HHS Public Access

Author manuscript

Cancer Causes Control. Author manuscript; available in PMC 2019 August 07.

Published in final edited form as:

Cancer Causes Control. 2018 December ; 29(12): 1265–1275. doi:10.1007/s10552-018-1094-0.

PROMISING Practices for the Prevention of Liver Cancer: a review of the literature and cancer plan activities in the National Comprehensive Cancer Control Program

Behnoosh Momin, DrPH, MS, MPH[1], **Alexander J. Millman, MD**[2], **Danielle Beauchesne Nielsen, MPH**[3], **Michelle Revels**[3], **C. Brooke Steele, DO**[1]

[1]Division of Cancer Prevention and Control, Centers for Disease Control and Prevention, Atlanta, GA

[2]Division of Viral Hepatitis, Centers for Disease Control and Prevention, Atlanta, GA

[3]ICF, Atlanta, GA

Abstract

Introduction: Hepatitis B virus (HBV) and hepatitis C virus (HCV) infections are risk factors for hepatocellular carcinoma, a type of primary liver cancer, and are most prevalent in people born 1945–1965. Relatively little information is available for liver cancer prevention, compared to other cancers. In this review, we provide a summary of current promising public health practices for liver cancer prevention from the literature, as well as liver cancer-related initiatives in the National Comprehensive Cancer Control Program (NCCCP).

Methods: Two types of source materials were analyzed for this review: published literature (2005-present), and current cancer plans from the NCCCP (2005–2022). A search strategy was developed to include a review of several scientific databases. Of the 73 articles identified as potentially eligible, 20 articles were eligible for inclusion in the review. Eligible articles were abstracted using a data abstraction tool. Three independent keyword searches on 65 NCCCP plans were conducted. Keyword searches within each of the plans to identify activities related to liver cancer were conducted. Relevant information was abstracted from the plans and saved in a data table.

Results: Of the 20 eligible articles, 15 articles provided information on interventions related to liver cancer and hepatitis B or hepatitis C prevention. All 15 of the intervention articles were related to hepatitis; 13 were hepatitis B-focused, two were hepatitis C-focused, and 14 focused on Asian/Pacific Islander American populations. The independent keyword search of NCCCP plans produced 46 results for liver, 27 results for hepatitis, and 52 results for alcohol. Two plans included activities related to liver cancer. Twenty-four plans included activities related to hepatitis.

Address for Correspondence: Dr. Behnoosh Momin, 4770 Buford Highway, MS F-76, Atlanta, GA 30341, Telephone: (770) 488-3112, BMomin@cdc.gov, Fax: (770) 488-4335.

Conflicts of Interest: None.

Discussion: A majority of the intervention articles published focused on HBV infection in Asian/Pacific Islander American populations, and a small percentage of NCCCP plans included liver-related content. The findings from this review will inform the development of an Action Plan on liver cancer prevention for the NCCCP, which will assist programs with the adoption and uptake of promising practices for the prevention of liver cancer.

Keywords

comprehensive cancer control; carcinoma; hepatocellular; primary prevention; health promotion

Introduction

Worldwide, liver cancer is the fifth most common cancer among men, the ninth most common cancer among women, and the second most common cause of cancer death for men and women combined [1]. In the United States, each year approximately 31,000 new cases of liver cancer are diagnosed and almost 25,000 people die from the disease [2]. Liver cancer is more common in men than women, and among Asian/Pacific Islander, Hispanic and American Indian/Alaska Native populations compared with other racial and ethnic groups [2]. The five-year net survival rate for liver cancer is 14.8% [3]. Liver cancer incidence has been increasing in the United States since the mid-1970s [4]. A major factor contributing to the increase in hepatocellular carcinoma (HCC), the most common type of liver cancer, is a high prevalence of chronic hepatitis C virus (HCV) infection among “baby-boomers,” or those born during 1945 through 1965 [4]. Increases in obesity and type II diabetes over the past several decades have also likely contributed to the increasing liver cancer trend, because of their association with non-alcoholic fatty liver disease (NAFLD) and non-alcoholic steatohepatitis (NASH) [5]. Other notable risk factors for development of HCC include chronic infection with hepatitis B virus (HBV) and alcoholic cirrhosis [6].

Due to recent advances in treatment, hepatitis C is now curable with short and easily tolerable courses of treatment [7]. Most cases of HBV infection can be prevented through vaccination [8]. The extent to which these preventive interventions are adopted within populations is unclear. The Centers for Disease Control and Prevention’s (CDC) National Comprehensive Cancer Control Program (NCCCP) is well positioned to raise awareness of the growing incidence of liver cancer and the critical role prevention efforts can play in reducing future incidence and liver cancer-related morbidity and mortality. Recipients of NCCCP funding develop specific plans to address the burden of cancer in their population. Current recipients of funding include all 50 states, the District of Columbia, and several tribes and territories [9].

In 2010, a review of NCCCP plans for liver cancer prevention activities revealed that most plans did not address the connection between chronic HBV and/or HCV infections and liver cancer, and only a few plans mentioned prevention activities to reduce the burden of liver cancer [10]. In order to increase uptake and identify liver cancer prevention activities that can be included in NCCCP plans for the broader cancer control community, we undertook a review of the current literature related to public health liver cancer prevention efforts to inform the NCCCP, and also conducted an updated review of NCCCP plans. The findings

from this review will inform the development of an Action Plan on liver cancer prevention for the NCCCP, which will assist programs and the cancer community with the adoption and uptake of relevant, non-clinical, promising practices for the prevention of liver cancer.

Methods

Data Sources

Published Literature—For the review of published literature, we developed a strategy to search several scientific databases, including PubMed and EBSCOhost (which included seventeen databases within EBSCO), for interventions within the scope of NCCCP capabilities. Table 1 lists the search terms and phrases used for the published literature.

We used a two-step process to determine final eligibility for inclusion in this review. First, we reviewed article abstracts to determine if they were: 1) published in English; 2) published in peer-reviewed publications including government reports, reviews, dissertations, and conference abstracts; 3) published between 2005 and 2015 and 4) focused on research-tested interventions (non-clinical) or promising practices, strategies, or activities related to liver cancer prevention or hepatitis B/hepatitis C prevention that would serve to inform the work of the NCCCP and broader cancer control community.

Because the objective of our review is to increase adoption of practices within the NCCCP and the broader cancer control community, the setting for eligible intervention studies was also restricted to the geographic areas where NCCCP-supported programs are located (states, tribes, and territories). Based on this preliminary review, if an abstract met all the eligibility requirements, we reviewed and abstracted the full article. Of the 73 articles identified as potentially eligible, 20 articles were eligible for inclusion in this review. It is important to note that if an article was not directly tied to the prevention of liver cancer, it was excluded from further review. All eligible articles were abstracted using a data abstraction tool that included data points (topic, citation, study description, article focus, study year, study design, study sample, intervention type, outcomes, etc.) for abstraction and a description of those data points. Following abstraction, we grouped the articles in seven relevant topic areas. Table 2 provides details on the number of articles based on eligibility within each topic. Three investigators were each assigned, and responsible for abstracting data from a unique subset of the 20 eligible articles. One of the three investigators reviewed data abstracted across all articles for accuracy.

NCCCP Plans—NCCCP plans are publicly available and were obtained from the CDC website at https://www.cdc.gov/cancer/ncccp/index.htm using the search tool available on the website, we conducted three independent keyword searches for the terms liver, hepatitis, and alcohol of all 65 NCCCP plans currently available on the website. We conducted subsequent keyword searches within each of the individual 65 plans to identify goals, strategies, objectives, activities, and other elements related to liver cancer within each plan. Relevant information was abstracted from the plans. All searches were done by one investigator and content abstracted was reviewed for accuracy by all investigators.

Results

Published Literature

Of the 20 eligible articles, four were systematic reviews, one primarily provided recommendations, and 15 described specific interventions or programs related to: hepatitis B, hepatitis C, or liver cancer prevention. The four systematic reviews were published between 2012–2015 [11–14] and one [15] was a “report and recommendation article” published in CDC’s Morbidity and Mortality Weekly Report. Of the 15 intervention articles (Table 2), 13 focused on hepatitis B, two focused on hepatitis C, and 14 focused on Asian/Pacific Islander American populations [16–30]. None of these articles were related to alcohol or NAFLD/NASH, discussed baby boomers, people in urban areas, or areas with high rates of intravenous drug use.

Surveillance

Surveillance was discussed in the systematic reviews and recommendations article, but not in the intervention articles. One study emphasized the importance of investing in surveillance of hepatitis B and hepatitis C to guide prevention efforts. In addition to reporting to health departments, Perez et al. recommended that hepatitis B and hepatitis C **s**urveillance include identifying persons requiring counseling and linkage to care [14]. Similarly, Meyers et al. reported that primary care settings located in clinics serving homeless persons, or people who inject drugs represent key opportunities for hepatitis C care linkage interventions [12]. They also indicated that once patients are successfully diagnosed, linked to care, and initiated on treatment, adherence to medication therapy needs to be optimized [12]. Meyer [12] recommends strategic incorporation of evidenced-based interventions into hepatitis C treatment implementation efforts to most effectively deliver treatment and maximize treatment outcomes.

Other studies described in the systematic reviews also recommended development of surveillance registries for HBV infection. These registries can facilitate the notification, counseling, and medical management of persons with chronic HBV infection [15]. Registries can include the following elements: 1) demographic characteristics; 2) serologic test results; 3) ethnicity and/or country of birth; 4) information about contacts identified and managed; and 5) medical referrals made [15].

Knowledge and Awareness

Fifteen articles described knowledge and awareness interventions and provided information on primary and/or secondary outcomes. The majority of these interventions (n=12) described interventions that were culturally and linguistically tailored for Asian American populations. They included lay health worker interventions, community-based outreach programs, health education interventions, electronic health record (EHR) prompts, faith-based interventions, and mass media campaigns. Three of the eligible studies [16, 19, 30] described interventions developed using the Health Behavior Framework, [31] which represents a synthesis of several of the major health behavior change theories. The framework guided the development of data collection instruments and intervention design and implementation.

One study [27] described the intervention components from four studies [16, 19, 30] that were used to promote hepatitis B testing. These studies primarily focused on modifying individual (e.g., knowledge, health beliefs, patient-provider communication) and community level (e.g., social norms) factors of the Health Behavior Framework [27]. These studies described the type and degree of modification necessary to culturally tailor the intervention approaches and messages [27].

Improvements in knowledge of hepatitis B or hepatitis C and screening behaviors were also commonly observed among intervention participants. Increases in knowledge were typically assessed through self-report questionnaires and were reported in five of the eligible studies [19–20, 28–30]. One study reported an experimental lay health worker group was more likely than the control group to know that: Cambodian Americans have higher rates of HBV infection than whites, HBV cannot be spread by eating food prepared by an infected person, HBV cannot be spread by sharing chopsticks, and HBV cannot be spread by shaking hands [30]. Another study that offered a lay health worker intervention for Hmong Americans found statistically significant differences (mean knowledge score gain between pre-tests and post-tests) detected in 6 out of 11 hepatitis B-related knowledge items for the intervention group (e.g., one cannot get HBV infection by sharing food/eating utensils, Hmong are more likely than white Americans to be infected with HBV), compared to only 1 item for the control group (HBV causes liver cancer) [19]. A study that examined the impact of delivering lecture-based, community hepatitis B education found that all eight participating Asian groups had statistically significantly improved knowledge of hepatitis B and its transmission at post-test compared to a pre-test [20–21].

Two literature reviews provided three recommendations for developing effective patient and provider education programs. Perez et al. made a recommendation to develop and/or disseminate health education programs for the general public, high-risk populations, and decision makers. This can be accomplished through awareness campaigns, health communication activities, and community outreach to promote education and knowledge about the risk factors, prevention, and transmission of HCV, importance of testing and counseling, medical management of the condition to prevent chronic liver disease, and identification of facilities that offer integrated care and service delivery for infected individuals [14]. Another recommendation from Perez et al. was to create a professional training program for health care and social service providers regarding the prevention, detection, and medical management of persons infected with HCV, HBV, and HIV in order to help them deliver better services to infected patients [14]. Lastly, patient education can be conducted in a culturally sensitive manner in the patient's primary language (both written and oral when possible). Ideally, bilingual, bicultural, and medically trained interpreters could be used when indicated [15].

Immunization

Two articles described immunization interventions in the context of liver cancer prevention. For those individuals who are susceptible to HBV infection, completion of the vaccination series is the essential step preventing infection. Immunization could prevent 95% of infections [32–33]. One of the studies examined factors associated with outcomes of blood

screening and infection status among five Asian-American group and found that age and race/ethnicity were associated with immunization status. Older persons were more likely to be immunized than younger persons [21]. Compared with the other Southeast Asian groups, Chinese, Korean, and Vietnamese persons were more likely to receive vaccinations than Asian Indians [21].

CDC recommendations state that prior to receiving hepatitis B immunization, most individuals should have their HBV serologies tested to avoid unnecessarily vaccinating individuals who are already chronically infected with HBV, or those who were infected and cleared the virus and are now immune [34]. Chronically infected individuals should be linked to care [34]. Another study [17] provided results from a pilot program that offered free HBV testing with low-cost hepatitis B vaccination. At an annual symposium on hepatitis B prevention and education organized by a local community organization in California, sponsors offered participants free HBV serologic testing; over half were tested [17]. At a follow-up event, 72 participants paid a discounted fee for the hepatitis B vaccine, with the first shot administered on-site and follow-up shots scheduled 1 and 6 months later [17]. Results from this pilot study indicated that out of 1106 adults tested, 9% were chronically infected with HBV, and 53% were susceptible. Of those who chose to have the hepatitis B or combined hepatitis B/hepatitis A vaccine at their first visit, 87% of unprotected adults and 81% of untested adults completed the hepatitis B vaccination [17].

Viral Hepatitis Services

Four articles described viral hepatitis services interventions. A systematic review conducted in 2012 [11] highlighted research findings associated with reducing the development of HCC in patients with HCV-related liver cirrhosis. This involved confining intensive screening and prevention programs to high-risk patients, hepatitis B vaccinations, counseling newly infected patients, testing for HCV in all persons with risk factors for infection, treatment for all HCV-infected persons and preventing chronic liver disease of any etiology, including alcohol.

Another study assessed the effectiveness of EHR prompts to increase HBV testing in Chinese and Vietnamese patients within an academic health system [22]. A randomized controlled trial conducted for this study in 2011 found that providers ordered hepatitis B surface antigen (HBsAg) tests for 36 out of 88 (40.9%) of the intervention patients, and only 1 out of 87 (1.1%) of the control patients. Results from this study indicate that EHR-based provider prompts significantly increase HBV testing in Chinese and Vietnamese patients when compared to usual care.

Three studies included under knowledge and awareness described educational interventions conducted with a specific Asian subgroup (Korean, Cambodian and Hmong Americans) to increase the number of individuals who get tested for hepatitis B [16, 19, 30]. Each of the interventions included a culturally relevant educational session that reviewed HBV, liver cancer, and the importance of being tested as well as vaccinated against hepatitis B. One study examined use of patient navigators to take participants to a healthcare provider for testing, or for follow-up if they tested positive [19]. In all three studies, researchers followed

up with participant's 6-month post-intervention and reported that the intervention group was more likely to report receiving a HBV test than the control group.

In addition to hepatitis testing, patients who test positive for HBV or HCV infection should receive appropriate follow-up and treatment services [12, 15]. Primary care settings represent key linkage opportunities, particularly if these practices have ties to populations at high risk for HBV or HCV infection [12, 15]. Additionally, strategies to expand linkages to hepatitis C treatment could include correctional settings, because of the high prevalence of disease and the highly structured nature of a controlled environment; however, this setting is underutilized [12].

NCCCP plans

The independent keyword search of 65 NCCCP plans identified 59 plans that mentioned one of three keywords: liver (46 plans), hepatitis (27 plans), and alcohol (52 plans). Of these 59 plans, 36 were created in 2015 or earlier. Table 4 provides examples of the types of HBV-, HCV- and alcohol-related activities awardees planned.

We identified 26 NCCCP plans that included specific goals and strategies to address liver cancer prevention and control. The "hepatitis" keyword search yielded 24 plans that included goals, objectives, strategies, or activities; the "liver" keyword search yielded two plans that included goals, objectives, strategies, or activities. Among the 24 plans addressing hepatitis, goals, objectives, and strategies were most commonly framed within the context of infectious diseases or immunization and focused on HBV knowledge and awareness and immunization.

The keyword search using the term "alcohol" yielded 21 plans that included goals, objectives, and strategies related to alcohol. These plans used the framework of healthy lifestyle, eating, or healthy nutrition to focus on reducing consumption beyond recommended levels.

Discussion

Investing in surveillance of hepatitis B and hepatitis C is essential to the prevention of liver cancer, suggesting the need for the NCCCP to continue to help with tracking vaccine uptake, but also identifying those requiring counseling and linking them to care. Although the literature recommends strategic incorporation of evidence-based interventions into hepatitis C treatment implementation efforts, the recommendation did not specify which interventions to implement [12]. Therefore, the NCCCP could be engaged in identifying strategies within their population for retaining people with HCV infection in care even after successful completion of treatment, as well as for continued surveillance of liver cancer (for those with advanced liver disease at the time of hepatitis C treatment) and of reinfection.

The findings focused on the need to modify individual and community level factors of the Health Behavior Framework to promote hepatitis B testing [27]. NCCCPs are actively engaged in increasing knowledge and awareness on hepatitis B vaccination, and improving health professionals' knowledge related to the increased use of the vaccine. However, there

is an opportunity for the NCCCP to help with culturally tailoring the intervention approaches and messages for their respective populations. Delivering lecture-based hepatitis B education has been shown to significantly improve knowledge of hepatitis B and its transmission [20–21], suggesting that the NCCCP can facilitate the modification of existing educational campaigns to incorporate this promising intervention in their population. Additionally, the development and dissemination of effective patient and provider education programs, and professional training programs to state cancer programs and key clinical staff is essential in order to help them deliver better services to infected patients. The NCCCP can help implement these programs through the development of awareness campaigns and community outreach initiatives within their population. NCCCPs could ensure that these educational programs promote education and knowledge about the risk factors, prevention, and transmission of HCV, importance of testing and counseling, medical management of the condition to prevent chronic liver disease, and identification of facilities that offer integrated care and service delivery for infected individuals [14]. NCCCPs could also ensure that these educational programs are conducted in a culturally sensitive manner. Additionally, the training programs developed and delivered by NCCCPs could include information on the prevention, detection, and medical management of persons infected with HCV and HBV, in order to help them deliver better services to infected patients [14].

Hepatitis B vaccination is the most effective way to prevent HCC, the most common type of liver cancer, associated with chronic HBV infection [11]. In 2008, the CDC recommended hepatitis B testing for persons born in countries where HBV infection prevalence is ≥2%, which includes much of sub-Saharan Africa and Asia. In 2014, the United States Preventive Services Task Force (USPSTF) also recommended hepatitis B testing for these populations [35]. Therefore, another promising practice for the prevention of infection and liver cancer for those individuals who are susceptible to HBV infection includes completion of the vaccination series. Hsu and colleagues [21] found that age and race/ethnicity were associated with immunization status, therefore NCCCP awardees, through a needs assessment, can reach out to those populations that are less likely to receive vaccinations. Providing a discounted fee for the hepatitis B vaccine has been shown to improve completion of the vaccination, [17] suggesting that NCCCPs could partner with local community organizations to offer similar incentives, or promote existing vaccination programs.

In 2017, the National Academies of Sciences, Engineering, and Medicine, published a phase two report on a national strategy for the elimination of hepatitis B and C [7]. In the report, the authors stated that diagnosing 90 percent of cases, bringing 90 percent of those to care, and treating 80 percent of those for whom treatment is indicated, would result in a cumulative 50 percent reduction in mortality by 2030, averting over 60,000 deaths. The same level of diagnosis, care, and treatment would reduce incident liver cirrhosis by about 45 percent and new cases of HCC by a third [7]. Thus, NCCCPs can play a critical role in reducing the development of liver cancer in patients with HCV-related cirrhosis by helping to deliver and implement prevention programs to high-risk patients. These programs could include testing for hepatitis C in all persons with risk factors for infection and treatment for all HCV-infected persons. NCCCP-supported programs could expand their primary care partnerships to include local clinics that serve populations at high risk for viral hepatitis

infection (e.g., individuals who inject drugs or are homeless) to screen them for hepatitis C and link them to care. The major challenge in scaling up hepatitis C treatment is currently increasing testing to identify those infected and reducing payer imposed restrictions to treatment access [36]. NCCCP awardees could develop new or strengthen existing partnerships within their state health departments' hepatitis program so that they can work in a more coordinated manner to reach high risk individuals and increase their awareness of liver cancer and the need for increased prevention efforts. Risk-based testing guidelines were issued in 1998 by CDC, to recommend hepatitis C testing in persons at high risk for HCV infection, including past or current injection drug users and those in receipt of a blood transfusion before 1992. In 2012, the CDC recommended 1-time hepatitis C testing for individuals born during 1945 through 1965 (i.e., "baby boomer" generation) regardless of ascertainment of other risk factors [37] because of the high prevalence in that population (~3% versus ~1% in the general populations). The following year, the USPSTF issued similar recommendations [38]. These populations were targeted because there is evidence of an increased burden of HCV infection and liver cancer-associated mortality among this birth cohort. Even though baby boomers' risk is elevated, a 2013 National Health Interview Survey indicated that only 12.3% reported receiving hepatitis C testing [39]. These recommendations provide a unique opportunity for NCCCP awardees to identify settings appropriate for viral hepatitis vaccination, screening, and treatment in communities, as well as to work with partners and state and local health departments to support standard case finding measures and ensure follow-up and monitoring of people with HBV and HCV infections.

Two additional promising practices found in the literature include EHR-based provider prompts and the use of patient navigators. Hsu and colleagues [22] indicate that EHR-based provider prompts can increase hepatitis B testing in patients when compared to usual care; thus, EHR prompts are a promising intervention that can be utilized by the NCCCPs. Lastly, the use of patient navigators to take participants to a healthcare provider for testing, or for follow-up if tested positive, is another promising practice that could be adopted by the programs.

This review was subject to several limitations. First, among studies identified in the published and grey literature, some intervention details were missing such as information on the necessary resources needed to implement the intervention successfully. Because this information was missing, we made "informed inferences" about the types of resources necessary for intervention implementation. Second, interventions identified in the published literature focused on the individual level, which may be less relevant to the NCCCP given the program's emphasis on increasing population-based health. Third, there is a lack of generalizability in most of the intervention studies identified in the published and grey literature. Almost all focused on Asian American subpopulations (e.g., foreign-born Chinese adults); and, sample sizes were small. Fourth, our review of the literature focused on public health programs related to liver cancer and may have missed articles more clinical in nature and focused only on specific forms of liver cancer (e.g., HCC). Fifth, we did not control for the limitations of reviewed studies related to research design including reporting bias, selection bias, accuracy, and reliability of identified risk factors, cost and budget limitations, lack of randomization of participants to a non-intervention group to assess the effectiveness

of event activities, and incomplete data/loss to follow-up. Sixth, NCCCP plans are updated on different cycles, thus, some plans may not be as recent as other plans. Therefore, our findings may not reflect newer liver cancer prevention and control activities developed or being planned by some NCCCP awardees. Lastly, we did not review grantee progress reports; therefore, information related to grantee progress toward meeting objectives was not assessed.

In conclusion, promising practices in the areas of surveillance, primary prevention through immunization, knowledge and awareness of infection status, and improved viral hepatitis treatment services, have the ability to reverse increasing liver cancer trends. NCCCP awardees are including hepatitis-related activities in their cancer plans; however, there is a need for awardees to diversify their interventions. CDC has supported the development of a number of technical assistance resources in order to assist programs to either begin or build upon their ongoing work. Examples include a viral hepatitis and liver cancer national prevention profile, state specific prevention profiles, as well as a worksheet to help public health professionals address the burden of viral hepatitis, all of which can be found on the CDC liver cancer website [40]. The findings from this review of published literature and NCCCP plans will inform the development of an Action Plan on liver cancer prevention for the NCCCP. This plan will assist programs with the adoption and uptake of promising practices for the prevention of liver cancer within their respective populations.

References

1. Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer. 2015;136(5):E359–86. doi: 10.1002/ijc.29210 Epub 2014 Oct 9 [PubMed: 25220842]
2. U.S. Cancer Statistics Working Group. United States Cancer Statistics: 1999–2014 Incidence and Mortality Web-based Report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; 2017 Available at: www.cdc.gov/uscs
3. Momin BR, Pinheiro PS, Carreira H, Li C, Weir HK. Liver Cancer Survival in the United States by Race and Stage (2001–2009): Findings From the CONCORD-2 Study. Cancer. 2017;123(Suppl 24): 5059–5078. doi:10.1002/cncr.30820 [PubMed: 29205306]
4. Ryerson AB, Eheman CR, Altekruse SF, et al. Annual Report to the Nation on the Status of Cancer, 1975–2012, featuring the increasing incidence of liver cancer. Cancer. 2016;122:1312–1337 [PubMed: 26959385]
5. Campbell PT, Newton CC, Freedman ND, et al. Body mass index, waist circumference, diabetes, and risk of liver cancer for US adults. Cancer Res. 2016;76:6076–6083 [PubMed: 27742674]
6. Ahmed F, Perez JF, Jamison PM, Friedman C, Bell BP, & Kwong S (2008). National trends and disparities in the incidence of hepatocellular carcinoma. Preventing Chronic Disease, 5(3), A74 [PubMed: 18558024]
7. National Academies of Sciences, Engineering, and Medicine. 2017 A National Strategy for the Elimination of Hepatitis B and C: Phase Two Report. Washington, DC: The National Academies Press. doi: 10.17226/24731
8. Schillie S, Vellozzi C, Reingold A, et al. Prevention of Hepatitis B Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep 2018;67(No. RR-1):1–31. DOI: 10.15585/mmwr.rr6701a1
9. National Comprehensive Cancer Control Program (NCCCP). https://www.cdc.gov/cancer/ncccp/index.htm. Accessed September 2017
10. Momin B, & Richardson L (2012, 8). An analysis of content in comprehensive cancer control plans that address chronic hepatitis B and C virus infections as major risk factors for liver cancer.

Journal of Community Health, 37(4), 912–916. Retrieved March 1, 2016, from http://www.ncbi.nlm.nih.gov/pubmed/22160788 [PubMed: 22160788]

11. Cabibbo G, Maida M, Genco C, Antonucci M, Camma C. Causes of and Prevention Strategies for Hepatocellular Carcinoma. Causes of Prevention Strategies for Hepatocellular Carcinoma. Seminar in Oncology. 2012 39(4):374–383
12. Meyer JP, et al. (2015). Evidence-based interventions to enhance assessment, treatment, and adherence in the chronic Hepatitis C care continuum. Int J Drug Policy 26(10): 922–935 [PubMed: 26077144]
13. Palmateer N, et al. (2010). Evidence for the effectiveness of sterile injecting equipment provision in preventing hepatitis C and human immunodeficiency virus transmission among injecting drug users: a review of reviews. Addiction 105(5): 844–859 [PubMed: 20219055]
14. Perez CM, et al. (2015). Tackling the Health Challenge posed by Hepatitis C in Puerto Rico: A Call for Immediate Public Health Actions. P R Health Sci J 34(2): 53–59 [PubMed: 26061053]
15. Weinbaum CM, Williams I, Mast EE, Wang SA, Finelli L, Wasley A, et al. (2008). Centers for Disease Control and Prevention (CDC). Recommendations for identification and public health management of persons with chronic hepatitis B virus infection. MMWR Recomm Rep; 57(RR-8): 1–20. http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5708a1.htm
16. Bastani R, Glenn BA, Maxwell AE, Jo AM, Herrmann AK, et al. Cluster-randomized trial to increase hepatitis B testing among Koreans in Los Angeles. Cancer Epidemiology, Biomarkers and Prevention. 2015; in press
17. Chang ET, et al. (2009). 3 For Life: a model pilot program to prevent hepatitis B virus infection and liver cancer in Asian and Pacific Islander Americans. Am J Health Promot 23(3): 176–181 [PubMed: 19149422]
18. Chao S, Chang E, Le P, Prapong W, Kiernan M, & So S (2009). The Jade Ribbon Campaign: a model program for community outreach and education to prevent liver cancer in Asian Americans. Journal Of Immigrant & Minority Health, 11(4), 281–290 10p. doi:10.1007/s10903-007-9094-2 [PubMed: 17990118]
19. Chen MS Jr, Fang DM, Stewart SL, Ly MY, Lee S, Dang JH, et al. Increasing Hepatitis B Screening for Hmong Adults: Results from a Randomized Controlled Community-Based Study. Cancer Epidemiol Biomarkers Prev. 2013
20. Hsu C, Liu L, Juon H, Chiu Y, Bawa J, et al. Wang M, (2007). Reducing liver cancer disparities: a community-based hepatitis-B prevention program for Asian-American communities. Journal Of The National Medical Association, 99(8), 900–907 8p [PubMed: 17722668]
21. Hsu CE, Zhang G, Yan FA, Shang N, Le T What made a successful hepatitis B program for reducing liver cancer disparities: an examination of baseline characteristics and educational intervention, infection status, and missing responses of at-risk Asian Americans. J Community Health. 2010 6; 35(3): 325–35 [PubMed: 20135208]
22. Hsu L, Bowlus CL, Stewart SL, Nguyen TT, Dang J, Chan B, et al. Electronic messages increase hepatitis B screening in at-risk Asian American patients: a randomized, controlled trial. Dig Dis Sci. 2013;58(3):807–14 [PubMed: 23073671]
23. Juon H, Strong C, Oh T, Castillo T, Tsai G, & Oh L (2008). Public health model for prevention of liver cancer among Asian Americans. Journal Of Community Health, 33(4), 199–205 7p [PubMed: 18363085]
24. Juon HS, Lee S, Strong C, Rimal R, Kirk GD, Bowie J. Effect of a liver cancer education program on hepatitis B screening among Asian Americans in the Baltimore-Washington metropolitan area, 2009–2010. Preventing chronic disease. 2014;11:130258 [PubMed: 24503341]
25. Ma GX, Zhang GY, Jung MY, Ma XS, Zhai S et al., 2015 HCV screening behaviors and infection status among Vietnamese Americans. Am J Health Behav. 39 (5), 640–651 [PubMed: 26248174]
26. Marineau M, Tice AD, Taylor-Garcia D, Akinka KT, Lusk H, Ona F. Culturally sensitive strategies designed to target the silent epidemic of Hepatitis B in a Filipino Community. Hawaii Medical Journal. 2007 (66): 154–156 [PubMed: 17621862]
27. Maxwell AE, Bastani R, Glenn BA, Taylor VM, Nguyen TT, Stewart SL, Burke NJ, Chen MS. Developing Theoretically Based and Culturally Appropriate Interventions to Promote Hepatits B Testing in 4 Asian American Populations, 2006–2011. Prev Chronic Dis 2014; 11:130245

28. Norton BL, et al. (2014). Community-based HCV screening: knowledge and attitudes in a high risk urban population. BMC Infect Dis 14: 74 [PubMed: 24512462]
29. Taylor VM, Hislop TG, Tu SP, Teh C, Acorda E, Yip MP, et al. Evaluation of a hepatitis B lay health worker intervention for Chinese Americans and Canadians. Journal of community health. 2009;34(3):165–72 [PubMed: 19127416]
30. Taylor VM, Bastani R, Burke N, Talbot J, Sos C, Liu Q, et al. Evaluation of a hepatitis B lay health worker intervention for Cambodian Americans. Journal of community health. 2013;38(3):546–53 [PubMed: 23299978]
31. Bastani R, Glenn BA, Taylor VM, Chen MS, Nguyen TT, Stewart SL, & Maxwell AE (2009). Integrating theory into community interventions to reduce liver cancer disparities: The Health Behavior Framework. Preventive medicine, 50(1–2), 63–7. [PubMed: 19716379]
32. Orlando R, Foggia M, Maraolo AE, et al. Prevention of hepatitis B virus infection: from the past to the future. European Journal of Clinical Microbiology & Infectious Diseases, 2015, Volume 34, Number 6, Page 1059 [PubMed: 25678010]
33. CDC Yellowbook. https://wwwnc.cdc.gov/travel/yellowbook/2018/infectious-diseases-related-to-travel/hepatitis-b. Accessed on October 23, 2018.
34. Abara WE, Qaseem A, Schillie S, McMahon BJ, Harris AM, for the High Value Care Task Force of the American College of Physicians and the Centers for Disease Control and Prevention. Hepatitis B Vaccination, Screening, and Linkage to Care: Best Practice Advice From the American College of Physicians and the Centers for Disease Control and Prevention. Ann Intern Med. 2017;167:794–804. doi: 10.7326/M17-1106 [PubMed: 29159414]
35. U.S. Preventive Services Task Force. (2014). Final recommendation statement: Hepatitis B, non-pregnant adolescents and adults, May 2014. Rockville, MD: Author Retrieved January 18, 2016, from http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/hepatitis-b-virus-infection-screening-2014
36. Millman AJ et al. Barriers to Treatment Access for Chronic Hepatitis C Virus Infection: A Case Series. Topics in Antiviral Medicine. https://www.iasusa.org/sites/default/files/tam/25-3-110.pdf
37. Smith BD, Morgan RL, Beckett GA, Falck-Ytter Y, Holtzman D, Teo CG, et al. Recommendations for the identification of chronic hepatitis C virus infection among persons born during 1945–1965. MMWR Recomm Rep. 2012;61(RR-4):1–32
38. Moyer VA. Screening for hepatitis C virus infection in adults: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med. 2013;159(5):349–57. doi: 10.7326/0003-4819-159-5-201309030-00672 [PubMed: 23798026]
39. Jemal A, Fedewa SA. Prevalence of hepatitis C virus testing in cohorts born between 1945 and 1965 in the U.S. Am J Prev Med. 2015;48(5):e7–9. doi: 10.1016/j.amepre.2014.12.002 [PubMed: 25891065]
40. Centers for Disease Control and Prevention. https://www.cdc.gov/cancer/liver/index.htm. Accessed on October 23, 2018.

Table 1:

Key Words and Phrases for the Published Literature

Key Words	Key Phrases
Alcohol	Chronic alcohol AND liver cancer
Alcohol Abuse	Chronic hepatitis AND liver cancer
Baby-boomers	Interventions to prevent liver cancer
Chronic Alcohol	Prevention of liver cancer
Cirrhosis	
HBV	
HCV	
Hep B/C	
Hepatitis	
Hepatitis B testing	
Hepatocellular carcinoma/HCC	
Injection drug use	
Interventions	
Liver cancer	
Liver disease	
Non-alcoholic fatty liver disease (NAFLD)	
Non-alcoholic steatohepatitis (NASH)	
Prevention	
Vaccine/vaccination/vaccinate	

Table 2:

Number of Articles Based on Eligibility by Topic, 2005–2015

Topic	Potentially Eligible Based on Title/Abstract Review	Ineligible	Eligible Following Full-Text Review
Liver Cancer/HCC	5	5	0
Liver Cancer/Hepatitis	3	3	0
Liver Cancer/HBV	35	21	14
Liver Cancer/HCV	20	15	5
Liver Cancer/Alcohol	3	2	1
Liver Cancer/NAFLD/NASH	4	4	0
Other (HIV, chronic disease, cancer)	3	3	0
Total	**73**	**53**	**20**

Table 3:

Overview of Intervention Articles from Published Literature

	Author	Study Sample/Intervention Target	Focus of Intervention
1.	Bastani (2015)	Korean Americans	Increased HBV testing
2.	Chang (2009)	Asian/Pacific Islander Americans	Increased HBV testing and vaccination
3.	Chao (2009)	Asian Americans	Increased HBV awareness, testing, follow-up with physician
4.	Chen (2013)	Hmong Americans	Increased HBV testing
5.	Hsu (2007)	Asian Americans	Increased HBV knowledge, testing, and awareness of disease status
6.	Hsu (2010)	Asian Americans	Increased knowledge of HBV prevention
7.	Hsu (2013)	Asian Americans	Increased HBV testing
8.	Juon (2008)	Asian Americans	Increased HBV testing and vaccination
9.	Juon (2014)	Asian Americans	Increased HBV testing
10.	Ma (2015)	Vietnamese Americans	Increased HCV testing and knowledge
11.	Marineau (2007)	Filipino Americans	Increased HBV knowledge, testing, and awareness of disease status
12.	Maxwell (2014)	Asian Americans	Increased HBV testing
13.	Norton (2014)	Participants at homeless shelters, drug rehabilitation centers, women's centers	Increased knowledge of HCV; improved attitudes toward HCV screening
14.	Taylor (2009)	Chinese Americans	Increased HBV knowledge and testing
15.	Taylor (2013)	Cambodian Americans	Increased HBV knowledge and testing

Table 4:

Examples of HBV, HCV, and Alcohol Activities in NCCCP Plans Organized by Institute of Medicine Category

IOM Category	HBV Example Activities	HCV Example Activities	Alcohol Example Activities
Surveillance	• Participate in the state information immunization system to track vaccine uptake within clinics • Increase provider participation and improve completion of vaccination protocols in the state immunization information system • Advocate to make the state immunization registry an opt-out program and to use this registry for adults • Facilitate national and state coordination among immunization and cancer programs • Monitor HCC incidence trends	• Monitor emerging science investigating the relationship between infectious agents and cancer • Monitoring HCC incidence trends	• Add questions to BRFSS and YRBS or conduct surveys to monitor trends in knowledge, attitudes, and behavior trends related to high cancer-risk alcohol and sexual behaviors among adults in the state • Develop baseline data to illustrate alcohol problem in the state • Coordinate data input/output with national and regional registries • Develop surveillance tools to update baseline data
Knowledge & Awareness	• Educate parents about hepatitis B vaccine as a cancer prevention method • Increase awareness of vaccination for hepatitis B • Improve health professional knowledge, practice behaviors, and system support related to increased use of hepatitis B vaccine • Support educational campaigns targeted to at-risk adolescents and adults regarding the benefits and risks of the HBV vaccine • Develop media messages on infectious disease vaccinations and cancer • Increase awareness of the value of vaccination • Initiate patient education in primary care settings on hepatitis B using bilingual, bicultural health professional staff • Provide training to state cancer program staff and key clinical staff regarding recommended screening methods and technology • Implement policy, systems, and environmental change and other	• Educate high-risk populations, including injection drug users, on how to prevent contracting hepatitis C • Educate high-risk populations, including veterans and baby boomers, on the importance of getting tested for hepatitis C • Launch hepatitis C prevention campaign • Implement policy, systems, and environmental change and other evidence-based strategies that address infectious disease causes related to cancer. • Promote safer health care practices to reduce exposure of patients and health care workers to hepatitis viruses by enforcement of requirements for safer equipment and injury reporting, reducing needle stick injuries	• Train the community (including community leaders and government officials) on the misuse of alcohol • Increase awareness of the connection between alcohol consumption and cancer risk • Educate providers on how to counsel patients regarding negative health effects of excessive and binge drinking • Increase efforts targeting community and government leaders to increase awareness of societal costs of alcohol use • Discourage consumption of alcoholic beverages in excess of recommended levels • Inform the public of the adverse

IOM Category	HBV Example Activities	HCV Example Activities	Alcohol Example Activities
	evidence-based strategies that address infectious disease causes related to cancer • Support educational campaigns targeted to at risk adolescents and adults regarding the benefits of HVB vaccine.		consequences of underage drinking
Immunization	• Continue birth dose and school requirements for HepB vaccination • Promote vaccination programs and requirements in schools and hospitals • Implement vaccine reminder and recall systems targeted at providers and clients in pediatric and primary care provider offices • Enhance access to vaccination services through home visits, cost reductions and vaccination programs in nontraditional settings • Work with relevant partners to help implement effective primary-prevention policy, including HBV vaccine policies • Institute reminder-recall systems in health care settings to increase the use of the HBV vaccine according to evidence-based guidelines • Ensure access to the HBV vaccine for persons and communities at-risk • Promote the increase of pediatric and adult hepatitis B vaccinations • Increase community demand through incentives, reminder systems and vaccine requirements for childcare, schools and colleges • Implement provider or system-based intervention that includes immunization information tests, provider assessments and feedback and standing orders • Promote the use of HBV vaccines in venues where persons at risk for HBV access services, such as sexually transmitted disease (STD) clinics and needle exchange programs.	• Support for research in developing a vaccine against HCV	
Viral Hepatitis Services	• Revise and update policy and procedure for hepatitis B screening program • Work with partners to identify who is not being screened for	• Implement standing provider orders for hepatitis C testing of adults born between 1945–1965 and those considered high risk	

IOM Category	HBV Example Activities	HCV Example Activities	Alcohol Example Activities
	hepatitis B and target those populations • Develop partnerships between health department and community organizations to develop a community education plan and educational materials on the HBV vaccine	• Promote access and coverage for hepatitis C treatment among public and private health plans. • Advocate for HCV screening and treatment at tribal clinics • Promote evidence based harm reduction through needle exchange programs, increasing the number of municipalities allowing needle exchange programs designed to educate injection drug users about infection prevention, supply sterile needles and syringes, and offer referral to substance use treatment	