Implementing Teledermatology for Rural Veterans: An Evaluation Using the RE-AIM Framework

Sara B. Peracca, PhD, MPH, MS,[1] George L. Jackson, PhD, MHA,[2,3] Rebecca P. Lamkin, MA,[4] David C. Mohr, PhD,[4,5] Molly Zhao, BA,[4] Olevie Lachica, BS,[1] Julia C. Prentice, PhD,[4,6] Andrea M. Grenga, BA,[7] Allen Gifford, MD,[4] Jennifer G. Chapman, BASW,[2] Martin A. Weinstock, MD, PhD,[7–9] and Dennis H. Oh, MD, PhD[1,8,10]

[1]Dermatology Service, San Francisco Veterans Affairs Health Care System, San Francisco, California, USA.
[2]Center of Innovation to Accelerate Discovery and Practice Transformation (ADAPT), Durham Veterans Affairs Health Care System, Durham, North Carolina, USA.
[3]Department of Population Health Sciences and Division of General Internal Medicine, Department of Medicine, Duke University, North Carolina, USA.
[4]Center for Healthcare Organization and Implementation Research (CHOIR), Veterans Affairs Boston Health Care System, Boston, Massachusetts, USA.
[5]Department of Health Law, Policy and Management, School of Public Health, Boston University, Boston, Massachusetts, USA.
[6]Department of Psychiatry, School of Medicine, Boston University, Massachusetts, USA.
[7]Providence VA Medical Center, Providence, Rhode Island.
[8]Office of Connected Care, Veterans Health Administration, Washington, District of Columbia, USA.
[9]Dermatoepidemiology Unit, Departments of Dermatology and Epidemiology, Brown University, Providence, Rhode Island, USA.
[10]Department of Dermatology, University of California at San Francisco, San Francisco, California, USA.

Abstract

Introduction: *Few systematic evaluations of implementing teledermatology programs in large health care systems exist. We conducted a longitudinal evaluation of a U.S. Department of Veterans Affairs (VA) initiative to expand asynchronous consultative teledermatology services for rural veterans.*

Methods: *The reach, effectiveness, adoption, implementation, and maintenance framework guided the evaluation, which included analysis of quantitative VA administrative data as well as an online survey completed by participating facilities. The first 2 years of the program were compared with the year before the start of funding.*

Results: *Sixteen hub facilities expanded teledermatology's reach over the 2-year period, increasing the number of referral spoke sites, unique patients served, and teledermatology encounters. Effectiveness was reflected as teledermatology constituted an increasing fraction of dermatology activity and served more remotely located patients. Adoption through defined stages of implementation progressed as facilities engaged in a variety of strategies to enhance teledermatology implementation, and facilitators and barriers were identified. Program maintenance was assessed by Program Sustainability Index scores, which reflected the importance of executive support, and ongoing concerns about staffing and longitudinal funding.*

Discussion: *Enabling hubs to create solutions that best fit their needs and culture likely increased reach and effectiveness. Important facilitators included organizational leadership and encouraging communication between stakeholders before and during the intervention.*

Conclusions: *A systematic analysis of teledermatology implementation to serve rural sites in VA documented a high degree of implementation and sustainability as well as areas for improvement.*

Keywords: *teledermatology, telehealth, e-health, policy, dermatology*

Introduction

Teledermatology is a proven strategy to increase access to dermatologic expertise, including in rural areas.[1–3] The asynchronous or store-and-forward variant of consultative teledermatology allows primary care clinics to share text describing a patient's clinical history and images of the patient's skin with a remotely located dermatologist who then communicates a diagnosis and management recommendations to the primary care provider (PCP).[4] The basic process of asynchronous teledermatology is simple in principle, requires inexpensive equipment, and can function with minimal communication technology. In practice, however, asynchronous teledermatology requires coordination of multiple elements in a health care system and, even if successfully implemented initially, many teledermatology programs have not been sustainable.[5–7] Much remains to be understood about the factors that facilitate and inhibit adoption.

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Asynchronous teledermatology has been an important part of the U.S. Department of Veterans Affairs (VA) telehealth portfolio.[8] However, many VA facilities, defined as hospitals and their associated community-based outpatient clinics (CBOCs), still do not leverage teledermatology even though they lack in-person dermatologists or have oversubscribed dermatology clinics with long patient wait times.[9]

In an attempt to foster teledermatology in rural areas, VA Office of Rural Health (ORH) funded an Enterprise-Wide Initiative (EWI) for teledermatology, which was nationally implemented by the Office of Connected Care (OCC). VA facilities applied to support hubs of dermatologists reading teledermatology consults and spokes, which included both entire facilities and selected CBOCs within facilities where primary care clinics lacked dermatologists. Full funding required at least 50% of a spoke's patient population to live in rural or highly rural areas.[10] Funding supported salaried effort by dermatologists to read consults and by PCPs to submit and manage consults, and travel costs to train PCPs in minor dermatologic procedures (e.g., cryotherapy or skin biopsies) were also covered.

We evaluated the first 2 years of the EWI using the Glasgow reach, effectiveness, adoption, implementation, maintenance (RE-AIM) implementation science framework, developed to facilitate the translation of research into practice.[11–13] Using this approach, we systematically assessed the multiple facets of the implementation and sustainment of asynchronous teledermatology in a large, fully integrated, national health care system.

Methods

Seventeen VA hub facilities applied and 16 were selected to receive funding in FY 2017 (i.e., October 2016–September 2017). Half of the hubs commenced funding at the start of FY 2017, while half commenced funding midway through FY 2017. Fifteen hubs continued in FY 2018. The evaluation utilized three data sources: (1) VA Corporate Data Warehouse (CDW), containing demographic and encounter data for each patient in the VA electronic health record; (2) ORH's management and analysis tool (OMAT), containing quarterly data reported by funded hubs; and (3) an online survey completed by each hub at the end of each FY, designed by our evaluation team to capture additional quantitative and qualitative data. The CDW associates each health care encounter with numeric stop codes. We identified visits by their primary dermatology stop code associated with secondary stop codes, which capture referral and reading sites' asynchronous teledermatology activity. To avoid double-counting encounters, we used only encounters with a reading site stop code.

Table 1 shows RE-AIM's five dimensions as applied to the teledermatology EWI. We measured *reach*—the degree to which veterans receive services—by (1) the number of spokes served by teledermatology, as reported in OMAT and corroborated by our hub survey; (2) the number of teledermatology encounters, including data on veteran subgroups in CDW, using one-way analysis of variance (ANOVA) to test significance; and (3) the number of PCPs trained in minor teledermatology procedures, as reported in OMAT. While there is overlap between reach and effectiveness, we measured *effectiveness* as the percentage of dermatology activity at a hub that

Table 1. RE-AIM Evaluation Measures

RE-AIM DOMAIN	DOMAIN DESCRIPTION	RE-AIM OUTCOMES
Reach	Degree to which veterans are impacted	Spokes and primary care clinics impacted
		Teledermatology encounters
		PCPs trained
Effectiveness	Ability to change patient-centric outcomes	Teledermatology as % all dermatology encounters
		Travel distance to the nearest Veterans Affairs dermatology clinic
Adoption	Degree to which end users use teledermatology	Self-reported progress in implementing teledermatology
Implementation	Factors impacting the ability to implement teledermatology as planned	Degree of concern related to support and resources from key health system stakeholders
		Implementation barriers and facilitators
		Perceptions related to PCP training based on open-ended responses from hubs
Maintenance	Can teledermatology be sustained over time?	Degree of sustainability reported by hubs utilizing the PSI

PCP, primary care provider; PSI, Program Sustainability Index; RE-AIM, reach, effectiveness, adoption, implementation, and maintenance.

was through teledermatology and the estimated average travel distance to points of care by using each patient's zip code, and the *t*-test was used to assess significance.

To assess *adoption*, *implementation*, and *maintenance*, we relied on data collected from the hub survey. For *adoption*, we utilized a modification of the stages of implementation completion (SIC) model,[14,15] enumerating key preimplementation, implementation, and sustainability milestones. To assess implementation, we measured the level of concern key stakeholders had in implementing teledermatology using a 3-point scale as well as open-ended questions to understand facilitators and barriers to teledermatology implementation. In the qualitative analysis, we categorized facilitators and barriers and ascertained commonality across hubs. To assess maintenance, we utilized the Program Sustainability Index (PSI) based on six key elements: leadership competence, effective collaboration, demonstrating program results, strategic funding, staff involvement and integration, and program responsivity.[16]

Results

REACH

In FY 2017, the first year of the initiative, 16 hubs served 137 spokes in 31 states and 3 territories. The following year, FY 2018, 1 hub, which served 3 spokes, opted out after merging with a nonparticipating hub. The remaining 15 hubs increased service to a total of 165 spokes in 35 states and 3 territories. Some spokes included multiple primary care clinics. All 16 hubs responded to the survey in FY 2017 and 14 of 15 hubs responded in FY 2018.

Overall, teledermatology encounters and unique patients increased in each of the first 2 years (*Fig. 1*). In both years, most hubs (15/16 in FY 2017 and 10/14 in FY 2018) reported concentrating their implementation efforts on CBOCs, which were typically rural due to EWI selection criteria. Some hubs served spokes belonging to other facilities; for example, one facility was a hub for 28 spokes associated with 8 other facilities.

Rural veterans served by teledermatology are shown in *Table 2*. The overall number of unique rural patients served by teledermatology increased slightly and significantly in each of the first 2 years. Surprisingly, the number of rural encounters decreased slightly, but significantly, although it was attributable to just 4 of 15 hubs. With the exception of rural Native American veterans, all rural veteran subgroups exhibited annual increases in both encounters and unique patients. Only differences in rural Operation Enduring Freedom/Operation Iraqi Freedom veteran encounters and in unique rural females, however, were significant across years ($p < 0.001$). While the intent of the EWI was to facilitate care at rural sites, all 16 hubs self-reported also serving 22 nonrural spokes in FY 2017, and 14 of 15 hubs served 37 nonrural spokes in FY 2018.

The EWI also funded provider training in minor dermatological procedures to further minimize the need for patients to travel to a dermatologist. Hubs trained four times the number of staff in FY 2018 (416 individuals) than in FY 2017 (105 individuals).

EFFECTIVENESS

As teledermatology activity grows and enables patients to avoid visits to conventional dermatology clinics, one expects teledermatology to become a larger fraction of a hub's dermatology activity; we used this measure as one means of assessing the initiative's effectiveness. At funded hubs, teledermatology, as a percentage of all dermatology activity, increased at a faster rate than at nonfunded hubs (*Fig. 2A*). Moreover, at funded hubs, as the number of teledermatology encounters increased annually, the number of dermatology encounters decreased, particularly in FY 2018, in contrast to rising dermatology encounters in VA overall during this period (data not shown), suggesting that teledermatology was able to avert some in-person visits (*Fig. 2B*).

Teledermatology also enhanced geographic access (*Table 3*). As expected, veterans served by teledermatology were

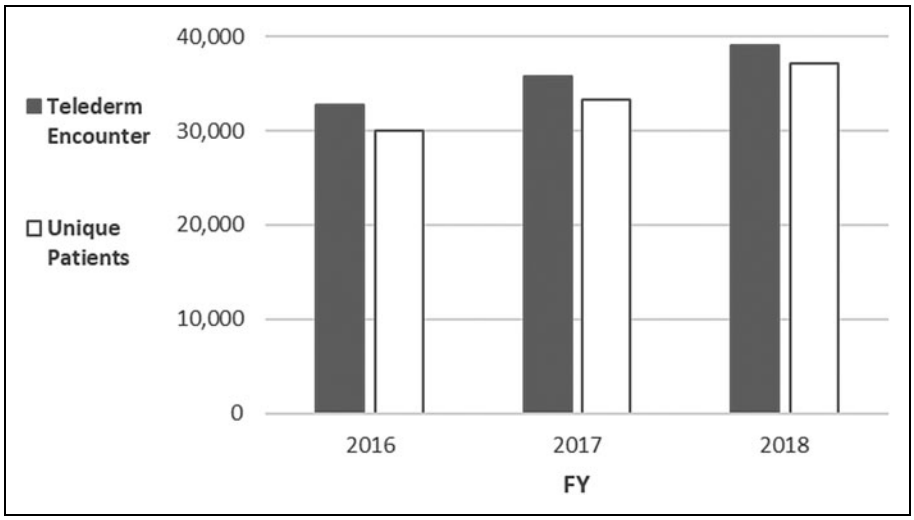

Fig. 1. Overall teledermatology activity. Teledermatology encounters (dark bars) and unique patients served by teledermatology (white bars) for all funded hubs.

Table 2. Rural Veteran Subgroups Served by Teledermatology

	TELEDERMATOLOGY ENCOUNTERS (% CHANGE FROM PRIOR YEAR)				UNIQUE PATIENTS (% CHANGE FROM PRIOR YEAR)			
	FY 2016	FY 2017	FY 2018	*p*	FY 2016	FY 2017	FY 2018	*p*
All rural	16,100	15,806 (–1.8)	15,831 (0.2)	<0.001	14,572	14,841 (1.8)	15,025 (1.2)	<0.001
Rural female	950	983 (3.5)	1,021 (3.9)	0.09	869	935 (7.5)	958 (2.5)	<0.001
Rural OEF/OIF	876	978 (11.6)	1,073 (9.7)	<0.001	811	937 (15.5)	1030 (9.9)	0.80
Rural Native American	155	168 (8.4)	162 (–3.6)	0.42	145	159 (9.7)	158 (–0.6)	0.23

OEF, Operation Enduring Freedom; OIF, Operation Iraqi Freedom.

more likely to travel farther to dermatology clinics than to their primary care clinics. However, compared with non-ORH-funded teledermatology hubs, funded hubs were more likely to serve patients who were more remotely located from both their primary care and dermatology clinics, and these differences were highly statistically significant each year, consistent with the EWI's goals of serving rural and highly rural patients.

Hubs stated qualitatively that teledermatology enabled them to treat patients with skin problems more quickly and appropriately by, for example, detecting and treating melanomas earlier. One hub remarked that new patients would now be treated within 30 instead of 80 days. Another hub stated that VA's 7-day standard for teledermatology consult completion likely leads to a faster time to treatment than utilizing non-VA care providers.

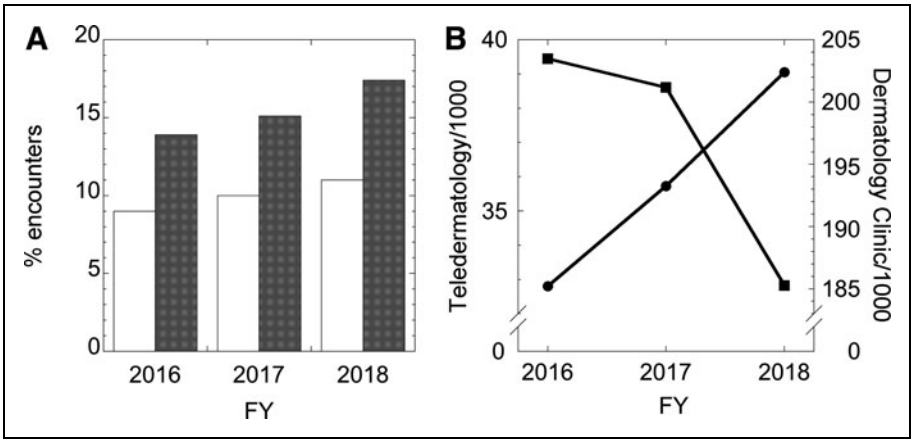

Fig. 2. Teledermatology initiative effectiveness. **(A)** Teledermatology activity as a percent of all dermatology encounters at all Veterans Affairs hubs (white bars) and funded hubs (dark gray). **(B)** In-person dermatology clinic encounters (■) and teledermatology encounters (●) at funded hubs.

ADOPTION

Using our modified SIC instrument (*Fig. 3*), we observed a wide range of implementation progress in the first year. At the end of FY 2017, no programs were in the lowest three stages and were distributed from the fourth lowest stage (preparing for implementation) to the highest stage (ready to disseminate expertise to others). However, by the second year of the program, a shift from the lower to higher stages occurred, and by the end of FY 2018, all hubs reported wider implementation, with six hubs at the highest level.

IMPLEMENTATION

We surveyed hubs to understand barriers and facilitators. There was generally strong support from key stakeholders to implement teledermatology with available staffing and resources. For example, 8/16 and 8/14 leaders had no concern in FY 2017 and FY 2018, respectively. In FY 2017, telehealth support staff (13/16) and dermatologists (11/14) exhibited the highest degree of concern, while PCPs (8/14) and nursing staff (8/14) were the most concerned stakeholders in FY 2018.

Open-ended responses provided a richer understanding of concerns. Understaffing, particularly at rural spokes, was the most common implementation barrier at 13 of 16 facilities in FY 2017 and 8 of 14 facilities in FY 2018. Although hubs alleviated some of this concern by hiring new staff, restructuring current staff positions, and even incorporating into a regional telehealth network, hiring and retention of teledermatology staff continued to be concerns at almost all hubs and spokes each year. Difficulty in hiring new staff was exacerbated by the finite

Table 3. Veteran Travel to Sites of Care

SITE	DISTANCE, MILES (SD)			
	FY 2017		FY 2018	
	FUNDED	NONFUNDED	FUNDED	NONFUNDED
Primary care clinic	24 (21)[a]	19 (17)	25 (23)[a]	20 (17)
Dermatology clinic	59 (45)[a]	52 (42)	60 (46)[a]	51 (42)

[a]Denotes statistically significant difference with nonfunded sites ($p < 0.001$).
SD, standard deviation.

timeline of EWI funds. While several hubs cited the need for staff overall, others identified the continued need for clinical staff to perform dermatologic procedures or for dermatology readers. In some cases, despite the explicit intent to fund dermatologist and PCP effort, dermatologists funded to read teledermatology cases risked being diverted to see patients.

To alleviate some burden on the teledermatologists' time, five hubs introduced resident trainees to assist with teledermatology.

Less frequent barriers included the following: (1) technical issues (i.e., image quality and software problems); (2) time spent working with information technology specialists who rotated quarterly, resulting in discontinuities in relationships and service; (3) program restrictions on funding use; (4) lack of physical space for imaging and performing dermatologic procedures at spokes (noted by two hubs in FY 2017 and none in FY 2018); and (5) lack of equipment. In response to the need for additional equipment, the EWI allowed FY 2018 funds to be used to purchase cameras and dermatoscopes.

The most commonly reported implementation facilitator was communication, particularly between primary care and dermatology staff, whereby dermatologists were able to provide advice and encourage the use of teledermatology. With communication, hubs learned that PCPs perceived teledermatology to be additional work for them. Hubs innovated by sharing teledermatology management with dermatology and pharmacy and by creating standardized letters for common diagnoses to assist PCPs in efficiently educating patients. Enabling teledermatology support staff to communicate their concerns in clinical staff meetings was also beneficial. One hub displayed mini-teledermatology presentations on public monitors throughout the facility, educating both staff and veterans about teledermatology.

MAINTENANCE

The PSI revealed several hubs with very low sustainability scores (<3) in the first year, whereas no hubs reported such low levels in any of the six categories in the second year (*Table 4*). Hubs reported a very high degree of staff and leadership involvement. The greatest uncertainty concerned the availability of future funding and the degree to which the program had plans to respond to veterans' needs (e.g., plans to consolidate or otherwise change the program if it was ineffective).

Involvement of senior leadership was an important indicator of the ability to sustain programs. At all but one hub, senior leaders, facility directors, or chiefs of staff received regular reporting. For example, one hub provided a white paper to the regional network's executive leadership team. The frequency with which staff reported to senior leadership, however, decreased between FY 2017 and FY 2018.

Discussion and Conclusions

Although conceptually straightforward, asynchronous teledermatology requires many elements to be successfully implemented and sustained. For large and complex health care organizations, understanding the real-world factors that govern implementation of teledermatology is critical for successfully scaling teledermatology nationally. Effective templates, workflows, and operational models are important for scaling up teledermatology.[17–19] VA is fortunate as it has already standardized many of these operational elements while allowing some flexibility. The VA EWI provided an opportunity to study teledermatology implementation systematically within an organization in which it is already widely practiced, but penetrance is incomplete.

The RE-AIM framework was advantageous since it is flexible, readily translated into operational stages, and led us to examine individual- (e.g., distances traveled by veterans), organizational- (e.g., number of providers trained across facilities), and community-level (e.g., interactions among staff) factors. Our results indicate that the teledermatology EWI has had moderate success in reaching the target population of rural veterans, as measured by the number of rural clinics participating and the number of patients served. Furthermore, the average travel distance between veterans' homes and both primary care and dermatology clinics increased between FY 2017 and FY 2018, suggesting that more patients in more rural areas were served as the initiative matured.

Other effects grew more pronounced each year, such as teledermatology activity as a proportion of all dermatology encounters, illustrating that teledermatology's effects may require time to become fully apparent. Fractional teledermatology activity was inversely correlated with usual care

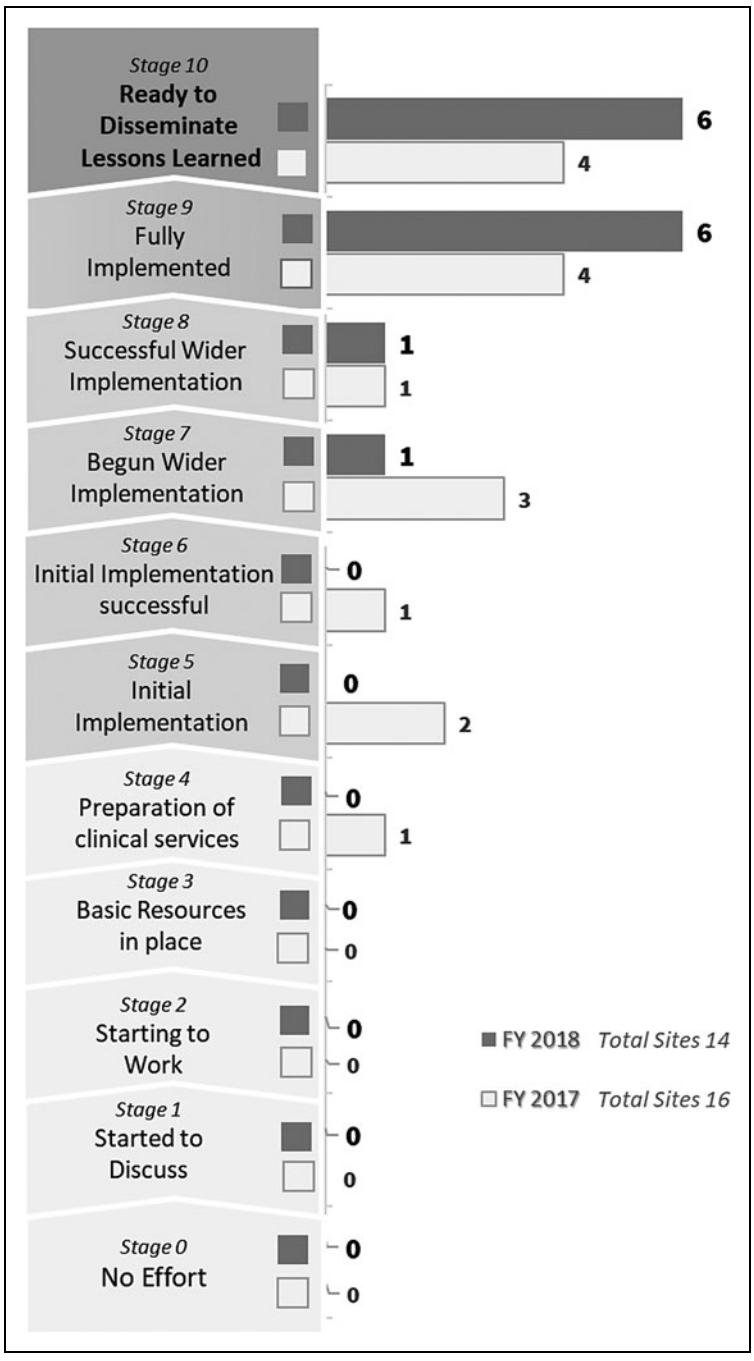

Fig. 3. Stages of implementation completion. Each stage displays the number of hubs self-reporting that stage of implementation in FY 2017 (unbolded) and FY 2018 (bold type).

dermatology clinic encounters. Such an effect may have the secondary benefit of increasing access to in-person dermatology clinics, as we and others have reported.[20,21]

Interestingly, while the number of unique rural patients increased modestly, the number of rural teledermatology encounters declined each year. Because the overall rural veteran population has remained relatively stable during the past 2 years, our observed decline in rural teledermatology encounters appears to be real. Although our data do not indicate why the decline occurred, a possible explanation is that rural PCPs progressively learned from teledermatology encounters to diagnose and manage routine skin conditions and thus increasingly became self-reliant for common diagnoses. Previous teledermatology studies have reported this educational benefit.[22–24]

Our analysis revealed some important facilitators and barriers for teledermatology implementation and sustainment. One of the most important facilitators may have been the existence of the initiative itself, which provided a multiyear funding mechanism to support several key elements of teledermatology operations, as well as some degree of marketing to leadership at hubs due to the national prominence of the ORH program. Other studies have also reported the importance of funding as well as organizational leadership in fostering success in telehealth.[6,24,25] The PSI and SIC data also support the significance of funding, which was a prominent concern in the second year when stakeholders were likely aware that a single year of funding remained before other sources would be required to continue teledermatology at their facilities.

Communication emerged as a consistent facilitator for implementation from all participating hubs, and the lack of communication is a known barrier,[25,26] likely due to the highly collaborative nature of asynchronous teledermatology, which not only depends on PCPs and dermatologists for patient and clinician acceptance but also relies on additional staff for clinical, business, and

Table 4. Program Sustainability

	SCALE MEAN[a] (SD)		FACILITIES WITH SCALE VALUE <3		FACILITIES WITH SCALE VALUE ≥3 TO <6		FACILITIES WITH SCALE VALUE ≥6	
	2017	2018	2017	2018	2017	2018	2017	2018
Overall sustainability	5.4 (1.0)	5.6 (0.7)	1	0	11	10	4	4
PSI subscales								
Leadership	5.7 (1.5)	5.9 (0.9)	1	0	6	4	9	10
Activities of instigators or principal supporters for initiatives and quality control.								
Collaboration	5.3 (1.4)	5.6 (0.9)	2	0	9	8	5	6
Partnerships of relevant stakeholders who actively support teledermatology goals and who have clearly identified responsibilities.								
Demonstrating program results	5.5 (1.3)	5.6 (0.8)	1	0	6	6	9	8
Evaluation of teledermatology processes and outcomes and informing stakeholders of results.								
Strategic funding	5.0 (1.8)	4.9 (1.4)	3	0	7	9	6	5
Plans and resources are in place to support current and future teledermatology program requirements.								
Staff involvement and integration	6.2 (0.8)	5.9 (0.9)	0	0	3	5	13	9
Inclusion of committed, qualified frontline staff in teledermatology design, implementation, evaluation, and decision-making.								
Program responsivity	4.6 (1.1)	5.3 (1.6)	0	0	16	6	3	6
Ability of processes involved in the use of teledermatology to adapt to meet changes in veteran needs.								

[a]Scale from 1 (not at all) to 7 (very much).

technical support. Our results suggest that implementation in large and complex health care organizations would benefit by pre-establishing standardized specific modes and schedules for communication between stakeholders both before (preimplementation) and during the rollout of a telehealth intervention. Leveraging telecommunications technology to communicate with stakeholders such as PCPs and patients can facilitate dissemination of program and educational information in large and geographically dispersed organizations.

Enabling each hub to create solutions that best fit its particular needs and culture arguably increased reach and effectiveness. Hubs developed innovative strategies to overcome the various barriers in expanding and maintaining teledermatology. As a result, some flexibility in the uses of funding rather than arbitrarily deciding what facilities need most may be beneficial. This issue of flexibility in funding usage illustrates the tension between the desire to have a nationally standardized program and allowing enough local control to innovatively address heterogeneity in human and material resources from one facility to another.

Perceived disruption to the PCP workflow by teledermatology was a commonly reported barrier, consistent with prior studies.[9,24,27] Inherent to asynchronous teledermatology

is a need for PCPs to bear additional responsibility for providing patient history as well as for executing recommendations of the teledermatologist. The initiative was designed to address this challenge by explicitly funding PCP time to execute teledermatology-specific functions. While PCP engagement remained a common barrier to adoption of teledermatology, our data revealed that primary care concerns were minor rather than major. Some hubs adapted innovative solutions to address this challenge, notably shifting some patient care responsibilities to the dermatologist, pharmacist, or nurse. As the initiative continues, it remains to be seen which solutions will be optimal and under what settings they will be most applicable and sustainable.

Our evaluation has limitations: first, we did not interview veterans who participated in the program to gain insights from the patient perspective. Although many studies report that patients are satisfied with teledermatology, it will be important to understand why some patients continue to travel to dermatology clinics rather than receive care through their PCP. Second, while participation in the initiative was open to all facilities, the 16 hubs and associated spokes studied were the successful applicants and thus were selected for motivation and resources that might not have existed at the same level had the hubs been chosen randomly.

This study provides a relatively comprehensive understanding of the process of implementing teledermatology services with a focus on rural areas, including identification of barriers and facilitators. The teledermatology initiative resulted in a cohort of VA facilities that can mentor other VA facilities seeking to expand teledermatology services. The challenges and lessons learned in VA are likely to be applicable to implementing teledermatology programs elsewhere, particularly in other large, integrated health care systems.

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Based on VA regulations (VHA Handbook 1058.05 issued on October 28, 2011, and subsequently the VHA Program Guide 1200.21 issued on January 9, 2019), this evaluation has been certified as a nonresearch quality improvement activity by the Director of the VA ORH.

Disclaimer

The views expressed in this report are those of the authors and do not reflect the position or policy of Veterans Affairs or the U.S. Government.

Disclosure Statement

No competing financial interests exist.

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Address correspondence to:
Dennis H. Oh, MD, PhD
Dermatology Service (190)
San Francisco VA Health Care System
4150 Clement Street
San Francisco, CA 94121
USA

E-mail: dennis.oh@va.gov

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