Sociotechnical Perspective on Implementing Clinical Video Telehealth for Veterans with Spinal Cord Injuries and Disorders

Rachael N. Martinez, PhD,¹ Timothy P. Hogan, PhD,^{2,3}
Salva Balbale, MS,^{1,4} Keshonna Lones, MHA,¹
Barry Goldstein, MD, PhD,^{5,6} Christine Woo, MS,⁷
and Bridget M. Smith, PhD^{1,8}

¹Center of Innovation for Complex Chronic Healthcare, Edward Hines Jr. Veterans Affairs Hospital, U.S. Department of Veterans Affairs, Hines, Illinois.

²Center for Healthcare Organization and Implementation Research, Edith Nourse Rogers Memorial Veterans Hospital, U.S. Department of Veterans Affairs, Bedford, Massachusetts.

³Division of Health Informatics and Implementation Science, Department of Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, Massachusetts.

⁴Center for Healthcare Studies, Institute of Public Health and Medicine, Northwestern University Feinberg School of Medicine, Chicago, Illinois.

⁵Spinal Cord Injuries and Disorders System of Care Program Office, U.S. Department of Veterans Affairs, Seattle, Washington.

⁶Department of Rehabilitation Medicine, University of Washington, Seattle, Washington.

⁷Louis Stokes Cleveland DVAMC, U.S. Department of Veterans Affairs, Cleveland, Ohio.

⁸Feinberg School of Medicine, Northwestern University, Chicago, Illinois.

Abstract

Background: Real-time videoconferencing technology such as clinical video telehealth (CVT) offers a means to reach patient populations who face limited access to healthcare. The Veterans Health Administration has invested in CVT to improve care access for U.S. military veterans with spinal cord injuries and disorders (SCI/D); however, no studies have assessed the factors that influence implementation of this technology in clinical practice for individuals with SCI/D.

Introduction: Guided by a sociotechnical perspective, the purpose of this study was to identify factors that influence implementation of CVT for veterans with SCI/D.

Materials and Methods: We conducted semistructured telephone interviews with 40 healthcare providers who use CVT to deliver services to veterans with SCI/D.

Results: Factors related to workflow and communication were widely reported as implementation barriers. Coordinating

logistics for CVT appointments was challenging, and effective communication between CVT team members across facilities was considered crucial. Providers also cited factors related to technical infrastructure, people, and organizational features, including the need for appropriate equipment, space, personnel, and support for using CVT equipment.

Discussion: The implementation of CVT in the care of veterans with SCI/D was influenced by an interrelated set of social and technical factors. Key among them were social factors related to people, workflow, and communication, given that CVT supports healthcare teams interacting remotely in real time.

Conclusions: CVT implementation requires teams working together to negotiate a complex, distributed process across multiple sites. Such complexity places a premium on teamwork and communication among healthcare teams before, during, and after a CVT encounter.

Keywords: telehealth, telemedicine, spinal cord injury, socio-technical model, communication, coordination, teamwork, veteran

Introduction

Spinal cord injuries (SCI) can lead to substantial physical, psychological, and social challenges.¹⁻³ In the United States (U.S.), approximately 276,000 individuals are living with SCI and approximately 12,500 new cases are reported annually.^{4,5} These individuals require frequent, specialized, and interdisciplinary healthcare to address impairments to mobility and autonomic functions,^{6,7} as well as secondary complications, including bowel or bladder dysfunction,⁸ pressure ulcers,⁹ pain,¹⁰ depression, and other comorbidities.¹¹⁻¹⁴ Despite these complex needs, individuals with SCI face significant challenges accessing care.^{15,16} Delivery of care to individuals with SCI in rural settings is particularly challenging given transportation and mobility issues and limited available services.¹⁷⁻¹⁹ For these reasons, expanding access to care is important to improving outcomes for this population.^{17,20,21}

To improve care access for U.S. veterans with spinal cord injuries and disorders (SCI/D), the Veterans Health Administration

(VHA) SCI/D System of Care has adopted the use of Clinical Video Telehealth (CVT), a real-time videoconferencing technology, to provide healthcare services. The VHA SCI/D System of Care is organized as an integrated hub-and-spoke network. Use of CVT is designed to optimize access for individuals with SCI/D who obtain care at local VHA care facilities (i.e., spoke sites) by connecting them with providers at VHA SCI/D Centers (i.e., hub sites).^{22,23}

Evidence shows that use of CVT in SCI/D care produces similar outcomes compared with in-person visits, and is associated with high levels of patient satisfaction.^{24–27} Recent studies have also described issues that are unique to implementing new practices in SCI/D care settings^{28,29}; these findings suggest a need to assess factors that may influence CVT implementation specifically in SCI/D care. The purpose of this study was to examine, from a sociotechnical perspective, the range of factors that influence implementation of CVT across VHA SCI/D facilities. We used Sittig and Singh's sociotechnical model,³⁰ developed to advance knowledge of the social and technical factors that shape implementation and evaluation of health information technology (HIT) interventions, to guide our evaluation (Table 1). To our knowledge, the implementation of CVT in SCI/D care represents a novel context in which to apply the sociotechnical model.³⁰

Materials and Methods

We conducted a qualitative, formative evaluation using semistructured telephone interviews. Interviews were conducted between January and July 2014. This study was approved by VHA Institutional Review Boards.

PARTICIPANTS

We used a purposeful sampling strategy to identify healthcare team members based at spoke sites that use CVT technology within the VHA SCI/D System of Care. We recruited participants from a list of 155 providers from 69 spoke sites, all of whom were invited to complete a semistructured interview.

PROCEDURE

We e-mailed providers to inform them of the opportunity to participate and sent a follow-up e-mail a week later with a formal invitation. Verbal consent was obtained at the beginning of each participant telephone call. Before the start of the interviews, participants were asked to complete a demographics questionnaire. Two authors trained in qualitative methods conducted the interviews. Interviews lasted approximately 45–60 min, were audio-recorded, and transcribed verbatim.

MEASURES

We designed a semistructured interview guide with open-ended questions and corresponding probes. The guide was reviewed by clinicians, refined, and pilot tested in a provider interview before data collection. Interview topics included the following: (1) provider teams and roles, (2) process of using CVT; (3) inhibiting and facilitating factors to implementing CVT; and (4) general perceptions of the technology. Sample interview questions are listed in Table 2.

DATA ANALYSIS

Descriptive statistics were used to analyze questionnaire data. Interview transcripts were loaded into NVivo (QSR

Table 1. Sittig and Singh's (2010) Sociotechnical Dimensions for Understanding Health Information Technology in Healthcare Settings

DIMENSION	DESCRIPTION
Hardware and software computing infrastructure	Technical dimension composed of physical devices and software
Clinical content	All data, information, and knowledge stored in a system
Human computer interface	Devices and software that support interaction between a system and users
People	Those individuals involved in the design, development, implementation, and use of the technology
Workflow and communication	Tasks and collaboration necessary to ensure that patients receive the appropriate care and services
Internal organizational policies, procedures, and culture	Structures, policies, and procedures of an organization that influence technology management
External rules, regulations, and pressures	Forces outside an organization that facilitate or impede efforts to design, implement, use, and evaluate technology
System measurement and monitoring	Includes system availability, its use by stakeholders, its effectiveness, and associated intended and unintended consequences

Table 2. Interview Guide Topic Areas and Sample Questions

Topic area I: Contextual issues—team, role, and work characteristics
Tell me about the team that you are a part of at your facility.
What is your role/contribution on the team?
Topic area II: Process of utilizing CVT for providing services to veterans with SCI/D
Please step me through a typical appointment with a veteran undergoing treatment for SCI/D. Probes: Who and what is involved in prescreening activities? What is the actual encounter like? What happens after the encounter is over?
Topic area III: Inhibiting and facilitating factors to implementing CVT
What types of challenges has your team encountered in the setup of CVT?
What types of challenges has your team encountered in providing telehealth services to veterans with SCI/D?
What has helped enhance the implementation of CVT?
Do you have any best practices for the challenges that your team has encountered?
Topical area IV: Concluding perceptions
Do you see value in providing telehealth services to patients? Why or Why Not?
CVT, clinical video telehealth; SCI/D, spinal cord injuries and disorders.

International Pty Ltd. Version 8.0, 2008) and analytic work proceeded through thematic content analysis, which involves deriving concepts from data and comparing them with other data to facilitate meaningful categorization.^{31,32} We initiated coding with a list of basic categories from the interview topics (Table 2). Within these categories, emergent subcodes were identified and defined in a codebook. Two of the authors reviewed a subset of the transcripts independently and then met to compare emergent subcodes. They then coded the entire data set independently using the categories and subcodes identified, refining codes as necessary. The initial list of basic codes and subcodes became saturated after coding 10–12 transcripts. The eight dimensions of the sociotechnical model³⁰ were applied to the data set after this initial analysis. Two authors independently categorized codes and subcodes from the codebook within the most representative dimensions of the model. Consensus was obtained between the two authors and subsequent discussions regarding interrelatedness of the dimensions were captured in memos.

Results

As shown in Table 3, 40 providers representing 33 different SCI/D care facilities participated; the sample comprised

Table 3. Provider Demographic Characteristics

CHARACTERISTICS	N	PERCENTAGE
Gender	40	
Female	31	77.5
Male	9	22.5
Age	40	
25–35 years	5	12.5
36–45 years	7	17.5
46–55 years	17	42.5
56–65 years	11	27.5
Role at VHA	40	
Social worker	18	45.0
Nurse	11	27.5
Physician	6	15.0
Advanced practice nurse	4	10.0
Physical therapist	1	2.5
Total years worked with individuals with SCI/D	40	
Less than 3 years	7	17.5
3–10 years	20	50.0
Greater than 10 years	13	32.5
% of time caring for individuals with SCI/D	39	
< 50% of time caring for individuals with SCI/D	19	48.7
≥ 50% of time caring for individuals with SCI/D	20	51.3
Number of individuals with SCI/D seen a month	38	
0–9 individuals	15	39.5
10–30 individuals	15	39.5
Greater than 30 individuals	8	21.0
Healthcare services provided over CVT	32	
Discharge planning	29	90.6
Wound management	24	75.0
Rehabilitation therapy consultation	19	59.4
Postdischarge follow-up	18	56.3
Patient education	15	46.9
Preadmission evaluation	13	40.6
Wheelchair consultation	10	31.3
Caregiver support/education	7	21.9
Urological management	6	18.8
Psychological counseling	5	15.6
Other	5	15.6

VHA, Veterans Health Administration.

primarily social workers, nurses, and physicians. We used the eight sociotechnical model dimensions³⁰ to organize and describe the factors identified through our analysis that influence CVT implementation for veterans with SCI/D. The model dimensions are recognized as interdependent; we presented factors within the most representative dimension. Of note, factors related to external rules, regulations, and pressures are not discussed as they did not emerge in the interviews. Representative participant quotations are presented in Table 4.

HARDWARE AND SOFTWARE COMPUTING INFRASTRUCTURE

Several challenges reflecting the technical requirements for implementing CVT, including appropriate equipment, bandwidth, and physical space, were reported. Providers mentioned equipment failure as a problem. A related issue was limited bandwidth, which occasionally resulted in dropped calls or delayed audio/video. Given the limited space available in most care settings, identifying sufficient space for CVT equipment was a common challenge across sites. To overcome these issues, providers described the importance of using up-to-date equipment and working with other clinics outside of SCI/D to locate space for CVT equipment and appointments.

CLINICAL CONTENT

Factors related to clinical content extended beyond CVT storage capacity to encompass the use of CVT for sharing clinical information. Several providers emphasized the importance of establishing correct CVT clinic stop-codes (i.e., identifiers used to denote workload for outpatient encounters, inpatient appointments in outpatient clinics and inpatient billable professional services). As participants explained, incorrect clinic stop-codes can have unintended consequences for workload credit and healthcare reimbursement.

Conducting appointments over CVT also presents unique challenges to gather clinical information. A common concern was the perceived limits to evaluate physical symptoms over CVT. Many providers found it difficult to assess complaints (e.g., wounds) without being physically present to use their own hands. However, many reported the benefit of using CVT to consult specialists outside their facility to gain insight into clinical issues beyond their expertise.

HUMAN COMPUTER INTERFACE

Providers commonly reported that the more they interacted with the CVT technology, the more confident they became with powering the equipment on and off, adjusting the camera, placing video calls, and speaking with remote clinical

teams over a CVT screen. The same was reported to be true for individuals with SCI/D. Some providers encountered initial hesitance from individuals with SCI/D, which they mostly attributed to patients' uncertain feelings about the new technology. Once providers explained what CVT was and how it worked, however, most said that patients were comfortable having a CVT encounter.

PEOPLE

Many providers stressed the importance of having adequate staff to address the steps involved in implementing CVT services. Many found it difficult to execute a CVT encounter without staff who possessed knowledge of the equipment and related technical skills. They emphasized the importance of having at least one on-site CVT champion, who could be a telehealth coordinator, nurse, social worker, IT administrator, or anyone who can help coordinate CVT activities. Advocating for CVT use, scheduling CVT appointments, preparing CVT equipment, obtaining special equipment, and/or distributing CVT-related work to prevent providers from getting overwhelmed were all tasks identified in the purview of a CVT champion.

An essential aspect of this dimension of the sociotechnical model is the availability of training to overcome user-related problems with a given technology. The VHA has established standard online training for providers who use CVT. Although the providers in our sample generally perceived this training as informative, they suggested supplementing it with in-person, hands-on training activities. Many reported the benefits of face-to-face contact with on-site and off-site staff who know how to use CVT. In particular, one provider discussed the benefit of having experienced providers share their knowledge with newer providers on using CVT technology. Furthermore, providers indicated that they would value "refresher" trainings, given the many details that must be tracked, especially when initiating CVT use.

WORKFLOW AND COMMUNICATION

Implementing CVT technology generally involves two main processes—coordinating logistics surrounding CVT appointments and interacting over CVT to deliver services. A commonly reported problem among participants was scheduling encounters. Scheduling can be difficult because appointment times depend on the availability of CVT equipment, space, patient with SCI/D, and multiple providers at multiple sites, some of which may be in different time zones. Other activities include setting up equipment and confirming the transfer of information between sites before and after encounters. Coordinating these activities often involves multiple people from participating facilities.

Table 4. Exemplary Quotations Representing Sociotechnical Dimensions and Subcodes

SOCIOTECHNICAL DIMENSION	SUBCODE	SUBCODE DEFINITION	EXEMPLARY QUOTE
Hardware and software computing infrastructure	Technical requirements of CVT	Technological issues (e.g., equipment malfunctions and limited bandwidth) can delay setup or inhibit use.	When you get multiple calls, sometimes the bandwidth can't manage all the calls and you'll get interference or you start dropping calls.
	Space	Facilities lack necessary space for conducting appointments over CVT (e.g., a small room makes it difficult for camera to capture whole room).	We have our SCI clinic use the same space as rehab. The room the CVT equipment is in right now is not very big or very private, we can't really do a physical exam in there. It's just not conducive to a true appointment where you're laying hands and looking at all the things you might need to look at.
Clinical content	Establishing correct clinic stop-codes	Establishing correct clinic stop-codes is necessary for accurately tracking telehealth activities.	There was a while where CVT encounters weren't being coded right, they weren't counting the numbers correctly and it was a scheduling/coding thing. We'd get these notes later on, and all these orphaned appointments out there and orphan meaning that one end or the other, they weren't being coded and checked out correctly. [...] I think there's still a bunch of appointments that get lost in the system that are never getting counted. I don't know if it's exactly accurate, but that's like anything with the computerized system. There are always glitches here and there.
	Limitation of evaluating physical symptoms over CVT	Degree to which providers feel it is difficult to assess the health condition of the patient over CVT.	The patients with a spinal cord injury are so special with urosepsis and wound care issues, [...] so accommodating them was so hard for my nursing staff to wrap their arms around not physically touching that person. It was such a difficult transition to make, but now the other clinics are off and running and they're looking and going, "Wow, that's cool, and that really works."
	Value of accessing specialists over CVT	CVT increases access to experts and educational resources to facilitate healthcare team decision-making.	I like that with spinal cord injury, we have access to the specialists at the SCI Center because we don't have that here. [...] Our patient can show up here and have the conversation with them. That's really great.
Human computer interface	Provider comfort level with CVT	Providers become more comfortable and confident with using CVT the more they are able to interact with it.	The more we worked with [CVT technology], the more confident we've become.
	Patient comfort level with CVT	Some patients are not initially comfortable with having appointments over CVT but can be open to the idea once introduced to the technology.	Whenever the veterans were here for the face-to-face visit and we showed them the equipment, I think that helped them to be a little bit more comfortable [...] so that when I did talk to them and said, "Let's do this by telehealth," they would say, "That's the thing in the corner, right? Okay, well yeah, that's not scary or anything."
People	Need for knowledgeable staff	Providers need staff with appropriate knowledge about CVT technology and clinical processes.	We know now that sometimes you need more than just a tech. Not doubting the techs, but sometimes you need a clinical person [...] It's like with anything, you implement, you reassess, and you change as you go.
	Need for CVT champion	CVT champions play an important role in facilitating CVT use.	I think it would be hard without one person spearheading it. [The CVT champion] really took the reins on it, and has made a lot of connections with [remote sites and leadership]. I really think [the CVT champion] paved the way for telehealth here.

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Table 4. Exemplary Quotations Representing Sociotechnical Dimensions and Subcodes *continued*

SOCIOTECHNICAL DIMENSION	SUBCODE	SUBCODE DEFINITION	EXEMPLARY QUOTE
	Value of supplementing online training with in-person training	Supplemental in-person training gives providers a hands-on opportunity to practice with CVT technology.	I think the online training is useful, but I think the negatives with the online training is you sit for an hour or two and you learn via just watching the computer screen and I'm a hands-on person and I have to learn by redundantly doing something over and over again and the problem is that if I'm not doing it while I'm reading or looking at this system, it doesn't really help me.
	Providers training providers	Providers who are comfortable with CVT technology can share their experiences and knowledge with other healthcare team members.	We have a robust telehealth program, so there are lots of experienced providers that are comfortable with telehealth that can mentor newer providers. I think it's important to have some people that are very comfortable with it and experienced with it to help the newer people and model how it can be done.
Workflow and communication	Communication about CVT activities	Communication about CVT activities (e.g., scheduling) facilitates process.	We connect with each other and there's an expectation that the team is there and ready to go, and our team is here and ready to go. I organize our team, I take responsibility for that. She and I have had a lot of communication. We instant message each other, we set it up well. Then we proceed with the patient.
	Communication about patient medical information	Communication about patient's medical history and symptoms ensures that health concerns are addressed effectively.	Their [patients with SCI/D] discharges are very complicated and very complex and trying to set up healthcare and resources for them. It's important that we all talk and we're on the same page. I think getting the [patient] information beforehand of what is needed is the key thing and trying to make sure that the visit is focused and to the point [...] because if you have a doctor sitting on the other end, you don't want to be going over 50 different things if you're there to talk about one or two things.
	Establishment of healthcare team communication, trust, and rapport	Establishing relationships between healthcare team members at both sites allows for open communication, and builds trust and rapport.	I think that it's really crucial that folks already have that relationship established well with the [distant facility], because if you have that in place, [CVT] is just like icing on the cake. [...] If you don't communicate well with them, if you don't have that whole idea of how you're going to co-manage patients, adding this on with the technology, the extra time, is a beast to even attempt because you don't already have that rapport.
			I can see who my counterparts are at the center, I get to actually see them and they see me. I think it establishes a little more rapport and it's more personal. It feels like more like you're interacting with an extension of your own team, just by being able to see them and communicate. I don't really know the providers at [the other facility], and they don't really know me that well, so there's an issue of trust there. It's like, "How do we know that her clinical judgment is appropriate? We don't know her as a provider." So part of it is establishing that relationship and then over time developing that relationship so that they can make a more accurate determination of whether you're making clinically sound judgments.

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Table 4. Exemplary Quotations Representing Sociotechnical Dimensions and Subcodes *continued*

SOCIOTECHNICAL DIMENSION	SUBCODE	SUBCODE DEFINITION	EXEMPLARY QUOTE
Internal organizational policies, procedures, and culture	Support and resources from leadership	Receiving support and resources from leadership facilitates the effective implementation of CVT.	We had an executive leadership group that said, "This is the Director's directive and he's right, and we need to reach out to these patients. We're going to develop a department for you. We're going to give you a chief physician and we're going to hire people into those roles and you have our support and it's an expectation said of you, and you will do this," and we did. You have to have support from the top.
System measurement and monitoring	Efficiency of using CVT technology	CVT technology allows for open communication between multiple healthcare team members to address the patient's needs in a timely manner.	We had two surgeons, one on my end and one on their end communicating face-to-face on the veteran's condition. That just seemed like a better way to have a difficult conversation about a very complex medical issue. It's better than reading the chart note in remote data, better than email because it was real time, and I think it was valuable. [...] I think those two surgeons accomplished a weeks-worth of work and consultation in less than an hour by being able to do it that way.
	Value of using CVT technology for preventive healthcare	CVT technology allows for healthcare team to connect and intervene more frequently with patients, which can prevent issues.	The more preventive healthcare we can do, the fewer hospitalizations, wounds, UTIs, and pneumonia they're going to have. They see us four times a year, instead of twice a year. They're going to be healthier.
	Value of using CVT technology to engage patients	CVT technology gives patients the opportunity to interact with their healthcare team as a whole, and participate in their healthcare decisions.	The benefits [of CVT] for being transferred out into the world for the first time if you're a spinal cord injured patient, are comfort, quality, consistency in care, and a more effective and efficient handoff from provider to provider group. It's an opportunity for the veteran to see their whole multidisciplinary team and realize that they're not just alone.

Another prominent issue described by providers is the relationship between the success of CVT encounters and communication among team members at participating facilities. Participants unanimously agreed that ongoing communication across facilities is essential. This communication must span multiple levels, including troubleshooting technical issues and determining a process for sharing patient medical information (e.g., medical history and symptoms) in a timely manner. Providers reported that CVT appointments run more efficiently when patient medical information is shared between facilities in advance. Some described the benefit of holding team conversations over teleconference or e-mail before CVT appointments to communicate that information and prepare for a focused visit.

Also of importance is the actual interaction over CVT to access and deliver the needed services. Many providers emphasized the importance of being "on the same page" with remote team members and having the necessary information to make informed decisions as a team. Many providers reported tremendous benefit from seeing remote team member faces and expressions, which helped make the connection

more personal. The importance of establishing relationships with providers across facilities to support the CVT encounter was frequently discussed. When providers were not familiar with other team members, issues of trust were potentially exacerbated over CVT. Establishing rapport with team members during CVT training and encounters was recognized as a means to support team building and development of trust. The more team members at local and distant facilities interacted with each other, the more chances there were for them to know and become comfortable with each other.

INTERNAL ORGANIZATIONAL POLICIES, PROCEDURES, AND CULTURE

Leadership from multiple organizational levels influenced how CVT was implemented in SCI/D care. At the overall system level, VHA leadership was responsible for providing funding for facilities to obtain CVT equipment. At the facility level, buy-in from the hospital director, SCI/D Center Chief, and leaders of the healthcare team facilitated CVT uptake and use. Providers noted that support from VHA leadership was crucial to implementing CVT.

SYSTEM MEASUREMENT AND MONITORING

Many providers discussed the effectiveness of CVT for promoting access to healthcare services. Most explained that a tremendous advantage of CVT is the convenience offered to individuals with SCI/D, and that the technology has enhanced access for many who may have previously gone without assessments or treatments because of geographic and distance-related barriers. The option to travel to a nearby VHA facility as opposed to an SCI/D Center was reported by providers as an effective solution to save veterans hours of travel time. Providers explained that CVT encounters can be more efficient because the entire healthcare team is present along with the patient and sometimes his/her family, allowing for questions and concerns to be addressed in real time.

Finally, using CVT as part of SCI/D care may increase patient engagement and improve outcomes. Providers reported that CVT allows them to intervene early and meet more frequently with individuals with SCI/D, facilitating preventive, seamless care. They also explained that CVT use empowers individuals with SCI/D to engage in healthcare decision-making and connect with their healthcare team, as a whole, more frequently.

Discussion

This study is the first to examine perspectives of healthcare providers regarding implementation of CVT to evaluate and treat veterans with SCI/D. Application of the sociotechnical model highlighted a range of factors that influence CVT implementation while accounting for the complex interactions of HIT and the SCI/D care context.

Despite several benefits of utilizing CVT in SCI/D care, the process of implementing this technology is complicated, given the many steps and people it involves. The required coordination and effective communication between local and remote team members at both facilities were seen as crucial for implementation (workflow and communication dimension of the sociotechnical model). Insufficient resources were identified as an additional challenge. Providers reported the need to have appropriate equipment, space, personnel, and support for setting up and using CVT equipment at both facilities. These resources span several sociotechnical model dimensions, including hardware and software computing infrastructure, people, and internal organizational policies. Addressing such resource needs can improve the implementation of CVT. These results are consistent with a recent systematic review of knowledge translation and implementation change in SCI/D, which emphasized insufficient resources (e.g., funding, personnel) and communication as key barriers to implementation, and communication among team members as a

key facilitator.²⁹ Teamwork and effective communication throughout the healthcare setting are essential for providing efficient, quality care to optimize patient outcomes.^{33,34} The Institute of Medicine emphasizes the importance of teamwork stating that it involves “changing the existing construct of care delivery to one of open collaboration with patients, team-based care [and] delivery of care within and outside the hospital” (p. B18).³⁵ Providing SCI/D care has been recognized as a team-based enterprise for well over 40 years. Healthcare organizations, especially those using CVT to provide care for patients with SCI/D, may benefit from developing teamwork at multiple levels—across organizations, providers, patients, and their families—to deliver high-quality care.³⁶

Many providers in this study highlighted the importance of leadership support to initiate and sustain use of CVT technology, and the value of having a dedicated person to coordinate CVT activities. The importance of leadership support and local champions to implementation success was also demonstrated in a recent study evaluating implementation of methicillin-resistant staphylococcus aureus (MRSA) prevention guidelines in SCI/D Centers.²⁸ Facilitation via internal facilitators (i.e., individuals familiar with organizational features) and external facilitators (i.e., experts in general implementation activities) is an important strategy with proven success in implementing evidence-based practices and programs.³⁷

Healthcare teams, including those who provide SCI/D care, are complex, adaptive systems that comprise multiple individuals interconnected with each other and their environment.³⁸ Integrating CVT technology into this context has unique implications for care delivery, given that CVT involves face-to-face interaction at a distance and distributes control of care processes across facilities. The processes involved in implementing CVT in SCI/D care also highlight the importance of understanding the interactions among dimensions of the sociotechnical model.³⁰ When CVT technology is used across healthcare facilities, it changes relationships within and between those facilities, in a sense, creating a whole new organization. The sociotechnical model underscores the implications of a new, virtual organization in which healthcare is practiced.

Specific attributes of CVT technology emphasize different dimensions of the sociotechnical model. Typically, the hardware and software computing infrastructure dimension of the model encompasses technical aspects, but the nature of CVT requires consideration of other infrastructural factors that impact the technology’s implementation—namely, space. Although space itself is not necessarily a technical issue, it is difficult to conduct appointments over CVT technology without sufficient space that offers privacy and room to host a

clinical care team and an individual with SCI/D. Because CVT supports people interacting remotely, the sociotechnical model dimensions centered on people, workflow, and communication were particularly relevant to our analysis. The real-time video stream supported by CVT allows for continuous interaction among people as opposed to static data sharing. Moreover, CVT benefits from the engagement of additional staff with specific knowledge, including system users (e.g., physicians) and those who support users (e.g., IT). Formal, tailored training provided by SCI/D leadership has been acknowledged as an important facilitator for implementation.²⁸ In the case of CVT, training is important for use of technology, and to bring the new organization together to establish rapport. When providers are unfamiliar or have not worked previously with remote counterparts, trust issues may arise. Meeting face-to-face in-person or over CVT before coordinating patient care may help in developing relationships and trust. Research has shown that the integration of virtual care modalities into the care of complex patient populations is facilitated when relationships among team members are established or recognized as important to develop.^{39,40}

LIMITATIONS AND FUTURE RESEARCH

A strength of this study is the inclusion of multiple facilities from the largest integrated healthcare system in the United States that cares for individuals with SCI/D. However, our findings are based on self-reports of provider experiences and perceptions. As evidenced by our data, veterans with SCI/D face unique challenges in accessing care and CVT has considerable potential to improve access for this population. By thoughtfully integrating this technology with the workflow of providers and the care experiences of patients, improvements in access may be realized and use of CVT can be sustained. Future research should focus on how best to help providers and patients understand the potential value of CVT to their practice and care.

Conclusions

We build on previous research that shows how sociotechnical models can be used to understand the sociotechnical aspects of implementation of virtual technology and the complex interactions of technology within a healthcare system.⁴¹ Using the eight-dimensional sociotechnical model as a lens magnifies the key issues inherent in CVT implementation in SCI/D. The extent to which our data represent the model dimensions demonstrates the many social and technical factors relevant in this context. Implementation of CVT requires teams of people working together to negotiate a complex,

distributed process across multiple sites. Such complexity places a premium on coordination and communication among stakeholders and may have various implications for providers as roles may change or be redefined. As CVT implementation continues to grow in the SCI/D community, efforts are needed to evaluate the application of CVT for SCI/D care.⁴²

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Address correspondence to:

Rachael N. Martinez, PhD

Center of Innovation for Complex Chronic Healthcare

Edward Hines Jr. Veterans Affairs Hospital

U.S. Department of Veterans Affairs

5000 South 5th Avenue (151H)

Hines, IL 60141-5151

E-mail: rachael.n.martinez@va.gov

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