



# Major Shifts in Outpatient Cirrhosis Care Delivery Attributable to the COVID-19 Pandemic: A National Cohort Study

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The coronavirus disease 2019 (COVID-19) pandemic has disrupted health care delivery in the United States, with increased reliance on telemedicine visits as opposed to in-person outpatient appointments. We used national data to evaluate shifts in modes of hepatology outpatient care for patients with cirrhosis during the pandemic. This was a retrospective cohort study among U.S. veterans with cirrhosis. We used linear regression to evaluate absolute and percentage changes from baseline in hepatology in-person visits and telemedicine visits from January 1, 2020, to August 11, 2020. The proportion of in-person and telemedicine visits were plotted geographically to demonstrate state-level shifts in care delivery over time. Patient-level characteristics in the pre-COVID and during-COVID periods were also compared. We identified 5,618 in-person and 6,210 telemedicine hepatology visits among patients with cirrhosis. In-person visits significantly declined (-16.0% per week; 95% confidence interval [CI] -20.7, -11.2;  $P < 0.001$ ), while telemedicine visits significantly increased (61.3% per week; 95% CI 45.1, 77.5;  $P < 0.001$ ) in the early during-COVID period. At the U.S. state level, we found that nearly all states experienced a significant shift toward telemedicine over the course of several weeks. Patients over the age of 70 years and Black patients were less likely to receive telemedicine visits in the pre-COVID period (each  $P < 0.05$ ), although these differences were eliminated in the during-COVID periods. **Conclusion:** Among patients with cirrhosis, hepatology outpatient care delivery has shifted heavily toward telemedicine due to COVID-19. This occurred across the United States, and changes have been sustained through August 2020. Expanded telemedicine visits among older patients and Black patients may reflect dedicated efforts to increased access to care among these groups. (*Hepatology Communications* 2022;6:3186-3193).

The novel coronavirus disease 2019 (COVID-19) pandemic has caused major disruptions to health care delivery for vulnerable patients.<sup>(1,2)</sup> Our group recently demonstrated that national inpatient use for patients with cirrhosis declined significantly during the early COVID-19 period across the nation.<sup>(3)</sup> However, shifts in hepatology outpatient care delivery for these patients have not been objectively explored at the national level.

Early in the pandemic, many health systems began supplanting in-person outpatient visits with telemedicine appointments, to minimize health care exposure and curb infectious spread.<sup>(4)</sup> It is unknown how rapidly these changes were able to be implemented in the United States among hepatology services, to what extent the volume of telemedicine visits has compensated for the previous volume of in-person visits, and to what extent telemedicine use has persisted as the

*Abbreviations:* ALD, alcohol-induced liver disease; CI, confidence interval; COVID-19, coronavirus disease 2019; HIPAA, Health Insurance Portability and Accountability Act; HCV, hepatitis C virus; VHA, Veterans Health Administration; VOCAL, Veterans Outcomes and Costs Associated with Liver Disease.

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pandemic has continued to evolve. Finally, it is not known whether there are particular patient groups who have experienced expanded or restricted access to telemedicine-based services. To address these knowledge gaps, we aimed to investigate telemedicine and in-person outpatient shifts in the Veterans Health Administration (VHA), the largest national provider of liver-related care, and to evaluate state-level differences during the evolution of the pandemic.

## Patients and Methods

### STUDY DESIGN AND DATA SOURCE

We performed a retrospective cohort study using VHA data from the Veterans Outcomes and Costs Associated with Liver Disease (VOCAL) cohort, which contains data on approximately 129,000 patients with cirrhosis, identified using a validated algorithm based on International Classification of Diseases codes between January 1, 2008, and December 31, 2016.<sup>(5,6)</sup> The VOCAL cohort represents data from 49 U.S. states and territories, and has been used for numerous studies relating to chronic liver disease as well as health care use.<sup>(7-9)</sup> As our goal was to study shifts in outpatient specialty care delivery early in the U.S. course of the pandemic, we ascertained all outpatient hepatology in-person visits from January 1, 2020, to August 11, 2020, from the electronic health records for patients with cirrhosis. This time window encompassed the period during which inpatient cirrhosis hospitalizations ultimately nadired in the VHA cohort,<sup>(3)</sup> representing an interval of active change in care delivery. We ascertained hepatology outpatient

visits using primary or secondary stop codes for hepatology (337) in the VHA outpatient clinic visits table. Telemedicine visits were designated by additional stop code modifiers for phone or video encounter (324 and 179, respectively). Only completed visits were included, and visits among patients who previously received liver transplantation were excluded.

### VARIABLE COLLECTION

For each outpatient visit, we collected patient-level data including demographics (age, sex, race), comorbidities (diabetes mellitus, hypertension, coronary artery disease, congestive heart failure), and prior cirrhosis decompensation using previously described methods.<sup>(6,10,11)</sup> Etiology of liver disease was classified using a validated algorithm in the VHA as hepatitis C virus (HCV), hepatitis B virus, alcohol-induced liver disease (ALD), HCV + ALD, nonalcoholic fatty liver disease, or other.<sup>(12)</sup> Center-level characteristics including U.S. region (West, Midwest, Northeast, South), rurality (urban/rural), and academic center (yes/no) were also ascertained.

### STATISTICAL ANALYSIS

The number of national in-person and telemedicine visits were aggregated by calendar week and plotted over time. The percentage change in visits was also plotted in reference to a baseline period (weeks 1 to 9, called the “pre-COVID period”), as the first widely publicized U.S. COVID-19-related death occurred in week 9.<sup>(13)</sup> Changes to in-person and telemedicine visits from weeks 9 to 16 (in the “during-COVID period”) and weeks 6 to 32 (during-COVID period) were tested using linear regression by incorporating

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an interaction term between calendar week and pre/during-COVID periods. An alpha threshold of 0.05 was used for statistical significance. To explore geographic variation in shifting outpatient management during the pandemic evolution, state-level percentages of telemedicine visits were computed over four periods: weeks 1-9 (pre-COVID), 9-16 (during COVID), 16-23 (during COVID), and 23-32 (during COVID). These data were displayed geographically for states in the continental United States for each period, to demonstrate shifts in outpatient visits over time. To evaluate changes in characteristics of patients receiving telemedicine versus in-person outpatient visits, as well as center-level trends, we computed descriptive statistics between groups during pre-COVID and during-COVID periods. Continuous data were reported as medians and interquartile ranges, and categorical data as percentages. Wilcoxon rank sum tests and chi-squared tests were performed to formally test for differences in variables, as indicated.

## ETHICAL CONSIDERATIONS AND DATA MANAGEMENT

This study received institutional review board approval from the Corporal Michael J. Crescenz VA Medical Center, Philadelphia, Pennsylvania. Data management and analyses were performed using a combination of structured query language and Stata 15.1/IC (College Station, Texas).

## Results

### NATIONAL TRENDS IN OUTPATIENT VISITS

We identified a total of 5,618 in-person and 6,210 telemedicine hepatology outpatient visits among patients with cirrhosis in the VOCAL cohort. From calendar weeks 9 to 16, the number of in-person visits declined significantly, both in absolute terms (-47.2 per week; 95% CI -61.4, -33.1;  $P < 0.001$ ) and as a percentage change from baseline (-16.0% per week; 95% CI -20.7, -11.2;  $P < 0.001$ ) (Table 1 and Fig. 1). In tandem with this, telemedicine visits significantly increased from weeks 9 to 16 (absolute

39.9 per week [95% CI 29.3, 50.4;  $P < 0.001$ ]; percentage change 61.3% per week [95% CI 45.1, 77.5,  $P < 0.001$ ]) (Table 1 and Fig. 1). From weeks 16 to 32, there was a nonsignificant trend toward increasing in-person visits (absolute 3.6 per week; 95% CI -0.4, 7.7;  $P = 0.08$ ), and telemedicine visits remained stable (absolute -0.9 per week; 95% CI -4.0, 2.1;  $P = 0.53$ ). The total number of hepatology outpatient visits (in-person or telemedicine) was sustained in the transition between pre-COVID and during-COVID periods (average visits, 361.0; 95% CI 296.2, 425.8; and interaction between period and weeks,  $P = 0.49$ ).

### STATE-LEVEL TRENDS IN OUTPATIENT VISITS

At the U.S. state level, the proportion of outpatient visits conducted using telemedicine increased during the course of the pandemic for nearly all states (Fig. 2). For example, most states in the pre-COVID period had fewer than 20% of all visits performed using telemedicine, whereas by late April 2020, most states had over 60% of all visits conducted through telemedicine.

### PATIENT AND CENTER-LEVEL CHARACTERISTICS OF VISITS OVER TIME

In the pre-COVID period, telemedicine visits were significantly less frequent among patients age 70 years or older (30.1% telemedicine vs. 36.8% in-person;  $P = 0.003$ ), Black patients (15.2% vs. 25.8%;  $P < 0.001$ ), and in those with ALD (15.9% vs. 23.7%;  $P = 0.002$ ) (Table 2). In the during-COVID periods, however, there were no significant differences between telemedicine and in-person visits by age or race (each  $P > 0.05$ ). However, patients with prior decompensated cirrhosis were significantly more likely to receive in-person outpatient visits during this time (e.g., 40.2% in-person vs. 33.7% telemedicine [ $P = 0.001$ ] during weeks 9-16). Regarding center-level trends, significant shifts toward telemedicine visits during the pandemic were noted across all U.S. regions, for both urban and rural centers, and for academic and nonacademic centers (Table 2).

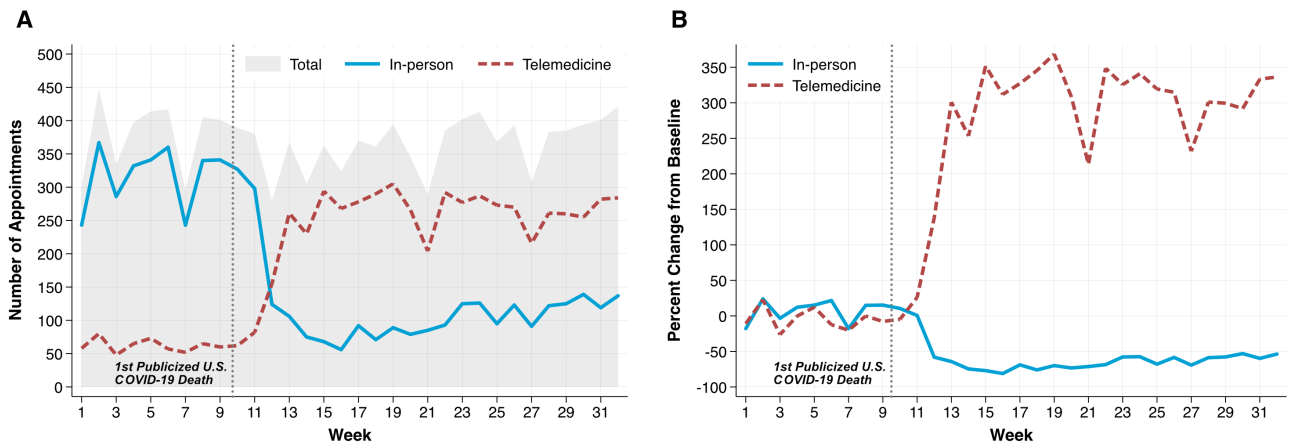
TABLE 1. LINEAR REGRESSION MODELS OF 2020 IN-PERSON AND TELEMEDICINE VISITS OVER TIME

Variable	Beta	95% CI	PValue
In-Person Visits			
Model With Number of Visits			
COVID period (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	468.44	(274.61, 662.27)	<0.001
Weeks 16-32	-278.15	(-393.03, -163.27)	<0.001
Calendar week	4.22	(-5.45, 13.88)	0.378
COVID period × calendar week interaction (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	-51.43	(-68.56, -34.30)	<0.001
Weeks 16-32	-0.58	(-11.06, 9.90)	0.911
Model With Percentage Change From Baseline			
COVID period (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	158.3	(92.80, 223.80)	<0.001
Weeks 16-32	-94	(-132.82, -55.17)	<0.001
Calendar week	1.42	(-1.84, 4.69)	0.378
COVID period × calendar week interaction (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	-17.38	(-23.17, -11.59)	<0.001
Weeks 16-32	-0.19	(-3.74, 3.35)	0.911
Telemedicine Visits			
Model With Number of Visits			
COVID period (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	-390.55	(-535.20, -245.90)	<0.001
Weeks 16-32	226.51	(140.78, 312.24)	<0.001
Calendar week	-0.62	(-7.83, 6.59)	0.862
COVID period × calendar week interaction (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	40.51	(27.73, 53.29)	<0.001
Weeks 16-32	-0.32	(-8.14, 7.51)	0.935
Model With Percentage Change From Baseline			
COVID period (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	-600.07	(-822.33, -377.82)	<0.001
Weeks 16-32	348.03	(216.30, 479.76)	<0.001
Calendar week	-0.95	(-12.03, 10.13)	0.862
COVID period × calendar week interaction (ref weeks ≤9)	(ref)	(ref)	
Weeks 9-16	62.24	(42.60, 81.88)	<0.001
Weeks 16-32	-0.49	(-12.50, 11.53)	0.935

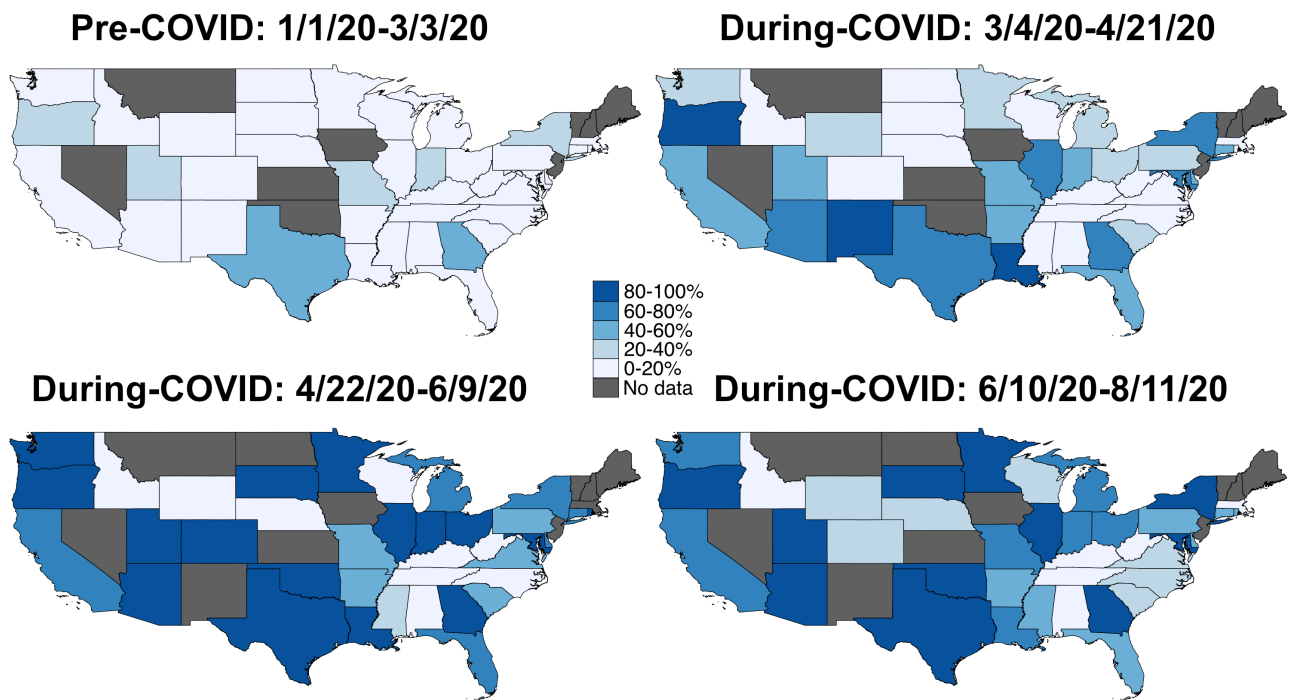
## Discussion

In this large cohort study of U.S. veterans with cirrhosis, we observed objective changes in the outpatient modes of health care delivery attributable to the COVID-19 pandemic at the national level. The data suggest that the VHA system quickly and effectively shifted resources toward telemedicine-based outpatient care, and that these shifts occurred almost uniformly across the continental United States. Importantly, there were several demographic disparities in telemedicine visits in the pre-COVID period that were eliminated in the during-COVID period.

In particular, Black patients and older patients were less likely to have telemedicine visits than in-person visits before the pandemic. This is consistent with prior literature suggesting that disparities in telemedicine access may arise in groups with unreliable access to telecommunication devices or in those with limited digital device literacy.<sup>(14-16)</sup> However, in the course of the COVID pandemic, differences in telemedicine visits were not present by age or race. This may reflect the dedicated efforts undertaken by the VHA to expand telemedicine access to patients with limited digital resources or digital literacy,<sup>(17)</sup> which have included expansion of telehealth help



**FIG. 1.** Changes in in-person appointments and telemedicine visits in the pre-COVID and during-COVID periods in absolute numbers (A) and as percentage change from baseline (B). Pre-COVID period is defined as calendar weeks 1-9; during-COVID period is defined as weeks 9-32.



**FIG. 2.** U.S. state-level changes in percentage of telemedicine visits in the pre-COVID period and during-COVID periods. Percentage of telemedicine visits is computed as  $(\# \text{ telemedicine} / [\# \text{ in-person} + \# \text{ telemedicine}]) \times 100$ . Pre-COVID period is defined as calendar weeks 1-9; during-COVID period is defined as weeks 9-32.

desk resources and distribution of digital devices to patients.

Another important finding in this study is that while significant shifts in the mode of hepatology care delivery were taking place, the overall volume of

outpatient visits was sustained in this transition. This is in contrast to recently published data in the VHA system among a general medicine cohort inclusive of all in-person and telemedicine appointments. As reported by Baum et al., the overall volume of visits was

TABLE 2. CHANGES IN PATIENT AND CENTER-LEVEL CHARACTERISTICS FOR IN-PERSON VERSUS TELEMEDICINE VISITS ACROSS PRE-COVID AND DURING-COVID PERIODS

Factor	Weeks 1-9 (Pre-COVID)			Weeks 9-16 (During COVID)			Weeks 16-32 (During COVID)		
	In-Person (n = 2,853)	Telemedicine (n = 558)	P Value	In-Person (n = 1,054)	Telemedicine (n = 1,352)	P Value	In-Person (n = 1,711)	Telemedicine (n = 4,300)	P Value
Age (years), median (IQR)	68 (63, 71)	67 (62, 70)	0.001*	67 (63, 71)	67 (63, 71)	0.32	67 (63, 71)	68 (64, 71)	0.11
Age category			0.003*			0.44			0.46
<70 years	1,803 (63.2%)	390 (69.9%)		674 (63.9%)	885 (65.5%)		1,054 (61.6%)	2,605 (60.6%)	
≥70 years	1,050 (36.8%)	168 (30.1%)		380 (36.1%)	467 (34.5%)		657 (38.4%)	1,695 (39.4%)	
Male sex	2,753 (96.5%)	540 (96.8%)	0.74	1016 (96.4%)	1308 (96.7%)	0.64	1,659 (97.0%)	4,116 (95.7%)	0.026*
Race			<0.001*			0.019			0.27
White	1,628 (57.1%)	345 (61.8%)		599 (56.8%)	768 (56.8%)		973 (56.9%)	2,430 (56.5%)	
Black	735 (25.8%)	85 (15.2%)		282 (26.8%)	307 (22.7%)		417 (24.4%)	1,025 (23.8%)	
Hispanic	204 (7.2%)	66 (11.8%)		67 (6.4%)	125 (9.2%)		143 (8.4%)	372 (8.7%)	
Asian	55 (1.9%)	10 (1.8%)		22 (2.1%)	39 (2.9%)		29 (1.7%)	114 (2.7%)	
Other	231 (8.1%)	52 (9.3%)		84 (8.0%)	113 (8.4%)		149 (8.7%)	359 (8.3%)	
Etiology of liver disease			0.002*			0.44			0.002*
HCV	635 (22.3%)	148 (26.5%)		203 (19.3%)	297 (22.0%)		368 (21.5%)	1,037 (24.1%)	
Hepatitis B virus	114 (4.0%)	22 (3.9%)		42 (4.0%)	59 (4.4%)		51 (3.0%)	167 (3.9%)	
ALD	676 (23.7%)	89 (15.9%)		256 (24.3%)	287 (21.2%)		437 (25.5%)	893 (20.8%)	
HCV + ALD	993 (34.8%)	207 (37.1%)		381 (36.1%)	494 (36.5%)		587 (34.3%)	1,523 (35.4%)	
NAFLD	331 (11.6%)	75 (13.4%)		129 (12.2%)	161 (11.9%)		200 (11.7%)	513 (11.9%)	
Other	104 (3.6%)	17 (3.0%)		43 (4.1%)	54 (4.0%)		68 (4.0%)	167 (3.9%)	
Prior cirrhosis	1,075 (37.7%)	199 (35.7%)	0.37	424 (40.2%)	456 (33.7%)	0.001*	678 (39.6%)	1,543 (35.9%)	0.007*
decompensation									
Diabetes	1,425 (49.9%)	252 (45.2%)	0.039*	513 (48.7%)	612 (45.3%)	0.097	823 (48.1%)	1,837 (42.7%)	<0.001*
Hypertension	2,417 (84.7%)	466 (83.5%)	0.47	886 (84.1%)	1,153 (85.3%)	0.41	1,443 (84.3%)	3,619 (84.2%)	0.87
Coronary artery disease	653 (22.9%)	113 (20.3%)	0.17	250 (23.7%)	287 (21.2%)	0.15	376 (22.0%)	920 (21.4%)	0.62
Congestive heart failure	339 (11.9%)	63 (11.3%)	0.69	121 (11.5%)	163 (12.1%)	0.66	191 (11.2%)	524 (12.2%)	0.27
Center region			0.002*			<0.001*			<0.001*
West	730 (25.6%)	161 (29.3%)		209 (19.8%)	349 (26.0%)		402 (23.5%)	1206 (28.2%)	
Midwest	534 (18.7%)	92 (16.8%)		236 (22.4%)	216 (16.1%)		288 (16.8%)	862 (20.1%)	
Northeast	542 (19.0%)	71 (12.9%)		185 (17.6%)	277 (20.6%)		350 (20.5%)	621 (14.5%)	
South	1046 (36.7%)	225 (41.0%)		423 (40.2%)	501 (37.3%)		671 (39.2%)	1,591 (37.2%)	

TABLE 2. Continued

Factor	Weeks 1-9 (Pre-COVID)		Weeks 9-16 (During COVID)		Weeks 16-32 (During COVID)	
	In-Person (n = 2,853)	Telemedicine (n = 558)	In-Person (n = 1,054)	Telemedicine (n = 1,352)	In-Person (n = 1,711)	Telemedicine (n = 4,300)
Center rurality						
Urban	32 (1.1%)	3 (0.5%)	10 (1.0%)	7 (0.5%)	13 (0.8%)	70 (1.6%)
Rural	2,815 (98.9%)	553 (99.5%)	1,035 (99.0%)	1,325 (99.5%)	1,683 (99.2%)	4,181 (98.4%)
Academic center						
Yes	611 (21.4%)	112 (20.1%)	254 (24.1%)	233 (17.2%)	521 (30.5%)	588 (13.7%)
No	2,241 (78.6%)	444 (79.9%)	800 (75.9%)	1,118 (82.8%)	1,190 (69.5%)	3,702 (86.3%)
		PValue		PValue		PValue
		0.21		0.22		0.009*
		0.50		<0.001*		<0.001*

\*Statistically significant at the alpha = 0.05 level. Abbreviations: IQR, interquartile range; and NAFLD, nonalcoholic fatty liver disease.

lower in the during-COVID period as compared with a pre-COVID period, indicating that telemedicine visits have not entirely compensated for the decline in in-person visits.<sup>(18)</sup> A possible explanation for these findings is that some degree of outpatient volume was nonessential or less essential in a general medicine cohort, and has therefore been deferred. However, as patients with cirrhosis represent a higher acuity and more vulnerable patient population, it is likely that aggressive triaging has taken place, to preserve access to care for these individuals. Indeed, we found that in the during-COVID period, patients with decompensated cirrhosis were more likely to have in-person visits than telemedicine visits, suggesting that active decision making is occurring in this cohort to prioritize in-person visits for the sickest patients.

There are several important limitations that we acknowledge in this study. First, there is the possibility of misclassification. In particular, some degree of underascertainment of telemedicine visits may have occurred due to potentially delayed adoption of associated stop codes. However, the demonstrated trends in declining in-person visits and rising telemedicine visits should not be substantively impacted by this. Second, as the VHA patient population is primarily male with a higher burden of psychosocial comorbidities, the generalizability of our findings to non-VHA settings may be limited. However, given the wide-reaching impacts of the pandemic, we feel that similar practice changes very likely occurred across many health systems during the early U.S. COVID-19 pandemic period. Finally, we do not provide an assessment of quality of outpatient care in this study. It is possible that despite sustained volumes of outpatient visits, preventative care examinations such as hepatocellular carcinoma or esophageal variceal screening may not demonstrate similar trends.

In conclusion, the early COVID-19 pandemic has resulted in major shifts in outpatient care delivery, with reduced in-person visits and expanded telemedicine-based appointments. These transitions occurred rapidly and across the nation and have been sustained through August 2020. The data also suggest that demographic disparities in telemedicine access have been successfully mitigated during the COVID-19 pandemic. However, future research will need to establish whether shifts in modes of care delivery have translated into impacts on quality of care. Additionally,

it remains unclear to what extent shifts toward telemedicine will persist as the pandemic wanes in the United States, and how resource allocation should be handled during that transition.

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