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MAJOR ARTICLE

Results of a Hepatitis C Virus Screening Program of the 1945–1965 Birth Cohort in a Large Emergency Department in New Jersey

Julia Kang Cornett,[1] Vimal Bodiwala,[1] Victor Razuk,[1] Devangi Shukla,[1] and Navaneeth Narayanan[1,2]

[1]Division of Infectious Diseases, Department of Medicine, Rutgers Robert Wood Johnson Medical School, New Brunswick, New Jersey; [2]Department of Pharmacy Practice and Administration, Rutgers Ernest Mario School of Pharmacy, Piscataway, New Jersey

Background. Persons born between 1945 and 1965 account for an estimated 81% of those infected with hepatitis C virus (HCV) in the United States. However, up to 60% remain undiagnosed. Prior studies have reported HCV screening results from large urban emergency departments.

Methods. This is a retrospective cohort study of patients in the 1945–1965 birth cohort tested for HCV in a large emergency department (ED) in New Jersey from June 1, 2016, through December 31, 2016. The purpose was to report HCV antibody and viral load results of this testing program located in a small urban/suburban area and to analyze specific characteristics associated with positive results, such as race/ethnicity and insurance status. Descriptive statistics were performed, and, using a multivariate logistic regression model, adjusted odds ratios and 95% confidence intervals were calculated.

Results. A total of 3046 patients were screened: 55.8% were white, and 17.9% were black; 52.1% had private insurance, 33.4% Medicare, 3.9% Medicaid. One hundred ninety-two were antibody positive (6.3%). Of 167 with HCV viral load testing results, 43% had a positive viral load. On multivariate analysis, black race and Medicaid were independently associated with a positive HCV viral load.

Conclusions. HCV antibody seropositivity was above 6% and twice as high as the Centers for Disease Control and Prevention estimated prevalence in this birth cohort. These results indicate that EDs outside of large urban cities are also important sites for routine HCV screening. Other findings of interest include 43% with chronic HCV infection and the persistent association between black race and positive HCV viral load even when adjusted for insurance status.

Keywords. birth cohort screening; emergency department screening; hepatitis C.

Hepatitis C virus (HCV) is the most common chronic bloodborne infection in the United States, impacting more than 3.5 million Americans [1, 2]. Without treatment, approximately 80% of individuals who contract hepatitis C develop chronic infection, and up to 20% develop liver cirrhosis [3]. A recent Centers for Disease Control and Prevention (CDC) study reported that the number of HCV-related deaths in the United States increased by 6.2% per year from 2003 to 2013 [4]. Meanwhile, the mortality rate for 60 other nationally notifiable infectious conditions decreased by 3.4% per year in the same time period—an improvement attributed to effective public health programs and policies [4].

Both the CDC and the US Preventative Services Task Force recommend that all adults born between 1945 and 1965 (baby boomers) should receive 1-time screening for HCV even in the absence of other risk factors for HCV [5, 6]. The CDC recommends screening with a hepatitis C antibody test, which, if positive, should be followed by HCV nucleic acid testing (NAT) to determine whether chronic HCV infection is present [5].

Approximately 81% of all persons living with chronic HCV are in the 1945–1965 birth cohort, with an estimated prevalence of 3.25% in this birth cohort, 5 times higher than among adults born in other years [5, 7]. Baby boomers also account for a majority of deaths related to HCV infection [8]. However, up to 60% of persons in this birth cohort with chronic HCV infection remain unaware of being infected [9]. The development of novel direct-acting antiviral oral drugs that have proven to be safe and highly effective further supports the increased screening of patients at risk for HCV [10].

Implementation of HCV screening in the emergency department (ED) can play a critical role in identifying HCV-infected patients within this birth cohort. The ED acts as a health care

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Correspondence: J. Kang Cornett, MD, 1 Robert Wood Johnson Place, MEB 366, New Brunswick, NJ 08901 (kangju@rwjms.rutgers.edu).

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safety net for many difficult-to-access patients who do not seek medical care services outside the ED [11]. So far, only a few ED sites have reported their experiences with screening this high-risk birth cohort for HCV, and all have been ED sites in urban settings [12–15]. In 1 recent study from a large New York City ED, 7.3% of tested patients in the 1945–1965 birth cohort were HCV antibody (Ab) positive [12]. Prevalence of HCV seropositivity among tested patients was 13.7% when the 1945–1965 birth cohort was targeted for screening in a large urban ED in California [13].

All the ED sites that have reported their experiences with HCV screening are large urban hospitals that serve many patients known to be at higher risk for HCV infection, including injection drug users, minorities, and persons of low income [16]. Therefore, it remains unknown whether routine screening of baby boomers for HCV is warranted in other ED settings.

In June 2016, opt-out routine HCV screening of the 1945–1965 birth cohort was implemented as a service grant project in a large ED located in a 600-bed tertiary care hospital in New Jersey. In this paper, we report characteristics of the screened population and results of HCV antibody (Ab) and HCV viral load (VL) testing. We also analyzed relevant characteristics of patients screened for HCV as well as additional characteristics for those who tested HCV Ab and HCV VL positive. Our aim was to determine whether routine HCV screening of the baby boomer birth cohort is warranted in emergency departments located outside large urban cities. To our knowledge, this is the first paper to report findings of HCV screening from this type of setting.

METHODS

The study site was a 600-bed tertiary care academic hospital located in a small city in New Jersey that draws its socioeconomically diverse patient population from that city as well as the surrounding suburbs. The ED has approximately 95 000 patient encounters each year, involving approximately 65 000 unique patients within all age categories. Among all patients, 51% of the patients are female. Approximately 40% are white, 32% are Hispanic, and 19% are black. Approximately 32% have private insurance, 31% public/Medicaid, 20% Medicare, and 13% are uninsured.

Approximately 14 000 patients in the 1945–1965 birth cohort were seen in 2016. Within this group, 50% were female, 49% white, 21% Hispanic, and 19% African American. Approximately 43% had private insurance, 25% Medicare, 16% Medicaid, and 9% were uninsured.

Study Design

This was a single-center, retrospective cohort study of patients tested for HCV in the ED. We conducted a descriptive analysis of the results of opt-out HCV screening targeting the 1945–1965 birth cohort from June 1, 2016, to December 31, 2016. The Rutgers Institutional Review Board approved the study.

Screening and HCV Testing

The patient population consisted of any patient born between 1945 and 1965 who obtained a routine screening test for hepatitis C in the ED during the time period of June 1, 2016, to December 31, 2016. An opt-out HCV test order was automatically generated in the electronic medical record (EMR) for birth cohort patients seen in the ED from 11 AM–7 PM daily as a result of a service grant. This HCV test order was linked to the service grant principal investigator (J.K.C.), enabling exclusion of any patients who obtained an HCV test for diagnostic or any other nonscreening purpose. The testing hours were based on when the ED saw the most patients and the availability of grant personnel for questions from patients or staff. Patients received a handout explaining the rationale for screening and that they could refuse testing. The handout also stated that patients would be contacted with results and provided the phone number of the linkage to care coordinator for questions or concerns. Patients could be excluded from screening at the discretion of any ED provider, including emergencies or inability to consent. Elecsys Anti-HCV COBAS Modular e601 (Roche Molecular Diagnostics) was performed on all samples to test for HCV Ab. Patients who tested HCV Ab positive were automatically reflexed to the COBAS AmpliPrep/TaqMan HCV Quantitative Test v2.0 (Roche Molecular Diagnostics, Pleasanton, California) to determine HCV VL.

Data Collection

Sociodemographic data for all patients screened from June 1, 2016, through December 31, 2016, were obtained from the hospital's electronic medical records. Data were entered into patient de-identified, password-protected Microsoft Excel data collection sheets. For all screened patients, age, decade of birth, sex, race/ethnicity, and insurance coverage information were collected. For all patients who tested HCV Ab positive, additional data were collected, including active or prior intravenous drug use, country of origin, homelessness, current county of residence, and primary language.

Data Analysis

Descriptive statistics were performed for all variables. Continuous data were reported as means with standard deviations, or medians with interquartile ranges (IQRs) if the variable was not normally distributed. Normality for continuous variables was determined by Shapiro-Francia test. All categorical data were reported as percentages. The significance level was set at $P < .05$ (2-sided). We performed a univariate logistic regression to estimate the crude odds ratio and 95% confidence intervals (CIs). Any variable in the univariate analysis with $P < .2$ was entered into a multivariate logistic regression model to identify any variable independently associated with having a positive HCV VL. Through the multivariate logistic regression model, an adjusted odds ratio and 95% CI were calculated, adjusting for potential confounders (with modest association,

$P < .2$), to evaluate the presence and magnitude of association with outcome of interest. Data analysis was performed using Stata, version 15.0 (StataCorp).

RESULTS

During the study period, 2928 baby boomers were tested for hepatitis C. The median age was 60.3 years. Approximately 56.7% were white, 18% black, 42% had private insurance, 35.8% Medicare, 13.6% Medicaid, and 8.5% were uninsured. The characteristics of these patients are summarized in Table 1.

A total of 192 patients tested positive for HCV Ab, resulting in a seroprevalence of 6.6%. Among white patients (n = 1661), 109 were HCV Ab positive (6.6%), and among black patients (n = 528), 47 were HCV Ab positive (8.9%). Among Medicare patients (n = 1048), 81 were HCV Ab positive (7.7%), and among Medicaid patients (n = 397), 49 were positive (12.3%). HCV VL result was obtained for 167 of the 192 HCV Ab–seropositive patients (25 patients did not have an HCV VL test performed due to quantity insufficient for analysis), and 71/167 (43%) were HCV VL positive.

In assessing the overall prevalence of HCV VL positivity in our sample, there were 2903 patients with valid HCV Ab and, for positive results, an HCV VL result. The overall HCV VL prevalence was 2.4% (71/2903). Prevalence rates for HCV Ab and HCV VL by demographic and socioeconomic characteristic are summarized in Table 2.

On multivariate logistic regression analysis, black race (OR, 2.62; 95% CI, 1.53–4.51), Medicare (OR, 4.02; 95% CI,

Table 1. Characteristics of All Screened Patients and Those Who Are HCV Ab and HCV VL Positive

Characteristic	All Patients Screened (n = 2928) (%)	HCV Ab–Positive Patients (n = 192) (%)	HCV VL–Positive Patients (n = 71) (%)
Age, median (IQR), y	60.3 (55.6–65.9)	59.9 (56.6–64.7)	59.7 (55.8–63.6)
Birth cohort			
1945–1955	1391 (47.5)	82 (42.7)	29 (40.8)
1956–1965	1537 (52.5)	110 (57.3)	42 (59.2)
Sex			
Female	1389 (47.4)	76 (39.6)	27 (38)
Male	1539 (52.6)	116 (60.4)	44 (62)
Race/ethnicity			
White	1661 (56.7)	109 (56.8)	29 (40.9)
Black	528 (18)	47 (24.5)	29 (40.9)
Hispanic/other	521 (17.8)	26 (13.5)	8 (11.2)
Asian	218 (7.5)	10 (5.2)	5 (7)
Insurance			
Private	1230 (42)	48 (25)	11 (15.5)
Medicaid	397 (13.6)	49 (25.5)	25 (35.2)
Medicare	1048 (35.8)	81 (42.2)	30 (42.3)
Self-pay/uninsured	249 (8.5)	10 (5.2)	3 (4.2)
Unknown/other	4 (0.1)	4 (2.1)	2 (2.8)
Injection drug user		41 (21.4)	18 (25.4)
Country of origin[a]			
United States		156 (81.3)	63 (88.7)
Other[b]		31 (16.2)	7 (9.9)
Homeless		7 (3.7)	5 (7)
Current county of residence in NJ			
Middlesex		141 (73.4)	54 (76.1)
Somerset		15 (7.8)	5 (7)
Monmouth		12 (6.3)	4 (5.6)
Union		10 (5.2)	4 (5.6)
Out of state		6 (3.1)	2 (2.8)
Other[c]		8 (4.2)	2 (2.8)
Primary spoken language			
English		169 (88)	62 (87.3)
Spanish		10 (5.2)	4 (5.6)
Other		13 (6.8)	5 (7)

Abbreviations: Ab, antibody; HCV, hepatitis C virus; IQR, interquartile range; VL, viral load.

[a]Missing data for 5 patients in the antibody-positive group and 1 patient in the viral load–positive group.

[b]Includes Africa, Central and South America, East Asia, Europe, South East Asia, and the Caribbean.

[c]Includes Burlington, Hudson, Hunterdon, Mercer, and Ocean counties.

Table 2. Prevalence of HCV Ab and HCV VL by Characteristic

Characteristic	Total No. Tested (Denominator) for Each Characteristic	Prevalence of Positive HCV Ab, No. Positive Antibody/At Risk Tested Patients (%)	Total No. Tested (Denominator) for Each Characteristic	Prevalence of Positive HCV VL, No. Positive Viral Load/At Risk Tested Patients (%)
All patients	2928	192 (6.6)	2903[a]	71 (2.4)
Birth cohort				
1945–1955	1391	82 (5.9)	1382	29 (2.1)
1956–1965	1537	110 (7.2)	1521	42 (2.8)
Sex				
Female	1389	76 (5.5)	1379	27 (1.9)
Male	1539	116 (7.5)	1524	44 (2.9)
Race/ethnicity				
White	1661	109 (6.6)	1644	29 (1.8)
Black	528	47 (8.9)	523	29 (5.5)
Hispanic/other	521	26 (4.9)	518	8 (1.5)
Asian	218	10 (4.6)	218	5 (2.3)
Insurance				
Private	1182	48 (3.9)	1220	11 (0.9)
Medicaid	397	49 (12.3)	392	25 (6.4)
Medicare	1048	81 (7.7)	1039	30 (2.9)
Self-pay/uninsured	249	10 (4)	248	3 (1.2)
Unknown/other	4	4 (100)	4	2 (50)

Abbreviations: Ab, antibody; HCV, hepatitis C virus; VL, viral load.

[a]Twenty-five patients excluded due to invalid blood draw or viral load test.

1.93–8.39), and Medicaid (OR, 6.11; 95% CI, 2.95–12.68) were independently associated with a positive HCV VL among all tested patients (Table 3). Among HCV Ab–positive patients, black (OR, 4.28; 95% CI, 1.85–9.89) and Asian race (OR, 6.28; 95% CI, 1.09–36.11) were independently associated with positive HCV VL (Table 4).

DISCUSSION

We aimed to screen a high-risk cohort, baby boomers, in a setting outside of large urban cities and other epicenters for HCV infection. Our results demonstrated a significant prevalence of HCV Ab and HCV VL positivity in this convenience sample. After adjusting for potential confounders, black race and Medicare and Medicaid status were independently associated with higher odds of HCV VL positivity among the entire screened population. Among only HCV Ab–positive patients, insurance status was not associated with higher odds of HCV VL positivity; however, black race continued to have a significant association in multivariate analysis. Also of interest is that only 42.5% of HCV Ab–positive patients in our screened

Table 3. Logistic Regression Model Assessing Factors Associted With Positive HCV VL Among All Screened Patients

Characteristic	Crude OR (95% CI) (n = 2903)[a]	Adjusted OR (95% CI) (n = 2903)[a]
Sex		
Female	Reference	Reference
Male	1.49 (0.92–2.42)	1.59 (0.97–2.61)
Age	0.96 (0.92–1.00)	0.95 (0.91–0.99)
Race/ethnicity		
White	Reference	Reference
Black	3.27 (1.93–5.52)	2.62 (1.53–4.51)
Hispanic/other	0.87 (0.39–1.92)	0.78 (0.34–1.80)
Asian	1.31 (0.50–3.41)	1.26 (0.46–3.42)
Insurance[b]		
Private	Reference	Reference
Medicaid	7.49 (3.65–15.36)	6.11 (2.95–12.68)
Medicare	3.27 (1.63–6.55)	4.02 (1.93–8.39)
Self-pay/uninsured	1.34 (0.37–4.86)	1.34 (0.36–4.94)

Abbreviations: CI, confidence interval; HR, hazard ratio.

[a]Twenty-five patients excluded due to invalid blood draw or viral load test.

[b]Unknown/other not shown due to high degree of error and wide confidence intervals due to small sample size (n = 4).

Table 4. Logistic Regression Model Assessing Factors Associated With Positive HCV VL Among HCV Ab–Positive Patients

Characteristic	Crude OR (95% CI) (n = 167)	Adjusted OR (95% CI) (n = 163)[b]
Age	0.94 (0.89–1.00)	0.94 (0.88–1.02)
Race/ethnicity		
White	Reference	Reference
Black	4.85 (2.20–10.66)	4.28 (1.85–9.89)
Hispanic/other	1.16 (0.44–3.04)	1.75 (0.58–5.33)
Asian	2.17 (0.58–8.09)	6.28 (1.09–36.11)
Insurance[a]		
Private	Reference	Reference
Medicaid	3.22 (1.29–8.11)	2.06 (0.72–5.92)
Medicare	1.75 (0.75–4.07)	1.61 (0.63–4.07)
Self-pay/uninsured	1.23 (0.26–5.80)	1.28 (0.21–8.02)
Country of origin[b]		
Other[c]	Reference	Reference
United States	2.31 (0.91–5.85)	4.65 (1.08–19.96)
Homeless		
No	Reference	Reference
Yes	7.20 (0.82–63.03)	4.13 (0.40–42.5)

Abbreviations: CI, confidence interval; HR, hazard ratio.

[a]Unknown/other not shown due to high degree of error and wide confidence intervals due to small sample size (n = 4).

[b]Final analytic sample in adjusted model, n = 4 excluded due to missing data for country of origin.

[c]Includes Africa, Central and South America, East Asia, Europe, South East Asia, and the Caribbean.

population had positive HCV viral loads. While the EMR was reviewed for documentation of prior treatment, it is possible that additional patients had been treated. It is also possible that spontaneous clearance rates were higher in our population. The absence of a significant association between insurance status and HCV VL positivity suggests that access to HCV treatment is not the sole explanation for our low rates of HCV VL positivity.

It was recently reported that HCV testing prevalence among baby boomers increased from 12.3% to 13.8% from 2013 to 2015 [17]. These results indicate that national guideline recommendations on HCV screening of this high-risk birth cohort have made only a minimal impact thus far and that there is a crucial need for increased screening efforts. The rate of positive HCV Ab results in our screened population, while lower than reported from large urban EDs, was still double the expected HCV seroprevalence in this birth cohort of 3.25% [5, 13–16]. While this study was a descriptive analysis rather than a true seroprevalence study, our findings support the argument that ED screening for HCV is important in a variety of settings. But as the authors of a recent HCV screening study noted, HCV infection may be perceived as an epidemic limited to epicenters, rather than as a nationwide health problem [14]. Previously noted studies assessing HCV testing in emergency departments were all conducted in large urban epicenters such as Baltimore and New York City. Our study serves as the first report from an ED setting not located in a large urban location and may be considered more generalizable to other smaller US urban/suburban settings.

This study had several limitations. The study relied on data obtained solely from EMR review as investigators did not actively collect data from patients, including assessment of risk factors or prior history of hepatitis C infection. HCV screening occurred only during a set 8-hour period daily, which may have impacted study population demographics and therefore study results. It is possible that the absence of 25 viral load results due to invalid laboratory testing could have impacted results. Lastly, the study was conducted at a single academic hospital in New Jersey, so findings from this study may not be generalizable to hospitals in rural or nonacademic settings.

Despite these limitations, there are several strengths of this study. First, we believe our study to be the first report of data from an HCV screening program in a small urban/suburban ED with demographics unlike those of previous studies in large urban EDs. Second, all HCV Ab–positive results were automatically reflexed to HCV VL testing, allowing determination of active infection. Several previous studies only noted HCV antibody results in the absence of reflex testing. Third, statistical methods were able to assess for factors associated with HCV VL positivity in an already high-risk cohort while controlling for demographic and socioeconomic confounders. Lastly, screening occurred in a diverse patient population in terms of race/ethnicity and socioeconomic status, which enhances the external validity of our screening methods and study results to various communities across the United States. Results from our study can be used to advocate for the expansion of routine screening programs of the baby boomer cohort in diverse ED settings not limited to HCV epicenters in large urban settings.

CONCLUSION

Despite a setting unlike those of prior HCV ED screening studies, HCV antibody seropositivity among the 1945–1965 birth cohort in a small city/suburban setting in New Jersey was still above 6% and twice as high as the CDC estimated prevalence in this birth cohort [5]. These results indicate that ED settings outside large urban hospitals are also important sites for routine HCV screening.

This study supports findings from prior publications that HCV screening is feasible in EDs and that high rates of HCV prevalence among baby boomers can be found in diverse ED settings. It also expands the current information base on HCV infection in the 1945–1965 birth cohort by including a population with different demographics than prior studies. Widespread implementation of HCV screening efforts in EDs across the nation, not just in epicenters, is needed to increase identification of patients with HCV.

The most striking difference between this study's results and those of prior reports of HCV screening in urban EDs was the low overall rate of positive HCV viral load. Our rate of approximately 40% contrasts with findings of other similar studies, which reported rates of chronic HCV of approximately 70%–87% [13–16]. Whether this low rate is related to treatment or to intrinsic characteristics of this population is an area of interest for further research as factors that determine spontaneous clearance have not been fully elucidated. Data from similar institutions could be helpful in this determination.

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