Preventive Medicine Reports 38 (2024) 102602

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Differences in Provider Hepatitis C Virus Screening Recommendations by Patient Risk Status

Alfu Laily [a], Robert Duncan [b], Kaitlyn M. Gabhart [c], Lauren D. Nephew [d], Shannon M. Christy [e,f,g,h], Susan T. Vadaparampil [e,g,h], Anna R. Giuliano [h,i], Monica L. Kasting [a,j,*]

[a] Department of Public Health, College of Health and Human Sciences, Purdue University, 820 Mitch Daniels Blvd, West Lafayette, IN 47907, USA
[b] Department of Human Development and Family Studies, College of Health and Human Sciences, Purdue University, 1202 West State St., West Lafayette, IN 47907, USA
[c] Department of Psychology, Vanderbilt University, 230 Appleton Pl, Nashville, TN 37203, USA
[d] Division of Gastroenterology and Hepatology, Indiana University School of Medicine, 340 W 10th St., Indianapolis, IN 46202, USA
[e] Department of Health Outcomes and Behavior, Moffitt Cancer Center, 12902 USF Magnolia Drive, Tampa, FL 33612, USA
[f] Department of Gastrointestinal Oncology, Moffitt Cancer Center, 12902 USF Magnolia Drive, Tampa, FL 33612, USA
[g] Department of Oncological Sciences, University of South Florida, 12902 USF Magnolia Drive, Tampa, FL 33612, USA
[h] Center for Immunization and Infection Research in Cancer, Moffitt Cancer Center, 12902 USF Magnolia Drive, Tampa, FL 33612, USA
[i] Department of Cancer Epidemiology, Moffitt Cancer Center, 12902 USF Magnolia Drive, Tampa, FL 33612, USA
[j] Cancer Prevention and Control Program, Indiana University Simon Comprehensive Cancer Center, 535 Barnhill Dr., Indianapolis, IN 46202, USA

ARTICLE INFO

Keywords:
Average risk
Hepatitis C virus
High risk
Providers
Recommendation
Screening

ABSTRACT

Providers' recommendation is among the strongest predictors to patients engaging in preventive care. Therefore, the aim of this study was to compare providers' Hepatitis C Virus (HCV) screening recommendation quality between high-risk and average-risk patients to determine if providers are universally recommending HCV screening, regardless of risk behaviors. This cross-sectional survey of 284 Indiana providers in 2020 assessed provider characteristics, HCV screening recommendation practices (strength, presentation, frequency, timeliness), self-efficacy, and barriers to recommending HCV screening. T-test and Chi-square compared recommendation practices for high-risk and average-risk patients. Prevalence ratios were calculated for variables associated with HCV recommendation strength comparing high-risk and average-risk patients. Logistic regression analyses examined factors associated with HCV recommendation strength for high- and average-risk patients, with odds ratios. Compared to average-risk patients, high-risk patients received higher proportion of HCV recommendations that were strong (70.4 % v. 42.4 %), routine (61.9 % v. 55.6 %), frequent (37.7 % v. 28 %), and timely (74.2 % v. 54.9 %) (P-values < 0.001). Compared to average-risk patients, providers with high-risk patients had a lower percentage of giving a strong recommendation if they were nurse practitioner (PR = 0.49). For high-risk patients, providers with higher self-efficacy (aOR = 2.16;95 %CI = 0.99–4.69) had higher odds, while those with higher perceived barriers (aOR = 0.19;95 %CI = 0.09–0.39) and those with an internal medicine specialty compared to family medicine (aOR = 0.22;95 %CI = 0.08–0.57) had lower odds of giving a strong recommendation. These data suggest providers are not universally recommending HCV screening for all adults regardless of reported risk. Future research should translate these findings into multilevel interventions to improve HCV screening recommendations regardless of patient risk status.

1. Introduction

There are 2.7 million people in the U.S. currently living with chronic hepatitis C virus (HCV) (Edlin et al., 2015). The majority of people infected with HCV are asymptomatic and almost half are unaware of their infection (Hoofnagle, 1997; Kim et al., 2019; The European

* Corresponding author at: 812 Mitch Daniels Blvd, Room 216, West Lafayette, IN 47907, USA.
E-mail addresses: alaily@purdue.edu (A. Laily), duncan99@purdue.edu (R. Duncan), kgabhart@purdue.edu (K.M. Gabhart), lnephew@iu.edu (L.D. Nephew), shannon.christy@moffitt.org (S.M. Christy), susan.vadaparampil@moffitt.org (S.T. Vadaparampil), anna.giuliano@moffitt.org (A.R. Giuliano), mlkastin@purdue.edu (M.L. Kasting).

https://doi.org/10.1016/j.pmedr.2024.102602
Received 22 February 2023; Received in revised form 5 January 2024; Accepted 6 January 2024
Available online 9 January 2024

Paediatric Hepatitis C Virus Network, 2005). Chronic, undetected HCV infection can develop into chronic liver disease or liver cancer (Schillie et al., 2020). HCV is attributable to 50 % of liver cancers in the U.S. (Centers for Disease Control and Prevention, 2022), resulting in a predicted cost burden of $1.4 billion in 2025 (Razavi et al., 2013). While the national average of HCV cases per 100,000 people in the U.S. was 1.2 in 2018, Indiana cases dramatically increased from 1.8 in 2014 to 4.0 in 2018 (Center of Disease Control and Prevention, 2020). Thus, there is an urgent need to address HCV infection and disease in Indiana.

A significant proportion of HCV infections are asymptomatic and routine HCV screening is one of the primary means of identifying people who are unaware of their infection (Shehata et al., 2018). Around 45 % of people infected with HCV did not recall having a specific risk behavior; thus, risk-based screening alone fails to identify almost half of infections (Schillie et al., 2020; Smith et al., 2012). Furthermore, HCV infection is unequally distributed in the population with 75 % of infected people being born between 1945 and 1965 (Schillie et al., 2020). Prior to 2013, the U.S. Preventive Services Task Force (USPSTF) recommended HCV screening only for those who displayed high-risk behaviors or medical conditions (e.g., intravenous drug users, received a blood donation prior to 1992). In 2013, the USPSTF updated their recommendation to include one-time universal screening for everyone born 1945–1965 (United States Preventive Services Taskforce, 2013), followed by updated recommendations in 2020 to include everyone ages 18–79 (US Preventive Services Task Force et al., 2020). Prior to the national recommendation change, one hospital implemented universal screening for their patients, which resulted in a five-fold increase in screening completion (Winetsky et al., 2019). As the recommendation has changed from risk-based to universal screening, primary care providers (PCPs) no longer need to assess HCV infection risk and instead should screen all adults ages 18–79. Once implemented, universal screening has the potential to support the U.S. Viral Hepatitis National Strategic Plan to eliminate viral hepatitis as a public health threat by 2025 (Office of Infectious Disease and HIV/AIDS Policy, 2021), particularly by increasing the proportion of people who are tested and aware of their viral hepatitis status (Objective 2.1 of the National Strategic Plan).

A strong recommendation from healthcare providers is one of the strongest predictors of preventive services uptake (Michael, 2019; Shepperd et al., 2014). Unfortunately, providers tend to recommend HCV screening on an individual, case-by-case basis rather than adopting universal screening consistently. (Yakovchenko et al., 2019). This study is informed by the Health Belief Model and the Competing Demands Model, both of which include constructs that are associated with provider-reported screening behaviors including self-efficacy and perceived barriers to screening (Kasting et al., 2020; Kasting et al., 2021; Jaén et al., 1994). Therefore, this study aimed to examine: 1) differences in provider-reported HCV screening recommendations for patients engaging in high-risk behaviors compared to average-risk patients to determine if PCPs are indeed engaging in universal recommendations, and 2) factors associated with screening recommendations.

2. Methods

2.1. Procedures and participants

This study is part of a larger study examining HCV screening among PCPs in Indiana. The total survey consisted of 94-items and took approximately 20 min to complete. PCPs practicing in Indiana were recruited in August-November 2020 by Dynata, a survey market research firm. Potential PCPs were invited to participate in a cross-sectional survey and were provided a link to complete the survey. Inclusion criteria were: 1) a PCP (physician, nurse practitioner, or physician assistant practicing in internal medicine, or adult family medicine) and 2) practicing in Indiana. All participants received a study information sheet and consented to participate. This study was reviewed and approved as exempt by the Institutional Review Board at Purdue University: IRB-2019–846.

2.2. Variable and measures

We assessed PCPs' demographic characteristics, clinic characteristics, HCV screening recommendations, and theoretical variables,

HCV Screening Recommendation. Consistent with previous literature (Gilkey et al., 2016), we examined aspects of the HCV screening recommendation, including recommendation strength, presentation, frequency, and timeliness. We asked PCPs about those practices in eligible patients, specifically their patients who have not been previously screened. We measured recommendation strength with a four-point Likert scale from "I strongly recommend" to "I recommend against," and we dichotomized it is as "I strongly recommend" compared to all other response options, as is consistent with previous literature (Kester et al., 2012). We measured presentation with the focus of patient-PCP communication regarding screening decision-making, by asking participants how they usually present HCV screening to their patients. Response options were: routine, optional, it is added to their routine bloodwork and not discussed, and it is not discussed & not added to bloodwork. This variable was dichotomized so that routine presentation was compared to all other response options. We measured frequency by asking how often they recommended HCV screening to their eligible patients in the last 12 months for high-risk patients and 4 months for average-risk patients. Responses were on a five-point Likert scale from "never/almost never" to "always/almost always." This variable was dichotomized so that "always/almost always" was compared to all other response options. We measured timeliness by asking PCPs whether they recommend HCV screening at the current visit, at a later visit, give the patients a choice about when to get screened, don't discuss HCV screening at all, or recommend against getting screened. This variable was dichotomized and "recommend they get screened at the current visit" was compared to all other response options.

We compared recommendation quality for high-risk vs. average-risk patients. High-risk patients were defined as patients who may be engaging in behaviors that put them at risk of HCV infection (e.g., intravenous drug use), while average-risk patients are any adults aged 18–75 years old. We defined a high-quality recommendation if PCP reported making a recommendation that was strong, routine, frequent, and timely. Any recommendation that did not include all these characteristics was considered a low-quality recommendation. Recommendation quality was examined separately for both high-risk and average-risk patients.

Theoretical Variables. Self-efficacy was assessed with 8-items where PCPs rated their ability to provide various aspects of HCV screening and care. Responses were on a five-point Likert scale from no proficiency to expert proficiency; we calculated a mean score for self-efficacy (range: 1–5). We assessed barriers to HCV screening using an 11-item scale with response options on a five-point Likert scale from strongly disagree to strongly agree. Barriers included items that measured both provider-level barriers (e.g., time limits, discomfort managing a positive result, lack of access to specialists for treatment, etc.) and providers' perceptions of patient-level barriers (e.g., patient not interested, lack of insurance, patient fear of positive result, etc.). Because barriers likely differ for high- and average-risk patients, PCPs answered two separate barriers scales, one for each patient group. We created a mean score (range: 1–5) for the barriers scale.

2.3. Data analysis

Statistical analyses were performed with IBM SPSS Statistics v28.0 and $p < 0.05$ was considered significant. First, we described the data using means and standard deviations or number and percentages. Differences in strength, presentation, frequency, and timeliness for average-risk vs. high-risk patients were compared by using Chi-square

tests. Because recommendation strength is one of the strongest predictors of uptake (Michael, 2019; Shepperd et al., 2014), we then examined the association between our covariates and recommendation strength separately for high-risk and average-risk patients. Initially, we conducted bivariate analyses using T-tests and Chi-square tests, whichever appropriate, to examine which variables were associated with PCPs giving strong recommendations. Finally, we conducted separate logistic regression analyses for each patient group to examine factors associated with giving a strong recommendation. First, we included all the variables in the model. Then, we conducted a backward selection to determine the best-fit model with a p-value of 0.1 needed to stay in the model. In these logistic regression models, we reported adjusted odds ratio (OR). As our outcome was common (prevalence >10 %), we reported prevalence ratios (PR) to mitigate potential overestimation of the OR from logistic regression. Prevalence ratios were calculated from % or mean of variable of interest in one group (e.g., high-risk patients) divided by % or mean of the same variable of interest in another group (e.g., average-risk patients). Prevalence ratios (PRs) should not be construed as indicators of risk in this cross-sectional study, since they signify the prevalence or percentage at a specific moment in time, without the element of time-based follow-up. To provide additional context, we have also included the risk ratios (RR) calculated from the log binomial regression model as Supplemental Table S1. To derive these RRs for both average-risk and high-risk patients, we analyzed variables from the best-fit models.

3. Results

The final sample included 284 PCPs. PCPs were almost equally divided by sex with 49.6 % (n = 130) females. Average age was 47.3 years (SD = 10.9; range = 25–72). The majority of PCPs were non-Hispanic White (n = 197,75.2 %), specialized in family medicine (n = 171, 60.2 %), and were physicians (n = 197, 69.7 %). The largest proportion practiced in private practices (n = 145, 55.3 %), in suburban areas (n = 122, 46.6 %), and most reported the majority of their patient's racial/ethnic category was White (n = 210, 80.8 %). For a full sample description, see Table 1.

PCPs reported their HCV screening recommendation strength, presentation, frequency, and timeliness differently between high-risk and average-risk patients (Table 2 & Fig. 1).

For recommendation quality indicators (Fig. 1), high-risk patients received a high-quality recommendation more than average-risk patients. Specifically, there was a statistically significant difference ($p < 0.001$) in PCPs providing high-risk vs. average-risk patients recommendations that were strong (70.4 % vs 42.4 %), routine (61.9 % vs 55.6 %), frequent (37.7 % vs 28.0 %), and timely (74.2 % vs. 54.9 %).

In the bivariate analyses among PCPs who provided responses, recommendation strength for average-risk patients was significantly associated with majority of patients' race/ethnicity ($p < 0.001$), majority of patients' age range ($p = 0.011$), provider type ($p = 0.009$), self-efficacy (<0.001), and barriers (<0.001). For high-risk patients, recommendation strength was significantly associated with clinical specialty ($p = 0.019$), self-efficacy (<0.001), and barriers (<0.001). When comparing recommendations for high risk vs. average risk patients, a higher percentage of nurse practitioners reported strong recommendations for average risk patients than high-risk patients (PR = 0.49). Likewise, those who practiced in public health setting also reported a higher percentage of strongly recommending HCV screening for average risk patients compared to high-risk patients (PR = 0.57). For all other comparisons, the percent giving a strong recommendation was higher for high-risk compared to average-risk patients, resulting in a PR larger than 1 (Table 3).

The full logistic regression model for both average-risk and high-risk patients, with all variables of interest included, is reported in Table 4. In the best-fit logistic regression model for average-risk patients, the odds of giving a strong recommendation were significantly higher for PCPs who had a patient population where the majority race/ethnicity was listed as Non-Hispanic Black (aOR = 7.34; 95 %CI = 1.73–31.20; vs. Non-Hispanic White), and for PCPs who had higher self-efficacy (aOR = 2.13; 95 %CI = 1.08–4.21). In average risk patients, the odds of giving a strong recommendation was lower for PCPs who listed their provider

Table 1
Characteristics Distribution of Primary Care Providers Sample in Indiana from August-November 2020.

Variables	Mean (SD)/n(%)
Age	47.3 (10.9)
Years of practicing medicine	17.6 (10.6)
Sex	
Male	125 (47.7)
Female	130 (49.6)
Prefer not to say	7 (2.7)
Race/Ethnicity	
Non-Hispanic White	197 (75.2)
Non-Hispanic Black	8 (3.1)
Hispanic	6 (2.3)
Asian	34 (13.0)
Other*	17 (6.5)
Majority of Patients' Race/Ethnicity	
Non-Hispanic White	210 (80.8)
Non-Hispanic Black	17 (6.5)
Hispanic	4 (1.5)
Asian	8 (3.1)
Other	21 (8.1)
Majority of Patients' Age Range	
Younger than 18	5 (1.9)
18-25	8 (3.1)
25-40	40 (15.4)
41-55	92 (35.4)
56-75	109 (41.9)
Over 75	6 (2.3)
Primary Clinical Specialty	
Family Medicine	171 (60.2)
Internal Medicine	70 (24.6)
Other Primary Care**	43 (15.1)
Type of Provider	
Physician	198 (69.7)
Nurse practitioner	59 (20.8)
Physician assistant	27 (9.5)
Type of Practice Venue	
Private practice	145 (55.3)
Academic	18 (6.9)
Public health	10 (3.8)
Federally Qualified Health Center	20 (7.6)
Community clinic	44 (16.8)
Other	25 (9.5)
HCV Training After Residency	
Yes	224 (80.6)
No	54 (19.4)
Area of Clinic	
Rural	64 (24.4)
Urban	76 (29.0)
Suburban	122 (46.6)

*"Other" race/ethnicity included: American Indian/Alaska Native (n = 2), Native Hawaiian/Pacific Islander (n = 2), not specified (n = 2), prefer not to answer (n = 9), unknown (n = 2).
**"Other primary care" specialties included: OBGYN (n = 10), emergency medicine (n = 7), pediatrician (n = 5), other/unknown = (21).

Table 2
Percentages of Indiana PCPs Reporting HCV Recommendation Practices, from August-November 2020*.

Construct	High-risk	Average-risk
Strength *(How strongly do you recommend HCV screening to your patients?)*		
Strongly recommends	67.3	14.1
Recommends, but not strongly	22.5	41.2
No recommendation for or against	4.2	39.8
Recommends against	0.7	0.7
Presentation *(How do you usually present HCV screening to your patients?)*		
Routine	56.7	23.9
Optional	29.2	48.2
Not discussed (but added to bloodwork)	6.7	3.2
Not discussed (not added to bloodwork)	2.5	21.1
Frequency *(In the past 12 months (high-risk)/4 months (average-risk), how often did you recommend HCV screening to your high-risk/average-risk patients?)*		
Never/almost never (approximately 10 % of the time)	7.4	35.2
Occasionally (approximately 10–39 % of the time)	14.8	31.7
About half the time (approximately 40–59 % of the time)	13.0	11.3
Usually (approximately 60–90 % of the time)	23.6	10.9
Always/almost always (greater than 90 % of the time)	35.9	7.4
Timeliness *(For your patients, do you usually…)*		
Recommend screening at current visit	72.9	27.8
Recommend screening at a later visit	11.6	11.3
Give a choice about when to get screened	10.9	30.3
Don't discuss when to get screened	2.8	25.7
Recommend not getting screened	0	1.8

*The percentages do not add up to 100% due to missing data.

type as physician assistant (aOR = 0.15; 95 %CI = 0.04–0.63; vs. physician) and for those who reported more barriers (aOR = 0.41; 95 % CI = 0.23–0.72). In the best-fit logistic regression model for high-risk patients, the odds of giving a strong recommendation for HCV screening was significantly higher for PCPs with HCV screening training after residency (aOR = 5.01; 95 %CI = 1.89–13.31); while higher barriers (aOR = 0.19; 95 %CI = 0.09–0.39) and internal medicine specialty (aOR = 0.22; 95 %CI = 0.08–0.57; vs. family medicine) were associated with lower odds of giving a strong recommendation.

4. Discussion

In this cross-sectional study of PCPs, only 42.4 % PCPs are strongly recommending HCV screening to average-risk patients. Most PCPs are continuing to follow out-of-date guidance of risk-based HCV screening. Because provider recommendation is one of the strongest predictors of preventive service uptake (Michael, 2019; Shepperd et al., 2014), universally providing strong recommendation of HCV screening to patients, regardless of risk status, is crucial in improving HCV screening rates.

PCPs in our sample reported giving higher quality recommendations for HCV screening to high-risk compared to average-risk patients. These findings suggest that PCPs are still basing their HCV recommendations for patients on patient risk factors instead of practicing universal recommendation regardless of patients' risk status, as is recommended by the USPSTF (US Preventive Services Task Force et al., 2020). If providers continue to recommend based on risk status, we risk missing almost half of people infected with HCV, who report no risk behaviors (Schillie et al., 2020; Smith et al., 2012). Research shows it takes an average of 17 years for only 14 % of new clinical discoveries to enter day-to-day medical practice (Westfall et al., 2007), and only approximately half of recommended care is delivered to adults (McGlynn et al., 2003). To accelerate the implementation, the guideline's message for healthcare providers should be simple, clear, and persuasive and the format should be explicit to promote practice use (Kastner et al., 2015). In addition, recommendation quality affects the initiation and completion of preventive care. For example, one study reported that patients who received a strong recommendation from their providers had 17.6 % higher completion rate of Human Papillomavirus (HPV) vaccination series compared to the patients who received a recommendation that was not strong from their providers (Kester et al., 2012). Another study found that patients who received a strong and timely recommendation had nine times the odds of initiating the HPV vaccination compared to patients without recommendation (Gilkey et al., 2016). While this research was not examining HCV screening specifically, these are nonetheless other routine preventive services and coupled with the current study findings, have implications for improving HCV screening.

For both high-risk and average-risk patients, perceived self-efficacy and barriers were associated with recommendation strength. In both patient groups, PCPs had higher odds of giving strong recommendations if they had higher perceived self-efficacy and lower odds of giving a

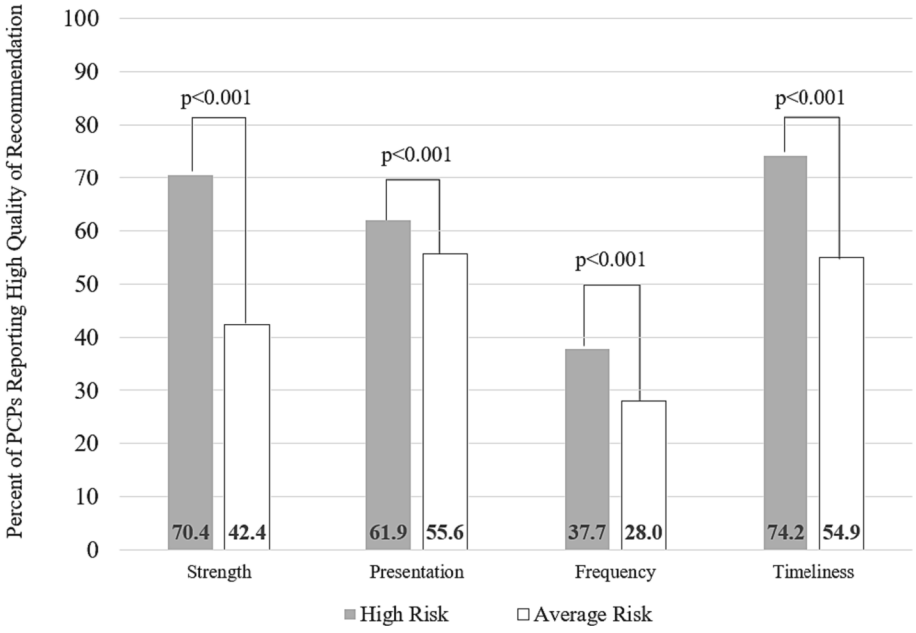

Fig. 1. Differences in HCV Recommendation Quality Indicators for High-Risk and Average-Risk Patients Reported by Indiana PCPs from August-November 2020.

Table 3
Bivariate Comparisons for Strength of HCV Screening Recommendation Reported by Indiana PCPs from August-November 2020.

	Average-risk			High-risk			Prevalence Ratio of Strong Recommendation (% high-risk/% average-risk)
	Strong (n = 112, 39.4 %)**** n(%) or M(SD)	Not strong (n = 155, 54.6 %)**** n(%) or M (SD)	p-value	Strong (n = 191, 67.3 %)**** n(%) or M(SD)	Not strong (n = 78, 27.5 %)**** n(%) or M (SD)	p-value	
Age	46.7 (10.8)	47.6 (11.1)	0.530	48.1 (11.2)	46.2 (10.4)	0.201	–
Years practicing medicine	16.2 (10.2)	18.3 (10.6)	0.116	18.5 (11.1)	16.2 (9.2)	0.091	–
Sex							
Male	45 (36.0)	80 (64.0)	0.185	83 (68.0)	39 (32.0)	0.617	1.89
Female	54 (44.3)	68 (55.7)		88 (71.0)	36 (29.0)		1.60
Race/Ethnicity							
Non-Hispanic White	71 (37.4)	119 (62.6)	0.075	130 (68.8)	59 (31.2)	0.347	1.84
Other	32 (50.0)	32 (50.0)		48 (75.0)	16 (25.0)		1.50
Majority of Patients' Race/Ethnicity							
Non-Hispanic White	70 (34.5)	133 (65.5)	<0.001***	143 (70.8)	59 (29.2)	0.856	2.05
Non-Hispanic Black	9 (56.3)	7 (43.8)		11 (64.7)	6 (35.3)		1.15
Others	23 (69.7)	10 (30.3)		23 (71.9)	9 (28.1)		1.03
Majority of Patients' Age Range							
≤ 40	28 (59.6)	19 (40.4)	0.011*	40 (78.4)	11 (21.6)	0.067	1.32
41–55	31 (33.7)	61 (66.3)		55 (61.8)	34 (38.2)		1.83
≥ 56	44 (38.6)	70 (61.4)		82 (73.9)	29 (26.1)		1.91
Primacy Clinical Specialty							
Family Medicine	75 (45.2)	91 (54.8)	0.064	128 (77.1)	38 (22.9)	0.019*	1.71
Internal Medicine	29 (43.3)	38 (56.7)		39 (60.0)	26 (40.0)		1.39
Other	8 (23.5)	26 (76.5)		24 (63.2)	14 (36.8)		2.69
Type of Provider							
Physician	81 (43.1)	107 (56.9)	0.009**	137 (71.7)	54 (28.3)	0.185	1.66
Nurse practitioner	27 (50.9)	26 (49.1)		42 (25.0)	14 (75.0)		0.49
Physician assistant	4 (15.4)	22 (84.6)		12 (54.5)	10 (45.5)		3.54
Type of Practice Venue							
Private practice	50 (35.2)	92 (64.8)	0.143	98 (70.5)	41(29.5)	0.202	2.00
Academic	8 (44.4)	10 (55.6)		12 (66.7)	6 (33.3)		1.50
Public Health	7 (70.0)	3 (30.0)		4 (40.0)	6 (60.0)		0.57
FQHC	6 (31.6)	13 (68.4)		16 (80.0)	4 (20.0)		2.53
Community clinic	22 (51.2)	21 (48.8)		29 (67.4)	14 (32.6)		2.32
Other	10 (45.5)	12 (54.5)		19 (82.6)	4 (17.4)		1.82
HCV Screening Training (after residency)							
Yes	94 (44.3)	118 (55.7)	0.218	156 (73.2)	57 (36.8)	0.115	1.65
No	17 (34.7)	32 (65.3)		31 (62.0)	19 (38.0)		1.79
Area of Clinic							
Rural	27 (42.2)	37 (57.8)	0.421	45 (71.4)	18 (28.6)	0.916	1.69
Urban	33 (45.8)	39 (54.2)		50 (68.5)	23 (31.5)		1.50
Suburban	43 (36.4)	75 (63.6)		83 (70.9)	34 (29.1)		1.95
Self-efficacy	3.4 (0.52)	3.1 (0.52)	<0.001***	3.3 (0.55)	3.1 (0.51)	<0.001***	–
Barriers	2.5 (0.65)	2.8 (0.53)	<0.001***	2.6 (0.59)	3.0 (0.56)	<0.001***	–

*p < 0.05, **p < 0.01, ***p < 0.001,**** the percentages do not add up to 100 % due to missing data.

strong recommendation if they had higher barriers. This is consistent with other research that found that healthcare providers who self-reported higher self-efficacy were more likely to deliver preventive services (Ozer et al., 2004), including providing more disease screening (Meredith et al., 2017). Our finding supports the concept that self-efficacy is a crucially linked with providing HCV screening recommendations. Our study suggested that PCPs with HCV training after residency had higher odds of giving a strong recommendation for high-risk patients compared to PCPs without training. Training increases HCV-related knowledge and improves self-efficacy (Garrard et al., 2006; Flores et al., 2022), thus substantially equipping PCPs to give strong a recommendation. Therefore, future interventions should aim to provide

Table 4
Logistic Regression Analyses Examining the Odds Ratios of Indiana PCPs in 2020 Giving a Strong Recommendation for HCV Screening in Average-risk and High-risk Patients.

	Average-risk aOR (95 %CI)		High-risk aOR (95 %CI)	
	Full Model[1]	Best-fit Model[2]	Full Model	Best-fit Model
Age	1.00 (0.93–1.08)	#	1.00 (0.91–1.10)	#
Years practicing medicine	0.98 (0.90–1.06)	#	1.02 (0.91–1.13)	#
Sex				
Male	Ref	Ref	Ref	#
Female	1.94 (0.88–4.26)	1.95 (0.92–4.14)	1.03 (0.41–2.59)	
Race/Ethnicity				
Non-Hispanic White	Ref	#	Ref	#
Other	1.81 (0.77–4.23)		1.81 (0.69–4.75)	
Majority of Patients' Race/Ethnicity				
Non-Hispanic White	Ref	Ref	Ref	#
Non-Hispanic Black	8.52 (1.56–46.60)*	7.34 (1.73–31.20)**	0.38 (0.07–2.20)	
Others	6.23 (1.83–21.23)**	6.20 (2.02–19.00)**	1.00 (0.24–4.06)	
Majority of Patients' Age Range				
≤ 40	Ref	#	Ref	Ref
41–55	0.25 (0.09–0.73)*		0.19 (0.05–0.74)*	0.25 (0.08–0.78)*
≥ 56	0.42 (0.15–1.17)		0.73 (0.21–2.56)	0.86 (0.28–2.59)
Primacy Clinical Specialty				
Family Medicine	Ref	#	Ref	Ref
Internal Medicine	0.82 (0.33–2.04)		0.22 (0.08–0.62)**	0.22 (0.08–0.57)**
Other	0.36 (0.10–1.33)		0.39 (0.11–1.34)	0.37 (0.12–1.12)
Type of Provider				
Physician	Ref	Ref	Ref	#
Nurse practitioner	0.72 (0.24–2.16)	0.91 (0.36–2.29)	2.40 (0.60–9.60)	
Physician assistant	0.14 (0.03–0.73)*	0.15 (0.04–0.63)*	0.51 (0.13–2.03)	
Type of Practice Venue				
Private practice	Ref	Ref	Ref	Ref
Academic	2.73 (0.52–14.16)	1.85 (0.43–7.98)	10.16 (1.54–67.01)*	4.44 (0.94–20.93)
Public Health	5.22 (0.66–41.32)	4.58 (0.80–26.40)	0.67 (0.08–5.65)	0.37 (0.06–2.43)
FQHC	0.32 (0.07–1.41)	0.33 (0.08–1.38)	5.63 (1.05–30.18)*	4.27 (1.00–18.26)
Community clinic	2.03 (0.76–5.42)	2.13 (0.88–5.19)	0.86 (0.28–2.69)	1.07 (0.37–3.09)
Other	1.23 (0.31–4.84)	1.46 (0.43–4.99)	1.65 (0.32–8.59)	1.52 (0.33–7.09)
HCV Screening Training (after residency)				
No	Ref	#	Ref	Ref
Yes	2.02 (0.78–5.26)		4.70 (1.61–13.74)*	5.01 (1.89–13.31)**
Area of Clinic				
Rural	Ref	#	Ref	#
Urban	0.37 (0.12–1.12)		0.50 (0.14–1.76)	
Suburban	0.48 (0.20–1.18)		0.49 (0.18–1.37)	
Self-efficacy	1.99 (0.95–4.15)	2.13 (1.08–4.21)*	1.96 (0.78–4.88)	2.16 (0.99–4.69)
Barriers	0.32 (0.17–0.63)***	0.41 (0.23–0.72)**	0.15 (0.07–0.34)***	0.19 (0.09–0.39)***

1 Includes all variables.
2 Only includes variables that are best-fit from backward selection (a p-value of 0.1 needed to stay in the model).
Not significant in bivariate analyses, excluded from best-fit model.
*p < 0.05, **p < 0.01, ***p < 0.001.

PCPs with training and education to increase self-efficacy to discuss HCV screening with patients, complete HCV screening, and treat or refer any positive cases to a specialist.

The odds of giving a strong recommendation to both average-risk and high-risk patients were lower for PCPs that perceived higher barriers. The barriers construct in our study examined barriers at both the provider-level and at the patient-level. This allowed us to examine barriers to HCV screening more holistically by giving PCPs the opportunity to report not only barriers that they have, but also the barriers that they perceive their patients' experience. Several studies posited that limited time during a clinic visit is a common provider-reported barrier when recommending HCV screening to their patients (Kasting et al., 2020; Winetsky et al., 2019). PCPs may experience competing demands on their time that impact how HCV screening as a preventive service is recommended. Future research should examine systemic changes and interventions that can facilitate HCV screening during a limited clinic visit including a best practice alert or standing orders for HCV screening.

PCPs practicing in clinics where most of the patient population is non-White had higher odds of reporting a strong recommendation to average-risk patients compared to PCPs who have majority White patients. Research also shows that non-Hispanic Blacks experience higher HCV-related mortality, higher hepatocellular carcinoma-related

mortality, and higher rates of chronic HCV infection compared to other race/ethnicities (Ford et al., 2017; Kim et al., 2018; Levine et al., 2020). Current recommendations for universal screening should reduce the stigma associated with HCV infection toward certain races/ethnicities. Moreover, it is important to consider that this reduction in stigma can be incorporated into provider training to create a supportive environment where PCPs feel more comfortable initiating discussions about HCV screening, ultimately promoting equitable access to screening services for all patients.

Our study also indicated that for both average-risk and high-risk patients, PCPs who work in clinics where the majority of patients are younger than 40 years old had higher odds of giving a strong HCV recommendation compared to PCPs with patients who were older than 40 years old. HCV infection in the U.S. has a bimodal distribution with most of the infections occurring in patients aged 20–39 years and 50–69 years (Ryerson, 2020). The fact that providers who work in clinics with a majority older population reported giving a strong recommendation less frequently is concerning because prevalence of chronic HCV infection in the general population born between 1945 and 1965 is 6-fold greater than other adults (Denniston et al., 2014). Therefore, future interventions should target providers working in clinics with older populations to ensure this birth cohort is receiving a strong recommendation for HCV screening.

Physician assistants had lower odds of giving a strong recommendation compared to physicians. A recent study reported that compared to physicians, physician assistants need a readily available evidence-based patient decision aids and more time to facilitate implementing standardized practice guidelines (Cook et al., 2018). This may contribute to a significant number of missed opportunities to screen a large proportion of patients because research shows that 43.4 % of physician assistants were practicing in primary care and would be responsible for routine preventive screenings (Agent for Healthcare, 2022). Therefore, it is crucial to provide HCV screening education and standardization to all clinicians who provide primary care to patients.

Among high-risk patients, internal medicine PCPs had lower odds of giving a strong recommendation compared to family medicine PCPs. This is consistent with previous research that found that family medicine PCPs had higher rates of screening their patients for HCV compared to other primary care specialties (e.g., internal medicine) (Kasting et al., 2021). On the contrary, another study reported that there was a knowledge gap in HCV screening during training years between internal medicine and family medicine, with more internal medicine residents correctly answering questions on HCV screening knowledge (Nallapeta et al., 2021). Our study indicates future research should focus on improving HCV screening recommendation across primary clinical specialties.

Our best-fit model, indicated higher odds for providing a strong recommendation for high-risk patients if the PCP practiced in an academic setting or FQHC. While this finding was not strongly statistically significant in our model, it is consistent with recent literature which found that health providers practicing in FQHCs performed significantly better on ambulatory care services (Goldman et al., 2012). However, a different study found there was no difference in screening practices between health providers who practiced in academic settings compared to those who practiced in private settings (Turner et al., 1992). Given these differing results, more research is warranted to facilitate a strong recommendation from PCPs, regardless of practice setting.

This study should be interpreted considering some limitations. First, we used a survey sampling company to recruit participants from a single state and they may not be representative of the general population of PCPs in the United States. In addition, because of this recruitment method, we are unable to calculate the true response rate. Second, our sample differed demographically from healthcare providers in the U.S. Specifically, compared to providers nationwide, our health care provider sample had a higher proportion of non-Hispanic White providers (75.2 % v. 56.2) and lower proportion of male providers (47.7 % v. 64.1 %) (AAMC A of AMC, 2018), this may limit the generalizability of our findings. Third, as odd ratios subject potential misinterpretation (e.g., they reflect changes in odds and not probabilities, overestimation), we reported risk ratio from log binomial regressions as a supplement to our logistic regression models, and the log binomial models did not achieve convergence. Although the direction of both odd ratios from logistic regression and risk ratios of log binomial model remained the same, and generally the values were similar to each other, a few of the coefficients changed in terms of statistical significance (i.e., p-value thresholds). Fourth, the presence of missing data is a potential constraint on the robustness of our findings. While we have opted to include these incomplete responses, we recognize that it may introduce incomplete interpretation to our research. Last, the data were self-reported, as such, we do not have electronic health record-verified rates of test ordering rates, and this may be subject to social desirability bias and recall bias. However, the anonymous nature of the study likely limited the social desirability bias.

5. Conclusions

Our findings demonstrated that PCPs are not recommending HCV screening universally to all adults. We observed significant differences in PCP-reported HCV screening recommendations between average-risk and high-risk patients. Recommendation strength for average-risk patients was associated with the demographic distribution of the patient population (age, race/ethnicity), provider type, perceived self-efficacy, and perceived barriers. For high-risk patients, recommendation strength was associated with patient age, clinical specialty, practice venue, HCV screening training after residency, and perceived barriers. Future research should focus on developing multilevel interventions that address perceived barriers to screening and improve provider self-efficacy for HCV screening and follow-up care. Moreover, future interventions should intervene at multiple levels to not only emphasize sustainable provider education for PCPs to ensure the adoption of new guidelines, but also to improve patient understanding of HCV-related disease.

CRediT authorship contribution statement

Alfu Laily: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Robert Duncan:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Kaitlyn M. Gabhart:** Writing – review & editing, Investigation, Data curation. **Lauren D. Nephew:** Writing – review & editing, Methodology, Conceptualization. **Shannon M. Christy:** Writing – review & editing, Methodology, Conceptualization. **Susan T. Vadaparampil:** Writing – review & editing, Methodology, Conceptualization. **Anna R. Giuliano:** Writing – review & editing, Methodology, Conceptualization. **Monica L. Kasting:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Funding

Dr. Kasting's work on this project was funded, in part, by Grant

Numbers KL2TR002530 (B. Tucker Edmonds, PI), and UL1TR002529 (S. Moe and S. Wiehe, co-PIs) from the National Institutes of Health, National Center for Advancing Translational Sciences, Clinical and Translational Sciences Award. Work on this project was made possible, in part, by pilot funding from the Indiana University Simon Comprehensive Cancer Center. The Purdue University Libraries provided funding for publication costs.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2024.102602.

References

AAMC A of AMC. Percentage of all active physicians by race/ethnicity, 2018. AAMC. Published 2018. Accessed July 29, 2022. https://www.aamc.org/data-reports/workforce/interactive-data/figure-18-percentage-all-active-physicians-race/ethnicity-2018.

Agent for Healthcare Research and Quality. The Number of Nurse Practitioners and Physician Assistants Practicing Primary Care in the United States. Published 2018. Accessed July 10, 2022. https://www.ahrq.gov/research/findings/factsheets/primary/pcwork2/index.html.

Center of Disease Control and Prevention. Hepatitis C Surveillance in the United States, 2018. Published November 18, 2020. Accessed July 21, 2022. https://www.cdc.gov/hepatitis/statistics/2018surveillance/HepC.htm.

Centers for Disease Control and Prevention. CDC Fact Sheet: Viral Hepatitis and Liver Cancer. *201*Published online 201Accessed March 9, 2022. https://www.cdc.gov/nchhstp/newsroom/docs/factsheets/viral-hep-liver-cancer.pdf.

Cook, D.A., Pencille, L.J., Dupras, D.M., Linderbaum, J.A., Pankratz, V.S., Wilkinson, J. M., 2018. Practice variation and practice guidelines: Attitudes of generalist and specialist physicians, nurse practitioners, and physician assistants. PloS One. 13 (1), e0191943–e. https://doi.org/10.1371/journal.pone.0191943.

Denniston, M.M., Jiles, R.B., Drobeniuc, J., et al., 2014. Chronic Hepatitis C Virus Infection in the United States, National Health and Nutrition Examination Survey 2003 to 2010. Ann Intern Med. 160 (5), 293–300. https://doi.org/10.7326/M13-1133.

Edlin, B.R., Eckhardt, B.J., Shu, M.A., Holmberg, S.D., Swan, T., 2015. Toward a more accurate estimate of the prevalence of hepatitis C in the United States. Hepatol Baltim Md. 62 (5), 1353–1363. https://doi.org/10.1002/hep.27978.

Flores, B.E., Fernandez, A.A., Wang, C.P., et al., 2022. Educating Primary Care Providers and Associate Care Providers About Hepatitis C Screening of Baby Boomers: a Multi-practice Study. J Cancer Educ. 37 (1), 217–223. https://doi.org/10.1007/s13187-020-01805-2.

Ford, M.M., Desai, P.S., Maduro, G., Laraque, F., 2017. Neighborhood Inequalities in Hepatitis C Mortality: Spatial and Temporal Patterns and Associated Factors. J Urban Health. 94 (5), 746–755. https://doi.org/10.1007/s11524-017-0174-x.

Garrard, J., Choudary, V., Groom, H., et al., 2006. Organizational change in management of hepatitis C: Evaluation of a CME program. J Contin Educ Health Prof. 26 (2), 145–160. https://doi.org/10.1002/chp.63.

Gilkey, M.B., Calo, W.A., Moss, J.L., Shah, P.D., Marciniak, M.W., Brewer, N.T., 2016. Provider communication and HPV vaccination: The impact of recommendation quality. Vaccine. 34 (9), 1187–1192. https://doi.org/10.1016/j.vaccine.2016.01.023.

Goldman, L.E., Chu, P.W., Tran, H., Romano, M.J., Stafford, R.S., 2012. Federally Qualified Health Centers and Private Practice Performance on Ambulatory Care Measures. Am J Prev Med. 43 (2), 142–149. https://doi.org/10.1016/j.amepre.2012.02.033.

Hoofnagle, J.H., 1997. Hepatitis C: The clinical spectrum of disease. Hepatol Baltim Md. 26 (S3), 15S–20S. https://doi.org/10.1002/hep.510260703.

Jaén, C.R., Stange, K.C., Nutting, P.A., 1994. Competing demands of primary care: a model for the delivery of clinical preventive services. J Fam Pract. 38 (2), 166–171.

Kasting, M.L., Rathwell, J., Gabhart, K.M., et al., 2020. There's just not enough time: a mixed methods pilot study of hepatitis C virus screening among baby boomers in primary care. BMC Fam Pract. 21 (1), 248. https://doi.org/10.1186/s12875-020-01327-2.

Kasting, M.L., Giuliano, A.R., Reich, R.R., Rathwell, J., Roetzheim, R.G., Vadaparampil, S.T., 2021. Factors Associated with Screening Baby Boomers for Hepatitis C Virus Infection Among Primary Care Providers: a Retrospective Analysis. J Gen Intern Med JGIM. 36 (11), 3584–3586. https://doi.org/10.1007/s11606-020-06371-3.

Kastner, M., Bhattacharyya, O., Hayden, L., et al., 2015. Guideline uptake is influenced by six implementability domains for creating and communicating guidelines: a realist review. J Clin Epidemiol. 68 (5), 498–509. https://doi.org/10.1016/j.jclinepi.2014.12.013.

Kester, L.M., Zimet, G.D., Fortenberry, J.D., Kahn, J.A., Shew, M.L., 2012. A National Study of HPV Vaccination of Adolescent Girls: Rates, Predictors, and Reasons for Non-Vaccination. Matern Child Health J. 17 (5), 879–885. https://doi.org/10.1007/s10995-012-1066-z.

Kim, N.J., Locke, C.J., Park, H., Magee, C., Bacchetti, P., Khalili, M., 2018. Race and Hepatitis C Care Continuum in an Underserved Birth Cohort. J Gen Intern Med JGIM. 34 (10), 2005–2013. https://doi.org/10.1007/s11606-018-4649-6.

Kim, H.S., Yang, J.D., El-Serag, H.B., Kanwal, F., 2019. Awareness of chronic viral hepatitis in the United States: An update from the National Health and Nutrition Examination Survey. J Viral Hepat. 26 (5), 596–602. https://doi.org/10.1111/jvh.13060.

Levine, R.S., Mejia, M.C., Salemi, J.L., et al., 2020. A descriptive study of racial inequalities in mortality from hepatocellular cancer before and after licensure of lifesaving drugs for hepatitis C virus in the United States. EClinicalMedicine. 22.

McGlynn, E.A., Asch, S.M., Adams, J., et al., 2003. The Quality of Health Care Delivered to Adults in the United States. N Engl J Med. 348 (26), 2635–2645. https://doi.org/10.1056/NEJMsa022615.

Meredith, L.S., Azhar, G., Okunogbe, A., et al., 2017. Primary Care Providers with More Experience and Stronger Self-Efficacy Beliefs Regarding Women Veterans Screen More Frequently for Interpersonal Violence. Womens Health Issues. 27 (5), 586–591. https://doi.org/10.1016/j.whi.2017.06.003.

Michael, E., 2019. Cancer survivors likely to receive HPV vaccine after provider recommendation. Infect Dis Child. 32 (1).

Nallapeta, N., Mikhael, M., Keum, J., et al., 2021. S1091 Barriers to Hepatitis C Virus Testing According to Latest CDC Recommendations Among Trainees of Internal Medicine and Family Medicine at a Single Tertiary Academic Medical Center. Am J Gastroenterol. 116 (1).

Office of Infectious Disease and HIV/AIDS Policy. Viral Hepatitis National Strategic Plan. HHS.gov. Published January 7, 2021. Accessed November 9, 2022. https://www.hhs.gov/hepatitis/viral-hepatitis-national-strategic-plan/index.html.

Ozer, E.M., ADAMS, S.H., Gardner, L.R., ailloux, D.E., Wibbelsman, C.J., Irwin, C.E., 2004. Provider self-efficacy and the Screening of adolescents for risky health behaviors. J Adolesc Health. 35 (2), 101–107. https://doi.org/10.1016/S1054-139X(03)00536-6.

Razavi, H., ElKhoury, A.C., Elbasha, E., et al., 2013. Chronic hepatitis C virus (HCV) disease burden and cost in the United States. Hepatol Baltim Md. 57 (6), 2164–2170. https://doi.org/10.1002/hep.26218.

Ryerson, A.B., 2020. Newly Reported Acute and Chronic Hepatitis C Cases - United States, 2009–2018. MMWR Morb Mortal Wkly Rep. 69. https://doi.org/10.15585/mmwr.mm6914a2.

Schillie, S., Wester, C., Osborne, M., Wesolowski, L., Ryerson, A.B., 2020. CDC Recommendations for Hepatitis C Screening Among Adults - United States, 2020. MMWR Recomm Rep. 69 (2), 1–17. https://doi.org/10.15585/mmwr.rr6902a1.

Shehata, N., Austin, T., Ha, S., Timmerman, K., 2018. Barriers to and facilitators of hepatitis C virus screening and testing: A scoping review. Can Commun Dis Rep. 44 (7–8), 166–172. https://doi.org/10.14745/ccdr.v44i78a03.

Shepperd, J.A., Howell, J.L., Logan, H., 2014. A survey of barriers to screening for oral cancer among rural Black Americans. Psycho-Oncol Chichester Engl. 23 (3), 276–282. https://doi.org/10.1002/pon.3415.

Smith, B.D., Morgan, R.L., Beckett, G.A., et al., 2012. Recommendations for the Identification of Chronic Hepatitis C Virus Infection Among Persons Born During 1945–1965. MMWR Recomm Rep. 61 (4), 1–32.

The European Paediatric Hepatitis C Virus Network. Three Broad Modalities in the Natural History of Vertically Acquired Hepatitis C Virus Infection. *Clin Infect Dis*. 2005. 41(1). 45-51. doi:10.1086/430601.

Turner, B.J., Amsel, Z., Lustbader, E., Schwartz, J.S., Balshem, A., Grisso, J.A., 1992. Breast Cancer Screening: Effect of Physician Specialty, Practice Setting, Year of Medical School Graduation, and Sex. Am J Prev Med. 8 (2), 78–85. https://doi.org/10.1016/S0749-3797(18)30838-9.

United States Preventive Services Taskforce. Archived: Hepatitis C: Screening. Published 2013. Accessed June 15, 2022. https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/hepatitis-c-screening-2013.

US Preventive Services Task Force, Owens, D.K., Davidson, K.W., et al., 2020. Screening for Hepatitis C Virus Infection in Adolescents and Adults: US Preventive Services Task Force Recommendation Statement. JAMA. 323(10):970 https://doi.org/10.1001/jama.2020.1123.

Westfall, J.M., Mold, J., Fagnan, L., 2007. Practice-Based Research—"Blue Highways" on the NIH Roadmap. JAMA. 297 (4), 403–406. https://doi.org/10.1001/jama.297.4.403.

Winetsky, D., Zucker, J., Carnevale, C., et al., 2019. Attitudes, practices and perceived barriers to hepatitis C screening among medical residents at a large urban academic medical center. J Viral Hepat. 26 (11), 1355–1358. https://doi.org/10.1111/jvh.13181.

Winetsky, D., Zucker, J., Slowikowski, J., Scherer, M., Verna, E.C., Gordon, P., 2019. Preliminary Screening Results Outside the 1945–1965 Birth Cohort: A Forgotten Population for Hepatitis C? Open Forum. ofz178-ofz178 Infect Dis. 6 (5). https://doi.org/10.1093/ofid/ofz178.

Yakovchenko, V., Bolton, R.E., Drainoni, M.L., Gifford, A.L., 2019. Primary care provider perceptions and experiences of implementing hepatitis C virus birth cohort testing: a qualitative formative evaluation. BMC Health Serv Res. 19 (1), 236. https://doi.org/10.1186/s12913-019-4043-z.