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Oral Prescription Opioids as a High-Risk Indicator for Hepatitis C Infection: Another Step Toward HCV Elimination

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Abstract

Background: The opioid epidemic across the U.S. poses an array of public health concerns, especially HCV transmission. HCV is now widely curable, yet incident rates are increasing due to the opioid epidemic. Despite the established trajectory from oral prescription opioids (OPOs) to opioid use disorder (OUD), OUD to injection drug use (IDU), and IDU to hepatitis C virus (HCV), OPOs are not a defined risk factor (RF) for HCV infection. The objective of this study was to observe rates of HCV testing and Ab reactivity (HCVAb+) in patients receiving OPOs to substantiate them as a RF, ultimately contributing to HCV elimination. **Methods:** Data from MedStar Health patients receiving OPOs from 1/2017 to 12/2018 were collected and analyzed using chi-squared or student *t*-tests and logistic regression for uni- or multivariable analyses, respectively. Statistical significance was defined as $P < .05$; Epi Info and SAS v 9·4 were used for statistical analyses; IRB approval was received. **Results:** There were 115 415 individuals prescribed OPOs over the study period. In this population, 8.6% (932) were HCVAb+ when tested and not previously diagnosed (10 900); 3.4% (3893) had an OUD diagnosis, 20.6% (803) of whom were HCV tested; 25.4% (361) of all HCVAb+ (1421) had an OUD diagnosis. OUD (ORadj 8.53 [7.22-10.07]) was an independent predictor of HCVAb+ in this population. **Conclusions:** (1) In a large population prescribed oral opioids, HCVAb+ was 8.6%, higher than our previously published data (2.5%) and the US rate (1.7%); (2) only 20% of patients diagnosed with OUD were tested; and (3) only 25% of HCVAb+ patients were classified with OUD; this suggests underreporting of OUD in this population. Primary Care and Community Health Recommendations: (1) Re-testing for HCV in patients taking OPOs; (2) increased HCV testing among OUD patients; and (3) improved surveillance and reporting of OUD.

Keywords

hepatitis C virus, oral prescription opioids, HCV testing, prevention, opioid use disorder

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Introduction

Despite the concerted efforts of care providers and public health organizations, the opioid and subsequent hepatitis C viral (HCV) infection epidemic in the United States has only worsened over time. The Substance Abuse and Mental Health Services Administration (SAMHSA) tracked admissions across the US for substance use disorders (SUDs) from 2007 to 2017; within this time period, the percentage of hospital admissions for opioid use disorder (OUD) increased from 18% to 34% of admissions for SUDs, exceeding all others, and the raw number of annual admissions for OUD increased by 230 000.[1] Additionally, admissions for OUD have been decreasing for oral use and increasing for injection use.[2] This indicates both an increase in OUD prevalence and evolution of higher-risk drug use patterns over time. The

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medical community has attempted to curb these increases by limiting opioid prescriptions. In a recent study on this trend, the CDC found that prescriptions were increasing between 2014 and 2015, but began to decrease in 2015 and continued to do so through 2017. It was also noted that prescription rates differed regionally, with rural healthcare providers prescribing more opioids, although the trends were similar across regions.[3] Considering the established trajectory from oral prescription opioids (OPOs), to nonmedical opioid use, to OUD, and then injection drug use (IDU), decreasing prescriptions of oral opioids is an important strategy for combating the opioid epidemic in the US.[4-6]

A major consequence of the opioid epidemic are increased HCV infection rates, as IDU has long been considered the most significant risk factor for contracting this blood-borne virus.[7-9] This relationship has been documented on both the local and national scale. In studies of the trajectory from OPO use to OUD use, high HCV rates, and high-risk behaviors (such as needle and paraphernalia sharing) were found among participants.[5,6] Statewide data from SAMHSA and the National Notifiable Disease Surveillance System (NNDSS) suggest a correlation between increased admissions for OUD and increased HCV infection rates between 2004 and 2014, further indicating that the opioid epidemic is associated with the rise in HCV.[10] This association is further supported by the higher incidence rates of HCV in younger cohorts between the ages of 20-29 and 30-39.[7] As older patients, especially those belonging to the birth cohort (BC, born between 1945 and 1965), account for a majority of chronic HCV cases, the CDC previously only recommended screening this population.[11] In response to increasing cases in younger patients, a reassessment of risk factors was deemed necessary. In early 2020, the USPSTF issued updated guidelines advising universal HCV testing for adults between 18 and 79 years old.[12] Moving forward, it will be critical that the next phase of HCV elimination identifies patient populations requiring re-testing and connects them to care.

Despite the established trajectory from OPOs to OUD, OUD to IDU, and IDU to HCV, we have found no studies demonstrating an association between OPOs and HCV infection. The current study fills this gap in the literature by observing rates of HCV screening, HCV antibody (Ab) reactivity, and OUD in all patients receiving OPOs in the MedStar Health (MSH) system between January 2017 and December 2018. The aim of this study is to support exploring OPOs as a risk factor marker for HCV and observe trends related to OUD amongst patients treated with OPOs. Ultimately, this study aims to improve healthcare providers' ability to retest for HCV after an initial screen for HCV and counsel patients who are prescribed oral opioids regarding the connection between opioid use and HCV. Although HCV is currently a widely curable disease, chronic untreated infections can lead to continued transmission, cirrhosis and hepatocellular carcinoma; thus, decreasing HCV transmission by improving screening and linkage to care is in the interest of the public good.

This study was approved by the MedStar Health Research Institute (MHRI) Institutional Review Board.

Methods

Study Setting/Population

MedStar Health System is the largest regional healthcare system in the mid-Atlantic, with 10 hospitals, over 300 outpatient practices and approximately 2 million person visits annually. MSH serves a diverse patient population in urban, suburban, and rural locations throughout the District of Columbia, Maryland, and Northern Virginia.

Electronic Health Record (EHR) Data Abstraction

Data is reported from January 1, 2017 through December 31, 2018. During this study period, MSH primarily utilized the Cerner MedConnect EHR for outpatient care documentation for both primary and specialty care clinic visits. Data for all unique outpatients with OPOs was extrapolated from the Cerner MedConnect EHR and a limited de-identified data set was reported to Excel. Patient demographics included age, gender, and race/ethnicity. Data from the EHR on gender and race/ethnicity were limited by the system: gender was available only as a binary (male/female) output; race was not input uniformly as "Black" but often as "African American" and ethnicity was input separately as Hispanic or not Hispanic only. Other patient data included name of opioid prescribed, date and duration of prescription, anti-HCV antibody (HCV Ab), and HCV ribonucleic acid (RNA) results, anti-HIV results, anti-HBV results, date of HCV, and substance use disorder diagnoses if these were recorded in the EHR. HCV Ab results are reported here, and not the RNA, as the Ab is the primary screening tool for HCV infection acquisition and having ever been infected. It is not being used to determine active infection as the aim in this study is to determine HCV risk exposure. All test results were collected based on the location of the provider who endorsed the laboratory result document to ensure test results were correctly allocated to the proper site.

Statistical Analysis

Data is reported in proportions and as univariate and multivariate logistic regression analyses. Continuous variables were described by means with standard deviations, and medians with interquartile ranges; 2 sample *t*-test and Wilcoxon rank sum tests (when normality assumption of the data was not satisfied), as appropriate, were used to

Table 1. Demographic Variables Among Patients Prescribed Oral Opioids in MSH.

Characteristics	OPO (percent)	HCVAb test (percent)	OR (CI_{95})[a]	OR_{adj} (CI_{95})[b]	HCVAb+ (percent)	OR (CI_{95})[a]	OR_{adj} (CI_{95})[b]
Total	115 415	11 464 (9.9)			1421 (12.4)		
Age in years, mean ± SD	57.89 ± 16.7	55.6 ± 14.8	$P < .0001$[c]	0.98 (0.98-0.99)	58.0 ± 11.6	$P < .0001$[c]	NS
Sex							
Male	43 276 (37.5)	4397 (10.2)	1.0 (1.0-1.1)	1.1 (1.0-1.1)	778 (17.7)	2.2 (1.9-2.4)	2.0 (1.7-2.2)
Female	72 113 (62.5)	7066 (9.8)			643 (9.1)		
Race							
Black	42 840 (38.6)	6031 (14.1)	2.1 (2.0-2.2)	2.0 (2.0-2.1)	838 (13.9)	1.2 (1.1-1.4)	1.5 (1.3-1.7)
White*	60 478 (54.5)	4448 (7.4)			512 (11.5)		
Other**	7609 (6.9)	811 (10.7)	1.5 (1.4-1.6)	1.5 (1.4-1.7)	58 (7.2)	0.60 (0.45-0.79)	0.84 (0.63-1.1)

[a]OR calculated using Fisher's χ^2 test.
[b]OR calculated using multiple logistic regression.
[c]*P* value calculated based on student's *t*-test.
*Reference category for Black and Other analyses. **Other designation includes: Asian, Hawaiian/Pacific Islander, Indian/Alaskan Native, Other, 2 or more races.

compare distributions of continuous variables between 2 groups. Categorical variables were described by frequencies and percentages; chi-square and Fisher's exact (when cells have counts <5) tests, as appropriate, were used to compare proportions of categorical variables. Multivariate logistic regression analysis was conducted adjusting for age, gender, race, ethnicity, chronicity, birth cohort (BC) designation and OUD to examine for independent predicting variables associated with HCV Ab testing rates and positive rates among those tested for HCV. Multivariate logistic regression analysis was performed adjusting for age, gender, race, ethnicity, chronicity and BC designation to examine for independent predicting variables associated with OUD. Statistical significance was defined as $P < .05$. Analysis was conducted using SAS v 9.4 and Epi Info™.

Results

Demographics and Testing

There were 115 415 unique patients identified who were prescribed oral opioids (OPOs) between January 1, 2017 and December 31, 2018 (Table 1). The mean age (±std deviation [SD]) was 57.9 ± 16.7 years, 62.5% (n = 72 113) were female, 54.5% (60 478) were white and 38.6% (42 480) were African-American/Black (Table 1). HCV Ab testing was performed in 9.9% (11 464/115 415) of the population. Of the 11 464 tested, 12.4% (1421) received a reactive/positive result. Males and females were tested at similar rates (9.8% and 10.2% OR 1.0 [CI95 1.0-1.1], respectively). On multivariable analysis, males were twice as likely to test HCV Ab positive than females (17.7% and 9.1%; OR_{adj} 1.97 [CI95 1.74-2.22]). Black individuals were twice as likely to be tested than White (14.1% and 7.4%; 2.03 [1.95-2.12]) and 50% more likely to test positive (13.9% and 11.5%; 1.49 [1.31-1.69]) (Table 1).

HCV Diagnosis Timeline

In order to focus analysis on *new* diagnoses of HCV, HCV diagnosis status was categorized into old diagnosis (ICD9/10 charted before January 1, 2017), new diagnosis (ICD10 charted during study period), and HCV screening eligible (no prior ICD HCV diagnosis with prior HCVAb/RNA+) (Supplemental Table). In total, 3.4% of the total study population (n = 3868) had received an HCV diagnosis, of which 46.8% (1809/3868) were new diagnoses. Of the total HCV Ab positive results, 34.4% (489/1421) had previously been diagnosed with HCV, 20.9% (297/1421) did not have an HCV diagnosis documented, and 44.7% (635/1421) were newly diagnosed with HCV. This final group will be referred to as "*test-confirmed new diagnoses*." The overall rate of HCV Ab positivity was 8.6% (932/10900) amongst the combined new diagnoses and HCV screening eligible (excludes old diagnoses).

Birth Cohort and Opioid Use Disorder

Of the total study population, 3.4% (n = 3893/115 415) had an ICD diagnosis of OUD; 20.6% (803/3893) were tested for HCV Ab, of which 45.0% (361/803) tested positive (Figure 1). Patients tested with OUD were over 8 times more likely (OR_{adj} 8.53 [7.22-10.07]) to be HCV Ab positive than non-OUD patients (Table 2). Of the positive HCV Ab tests in OUD diagnosed individuals, 45.4% (164/361) were *test-confirmed new HCV diagnoses*. Of the total 1421 positive tests, 25.4% (361/1421) belonged to OUD patients (Figure 1); of the total 635 *test-confirmed new diagnoses*, 25.8% (164/635) belonged to OUD patients (Figure 2).

Of the total study population with OPOs, 48.0% (55 616/115 415) belonged to the birth cohort (BC); 11.6% (6467/55 616) were tested for HCV Ab, of which 16.1% (1041/6467) tested positive (Figure 1). Patients tested in the

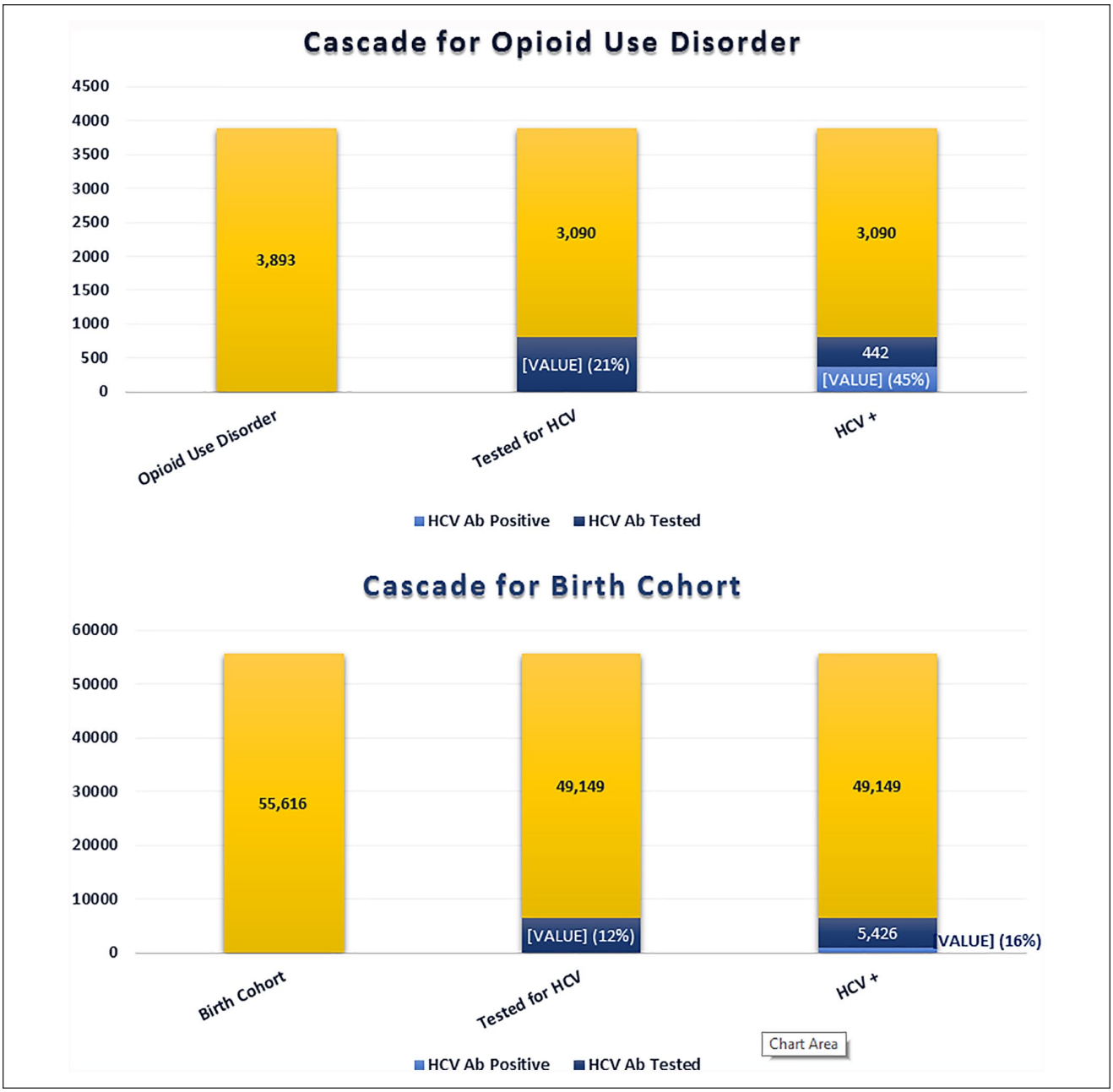

Figure 1. Cascade diagrams for OUD and BC patients from inclusion to HCV tested to HCV Ab positivity.

Table 2. Birth Cohort Inclusion and OUD Diagnosis Among Those Prescribed Oral Opioids in MSH.

Characteristics	OPO (percent)	HCVAb test (percent)	OR $(CI_{95})^a$	OR_{adj} $(CI_{95})^b$	HCVAb+ (percent)	OR $(CI_{95})^a$	OR_{adj} $(CI_{95})^b$
Birth Cohort	55616 (48.0)	6467 (11.6)	1.4 (1.4-1.5)	1.8 (1.7-1.8)	1041 (16.1)	2.3 (2.1-2.6)	2.4 (2.1-2.9)
Non-birth Cohort	59800 (52.0)	4997 (8.4)			380 (7.6)		
Opioid use disorder†	3893 (3.4)	803 (20.6)	2.5 (2.3-2.7)	2.3 (2.1-2.5)	361 (45.0)	7.4 (6.4-8.6)	8.5 (7.2-10.1)
Non-OUD	111522 (96.6)	10661 (9.6)			1060 (9.9)		

[a]OR calculated using Fisher's χ^2 test.
[b]OR calculated using multiple logistic regression.

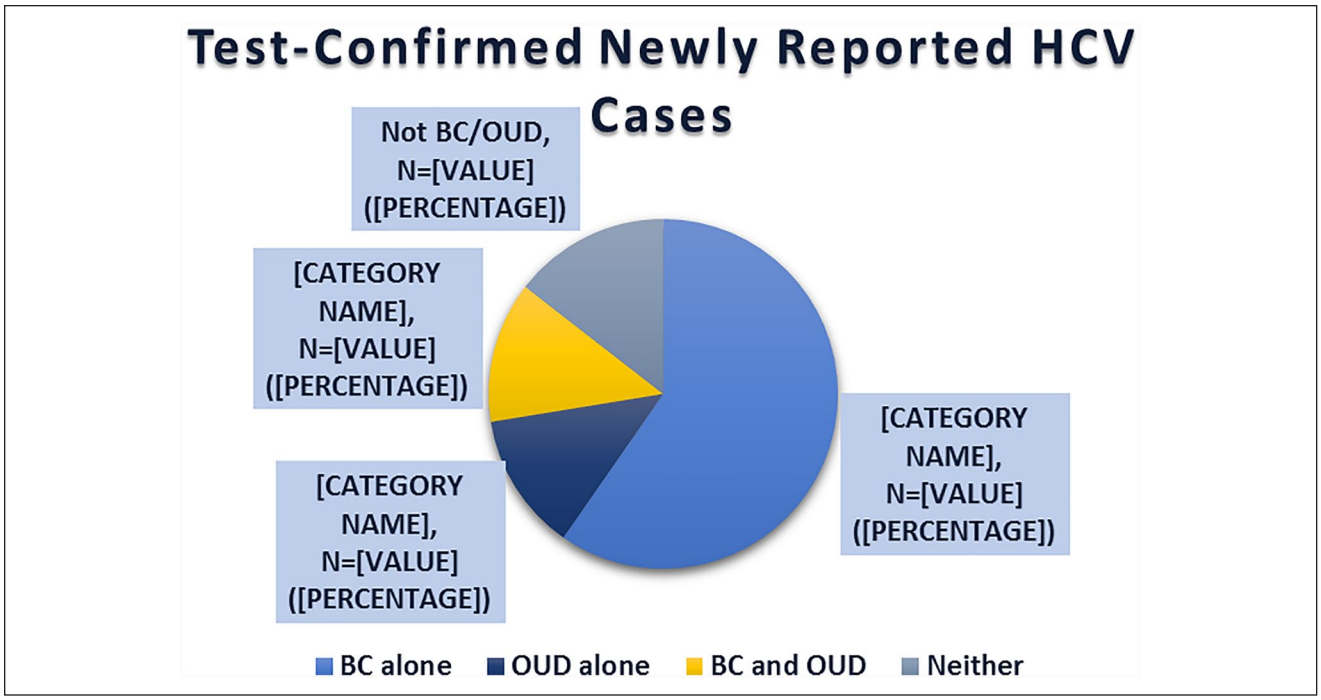

Figure 2. Proportion of HCV antibody positive results in newly reported cases of HCV (n = 635) in the birth cohort (BC), patients diagnosed with opioid use disorder (OUD), both, or neither.

BC were about 2.5 times more likely (OR_{adj} 2.45 [2.07-2.89]) to be HCV Ab positive than non-BC patients (Table 2). Of the positive tests in the BC, 44.4% (462/1041) were *test-confirmed new diagnoses*. Of the total 1421 positive tests, 73.2% belonged to BC patients (Figure 2); of the total 635 *test-confirmed new diagnoses*, 72.8% belonged to BC patients (Figure 2).

In the BC alone, Black race (OR_{adj} 2.22, CI_{95} 1.90-2.59), male (2.45, 2.12-2.82), and OUD (6.97, 5.60-8.67), were independent predictors of HCV Ab+; White race (1.68, 1.32-2.13) and OUD (9.65, 7.46-12.48) were independent predictors in the non-BC. Looking at positivity rates across different age groups, a peak can be seen in the age 61 to 70 cohort for both patients with OUD (59.0%) and without OUD (16.2%), and OUD had significantly ($P < .0001$) higher HCVAb positivity rates than non-OUD at every age group with more than 5 tests (Figure 3).

Discussion

HCV and OPOs

The aim of this paper was to test whether oral prescription opioids (OPOs) should be included as a risk factor marker for HCV infection as the next step in global elimination. In this large study (n = 115 415) of patients prescribed oral opioids, our data support that persons prescribed OPOs warrant HCV testing and repeat testing if initially negative or treated.

In our system-wide population sample, 12.4% of tested individuals were HCV Ab positive. Although this value is not a prevalence rate itself since not everyone was tested, it is greater than the previously published reference HCV Ab positivity rate in MSH (2.6%), the District of Columbia (2.3%), and the estimated HCV Ab prevalence rate in the US (between 0.93% and 1.7%).[7,13-15] Removing any cases diagnosed before the study date still yielded an HCV Ab positivity rate of 8.6%. Although no direct comparison can be made to those who are not being treated with OPOs, comparison to historical values allows us to conclude that rates of HCV Ab positivity are markedly increased in this population, thus OPOs should be further included as a RF for HCV by federal, state, and local public health agencies.

This conclusion warrants action from many stakeholders in the global effort to eliminate HCV. Oral prescriptions for opioids should be treated as an HCV high-risk indicator, and potentially as a risk factor, for screening, re-testing, and counseling purposes. Perhaps the most effective way to implement this policy will be by leveraging EHR systems to notify practitioners and simplify clinical decision-making. Geboy et al[13] studied this strategy for HCV screening in the birth cohort (BC) at MSH primary care sites. Between July 2015 and December 2016, over 9000 members of the BC were screened, amounting to approximately 11.5% of the

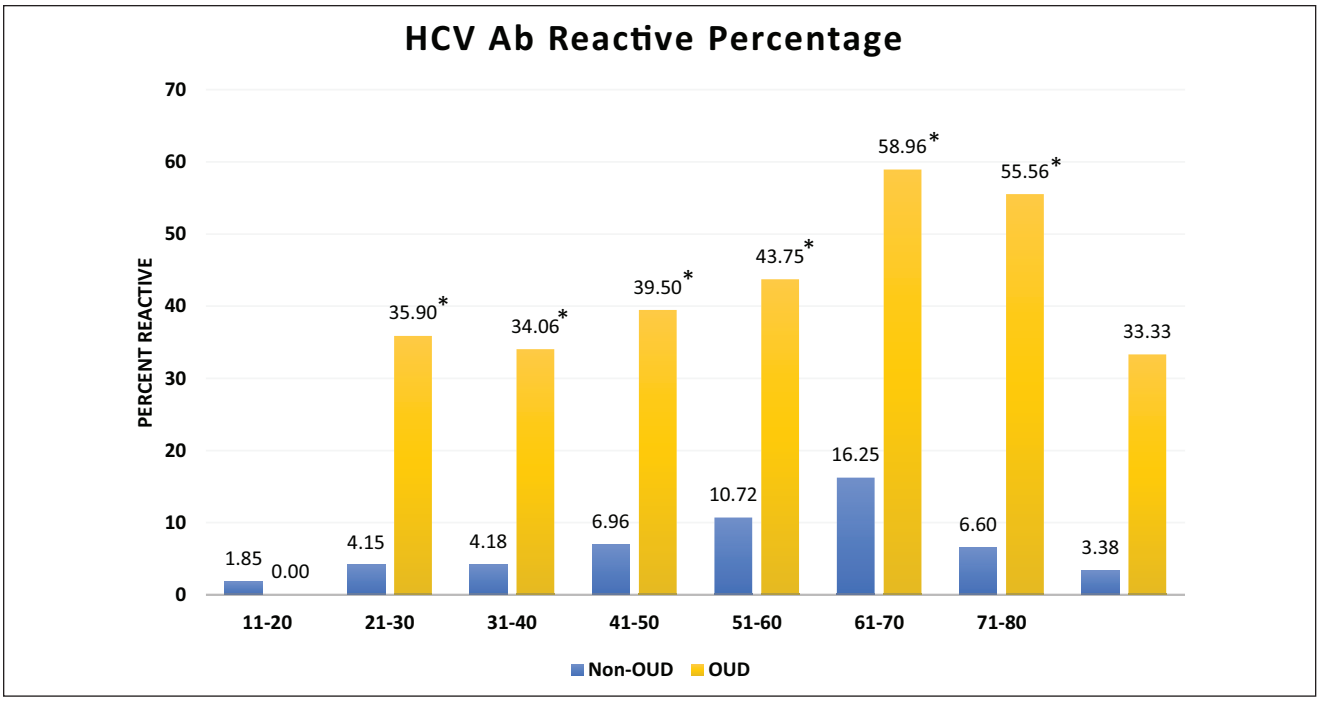

Figure 3. Percent of HCV Ab tests which were reactive in non-OUD (blue) and OUD (gold) patients in different age groups.
*Indicates $P < .0001$.

eligible population; 22% of the infected were cured during this period. Although their study was encouraging, the large sample size and timeline complicated comparison to an EHR lacking a screening prompt. Trinh et al,[16] on the other hand, performed a quality improvement study within a primary care clinic to increase HCV screening rates in the BC; within 3 years, screening rates rose from 24% to 90%. The 2 main interventions which were most effective at increasing screening rates were EHR-triggered reminders and individualized provider feedback based on personal HCV screening rates.

Still, there are limitations to these approaches, especially the concern that they may not address the root of the problem: insufficient patient and provider education regarding HCV and oral prescribed opioids. This disconnect is exemplified by the findings of Konerman et al,[17] who observed high rates of OPOs in patients with cirrhosis. Additionally, the highest doses of OPOs were given to patients with HCV cirrhosis, despite the potentially damaging effects of opioids and their decreased metabolism. Especially considering the current study, providers' awareness of the harmful relationship between OPOs and HCV should be improved.

Thus, even before our discussion of OUD and HCV, we suggest 3 recommendations as the next logical steps in HCV elimination: (1) widescale implementation of EHR HCV screening prompts for those treated with OPOs; (2) personalized HCV screening reports for providers in primary care clinics; and (3) low-time-commitment but effective educational efforts for providers regarding the mutually deleterious relationship between OPOs and HCV.

OUD, OPOs, and HCV

Among those treated with OPOs at MSH, only 3.4% had a documented diagnosis of OUD. This rate is not only high compared to the US prevalence estimate of 0.8%, but also compared to previous studies of OUD incidence rates in new OPO users with cancer.[18,19] Of note, increases in prevalence of OUD have been observed over the past decade based on results from the National Surveys on Drug Use and Health.[20] The theory that OPOs increase risk for OUD is corroborated by comparing our results to other prevalence rates; however, the significantly higher rates compared to previous studies of OPO populations might suggest a contributory high rate in the studied community. Future studies might consider the rate of OUD among all MSH patients to better study RFs.

Among those Ab tested with diagnosed OUD, 45% were HCVAb+, or 8.5 times more likely to be positive than people without OUD. This rate is much higher than the previously mentioned rates in MSH and the US, but comparable to rates among PWID in Europe (65%) and worldwide (62.5%).[21,22] Although OUD is not equivalent to IDU, the established trajectory from OUD to IDU, especially among

those treated with OPOs, likely explains these results.[4-6] Despite the expectedly high rates of HCV Ab positivity among this group, the screening rate was only 21% during our study period. This value is relatively high compared to national rates such as those reported in Kasting et al,[23] which ranged from 11.5% to 12.8% within the BC; however, they argue that screening rates must be increased to improve our chances of eliminating HCV. We add that this is especially true for high-risk, high-prevalence groups such as those with OUD. In the face of challenges to screening this cohort, such as stigma and the insidious nature of HCV,[22] actions such as those suggested by Trinh et al[16] may also help overcome these barriers to OUD testing. This could be further complicated by racial bias, potentially evident in the results reported here. Although Black individuals were only 1.5 times more likely to be HCVAb+, they were 2 times more likely to be tested. Future work will address improving the low HCV screening rates in the OUD population while considering the potentially biased perception of HCV toward Black communities. Future work will also address improving the low HCV screening rates in the OUD population.

Another obstacle in HCV elimination is identification of risk, which likely influenced our findings. Specifically, we observed that only 25% of all HCV Ab positive individuals were diagnosed with OUD; however, the theory that OPOs lead to HCV through an OUD trajectory would predict a much higher percentage of HCV Ab positive individuals with OUD. As discussed above, IDU is the main risk factor for HCV, and an estimated 75% of HCV cases in the US are associated with IDU.[10,11] Our findings in the context of established OUD progression leads to the logical conclusion that OUD was underreported or underdiagnosed in this population. OUD underreporting is not a surprising or rare occurrence considering the stigma surrounding substance use disorders. Gunn et al[24] observed that 40% of HCV positive patients admitted to IDU only after they were made aware of their HCV status. Several tests which have demonstrated high sensitivity and specificity for capturing OUD diagnosis, such as the Screen of Drug Use (SoDU) or the Screener and Opioid Assessment for Patients with Pain (SOAPP),[25,26] might be widely implemented among high-risk groups to approach this issue. Further, risk stratification for the development of OUD when prescribing opioids might decrease incidence rates among those treated with OPOs.[27] More effectively and openly discussing OUD with patients will enable providers to identify this potentially high-risk HCV group without stigma, thus positively contributing to HCV elimination. Our discussion of OUD thus points to several additional recommendations: (1) similarly to above, implementation of EHR HCV screening prompts for those with OUD; and (2) increased use of OUD screening and risk stratification tools, especially among those treated with OPOs.

Primary Care and Community Health Context: Universal Screening

The findings and recommendations of this study should be taken in the context of a shift toward universal HCV screening. While high prevalence rates (3.25%) and old cost-effectiveness models led to birth cohort (BC) testing guidelines, new models have called for HCV screening protocols to include the general public.[11,12,28-30] The USPSTF updated their guidelines in 2020 to reflect this shift, with a level B recommendation for 1 time HCV screening in adults ages 18 to 79.[31] Newer treatments have demonstrated higher success rates among those earlier in disease progression,[32,33] further supporting the case for widespread screening. The authors endorse this idea, as screening is a cost-effective measure for decreasing expensive and quality-of-life reducing health outcomes such as cirrhosis and hepatocellular carcinoma.

Guidelines also include recommendations for repeated testing among those with continued risk,[34] substantiated by high odds of reinfection among those with risk factors such as IDU.[35] Applied in the context of universal screening, our findings suggest a final recommendation: repeated HCV testing in those being treated with OPOs is warranted throughout the course of treatment, especially with a diagnosis of OUD. Although we could not find a specific cost-benefit study conducted for re-testing HCV in high risk groups, we expect that, as in the aforementioned universal screening analyses,[11,12,28-30] this intervention would decrease morbidity resulting in increased quality-of-life and decreased overall cost. We assert that an added benefit of creating an automatic EHR prompt for HCV re-testing in patients on OPOs would be decreasing stigma by normalizing the patient's experience. Without a prompt, a patient who developed OUD while taking OPOs might interpret this as provider judgment if they suggest HCV testing. An EHR warning would, along with positive provider communication, help the patient to recognize that the trajectory of their condition is well-established and, more importantly, understood.

Limitations

The main limitations of this paper arise from its retrospective, observational nature. Because the data collected only included patients receiving OPOs, our findings regarding other risk factors such as BC and OUD are not necessarily generalizable to the overall population. We cannot state definitively that OPOs are causing increased HCV risk among this population, as there might be a confounding factor skewing the results. Still, we can state with a high degree of certainty that HCV infection rates are higher in this subset of the population, and that other risk factors compound HCV risk within this cohort. Additionally, since we only

collected structured data and did not collect data from the entirety of each patient's medical history, our conclusions regarding OUD diagnosis are limited to the study period. In other words, if a patient no longer had OUD but had originally contracted HCV via IDU decades ago, our data extraction could not capture this complexity; therefore, we might be underestimating the percentage of HCV Ab+ cases with OUD as a risk factor. Based solely on the current study period, we nonetheless conclude that OUD is underreported in this population. Another limitation was the inability to accurately confirm dates and duration of opioid use. While the original analysis intended to consider short- versus long-term use of OPOs, an audit of the data revealed the internal prescription dates were not comprehensive. Therefore, we cannot make conclusions related to the effect of opioid chronicity on HCV infection rates. Improved shared pharmacy OPO data should be implemented for wide-scale use and reporting.

Conclusions: Summary of Recommendations

In conclusion, our findings indicate that OPOs should be considered a risk factor indicator for HCV infection, HCV screening rates among those with OUD require improvement, and OUD is underdiagnosed and/or underreported in OPO populations. To address these issues, we recommend the following: (1) widescale addition to the universal HCV alert algorithm to repeat testing for those treated with OPOs and/or with OUD; (2) personalized HCV screening reports for providers in primary care clinics; (3) low-time-commitment but effective educational efforts for providers regarding the mutually deleterious relationship between OPOs and HCV; (4) increased use of OUD screening and risk stratification tools, especially among those treated with OPOs; and (5) repeat testing in those treated with OPOs throughout the course of treatment, especially with a diagnosis of OUD. Implementation of these screening strategies is the next logical step toward national and global HCV elimination.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr. Dawn Fishbein has served on a Gilead Advisory Board regarding HCV.

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Ethics Approval and Consent to Participate

Ethics approval was obtained from MedStar Institutional Review Board. No informed consent was needed as all patient data was deidentified.

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Availability of Data and Material

Data supporting our findings can be found through the corresponding author: Benjamin Hack (bh654@georgetown.edu)

Supplemental Material

Supplemental material for this article is available online.

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