPs	277	San Francisco	Lack of familiarity with treatment eligibility criteria
Nguyen et al. [40]	Retrospective analysis of patient data	CHB patients	1402	San Francisco Bay Area	Care only at primary care clinics Desire for further observation PCPs (vs. GIs)
Vu et al. [43]	Retrospective cohort study	Treatment-eligible patients with CHB	608	A community GI clinic and a university liver clinic in the San Francisco Bay Area	Desire for further observation -Being treated at a community GI clinic as opposed to an academic center
Zhang et al. [45]	Retrospective cohort study	CHB patients	612		Desire for further observation

CHB chronic hepatitis B, *HBV* hepatitis B virus, *PCPs* primary care physicians, *HCC* hepatocellular carcinoma

Table 3 System-related barriers to CHB monitoring and surveillance

References	Method	Study population	Sample size	Region in US	System-related barriers
Barriers to monitoring and surveillance					
Blanas et al. [14]	Focus groups	African community organization leaders, community health workers, and experts in the field of viral hepatitis	39	New York	Ineligibility for health insurance under the Affordable Care Act for undocumented immigrants
Burman et al. [16]	Cross-sectional survey on providers and retrospective evaluation of electronic patient records	Providers and CHB patients	148 providers; 1727 chronic hepatitis B patients	San Francisco area	Lack of clarity of guidelines
Caballero et al. [54]	Cross-sectional needs assessment	Health education directors and medical providers	13 health education directors; 14 medical providers	San Jose, CA; Oakland, CA; Chicago, IL; Los Angeles, CA; Hilo, HI; New York, NY; Worcester, MA; Seattle, WA; Honolulu, HI; Ebeye, Republic of the Marshall Islands; Lowell, MA; San Francisco, CA; Waianae, HI; Waimanalo, HI	Lack of clear protocols in certain community centers Lack of coordination between prevention and hepatitis B related medical services Lack of funding
Dalton-Fitzgerald et al. [49]	Web-based survey	PCPs (who reported seeing at least 1 patient with cirrhosis per week)	77	The Parkland Health and Hospital System, Dallas County	No reminder systems for HCC surveillance A lack of US Preventive Services Task Force recommendations
Fitzgerald et al. [19]	Cross-sectional survey	PCPs	109	NYC regions with highest number of African or Chinese-born individuals	Lack of clear guidelines for HBV Lack of referral options for patients found to have liver cancer
Khalili et al. [29]	Cross-sectional survey	Primary care and specialty providers	109	San Francisco safety net healthcare system	Lack of imaging resources Unclear HCC screening guidelines
Lee et al. [31]	Semi-structured face-to-face interviews	Korean American HBV patients & key informants (community health leaders)	12 Korean Americans; 9 key informants	US general	Complicated multi-stage service operations
McGowan et al. [33]	Survey	PCPs	391	North Carolina	Lack of available surveillance services among a minority of participants

CHB chronic hepatitis B, *PCPs* primary care physicians, *HCC* hepatocellular carcinoma, *HBV* hepatitis B virus

guidelines and direct outreach efforts among non-profits geared towards the CHB population.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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