2019

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Impact of Availability of Telehealth Programs on Documented HIV Viral Suppression: A Cluster-Randomized Program Evaluation in the Veterans Health Administration

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Background. Telehealth may improve care for people with HIV who live far from HIV specialty clinics. We conducted a cluster-randomized evaluation to determine the impact of availability of HIV telehealth programs on documented viral suppression in Veterans Administration clinics.

Methods. In 2015–2016, people who previously traveled to HIV specialty clinics were offered telehealth visits in nearby primary care clinics. Patients were cluster-randomized to immediate telehealth availability (n = 925 patients in service areas of 13 primary care clinics offering telehealth) or availability 1 year later (n = 745 patients in 12 clinics). Measures during the evaluation year included telehealth use among patients in areas where telehealth was available and documented HIV viral suppression (viral load performed and <200 copies/mL). Impact of telehealth availability was determined using intention-to-treat (ITT) analyses that compared outcomes for patients in areas where telehealth was available with outcomes for patients where telehealth was not available, regardless of telehealth use. Complier average causal effects (CACEs) compared outcomes for telehealth users with outcomes for control patients with equal propensity to use telehealth, when available.

Results. Overall, 120 (13.0%) patients utilized telehealth when it was available. Availability of telehealth programs led to small improvements in viral suppression in ITT analyses (78.3% vs 74.1%; relative risk [RR], 1.06; 95% confidence interval [CI], 1.01 to 1.11) and large improvements among telehealth users in CACE analyses (91.5% vs 80.0%; RR, 1.14; 95% CI, 1.01 to 1.30).

Conclusions. Availability of telehealth programs improved documented viral suppression. HIV clinics should offer telehealth visits for patients facing travel burdens.

Keywords. HIV; randomized trial; telehealth; veterans.

In the United States, health care for people with HIV infection has historically been concentrated in HIV specialty clinics in large urban areas [1, 2]. This specialized and centralized delivery system promotes high-quality care for patients with a complex and stigmatized condition, but also creates poor geographic access to care for patients in outlying suburban and rural areas far from specialty clinics [1, 3]. Telehealth programs have potential to improve access to HIV specialty care in outlying areas, which could in turn improve retention in care and treatment outcomes [4, 5]. The available evidence indicates that telehealth programs deliver high-quality HIV care, but prior studies have been small, suffered from selection bias, or lacked a control group [6, 7].

The Veterans Affairs (VA) health care system is the largest provider of HIV care in the United States and provides an opportunity to conduct large, randomized evaluations of HIV telehealth programs [8]. Most veterans with HIV who live in outlying suburban and rural areas travel to obtain care in HIV specialty clinics in large urban facilities, with 21% traveling more than 1 hour each way [6]. In response, some VA health care systems have implemented HIV telehealth programs that give patients the opportunity to receive HIV specialty care in primary care clinics closer to their homes, instead of traveling to the central HIV specialty clinic.

Received 8 January 2019; editorial decision 24 April 2019; accepted 29 April 2019.

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Open Forum Infectious Diseases®

Published by Oxford University Press on behalf of Infectious Diseases Society of America 2019.

DOI: 10.1093/ofid/ofz206

We conducted a cluster-randomized program evaluation in 3 VA health care systems that began HIV telehealth programs in 2015–2016. We randomized groups of patients to the opportunity to use telehealth in primary care clinics closer to their homes, not to actual telehealth use. Our goal was to determine the effectiveness of HIV telehealth programs implemented as quality improvement programs in real-world settings. Specifically, we aimed to determine (1) the frequency of use of HIV telehealth visits among patients offered telehealth instead of traveling to the HIV clinic for care (ie, program uptake); (2) the impact of the availability of telehealth programs on documented HIV viral suppression among all patients offered telehealth; and (3) the impact of telehealth on documented HIV viral suppression among patients who used telehealth when it was made available.

METHODS

Systems redesign teams in the 3 networks implemented HIV telehealth programs as local quality improvement initiatives. A central evaluation team at the Veterans Rural Health Resource Center – Iowa City (VRHRC-IC) measured program impacts on patient outcomes using data routinely collected during health care delivery and stored in VA administrative databases. The evaluation was approved by the Institutional Review Boards (IRBs) at the University of Iowa and Iowa City VA. Local telehealth programs were classified as quality improvement activities by the VA Office of Rural Health and local IRBs.

Local Contexts and Telehealth Programs

Each care network included (1) a centrally located HIV clinic in a large VA facility in an urban area with a population >1 million and (2) 8–9 affiliated VA primary care clinics in surrounding suburban and rural areas 14–114 miles from the HIV clinic. HIV clinics provided comprehensive primary care for people with HIV. Before telehealth programs, people with HIV who lived closer to an outlying primary care clinic than to the HIV clinic traveled to the HIV clinic for all care, with a minority (10%–15%) having any visit history in the nearest primary care clinic.

Teams working to establish HIV telehealth programs in each network included a program coordinator within the HIV clinic (registered nurse, nurse practitioner, or physician assistant), an HIV specialist physician, and a facility telehealth coordinator. Local teams participated in twice-monthly facilitation calls with a team at the VRHRC-IC with experience implementing HIV telehealth programs in the VA. Protocols for telehealth scheduling and visits followed local facility policies. Protocols varied across networks but in all cases involved secure videoconferencing between HIV specialist providers in central HIV clinics and patients in private rooms in primary care clinics. Telehealth visits were conducted by the same providers conducting in-person visits and included the same care elements. Telehealth technicians in primary care clinics obtained vital signs and assisted with use of videoconferencing units and related technology as available to conduct limited physical exams (eg, remote stethoscopes and high-resolution exam cameras for skin and oral exams). Laboratory and in some cases basic radiology facilities were available in primary care clinics.

Patient Cohort and Clinic Randomization

Because resource constraints made it unrealistic to implement HIV telehealth visits in all primary care clinics simultaneously, local teams agreed to random assignment of primary care clinics to immediate initiation of HIV telehealth visits (ie, "intervention clinics") or initiation 1 year later as controls. Assignment of clinics and associated patients to intervention or control status involved 3 steps. First, VRHRC-IC analysts used geographic information system (GIS) software (ArcGIS v10.4, Esri, Redlands, CA) to divide geographic areas served by each of the 3 networks into smaller service areas assigned to each primary care clinic. Each service area consisted of the region that was closer to the assigned primary care clinic than to any other network clinic based on calculated existing road drive times (Figure 1, service area map).

Second, analysts used administrative data to identify patients in care in each HIV clinic in the year before telehealth program initiation and assigned each patient to the nearest primary care clinic based on residential address in the clinic's service area. To minimize travel burden, patients living closer to the HIV clinic than to any primary care clinic (55%–75% across facilities) were not offered telehealth and were thus excluded from the cohort. Criteria for identifying patients in care were (1) any visits to the HIV specialty clinic in the year before telehealth program implementation and (2) International Classification of Diseases 9, Clinical Modification (ICD-9-CM), codes for HIV infection (V08 and 042) at any time in the past.

Finally, primary care clinics (n = 25 total) within each network were pair-matched based on the number of HIV clinic patients assigned to the clinic and the distance between the primary care clinic and the HIV specialty clinic. One clinic in each pair was randomly assigned to immediate initiation of HIV telehealth programs (ie, intervention) or delayed initiation 1 year later (ie, control). Each clinic pair was assigned the same index date for assessing outcomes after telehealth implementation, based on the date the intervention clinic implemented telehealth.

Telehealth Initiation

Each local telehealth coordinator received a list of patients in care in the HIV clinic in the past year with information on the geographically assigned primary care clinic for each patient and the estimated round-trip travel time each patient could save using telehealth instead of traveling to the HIV clinic (ie, twice the difference in drive time to the HIV clinic minus time to

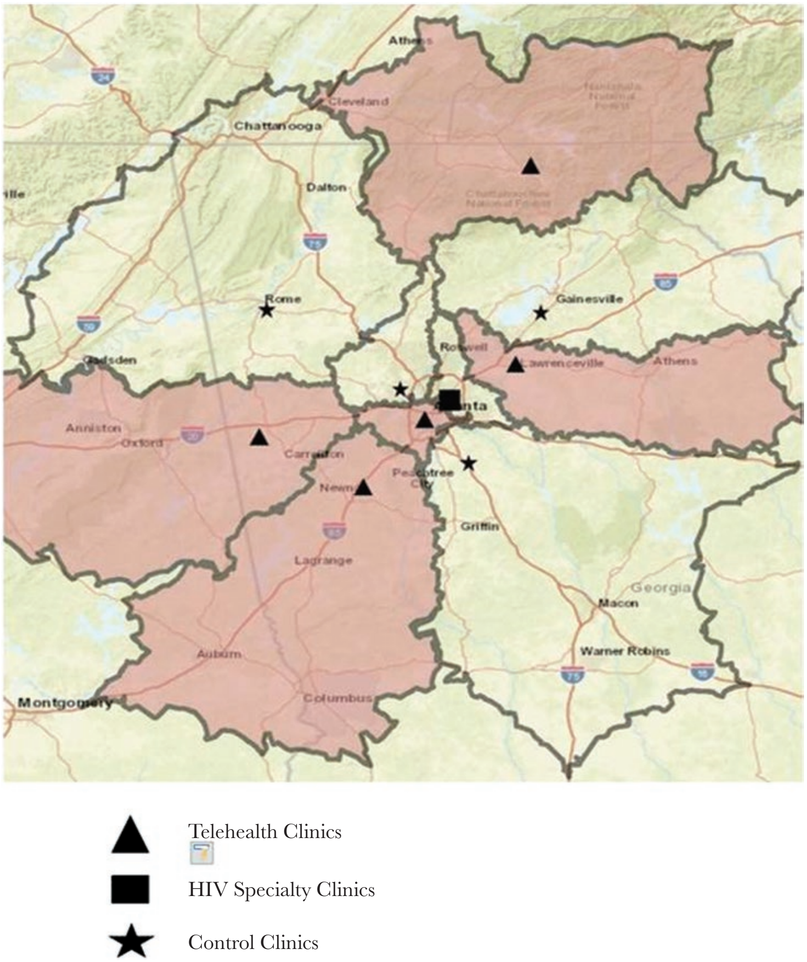

Figure 1. Map showing geographic service areas of 9 primary care clinics in the Atlanta VA network based on existing road drive times. Service areas are irregularly shaped due to variation in road networks. In the baseline year, patients traveled to the HIV specialty care clinic (see map legend) in the main facility for care. In the evaluation year, patients were offered telehealth if they resided in the service area of clinics randomized to host HIV telehealth visits (shaded areas). Patients in these areas were given the option of using telehealth visits in the nearest primary care clinic or continuing to travel to the HIV specialty clinic. Patients in service areas of control clinics (unshaded areas) were offered telehealth at the end of the evaluation year. Patients living closer to the HIV specialty clinic than to a primary care clinic were not offered telehealth and not included in analyses. See the "Methods" section for details.

primary care clinic hosting telehealth visits). Beginning approximately 3 months before HIV telehealth visits became available, program coordinators reached out by telephone or in person to patients living in the service area of telehealth clinics and described the telehealth program, including the estimated travel time the patient could save. Coordinators offered the patient a choice of receiving HIV specialty care through telehealth visits or continuing to travel to the HIV specialty clinic. In keeping with the nature of the quality improvement programs, the only criterion for offering telehealth to patients in the service area of telehealth clinics was that the patient's primary provider in the HIV clinic confirm that telehealth visits were clinically appropriate based on the patient's care needs. Over 90% of eligible patients were offered telehealth according to logs maintained by local coordinators. Patients choosing to use telehealth were scheduled for appointments at previously assigned follow-up intervals, as determined at their last HIV clinic visit. Patients living in the service areas of control clinics were contacted 1 year later—at the end of the evaluation period—and offered telehealth visits in control clinics.

Patient Characteristics and Outcomes

We used data routinely generated during care delivery and included in the VA's Corporate Data Warehouse (eg, patient demographics, residential addresses, stop codes for clinic visits, diagnosis codes, medication prescriptions, and laboratory results) to follow patients assigned to intervention and control clinics from the beginning of the year before telehealth program initiation through the evaluation year. We excluded patients who died during the evaluation year (Figure 2, flow diagram).

We created a series of variables for each patient indicating (1) residence in the service area of a telehealth intervention or control clinic; (2) telehealth use, retention in care, and documented viral suppression in the evaluation year (see below); and (3)

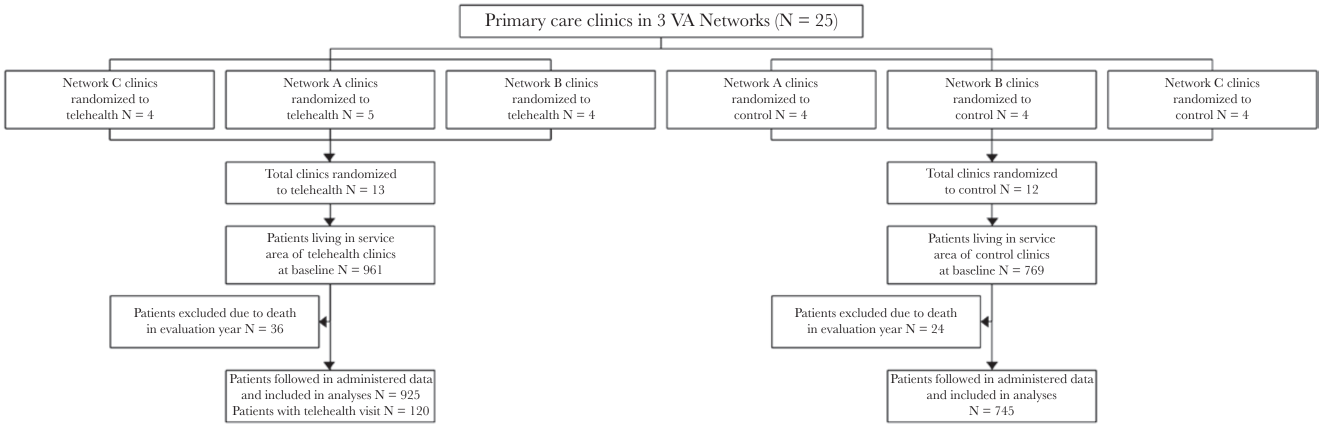

Figure 2. Flowchart showing assignment of 25 primary care clinics and associated patients to telehealth and control status. Primary care clinics were affiliated with 3 HIV specialty care clinics in 3 networks.

risk-adjustment variables describing baseline patient characteristics before telehealth program initiation, including age, sex, race (ie, white, black, other, or missing), time in HIV care in the VA (ie, days from first HIV diagnosis code in the VA to the beginning of the telehealth program), last CD4 count, comorbidities, number of primary care clinic and HIV specialty clinic visits in the prior year, estimated round-trip travel time saved if the patient used telehealth in the nearest primary care clinic instead of traveling to the HIV clinic, urban vs rural residence, and baseline measures for retention in care and viral suppression in the prior year (see below). We used Rural Urban Commuting Area (RUCA) codes linked to ZIP codes to classify patient residences as urban or rural [9] and ICD-9-CM codes and previously defined algorithms to create a series of indicator variables for presence of comorbidities in the prior year (ie, hepatitis C infection, diabetes, hypertension, any cardiovascular disease, depression, malignancy, chronic kidney disease, and alcohol or illicit substance use diagnoses) [10].

To assess telehealth program uptake, we used clinic stop codes to create a binary variable indicating whether each patient used any HIV telehealth visits in the evaluation year and count variables for the number of telehealth and in-person HIV clinic visits. The primary outcome measure for each patient was a binary variable indicating documented viral suppression during the evaluation year based on viral load measurements obtained during routine care delivery and included in administrative data, coded 1 if HIV viral load was measured during the evaluation year and the last viral load was <200 copies/mL, and otherwise 0. We included all patients regardless of record of antiretroviral medication fills; 5.9% of patients in control clinics and 5.3% of patients in telehealth clinics had no antiretroviral fills. We examined documented viral suppression (ie, viral load testing done and <200 copies/mL) among all patients because we sought to examine a comprehensive, pragmatic measure of viral load monitoring and suppression in routine care delivery at a time when antiretroviral therapy was recommended for all patients with monitoring of viral load at least every 6 months.

We measured retention in care during the evaluation year using a dichotomous measure that required 2 HIV specialty clinic visits—either in-person or telehealth—with a provider (ie, MD, physician's assistant, or advanced practiced nurse) during the evaluation year. This is the visit-constancy measure used to track retention in HIV care in the VA [11]. Reliable data on missed clinic visits were not available.

Analyses

We compared baseline characteristics of patients assigned to intervention and control clinics using chi-square tests, adjusting for clustering of patients within clinics. We determined the number and proportion of patients assigned to intervention clinics who had any telehealth visits in the evaluation year, overall and by baseline characteristics, and the median number of telehealth and in-person HIV clinic visits. We fitted a multivariable logistic regression model for associations between baseline patient characteristics and telehealth use.

We examined the impact of availability of telehealth programs on retention in care and documented viral suppression at the population level using intention-to-treat (ITT) analyses. These analyses compared outcomes among all patients assigned to intervention clinics where telehealth was available with outcomes of patients assigned to control clinics, regardless of whether the patient used HIV telehealth visits. ITT analyses employed generalized estimating equations (GEEs) with log links and Poisson distributions to estimate relative risk of viral suppression or retention in care while accounting for patient clustering in primary care clinic service areas. Models included an indicator variable for assignment to a telehealth clinic or control clinic and patient characteristics that were significant predictors of each outcome (eg, age, race, substance abuse diagnosis, baseline measures of the outcome variable, time in HIV care, and indicator variables for facility network).

To determine program impacts among telehealth users, we also estimated the CACE of telehealth on viral suppression and retention in care using principal stratification methods [12]. In these analyses, the propensity of patients assigned to intervention clinics to use telehealth was estimated using logistic regression and observed baseline characteristics (ie, age, race, travel time saved with telehealth visits, primary care clinic utilization in the prior year, VA network, and comorbidities). Coefficients associated with patient characteristics from the logistic regression model were applied to patients in control clinics to estimate the propensity of control patients to have used telehealth had it been it available. Estimated propensities for telehealth use were used to weight intervention and control patients to create a pseudo-population of telehealth users assigned to intervention clinics and nonusers assigned to control clinics who would have been equally likely to have used telehealth had it been available to them. Subsequently, outcomes were compared using weighted GEE models to control for patient clustering in primary care catchment areas.

We used coefficients from the ITT and CACE analyses and the method of recycled predictions to estimate risk-adjusted viral suppression, retention in care, and the absolute difference in each outcome between patients assigned to telehealth vs control clinics [13]. Confidence intervals around relative risk ratios, and risk-adjusted outcome rates and absolute differences were estimated by 1000 bootstrap resamples to estimate the standard deviation of the coefficient associated with the telehealth indicator variable, risk-adjusted outcome rates, and absolute differences. Bootstrapped samples were generated using a 2-part sampling process that involved first sampling the assigned primary care clinics with replacement and then sampling patients with replacement within the selected clinics to account for the variability in the weights.

As telehealth programs could impact documented viral suppression by affecting both the performance of viral load testing and viral suppression among those with viral load testing performed, we also compared the proportions of patients with viral load testing performed during the evaluation year among those assigned to control vs telehealth clinics. We then examined associations between the availability of telehealth programs and viral suppression in analyses limited to patients with viral loads performed during both the baseline year and the evaluation year.

RESULTS

Analyses included 1670 patients in 25 clinics (925 in 13 telehealth intervention clinics and 745 in 12 control clinics). Patients assigned to intervention and control clinics were similar for most characteristics (Table 1), with no differences in baseline retention in care and viral suppression before randomization, comorbid conditions, rural residence, age, sex, or prior use of VA health services. Most (71%) patients in areas of telehealth clinics lived more than 60 minutes' travel time from the HIV clinic, and 27.4% could save more than 60 minutes' travel time using telehealth.

Overall, 120 (13.0%) of 925 patients in service areas of intervention clinics used telehealth in the evaluation year (Table 2). Telehealth use was strongly associated with the amount of travel time a patient could save, ranging from 3.1% of patients saving <15 minutes to 25.3% saving >60 minutes ($P < .001$). White race, rural residence, baseline viral suppression, greater number of primary care visits in the prior year, presence of a hypertension diagnosis, and absence of a substance use, depression, or hepatitis C diagnosis were also associated with telehealth use in bivariable analyses. Associations between patient characteristics and telehealth use were similar in multivariable analysis, with exception of hepatitis C and substance use diagnoses and rural residence (Supplementary Data).

Telehealth users had more total HIV clinic visits than control group patients. Among users, the median number of telehealth visits in the evaluation year (range) was 2 (1–6), and the median number of total HIV clinic visits (ie, combined telehealth and in-person) (range) was 4 (1–9). The median number of total clinic visits in the control group (range) was 3 (0–14; $P = .01$ for Kruskal-Wallis rank-sum test comparing total visits).

The availability of telehealth programs led to small population-level improvements in documented viral suppression in ITT analyses that compared all patients residing in service areas of telehealth clinics with all patients in areas of control clinics (78.3% vs 74.1%; absolute difference, 4.3%; 95% confidence interval [CI], 0.1% to 8.4%; RR, 1.06; 95% CI, 1.01 to 1.11; $P = .01$) (Table 3). There were large improvements in documented viral suppression among telehealth users in CACE analyses (91.5% vs 80.0%; absolute difference, 11.5%; 95% CI, 0.1% to 21.6%; RR, 1.14; 95% CI, 1.01 to 1.30; $P = .03$).

Patients residing in the service areas of telehealth clinics were more likely to have viral load testing performed as part of routine care during the evaluation year compared with patients in the area of control clinics (89.2% vs 83.4%) (Supplementary Data). In sensitivity analyses including only patients with viral load testing during the baseline and evaluation years (n = 1413), neither the availability of telehealth programs (ie, ITT results) nor actual telehealth use (ie, CACE results) was associated with viral suppression (Supplementary Data). This indicates that associations between telehealth programs and documented viral suppression were related to increased performance of viral load testing during routine care with telehealth, not with improved viral suppression among those with testing completed.

Improvement in retention in care was greater in the CACE analyses than in the ITT analyses, but neither reached statistical significance (ITT, 76.1% vs 72.6%; RR, 1.05; 95% CI, 1.00

Table 1. Patient Characteristics, by Residence in Service Area of a Control or Telehealth Intervention Clinic (n = 1670 Patients in 25 Clinics)

Patient Characteristics	Control (n = 745) % (No.)	Telehealth (n = 925) % (No.)	P	Patient Characteristics	Control (n = 745) % (No.)	Telehealth (n = 925) % (No.)	P
Age, y			.936	Baseline CD4 count, cells/mm^3			
<30	5.1 (38)	3.0 (28)		Missing	8.7 (65)	4.1 (38)	.366
30–39	9.3 (69)	10.6 (98)		<200	6.2 (46)	7.7 (71)	
40–49	18.7 (139)	18.2 (168)		200–349	9.5 (71)	11.8 (109)	
50–65	50.9 (379)	54.3 (502)		350–499	18.5 (138)	17.8 (165)	
>65	16.1 (120)	14.0 (129)		≥500	57.1 (425)	58.6 (542)	
Race				Primary care clinic visits in prior year			
Black	61.5 (458)	70.4 (651)	.936	0	74.0 (551)	69.7 (645)	.986
White	34.5 (257)	26.6 (246)		1	13.0 (97)	14.2 (131)	
Other	1.6 (12)	1.7 (16)		≥2	13.0 (97)	16.1 (149)	
Missing	2.4 (18)	1.3 (12)					
Sex male	95.8 (714)	96.2 (890)	.531	Inpatient admission in prior year	13.4 (100)	13.4 (124)	.376
Years in HIV care				HIV clinic visits in prior year			
<1	7.4 (55)	4.3 (40)	.240	1	13.7 (102)	11.9 (110)	.930
1–5	26.6 (198)	26.5 (245)		2–3	48.1 (358)	44.4 (411)	
>5	66.0 (492)	69.2 (640)		4–9	35.2 (262)	39.8 (368)	
				≥10	3.1 (23)	3.9 (36)	
Travel time to HIV clinic, roundtrip min				Travel time saved with telehealth, min			
<60	10.7 (80)	29.0 (268)	.207	<15	14.5 (108)	13.8 (128)	.706
60–89	39.6 (295)	36.2 (335)		15–29	17.5 (130)	17.7 (164)	
90–119	18.4 (137)	13.3 (123)		30–59	27.1 (202)	41.1 (380)	
≥120	31.3 (233)	21.5 (199)		≥60	40.9 (305)	27.4 (253)	
Baseline retention in care	79.7 (594)	81.5 (754)	.417	Substance use diagnosis	20.0 (149)	24.8 (229)	.870
Baseline viral suppression	82.3 (613)	80.9 (748)	.231	Diabetes	13.6 (101)	15.1 (140)	.744
Depression	36.8 (274)	35.9 (332)	.622	Hepatitis C	10.7 (80)	11.8 (109)	.900
Hypertension	42.2 (314)	43.2 (400)	.978	Liver disease	15.4 (115)	13.4 (124)	.405
Antiretroviral receipt	94.5 (704)	95.8 (886)	.178	Residence			
Chronic kidney disease	1.5 (11)	1.4 (13)	.832	Urban	82.2 (612)	82.9 (767)	.658
Malignancy	8.1 (60)	6.8 (63)	.100	Rural	17.7 (132)	16.5 (153)	
Cardiovascular disease	3.9 (29)	2.1 (19)	.204	Missing	0.1 (1)	0.5 (5)	

to 1.10; *P* = .06; CACE, 86.4% vs 76.5%; RR, 1.13; 95% CI, 0.98 to 1.32; *P* = .10).

DISCUSSION

We conducted a pragmatic experiment in health care delivery that randomized groups of patients to the opportunity to receive HIV specialty care via telehealth in nearby primary care clinics, instead of traveling to a distant HIV clinic. We randomized groups of patients to telehealth availability; patients in areas where telehealth was made available could then choose to have telehealth visits in a nearby primary care clinic or continue to travel to the HIV specialty clinic. Our findings describe the impact of HIV telehealth programs implemented as quality improvement programs in real-world settings and are most relevant to other urban HIV clinics that serve patients who travel long distances to the clinic from outlying suburban and rural areas [1].

Thirteen percent of patients living in areas where telehealth was available completed a telehealth visit in the evaluation year. Low telehealth use likely reflected the fact that patients in these 3 health care systems were already accustomed to traveling to the HIV clinic for care, and many could save relatively little travel time by using telehealth. Not surprisingly, the proportion of patients using telehealth increased as travel time saved increased, with 25.3% using telehealth if they could save more than an hour. Other factors that may have impacted telehealth use include perceived HIV stigma in primary care clinics, visit convenience, transportation options, and comfort with specific aspects of telehealth visits. An ongoing study is exploring how these factors influence telehealth use.

The availability of telehealth programs was associated with small improvements in documented viral suppression in ITT analyses that compared all patients in areas where telehealth was available with patients in areas of control clinics where telehealth was not available, regardless of telehealth use. ITT

Table 2. Telehealth Use in Evaluation Year Among 925 Patients in Areas of Telehealth Intervention Clinics

Patient Characteristics	Telehealth Use, % (No.)	*P*	Patient Characteristics (cont.)	Telehealth Use, % (No.)	*P*
Race			Time in HIV care, y		
Black	8.3 (54)	.004	<1	10.0 (4)	.105
White	25.6 (63)		1–5	12.7 (31)	
Other	12.5 (2)		>5	13.3 (85)	
Missing	8.3 (1)		Baseline retention in care		
Age, y			Yes	13.4 (101)	.391
<30	7.1 (2)	.077	No	11.1 (19)	
30–39	4.1 (4)		Baseline viral suppression		
40–49	13.1 (22)		Yes	15.0 (112)	<.001
50–65	12.8 (64)		No	4.5 (8)	
>65	21.7 (28)		Antiretroviral receipt in prior year		
Sex			Yes	13.1 (116)	.256
Male	12.8 (114)	.613	No	10.3 (4)	
Female	17.1 (6)		Baseline CD4, cells/mm^3		
Residence			Missing	7.9 (3)	<.001
Urban	10.2 (78)	.030	<200	14.1 (10)	
Rural	26.1 (40)		200–349	9.2 (10)	
Missing	40.0 (2)		350–499	13.9 (23)	
Substance use diagnosis			≥500	13.7 (74)	
Yes	8.7 (20)	.029	Primary care clinic visits		
No	14.4 (100)		0	9.0 (58)	.014
Diabetes			1	13.7 (18)	
Yes	15.7 (22)	.172	≥2	29.5 (44)	
No	12.5 (98)		HIV clinic visits		
Depression			1	10.9 (12)	.355
Yes	10.8 (36)	.033	2–3	13.9 (57)	
No	14.2 (84)		4–9	12.8 (47)	
Hypertension			≥10	11.1 (4)	
Yes	17.3 (69)	<.001	Inpatient admissions		
No	9.7 (51)		Yes	12.1 (15)	.800
Hepatitis C			No	13.1 (105)	
Yes	10.1 (11)	.016	Travel time to HIV clinic, min		
No	13.4 (109)		<120	4.1 (11)	.018
Liver disease			120–179	12.5 (42)	
Yes	8.9 (11)	.056	180–239	20.3 (25)	
No	13.6 (109)		≥240	21.1 (42)	
Chronic kidney disease			Travel time saved with telehealth, min		
Yes	7.7 (1)	.618	<15	3.1 (4)	<.001
No	13.1 (119)		15–29	4.3 (7)	
Malignancy			30–59	11.8 (45)	
Yes	17.5 (11)	.513	≥60	25.3 (64)	
No	12.7 (109)				
Cardiovascular disease					
Yes	10.5 (2)	.548			
No	13.0 (118)				

Table 3. Impact of Telehealth Program Availability on Retention in HIV Care and Documented Viral Suppression[a]

	Telehealth Intervention Clinics	Control Clinics	Absolute Difference (95% CI)	Relative Risk (95% CI), *P*
ITT				
Retention in care	76.1 (75.4 to 77.0)	72.6 (71.8 to 73.4)	3.6 (0.0 to 7.7)	1.05 (1.00 to 1.10), .06
Documented viral suppression	78.3 (77.2 to 79.5)	74.1 (73.0 to 75.2)	4.3 (0.1 to 8.4)	1.06 (1.01 to 1.11), .01
CACE				
Retention in care	86.4 (76.2 to 95.3)	76.5 (68.5 to 84.7)	9.9 (−1.8 to 22.2)	1.13 (0.98 to 1.32), .10
Documented viral suppression	91.5 (84.0 to 97.4)	80.0 (72.3 to 88.1)	11.5 (0.1 to 21.66)	1.14 (1.01 to 1.30), .03

Abbreviations: CACE, complier average causal effect; CI, confidence interval; ITT, intention to treat.

[a]Results are the adjusted proportion of patients experiencing outcomes in telehealth and control clinics, absolute difference in outcomes, and relative risk for outcomes, with 95% confidence intervals in parentheses. ITT analyses compared patients in service areas of telehealth intervention clinics with patients in areas of control clinics, regardless of telehealth use, and were adjusted for patient age, race, baseline measure of outcome variable, time in HIV care, and facility. CACE analyses compared telehealth users with patients in areas of control clinics with equal propensity to use telehealth, if available.

analyses provide a useful population-level estimate of program impacts as implemented but underestimate telehealth effects among individual users if utilization is low. We also calculated the CACE to estimate impacts of telehealth programs on outcomes among telehealth users. These analyses compared outcomes among telehealth users in areas where it was available with outcomes among control patients with equal estimated propensity to use telehealth when available. Telehealth was associated with large absolute increases in documented viral suppression (11.5%) among telehealth users in CACE analyses.

Additional analyses showed that improvements in documented viral suppression were due to more frequent viral load testing during care (ie, fewer patients missing viral loads) in the telehealth intervention group compared with the control group, not to greater viral suppression among patients with viral load testing completed. We suspect that increased viral load testing in telehealth groups may have been a consequence of telehealth coordinators tracking patients in areas of telehealth clinics, offering telehealth visits, and arranging laboratory testing for patients in more nearby telehealth clinics. We also observed an increased frequency of HIV clinic visits among telehealth users. It is possible that telehealth improved viral load monitoring for patients who were less engaged in care initially due to travel burdens or other factors. In any case, increased monitoring of viral loads is a potentially significant impact of telehealth programs and may lead to opportunities to intervene to improve viral suppression.

This study has limitations. Findings may not generalize outside the VA, where HIV clinics serve younger populations including more women and where telehealth programs may be more difficult to establish due to payment barriers. In addition, we designed this cluster-randomized program evaluation to determine the impacts of telehealth programs implemented as quality improvement initiatives in real-world settings. This design may introduce biases that are not present in patient-level randomized efficacy trials.

CONCLUSIONS

Use of telehealth programs was low overall but increased with increasing travel time saved. The availability of telehealth programs was associated with small population-level improvements in documented viral suppression among all patients in service areas of telehealth clinics and large improvements among program users. HIV clinics should offer telehealth visits for patients facing travel burdens.

Supplementary Data

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

Notes

Financial support. This work was supported by the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development program (IIR# 15-147-1). Local quality improvement work to implement HIV telehealth programs was supported by the Veterans Health Administration's Office of Rural Health.

Disclaimer. The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs or the United States Government.

Potential conflicts of interest. Dr. Ohl is the principal investigator for an Investigator Sponsored Research grant from Gilead Science to the University of Iowa to conduct research unrelated to this manuscript. The authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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