Development of an Interdisciplinary Telehealth Model of Provider Training and Comprehensive Care for Hepatitis C and Opioid Use Disorder in a High-Burden Region

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Background: Hepatitis C virus (HCV) and the opioid epidemic disproportionately affect the Appalachian region. Geographic and financial barriers prevent access to specialty care. Interventions are needed to address the HCV-opioid syndemic in this region.

Methods: We developed an innovative, collaborative telehealth model in Southwest Virginia featuring bidirectional referrals from and to comprehensive harm reduction (CHR) programs and office-based opioid therapy (OBOT), as well as workforce development through local provider training in HCV management. We aimed to (1) describe the implementation process of provider training and (2) assess the effectiveness of the telehealth model by monitoring patient outcomes in the first year.

Results: The provider training model moved from a graduated autonomy model with direct specialist supervision to a 1-day workshop with parallel tracks for providers and support staff followed by monthly case conferences. Forty-four providers and support staff attended training. Eight providers have begun treating independently. For the telehealth component, 123 people were referred, with 62% referred from partner OBOT or CHR sites; 103 (84%) attended a visit, 93 (76%) completed the treatment course, and 61 (50%) have achieved sustained virologic response. Rates of sustained virologic response did not differ by receipt of treatment for opioid use disorder.

Conclusions: Providers demonstrated a preference for an in-person training workshop, though further investigation is needed to determine why only a minority of those trained have begun treating HCV independently. The interdisciplinary nature of this program led to efficient treatment of hepatitis C in a real-world population with a majority of patients referred from OBOTs and CHR programs.

Keywords. Hepatitis C virus; Injection drug use; Opioid use disorder; Substance use disorder; Opioid treatment; Healthcare delivery; Nurse navigator; Public health.

Hepatitis C virus (HCV) disproportionately affects people living in the Appalachian region of the United States [1]. Infections with HCV have risen rapidly in this region, particularly among young people [2], driven by the opioid epidemic and injection drug use [3]. People who use drugs and those living in rural regions face significant barriers to HCV treatment and limited access to services [4–9], including in Southwest Virginia [10], which has resulted in very low HCV treatment uptake among rural Appalachian people who inject drugs (PWID) [11, 12].

The presence of direct-acting antivirals (DAAs) has changed the landscape of HCV treatment. DAAs are well tolerated, highly effective, and require as few as 8 weeks of treatment, a stark contrast to earlier interferon-based regimens associated with frequent toxicities, limited effectiveness, and prolonged courses [13]. With the development of DAAs, national goals have been established for the elimination of HCV by 2030 [14]. Unfortunately, rather than moving toward elimination, new HCV infection rates continue to rise [15]. Modeling studies have demonstrated that even if access to DAAs were unlimited and unrestricted, goals for the elimination of HCV will not be achieved without targeting treatment to PWID [16] and incorporating comprehensive harm reduction (CHR) programs along with HCV treatment [17–19]. Although rural Appalachian PWID frequently interact with the health care system [12], they are rarely prescribed medication for HCV [12, 20], owing in part to provider reluctance to treat PWID [21].

Optimal HCV treatment requires care integrated with substance use disorder (SUD) treatment, access to CHR and social services, and close patient follow-up in a setting that is accessible to and

supportive of vulnerable populations [22]. Treatment for HCV and opioid use disorder can be initiated concurrently, with high uptake of treatment for opioid use disorder, and high rates of sustained virologic response (SVR) [23]. Given the presence of simple and effective HCV treatment through DAAs, there has been a push to shift HCV care from specialists based at academic medical centers to primary care providers (PCPs) [24]. With appropriate training, PCPs can achieve HCV treatment outcomes similar to, if not better, than specialists [25, 26]. However, treatment by PCPs has been slow to gain traction [22, 27, 28]. PCPs continue to report barriers to treating HCV, including feeling uncomfortable treating HCV and lacking the requisite treatment knowledge [27, 29]. In addition, the ability of PCPs to provide comprehensive care may be limited, particularly in rural settings where only 3% of rural PCPs are waivered to prescribe buprenorphine for treatment of opioid use disorder [30]. Clinicians who provide office-based opioid therapy (OBOT) also report barriers to providing HCV therapy, despite regular contact with a high-risk and high-prevalence population [31]. New strategies to approach the HCV-opioid syndemic are needed.

The University of Virginia (UVA) is a tertiary care medical center that serves as a referral center for a large portion of the state. Following the traditional model of specialists providing HCV treatment, UVA has successfully treated patients through the gastroenterology and infectious disease specialty clinics with a high overall SVR rate [32] compared with other health systems in the Southeastern United States [33]. However, this success accounted only for those patients who had received diagnoses and been connected to our health system. State epidemiologic data demonstrate that the highest rates of HCV occur in Southwest Virginia [10], a region hundreds of miles distant from the UVA health system yet within our referral region (Figure 1). Unfortunately, the high-burden Southwestern region also has the state's lowest rates of HCV treatment [10] owing to a dearth of specialty providers. Therefore, a clear need exists for increased access to HCV and SUD care in Southwest Virginia.

We developed an interdisciplinary telehealth model of comprehensive care for HCV and SUD in Southwest Virginia with provider training for HCV treatment in a high-burden region (Figure 2). Through partnerships with specialists, PCPs, the Virginia Department of Health (VDH), local health departments with CHR services, clinics, and medication-assisted treatment (MAT) programs, we aim to provide patient-centered care through telehealth and to develop the capacity for local treatment of the HCV-opioid syndemic. Here we (1) describe the implementation of the model of care and (2) evaluate the effectiveness of the telehealth model in successfully treating HCV.

METHODS

Objectives

Our objectives were (1) to implement a comprehensive model of care for people with HCV that overcame existing barriers and included care for SUD, access to CHR services, and connection to routine medical care through telehealth and provider training in HCV treatment and (2) to evaluate the effectiveness of the model in successfully treating HCV, and to assess for disparities in outcomes based on receipt of MAT, presence of an on-site nurse navigator, and Medicaid enrollment. This study was determined to be a quality improvement project, and it met criteria for nonhuman subject research by the UVA Health Sciences Research Institutional Review Board.

Model of Care Development

We developed a telehealth program of HCV care based on the foundation of a pre-existing HIV telehealth model for patients in Southwest Virginia who would not otherwise have access to specialty care. The Karen S. Rheuban Center for Telehealth at UVA (https://uvahealth.com/services/telemedicine) has provided telehealth services to rural Virginia for >2 decades. The robust network of telehealth access points and favorable state statutes relative to provision of and reimbursement for telehealth services [34] make telehealth an appealing option for delivery of HCV care to Southwest Virginia. Successful implementation of telehealth treatment of HCV has been previously demonstrated in the United States through the Extension for Community Healthcare Outcomes (ECHO) program [35]. The UVA team includes a portion of an infectious disease physician's time and a full-time clinical nurse coordinator. The infectious disease physician provides HCV treatment through telehealth and leads provider training. The nurse coordinator is responsible for receiving referrals for telehealth treatment, coordinating patient laboratory studies, imaging, and paperwork required to obtain medication, and guiding patients through the entire treatment process. The nurse coordinator performs community outreach and education to identify providers interested in providing HCV treatment and leads the training of clinician support staff.
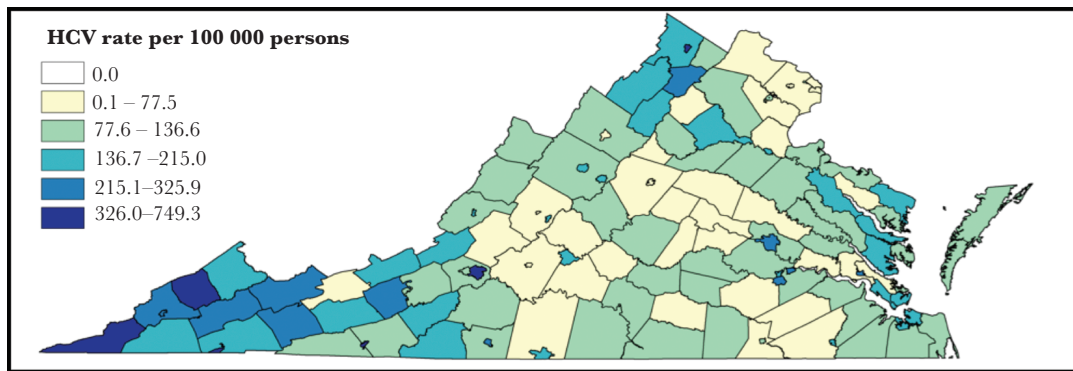
Increasing Capacity Through Provider Training

The aim of provider training was to increase access to HCV care by training local PCPs on HCV treatment, with priority given to those who provide OBOT and those in highest need regions. After initial training, ongoing support and mentoring is delivered through monthly calls where clinical updates or difficult cases are discussed. The training model was developed iteratively, based on participant feedback. Provider training workshops and continuing medical education credit are funded by VDH.
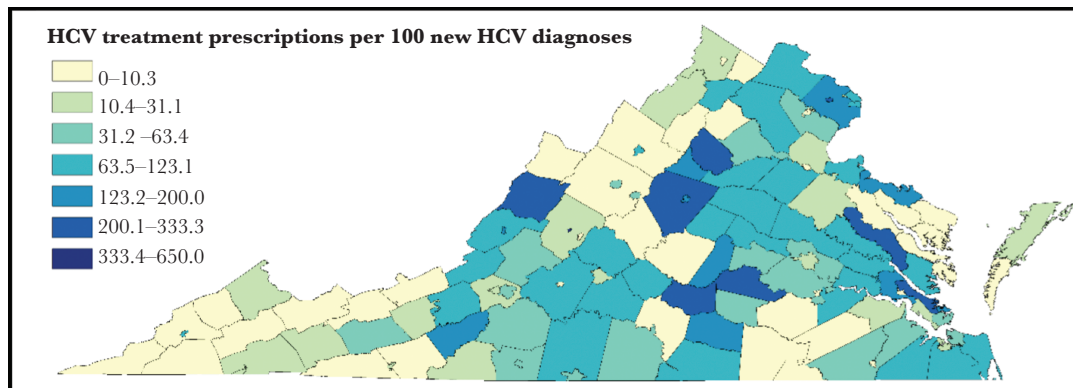
Direct Patient Care Through Telehealth

Telehealth access points are located at the local health department and community health centers. The local health department has a colocated CHR program that includes the state's first syringe services program and an on-site public health nurse who provides patient navigation services. Both the health
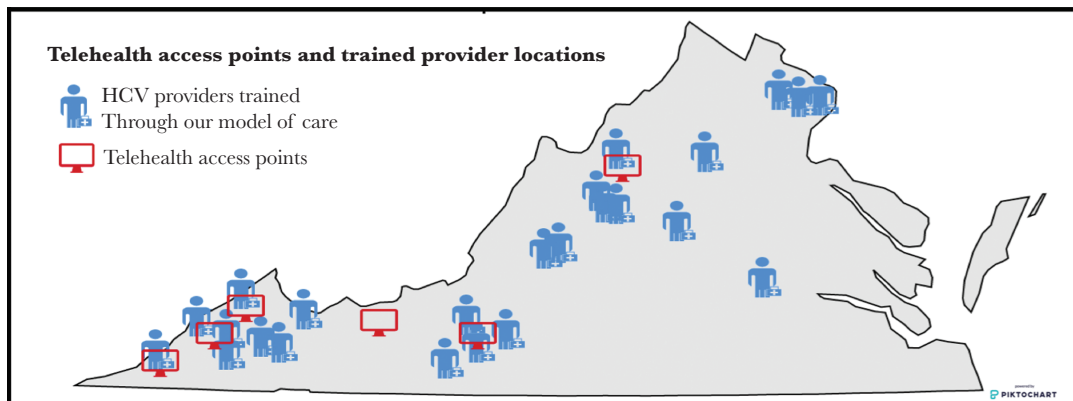
A

HCV rate per 100 000 persons

	0.0
	0.1 – 77.5
	77.6 – 136.6
	136.7 –215.0
	215.1–325.9
	326.0–749.3

B

HCV treatment prescriptions per 100 new HCV diagnoses

	0–10.3
	10.4–31.1
	31.2 –63.4
	63.5–123.1
	123.2–200.0
	200.1–333.3
	333.4–650.0

C

Telehealth access points and trained provider locations

HCV providers trained
Through our model of care

Telehealth access points

Figure 1. Distribution of hepatitis C virus (HCV) cases and treatment within Virginia and the development of access to HCV treatment through telehealth and provider training in areas or highest need. *A,* HCV case rate by city/county in Virginia for 2018, Virginia Department of Health, accessed August 2019. *B,* HCV treatment prescriptions per 100 new HCV diagnoses based on All-Payer Claims Databases for 2014 [10]. *C,* Access to HCV across the state of Virginia provided by our model of care through telehealth access points (n = 6) and providers (n = 36) who have completed HCV training through our program.

department and a local federally qualified health center have providers who provide OBOT and who wanted to receive training to treat HCV. Existing partnerships with specialty pharmacies were expanded to include provision of HCV treatment.

The only requirement for referral is a positive HCV antibody test and referral to a participating site (ClinicalTrials.gov NCT 21167). After referral, the nurse coordinator assists in managing required laboratory testing and paperwork, as well as performing liver staging using a mobile FibroScan (https://echosens.us/), because there is no local access to radiographic staging of liver disease. A VDH-sponsored program covers laboratory testing, because local health departments and other community-based screening programs rarely have financial support for confirmatory HCV viral load testing. The type of medication prescribed is influenced by the patients' insurance coverage and other medical conditions. For patients who are uninsured, the nurse
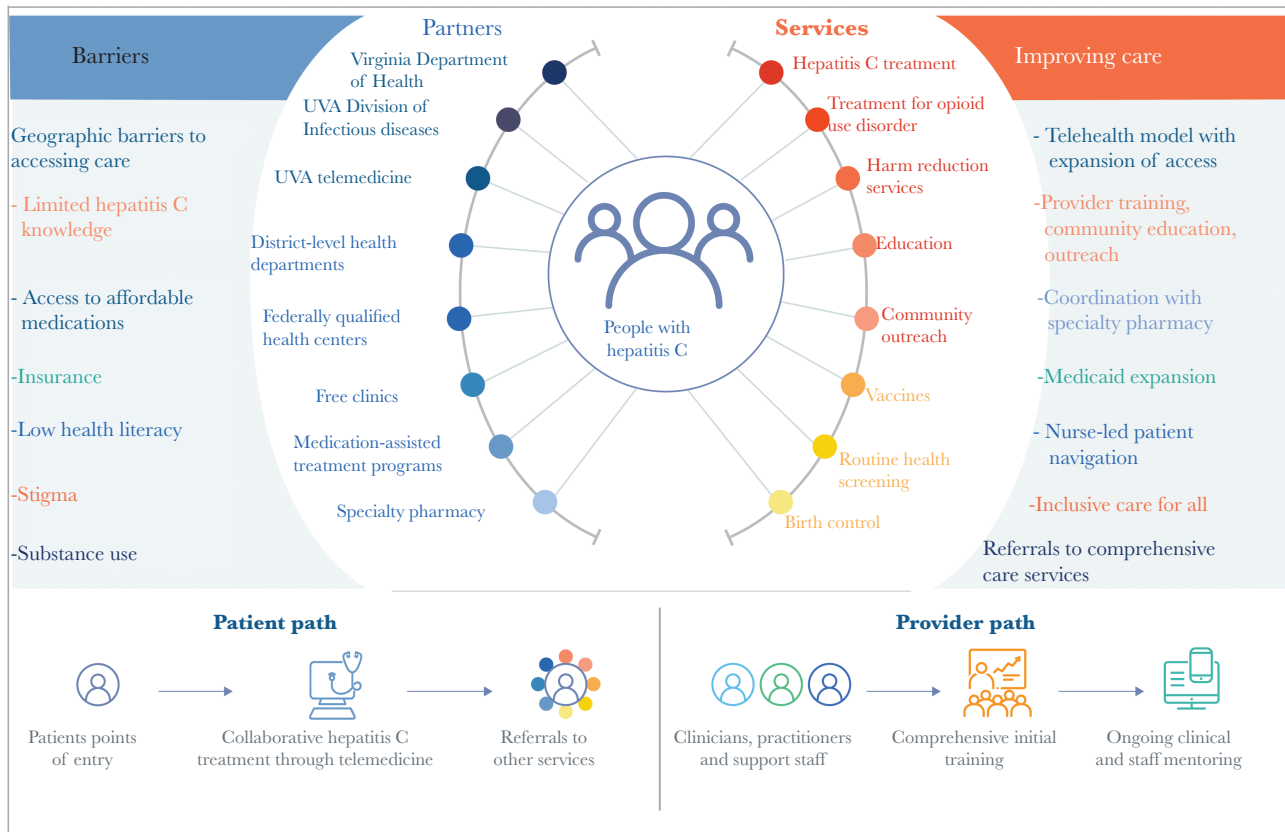
Figure 2. Model of comprehensive care for hepatitis C virus (HCV) and opioid use disorder (interdisciplinary telehealth model including provider training in a high-burden region). Abbreviation: UVA, University of Virginia.

coordinator assists in applying for Medicaid; if patients are determined to be noneligible, the nurse coordinator works with pharmaceutical patient assistance programs to ensure medication access. Medicaid was expanded in Virginia in January 2019 to include adults who earn <138% of the federal poverty level. Medicaid in Virginia covers DAAs regardless of liver fibrosis stage [36], although staging is still required for medication approval, given its importance for determining type and length of therapy and need for additional referrals.

Patients found to have advanced liver disease are referred to a hepatologist for comprehensive liver care [13]. All patients are offered hepatitis A and B vaccinations as well as referrals to additional services, including CHR, MAT, screening for sexually transmitted infections, pre-exposure prophylaxis for HIV, and family planning. Our model of care requires a total of 3 patient visits: the first is a nurse visit for completion of diagnostic studies; the second, a telehealth visit with the HCV provider; and the third, a follow-up nurse visit with viral load testing at 12 weeks after completion of therapy (SVR at 12 weeks [SVR12]), which serves as a determination of cure.

Effectiveness of the Telehealth Model

To monitor the effectiveness of this treatment model, we developed a cascade of care comprising the following steps: (1) referral for treatment, (2) attendance of initial telehealth specialist appointment, (3) completion of all diagnostic testing, including staging of liver disease, (4) prescription of medication, (5) insurance approval of medication, (6) medication started by the patient, (7) medication course completed, (8) posttreatment HCV viral load measured ≥12 weeks after treatment completion, and (9) achievement of SVR12.

Data Collection and Statistical Analyses

The population evaluated is all patients with active HCV referred to the telehealth treatment program during the program's initial 12 months (1 June 2018 to 31 May 2019). Follow-up data were measured through 15 February 2020. As part of routine clinic care, the nurse coordinator developed a clinical database tracking the cascade steps and date of completion, used to determine time to completion for each step. The following patient characteristics were obtained from the patient database: demographic variables, including age, sex, race, and ethnicity; insurance coverage; enrollment in and type of MAT; telehealth

location; genotype and fibrosis score; and treatment, including type of medication prescribed and duration.

As part of the evaluation of the model, we aimed to compare progress along the cascade and time to completion of cascade steps by receipt of MAT, presence of an on-site nurse navigator, and Medicaid status, hypothesizing that each of these factors could influence HCV care. Proportions were compared using χ^2 tests with Fisher exact tests if indicated. Times to step completion were compared using the Mann-Whitney test, owing to nonnormal distribution.

RESULTS

Implementation—Provider Training

The provider training model required modification based on feedback from clinic teams (Figure 3). Initially, based on discussions with local PCPs, we developed a graduated autonomy model of training, similar to previously implemented models [37]. However, this model was unsuccessful owing to the practical challenges of coordinating schedules for observing and performing visits with the specialist, PCPs, and patients. Providers also indicated a strong preference for in-person as opposed to on-line asynchronous instruction. Therefore, we moved to a 1-day training workshop focusing on provider training. Although the workshop was well received, providers expressed concern about their ability to implement a new treatment program without trained support staff, leading to the third phase. In the current iteration, providers and support staff
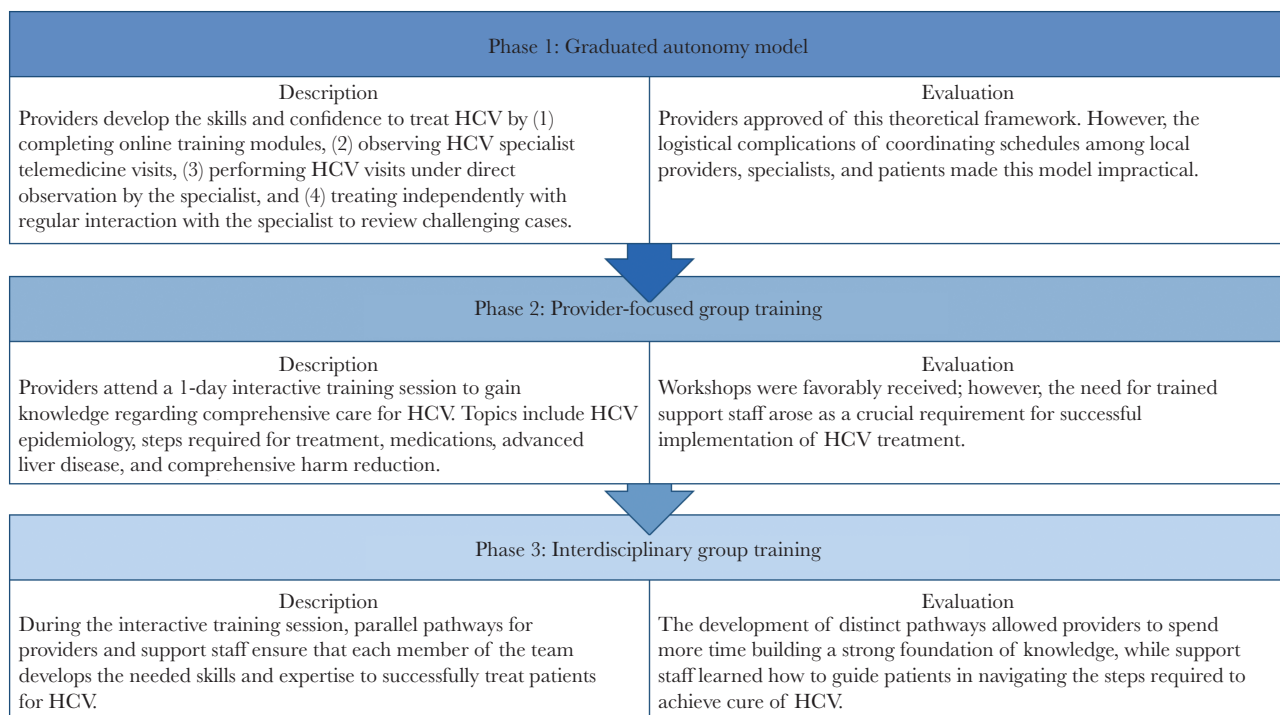
follow parallel tracks during a 1-day training session. Providers gain in-depth knowledge about the clinical management of HCV, while support staff learn the practical details related to the process of accessing medication and patient navigation.

Thirty-six providers and 8 support staff have completed HCV training workshops. They will serve patients in high-need regions of the state (Figure 1). Eight providers have begun treating patients independently, one located at the health department providing CHR services. Initial feedback suggests that enrollment of patients referred from CHR may be increasing owing to the flexible scheduling permitted by an on-site provider.

Patient Outcomes

A total of 123 referred patients with active HCV were included in analyses. An additional 8 patients were referred and found to have negative HCV viral loads indicative of spontaneous clearance and were therefore not included. The mean age was 40.5 years (standard deviation, 10.3 years), with the majority of patients <40 years old (Table 1). Nearly all patients were white and non-Hispanic. The most common insurance was Medicaid (63%), and a quarter of patients were uninsured. Thirty-one of 96 patients (33%) who underwent liver staging had advanced liver fibrosis. Seventy-six patients (62%) were enrolled in MAT, most commonly treated with buprenorphine-naltrexone. Most patients were prescribed glecaprevir-pibrentasvir for an 8-week duration.

Of the 123 referred patients, 103 (84%) linked to care by attending an appointment, 98 (80%) completed all required diagnostic testing, and 93 (76%) were prescribed medication

Phase 1: Graduated autonomy model	
Description	Evaluation
Providers develop the skills and confidence to treat HCV by (1) completing online training modules, (2) observing HCV specialist telemedicine visits, (3) performing HCV visits under direct observation by the specialist, and (4) treating independently with regular interaction with the specialist to review challenging cases.	Providers approved of this theoretical framework. However, the logistical complications of coordinating schedules among local providers, specialists, and patients made this model impractical.

Phase 2: Provider-focused group training	
Description	Evaluation
Providers attend a 1-day interactive training session to gain knowledge regarding comprehensive care for HCV. Topics include HCV epidemiology, steps required for treatment, medications, advanced liver disease, and comprehensive harm reduction.	Workshops were favorably received; however, the need for trained support staff arose as a crucial requirement for successful implementation of HCV treatment.

Phase 3: Interdisciplinary group training	
Description	Evaluation
During the interactive training session, parallel pathways for providers and support staff ensure that each member of the team develops the needed skills and expertise to successfully treat patients for HCV.	The development of distinct pathways allowed providers to spend more time building a strong foundation of knowledge, while support staff learned how to guide patients in navigating the steps required to achieve cure of HCV.

Figure 3. Iterative model of hepatitis C virus (HCV) provider training.

Table 1. Hepatitis C Virus Telehealth Model Patient Characteristics (N = 123)

Characteristic	Patients, No. (%)[a]
Age, mean (SD), y	40.5 (10.3)
Age group, y	
20–29	18 (15)
30–39	46 (37)
40–49	37 (30)
50–59	14 (11)
≥60	8 (7)
Sex	
Female	57 (46)
Male	66 (54)
Race/ethnicity	
White, non-Hispanic	122 (99)
Black, non-Hispanic	1 (1)
Insurance status	
Medicaid	78 (63)
Medicare	8 (7)
Private	6 (5)
Uninsured	31 (25)
MAT	
Any MAT	76 (62)
Buprenorphine-naloxone	65 (53)
Methadone	5 (4)
Naltrexone (extended release)	5 (4)
Buprenorphine	1 (1)
None	47 (38)
Telemedicine location	
Health departments	
FQHC	67 (54)
Free clinic	44 (36)
HCV genotype	12n(10)
1	84 (68)
2	15 (12)
3	19 (15)
Unable to determine[b]	5 (4)
Fibrosis score (n = 96)	
F0/F1	59 (61)
F2	6 (6)
F3	17 (18)
F4	14 (15)
Medication prescribed[c] (n = 93)	
Glecaprevir-pibrentasvir	73 (78)
Ledipasvir-sofosbuvir	19 (21)
Sofosbuvir-velpatasvir	2 (2)
Treatment duration[c] (n = 93)	
8 wk	74 (80)
12 wk	19 (20)

Abbreviations: FQHC, federally qualified health center; HCV, hepatitis C virus; MAT, medication-assisted treatment; SD, standard deviation.

[a]Data represent no. (%) of patients unless otherwise specified.

[b]Genotype could not be determined if viral load was below threshold required for genotype testing.

[c]The type of medication prescribed and the duration of treatment were determined by the patients' insurance coverage and other medical conditions.

(Figure 4). Of the 5 patients who completed diagnostic testing but were not prescribed medication, 2 were incarcerated, 2 were lost to follow-up, and 1 declined to apply for Medicaid to access treatment. Medication was approved, initiated, and completed for all those prescribed treatment. Of the 93 patients who completed treatment, 63 have obtained a posttreatment viral load measurement. For 8 patients, posttreatment SVR measurement is not due yet. SVR was achieved in 61 patients, representing 50% of all referred patients and 97% of those evaluated for SVR. There were 2 patients with virologic failure.

Patients receiving MAT progressed along the cascade at rates equivalent to those of patients not receiving MAT, and times to completion of individual steps were similar as well (Table 2). Patients receiving care at a telehealth access location with an on-site nurse navigator had a 50% reduction in time from referral to initial visit compared with those without an on-site nurse navigator (median [interquartile range], 11 [3–27.5] days vs 22 [12–46] days, respectively; $P = .001$). Progression along the cascade and time to completion of individual steps was similar for patients receiving Medicaid compared with all others.

DISCUSSION

This telehealth program in a state with Medicaid expansion and a favorable statutory environment for telehealth led to efficient linkage to HCV care, appropriate clinical evaluation, and prescription and procurement of medication among a real-world population with previously limited access to HCV care and high rates of SUD. The results of the first year of this program demonstrate that HCV treatment through telehealth can successfully reach high-risk populations when a comprehensive collaboration is developed that includes (1) coordination with the state health department to target programming and funding to the areas most affected by the HCV-opioid syndemic; (2) appropriate clinical staffing, including nurse coordinators; and (3) partnerships with local health departments, SUD treatment centers, and safety net clinics.

Overall linkage to care occurred at a high rate, particularly for a real-world model of care targeting a population that historically has faced geographic barriers and limited access to HCV care [32, 38–41]. Telehealth technology combined with a full-time nurse coordinator was able to overcome these barriers by decreasing geographic isolation and facilitating care coordination. However, we continue to lose patients at each step in the cascade of care. As calls escalate to simplify the cascade of care [22, 42], a streamlined cascade could simplify the process for patients and expand the pool of providers willing and able to treat patients for HCV. In this clinical cohort, the highest drop-off occurs at time of SVR measurement, resulting in patients who are unaware of treatment outcome and incomplete data at a state level relative to progress addressing the HCV epidemic. Despite laboratory cost coverage, physical distance and poor access to transportation limit patients' ability to return for laboratory testing. This drop-off is not unique to our study [8, 43, 44], suggesting a need for improved access to SVR12 testing. Ensuring Medicaid coverage for transport to a laboratory
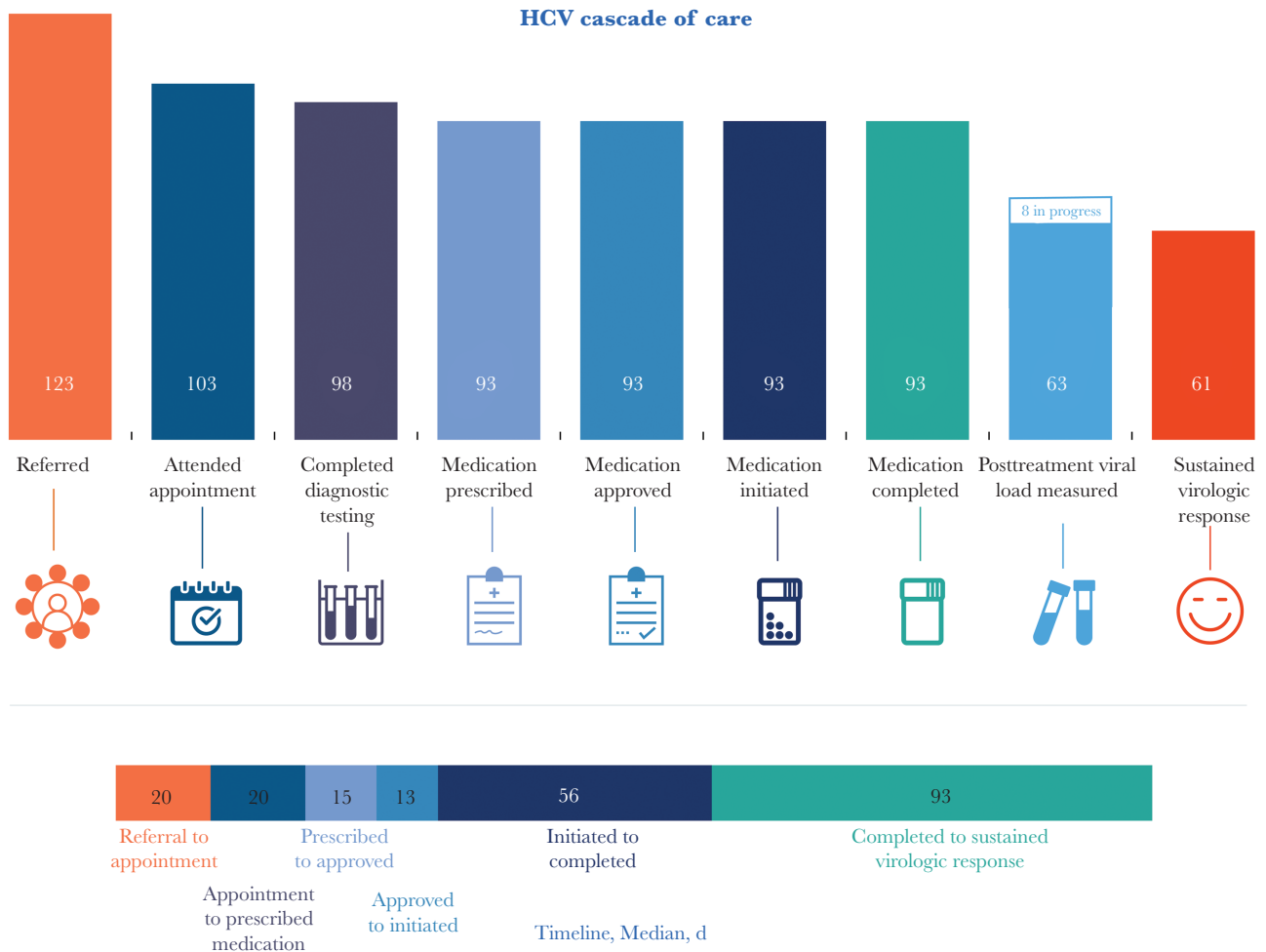
Figure 4. Hepatitis C virus (HCV) telehealth model cascade of care. *Top,* Cascade of care displays the numbers of patients (total N = 123) who completed each step required for treatment of HCV. *Bottom,* Timeline presents the median number of days to step completion. The median time from appointment to completion of diagnostic testing is combined with time from completion of diagnostic testing to prescription of medication, because some participants completed the diagnostic testing before their scheduled appointment.

appointment or coverage of mobile phlebotomy could address transportation barriers. Dried blood spot HCV testing may offer an option for shipping samples that could overcome transportation barriers [45].

The majority of our patients are enrolled in MAT programs. These patients had rates of progression along the cascade similar to those of patients not receiving MAT. This findings support recent studies demonstrating that patients receiving MAT have success in HCV treatment comparable to that of patients not receiving MAT [46]. Although we offer referrals to and receive referrals from a CHR program, patients who participated in CHR were not specifically tracked.

The presence of an on-site nurse navigator at a local health department led to a 50% reduction in time from referral to the initial telehealth visit. Although we saw rates of progression along the cascade similar to that of patients without a local nurse navigator, this early finding may suggest a benefit to local

nurse navigators. Public health settings and local health departments are well situated to provide comprehensive patient care for people with HCV in high-burden rural areas. In addition to trained health department–based PCPs who can deliver on-site HCV treatment along with vaccination services, family planning, pre-exposure prophylaxis, and sexually transmitted infection screening, treatment, and prevention, there are public health nurses who can facilitate patient navigation. Prior qualitative studies have demonstrated that engaging PWID in HCV care requires more than a single visit [47], and a local nurse presence provides an opportunity to develop a therapeutic relationship.

Insurance prior authorizations have been a major barrier to HCV treatment in the DAA era, with frequent insurance denial of treatment requiring appeal [48], diversion of clinical staff time to insurance paperwork [49], and delays between time of prescription and approval [50]. Together, these logistical barriers to medication access place a significant burden on staff that may

Table 2. Progression Along the Cascade of Care Stratified by Receipt of Medication-Assisted Treatment, Presence of On-Site Nurse Navigator at Telehealth Location, and Medicaid Insurance

Patient Category	Patients Completing Cascade Step, No. (%)			Time From Referral to Initial Visit, Median (IQR), d
	Attended Visit	Completed Medication	SVR	
All patients (N = 123)	103 (84)	93 (76)	61 (50)	17.5 (5–33)
MAT				
Yes (n = 76)	65 (86)	57 (75)	39 (51)	17.5 (6–33)
No (n = 47)	38 (81)	36 (76)	22 (47)	17 (5–34)
On-site nurse navigator				
Yes (n = 57)	49 (86)	46 (81)	26 (46)	11 (3–27.5)[a]
No (n = 66)	54 (82)	47 (71)	35 (53)	22 (12–46)[a]
Medicaid				
Yes (n = 78)	64 (83)	61 (79)	41 (53)	16 (5–31)
No (n = 45)	39 (85)	32 (70)	20 (43)	20 (7–37)

Abbreviations: IQR, interquartile range; MAT, medication assisted treatment; SVR, sustained virologic response.

[a] $P = .001$ for time from referral to initial visit based on presence of on-site nurse navigator. No differences were seen in time from referral to initial visit based on MAT or Medicaid status. No significant differences were seen in rates of completion of cascade steps based on receipt of MAT, on-site nurse navigator, or Medicaid status, using χ^2 tests to compare proportions.

limit clinics' ability to institute and scale up HCV treatment [49]. Historically, this burden has fallen most heavily on Medicaid patients [51] and may contribute to the observation that Medicaid patients have been less likely to link to care and receive treatment for HCV [39, 52]. In our model, progression along the cascade was similar for those on Medicaid compared with other types of insurance, probably owing to the full-time telehealth nurse coordinator who is expert at navigating the process of obtaining DAAs. Further reduction of HCV treatment restrictions for Medicaid patients [36] could alleviate the paperwork burden, streamline care, and enhance equity of access to HCV treatment. Reduced paperwork will allow skilled nursing or navigator time to be targeted to coordinating care with patients.

Improvements in access to comprehensive HCV treatment in high-burden areas require improved workforce capacity to deliver DAAs. However, as noted above, training medical providers is not sufficient for the development of local treatment programs. Support staff involvement is critical. Peers, people with prior experience with HCV treatment and/or substance use, may be an additional source of patient support, especially in areas where peer services are supported through state Medicaid programs [53]. However, at this time, results related to the success of peer support programs for HCV care are mixed [11, 31, 54].

We acknowledge limitations in the evaluation of our model. To truly eliminate HCV in the Southwest Virginia, efforts aimed at increasing testing would be needed. This model begins with patients whose HCV is already diagnosed. In addition, data reported are preliminary findings. We have presented all available data. However, many patients are continuing to progress along the cascade, and we anticipate ultimate cure rates to be higher than presented. Moreover, policy issues, including telehealth laws and reimbursement, Medicaid expansion, and the commitment of VDH to invest in this pilot program have led to the success of our model. Replication of this model elsewhere requires engagement with these policy issues on community and state levels.

A telehealth model can successfully provide HCV treatment and increase the workforce to move toward a goal of reducing disparities in HCV treatment access. This is a key opportunity for academic institutions in states with favorable policy environments.

Notes

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