Hepatitis C Screening Among Medicaid Patients With Schizophrenia, 2002–2012

Marilyn D. Thomas[*,1,2,], **Eric Vittinghoff**[2,], **Stephen Crystal**[3], **James Walkup**[3], **Mark Olfson**[4], **Mandana Khalili**[5,], **Priya Dahiya**[1], **Walker Keenan**[6], **Francine Cournos**[4], and **Christina Mangurian**[1,2,7,8]

[1]Department of Psychiatry and Behavioral Sciences, School of Medicine, Weill Institute for Neurosciences, University of California San Francisco, CA, USA; [2]Department of Epidemiology and Biostatistics, School of Medicine, University of California San Francisco, CA, USA; [3]Rutgers University Institute for Health, Health Care Policy and Aging Research, New Brunswick, NJ, USA; [4]Department of Psychiatry, Columbia University, New York, NY, USA; [5]Division of Gastroenterology and Hepatology, Department of Medicine, School of Medicine, University of California San Francisco, CA, USA; [6]Department of Psychiatry, School of Medicine, Yale University, New Haven, CT, USA; [7]Center for Vulnerable Populations at ZSFG, University of California San Francisco, CA, USA; [8]Philip R. Lee Institute for Health Policy Studies, University of California San Francisco, CA, USA

*To whom correspondence should be addressed; 1001 Potrero Avenue, San Francisco, CA, 94110, USA; tel: 628-206-4298, fax: 628-206-8942, e-mail: marilyn.thomas@ucsf.edu

Objective: Although people with schizophrenia are disproportionately affected by Hepatitis C virus (HCV) compared to the general population, HCV screening among US Medicaid recipients with schizophrenia has not been characterized. Following 1998 CDC recommendations for screening in high-risk populations, we estimated the proportion of Medicaid recipients with and without schizophrenia screened for HCV across states and over time. Examining patterns of screening will inform the current public health imperative to test all adults for HCV now that safer and more effective treatments are available. *Methods:* Data are drawn from 1 353 424 Medicaid recipients aged 15–64 years with schizophrenia and frequency-matched controls from 2002 to 2012. Participants with known HCV infection one year prior and those dual-eligible for Medicare were excluded. Multivariable logistic regression estimated associations between predictor variables and HCV screening. *Results:* HCV screening was low (<4%) but increased over time. Individuals with schizophrenia consistently showed higher screening compared to controls across years and states. Several demographic and clinical characteristics predicted higher screening, especially comorbid HIV (OR = 6.5; 95% CI = 6.0–7.0). Outpatient medical care utilization increased screening by nearly double in 2002 (OR = 1.8; CI = 1.7–1.9) and almost triple in 2012 (OR = 2.7; CI = 2.6–2.9). *Conclusions:* Low screening was a missed opportunity to improve HCV prevention efforts and reduce liver-related mortality among people with schizophrenia. Greater COVID-19 disease severity in HCV patients and the availability of effective HCV treatments increase the urgency to improve HCV screening. Eliminating Medicaid restrictions and expanding statewide HIV policies to include HCV would have multiple public health benefits, particularly for people with schizophrenia.

Key words: mental illness/testing/public health/public health insurance

Introduction

The estimated number of acute Hepatitis C Virus (HCV) infections increased from 24 700 to 57 500 from 2012 to 2019 in the United States.[1] Compared to the general population, people with severe mental illness (SMI), such as schizophrenia, have a significantly reduced lifespan,[2,3] and are at an increased risk of infectious diseases including HCV.[4] Due to various genetic, environmental, and psychosocial factors, people with schizophrenia are also at higher risk of both intravenous drug use and risky sexual behaviors[5,6]—each of which puts them at higher risk of HCV.[7,8] HCV prevalence for those with SMI has been estimated at 17% compared to 1% in the general North American population.[4] Among those with schizophrenia, a recent meta-analysis estimates that the prevalence of HCV is 6% and the odds of infection are 3 times higher than for those without schizophrenia.[9]

HCV-related mortality increased steadily in the United States from 3.7 to 5.0 deaths per 100 000 from 2003 to 2013[10] before declining in 2014.[11] Prior to 2014, HCV treatment was challenging because limited cure rates and severe side effects of interferon-based therapy

restricted its use in patients with schizophrenia.[12–14] Since 2014, however, direct acting combination antiviral oral medications with over 95% cure rates and low adverse effect profiles have become available, increasing the importance of detecting HCV.[15]

The 1998 Center for Disease Control and Prevention (CDC) recommendations for HCV screening targeted high-risk populations including those who inject drugs, have multiple sex partners, and are infected with HIV.[16,17] These recommendations were expanded in 2012 to include one-time screening in those born between 1945 and 1965,[18] and expanded further in 2020 to recommend universal screening in all adults.[19]

Barriers to primary care for patients with schizophrenia – poor quality of care, personal difficulties (eg, poverty, impaired cognition), and fragmented services, among others – contribute to lower rates of preventative screening.[20–22] By 2011, the annual rate of HCV screening among California Medicaid recipients with SMI including schizophrenia (4.7%) was lower than for US persons enrolled in private healthcare (12.7%) during 2008–2009.[23,24] This lack of screening is a missed opportunity to cure HCV infection and reduce its transmission, and may exacerbate COVID-19-related disease severity and mortality.[25,26] Moreover, HCV prevention efforts can vary by state and change over time, warranting investigation to identify successful statewide initiatives that may inform more targeted interventions. To the best of our knowledge, national HCV screening rates of Medicaid patients with schizophrenia have not been reported.

In this exploratory study, we aimed to evaluate (1) potential differences in HCV screening among Medicaid recipients with and without a schizophrenia diagnosis across states and over time; (2) the likelihood of HCV screening among patients by schizophrenia status; and (3) patient-level risk factors for screening among people with schizophrenia. Based on known patterns of care, HCV epidemiology, and preventative screening, we hypothesized that screening would (1) vary widely by state, (2) increase over time, (3) be lower in patients with schizophrenia, and be higher for schizophrenia patients who (4) were older and non-White, and (5) had comorbid diagnoses related to more frequent medical visits, specifically HIV infection, opioid use, and diabetes.

Methods

Study Sample and Design

In this retrospective cohort study, we compared HCV screening among people with schizophrenia to frequency-matched controls without schizophrenia. Data were from the Centers for Medicare & Medicaid Services (CMS) which provides a nationally representative sample of Medicaid recipients. However, a time lag in data availability limited our sample to patients enrolled during 2002 through 2012. All study patients met the following eligibility criteria: (1) Medicaid beneficiaries; (2) aged 15–64 years as of December 31 during the observed calendar year; (3) at least 11 months of eligibility during the observed calendar year, and (4) live in one of the 45 states with available Medicaid data during the study period. Medicaid data were deidentified, hence informed consent and institutional review board approval were waived.

Exposure Assessment

Patients with schizophrenia had (*a*) ≥1 inpatient claim for schizophrenia (ICD-9 295.x) or (*b*) ≥2 outpatient claims for schizophrenia within any given 6-month period during the observed calendar year. For overlapping outpatient claims during the 6-month period, patients were linked to the first claim. For example, if the first claim was in December 2005 and a second in February 2006, the patient was linked with calendar year 2005 as opposed to 2006. Controls were frequency-matched 1:1 by age, sex, and race/ethnicity, stratified by year of first eligibility for the schizophrenia and control cohort. Controls were excluded on date of first observed schizophrenia claim.

Outcome Assessment

Our primary outcome was any HCV screening, assessed dichotomously (0 = unscreened; 1 = screened) in every year of the study period. Following previous literature using Medicaid data[24] and among people with SMI,[27–29] antibody tests were used to assess HCV screening (CPT codes 86803 & 86804). Participants with known HCV infection one year prior to the observed year were excluded (for ICD-9 codes, see Supplementary Material A). For example, individuals with identified HCV infection in 2005 were excluded from subsequent years (2006–2012). Those who were screened in the previous calendar year, but were not diagnosed with HCV, were carried forward to the following year.

Covariates

All covariates were coded categorically along with mean age. Personal demographics included age (15–19, 20–29, 30–39, 40–49, 50–59, 60–64 years), sex (male, female), and race/ethnicity (White, Black, Asian or Pacific Islander, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, Multiracial, Unknown). In addition, cooccurring clinical diagnoses were assessed, specifically substance use disorders (alcohol, opioids, cocaine, amphetamine, cannabis, other), other selected mental health disorders (anxiety, depression), and medical conditions [hepatitis B virus (HBV), HIV, diabetes mellitus, hypertension, dyslipidemia, and sexually transmitted diseases (STDs: herpes simplex virus [HSV], chlamydia, syphilis, gonococcal infection)] (Supplementary Material A).[30] We also assessed clustered cooccurring clinical diagnoses dichotomously

(0 = none, 1 = yes): any substance use disorder, any STD, and any metabolic disorder (diabetes mellitus, hypertension, and dyslipidemia) as well as use of nonmental health care services (0 = no; 1 = yes) (for CPT codes, see Supplementary Material A).

Statistical Analysis

We restricted the analysis to beneficiaries who were not dually eligible for Medicare (62%) to avoid underestimating HCV screening that was covered by Medicare. Frequencies were used to describe patient characteristics in combination with chi-square tests of homogeneity to assess differences between patients with schizophrenia and controls. Logistic regression was used to estimate 2-sided associations of HCV screening with state, year, and patient characteristics including schizophrenia, adjusting for frequency matching factors, and using robust standard errors to account for patients being repeatedly followed over the years. Interactions between schizophrenia diagnoses and other patient characteristics were also estimated. We mapped distributions of HCV screening across states in 2012 and the change in screening between 2002 and 2012. Because management of schizophrenia may result in patterns of care that differ from controls,[31–33] we conducted a sensitivity analysis adjusting for use of outpatient general medical visits. STATA 16 (StataCorp, College Station, TX) was used to perform statistical analyses.

Results

Sample Characteristics

Table 1 presents the distribution of study sample characteristics at the beginning and end of the observation period (2002 and 2012). The final cohort comprised 528 382 patients in 2002 and 825 042 patients in 2012. In 2002, demographic characteristics of patients with schizophrenia (n = 228 453) were slightly more female (51.3%), White (43.8%), or Black (33.7%), with a mean age 42.6 years. In 2012, patients with schizophrenia (n = 348 396) were slightly more male (52.6%), White (38.0%), or Black (36.7%), with mean age 42.8 years.

HCV Screening, by Schizophrenia Status (2002–2012)

Overall HCV screening increased slightly yet significantly from 2002 (2.0%) through 2012 (3.1%), with consistently higher rates for patients with schizophrenia compared to controls (P < .001) (figure 1). Among patients with schizophrenia, HCV screening increased from 2.8% (95% confidence interval [CI] = 2.7–2.8) in 2002 to 3.9% (3.8–3.9) in 2012, with an adjusted change of 1.1% (1.0–1.2). Among controls, HCV screening increased from 1.4% (1.3–1.4) in 2002 to 2.6% (2.5–2.6) in 2012, with an adjusted change of 1.2% (1.2–1.3).

State-level HCV Screening in the Schizophrenia Population, 2012

As shown in figure 2, state-level screening among those with schizophrenia ranged from 0.3% to 11.8% in 2012, after adjusting for age, sex, and race/ethnicity. States with the lowest screening (<1.0%) included Hawaii (0.3%), Alaska (0.5%), and Maryland (0.5%). States with the highest screening (>5.0%) were mostly in the northeast and included Connecticut (11.8%), New York (8.7%), Massachusetts (8.3%), Vermont (7.8%), New Jersey (5.9%), and Minnesota (5.6%). Compared to controls, those with schizophrenia had double the screening in California, Iowa, Illinois, Maine, Montana, Vermont, Wisconsin, and West Virginia. Controls had slightly higher screening than schizophrenia patients in South Dakota, New Hampshire, and Wyoming, and double the screening in North Dakota. Changes in HCV screening from 2002 to 2012 across states ranged from −2.9% to 7.0% in patients with schizophrenia (Supplementary Material B).

Table 2 presents HCV screening estimates in 2002 and 2012 among enrollees with schizophrenia, adjusted for age, sex, race/ethnicity, and comorbidities. In 2002, screening was highest for individuals who were Native Hawaiian and other Pacific Islander, Hispanic/Latino, aged 20–39 years, had comorbid opioid and other drug use, and had certain medical comorbidities (specifically HBV, HIV, chlamydia, and syphilis infection). Changes in screening from 2002 to 2012 differed significantly for groups by sex, race/ethnicity (except for White and those with unknown race/ethnicity), age (except for 15–19 and 60–64 years), comorbid substance use (except amphetamine), other comorbid mental health conditions, and comorbid medical conditions (except HBV, hypertension, and syphilis).

Multivariable Logistic Regression

Adjusted odds ratios (OR) for HCV screening among individuals with schizophrenia were patterned by demographics and comorbidities during 2002 and 2012 (Supplementary Material C). In figure 3, 2012 estimates are presented by demographic factors (figure 3a) and comorbidities (figure 3b). Compared to each respective low-risk reference group, the likelihood of HCV screening was consistently higher across patient characteristics with a few exceptions: confidence intervals contained the null for American Indian/Alaskan Native (vs White) patients (OR = 1.13; CI = 0.91–1.40) and those diagnosed with comorbid use (vs no use) of amphetamine (OR = 0.89; CI = 0.78–1.03) and cannabis (OR = 1.06; CI = 0.99–1.13). Compared to those without each respective comorbidity, the likelihood of HCV screening was more than double for those with comorbid opioid use (OR = 2.09; CI = 1.94–2.25) and comorbid diagnosis of HIV (OR = 6.49; CI = 6.04–6.97), HBV (OR = 4.06; CI = 3.40–4.85), chlamydia (OR = 3.19; CI = 2.57–3.95), and HSV (OR = 2.51; CI = 2.25–2.80).

Table 1. Characteristics of Nondual Medicaid Patients with Schizophrenia and Controls (Total N = 1 353 424)

		2002			2012		
		Schizophrenia (n = 228 453)	Control (n = 299 929)	P-value	Schizophrenia (n = 348 396)	Control (n = 476 646)	P-value
Predictor class	Variable	n (%)	n (%)		n (%)	n (%)	
Demographics							
Sex	Female	117 187 (51.3)	150 114 (50.0)	.00	165 022 (47.4)	223 691 (46.9)	.00
	Male	111 266 (48.7)	149 815 (50.0)		183 374 (52.6)	252 955 (53.1)	
Race/ethnicity	White	100 096 (43.8)	154 729 (51.6)	.00	132 436 (38.0)	209 936 (44.0)	.00
	Black	76 896 (33.7)	90 768 (30.3)		127 997 (36.7)	157 812 (33.1)	
	AI/AN	1610 (0.7)	2175 (0.7)		2844 (0.8)	4099 (0.9)	
	Asian/PI	3803 (1.7)	6254 (2.1)		7186 (2.1)	11 106 (2.3)	
	Hispanic/Latino	19 768 (8.7)	25 425 (8.5)		37 878 (10.9)	49 929 (10.5)	
	Native Hawaiian/ OPI	3924 (1.7)	3408 (1.1)		5122 (1.5)	4550 (1.0)	
	Multiracial	418 (0.2)	216 (0.1)		1241 (0.4)	1591 (0.3)	
	Unknown	21 938 (9.6)	16 954 (5.7)		33 692 (9.7)	37 623 (7.9)	
Age, years	15–19	8276 (3.6)	8705 (2.9)	.00	14 404 (4.1)	27 632 (5.8)	.00
	20–29	32 082 (14.0)	40 068 (13.4)		61 986 (17.8)	77 452 (16.3)	
	30–39	47 909 (21.0)	71 315 (23.8)		66 266 (19.0)	99 906 (21.0)	
	40–49	72 991 (32.0)	99 579 (33.2)		78 531 (22.5)	115 614 (24.3)	
	50–59	51 147 (22.4)	61 604 (20.5)		95 846 (27.5)	118 960 (25.0)	
	60–64	16 048 (7.0)	18 658 (6.20)		31 363 (9.0)	37 082 (7.8)	
	Mean (SD)	42.6 (12.0)	42.1 (11.7)		42.8 (13.2)	41.8 (13.2)	
Comorbidities[a]							
Substance abuse	Alcohol	12 068 (5.3)	5614 (1.9)	.00	18 938 (5.4)	7539 (1.6)	.00
	Opioid	3791 (1.7)	3252 (1.1)	.00	10 360 (3.0)	7609 (1.6)	.00
	Cocaine	9817 (4.3)	2583 (0.9)	.00	16 222 (4.7)	3380 (0.7)	.00
	Amphetamine	1381 (0.6)	313 (0.1)	.00	4354 (1.3)	701 (0.2)	.00
	Cannabis	7018 (3.1)	1295 (0.4)	.00	22 462 (6.5)	4547 (1.0)	.00
	Other	14 263 (6.2)	3771 (1.3)	.00	28 935 (8.3)	8060 (1.7)	.00
	Any substance abuse	35 160 (15.4)	14 435 (4.8)	.00	71 740 (20.6)	27 188 (5.7)	.00
	No substance abuse	193 293 (84.6)	285 494 (95.2)		276 656 (79.4)	449 458 (94.3)	
Other mental health	Anxiety	18 988 (8.3)	13 344 (4.5)	.00	52 699 (15.1)	31 069 (6.5)	.00
	Depression	59 948 (26.2)	26 491 (8.8)	.00	97 059 (27.9)	43 078 (9.0)	.00
Medical	Diabetes mellitus	38 030 (16.7)	31 171 (10.4)	.00	74 425 (21.4)	55 805 (11.7)	.00
	Hypertension	60 582 (26.5)	57 636 (19.2)	.00	122 222 (35.1)	108 898 (22.9)	.00
	Dyslipidemia	36 265 (15.9)	32 504 (10.8)	.00	88 071 (25.3)	74 753 (15.7)	.00
	Metabolic disorder	91 384 (40.0)	81 362 (27.1)	.00	171 303 (49.2)	147 642 (31.0)	.00
	No metabolic disorder	137 069 (60.0)	218 567 (72.9)		177 093 (50.8)	329 004 (69.0)	
	Hepatitis B	796 (0.4)	581 (0.2)	.00	1210 (0.4)	1292 (0.3)	.00
	HIV	3129 (1.4)	4241 (1.4)	.17	5799 (1.7)	5131 (1.1)	.00
STDs	HSV	1474 (0.7)	1488 (0.5)	.00	3856 (1.1)	3484 (0.7)	.00
	Chlamydia	376 (0.2)	586 (0.2)	.01	930 (0.3)	1526 (0.3)	.00
	Syphilis	810 (0.4)	505 (0.2)	.00	958 (0.3)	758 (0.2)	.00
	Gonococcal infection	510 (0.2)	536 (0.2)	.00	645 (0.2)	747 (0.2)	.00
	Any STD	3014 (1.3)	2874 (1.0)	.00	6053 (1.7)	6213 (1.3)	.00
	No STD	225 439 (98.7)	297 055 (99.0)		342 343 (98.3)	470 433 (98.7)	

Note: SD = standard deviation; AI/AN = American Indian or Alaskan Native; PI = Pacific Islander; OPI = Other Pacific Islander; STD = sexually transmitted disease; HSV = herpes simplex virus.
[a]Totals are restricted to those with the comorbidity, therefore columns will not total 100%.

From 2002 to 2012, patients with comorbid HSV infection had the greatest increase in HCV screening (OR = 2.26; CI = 1.66–3.07) while screening decreased the most for those with comorbid dyslipidemia (OR = 0.77; CI = 0.65, 0.91) (Supplementary Material C). Our sensitivity analyses showed that further adjustment for having

at least one annual outpatient general medical visit did not meaningfully change the magnitude or precision of estimates apart from sex, amphetamine use, and diabetes in 2002 and cannabis use and hypertension in 2012 (data available upon request). In 2002, lower screening became significant for females while confidence intervals for those with comorbid diabetes and hypertension contained the null. In 2012, higher screening became significant for comorbid cannabis use while confidence intervals contained the null for comorbid hypertension. Compared to those having no visit (38.0% in 2002 and 31.6% in 2012), HCV screening for those with at least one health care visit was nearly double in 2002 (OR = 1.79; CI = 1.68–1.91) and almost triple in 2012 (OR = 2.72; CI = 2.58–2.88).
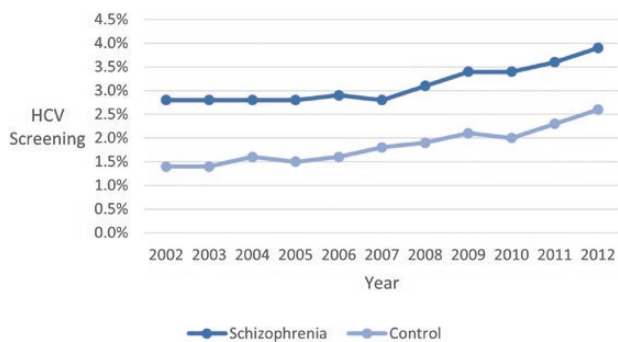

Fig. 1. HCV screening by year among nondual eligible Medicaid patients from 2002 to 2012 ($N = 7\,137\,564$).

Discussion

This is the first population-based study of HCV screening among US Medicaid patients with and without schizophrenia. As hypothesized, we found that HCV screening varied over time, across states, and by patient demographic and comorbid characteristics. However, contrary to our hypothesis, screening was higher for patients with schizophrenia compared to controls. We also found that despite 1998 CDC guidelines to target high-risk populations for annual screening,[16] over 95% of Medicaid patients with schizophrenia who were eligible for screening were not screened for HCV within any clinical setting (eg, general medical, emergency room) in 2012.

Among patients with schizophrenia, states in the northeast had the highest HCV screening rates and increases in screening from 2002 to 2012. Large state-level rises in HCV screening were potentially due to various integration of care initiatives implemented state-wide, warranting further examination that is beyond the scope of our exploratory study. For example, by 2012, several northeastern states had active initiatives to reduce Medicaid fragmentation[34] and were among the highest in Medicaid spending per enrollee.[35] There were also state-wide integration initiatives aimed to decrease hepatitis transmission. For instance, New York State launched the 2004 Viral Hepatitis Strategic Plan modeled after the HIV/AIDS prevention and care continuum.[36] Similarly in 2008, the Massachusetts' Office of HIV/AIDS was created to integrate strategies for HIV prevention with HCV
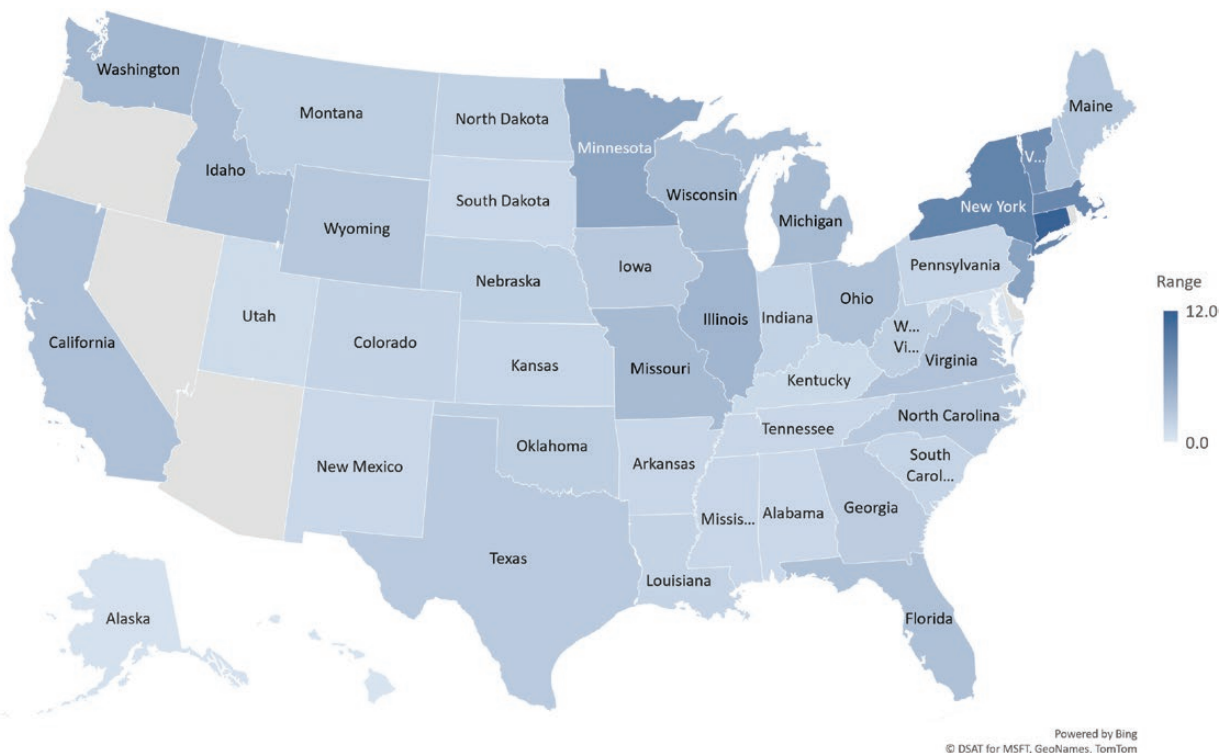

Fig. 2. 2012 HCV screening among nondual eligible Medicaid patients with schizophrenia ($N = 576\,849$).

Table 2. Adjusted Estimates of Percent HCV Screening Among Medicaid Patients with Schizophrenia (*N* = 576 849)

Predictor class	Variable	2002 (*n* = 228,453) Adj. % (95% CI)	2012 (*n* = 348,396) Adj. % (95% CI)	Change in Screening Rate (2012 vs. 2002) Adj. % (95% CI)	*P*-value
Demographics					
	Female	3.0% (2.9, 3.1)	4.1% (4.0, 4.2)	1.0% (0.9, 1.1)	.000
	Male	3.1% (3.0, 3.2)	3.3% (3.2, 3.4)	0.2% (0.1, 0.4)	.001
Race/ethnicity	Black	2.7% (2.6, 2.9)	4.0% (3.9, 4.1)	1.5% (1.4, 1.7)	.000
	AI or AN	1.9% (1.2, 2.6)	3.3% (2.7, 4.0)	1.4% (0.5, 2.3)	.004
	Asian or PI	3.3% (2.7, 3.9)	5.3% (4.8, 5.9)	1.6% (0.8, 2.4)	.000
	Hispanic/Latino	4.3% (4.0, 4.6)	5.1% (4.9, 5.3)	0.8% (0.4, 1.2)	.000
	Native Hawaiian or OPI	6.4% (5.6, 7.2)	4.5% (3.9, 5.1)	−2.1% (−3.0, −1.2)	.000
	Multiracial	2.9% (1.3, 4.5)	5.0% (3.8, 6.1)	2.3% (0.1, 4.5)	.042
	Unknown	3.4% (3.1, 3.6)	3.2% (3.1, 3.4)	−0.2% (−0.5, 0.1)	.224
	White	2.9% (2.7, 3.0)	3.2% (3.0, 3.4)	−0.2% (−0.5, 0.1)	.623
Age	15–19	3.3% (2.8, 3.8)	3.0% (2.7, 3.3)	0.0% (−0.4, 0.4)	.976
	20–29	3.3% (2.8, 3.8)	3.0% (2.7, 3.3)	0.7% (0.4, 0.9)	.000
	30–39	4.0% (3.7, 4.2)	4.4% (4.2, 4.6)	0.6% (0.4, 0.9)	.000
	40–49	3.8% (3.6, 4.0)	4.2% (4.0, 4.3)	0.7% (0.5, 0.8)	.000
	50–59	3.2% (3.1, 3.4)	3.7% (3.6, 3.8)	0.7% (0.5, 0.9)	.000
	60–64	1.9% (1.7, 2.1)	2.5% (2.3, 2.7)	0.2% (−0.1, 0.5)	.110
Comorbidities[a]					
Substance use	Alcohol	3.4% (3.1, 3.6)	4.7% (4.5, 4.9)	2.3% (1.9, 2.7)	.000
	Opioid	5.2% (4.5, 5.8)	6.9% (6.5, 7.3)	3.8% (2.7, 4.9)	.000
	Cocaine	3.0% (2.7, 3.4)	4.3% (4.0, 4.6)	4.0% (3.3, 4.7)	.000
	Amphetamine	3.9% (3.1, 4.8)	3.3% (2.9, 3.7)	1.0% (−2.5, 0.5)	.187
	Cannabis	2.8% (2.4, 3.1)	3.9% (3.6, 4.1)	2.4% (1.8, 3.0)	.000
	Other drug	5.2% (4.8, 5.6)	5.6% (5.4, 5.9)	1.9% (1.3, 2.5)	.000
Psychiatric	Anxiety	3.5% (3.3, 3.8)	4.1% (3.9, 4.2)	0.5% (0.1, 0.9)	.006
	Depression	3.6% (3.5, 3.8)	4.1% (4.0, 4.2)	0.8% (0.6, 1.0)	.000
Medical	Hepatitis B	14.5% (12.1, 17.0)	12.4% (10.6, 14.2)	−0.8% (−4.7, 3.0)	.677
	HIV	9.6% (8.6, 10.7)	17.5% (16.6, 18.5)	12.3% (10.6, 13.9)	.000
	Diabetes mellitus	3.3% (3.1, 3.5)	4.1% (3.9, 4.2)	0.4% (0.1, 0.6)	.003
	Hypertension	3.7% (3.6, 3.9)	3.9% (3.8, 4.0)	0.2% (0.0, 0.4)	.064
	Dyslipidemia	5.4% (5.1, 5.7)	4.9% (4.7, 5.0)	−0.7% (−1.0, −0.4)	.000
STDs	HSV	4.0% (3.1, 4.9)	8.3% (7.5, 9.0)	7.5% (5.8, 9.2)	.000
	Chlamydia	5.7% (3.4, 8.1)	10.2% (8.3, 12)	8.3% (4.8, 11.9)	.000
	Syphilis	6.9% (5.3, 8.4)	6.6% (5.4, 7.9)	3.0% (−0.2, 6.1)	.064
	Gonococcal	3.4% (2.0, 4.9)	6.0% (4.4, 7.7)	7.0% (3.7, 10.3)	.000

Abbreviations: AI or AN = American Indian or Alaskan Native; PI = Pacific Islander; OPI = Other Pacific Islander; CI = confidence interval; REF = reference group; Adj = adjusted; STD = sexually transmitted disease; HSV = herpes simplex virus.
Estimates are adjusted for race/ethnicity, age, sex, and comorbidities (substance use, psychiatric, medical).
[a]Respective comorbid reference group includes those who do not have the condition.

programs.[37] Also, Connecticut stakeholders partnered with the CDC to develop the Viral Hepatitis Prevention Plan that was released in 2004.[38] Despite these efforts however, CMS reports that chronic HCV prevalence for Medicaid only enrollees in 2012 was still higher than the national average (1.6%) in Connecticut (5.4%) and New York (2.7%), but not Massachusetts (1.3%).[39]

It is conceivable that a nationwide comprehensive integrated prevention program could have wide ranging positive impacts on HCV screening and prevention efforts; however, the low rate of HCV screening found during the current study period suggests that national CDC guidelines were insufficient when compared to state-level efforts. In addition to new CDC recommendations for universal HCV screening in adults,[19] expanding statewide HIV prevention policies to include HCV might mitigate traditional clinical challenges in HCV screening among this vulnerable population. To effectively address this issue for people with schizophrenia, we recommend that policymakers permit reimbursement of HCV screening in behavioral health care settings.

In 2012, the CDC newly recommended one-time HCV screening for adults born during 1945–1965 (ie, "baby boomers", aged 47–67 years) given the high prevalence of persistent chronic HCV infection in this population.[16] During 2011–2016, significant HCV infection was most prevalent among those aged 50–64 years.[40] However, our results among people with schizophrenia within the Medicaid program did not find this age group to be prioritized as expected. In fact, we found that as age
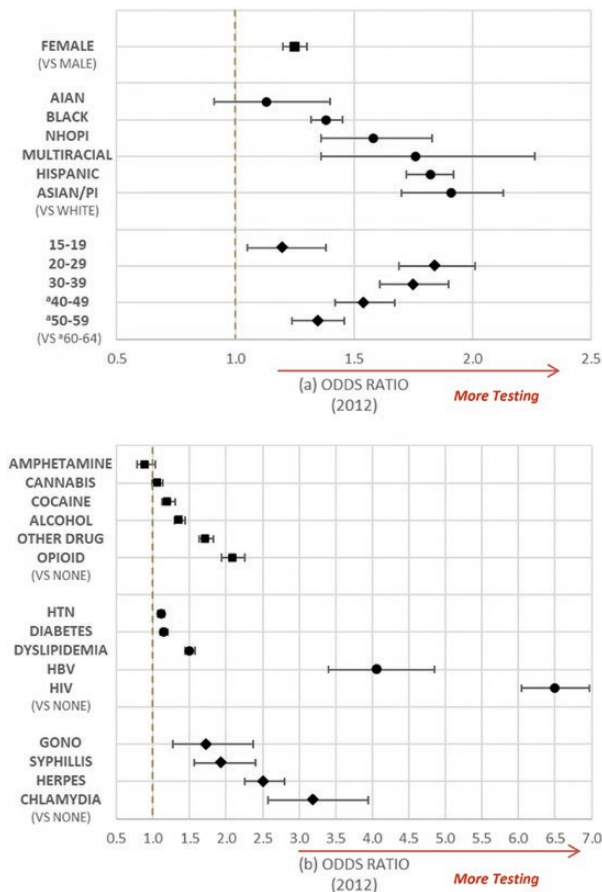
Fig. 3. Odds ratios for HCV screening among Medicaid patients with schizophrenia in 2012 by (a) demographic factors and (b) and comorbidities (N = 576 849). Note: [a]baby boomers, AIAN = American Indian or Alaskan Native, PI = Pacific Islander, and NHOPI = Native Hawaiian or other Pacific Islander.

increased, HCV screening decreased. For example, HCV screening was highest among patients aged 20–39 years in 2002 and 2012. One explanation is that the birth cohort recommendations published in August 2012 were not put into effect rapidly for the remainder of 2012. Another possibility is provider bias; providers may assume that younger individuals are more likely to engage in higher risk behaviors than older patients and providers may thereby be more likely to target younger patients for screening. For instance, rising acute HCV cases in younger people linked to the opioid epidemic may have prompted increased screening.[41] Additional investigations to help elucidate the role of patient age on HCV screening might include surveying providers on how factors related to age inform their decisions to conduct HCV screening.

We also found variation in HCV screening by race/ethnicity among people with schizophrenia. Similar to prior research,[24] we found that Asian or Pacific Islanders had nearly double the HCV screening as Whites. Nonetheless, our national sample had comparable screening for both Hispanic and multiracial enrollees. The high degree of unknown (ie, misclassified) race/ethnicity status in this

Medicaid cohort reduces the validity of this as a predictor; nearly 1 in 10 patients with schizophrenia were of unknown race/ethnicity. This finding aligns with recent work showing that race/ethnicity is largely incomplete for Medicaid patients.[42] Addressing structural discrimination at the intersection of race/ethnicity and mental illness within the population covered by Medicaid will require accurate and complete patient demographic information.

Most notably, we found that among patients with schizophrenia the highest likelihood of HCV screening was among those with comorbid HIV (>6x) and HBV (>4x) followed by chlamydia (>3x), HSV (>2x), and opioid use (>2x), as hypothesized, though comorbid diabetes predicted 15% higher odds. Our finding of higher HCV screening among people who have schizophrenia and also comorbid HIV, HBV, substance use disorders, and sexually transmitted infections is likely explained in part by 1998 and 1999 CDC recommendations for screening high-risk people,[16,17] which remained in place throughout the study period.[43] Because of shared risk, HBV and HCV screening are often combined, especially among those with substance use disorders, as chronic HCV infection is complicated by alcohol and other substance use. Hence, there appears to be some risk-based assessment of the need for HCV screening recommended by CDC policy, which is consistent with prior literature.[24]

Compared with prior literature, HCV screening in the 2012 Medicaid population with schizophrenia was similar to 2011 reports from California Medicaid recipients with SMI (3.3% and 4.7% respectively),[24] and lower than US persons enrolled in private healthcare during 2006–2008 (12.7%).[23] These combined results raise serious concerns about the overall effectiveness and implementation of early and ongoing public health policies aimed to prevent and treat HCV in this high risk population, and for Medicaid patients overall. Our study lays the groundwork for future investigations to better understand how HCV prevention and treatment efforts are evolving in the United States for patients with schizophrenia.

The low overall rate of HCV screening found in the current study also has important policy implications. During the pandemic, COVID-19 infection in HCV patients has been linked to greater COVID-19 disease severity and hospitalization,[25,26] liver impairment,[44,45] and in-hospital mortality.[26,44] Now that we have highly efficacious HCV therapies that can reduce the considerable morbidity and mortality associated with this infection,[10,46-48] HCV screening should be added to routine panel screening of COVID-19 risk. Underdiagnosis of HCV will likely result in increased HCV transmission, prevalence, morbidity, and mortality, perhaps more for those infected with COVID-19.

Moreover, restrictive policies can inadvertently undermine broader HCV prevention efforts. In addition to the CDC's 2020 endorsement of universal HCV screening,[19] the World Health Organization proposed a global strategy to eliminate HCV by 2030 through increases in

screening and treatment.[49] Currently, most US states are not on track to achieve this goal, which is likely due in part to state Medicaid restrictions.[50] Various states have implemented hepatic fibrosis, sobriety, and prescriber restrictions on access to HCV treatment.[51] These discriminatory restrictions may exacerbate poor outcomes for those with schizophrenia, particularly for those with comorbidities. For example, 2012 HCV screening was lowest in Hawaii, Alaska, and Maryland in the current study, all of which have maintained sobriety protocols to access treatment for nearly a decade.[51] Removing discriminatory Medicaid access restrictions and improving linkage to care for patients with schizophrenia can help reach the goal of eliminating HCV in the United States.

There are several methodological considerations. First, our large population-based retrospective cohort was nationally representative, hence study findings are generalizable to the 45 states studied. Second, results reflect HCV screening for Medicaid patients without dual enrollment in Medicare and should not be generalized to dual enrolled patients, uninsured patients, and privately insured patients. Notably, approximately 40% of US adults with schizophrenia have Medicaid without Medicare coverage.[52] Third, patients who were dual eligible for Medicare were excluded after matching; however, selection bias was likely minimal given the similar distributions of matching factors between cases and controls. Fourth, while case–control frequency matching accounted for confounding by age, sex, and race/ethnicity, there were unmeasured variables, such as incarceration frequency and housing stability, that may have confounded trends in the association between a schizophrenia diagnosis and being screened for HCV. Fifth, the absence of immigration data during the study period is a limitation since HCV screening is likely higher among immigrants upon entering the United States. However, this would lead to the underestimation of HCV screening. Sixth, internal validity could be further compromised by censoring, specifically patient changes in Medicaid eligibility during the study period and failure to capture infections. Seventh, because Medicaid claims data rely on clinicians to submit CPT billing codes for HCV screening and does not capture screening that occurs while individuals are incarcerated or receive care that is not paid for by Medicaid, inaccurate or underreporting can also result in underestimating HCV screening. Claims data analyses also rely on accurate clinical diagnoses. Finally, because the most recent data were collected in 2012, the HCV screening rates may not reflect contemporary practice. Nonetheless, our study fills a notable gap in knowledge by demonstrating that HCV screening in the Medicaid population changed by only 1.1% from 2002 to 2012 after 1998 CDC recommendations, which suggests screening may have changed little over the subsequent decade.

Despite the high risk of HCV among people with schizophrenia, fewer than 5% of Medicaid patients with schizophrenia received HCV screening each year. Implementing widespread HCV screening in the behavioral healthcare system nationwide could improve HCV detection and successful treatment for people with schizophrenia. While there appear to be screening improvements in US states, expanding integrative HCV prevention, screening, and treatment policies with fewer restrictions are needed to effectively reach this high-risk population. Implementation of such efforts nationwide can improve HCV primary and secondary prevention efforts, reduce HCV-related mortality, and contribute to HCV elimination efforts now that we have safe and highly effective HCV treatments.

Supplementary Material

Supplementary data are available at *Schizophrenia Bulletin Open* online.

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