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BRIEF REPORT

Limited Coverage of Hepatitis C Virus Testing in the United States, 2013–2017

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In the US household population, hepatitis C virus testing coverage marginally increased between 2013 and 2017 among persons born between 1966 and 1994 (13.2% to 16.8%) and persons born between 1945 and 1965 (12.3% to 17.3%). Testing coverage remains limited and sociodemographic disparities were observed in both populations.

Keywords. National Health Interview Survey; HCV; hepatitis; baby boomer; screening.

Hepatitis C virus (HCV) infection is a growing public health problem in the United States. In parallel with the opioid epidemic, HCV incidence is increasing in populations of young persons who inject drugs [1]. HCV-related morbidity and mortality are also rising among persons born between 1945 and 1965 ("baby boomers") [2]. However, due to the advent of highly efficacious direct-acting antivirals (DAAs), HCV infection can now be cured in nearly all patients who have access to treatment. Despite the high costs of HCV treatment, mathematical models suggest the scale-up of HCV treatment in combination with direct prevention is cost-effective at the population-level [3].

The World Health Organization has set global targets to achieve a 90% reduction in HCV incidence and 65% reduction in HCV-related mortality by 2030. Achieving these goals in the United States by 2030 could prevent approximately 28 000 HCV-related deaths [4]. Principal barriers to these goals, however, are that HCV infection is often clinically silent and most persons living with HCV are undiagnosed [5]. Reaching the national targets will require diagnosing at least 70 000–110 000 cases each year until 2030 [4]. Therefore, HCV testing strategies need to be continuously monitored and augmented, as needed.

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Since 1998, the US Centers for Disease Control and Prevention (CDC) has recommended HCV testing for all high-risk populations [6]. In 2012, the CDC also recommended 1-time HCV testing for baby boomers, independent of other risk factors [7]. The US Preventive Services Task Force endorsed these recommendations in 2013 [8]. Given the current epidemiology of the HCV epidemic, there is interest in extending the 1-time HCV testing recommendation to adults born after 1965, as it may be cost-effective [9]. It remains unclear, however, who is being reached under current recommendations as population-based data on HCV testing coverage are limited.

In this study, we describe trends in the percentage of individuals in the US household population who report ever being tested for HCV infection (2013–2017).

METHODS

Data Source

The National Health Interview Survey (NHIS), conducted annually by the National Center for Health Statistics (NCHS), is a cross-sectional household survey of the noninstitutionalized US civilian population. The NHIS uses a complex, multistage area probability sampling design. This analysis included data from the 2013–2017 NHIS sample adult component for which annual response rates ranged from 61.2% in 2013 to 53.0% in 2017. Participants who were born between 1945 and 1994 were eligible for inclusion in this analysis. Birth year was estimated as the difference between the survey year and the participants' age at interview. Informed consent was obtained from all participants, and the NCHS Review Board approved data collection. This analysis was considered exempt from review by the Johns Hopkins University School of Medicine Institutional Review Board.

Study Outcome

Participants were asked: "Have you ever had a blood test for hepatitis C?" Responses were coded as: "yes," "no," "don't know," "refused to answer," and "not ascertained." Participants with the latter 3 responses were considered to have inadequate data and were excluded from primary analyses. The outcome was the percentage of participants who reported ever being tested for HCV. Although the outcome is only reflective of persons who were aware of (and remember) being tested, it is referred to as "HCV testing coverage" for simplicity.

Statistical Analyses

The analyses were conducted using Stata/MP, v15.2 (StataCorp, College Station, TX). Survey weights were used to account for unequal selection probabilities, unit nonresponse, and noncoverage,

yielding estimates representative of the noninstitutionalized US civilian population. Taylor series linearization was used to estimate standard errors; logit-transformed 95% confidence intervals (CIs) were calculated for prevalence estimates.

All analyses were stratified by birth cohort: persons born between 1945 and 1965 ("baby boomers") and persons born between 1966 and 1994 ("non-baby boomers"). The primary independent variable of interest was survey year. Temporal trends in HCV testing coverage across all 5 years were assessed by linear regression, modeling survey year as a continuous variable (P_{trend}). To capture nonlinear effects and account for sociodemographic changes between surveys, survey year was also modeled as a categorical variable in multivariable logistic regression models. The difference in the predicted margins for 2013 and 2017 is presented as an adjusted prevalence difference (aPD). The multivariable models included adjustment for potential sociodemographic confounders determined a priori (birth year, sex, race/ethnicity, educational attainment, family health insurance, census region, and birthplace). Subgroup analyses were performed stratified by all sociodemographic characteristics. Adjusted odds ratios (aORs) of HCV testing coverage in 2017 were estimated from fully adjusted multivariable logistic regression models. Two-sided P values < .05 were considered statistically significant.

To test for potential item nonresponse bias because of missing data on the outcome and/or covariables, a sensitivity analysis was performed using multiple imputation (Supplementary Material). We also compared the percentage of participants who reported ever being tested for HCV, hepatitis B virus (HBV), and human immunodeficiency virus (HIV).

RESULTS

Of the 133 602 adults born between 1945 and 1994 who completed the sample adult component, 13 063 were excluded due to inadequate data on HCV testing. Participants were primarily excluded because they did not know their HCV testing history, the proportion of which was consistent over time (Supplementary Table S1). Inadequate HCV testing data were associated with sociodemographic factors (Supplementary Table S2). Characteristics of the analytic sample are provided by study year in Supplementary Table S3 (n = 120 539).

Between 2013 and 2017, there was a significant increase in HCV testing coverage among non-baby boomers (13.2% to 16.8%; aPD = +3.1% [95% CI = +1.9%, +4.3%]; Table 1). Similarly, among baby boomers, HCV testing coverage significantly increased from 12.3% in 2013 to 17.3% in 2017 (aPD = +4.5% [95% CI = +3.3%, +5.8%]; Table 1). Temporal trends in HCV testing coverage are shown by sociodemographic characteristics for both birth cohorts in Table 1. Notably, in both populations, there was no increasing temporal trend in HCV testing coverage among those without health insurance. Similar trends were observed in sensitivity analysis (Supplementary Table S4).

Correlates of HCV testing coverage in 2017 are shown for each birth cohort in Supplementary Table S5. For baby boomers, HCV testing coverage was significantly lower among females (vs males; aOR = 0.85 [95% CI = 0.75–0.98]), persons with less than a high school education (vs some college or more; aOR = 0.72 [95% CI = 0.56–0.93]), and foreign-born persons (vs US-born; aOR = 0.61 [95% CI = 0.44–0.83]). HCV testing coverage among baby boomers varied significantly by census region, with the West having the highest level of coverage. In addition, HCV testing coverage among baby boomers varied significantly by type of health insurance. In comparison to private health insurance, military health insurance (aOR = 2.49 [95% CI = 1.84–3.36]) and public/government health insurance (aOR = 1.37 [95% CI = 1.15–1.63]) were positively associated with HCV testing coverage among baby boomers. Lack of family health insurance among baby boomers was negatively associated with HCV testing coverage (vs private; aOR = 0.55 [95% CI = 0.39–0.79]).

Comparatively, HCV testing coverage was lower than HBV and HIV testing coverage among both birth cohorts (Supplementary Figure S1).

DISCUSSION

The percentage of baby boomers in the US household population who reported ever being tested for HCV only marginally increased between 2013 and 2017. Modest increases in HCV testing rates have also previously been documented among baby boomers covered by commercial health insurance [10], Medicare [11], and the Indian Health Service [12]. HCV testing coverage among baby boomers may be improving due to several reasons, such as the uptake of 1-time HCV testing recommendations and increasing awareness of DAAs. Nonetheless, this population-based study suggests national coverage of HCV testing remains limited in this key population.

Although a 1-time HCV testing recommendation has not yet been made for younger birth cohorts, reports of ever being tested for HCV also increased modestly in the non-baby boomer population. We hypothesize that HCV testing in this population may be increasing due to increased awareness of HCV infection as the opioid epidemic progresses. The limited coverage of HCV testing in this population should be used to inform models that examine the cost-effectiveness of expanding the 1-time HCV testing recommendations to younger birth cohorts [9].

This study has limitations. Primarily, the data were ascertained by self-report and may be subject to reporting biases (eg, recall and social desirability bias). Although we excluded participants who did not know their HCV testing history, it is possible that additional participants may have been tested for HCV but were unaware and/or did not recall being tested, thereby leading to an underestimation of testing coverage. It is notable, however, that participants were substantially less likely to report ever being tested for HCV than they were for HBV and HIV. Second, the NHIS does not collect data on key risk factors for HCV infection (eg, injection

Table 1. Temporal Trends in Hepatitis C Virus Testing Coverage in the US Household Population, National Health Interview Survey, 2013–2017

Characteristic, by Birth Cohort	2013 % (95% CI)	2014 % (95% CI)	2015 % (95% CI)	2016 % (95% CI)	2017 % (95% CI)	P_{trend} [a]	2013 vs 2017, Adjusted Prevalence Difference (95% CI)[b]
Non-baby Boomers (1966–1994)							
Total	13.2 (12.5–14.0)	13.6 (12.9–14.4)	14.0 (13.2–14.8)	15.7 (14.8–16.6)	16.8 (15.9–17.8)	**<.001**	**3.1 (1.9, 4.3)**
Birth year							
1985–1994	10.6 (9.4–11.8)	11.8 (10.7–13.1)	11.1 (10.1–12.3)	14.4 (13.1–15.8)	15.7 (14.3–17.3)	**<.001**	**4.4 (2.4, 6.3)**
1975–1984	15.6 (14.5–16.9)	16.2 (14.9–17.7)	17.1 (15.8–18.5)	17.3 (15.8–18.8)	17.5 (16.0–19.1)	**.040**	1.6 (-0.4, 3.5)
1966–1974	13.6 (12.4–15.0)	12.9 (11.7–14.1)	14.1 (12.7–15.5)	15.3 (13.9–16.8)	17.4 (15.8–19.1)	**<.001**	**3.2 (1.2, 5.2)**
Sex							
Female	13.3 (12.4–14.3)	13.3 (12.4–14.3)	14.0 (13.0–15.2)	16.0 (14.9–17.2)	16.7 (15.5–17.9)	**<.001**	**2.9 (1.4, 4.4)**
Male	13.1 (12.1–14.3)	13.9 (12.8–15.1)	14.0 (12.9–15.2)	15.3 (14.1–16.6)	17.0 (15.7–18.5)	**<.001**	**3.1 (1.4, 4.8)**
Race/ethnicity							
NH white	14.6 (13.6–15.7)	15.4 (14.4–16.4)	15.0 (13.9–16.0)	17.3 (16.2–18.5)	18.4 (17.3–19.5)	**<.001**	**3.4 (1.9, 4.9)**
NH black	13.2 (11.6–15.1)	13.7 (12.0–15.6)	14.8 (12.6–17.2)	14.9 (12.7–17.5)	17.3 (15.0–20.0)	**.008**	**3.1 (0.2, 6.1)**
NH Asian	10.3 (7.7–13.6)	11.3 (8.8–14.2)	12.6 (10.2–15.6)	12.5 (9.9–15.7)	13.2 (10.6–16.3)	.139	2.5 (-1.8, 6.8)
Hispanic	10.1 (8.9–11.5)	9.4 (8.2–10.7)	11.0 (9.5–12.7)	12.0 (10.1–14.2)	13.5 (11.6–15.5)	**.001**	1.9 (-0.3, 4.0)
NH other/multiracial	13.6 (9.0–20.0)	9.6 (5.5–16.4)	19.7 (14.0–26.8)	21.6 (14.4–31.1)	15.5 (10.1–23.1)	.204	2.4 (-6.6, 11.5)
Educational attainment							
Less than high school	10.5 (8.6–12.6)	7.5 (6.0–9.2)	11.1 (9.2–13.5)	11.4 (9.1–14.1)	13.1 (10.5–16.1)	**.017**	1.7 (-1.2, 4.6)
High school or GED	11.2 (9.9–12.6)	11.4 (10.1–12.9)	12.4 (10.8–14.2)	13.5 (11.9–15.4)	13.0 (11.4–14.8)	**.024**	1.1 (-1.1, 3.2)
Some college or more	14.6 (13.6–15.6)	15.6 (14.6–16.6)	15.0 (14.1–16.0)	17.1 (16.0–18.2)	18.6 (17.4–19.9)	**<.001**	**4.0 (2.4, 5.5)**
Family health insurance[c]							
Private	13.5 (12.5–14.5)	13.7 (12.7–14.7)	13.4 (12.5–14.4)	15.0 (14.0–16.0)	16.6 (15.5–17.8)	**<.001**	**2.9 (1.4, 4.4)**
Military	26.2 (20.0–33.4)	29.5 (22.3–38.0)	24.7 (19.1–31.2)	35.7 (29.2–42.6)	32.6 (25.5–40.7)	.093	2.4 (-6.6, 11.4)
Public/Government	15.9 (13.9–18.1)	16.0 (14.0–18.2)	18.4 (16.2–20.8)	18.6 (16.4–21.1)	21.0 (18.6–23.6)	**.001**	**5.0 (1.8, 8.1)**
Uninsured	10.2 (9.0–11.5)	10.7 (9.3–12.1)	11.0 (9.5–12.9)	11.9 (9.9–14.1)	11.0 (9.2–13.1)	.253	1.3 (-0.9, 3.6)
Census region							
Northeast	13.7 (12.0–15.7)	12.3 (10.6–14.3)	16.3 (14.1–18.8)	16.6 (14.7–18.8)	19.6 (17.2–22.3)	**<.001**	**4.9 (2.0, 7.8)**
Midwest	11.8 (10.2–13.6)	12.1 (10.6–13.8)	11.7 (10.2–13.4)	13.6 (11.9–15.5)	14.7 (13.2–16.4)	**.008**	**2.6 (0.4, 4.8)**
South	13.1 (12.0–14.4)	14.2 (12.9–15.5)	14.5 (13.2–15.9)	15.7 (14.3–17.2)	15.6 (14.1–17.3)	**.006**	**2.2 (0.2, 4.2)**
West	14.5 (12.8–16.3)	15.1 (13.6–16.7)	14.0 (12.6–15.5)	16.6 (14.8–18.6)	18.6 (16.8–20.6)	**.001**	**3.5 (1.0, 5.9)**
Born in the US							
No	9.5 (8.2–11.0)	9.5 (8.3–10.9)	11.3 (9.8–13.0)	11.7 (10.1–13.6)	13.2 (11.2–15.4)	**.001**	**2.6 (1.8, 4.9)**
Yes	14.2 (13.4–15.1)	14.8 (13.8–15.7)	14.8 (13.9–15.7)	16.8 (15.8–17.9)	17.9 (16.8–19.0)	**<.001**	**3.2 (1.8, 4.5)**
Baby Boomers (1945–1965)							
Total	12.3 (11.5–13.1)	12.4 (11.6–13.2)	13.4 (12.5–14.4)	14.5 (13.7–15.4)	17.3 (16.4–18.4)	**<.001**	**4.5 (3.3, 5.8)**
Birth year							
1955–1965	13.4 (12.3–14.6)	13.3 (12.1–14.4)	14.7 (13.4–16.0)	15.9 (14.7–17.1)	18.8 (17.5–20.2)	**<.001**	**4.7 (3.1, 6.4)**
1945–1954	10.7 (9.6–11.9)	11.2 (10.2–12.4)	11.6 (10.4–12.8)	12.7 (11.6–13.9)	15.2 (13.8–16.7)	**<.001**	**4.0 (2.3, 5.8)**
Sex							
Female	11.1 (10.1–12.3)	10.9 (9.8–12.0)	11.7 (10.6–12.8)	13.1 (12.0–14.2)	16.1 (14.8–17.5)	**<.001**	**4.2 (2.6, 5.8)**
Male	13.5 (12.3–14.8)	14.1 (12.9–15.4)	15.3 (13.9–16.8)	16.1 (14.9–17.5)	18.7 (17.3–20.2)	**<.001**	**4.5 (2.7, 6.3)**
Race/ethnicity							
NH white	12.4 (11.5–13.4)	12.6 (11.7–13.7)	13.5 (12.5–14.6)	14.7 (13.8–15.8)	18.0 (16.8–19.1)	**<.001**	**4.9 (3.4, 6.3)**
NH black	12.6 (10.7–14.7)	12.9 (10.9–15.2)	14.4 (12.0–17.3)	16.5 (13.9–19.5)	18.1 (15.3–21.3)	**<.001**	**4.8 (1.4, 8.3)**
NH Asian	10.1 (7.4–13.7)	10.2 (7.4–13.8)	11.9 (8.4–16.5)	9.0 (5.8–13.9)	11.5 (7.8–16.5)	.821	1.5 (-3.5, 6.5)
Hispanic	11.5 (9.3–14.0)	11.3 (9.4–13.7)	11.1 (9.1–13.5)	13.0 (10.0–16.6)	14.1 (11.2–17.5)	.135	1.6 (-2.0, 5.2)
NH other/multiracial	19.5 (12.1–29.9)	13.3 (7.4–22.8)	27.7 (18.3–39.7)	22.0 (14.3–32.2)	27.2 (18.1–38.8)	.138	6.7 (-6.1, 19.5)
Educational attainment							
Less than high school	9.3 (7.7–11.2)	9.5 (7.7–11.6)	10.8 (8.8–13.2)	11.9 (9.7–14.5)	13.9 (11.5–16.8)	**.001**	**3.8 (0.7, 6.8)**
High school or GED	8.9 (7.4–10.5)	9.8 (8.5–11.2)	10.4 (8.8–12.2)	11.9 (10.4–13.5)	13.8 (12.1–15.7)	**<.001**	**4.3 (1.9, 6.6)**
Some college or more	14.4 (13.4–15.5)	14.1 (13.0–15.3)	15.1 (13.9–16.4)	16.2 (15.0–17.4)	19.5 (18.2–20.8)	**<.001**	**4.5 (2.9, 6.1)**
Family health insurance[c]							
Private	11.4 (10.4–12.4)	11.1 (10.2–12.2)	12.1 (11.1–13.3)	13.5 (12.5–14.5)	16.8 (15.6–18.0)	**<.001**	**4.9 (3.4, 6.3)**
Military	24.3 (20.2–28.9)	23.9 (19.6–28.7)	20.8 (16.1–26.4)	27.9 (23.3–33.0)	31.6 (25.7–38.2)	**.023**	**7.2 (0.3, 14.0)**
Public/Government	13.7 (12.0–15.6)	13.2 (11.6–15.0)	16.1 (14.3–18.1)	14.4 (13.0–16.0)	18.3 (16.4–20.5)	**.001**	**4.4 (1.7, 7.0)**
Uninsured	11.1 (9.2–13.4)	11.6 (9.3–14.5)	11.1 (8.4–14.6)	15.3 (11.9–19.6)	9.2 (6.8–12.3)	.869	-2.1 (-6.1, 1.9)

Table 1. Continued

Characteristic, by Birth Cohort	2013 % (95% CI)	2014 % (95% CI)	2015 % (95% CI)	2016 % (95% CI)	2017 % (95% CI)	P_{trend} [a]	2013 vs 2017, Adjusted Prevalence Difference (95% CI)[b]
Census region							
Northeast	10.3 (8.6–12.2)	11.5 (9.7–13.6)	11.4 (9.4–13.6)	15.4 (13.5–17.5)	17.4 (15.3–19.7)	**<.001**	**6.9 (4.2, 9.7)**
Midwest	9.8 (8.5–11.3)	8.8 (7.3–10.6)	10.4 (8.6–12.6)	12.4 (10.8–14.2)	16.6 (14.6–18.7)	**<.001**	**5.6 (3.4, 7.8)**
South	12.8 (11.5–14.3)	13.1 (11.9–14.4)	14.2 (12.8–15.8)	14.6 (13.2–16.0)	15.9 (14.4–17.7)	**.001**	**2.6 (0.5, 4.8)**
West	15.5 (13.8–17.3)	15.9 (14.2–17.9)	16.7 (14.7–18.9)	15.9 (14.0–18.0)	20.4 (18.3–22.8)	**.004**	**3.6 (0.9, 6.3)**
Born in the US							
No	11.2 (9.4–13.2)	10.2 (8.5–12.1)	11.2 (9.3–13.4)	11.2 (9.1–13.8)	11.9 (9.8–14.5)	.458	0.0 (-2.9, 2.9)
Yes	12.5 (11.6–13.4)	12.8 (11.9–13.8)	13.8 (12.9–14.9)	15.2 (14.3–16.1)	18.4 (17.3–19.5)	**<.001**	**5.2 (3.8, 6.5)**

Abbreviations: CI, confidence interval; GED, General Educational Development; NH, non-Hispanic.

[a]Estimated by weighted linear regression across the 5 surveys (2013–2017).

[b]Reflects the difference in the adjusted predicted margins of hepatitis C virus testing coverage in 2013 (reference) and 2017. The weighted multivariable logistic regression model for non-baby boomers and baby boomers included adjustment for birth year, sex, race/ethnicity, educational attainment, type of family health insurance coverage, census region, and birthplace. Estimates in bold were statistically significant ($P < .05$).

[c]Type of family health insurance coverage is a hierarchical variable divided into ordered categories as shown from top to bottom (ie, persons who reported private insurance and military insurance were coded as having private insurance). Uninsured individuals reported no coverage or only single service coverage at the time of the interview.

drug use), so the implementation of risk-based testing recommendations could not be assessed. Third, the NHIS sampling frame does not include key high-risk populations (ie, the homeless, incarcerated individuals, and persons living on Indian reservations and in nursing homes), so this study may not be generalizable to the entire US population. These data should thus be considered in combination with administrative and local data sources.

As of 2017, the majority of the US household population has not been tested for HCV infection. This study also highlights sociodemographic disparities in HCV testing coverage, even in the baby boomer population for whom testing is universally recommended. These data indicate geographic region and lack of adequate health insurance are systemic barriers to HCV testing. Disparities in HCV testing could potentially perpetuate disparities in awareness of HCV infection (and subsequently across the HCV care continuum). In addition to interventions to improve HCV screening in traditional healthcare settings, integrating HCV testing programs into nontraditional settings (eg, nursing homes, emergency departments, and methadone clinics) and implementing community-based programs may be key strategies to expand coverage of HCV testing.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

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