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Disparities in Hepatitis C Testing in U.S. Veterans Born 1945-1965

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Abstract

Background/Aims—Universal one-time antibody testing for hepatitis C virus (HCV) infection has been recommended by the Centers for Disease Control (CDC) and the United States Preventive Services Task Force (USPSTF) for Americans born 1945-1965 (birth cohort). Limited data exists addressing national HCV testing practices. We studied patterns and predictors of HCV testing across the U.S. within the birth cohort utilizing data from the national corporate data warehouse (CDW) of the U.S. Veterans Administration (VA) health system.

Method—Testing was defined as any HCV test including antibody, RNA or genotype performed during 2000-2013.

Result—Of 6,669,388 birth cohort veterans, 4,221,135 (63%) received care within the VA from 2000-2013 with two or more visits. Of this group, 2,139,935 (51%) had HCV testing with 8.1% HCV antibody and 5.4% RNA positive. Significant variation in testing was observed across centers (Range: 7-83%). Older, male, African-Americans, with established risk factors and receiving care from urban centers of excellence were more likely to be tested. Among veterans free of other established risk factors (HIV negative, HBV negative, ALT≤40 U/L, FIB-4≤1.45, or APRI<0.5), HCV antibody and RNA were positive in 2.8% and 0.9%, respectively, comparable to established national average. At least 2.4-4.4% of veterans had scores suggesting advanced fibrosis

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(APRI≥1.5 or FIB-4>3.25) with >30-43% having positive HCV RNA but >16-20% yet to undergo testing for HCV.

Conclusion—Significant disparities are observed in HCV testing within the U.S. VA health system. Examination of the predictors of testing and HCV positivity may help inform national screening policies.

Lay Summary—Analysis of United States Veterans Administration data show significant disparities in Hepatitis C Virus (HCV) testing of veterans born 1945-1965 (birth cohort). A fifth of those not tested had evidence of advanced liver fibrosis. Our data suggests some predictors for this disparity and will potentially help inform future policy measures in the era of universal birth cohort testing for HCV.

Keywords

HCV; Hepatitis C virus; epidemiology; variances; testing; veterans; U.S.

Introduction

Modern treatment of patients with chronic hepatitis C virus (HCV) infection has been transformed by the advent of highly effective, all-oral, interferon-free treatment regimens [1-6]. Chronic HCV infection is associated with substantial morbidity and mortality [7, 8] and since 2007 has surpassed HIV as a cause of death in the U.S. per The National Center for Health Statistics [9]. Viral eradication, defined as a sustained virologic response (SVR) 12 weeks following completion of treatment, is attainable in over 90% of patients of nearly all sub-populations of patients with HCV infection, and associated with improved quality of life [10, 11], stabilization of liver disease [12], and decreased mortality [7]. However, approximately half of all infected individuals remain undiagnosed, and available data suggest that significant deficits exist in HCV testing [13-15]. Based on epidemiologic survey data confirming that greater than 75% of chronically infected individuals were born within the 1945-1965 birth cohort [16-19], one-time universal HCV antibody screening of all adults born 1945-1965 is recommended by the Centers for Disease Control and Prevention (CDC) and the U.S. Preventative Services Task Force (USPSTF) [13, 16, 20].

The U.S. Veterans Administration (VA) is the largest integrated health network in the U.S. The projected U.S. veterans' population is 21.7 million (9% females) with a total of 8.97 million enrollees in the VA system. Among U.S. veterans, HCV prevalence is presumed to be three-fold that of the general population based on cross-sectional analysis of enrolled veterans [18, 21]. Since 1998 [22, 23], the VA health system has employed national directives, education programs, practice guidelines, electronic medical record screening reminders, among other programmatic interventions, to promote HCV testing in veterans. High rates of HCV screening within national VA has been described within a one-year population sample [18], although data addressing broader trends and variation in HCV testing are limited. Examination of predictors of HCV testing and positive antibody and RNA may identify targets for intervention and refinement of testing strategy. In this study we use data from the national VA Corporate Data Warehouse (CDW) to study national, regional and local HCV testing in the VA Birth Cohort from 2000-2013.

Research Design and Methods

The VA Corporate Data Warehouse (CDW) is a data repository of over 8 million veterans in care and includes VA laboratory test results starting on October 1, 1999, from veterans with at least one VA outpatient visit [18]. Institutional review board approval was obtained both from the West Haven VA and Yale University. VINCI (VA informatics and computing infrastructure) approval using DART (data access request tracker) was obtained for access and use of CDW/VA electronic data. The CDW data was queried with MS SQL Server 2012R2/2014 and data was imported using SQL Import/Export tool utilizing well-established algorithms [24, 25].

Data on all veterans born 1945-1965 and accessing care at a VA facility from January 1st, 2000 to December 31st, 2013 were initially extracted. Veterans who had at least two VA center visits in that time-period were included in the study cohort. Veterans born outside 1945-1965, or with fewer than two visits from 2000-2013 were excluded. Baseline was established as a veteran's first VA encounter after January 1, 2000. Demographic data such as race, sex and year of birth were extracted. Baseline ALT value was set as the ALT measurement closest to baseline visit. The first HCV test in the study time period (2000-2013) performed after the first VA encounter was queried to determine HCV testing or screening status. Individuals tested prior to the year 2000 were excluded (n=45,333). HCV testing was defined as completion of any HCV laboratory assay including HCV antibody, genotype or RNA (to include individuals referred from outside providers for treatment). A positive HCV test was defined as any positive anti-HCV antibody, HCV RNA or HCV genotype, based on all HCV testing codes employed by the VA from 2000-2013. All anti-HCV testing codes employed by the VA from 2000-2013 were utilized for coding. We reasoned that patients with positive HIV and hepatitis B (HBV) and high scores for markers of chronic liver disease such as elevated ALT and FIB-4/APRI would have a higher likelihood of being tested for HCV. Thus we also determined HCV testing in the cohort of individuals without established risk factors (ALT<40 or missing, FIB-4<1.45 or missing, APRI≤0.5 or missing and not infected or negative for HIV or HBV). HBV positive was defined as any positive test for hepatitis B surface antigen (HBsAg), hepatitis Be antigen (HBeAg) and/or hepatitis B DNA (HBV DNA). HBV uninfected or negative were defined as those without these positive tests. HIV positive was defined by positive HIV positive antibody or RNA or by one inpatient ICD9 or two or more outpatient ICD9 codes. Number of visits per veteran from 2000-2013 was included in the final adjusted model. FIB-4 calculations were done as previously described [26, 27] utilizing the formula FIB-4= (Age × AST)/ (Platelets × (sqr (ALT); (APRI= [(AST/ULN AST) × 100]/ Platelets (109/L)).

Statistical analysis

Descriptive statistics (frequencies and percentages) were used to describe the patient, center and VISN level characteristics (VISN and VA administrative regions defined in detail in the results section). Generalized linear mixed models with a logistic link function were used to model the association between individual's screening status (screened at all during the cohort period) and the following *a priori* individual-level (race, gender, year of birth, ALT, FIB-4, APRI, number of visits, HIV status, HBV status), center-level (rural/urban status,

complexity level) and VISN-level (HCRC status, primary care of excellence status) covariates. We took into account that individuals are nested within centers and centers are nested within VISN. Shared frailty models were used to determine the association between time to screening (individuals not screened by December 31, 2013 were censored) and the same *a priori* covariates. We present odds ratios (OR) and 95% confidence intervals. Multiple imputation (number of imputations = 10) was used to impute the missing data for ALT, FIB-4, and APRI using the SAS (version 9.4, Cary NC) PROC MI procedure; the MIANALZE procedure was used to combine estimates across imputations. Variables included in the imputation were: testing, HCV RNA (positive or negative), HCV AB (positive or negative), time to testing, year of birth, encounter year, race, gender, center, HCV status (positive or negative), HIV status (positive or negative), HBV status (positive or negative) number of visits, number of rural and urban centers, number of low, medium and high complexity centers, VISN HCRC status, VISN primary care of excellence status, ALT, platelets, AST and age. All results presented utilize the imputed data.

Results

There were a total of 6,669,388 veterans born between 1945 and 1965 who presented at the VA from 2000 to 2013 across the United States and its territories; amongst them 4,221,135 veterans had two or more visits, creating the study cohort (VA Birth Cohort). Overall 2,139,935 (51%) were tested for HCV as of December 31, 2013.

The VA Birth Cohort was predominantly male (84.7%) and white (54.7%), and born between 1945 and 1949 (39.9%) (Table 1). ALT≤40 U/L was noted in 56.1% while 16.8% had ALT tests missing or not done. Surrogate liver fibrosis scores based on FIB-4 and APRI [26, 27] showed that a majority of veterans (56.1% and 69.5%) had scores suggestive of minimal or no fibrosis. The majority of birth cohort veterans were HIV (99.4%) and HBV (90.9%) negative. Analysis of corresponding HCV antibody (Ab) and RNA testing show an overall rate of 8.1% HCV Ab and 5.4% HCV RNA positivity. Those born between 1950-1954 and 1955-1959 had the highest rate of HCV Ab and RNA positivity of 11.9%/8.5% and 10.8%/7.7%, respectively. Blacks had 14.7%/10.5% HCV Ab/RNA positive rate; Whites had 7.6%/5% positive HCV Ab/RNA, and Asians had a HCV Ab/RNA rate of 2.6%/1.6%. A higher number of clinic visits was associated with increased testing rates along with higher HCV Ab and RNA positivity rates, likely representing patients who were sicker and had more medical visits. Patients with ALT >40 U/L, was HIV or HBV positive, or had FIB-4>3.25/APRI≥1.5 (suggesting advanced fibrosis), demonstrated the highest rates of HCV antibody and RNA positivity. We also considered veterans who did not have established risk factors (ALT≤40/missing, FIB-4<1.45/missing, APRI≤0.5/missing, HIV negative and HBV negative) in Supplemental Table 1. Thirty nine percent of the 2,401,686 veterans were tested for HCV and had an HCV antibody positive rate of 2.8% and RNA of 0.9%.

Analysis of predictors of being tested for HCV and for testing positive for HCV RNA is presented in Table 2. A multivariate generalized linear mixed model was created for determining the association between the probability of being tested and the *a priori*

covariates. Younger veterans (born 1960-1965) had lower odds (OR: 0.81 CI: 0.81, 0.82) of being tested and for being HCV RNA positive (OR: 0.76 CI: 0.74, 0.77).

Female veterans had lower odds of being tested (OR: 0.53 CI: 0.53, 0.53). Black veterans had the highest odds of being tested (OR: 1.10 CI: 1.09, 1.11) and being HCV RNA positive (OR: 1.70 CI: 1.68, 1.72). Asians had lower odds (OR: 0.85 CI: 0.83, 0.88) of being tested and being HCV RNA positive (OR: 0.22 CI: 0.20, 0.25). Veterans with ALT>40 (Testing: OR: 1.22 CI:1.21, 1.22; RNA: OR 3.53 CI:3.49, 3.58), FIB-4>3.25 (Testing: OR:1.22 CI: 1.21, 1.22; RNA: OR: 1.70 CI: 1.66, 1.75), APRI≥1.5 (Testing: OR: 2.32 CI: 2.26, 2.38; RNA: OR: 6.99 CI: 6.78, 7.20), HIV positive (Testing: OR: 1.54 CI: 1.48,1.60; RNA: 1.07 CI: 1.03, 1.11) or HBV positive (Testing: OR: 7.48, CI: 7.41, 7.56); RNA: OR: 7.96 CI: 7.87, 8.06) had high odds of being tested and being positive for HCV RNA.

The overall testing for HCV varied from 7% to 83% across VA centers (Figure 1). The VA is divided into multiple geographically defined inter-state regions (VA integrated service networks or VISNs) for administrative purposes with each VISN comprised of multiple medical centers. Centers were evaluated for their rural or urban location, and level of care complexity using the rural/urban and level of complexity designations defined by the VA. For rural/urban designation, we calculated the proportion of rural centers and classified them as being below (more urban) or above (more rural) the median. We found that urban locations had higher testing rates (54%) compared to rural locations (47%) (Table 3) with slightly lower odds of being tested at rural locations (OR: 0.93 CI: 0.74, 1.16; Table 2). For evaluation on the level of care complexity, we classified centers as either having or not having a high complexity center per standardized VA criteria. Eighty percent of the population resided at centers denoted by the VA as higher complexity centers (Table 3). Locations with at least one high complexity center had a higher rate of testing (52%) compared to those stations without any high complexity centers (48%) with corresponding higher odds of being tested (OR: 1.28 CI: 1.025, 1.601). Centers in the lowest quartile of HCV testing (≤43% HCV testing rate) were more likely to be rural, lower complexity, and lower volume of patients (Supplementary Table 2). No patient level differences were identified between centers. From 2001-2011, the National VA Hepatitis C Program established four centers of excellence called Hepatitis C Resource Centers (HCRC). It had also established Centers of Excellence in Primary Care Education (CoEPCE) (three of the centers with HCRC and CoEPCE overlapped). HCV testing ranged from ~35-60% at these stations, and the VISNs in which these stations were located had testing rates comparable to those, which did not have these centers (50-54%) (Table 3). The odds of being tested was higher in VISNs with CoEPCE while lower odds were noted at VISNs without HCRC, although the limited numbers of these centers may limit its statistical utility. We also present in Figure 2 an annual and cumulative HCV testing time from 2000-2013 with key changes in the VA and national HCV landscape denoted.

Discussion

To our knowledge, this is the largest study to evaluate national HCV testing practices in the U.S. This examination of a well-characterized cohort of 4.2 million veterans born 1945-65 for whom HCV testing practices were analyzed during a 14-year period of observation

(2000-2013). A previous study addressing this issue in national VA reported a 63% testing rate with 10.3% HCV RNA positivity among birth cohort veterans, but was limited to a cross-sectional analysis of one-year data [19]. This study reports a significantly lower HCV testing rate (51%) and HCV RNA positivity (5.4%). Our HCV RNA positivity rate remains higher than birth cohort estimates for the U.S. general population of 2.4% [17]. Of note, restriction of our analysis to individuals without identifiable risk factors for HCV reveals a lower testing rate (39%) with HCV antibody prevalence of 2.8% and HCV RNA positivity (0.9%), more akin to the broader U.S. population [28]. As more than 60% of U.S. veterans are not enrolled in VA care, caution is warranted in application of these findings to U.S. veterans not enrolled in VA care [29]. As previously described [30], blacks and males were associated with higher rates of HCV testing, and higher prevalence rates of positive HCV Ab and positive HCV RNA. Fewer than 5% of veterans in the birth cohort had advanced fibrosis or cirrhosis, defined as FIB-4>3.25 or APRI>1.5, yet more than one third were positive for HCV RNA, and as a group they comprised 30-43% of all patients with chronic HCV infection. It is notable that although veterans with FIB-4>3.25 or APRI>1.5 had higher odds of being tested for HCV compared with veterans with lower fibrosis scores, approximately one in five were never tested for HCV despite the presence of advanced liver disease. Recent NHANES data [31] confirm that a significant proportion of individuals with advanced liver disease remain unaware of their disease, and that patients who were aware or unaware of their infection had a similar proportion of cirrhosis.

Through a series of national directives and interventions, including implementation of electronic health record (EHR) clinical reminders [22], the VA has successfully tested more than half the birth cohort veterans seen in care between 2000-2013, which exceeds testing rates reported in other large health care systems [32]. Incorporation of targeted testing algorithms for at-risk or birth cohort individuals within health system EHRs may potentially enhance HCV testing in other non-VA populations [28, 30]. However, evidence to support specific EHR-based screening strategies remains lacking. We identified significant variability in HCV testing across VA centers (7-83%) and regional VISNs (36-66%) despite national directives, and signal the potential need for region or center-specific approaches to promote testing. Patient level predictors of this variability in testing included age, gender, and race, although observations regarding race require cautious interpretation due to a significant proportion of patients assigned to undeclared race status. Other patient level predictors included elevated ALT, co-infection with HIV and HBV, and high FIB-4/APRI, all of which were associated with higher HCV testing and HCV RNA positivity rates. Center level predictors of being tested include care received at urban and higher complexity centers, as well as VAs designated as centers of excellence in primary care and Hepatitis C Resource Centers (HCRCs). Of note, HCRCs were associated with lower testing but higher prevalence of HCV RNA positivity.

Our analysis has important limitations. First, although we have examined key patient, provider, and system-level predictors of HCV testing, many important predictors could not be evaluated, such as provider views of testing and screening, patient preference, and community acceptance of HCV testing. Second, although the VA CDW database provides a robust, comprehensive national analysis of 4.2 million birth cohort veterans, observations regarding HCV testing patterns in this cohort may not reflect testing patterns in veterans

born before or after the 1945-1965 period. Third, although the rate of HCV testing in VA centers may exceed that within the private sector, observations regarding disparities in HCV testing among veterans may not reflect patterns in the non-veteran general population. Fourth, our analysis is restricted to the period 2000-2013, and therefore does not fully reflect the effect of CDC and USPSTF screening recommendations, or the potential influence of availability of highly effective, all-oral, interferon-free treatment regimens. Future studies are needed to further examine temporal trends in HCV testing and diagnosis in response to federal screening recommendations and national VA initiatives.

National VA HCV testing rates exceed those in the general population [33]. With the availability of curative and potentially cost-effective interferon-free regimens [34, 35], improved detection of HCV is needed to reduce the ongoing burden of chronic liver disease [9]. Careful analysis of key predictors of HCV testing and regional/local variation in testing practices may help inform national HCV testing strategies within VA and non-VA settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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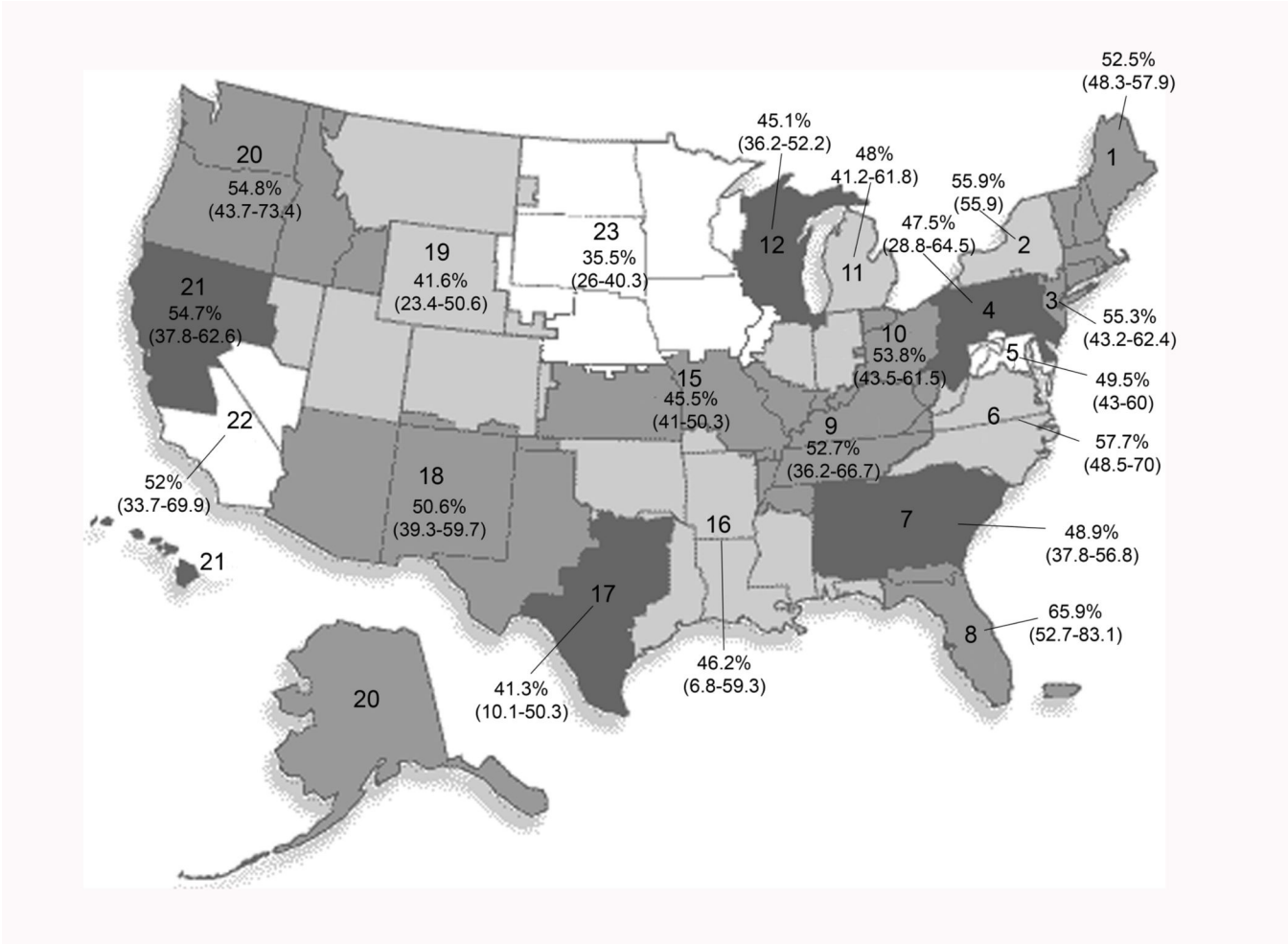

Figure 1.

HCV testing rates across Veterans Integrated Service Network (VISNs). Testing rates is summarized across the nation at the regional level (VISNs: 21 geographically defined multistate regions numbered 1-12 and 15-23). Within each VISN there are multiple stations, which have, many ‘centers’ linked to them. The range of HCV testing rates of the stations is denoted in parenthesis.

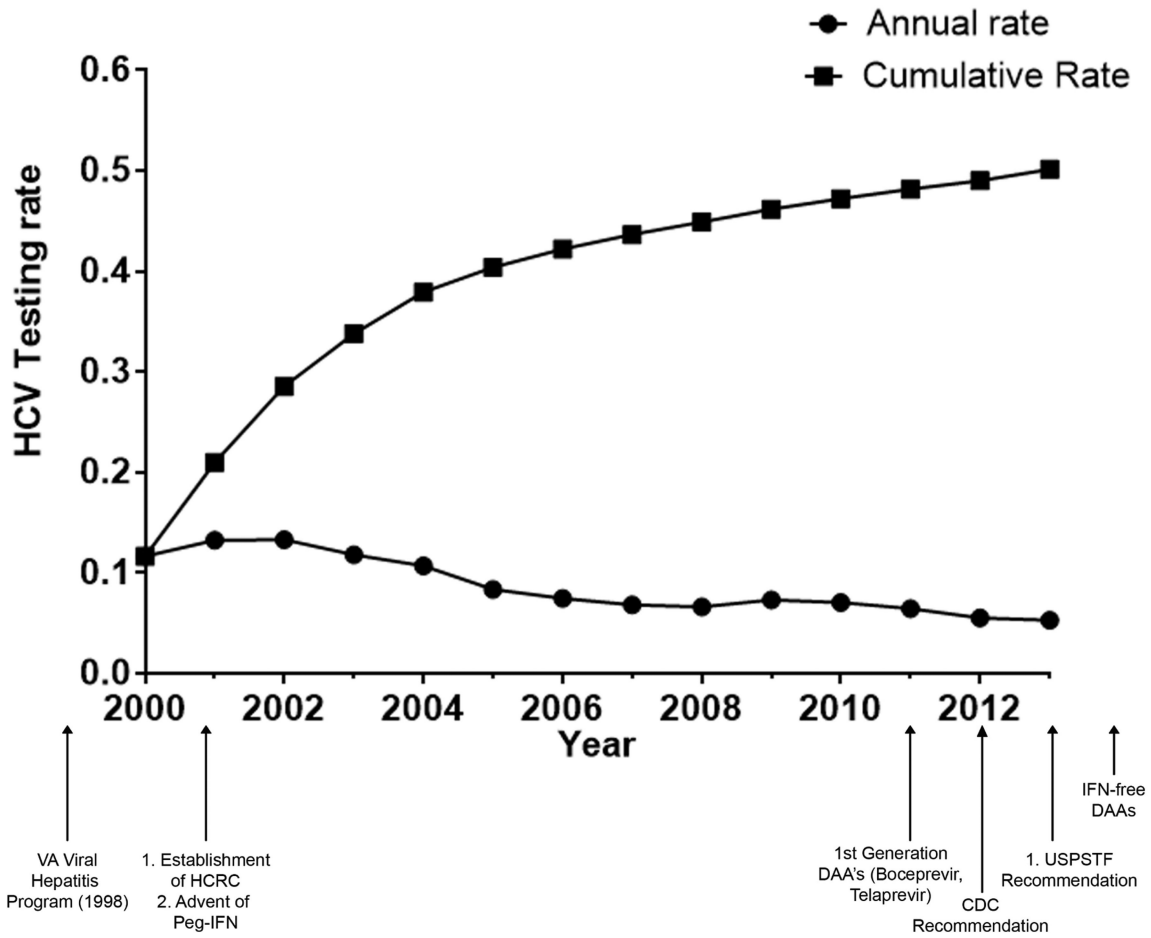

Figure 2.

Annual and Cumulative HCV testing 2000-2013. Annual testing rate calculated as the number of individuals tested in a given year divided by those seen in that year and those not tested in previous years; while cumulative testing rates were calculated as the total number tested/total number available for testing. Timeline of notable events in policies and therapies for hepatitis C that may affect the HCV testing has been denoted. Abbreviations: Peg-IFN: Pegylated interferon; DAA's: Direct acting antivirals. VA: Veterans' Administration; HCRC: VA Hepatitis C Resource Centers; PEG-IFN: pegylated interferon; DAA's: Direct acting antivirals; CDC: Centers for Disease Control; USPSTF: United States Preventative Services Task Force; IFN-free: Interferon-free

Table 1

Characteristics of birth cohort veterans tested for HCV

Characteristics	N (% overall)	% Tested for HCV	% of overall HCV Ab +ve	% of overall HCV RNA +ve
Overall	4,221,135	51%	8.1%	5.4%
○ **Year of birth:**				
• **1945-1949**	1,683,073 (39.9%)	53%	6.0%	3.7%
• **1950-1954**	1,002,366 (23.7%)	53%	11.9%	8.5%
• **1955-1959**	794,945 (18.8%)	51%	10.8%	7.7%
• **1960-1965**	740,751 (17.5%)	43%	4.5%	2.5%
○ **Sex:**				
• **Male**	3,726,077 (88.3%)	53%	8.7%	5.9%
• **Female**	495,058 (11.7%)	35%	3.0%	1.5%
○ **Race:**				
• **American Indian/Alaska Native**	29,661 (0.7%)	52%	7.9%	5.9%
• **Asian**	26,192 (0.6%)	50%	2.6%	1.6%
• **Black/African American**	666,983 (15.8%)	62%	14.7%	10.5%
• **Native Hawaiian/Pacific Islander**	45,957 (1.1%)	59%	8.7%	6.0%
• **Declined to Answer/Unknown**	1,141,956 (27.1%)	35%	5.1%	3.3%
• **White**	2,310,386 (54.7%)	55%	7.6%	5.0%
○ **ALT:**				
• **≤40**	2,631,683 (56.1%)	57%	6.5%	3.2%
• **>40**	880,511 (20.2%)	67%	18.8%	16.1%
• **Not done or missing**	708,941 (16.8%)	5%	0.5%	0.2%
○ **FIB-4:**				
• **<1.45**	2,369,163 (56.1%)	58%	6.8%	3.3%
• **1.45-3.25**	852,230 (20.2%)	63%	12.6%	9.3%
• **>3.25**	186,697 (4.4%)	80%	33.8%	30.5%
• **Missing values**	813,045 (19.3%)	9%	0.9%	0.5%
○ **APRI:**				
• **≤0.5**	2,933,008 (69.5%)	58%	6.5%	3.3%
• **>0.5-<1.5**	401,323 (9.5%)	73%	28.4%	20.7%
• **≥1.5**	102,958 (2.4%)	84%	45.6%	42.8%
• **Missing values**	783,846 (18.6%)	9%	0.8%	0.4%
○ **HIV Status**				
• **Positive**	25,059 (0.6%)	84.1%	31.9%	27.1%
• **Negative**	4,196,076 (99.4%)	50.5%	7.9%	5.3%
○ **HBV Status**				

Characteristics	N (% overall)	% Tested for HCV	% of overall HCV Ab +ve	% of overall HCV RNA +ve
• **Positive**	384,470 (9.1%)	85.8%	34.4%	26.9%
• **Negative**	3,836,665 (90.9%)	47.2%	5.4%	3.2%
○ **Visits**				
• **Q1[#] (<=13)**	1,097,384 (26.0%)	24%	2.8%	1.3%
• **Q2 (14-44)**	1,022,102 (24.2%)	47%	5.9%	3.5%
• **Q3 (45-113)**	1,032,887 (24.5%)	60%	9.2%	6.1%
• **Q4 (>113)**	1,068,762 (25.3%)	72%	14.4%	10.8%

[#]Q1-4: Quartiles; FIB-4, APRI calculations detailed in Methods, HIV: Human Immunodeficiency virus, HBV: Hepatitis B virus

Table 2

Odds of being tested for HCV and being positive for HCV *

Variables	Adjusted OR (95% CI) of being Tested	p-value	Adjusted OR (95% CI) of HCV RNA +ve	p-value
○ **Year of birth:**				
• **1945-1949**	1	<0.0001	1	<0.0001
• **1950-1954**	1.00 (0.99, 1.00)		2.20 (2.18, 2.23)	
• **1955-1959**	0.94 (0.93, 0.95)		2.10 (2.07, 2.13)	
• **1960-1965**	0.81 (0.81, 0.82)		0.76 (0.74, 0.77)	
○ **Gender**				
• **Male**	1	<0.0001	1	<0.0001
• **Female**	0.53 (0.53, 0.53)		0.35 (0.35, 0.36)	
○ **Race:**				
• **American Indian/Alaska Native**	0.98 (0.96, 1.01)	<0.0001	1.05 (1.01, 1.11)	<0.0001
• **Asian**	0.85 (0.83, 0.88)		0.22 (0.20, 0.25)	
• **Black/African American**	1.10 (1.09, 1.11)		1.70 (1.68, 1.72)	
• **Native Hawaiian/Pacific Islander**	1.01 (0.99, 1.03)		0.93 (0.89, 0.98)	
• **Declined to Answer/ Missing/Unknown**	0.45 (0.45, 0.45)		0.64 (0.63, 0.65)	
• **White**	1		1	
○ **ALT**				
• **≤40**	1	<0.0001	1	<0.0001
• **>40**	1.22 (1.21, 1.22))		3.53 (3.49, 3.58)	
○ **FIB-4**				
• **<1.45**	1	<0.0001	1	<0.0001
• **1.45-3.25**	1.07 (1.06, 1.08)		1.37 (1.35, 1.39)	
• **>3.25**	1.22 (1.21, 1.22)		1.70 (1.66, 1.75)	
○ **APRI**				
• **≤0.5**	1	<0.0001	1	<0.0001
• **>0.5-<1.5**	1.20 (1.19, 1.21)		3.20 (3.14, 3.25)	
• **≥1.5**	2.32 (2.26, 2.38)		6.99 (6.78, 7.20)	
○ **HIV status**				
• **Positive**	1.54 (1.48,1.60)	<0.0001	1.07 (1.03, 1.11)	0.0002
• **Negative**	1		1	
○ **HBV status**				
• **Positive**	7.48 (7.41, 7.56)	<0.0001	7.96 (7.87, 8.06)	<0.0001
• **Negative**	1		1	
○ **Rurality**				
• **Below median (more urban)**		0.503	1	0.068

Variables	Adjusted OR (95% CI) of being Tested	p-value	Adjusted OR (95% CI) of HCV RNA +ve	p-value
• **Above median (more rural)**	0.93 (0.74, 1.16)		0.85 (0.72, 1.01)	
○ **Complex centers per station**				
• **No high complex center**	1	0.0295	1	0.127
• **At least one high complex center**	1.281 (1.025, 1.601)		1.15 (0.96, 1.37)	
○ **HCRC center in VISN**				
• **Yes**	1	0.051	1	0.065
• **No**	1.26 (1.00, 1.58)		0.75 (0.56, 1.02)	
○ **CoEPCE in VISN**				
• **Yes**	1	0.025	1	0.522
• **No**	0.63 (0.43, 0.94)		1.10 (0.82, 1.49)	

*Adjusted for number of visits. HCRC: Hepatitis C Resource Centers; CoEPCE: Centers of Excellence in Primary Care Education

Table 3

Characteristics of HCV testing at VA stations and VISNs

Characteristics of centers per VISN	No. of stations or VISNs with the characteristics	Total N	% Tested
○ **Rurality** *			
• **Below median (more urban)**	65	2325634	54%
• **Above median (more rural)**	65	1895501	47%
○ **Complex centers per station**			
• **No high complex centers**	60	1,044,990	48%
• **At least one high complex center**	70	3,176,145	52%
○ **HCRC center in VISN**			
• **Yes**	4	764,421	50%
• **No**	17	3,456,714	51%
○ **CoEPCE in VISN**			
• **Yes**	4	740,786	54%
• **No**	17	3,480,349	50%

* Rurality is the proportion of rural centers out of the total number; then classified stations as being below or above the median of 0.24 with below median having a greater proportion of urban.