

Evaluation of Human Immunodeficiency Virus and Hepatitis C Telemedicine Clinics

Hemen N. Saifu, MPH; Steven M. Asch, MD, MPH; Matthew Bidwell Goetz, MD; Jason P. Smith, PharmD; Christopher J. Graber, MD, MPH; Dennis Schaberg, MD; and Benjamin C. Sun, MD, MPP

Electronic interactive healthcare consultations, also known as telemedicine, may reduce geographic barriers to timely subspecialty care. Human immunodeficiency virus (HIV) and hepatitis C are ideal test conditions for telemedicine, because they are high-risk, prevalent, and chronic illnesses where subspecialty care can often improve quality of life and survival. The demand for such services will likely increase as more patients become eligible for treatment with new antiviral regimens.¹ Unfortunately, limited access to subspecialty care is a major barrier to optimal care of patients infected with HIV and/or hepatitis C,^{2,3} particularly for those who live in rural settings.

The Veterans Affairs (VA) Healthcare System has taken a leadership role by investing heavily in telemedicine⁴⁻⁹ to better serve the 20% of veterans who reside in rural areas.⁹ Expanding telemedicine access to HIV/hepatitis C subspecialty care has been identified as a top priority by the VA national leadership and the VA HIV/Hepatitis Quality Enhancement Research Initiative.¹⁰ Although there have been reports of telemedicine care for HIV and hepatitis C in non-VA settings,¹¹⁻¹⁴ we are unaware of published reports describing HIV/hepatitis C telemedicine efforts within the VA system. To address this clinical need, the VA Greater Los Angeles Health System (VAGLAHS) implemented HIV and hepatitis C telemedicine services at 2 rural clinics.

The goal of this study was to assess the impact of telemedicine services for the VAGLAHS HIV and hepatitis C clinics on patient-oriented outcomes. We used clinic completion rates as a proxy measure for access. Our primary hypothesis was that telemedicine would safely improve clinic completion rates. We also hypothesized that telemedicine would be associated with high patient satisfaction and reduced health visit-related time.

METHODS

Study Design and Setting

This is a pre-post intervention study of HIV/hepatitis C clinic visits clustered by patients. We used the pre-intervention, in-person clinic completion rate of each patient as an internal control group to assess the impact of the telemedicine clinics.

The VAGLAHS HIV clinic initiated telemedicine consultations in February 2009 and the VAGLAHS hepatitis C clinic began telemedi-

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Background: Geographical barriers to subspecialty care may prevent optimal care of patients living in rural areas. We assess the impact of human immunodeficiency virus (HIV) and hepatitis C telemedicine consultation on patient-oriented outcomes in a rural Veterans Affairs population.

Methods: This was a pre- and post-intervention study comparing telemedicine with in-person subspecialty clinic visits for HIV and hepatitis C. Eligible patients resided in 2 rural catchment areas. The primary binary outcome was clinic completion. We estimated a logistic regression model with patient-level fixed effects. This approach controls for the clustering of visits by patient, uses each patient's in-person clinic experience as an internal control group, and eliminates confounding by person-level factors. We also surveyed patients to assess satisfaction and patient-perceived reductions in health visit-related time.

Results: There were 43 patients who accounted for 94 telemedicine visits and 128 in-person visits. Clinic completion rates were higher for telemedicine (76%) than for in-person visits (61%). In regression analyses, telemedicine was strongly predictive of clinic completion (OR 2.2; 95% confidence interval [CI]: 1.0-4.7). The adjusted effect of telemedicine on clinic completion rate was 13% (95% CI: 12-13). Of the 30 patients (70%) who completed the survey, more than 95% rated telemedicine at the highest level of satisfaction and preferred telemedicine to in-person clinic visits. Patients reported a significant reduction in health visit-related time (median 340 minutes, interquartile range 250-440), mostly due to decreased travel time.

Conclusions: HIV and hepatitis C telemedicine clinics are associated with improved access, high patient satisfaction, and reduction in health visit-related time.

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Take-Away Points

We evaluated human immunodeficiency virus (HIV) and hepatitis C telemedicine services at 2 rural clinics.

- HIV and hepatitis C are high-risk, prevalent, and chronic illnesses where subspecialty care can often improve quality of life and survival. Distance may be an important barrier to access.
- Visit completion rate, a proxy for access, was 13% greater for telemedicine compared with in-person clinics.
- >95% of respondents rated telemedicine at the highest level of satisfaction and preferred telemedicine to in-person visits.
- Telemedicine reduced health visit time by 340 minutes.
- This intervention was implemented within an existing telemedicine infrastructure without need for additional staff or equipment.

cine consultations in February 2010. Pre- and post-intervention data for this study were collected from June 2008 to June 2011. This study was approved by the VAGLAHS Institutional Review Board.

VAGLAHS has an existing telemedicine infrastructure that includes “hub” sites located in urban Los Angeles. The “spoke” sites in this study included the Santa Maria and Bakersfield clinics, which are respectively 160 and 110 miles driving distance from the urban clinics. Telemedicine consultations are performed utilizing video teleconferencing end units over a high-speed Internet connection (Polycom; Pleasanton, California). At the hub sites, mobile end units with 32" monitors can be moved between clinics. A clinical manager at each of the hub and spoke sites is responsible for providing support to the telemedicine program. The HIV/hepatitis C telemedicine clinics utilized this existing infrastructure, and no additional funds, staff, or equipment were required for implementation. However, the “clinical champions” and nursing staff for these clinics did provide in-kind time to develop policies and processes to implement telemedicine services.

Telemedicine consultations were performed by healthcare providers during the existing infectious disease and hepatitis C clinic times at the urban hub sites. For both the HIV and hepatitis C clinics, there was a single half-day clinic per week. Patients scheduled for a telemedicine consultation presented to a spoke site. An onsite nurse measured vital signs, and patients were placed in a private examination room set up with teleconferencing equipment. The healthcare providers at the hub sites could remotely conduct consultations; perform interviews and patient education; view chart notes, radiology tests, and electrocardiograms; enter orders for pharmacy, laboratory, and radiology; and perform documentation using the VA computerized patient record system. During the study period, there was a single provider in each of the HIV and hepatitis C clinics who performed all telemedicine consultations (CJG, JPS).

Study Cohort

The study population is a convenience sample of patients residing in the Santa Maria and Bakersfield catchment areas who were referred by their HIV or hepatitis C provider to the telemedicine clinic. Providers selected patients who were deemed to have stable disease. There were no other eligibility criteria such as viral load or active antiviral therapy.

Outcomes and Measurements

The primary binary outcome was clinic completion, defined as the completion of a scheduled appointment. Reasons for non-completion of a scheduled appointment included no-shows and patient cancellations. Cancellations by the clinic were excluded from this analysis.

Determination of clinic completion was performed by review of electronic medical records and administrative data. All telemedicine clinic encounters were reviewed. To create patient-specific internal control groups, we also reviewed all condition-specific in-person visits that occurred during the study period. For example, if a patient was scheduled for an HIV telemedicine clinic visit, we collected data on all prior scheduled HIV in-person clinic visits for that patient.

Secondary outcomes included patient satisfaction and health visit–related time. At the end of each telemedicine consult, a research assistant administered a 10-minute survey from the hub site. Overall satisfaction and ratings of physician interaction, privacy, physical environment, and convenience were measured on a 5-level Likert scale (very dissatisfied, somewhat dissatisfied, neither satisfied nor dissatisfied, somewhat satisfied, very satisfied). Preference for in-person versus telemedicine consultation was measured on a binary scale. Patients were also asked to estimate travel and on-site time required for in-person and telemedicine visits. For estimates of on-site time, patients were asked to consider time for checking in, waiting, and completing the consultation. Total health visit–related time is defined as the sum of travel and on-site time related to a clinic visit.

We collected demographic data on age at time of the first telemedicine visit, gender, and race/ethnicity from review of electronic medical records and administrative data. Race/ethnicity data were self-reported to VAGLAHS. Finally, we assessed whether there were any hospitalizations at a VA facility or deaths that occurred within 30 days of a subspecialty clinic.

All electronic and administrative records were reviewed by a research assistant (HNS). To assess inter-rater reliability, a physician-investigator (BCS) blinded to the research



assistant's abstractions independently re-reviewed notes from 50 randomly selected visits. There was 100% concordance on all data elements, including visit completion, demographic data, and occurrence of 30-day hospitalization or death.

Analysis

We performed unadjusted and adjusted analyses of the primary outcome of clinic completion rates. Contingency table methods were used to estimate unadjusted clinic completion rates for scheduled in-person and telemedicine visits. To assess the adjusted effect of telemedicine on clinic completion, we estimated a logistic regression model with person-fixed effects. The binary outcome is clinic completion, and the predictor is clinic setting (in-person vs telemedicine). This approach controls for the clustering of visits by patient, uses each patient's in-person clinic experience as an internal control group, and eliminates confounding by person-level factors. Odds ratio and 95% confidence intervals were calculated directly from the regression results. We performed sensitivity analyses with person-level random effects, and with no person-level effects; there were no qualitative differences in the results.

Although odds ratios are commonly reported effect measures, they may be difficult to interpret clinically. We used a bootstrapping approach to estimate the adjusted impact of telemedicine on clinic completion rates. We generated 1000 re-samples of the patient population of equivalent size to the original patient population. For each sample, we fit the logistic regression model with patient-level fixed effects, and the absolute rate difference was estimated by hypothetically setting all visits to either in-person or to telemedicine. We used estimates across all 1000 re-samples to generate a mean point estimate and 95% confidence intervals of the absolute rate difference between in-person and telemedicine visits.

To explore the possibility of condition-specific effects of telemedicine on visit completion, we re-fit the regression model with an interaction term between telemedicine and condition (HIV vs hepatitis C).

We describe all secondary outcomes in descriptive tables. All time-interval outcomes were highly right-skewed. Using patient estimates of health visit-related time, we calculated the median and interquartile range of the differences between in-person and telemedicine clinic visits. We used the Wilcoxon rank-sum test for non-parametric data to assess time-based measures.

Data entry was performed using Microsoft Access (Redmond, Washington). Data management and analyses were performed using SAS 9.1 (Cary, North Carolina).

■ **Table 1.** Cohort Characteristics

Variable	Study Cohort (n = 43)
Age (median, IQR)	57 (54-60)
Male (n, %)	42 (98%)
Race/ethnicity (n, %)	
White	18 (42%)
Hispanic	14 (33%)
Black	3 (7%)
Unavailable	8 (19%)
Primary condition	
Hepatitis C	31 (72%)
HIV	12 (28%)
Catchment area	
Bakersfield	25 (58%)
Santa Maria	18 (42%)
HIV indicates human immunodeficiency virus; IQR, interquartile range.	

RESULTS

There were 43 patients who accounted for 94 telemedicine visits and 128 in-person visits to HIV or hepatitis C subspecialty clinics. This cohort was predominantly male, as expected for a VA population, and the majority of patients were evaluated for hepatitis C (Table 1).

The in-person clinic completion rate of the study cohort was 61%, which is similar to the historic in-person clinic completion rate of 61% for HIV and hepatitis C visits by all patients from the study catchment areas from 2008 to 2010 ($P = 0.9$). The adjusted odds ratio of clinic completion associated with telemedicine was 2.3 (95% CI: 1.0-4.7; $P = 0.04$). In bootstrapped analysis, telemedicine was associated with an increased clinic completion rate of 13% (95% CI: 12-13) (Table 2). There was no evidence of a statistically important interaction effect ($P = 0.2$) between telemedicine and condition (HIV vs hepatitis C).

Of the 43 study cohort patients, 30 (70%) completed a telemedicine-facilitated survey. The remaining 13 patients did not complete the survey either because they did not show for their telemedicine visit or because of research assistant unavailability. There were no refusals to participate in the survey. Patients were highly enthusiastic about telemedicine, and >95% of respondents gave the highest possible rating for overall satisfaction and expressed a preference for telemedicine over in-person clinic visits (Table 3).

Respondents estimated that total health visit time was 340 minutes less for telemedicine compared with in-person visits ($P < 0.001$); time reduction was attributable to both shorter travel and on-site times (Table 4). However, the majority

■ **Table 2.** Effect of Telemedicine on Clinic Completion Rates

	In-Person Completion Rate	Telemedicine Completion Rate	Difference (95% CI)
Unadjusted analysis	61%	76%	15% (2%-27%)
Bootstrapped analysis	61%	74%	13% (12%-13%)

CI indicates confidence interval.

of perceived time reduction was related to travel. Approximately 65% of respondents reported that they traveled to the urban hub site by car, and the remainder used a VA shuttle or public transportation.

There were no study patients who died or were hospitalized at a VA facility within 30 days of the scheduled clinic visits.

DISCUSSION

In a rural VA population, the use of telemedicine for HIV and hepatitis C subspecialty evaluations was associated with increased clinic completion rates, high patient satisfaction, and patient-reported reductions in health-related visit times. This intervention was implemented within an existing telemedicine infrastructure without the need to hire additional staff or purchase equipment. Our study adds to prior case descriptions of HIV^{11,14} and hepatitis C¹² telemedicine interventions by using an internal control group to evaluate clinic completion rates. Our findings suggest that telemedicine can cost-effectively extend HIV and hepatitis C subspecialty care to rural and underserved populations within an integrated health system.

HIV and hepatitis C telehealth services were implemented simultaneously because of local institutional priorities. However, the treatment of these 2 conditions is quite different. HIV often requires chronic disease management and may be particularly amenable to serial telehealth clinics. In contrast,

hepatitis C often requires diagnostic procedures such as ultrasound and liver biopsy. Telemedicine may be helpful to facilitate pre-treatment evaluation, but a combination of in-person and telehealth visits may be necessary for hepatitis C patients. Despite differences in clinical management, we found that telehealth clinics improved access in both HIV and hepatitis C populations.

The observed improvements in telemedicine clinic completion rates are likely due to a high level of patient acceptance and perceived reduction in visit-related time. Although none of the study patients had previously participated in telemedicine services, the intervention was associated with a high degree of satisfaction with all aspects of care, including provider interaction, privacy, physical environment, and convenience. Patient enthusiasm did not appear to be dampened by occasional problems with video/audio quality and teleconferencing software, which typically were quickly resolved by telemedicine support staff.

Patients estimated that telemedicine saved a median of 6 hours of time per clinic visit. Distance and travel times are major barriers for rural populations to access urban subspecialty clinics. Several study participants noted that it was often difficult to arrange for transportation to Los Angeles, and many participants complained about heavy traffic. In contrast, transportation times were dramatically lower for rural-based spoke sites.

Although transportation represented the major component of visit-related time, participants also noted more rapid throughput at the rural spoke clinics. The urban hub site serves as the VA tertiary referral center for Southern California, and there are often long wait times to be registered by a clerk and to be seen by a doctor. Similar delays were not reported for the rural clinics.

Our results are qualitatively similar to a prior VA evaluation of a pulmonary telemedicine clinic implemented in a rural population.^{9,15} The pulmonary telemedicine intervention was associated with high patient satisfaction and reduction in patient travel. A formal cost-effectiveness analysis suggested that the pulmonary telemedicine intervention was 70% less costly than in-person consultations.

Our intervention is modeled on prior efforts to directly extend the presence of HIV^{11,14} and hepatitis C subspecialists¹² into rural clinics. An alternative telemedicine model is to train rural primary care providers in the management of complex, chronic illnesses. A recent report illustrates the success of the latter approach in the treatment of hepatitis C in rural com-

■ **Table 3.** Patient Satisfaction With Telemedicine

Survey Question	n (%)
First time using telemedicine	30 (100%)
Satisfaction with physician interaction (highest response level)	30 (100%)
Satisfaction with privacy (highest response level)	28 (93%)
Satisfaction with physical environment (highest response level)	30 (100%)
Satisfaction with convenience (highest response level)	29 (97%)
Overall satisfaction (highest response level)	29 (97%)
Prefer telemedicine over in-person visit	27 (96%) ^a

^aTwo patients did not complete this item.



■ **Table 4.** Patient Estimates of Health Visit–Related Time

Time Intervals (min)	In Person (median, IQR)	Telemedicine (median, IQR)	Difference ^a (median, IQR)
Travel time	300 (240-420)	40 (20-80)	240 (200-360)
On-site time	105 (60-180)	30 (30-55)	65 (30-125)
Total time	460 (360-540)	85 (60-130)	340 (250-440)

IQR indicates interquartile range.

^aTest for difference = 0; $P < .0001$ for all comparisons.

munities.¹³ Ultimately, any telemedicine intervention needs to be tailored to the unique patient needs and available resources of a given healthcare system.

Our study has several potential limitations. First, this was a convenience sample of patients with stable disease. Our health providers were conservative and selected patients who were least likely to suffer harm from participating in telemedicine. Because of changes in the standard of care for hepatitis C treatment,¹ none of our hepatitis patients were started on antiviral therapy during the study period. Patient selection may positively bias our results. However, others have demonstrated that telemedicine may be safe for patients initiating antiviral therapy.^{12,13} Future studies should assess the impact of telemedicine in unselected populations.

Second, we did not track clinical markers of disease progression, such as viral load and other blood tests. Because our study population was heterogeneous in condition (HIV and hepatitis C), management plan, viral load, and other baseline blood test values, we decided to focus on patient-oriented outcomes instead. We found no evidence of harm associated with the intervention, including 30-day death or hospitalization at a VA facility.

Third, 70% of the study patients completed the research survey, and there is the possibility of response bias. Even in the unlikely case that all non-respondents were extremely dissatisfied with telemedicine, the mean satisfaction level would still be high due to the overwhelmingly enthusiastic responses of patients who completed the survey.

Fourth, patient ratings of time and satisfaction were completed after the telehealth visit, and there may be differential recall in reporting the experiences related to prior clinic visits. It is possible that more recent events (ie, telehealth) were rated more positively because of better recall. Future studies could guard against potential recall bias by interviewing patients directly after both telehealth and clinic visits.

Fifth, although we did not identify any adverse events associated with telehealth visits, our preliminary study has a small sample size and does not exclude the possibility of adverse events. Definitive safety evaluation will require longer follow-up in a larger patient cohort.

Finally, the VA is a unique integrated health system serving a predominantly male and indigent population, and

our findings may not necessarily generalize to other systems of care. VA system features, such as an electronic medical management system and existing telemedicine infrastructure, may not readily be available elsewhere. We observed a high baseline rate of clinic no-shows (39%); the relative benefit of telemedicine in other settings may be heavily dependent on baseline visit completion rates. However, telemedicine interventions have been successful in non-VA settings.^{12,13,16,17}

In conclusion, we found that an HIV and hepatitis C telemedicine intervention was associated with improved clinic completion rates, high patient satisfaction, and reduced healthcare visit–related time. HIV and hepatitis C are high-risk, prevalent, and chronic illnesses where subspecialty care can often improve quality of life and survival. Video teleconferencing technology is a potentially cost-effective approach to extend sub-specialty HIV and hepatitis services to rural and underserved populations.

Author Affiliations: From Department of Medicine (HNS, SMA, MBG, JPS, CJG, DS, BCS), VA Greater Los Angeles Health System, Los Angeles, CA; Department of Medicine (SMA, MBG, CJG, BCS), UCLA, Los Angeles, CA; Department of Emergency Medicine (BCS), Oregon Health and Science University, Portland, OR.

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Address correspondence to: Hemen N. Saifu, MPH, Office 3246, Mail Stop 111G, Bldg 500, Wing 3E, 11301 Wilshire Blvd, Los Angeles, CA 90073. E-mail: Hemen.Saifu@va.gov.

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