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ORIGINAL ARTICLE

HCV hotline facilitates Hepatitis C elimination during the COVID-19 pandemic

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Abstract

The COVID-19 pandemic necessitates healthcare restrictions that also affected ongoing hepatitis C virus (HCV) elimination efforts. We assessed the value of a physician-operated HCV hotline on treatment and cure rates throughout the pandemic. All HCV patients undergoing HCV therapy at the Vienna General Hospital from 2019 to 2021 were included. An HCV hotline was established in 2019 and provided services including phone calls, text messages and voicemails. Patients were stratified by date of HCV therapy: 2019 (pre-COVID) vs. 2020/2021 (during-COVID) and use of the HCV hotline: users vs. non-users. Overall, 220 patients were included (pre-COVID: $n = 91$ vs. during-COVID: $n = 129$). The prevalence of intravenous drug use (60.5%) and alcohol abuse (24.8%) was high during COVID. During COVID, the number of DAA treatment starts declined by 24.2% ($n = 69$) in 2020 and by 34.1% ($n = 60$) in 2021 vs. pre-COVID ($n = 91$, 100%). Significantly more patients used the HCV hotline during-COVID (95.3%) vs. pre-COVID (65.9%; $p < .001$). Sustained virologic response (SVR) was 84.6% pre-COVID and 86.0% during-COVID. HCV hotline users achieved higher SVR rates during-COVID (88.2% vs. 33.3%, $p = .004$), but also pre-COVID (96.7% vs. 61.3%, $p < .001$) compared with non-users. Considering only patients with completed DAA treatments, SVR rates remained similarly high during-COVID (96.9%) versus pre-COVID (98.1%). HCV treatment initiations decreased during-COVID but importantly, nearly all DAA-treated HCV patients used the HCV hotline during the COVID pandemic. Overall, the SVR rate remained at 88.2% during COVID and was particularly high in HCV phone users—most likely due to facilitation of adherence.

KEYWORDS
COVID-19, elimination, hepatitis C virus, telemedicine

Abbreviations: 95%CI, 95% confidence interval; CLD, chronic liver disease; COVID-19, coronavirus disease of 2019; DAA, direct acting antiviral; EC, ethics committee; GT, genotype; HCC, hepatocellular carcinoma; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IQR, interquartile range; IVDU, intravenous drug use; LSM, liver stiffness measurement; LTFU, lost to follow-up; MSM, men who have sex with men; *n*, number; RNA, ribonucleic acid; SARS-CoV-2, severe acute respiratory syndrome-coronavirus-2; SVR, sustained virologic response; VCTE, vibration-controlled transient elastography.

1 | INTRODUCTION

The coronavirus disease of 2019 (COVID-19) pandemic has caused considerable morbidity and mortality due to the continuous spread of severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2),[1,2] which originated in Wuhan, China, in late 2019.[3,4] In early 2020, COVID-19 reached Europe and subsequently, drastic measures to limit the spread of the virus were taken.[5] These included travel restrictions, banning of large gatherings, implementation of protective equipment, but importantly also physical distancing, reduction of face-to-face visits and downscaling of in-hospital care for chronically ill patients, particularly in outpatient clinics.[5–9]

As chronic liver disease (CLD) patients are at particularly high risk for severe courses of COVID-19,[10–14] consensus statements for management of CLD patients were rapidly published by international societies.[6,7,15] These consensus statements emphasized the need for guideline-conform treatment of CLD patients, but also recommended decreasing face-to-face visits, performing laboratory testing preferably in local laboratories and, at least in the initial stages of the pandemic, postponing visits to specialized centres and delaying screening for oesophageal varices and surveillance visits for hepatocellular carcinoma (HCC).[6,15] At the same time, strategies of telemedicine became increasingly important and were encouraged by the consensus statements.[5,6,15–17]

The severe healthcare restrictions due to the COVID-19 pandemic also led to grave setbacks concerning the goals for HCV elimination on a global scale with HCV elimination programs slowing down or stopping in many centres.[18–20] In combination with concerns regarding increased transmission of bloodborne viruses due to a surge of intravenous drug use (IVDU) before the background of social isolation and financial worries due to a looming economic crisis,[21] this means that HCV elimination in times of the COVID-19 pandemic is a complex and important issue. In our centre, a hotline specifically designated to HCV patients was set up in 2019 in order to provide HCV patients with a low-barrier access to specialized healthcare and direct acting antiviral (DAA) therapy, as well as to improve adherence of the HCV patients undergoing DAA therapy.[22] The HCV hotline was continued throughout the COVID-19 pandemic as a means of telemedicine, allowing HCV patients to easily contact a designated physician.

The goal of this study was (i) to evaluate the numbers of DAA therapy initiations during the COVID-19 pandemic relative to corresponding time periods prior to COVID-19. Furthermore, we aimed to (ii) assess the dynamics regarding the use of the HCV hotline by patients undergoing DAA therapy and to (iii) analyse the time period-dependent impact of the HCV hotline by comparing SVR rates of patients using (HCV hotline users) and not using the HCV hotline (HCV hotline non-users) prior to and during COVID-19.

2 | PATIENTS AND METHODS

2.1 | Study design

This retrospective study included all HCV-ribonucleic acid (RNA)-positive patients, who underwent DAA treatment at the HCV outpatient clinic at the Medical University of Vienna from 01 January 2019 to 31 December 2021. As the impact of the COVID-19 pandemic in Austria started in early 2020,[5] the time period was subdivided into a restriction-free time span prior to (i.e. 01 January 2019–31 December 2019) and a time span during COVID-19 (i.e. 01 January 2020–31 December 2021), the latter with varying healthcare restrictions.

Concerning the HCV hotline, the numbers of in- and out-going phone calls, text messages and voicemails were recorded on a daily basis. Patient characteristics including age, sex, HCV-RNA, HCV genotype (GT), date of HCV diagnosis, transmission route, SVR, use of the HCV hotline, liver fibrosis stage, HIV coinfection, as well as risk factors for non-adherence including intravenous drug use and alcohol abuse[23–25] were retrieved from the medical records. Intravenous drug use was defined as ongoing or recent intravenous use of drugs, while alcohol abuse was defined as documented ongoing daily consumption of at least 60 g of alcohol[26,27] at DAA treatment initiation.

2.2 | Patient cohorts

The patients were stratified for (i) initiation of DAA therapy prior to (pre-COVID; i.e. 01 January 2019–31 December 2019) or during (during-COVID; i.e. 01 January 2020–31 December 2021) the COVID-19 pandemic and for (ii) patients, who did (HCV hotline users) and did not use the HCV hotline (HCV hotline non-users).

2.3 | The HCV hotline at the Medical University of Vienna

The HCV hotline at the Medical University of Vienna was established in 2019, as previously reported.[22] The HCV hotline, which specifically targets patients infected with HCV, is handled by a dedicated physician from Monday to Friday during regular working hours. Patients can call or send text messages to schedule appointments in the outpatient clinic, as well as ask questions, particularly concerning HCV infection and DAA therapy (i.e. duration and potential complications), enabling access to clinical visits and medical information without additional administrative barriers. The HCV hotline was promoted via a homepage (www.hep-c-hotline.at), flyers and a network of referring centres/physicians. Moreover, the HCV hotline was actively offered to patients during regular visits

at the outpatient clinic in order to enable easy contact for patients in case of questions or administrative difficulties concerning DAA treatment or scheduled visits.

Text messages were sent out to remind the patients of their appointments and to answer their questions. Moreover, patients could deposit questions or requests at the mailbox of the HCV hotline and if the patient was called, but did not answer, a message including a call back option was left in their mailbox.

2.4 | HCV treatment and SVR

DAA treatment was conducted in accordance with current treatment recommendations[28] and local reimbursement policies. Patients undergoing DAA treatment were scheduled for routine checkup visits 4 and 12 weeks after the end of treatment for assessment of SVR (SVR4 and SVR12, respectively). In this study, SVR was defined as sustained virological response 12 weeks after the end of treatment.

2.5 | Measurement of liver stiffness measurement (LSM)/vibration-controlled transient elastography (VCTE) and definition of fibrosis stages

LSM was assessed by VCTE (FibroScan®; Echosens, Paris, France) as previously described.[29] LSM was conducted after a fasting period of at least 4 hours. For staging of liver fibrosis (F0-4), the following cutoffs were used: F0/1: <7.1 kPa; F2: ≥7.1 kPa and <9.5 kPa; F3: ≥9.5 kPa and <12.5 kPa; F4: ≥12.5 kPa, as previously described.[29,30]

2.6 | Laboratory parameters

Routine laboratory parameters were assessed at the ISO-certified Department of Laboratory Medicine of the Medical University of Vienna. For quantification of HCV-RNA and HCV GT evaluation, Abbot RealTime HCV assay (Abbott Molecular) and VERSANT® HCV Genotype 2.0 Assay Line Probe Assay (Siemens Healthcare Diagnostics) were used, respectively. 12 IU/ml was the lower limit of quantification for HCV-RNA.

2.7 | Statistical analysis

For categorial variables, the number (*n*) and proportion (%) of patients with the parameter of interest were presented. Continuous data were reported as median with interquartile range (IQR). Mann–Whitney *U* test was implemented for comparing continuous variables between two different groups. Fisher's exact test and Chi-squared test were used for comparisons of categorical variables between two and three or more groups, respectively.

Statistical analyses were conducted using IBM SPSS Statistics 27 (IBM) and GraphPad Prism 8 (GraphPad Software). A two-sided *p*-value of <.05 was considered statistically significant.

2.8 | Ethics

The study was approved by the ethics committee of the Medical University of Vienna (No. 1968/2018). It was performed in accordance with the current version of the Helsinki Declaration. Due to the retrospective design of the study, the ethics committee waived the need for signed informed consent.

3 | RESULTS

3.1 | Patient characteristics (Table 1)

Overall, 220 HCV patients undergoing DAA therapy were included (pre-COVID: $n = 91$ vs. during-COVID: $n = 129$). Patients were predominantly male (pre-COVID: 75.8% vs. during-COVID: 68.2%; $p = .219$) and of similar age in both groups (pre-COVID: 43.6 years vs. during-COVID: 44.6 years; $p = .584$).

Most patients were infected with HCV GT 1 (pre-COVID: 65.9% vs. during-COVID: 69.5%) followed by GT 3 (pre-COVID: 20.9% vs. during-COVID: 25.8%). During-COVID, significantly more patients had IVDU as HCV transmission route (pre-COVID: 52.7% vs. during-COVID: 60.5%; $p = .041$), while significantly more patients were HIV coinfected pre-COVID (pre-COVID: 53.8% vs. during-COVID: 23.3%; $p < .001$). Significantly more patients had significant liver fibrosis/advanced chronic liver disease (F2/3/4) during COVID (pre-COVID: 36.3% vs. during-COVID: 54.0%; $p = .009$). Furthermore, the median duration from HCV diagnosis to DAA therapy initiation was numerically longer during COVID (pre-COVID: 1.3 years vs. during-COVID: 4.7 years; $p = .273$).

3.2 | DAA therapy initiations and SVR rates over the course of the COVID-19 pandemic (Tables 1 and 2; Figures 1 and 2)

In total, 69 and 60 DAA therapies were initiated in 2020 and in 2021, respectively, which means that DAA therapy starts declined (vs. 2019) by 24.2% in 2020 and by 34.1% in 2021. As compared with h1/2019 (i.e. 01 January 2019–30 June 2019), DAA therapy initiations declined almost by half (−45.9%) during the first half year of the COVID-19 pandemic (h1/2020). Interestingly, there was a subsequent marked increase of DAA therapy initiations during h2/2020 (i.e. 01 July 2020–31 December 2020; 120% compared with h2/2019), before the number of DAA therapy starts decreased again to levels considerably lower than pre-COVID-19 (h1/2021 and h2/2021: 65.6% and 66.7% compared with h1/2019 and h2/2019, respectively). There were no significant differences

TABLE 1 Characteristics of HCV patients undergoing DAA therapy pre-(01 January 2019–31 December 2019) and during-(01 January 2020–31 December 2021) COVID-19.

Patient characteristics	Pre-COVID ($n = 91$)	During-COVID ($n = 129$)	p-value
Sex, male/female (% male)	69/22 (75.8%)	88/41 (68.2%)	.219
Age, years (IQR)	43.6 (15.7)	44.6 (19.8)	.584
Genotype			.142
GT 1, *n* (%)	60 (65.9%)	89 (69.5%)	
GT 2, *n* (%)	3 (3.3%)	2 (1.6%)	
GT 3, *n* (%)	19 (20.9%)	33 (25.8%)	
GT 4, *n* (%)	9 (9.9%)	4 (3.1%)	
Transmission			**.041**
IVDU, *n* (%)	48 (52.7%)	78 (60.5%)	
MSM/Sexual transmission, *n* (%)	23 (25.3%)	18 (14.0%)	
Unknown, *n* (%)	14 (15.4%)	30 (23.3%)	
Other, *n* (%)	6 (6.6%)	3 (2.3%)	
HCV hotline users, *n* (%)	60 (65.9%)	123 (95.3%)	**<.001**
Sustained viral response, *n* (%)	77 (84.6%)	111 (86.0%)	.767
Fibrosis stage			.053
F0/1, *n* (%)	58 (63.7%)	57 (44.3%)	
F2, *n* (%)	12 (13.2%)	31 (24.0%)	
F3, *n* (%)	9 (9.9%)	13 (10.1%)	
F4, *n* (%)	12 (13.2%)	23 (17.8%)	
Unknown, *n* (%)	0 (0.0%)	5 (3.8%)	
F2/3/4, *n* (%)	33/91 (36.3%)	67/124 (54.0%)	**.009**
Duration from HCV diagnosis to DAA therapy initiation, years (IQR)	1.3 (14.9)	4.7 (15.7)	.273
HIV coinfection, *n* (%)	49 (53.8%)	30 (23.3%)	**<.001**
Alcohol abuse, *n* (%)	22 (24.2%)	32 (24.8%)	.915

Abbreviations: DAA, direct acting antiviral; GT, genotype; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IVDU, intravenous drug use; MSM, men who have sex with men.

Bold indicates are Significant *p*-values.

TABLE 2 Direct acting antiviral (DAA) therapy initiations, sustained virological response (SVR) rates and hepatitis C virus (HCV) hotline statistics during the COVID-19 pandemic (i.e. 01 January 2020–30 June 2020 [h1/2020], 01 July 2020–31 December 2020 [h2/2020], 01 January 2021–30 June 2021 [h1/2021] and 01 July 2021–31 December 2021 [h2/2021]). Data presented as absolute values and relative to the respective time periods before the pandemic (first or second half of 2019).

Parameter	h1/2020	h2/2020	h1/2021	h2/2021
DAA treatment starts, *n* (%)	33 (54.1%)	36 (120.0%)	40 (65.6%)	20 (66.7%)
SVR, *n* (%)	32 (61.5%)	30 (144.0%)	33 (76.9%)	16 (64.0%)
HCV hotline				
Phone calls, *n* (%)	493 (54.8%)	794 (130.4%)	781 (86.9%)	162 (26.6%)
Text messages, *n* (%)	246 (54.2%)	419 (392.3%)	462 (101.7%)	185 (51.5%)
Voice mails, *n* (%)	93 (167.4%)	81 (118.0%)	258 (388.4%)	187 (300.0%)

in transmission route, HCV GT or liver fibrosis stage throughout the pandemic. However, the prevalence of alcohol abuse varied with the highest number in h1/2021 (50.0%, $n = 20/40$; $p < .001$).

84.6% ($n = 77/91$) of patients undergoing DAA therapy achieved SVR pre-COVID. SVR rates remained on similar levels throughout the pandemic (h1/2020: 97.0% [$n = 32/33$]; h2/2020: 83.3% [$n = 30/36$]; h1/2021: 82.5% [$n = 33/40$]; h2/2021: 80.0% [$n = 16/20$]). The reasons for not reaching SVR during the COVID-19 pandemic included patients being lost to follow-up (10.9%; $n = 14/129$) and virological non-response (3.1%; $n = 4/129$). When excluding patients lost to follow-up and one patient, who died

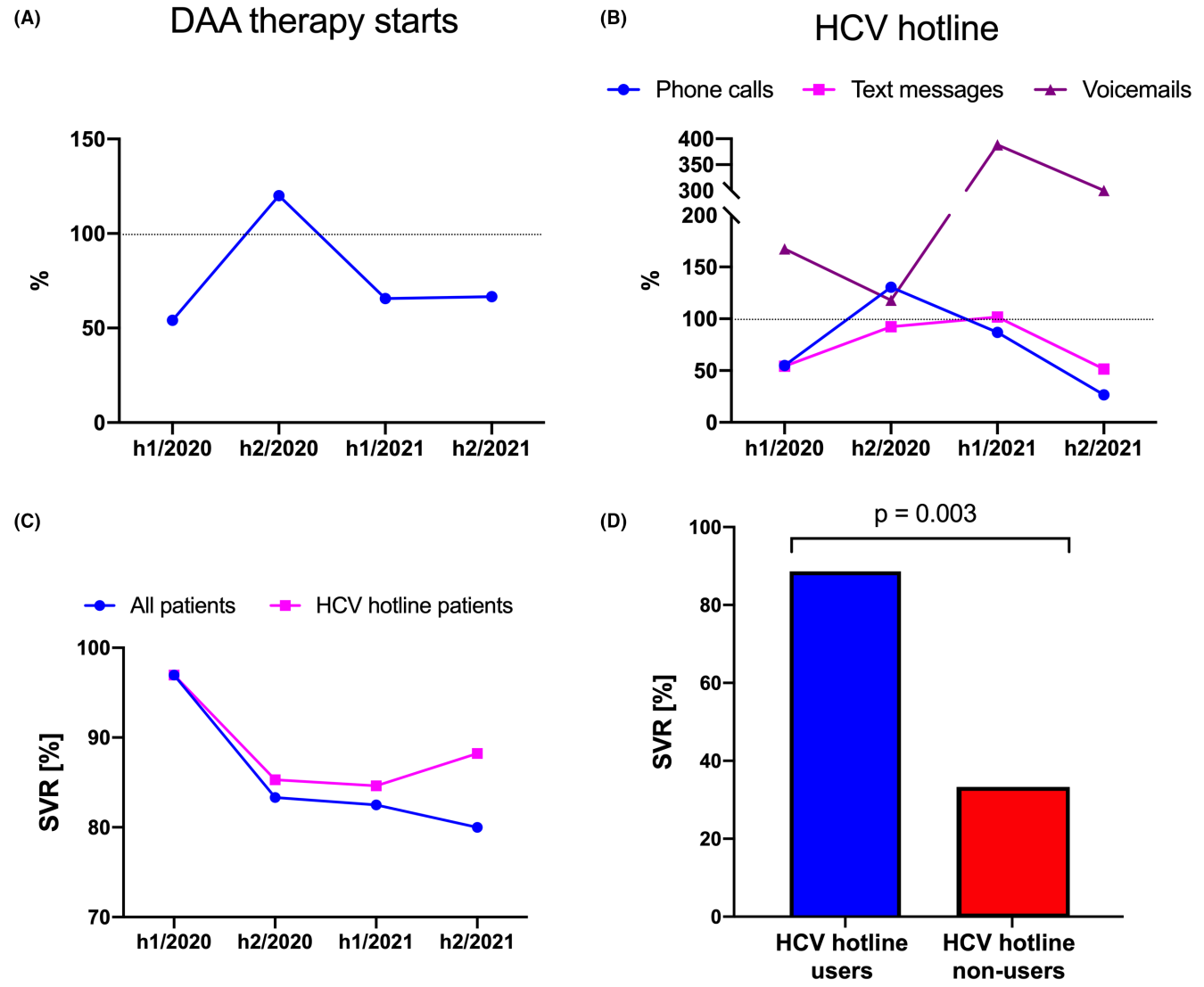

FIGURE 1 Evolution of (A) DAA treatment starts, (B) HCV hotline phone calls, text messages and voicemails over the course of the COVID-19 pandemic (i.e. 01 January 2020–30 June 2020 [h1/2020], 01 July 2020–31 December 2020 [h2/2020], 01 January 2021–30 June 2021 [h1/2021] and 01 July 2021–31 December 2021 [h2/2021]) relative to the respective time periods before the pandemic (01 January 2019–31 December 2019). (C) Percentage of sustained virologic response (SVR) shown for all HCV patients and for the subgroup of patients managed via the HCV hotline (HCV hotline users) over the course of the COVID-19 pandemic. Panel (D) shows the comparison of SVR rates between patients using (HCV hotline users) and not using the HCV hotline (HCV hotline non-users).

before SVR determination, per-protocol SVR rates were 98.1% pre-COVID and 96.9% during-COVID.

3.3 | Comparison of HCV hotline use prior to and during COVID-19 (Tables 1 and 2; Figure 1)

Importantly, a significantly larger proportion of patients used the HCV hotline during-COVID (pre-COVID: 65.9% vs. during COVID: 95.3%; $p < .001$). Of note, during the first half year of the pandemic (h1/2020), all patients made use of the offered HCV hotline ($n = 33/33$).

Parallel to reduced numbers of DAA therapy starts, phone calls as well as text messages sent from and received by the HCV hotline declined by almost 50% during the initial phase of the pandemic compared with the corresponding time span of 2019 (h1/2020: phone calls: 54.8% [$n = 493$], text messages: 54.2% [$n = 246$]), before considerably increasing in h2/2020 (phone calls: 130.4% [$n = 794$], text messages: 392.3% [$n = 419$], compared with h2/2019). In 2021, HCV hotline phone calls and text messages decreased again (h1/2021: phone calls: 86.9% [$n = 781$], text messages: 101.7% [$n = 462$]), with particularly low numbers in h2/2021 (phone calls: 26.6% [$n = 162$], text messages: 51.5% [$n = 185$]).

Interestingly, received and left voicemails were frequent throughout the pandemic, but especially during 2021 with the number of voicemails being more than three times higher than pre-COVID (h1/2021: 388.4% [$n = 258$]; h2/2021: 300.0% [$n = 187$]).

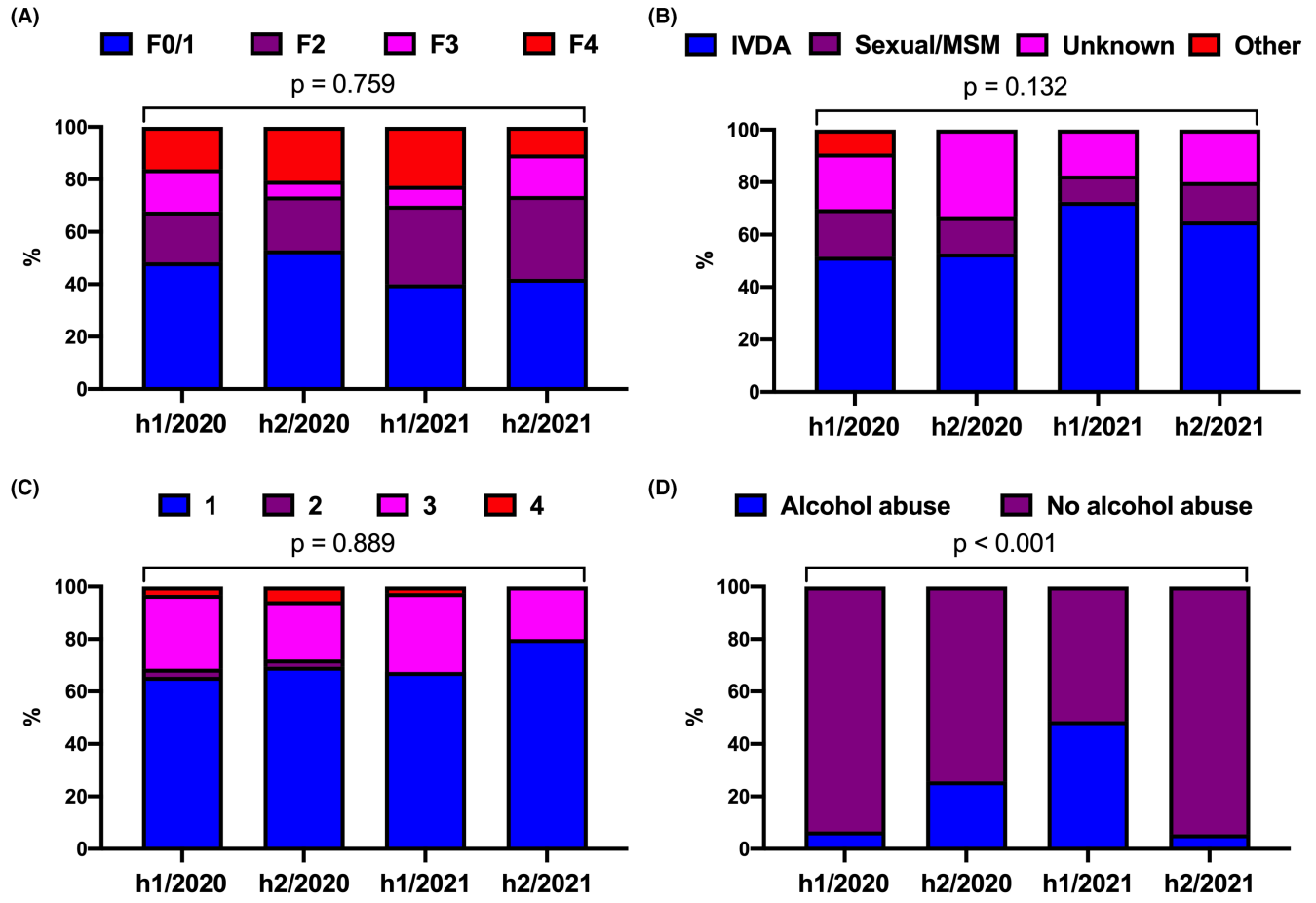

FIGURE 2 Proportion of patients with different (A) fibrosis stages, (B) transmission routes, (C) HCV genotypes and (D) alcohol abuse undergoing DAA therapy over the course of the COVID-19 pandemic (i.e. 01 January 2020–30 June 2020 [h1/2020], 01 July 2020–31 December 2020 [h2/2020], 01 January 2021–30 June 2021 [h1/2021] and 01 July 2021–31 December 2021 [h2/2021]). DAA, direct acting antiviral; IVDU, intravenous drug use; HCV, hepatitis C virus; MSM, men who have sex with men.

3.4 | Comparison of HCV hotline users prior to and during COVID-19 (Table 3; Figure S1)

Interestingly, HCV hotline users were significantly older than HCV hotline non-users pre-COVID (HCV hotline users: 45.6 years vs. HCV hotline non-users: 39.8 years; $p = .046$). The same trend could be observed during-COVID (HCV hotline users: 44.7 years vs. HCV hotline non-users: 38.9 years; $p = .394$). There was no gender difference in the use of the HCV hotline (during COVID: HCV hotline users: 68.3% male vs. HCV hotline non-users: 66.7% male; $p = .999$).

Notably, patients, who did and did not use the HCV hotline did not differ significantly in characteristics indicative of a particularly high risk for non-adherence, such as ongoing or recent IVDU (during-COVID: HCV hotline users: 59.4% [$n = 73/123$] vs. HCV hotline non-users: 83.3% [$n = 5/6$]; $p = .240$) or ongoing alcohol abuse (HCV hotline users: 26.7% [$n = 31/123$] vs. HCV hotline non-users: 16.7% [$n = 1/6$]; $p = .585$) at the time of DAA treatment initiation.

Pre-COVID, the prevalence of HIV coinfection was significantly higher in non-HCV hotline patients (HCV hotline users: 43.3% [$n = 26/60$] vs. HCV hotline non-users: 74.2% [$n = 23/31$]; $p = .005$), while there was no significant difference during COVID-19 (HCV hotline users: 22.0% [$n = 27/123$] vs. HCV hotline non-users: 50.0% [$n = 3/6$]; $p = .112$). During-COVID, the percentage of patients with significant liver fibrosis/advanced chronic liver disease (F2/3/4) was numerically higher among HCV hotline patients (HCV hotline users: 54.6% [$n = 65/119$] vs. HCV hotline non-users: 40.0% [$n = 2/5$]; $p = .585$).

3.5 | Association between HCV hotline use and treatment outcome prior to and during COVID-19 (Table 3; Figure 1)

Importantly, HCV hotline users had higher SVR rates pre-COVID (HCV hotline users: 96.7% [$n = 58/60$] vs. HCV hotline non-users: 61.3% [$n = 19/31$]; $p < .001$) and during-COVID (HCV hotline users: 88.2% [$n = 105/123$] vs. HCV hotline non-users: 33.3% [$n = 2/6$]; $p = .004$). The rate of patients being lost to follow-up was 5 (during-COVID) to 10 (pre-COVID) times higher in HCV hotline non-users (pre-COVID: HCV hotline users: 3.3% [$n = 2/60$] vs. HCV hotline non-users: 32.3% [$n = 10/31$], $p = .823$; during-COVID: HCV hotline users: 8.1% [$n = 10/123$] vs. HCV hotline non-users: 50.0% [$n = 3/6$];

TABLE 3 Patient characteristics of hepatitis C virus (HCV) patients undergoing direct acting antiviral (DAA) therapy pre-(01 January 2019–31 December 2019) and during-(01 January 2020–31 December 2021) COVID-19. Stratification for patients using (HCV hotline users) and patients not using the HCV hotline (non-HCV hotline users).

	Pre-COVID			During-COVID		
Patient characteristics	HCV hotline users ($n = 60$)	Non-HCV hotline users ($n = 31$)	p-value	HCV hotline users ($n = 123$)	Non-HCV hotline users ($n = 6$)	p-value
Sex, male/female (% male)	47/13 (78.3%)	22/9 (71.0%)	.449	84/39 (68.3%)	4/2 (66.7%)	.999
Age, years (IQR)	45.6 (19.3)	39.8 (15.0)	**.046**	44.7 (19.9)	38.9 (15.2)	.394
Sustained viral response, *n* (%)	58 (96.7%)	19 (61.3%)	**<.001**	105 (88.2%)	2 (33.3%)	**.004**
Reasons for SVR non-achievement			.823			.856
Lost to follow-up, *n* (%)	2 (3.3%)	10 (32.3%)		11 (8.9)	3 (50.0%)	
HCV persistence, *n* (%)	0 (0.0%)	1 (3.2%)		3 (2.4%)	1 (16.7%)	
Death, *n* (%)	0 (0.0%)	1 (3.2%)		0 (0.0%)	0 (0.0%)	
Fibrosis stage F2/3/4, *n*/Total *n* (%)	20/60 (33.3%)	13/31 (41.9%)	.419	65/119 (54.6%)	2/5 (40.0%)	.520
HIV coinfection, *n* (%)	26 (43.3%)	23 (74.2%)	**.005**	27 (22.0%)	3 (50.0%)	.112
IVDU, *n* (%)	28 (46.7%)	20 (64.5%)	.106	73 (59.4%)	5 (83.3%)	.240
Alcohol abuse, *n* (%)	10 (32.3%)	12 (20.0%)	.226	31 (26.7%)	1 (16.7%)	.585

Abbreviations: DAA, direct acting antiviral; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IVDU, intravenous drug use.
Bold indicates are Significant *p*-values.

$p = .856$), although the differences did not attain statistical significance due to small sample size.

4 | DISCUSSION

Despite ongoing efforts for HCV elimination, the number of patients initiating DAA therapy declined by approximately 25%–35% during the COVID-19 pandemic in our centre. Our results strongly suggest that an HCV hotline as a telemedical tool facilitates healthcare access for HCV patients, since SVR rates to DAA therapy remained high compared with pre-COVID. This was evidenced by broad utilization of the HCV hotline during-COVID (95.3% of HCV patients undergoing DAA therapy used the HCV hotline), as well as significantly higher rates of SVR among HCV hotline users both pre- and during-COVID.

In 2016, HCV elimination goals were defined by the World Health Organization.[31] However, the achievement of these goals has become considerably more difficult due to the COVID-19 pandemic, which required not only healthcare restrictions, postponement of routine procedures,[7,15] but also re-allocation of healthcare resources,[32] thus slowing down or stopping ongoing programmes for HCV elimination in many centres.[18–20]

Accordingly, the number of DAA therapy initiations in our study decreased by half, particularly during the first half year of the pandemic. This was most likely due to a strict lockdown in Austria, during which most routine visits in the outpatient clinic were cancelled and in-person visits were almost exclusively restricted to acute health issues.[5] Subsequently, there was a resurgence of DAA therapy starts during the second half of 2020 (h2/2020), which were attributed to a backlog of visits, which had to be deferred during the initial phase of the COVID-19 pandemic.[33] Finally, in 2021, the number of DAA therapy initiations settled at a level, which was considerably lower than pre-COVID (34.6% lower in h1/2021 and 33.3% lower in h2/2021), possibly due to remaining barriers for access to healthcare with the requirement of providing recent negative SARS-CoV-2 tests results in order to be granted access to healthcare facilities, as well as recurrent lockdowns due to rising numbers of SARS-CoV-2 infections.[34,35]

Nonetheless, SVR rates remained comparable with pre-COVID, ranging from 80% to 85%, signifying that patient adherence remained unchanged during the pandemic. When patients who had been lost to follow-up were not considered, SVR rates were 98.1% pre-COVID and 96.9% during COVID, confirming high SVR rates to DAA therapy as reported in previous studies.[23,36–38]

A large proportion of patients included in this study were members of high-risk groups for poor adherence.[23–25] Interestingly, the rate of patients with significant liver fibrosis/advanced chronic liver disease (F2/3/4) was higher during-COVID (Figure 3) and the duration from HCV diagnosis to DAA therapy initiation was longer in this cohort with a median duration of almost 5 years until DAA therapy start during-COVID.

Nevertheless, utilization of the HCV hotline, particularly during-COVID pandemic was extremely high with 95.3% of HCV patients undergoing DAA therapy using the hotline. This indicates the need for simple ways to access specialized physicians and healthcare information during times of the pandemic, which is in line with previous studies among CLD patients.[5] This is also supported by the fact that the number of voicemails remained high throughout the COVID-19 pandemic, serving as a means for patients to easily deposit questions or concerns. Moreover, in a time of frequent and profound changes in the organizational framework, the HCV hotline was an

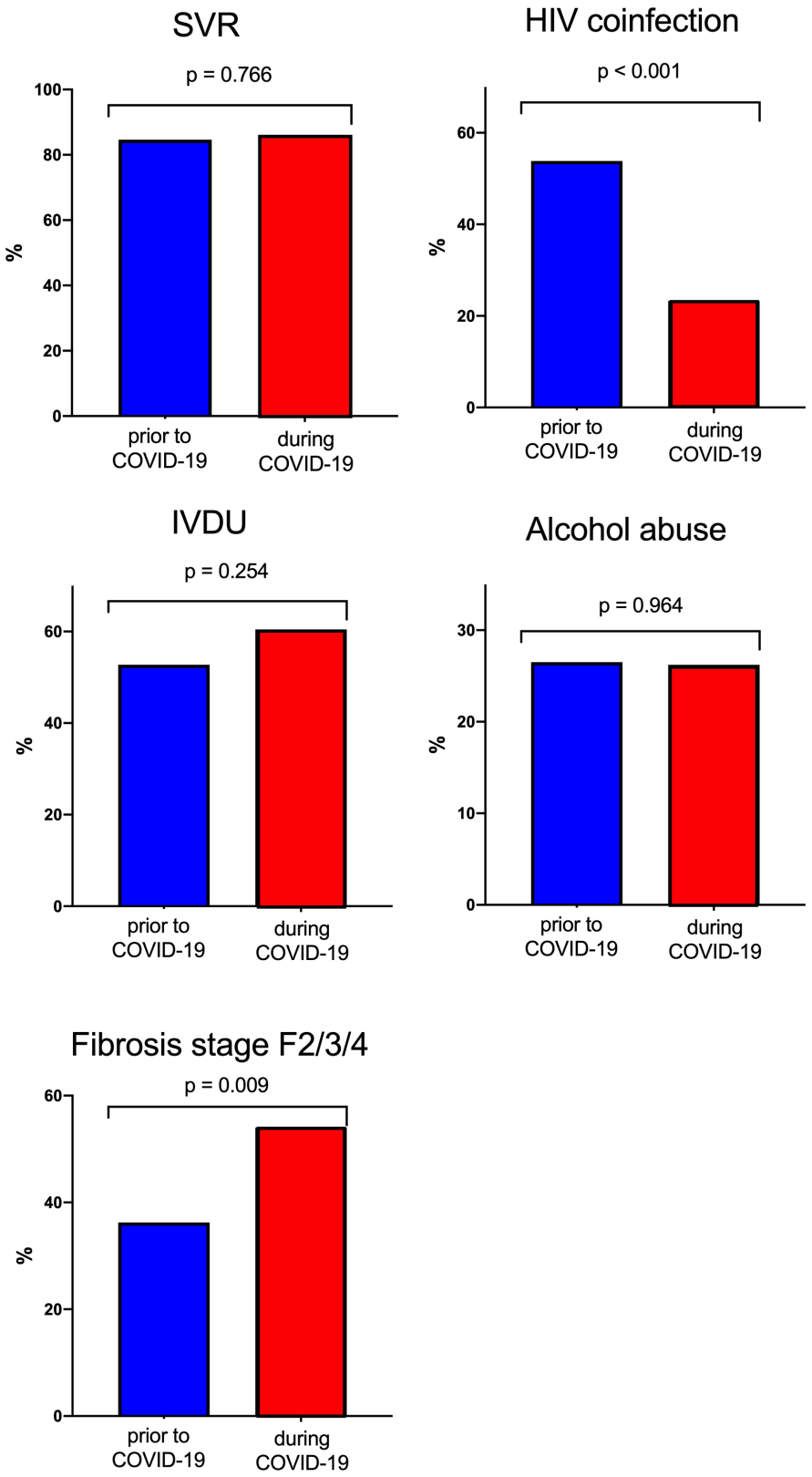

FIGURE 3 Comparison of relative numbers of (A) sustained virologic response (SVR), (B) human immunodeficiency virus (HIV) coinfection, (C) intravenous drug use (IVDU), (D) alcohol abuse and (E) fibrosis stage F2/3/4 among patients undergoing DAA therapy prior to (01 January 2019–31 December 2019) and during (01 January 2020–31 December 2021) the COVID-19 pandemic.

important means for patients to get information on the formal requirements to get access to healthcare facilities. Furthermore, this also shows that access to (smart)phones is widespread even among difficult-to-treat populations of HCV patients with a high prevalence of drug and alcohol abuse.[39,40] Interestingly, HCV hotline users were non-significantly older than HCV hotline non-users, indicating that age was not a factor associated with utilization of the HCV hotline, which is oftentimes a concern for telemedical interventions.[5,41]

Moreover, the positive impact of the HCV hotline on patient adherence in a population of HCV patients at high risk for poor

adherence was evident by the fact that both pre- and during-COVID, the rate of SVR was considerably higher among HCV hotline users. Importantly, patients, who did and did not use the HCV hotline had similar risk factors for poor adherence (i.e. IVDU and alcohol abuse), possibly suggesting that the difference in SVR rates was indeed caused by the low-barrier access to healthcare provided by the HCV hotline. This is also supported by the fact that the number of patients being lost to follow-up was consistently lower (10 times lower pre-COVID and 5 times lower during-COVID) among HCV hotline users. Nevertheless, it has to be acknowledged that loss of follow-up, and thus, inability to confirm SVR does not necessarily exclude HCV cure.

The implementation of telemedicine into the treatment of HCV patients has showed promising results in previous studies[42–44] and may be even more significant during COVID-19.[5,21] Our data show that the establishment of a simple, low-barrier HCV hotline is effective in providing access to healthcare in a difficult-to-treat HCV population.

This study also has limitations. Firstly, due to the retrospective study design, we cannot completely rule out selection bias. However, this was accounted for as good as possible by inclusion of all patients undergoing DAA therapy at our outpatient clinic during the relevant time period. Moreover, this study did not assess the use of the HCV hotline among HCV patients who did not undergo DAA therapy. Thirdly, due to the low numbers of patients without SVR, as well as of HCV hotline non-users, particularly during COVID, the respective results have to be interpreted with caution. Moreover, we did not use a standardized evaluation for the effect of the HCV hotline on patient management. Finally, as we did not assess the overall prevalence of HCV patients in Vienna pre- and during-COVID, we cannot rule out that the decrease in DAA therapies was due to a decrease of HCV prevalence. However, our data are in line with previous studies indicating a slowing down of HCV elimination efforts during the pandemic.[18–20]

In conclusion, the COVID-19 pandemic negatively impacted HCV elimination efforts, as evidenced by less DAA treatment initiations during COVID-19. Importantly, our HCV hotline was used by the overwhelming majority of patients during the pandemic and its use was associated with higher SVR rates both pre- and during-COVID. We strongly believe that the concept of a dedicated HCV hotline represents a valuable tool for telemedicine, since it seems to facilitate treatment adherence and thus increases the chance of SVR and ultimately supports the HCV elimination goals—especially during the COVID-19 pandemic.

AUTHOR CONTRIBUTIONS

All authors contributed either to research design (L.H. and T.R.) and/or the acquisition (L.H., M.J., D.B., D.C, T.B., L.S, B.S., M.M. and T.R.), analysis (L.H. and T.R.) or interpretation (all authors) of data. L.H. and T.R. drafted the manuscript, which was critically revised by all other authors.

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CONFLICT OF INTEREST

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

DECLARATION

The authors have nothing to disclose regarding the work under consideration for publication.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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