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Research and Applications

Electronic consultations and economies of scale: a qualitative study of clinician perspectives on scaling up e-consult delivery

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ABSTRACT

Objective: To explore Veterans Health Administration clinicians' perspectives on the idea of redesigning electronic consultation (e-consult) delivery in line with a hub-and-spoke (centralized) model.

Materials and Methods: We conducted a qualitative study in VA New England Healthcare System (VISN 1). Semi-structured phone interviews were conducted with 35 primary care providers and 38 specialty care providers, including 13 clinical leaders, at 6 VISN 1 sites varying in size, specialist availability, and e-consult volume. Interviews included exploration of the hub-and-spoke (centralized) e-consult model as a system redesign option. Qualitative content analysis procedures were applied to identify and describe salient categories.

Results: Participants saw several potential benefits to scaling up e-consult delivery from a decentralized model to a hub-and-spoke model, including expanded access to specialist expertise and increased timeliness of e-consult responses. Concerns included differences in resource availability and management styles between sites, anticipated disruption to working relationships, lack of incentives for central e-consultants, dedicated staff's burnout and fatigue, technological challenges, and lack of motivation for change.

Discussion: Based on a case study from one of the largest integrated healthcare systems in the United States, our work identifies novel concerns and offers insights for healthcare organizations contemplating a scale-up of their e-consult systems.

Conclusions: Scaling up e-consults in line with the hub-and-spoke model may help pave the way for a centralized and efficient approach to care delivery, but the success of this transformation will depend on healthcare systems' ability to evaluate and address barriers to leveraging economies of scale for e-consults.

Key words: remote consultation, electronic health records, integrated delivery of healthcare, qualitative research, Veterans health services

INTRODUCTION

Faced with an imperative to increase efficiency and reduce costs without sacrificing service quality, healthcare organizations in the United States and abroad are increasingly looking to telehealth. The COVID-19 pandemic has accelerated this trend, resulting in rapid growth in the uptake and use of telehealth technologies.¹⁻³ In this context, there is an urgent need to understand how these technologies can be scaled up even further while maintaining or improving care quality.

Electronic consultations (e-consults) are a technology well-positioned for scaling up. E-consults are an asynchronous, electronic mode of clinician-to-clinician communication via a shared electronic health record (EHR), virtual platform, or mobile application.⁴ By providing access to rapid specialist advice, e-consults empower primary care providers (PCPs) to manage a broader range of clinical issues⁵⁻⁷ and may obviate the need for a face-to-face specialist appointment altogether.⁸⁻¹⁰ Healthcare systems may be able to take advantage of economies of scale (ie, expand e-consult delivery while controlling the costs) by adopting a hub-and-spoke model, wherein a single pool of e-consultants (the “hub”) serves multiple sites¹¹ (also referred to as the “centralized e-consult model” below). The “hub” may be physical (eg, a specialty care service at a specific site) or virtual (a group of e-consultants drawn from multiple sites). See [Figure 1](#) for a visual comparison of the hub-and-spoke and decentralized models.

The hub-and-spoke design principles have been applied to in-person and telehealth (provider–patient) healthcare services alike,

and the benefits discussed in the literature include increasing healthcare systems’ capacity to serve larger numbers of patients, especially those in remote areas,¹²⁻¹⁵ and improving access to “in house” specialists.^{16,17} The hub-and-spoke design is well-positioned to capitalize on the documented benefits of e-consults by further expanding the access of clinicians at remote or low-resource sites to specialist advice and sparing patients the time and expense of travel. This design benefits healthcare systems that include both medical centers with a high concentration of specialists and low-complexity facilities. Additionally, as e-consult responses in a hub-and-spoke model would be more amenable to standardization and tracking, a hub-and-spoke model may reduce undesirable variation in quality and ensure a more robust quality assurance mechanism.

Variations of a hub-and-spoke model have already been implemented in several organizations. A particularly successful example is the Champlain BASE program that began as a regional pilot and has gradually expanded across Ontario and to other Canadian provinces.^{18,19} There are also private, subscription-based platforms that provide primary care practices and health systems with access to specialist e-consults, such as RubiconMD,²⁰ AristaMD,²¹ ConferMed,²² and others. Research on e-consults contains numerous insights about barriers and facilitators to successful implementation of a *new* e-consult program.²³⁻²⁵ However, little guidance exists on which factors health systems might want to consider prior to scaling up their *existing* e-consult system¹⁸ or, indeed, implementing a hub-and-spoke e-consult model anew. This study is guided by the following research question: What are the barriers and facilitators to

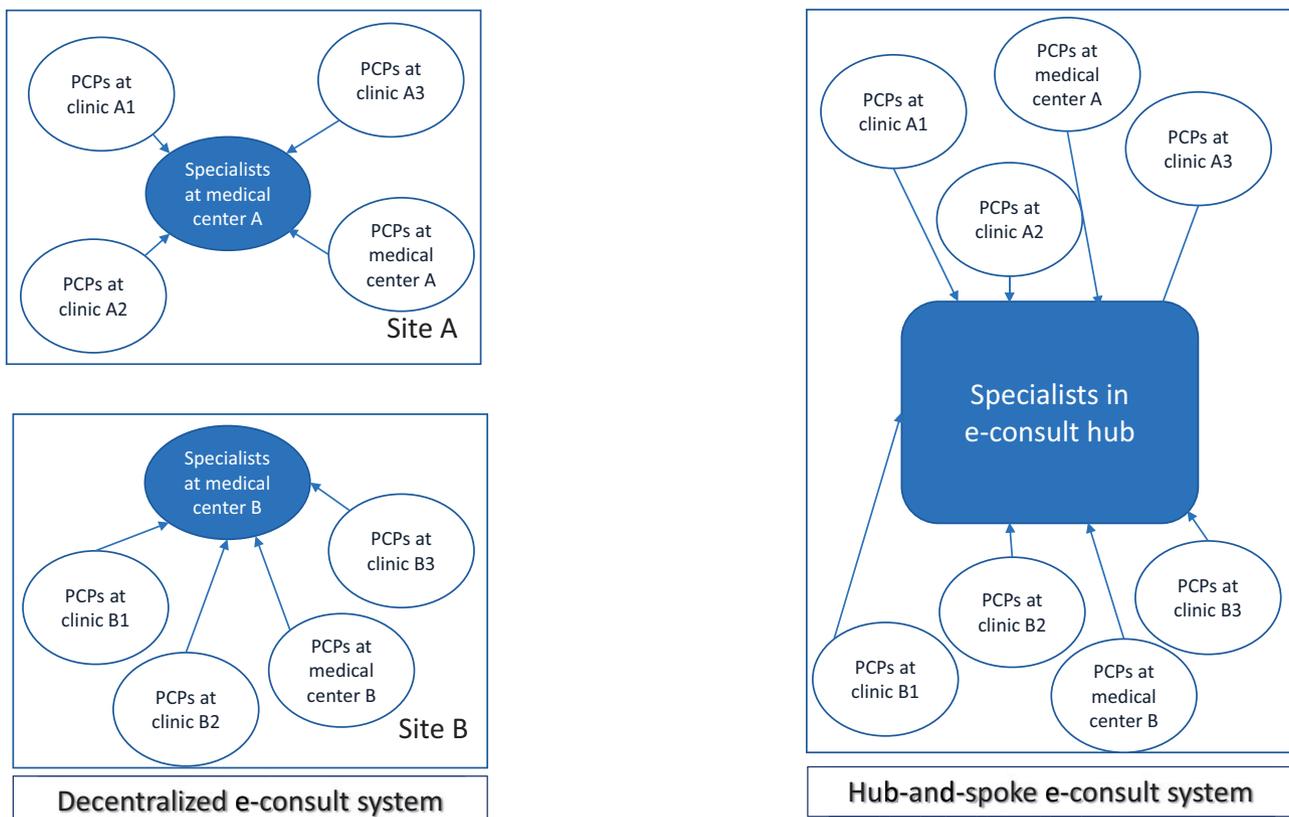


Figure 1. A decentralized vs hub-and-spoke e-consult system.

Table 1. Site characteristics

	Large sites ^a	Small sites ^a
Rural/urban (based on the VA Rural Veteran Health Care Atlas FY 2015 ²⁹)	Large sites serve predominantly urban veterans, with rural veterans constituting a smaller proportion (~10% mean per site as of FY 2015).	Small sites serve a large proportion of rural veterans (~45% mean per site as of FY 2015).
Complexity (based on the VHA Facility Complexity Model) ^b	Two of the sites are designated as highest complexity (1a); the third is medium complexity (2)	Two of the sites are designated as low complexity (3); 1 is medium complexity (2)
Clinical workforce (based on internal VA data)	As of FY20, the mean number of full-time employees per site was ~3300 including ~300 physicians.	As of FY20, the mean number of full-time employees per site was ~1200, including ~80 physicians.
Academic activity	Two of the sites are AAMC (Association of American Medical Colleges) members with highest levels of teaching/research; the third site has a moderate amount of teaching/research	None of the sites are AAMC members; 1 of the sites has a moderate amount of teaching/research
Outpatient appointment volume ^{30,31}	Higher outpatient appointment volume (a mean of >82 000 outpatient appointments scheduled, >46 500 completed in October of FY18 per site).	Lower outpatient appointment volume (a mean of >45 000 outpatient appointments scheduled, >24 000 completed in October of FY18 per site).
E-consult volume (based on internal VA consult data)	High (In FY18 across the 3 specialties included in the study, the ratio between completed e-consults and unique patients seen face-to-face had a mean of ~31% per site).	Low (In FY18 across the 3 specialties included in the study, the ratio between completed e-consults and unique patients seen face-to-face had a mean of ~12% per site)

^aDue to concerns about participant identifiability, we did not include granular information for each site. Instead, we provide a general profile for the 2 categories of sites included in this study. Where appropriate, we provided rounded up means for each site group.

^bIn the VHA system, each site is assigned a complexity level (1–5) that is calculated based on patient volume and risk, clinical services complexity, and level of teaching/research.

implementing a centralized e-consult system? We explore this question by exploring the perspectives of clinicians in Veterans Health Administration (VHA), 1 of the first US health systems to adopt e-consults.

MATERIALS AND METHODS

Setting

This study was conducted in the VA New England Healthcare System (VISN 1). One of the 18 VHA VISNs (Veterans Integrated Service Networks), VISN 1 comprises 8 VA Medical Centers (VAMCs) and more than 40 community-based outpatient clinics across New England. E-consults in VISN 1 (and VHA more generally) can be sent within the same VAMC, from a clinic to the “parent” VAMC, and between VAMCs. The latter approach is colloquially known as an “interfacility e-consult” (IFC) and is typically used if the referring clinician’s local VAMC does not have the relevant specialty service available. Unlike the hub-and-spoke system, IFCs do not rely on an established pool of e-consultants and are instead managed by receiving services on an ad hoc basis.

As is the case for VHA more broadly, e-consult use in VISN1 is robust but associated with several challenges, including lack of access to specialists in some subspecialties, variation in e-consult request and response quality, technological barriers to EHR use across sites, and lack of protected time for specialists to complete e-consults.^{9,24,26–28} Viewing the hub-and-spoke e-consult system as a powerful potential solution to these issues, our research team partnered with VISN1 leadership to explore the feasibility and acceptability of implementing this model on the VISN level.

Study design and site selection

We conducted a qualitative study using qualitative content analysis of semi-structured interviews to identify and describe salient categories. The study was conducted from October 2018 to September 2019. To increase feasibility while ensuring variation between sites, we selected 6 out of 8 VISN 1 sites, including 3 large urban sites with robust specialist availability and high e-consult volume and 3 smaller sites that are generally more rural, have fewer specialists, and tend to use e-consults less actively (Table 1).

Participants

We recruited PCPs and specialists at each site. Specialists were chosen to represent 3 high-volume medical subspecialties (cardiology, neurology, and pulmonology) and PCPs were recruited to represent a range of professional backgrounds (physicians and advanced practice providers). We also recruited clinical leaders at the site and VISN level to capture their perspectives on organizational context and priorities that may impact implementation of a hub-and-spoke design. All participants were identified using public directories, internal VA e-mail lists, or snowball sampling (via referrals from recruited participants). Invitations to participate were e-mailed. Verbal consent was obtained prior to each interview.

Data collection

Semi-structured interviews were conducted over the phone by the first author (EA), a medical anthropologist and experienced qualitative researcher. The interview opened with questions about participants’ personal experiences, practices, and perspectives related to e-consults. We asked participants to reflect on the idea of scaling up e-consult delivery in the VISN to the regional level in line with the hub-and-spoke model. Participants were prompted to share their

Table 2. Characteristics of interviewees (N = 73)

Characteristic	Number of interviewees N = 73 (100%)
Interviewee by role	
Staff clinician	60 (75.9%)
Clinical leader ^a	13 (16.5%)
Interviewee by site	
Site 1 (large)	19 (26%)
Site 2 (large)	14 (19.2%)
Site 3 (large)	10 (13.7%)
Site 4 (small)	10 (13.7%)
Site 5 (small)	12 (16.4%)
Site 6 (small)	6 (8.2%)
VISN level	2 (2.7%)
Interviewee by specialty	
Primary care	35 (48.0%)
Cardiology	14 (19.2%)
Neurology	12 (16.4%)
Pulmonology	9 (12.3%)
Other	3 (4.1%)
Interviewees by discipline	
Physicians	63 (86.3%)
Nonphysicians	10 (13.7%)

^aClinical leaders included clinicians in positions such as chief of medicine, chief of specialty care, chief of primary care, etc. Many, but not all, of these individuals were also either practicing PCPs or specialists in the 3 specialties included in the study. We decided not to provide more detailed information on their backgrounds so as to minimize the risk of inadvertent loss of confidentiality.

perspectives on the advantages and disadvantages of the model, as well as on the potential barriers and facilitators to implementing the model in VISN 1. See Appendix 1 for the interview guide and details on its development. Interviews continued until thematic saturation was reached (the last few interviews did not generate any new concepts).

Data analysis

Interviews were audio-recorded and transcripts imported into NVivo (QSR International). Qualitative content analysis procedures were used for data analysis.³² The initial code book, developed by 3 coders (EA, STR, VV), included both a priori and emergent concepts derived from transcripts. A subset of 15 transcripts was coded collectively to align coding approaches and refine the code book. Subsequently, all transcripts were coded individually, with the team meeting periodically to discuss difficult passages. After the coding was completed, the first author reviewed all passages pertinent to the hub-and-spoke system in the transcripts and identified categories describing the strengths and challenges of this approach as discussed by interviewees. The resulting categories were further refined through iterative discussion with coauthors. See Appendix 1 for additional details.

This study was approved by the VA Bedford IRB.

RESULTS

We interviewed 35 PCPs and 38 specialists in 3 specialties, including 13 clinical leaders, across 6 sites and at the VISN level (Table 2).

Interviewees anticipated the hub-and-spoke e-consult system to have both benefits and challenges (see Tables 3 and 4 for illustrative quotes).

Perceived benefits of the hub-and-spoke e-consult system

Expanded access to specialist expertise was the most commonly mentioned benefit of the centralized e-consult system. PCPs at smaller, more rural sites were particularly enthusiastic about the prospect of acquiring access to specialties that are unavailable or understaffed at the local level, and some specialists also mentioned this advantage. Some clinicians conjectured that expanding access to e-consults via a hub-and-spoke system might help avoid referrals “to the community” (ie, to non-VA clinicians).

Several interviewees thought that a centralized system would be beneficial to specialists in need of advice of *other* specialists with expertise in niche areas (eg, neurosurgery, pulmonary hypertension). Indeed, there was a perception that a centralized system could capitalize on specialty services’ areas of strength across different sites by expanding access to the highly specialized clinical expertise of certain specialists to other facilities beyond the medical center where these specialists are based.

Finally, several interviewees suggested that a central e-consultant would be able to provide more detailed and efficient responses if they had protected time to answer e-consults. This is not currently the case in VISN 1, where consultants generally have to fit e-consult responsibilities in among the rest of their duties.

Perceived barriers to the hub-and-spoke e-consult system

A diverse set of anticipated barriers emerged from our interviews, including local differences between sites, central e-consultants’ lacking an incentive to provide high-quality responses, potential erosion of local interclinician and clinician-patient relationships, risk of burn-out for central e-consultants if fully dedicated to the task, and technological barriers. A perception that the hub-and-spoke model does not provide additional benefit over the current system was also mentioned by a minority of participants.

Local differences

The most prominent barrier invoked by interviewees had to do with the perceived differences between sites comprising the hub-and-spoke system. While clinicians at all sites would be able to take advantage of the hub-and-spoke system, the centralized model would, by definition, actively draw on specialists at large (well-resourced) sites to staff the “hub,” whereas the smaller (low-resource) sites would be the primary beneficiaries. Many specialists, at large and small sites alike, doubted whether e-consultants at large sites would have sufficient knowledge of care processes at less complex facilities. Interviewees pointed out that the 8 sites constituting VISN 1 differ significantly with regard to which resources (diagnostic procedures, therapeutic interventions, appointments with subspecialists) are available and how easily accessible they are (whether considerable wait time and/or travel is involved). As a result, the reasoning went, a specialist who is not well-versed in these nuances may recommend a course of action that would not be feasible for the local PCP. Many interviewees felt that it would be challenging or even impossible for a single person to keep abreast of all local differences. However, other interviewees did not feel that local differences would be an insurmountable barrier and suggested educating central e-consultants on local context and creating a regularly updated inventory of locally available resources.

A variation on this concern focused on differences between local clinical “styles.” Some interviewees felt that specialty care services

Table 3. Categories and illustrative quotes: benefits of the hub-and-spoke e-consult system

Category	Illustrative quotes
Access to specialist expertise for low-resource sites	“The hub and spoke system would be perfect . . . for things like neurosurgery, which we don’t have here” (01, SS1, ^a PCP).
Keeping patients within VA	“I mean, it’s interesting. I can see that being relevant to opening up access to maybe some areas in more community-based or rural sort of settings” (02, LS2, cardiologist). “. . . I think there’s certain specialties . . . that exist at some of the larger medical centers that they do not have at other sites, and so they are referring out to the community and there may be opportunity there to use e-consults” (03, LS1, leader).
Access to subspecialty expertise for other specialists	“. . . there might be more of a role for subspecialty e-consults, and I’m thinking specifically of like, there’s a guy named . . . who does pulmonary hypertension, which is a very sort of—you know, specialized topic. And I’ve never done an e-consult to him, but that would be something I would like to have available, potentially” (04, SS3, pulmonologist).
Capitalizing on local sub-specialty expertise	“There might be a multitiered e-consult system . . . in which there are some specialists—for instance, dementia specialists, seizure specialists, of which we do have several in the VISN. We have some areas, like . . ., who have a dementia unit. We have some areas, like . . ., that have a seizure unit. We in [SS2] . . . do not have either one of them. So, what that means is that we would review all the e-consults. If we did not have the specific knowledge that would be needed, then we would refer it—then we would bump it to the specific person who did have more knowledge to determine whether that person would benefit from traveling to . . . or to . . ., or whether that person should see us first, or whether that patient can just be answered by an e-consult” (05, SS2, neurologist).
Protected time	“E-consults [are not] always given the attention that they need. . . sometimes you can get back a sentence that doesn’t totally answer the question or makes it clear that the provider didn’t fully review the chart either, because they didn’t have the time, or whatever. I think if someone’s job was to sit there and really review the chart in [the] way that you do when you see face-to-face patients, and it wasn’t sort of viewed as an add-on type of task—you know, adding on to the millions of other things we have that we’re thinking about each day as a clinician. I think if you had someone who is devoted specifically to that, and maybe it would be someone who feels more comfortable in that type of setting. Maybe you know, someone who prefers not to have patient interactions. I think that could benefit everybody. . . certainly, I think, from an access standpoint, it would be a huge benefit” (06, LS2, neurologist).

^aIn this and the subsequent table, the 3-digit number following the interviewee ID number refers to the interviewee’s location where LS1 is “large site 1,” SS1 is “small site 1,” etc).

across sites vary in their management styles, especially for those clinical areas where guidelines do not provide hard-and-fast rules. In such situations, they opined, a central e-consultant might end up making a recommendation counter to the approach favored by the local service, which would not be locally acceptable.

Local relationships

Many interviewees were worried about the implications of a hub-and-spoke system for the established local relationships—between clinicians and between clinicians and patients. Participants opined that having a personal relationship with the local e-consultant in a decentralized system allows referring providers to have more trust in the recommendations. Some specialists, across large and small sites alike, shared that they target the tone and content of their advice based on their knowledge of the referring provider’s personality and clinical style, an approach which would be less feasible in a centralized system with a much larger “pool” of e-consult senders.

Participants also thought that a hub-and-spoke system would not work as well for patients who are already followed by a local specialty service. Not surprisingly, there was a sense that specialists who have an established relationship with a patient might have better insight into that patient’s care and preferences. For example, 1 specialist pointed out that, while a central e-consultant might have a

more ‘objective’ approach, the lack of a personal acquaintance between the consultant, patient, and local providers would be a significant disadvantage.

Lack of incentives for central e-consultant

Specialists and PCPs alike worried that central e-consultants, unlike their local counterparts, would lack an incentive to provide judicious, high-quality e-consult responses. This concern took on a different emphasis in each case. Generally, participants felt that, in the current system, specialists are motivated to provide high-quality, detailed e-consult responses because well-answered e-consults will often prevent a face-to-face referral to specialist’s service and thus free them to see other patients. By contrast, there was a suspicion that e-consultants in a hub-and-spoke model would lack this incentive. Specialists, most of them at large sites, feared that a central e-consultant might have a lower threshold to recommend a face-to-face visit, which could potentially lead to an increase in local clinic volume. (In VA’s context, an unmanageable number of face-to-face referrals might undermine VA’s commitment to providing timely care to veterans.) For PCPs, the worry primarily focused on the quality and level of detail in e-consult responses. These participants were concerned that centralized e-consultants, lacking the motivation to

Table 4. Categories and illustrative quotes: barriers to the hub-and-spoke e-consult system

Category	Illustrative quotes
Local differences: Resources	<p>“...if you have somebody in [large site] doing an e-consult on somebody in—let’s say, [remote rural area]—they’re going to run into issues of just what services are available where, and where they are available. And if they recommend, let’s just say, navigational bronchoscopy, that can’t be done within 100 miles of where that person lives. So somehow they would need to know what resources are available in each area, because they are not uniformly distributed” (04, SS3, pulmonologist).</p> <p>“I’m not wild about it. ...one reason why I’m not wild about it is there is an enormous variability in resource availability. So you know, sometimes we’ll get a message from some consultant say, have the patient do a CT scan right now. I say wait a minute, we’re in ... We don’t have a CT scan right now. What are you talking about? I’m fearful from that concept that you’re going to have a very well-meaning specialist up at ... trying to make a suggestion to somebody down at the little clinic in ... without really having a good understanding about what that might mean, logistically” (07, LS1, PCP).</p> <p>“You know, if it was someone who was doing this at a national level, I would be concerned about that. I think physicians are smart people and I think if they have to sort of get a sense of the resources in 7 or 8 different places, I think that’s probably something that they could handle. Even if it means contacting the neurologist, maybe you’d need regular meetings where you contact the neurologist at each institution quarterly and just ask for an update. Are you doing EMGs, are you doing EEGs, are you doing MRIs? ...you check in quarterly and just let people know. But I think if this is your full-time job or you’re doing this regularly, I think after a while you just know. [One site] offers this. [Another site] offers that. And I think, as a general rule of thumb, most of the bigger places offer everything, and the smaller places don’t tend to offer a whole lot. So I think you can kind of use logic and updates and I don’t anticipate that that would actually be much of a problem...” (06, LS2, neurologist).</p>
Local differences: Clinical styles	<p>“It is... appropriate for areas that are well-defined within the guidelines. ... But there are many areas, for instance, [where] there remains great heterogeneity in the care. And therefore... [One site] may be one that pushes intervention, while [another site] in their management style uses medications for that. ...so, you have to understand the cultural differences, the geographic distribution. ... of the heterogeneity of care. In areas that are still ambiguous within the guidelines” (08, LS2, cardiologist).</p>
Lack of central e-consultant’s incentive	<p>“[One aspect of it] is whether or not the person who is deciding whether an e-consult should result in an actual visit by a [LS1] physician, whether that decision is being made by a [LS1] cardiologist versus somebody who doesn’t have any connection with us... And you know, then all of the sudden, we start getting all of these patients coming in where there really hasn’t been a discussion... I think we would want that decision to be made by a cardiologist who is in [LS1] about whether it is appropriate to see this patient in [LS1]. There’s an accountability there” (09, LS1, cardiologist).</p> <p>“I would hate for somebody [to convert] an e-consult to face-to-face because, when you convert to face-to-face, the patient has to be in within 30 days... Without having a say to it. Because we might not agree with that person (10, LS3, cardiologist).</p> <p>“If they’re up—you know, someplace not local, and they’re not going to be the one seeing the patient, whether or not—or at least potentially seeing the patient, whether or not that might shift—you know, again, kind of how much they tell you to do versus them taking the ball into their court” (11, LS2, PCP).</p>
Local relationships—clinicians have more trust in local specialists’ recommendations	<p>“...the... piece that I don’t like about a centralized process is that the providers who are sending the e-consult know who it is, know which pulmonologist is responding to them... And so, there’s a kind of—you have greater confidence in a personalized connection... I think there’s also an advantage that the... person who is placing the e-consult sends something to me, it’s pretty easy for them to then say, do a little Skype message to me saying—did you really mean this? Or pick up the telephone and say—did you really mean that? ...I think keeping it within one facility... makes communication a little bit more effective, because it’s a more personalized connection as opposed to sort of a depersonalized connection” (18, LS2, pulmonologist).</p> <p>“...when I get an e-consult back from a consultant that I trust, I’m very likely to follow their recommendations to the T. You know? And, if it’s a stranger, and I don’t know whether they are good or bad at what they do, like, where does that sort of fit in? I would really—I would truly hate it” (12, LS2, PCP).</p>
Local relationships—specialists can tailor their response to specific sender’s needs	<p>“...sometimes we know the providers well enough to know that they are worried about or whether we can tell them what to recommend they do, or whether we feel like they’re never going to want to do this, we better turn this into a face-to-face consult and see the patient ourselves. So, I’m not sure that a central system for e-consults is going to work that well, because of that” (13, SS3, neurologist).</p>

(continued)

Table 4.. continued

Category	Illustrative quotes
Local relationships—local specialists understand their patients better	<p>“I’ve learned to figure out which people—because most e-consults for us come from primary care. Which primary care docs I could—quote/unquote—trust fully and be able to do the e-consult. And which ones I might be a little more concerned or may want to look at it more deeply or, frankly, just convert those to an office visit. So it is somewhat dependent on who the referring doc is, how well I know them, and how much I trust their neurological exam and other aspects. So there is some selectivity on that part” (14, LS3, neurologist).</p> <p>“I think that it would. . . make sense because you would have. . . more kind of homogeneity in terms of the response and probably the style of response. . . and having kind of a more objective outlook. . . by having a person who likely was never involved in the clinical care of that patient be the person responding. . . that would be the strength, to have an objective opinion. However, that’s also the weakness, to have someone who doesn’t know anything about the patient potentially answering, whereas there could be somebody locally who knows something about the patient that could weigh in. So, I mean I think there’s certainly advantages to that, but the biggest disadvantage would be the lack of clinical connection with both the patient as well as the potential local providers in the area” (15, LS2, cardiologist).</p>
Central e-consultant burnout/fatigue	<p>“I think . . . not to have people revolt, to do like a centralized e-consult system, I think you would have to let them know that it’s coming, and then you would have to pay people for their time. Meaning, for the most part, these are clinicians that will be doing the e-consults, and they have a bunch of other competing responsibilities. . . And even just thinking about issues related to burnout and attrition, that the VA is losing neurologists every year. I mean, there’s already a nationwide shortage outside the VA for neurologists. There’s a VA nationwide shortage for neurologists. So, then if you want to add insult to injury and push more people out the door, give them more things to do and not pay them” (16, LS2, neurologist).</p> <p>“Well, I think if you have 1 designated individual who is doing a lot of this, they would be subject to burnout, because I think this would be a very taxing assignment. Just answering e-consults, I think that would be tough work. When I do it, I’m on the consult service, we spend an hour—it may involve an hour a day, looking at e-consults. And I do it for short periods of time for a couple of weeks on end, and I wouldn’t want to do that persistently. It’s just a bunch of consults every day, not, a huge stream of consults—that would be overwhelming. I think you would have a lot of burnout if you did that” (17, LS1, pulmonologist).</p>
Technological barriers/Interoperability	<p>“[I can think of] a couple things. One, the consultants would have to have access to the CPRS at each site. So that would have to be set up. And it’s difficult to use the JLV [an EHR tool that allows clinicians to view patient charts at other VAs]. . . So it’s sort of cumbersome to use that. It’s just not a very user-friendly kind of way to look at a medical record. So I think that could potentially be a problem” (18, LS1, pulmonologist).</p> <p>“If somebody didn’t go into the chart because if you know that right now to go into the chart—if I want to look at some study we did, it’s in VistA Imaging. If I want to go to [another site], it’s in another whole different web-based system to go see it. . . So that’s where I would be concerned about these individuals that would be at a hub, trying to cover all of that. Because they’re not going to see it. Until we open up the whole entire VISN1, which I’ve been an advocate for, open up all the charts across the board so we all can see everything and order stuff in and out of the systems, because right now we can’t” (19, LS3, leader).</p>
Lack of motivation for change	<p>“ . . . I think we already within our VISN do receive consults from other facilities and we can place them to other facilities as well, so we kind of do that already” (20, LS1, cardiologist).</p> <p>“I guess I don’t fully understand the model, so that’s why I’m hesitating. Like I’m not sure what it would add. So if I had, for example, if I felt like I wasn’t getting the kind of responses I wanted, and that changing that process would give me faster, better responses, or more detailed, or whatever, then I would see that” (21, LS2, PCP).</p>

prevent as many unnecessary face-to-face visits as possible, may be less likely to provide thorough responses.

Dedicated staff’s burnout/fatigue

One concern about the feasibility of the hub-and-spoke system had to do with the perceived impact on the dedicated staff. Several inter-

viewees, all of them at large sites, were worried that the e-consultant in a hub-and-spoke system might be at risk for burnout or fatigue. Some felt that this would be the case if the central e-consultants were not provided with sufficient work credit or protected time and, as a result, had to field large volumes of e-consults on top of other responsibilities. Others thought that having to exclusively answer

e-consults as one's main or sole clinical responsibility would be monotonous and taxing.

Technical barriers/interoperability

Some of our interviewees worried about technical barriers to implementing a hub-and-spoke e-consult system. In the current system, clinicians can access charts of patients at their own VA using CPRS, VA's legacy EHR system. The JLV (Joint Legacy Viewer) is another platform used to view records from other VAs. In the context of e-consults, the JLV may be used if the patient receives care at a different VA from the one where the consultant is employed or if the patient is at the *same* VA but has records from other facilities in their chart. Our interviewees were concerned that this arrangement would not be conducive to a hub-and-spoke system where interoperability is crucial because specialists would routinely need to access patient charts located at other VAs.

Lack of motivation for change

Finally, a small group of participants did not perceive a benefit of hub-and-spoke over the current, local model. As mentioned above, clinicians in VISN 1 *can* place e-consults to clinicians at other VAMCs when specific agreements have been formalized. Generally, these "interfacility e-consults" flow from smaller, more remote sites with limited specialist availability to larger, urban VAMCs. Interfacility e-consults are not systematically employed across the VISN, and there is no standardized approach to quality assurance. Nonetheless, a number of specialists and primary care providers, at both large and small sites, felt that the current e-consult model worked sufficiently well and told us that they saw no reason for changing it.

DISCUSSION

In this article, we examined clinician perspectives on scaling up e-consult use from a decentralized, local model to a regional hub-and-spoke model. While a hub-and-spoke approach has been successfully used and studied in application to telemedicine,^{13,14,33} in particular with stroke care,^{34,35} the literature on scaling up e-consults to a hub-and-spoke model is lacking. Our work makes an important contribution to the body of research on expanding access to healthcare by harnessing technology.

Our study was motivated by a perception that a hub-and-spoke e-consult model may allow healthcare systems to capitalize on economies of scale. Indeed, our interviewees saw several potential benefits to scaling up e-consult use to the hub-and-spoke model, including, most prominently, improving access to highly specialized clinical expertise at sites with limited specialist presence. Interestingly, this advantage was cited not only by PCPs but also by specialists, who viewed favorably the ability to consult colleagues with expertise in niche areas. At the same time, participants expressed concerns that ranged from the logistics of a hub-and-spoke system to its anticipated negative effects on local working relationships.

The most prominent concern expressed by participants had to do with the pronounced differences between sites comprising the hub-and-spoke system. The promise of the hub-and-spoke system lies in its greater efficiency and standardization, and its success is predicated on the ability of the central e-consultant to make evidence-based, context-independent, clinical recommendations. However, there was a sense among our interviewees that e-consultants in the "hub" (presumably located at a large, high-resource site) would not be able to adequately account for resource availability and other

unique local features of each spoke, resulting in recommendations that may be impossible to implement in low-resource settings. In the current system, by contrast, specialists leverage their knowledge of local nuances when formulating recommendations. This contrast evokes a tension between the movement for evidence-based medicine, with its positivist and rationalist underpinnings, and its critics who point out that the reality of practicing healthcare is often context-contingent and idiosyncratic.^{36–39} In light of this, health systems may benefit from creating implementation teams comprised by primary care and specialist clinicians, some of whom may be prospective members of the e-consult "hub" and/or site representatives from the "spokes," as well as researchers, if feasible. These teams could evaluate the extent of variation between participating sites and collaborate in developing the optimal system design to account for the variation—for example, via creating a multitiered e-consult program in which a central e-consultant is designated as the default recipient of all general e-consult questions but also has an option to engage a local specialist to obtain a context-specific perspective.

Another major concern about the hub-and-spoke e-consult model related to incentives. According to this logic, local e-consultants are inherently invested in providing a high-quality e-consult response because that may help prevent a face-to-face referral to the local service. By contrast, their central counterparts, who may never see the patient in person, may be more likely to answer the e-consult in a cursory way or avoid doing the due diligence and recommend a face-to-face appointment. High-demand services, like cardiology, operate under strict national mandates to reduce wait times for new patients,⁴⁰ and specialty care services are motivated to manage the volume of face-to-face referrals. This concern speaks to the larger issue: a perceived poor fit between an innovation and the local organizational practices and workflows is known to hamper the innovation's uptake.⁴¹ To implement a hub-and-spoke e-consult model successfully, the implementation teams would need to examine where the new model may be misaligned with existing routines and incentives. This may involve establishing a system in which all central e-consultant responses are forwarded to local specialty care services for review or allowing local specialists to forward e-consultations to the "hub," if desired, instead of requiring a by-default use of the central e-consult service. Another, potentially less burdensome, option to consider is instituting periodic meetings between hub consultants and local site representatives to debrief on any concerns about e-consult process and quality.

A different anticipated challenge was erosion of local relationships between clinicians. Interviewees expressed fear that well-established professional relationships with local colleagues would be undermined as a result of "outsourcing" e-consultant duties. This aligns with the insight by Greenhalgh and colleagues that healthcare workers may resist the implementation of new IT if they perceive them to compromise professional relationships.⁴² Indeed, the ability of social networks and peer influence to facilitate and hamper the adoption and diffusion of new organizational practices is well-documented.^{43,44} To address this barrier, we suggest that health systems create relationship-building opportunities between e-consultants in the hub and clinicians in the spokes (eg, virtual "meet and greet" conferences). They should also promote the message that the hub-and-spoke e-consult system will not replace local coordination of care between primary and specialty care services for other types of care (eg, face-to-face visits, video-based visits, specialized testing and procedures) and that this coordination must continue to draw on existing professional relationships.

Two other challenges that emerged in this study were more logistical in nature and concerned the feasibility, rather than desirability,

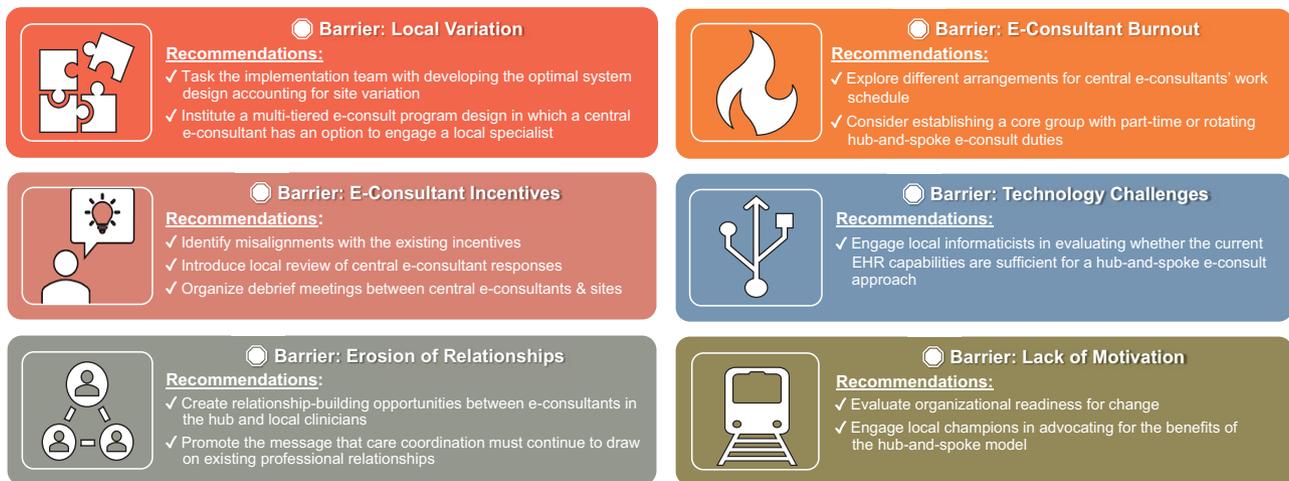


Figure 2. Recommendations for overcoming barriers to a hub-and-spoke e-consult model.

of implementing a hub-and-spoke model. One was a concern that central e-consultants would experience fatigue or even burnout if exclusively/mostly focused on answering e-consults. Distributing responsibilities between multiple central e-consultants to ensure that none of them is tasked with answering e-consults full-time appears desirable, as perceived lack of time for meaningful interactions with patients due to competing job demands has been tied to clinician dissatisfaction.⁴⁵⁻⁴⁷ We advise that health systems experiment with different arrangements for central e-consultants' work schedule until they find one that ensures reliable access to e-consults in the hub without sacrificing the central e-consultants' well-being. Alternatives may include establishing a core group with part-time hub-and-spoke e-consult duties or allowing the core group members to rotate for short periods of full-time hub-and-spoke e-consult duties.

Participants also anticipated challenges in using EHR platforms to access patient data across sites. While the specific nature of technological challenges at other systems may be different, interoperability is a salient barrier to the adoption and scaling up of healthcare innovations.^{41,48} Health systems can engage local informaticists in evaluating whether the current EHR capabilities are sufficient for a hub-and-spoke e-consult approach and which changes or modifications would be needed.

Finally, while many participants could see undeniable benefits of the hub-and-spoke model, some clinicians we interviewed did not immediately think that the new approach would be better than the system currently in place (sporadic use of interfacility e-consults). Prior to implementing a hub-and-spoke e-consult model, healthcare systems are advised to evaluate the organizational readiness for change.⁴⁹ If the hub-and-spoke model is not seen as clearly advantageous, implementation champions would need to advocate for the change by compellingly presenting the benefits of the new model.

We present the above-mentioned recommendations, in summary form, in [Figure 2](#). In a recent article, researchers involved in studying the Champlain BASE e-consult service in Canada summarized best practices in spreading and scaling up e-consult use in Canada, based on a policy forum discussion between key stakeholders.¹⁸ Their recommendations included bringing together stakeholders from different disciplines and organizations, building on existing policies and programs, and developing measures for evaluating impact of the spread/scale-up. Our work is complementary and synergistic with

that of the Champlain BASE researchers because, despite the shared focus, our methods yielded a distinct set of concerns and recommendations.

Our work has limitations. We focused data collection on a regional network of the VHA. Although our findings might be more relevant to healthcare systems with comparable levels of specialty care resources, organizational structure, and/or technological resources, the overall approach we employed may provide useful guidance for preimplementation assessment regardless of setting. We limited our interviews with specialists to 3 specialties, but our sample included clinicians practicing at organizationally diverse facilities, which constitutes a strength. Finally, all interviews were conducted prior to the COVID-19 pandemic. Given the unprecedented rise in telehealth that the pandemic has unleashed, it is also possible that some of the technological barriers to the hub-and-spoke e-consult design may be less prevalent now. It is also possible that, with greater use of telehealth, clinicians might be more open to system redesign intended to improve efficiency.

CONCLUSION

In the era of COVID-19 and its aftermath, as telehealth technologies become more prominent, scaling up e-consults in line with a hub-and-spoke model may help pave the way for a new approach to care delivery, one that is both virtual and centralized. However, the success of this transformation will depend on the healthcare systems' ability to evaluate and address barriers to leveraging economies of scale for e-consults, especially among end users on whom adoption depends. Our article, focused on the experience of primary care providers and specialists, presents insights from a case study of 1 of the largest integrated healthcare systems in the United States, as well as generalizable recommendations for healthcare organizations contemplating a scale-up of their e-consult systems.

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AUTHOR CONTRIBUTIONS

STR and VGV designed the research with input from EA, JDO, SLC, and SLS; EA, STR, and VGV collected the data; EA, STR, JDO, SLC, SLS, and VGV analyzed and interpreted the data; EA wrote the manuscript; STR, JDO, SLC, SLS and VGV revised and edited the manuscript for important intellectual content; all authors approved the final version to be published and are accountable for the accuracy and integrity of all aspects of the work.

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DATA AVAILABILITY STATEMENT

The data underlying this manuscript cannot be shared publicly for the privacy of the individuals that participated in the study.

DISCLAIMER

The contents of this article do not represent the views of the US Department of Veterans Affairs or the United States Government.

CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES

- Heyworth L, Kirsh S, Zulman D, Ferguson JM, Kizer KW. Expanding access through virtual care: The VA's early experience with Covid-19. *NEJM Catalyst Innov Care Deliv* 2020; 1 (4): 1–11. doi: <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0327>.
- Wosik J, Fudim M, Cameron B, et al. Telehealth transformation: COVID-19 and the rise of virtual care. *J Am Med Inform Assoc* 2020; 27 (6): 957–62.
- Smith AC, Thomas E, Snoswell CL, et al. Telehealth for global emergencies: implications for coronavirus disease 2019 (COVID-19). *J Telemed Telecare* 2020; 26 (5): 309–13.
- Vimalananda VG, Gupte G, Seraj SM, et al. Electronic consultations (e-consults) to improve access to specialty care: a systematic review and narrative synthesis. *J Telemed Telecare* 2015; 21 (6): 323–30.
- Kwok J, Olayiwola JN, Knox M, Murphy EJ, Tuot DS. Electronic consultation system demonstrates educational benefit for primary care providers. *J Telemed Telecare* 2018; 24 (7): 465–72.
- Liddy C, Abu-Hijleh T, Joschko J, Archibald D, Keely E. eConsults and learning between primary care providers and specialists. *Fam Med* 2019; 51 (7): 567–73.
- Keely EJ, Archibald D, Tuot DS, Lochnan H, Liddy C. Unique educational opportunities for PCPs and specialists arising from electronic consultation services. *Acad Med* 2017; 92 (1): 45–51.
- Vimalananda VG, Orlander JD, Afbale MK, et al. Electronic consultations (E-consults) and their outcomes: a systematic review. *J Am Med Inform Assoc* 2020; 27 (3): 471–3. doi: [10.1093/jamia/ocz185](https://doi.org/10.1093/jamia/ocz185)[published Online First: Epub Date].
- Gupte G, Vimalananda V, Simon SR, DeVito K, Clark J, Orlander JD. Disruptive innovation: implementation of electronic consultations in a Veterans Affairs Health Care System. *JMIR Med Inform* 2016; 4 (1): e6.
- Kirsh S, Carey E, Aron DC, et al. Impact of a national specialty e-consultation implementation project on access. *Am J Manag Care* 2015; 21 (12): e648–54.
- Elrod JK, Fortenberry JL Jr. The hub-and-spoke organization design: an avenue for serving patients well. *BMC Health Serv Res* 2017; 17 (Suppl 1): 457.
- Brooklyn JR, Sigmon SC. Vermont hub-and-spoke model of care for opioid use disorder: development, implementation, and impact. *J Addict Med* 2017; 11 (4): 286–92.
- Leshner AP, Fakhry SM, DuBose-Morris R, et al. Development and evolution of a statewide outpatient consultation service: leveraging telemedicine to improve access to specialty care. *Popul Health Manag* 2020; 23 (1): 20–8.
- Pimentel CB, Gately M, Barczi SR, et al. GRECC connect: geriatrics telehealth to empower health care providers and improve management of older veterans in rural communities. *Fed Pract* 2019; 36 (10): 464–70.
- Sarmiento KF, Folmer RL, Stepnowsky CJ, et al. National expansion of sleep telemedicine for veterans: The TeleSleep Program. *J Clin Sleep Med* 2019; 15 (9): 1355–64.
- Elrod JK, Fortenberry JL Jr. The hub-and-spoke organization design revisited: a lifeline for rural hospitals. *BMC Health Serv Res* 2017; 17 (Suppl 4): 795.
- Hirko KA, Kerver JM, Ford S, et al. Telehealth in response to the COVID-19 pandemic: implications for rural health disparities. *J Am Med Inform Assoc* 2020; 27 (11): 1816–8.
- Moroz I, Archibald D, Breton M, et al. Key factors for national spread and scale-up of an eConsult innovation. *Health Res Policy Syst* 2020; 18 (1): 57.
- Breton M, Smithman MA, Liddy C, et al. Scaling up eConsult for access to specialists in primary healthcare across four Canadian provinces: study protocol of a multiple case study. *Health Res Policy Syst* 2019; 17 (1): 83.
- RubiconMD. eConsult Platform. Secondary eConsult Platform. <https://www.rubiconmd.com/econsult-platform>. Accessed July 12, 2021.
- AristaMD. How eConsults Work | Virtual Access to Specialty Care. Secondary How eConsults Work | Virtual Access to Specialty Care. <https://www.aristamd.com/econsults/>. Accessed July 12, 2021.
- ConferMED. About ConferMED. Secondary About ConferMED. <https://www.confermed.com/about-confermed/>. Accessed July 12, 2021.
- Tuot DS, Leeds K, Murphy EJ, et al. Facilitators and barriers to implementing electronic referral and/or consultation systems: a qualitative study of 16 health organizations. *BMC Health Serv Res* 2015; 15: 568.
- Haverhals LM, Sayre G, Helfrich CD, et al. E-consult implementation: lessons learned using consolidated framework for implementation research. *Am J Manag Care* 2015; 21 (12): e640–7.
- Knox M, Murphy EJ, Leslie T, Wick R, Tuot DS. e-Consult implementation success: lessons from 5 county-based delivery systems. *Am J Manag Care* 2020; 26 (1): e21–e27.
- Parikh PJ, Mowrey C, Gallimore J, Harrell S, Burke B. Evaluating e-consultation implementations based on use and time-line across various specialties. *Int J Med Inform* 2017; 108: 42–8.
- Battaglia C, Lambert-Kerzner A, Aron DC, et al. Evaluation of e-consults in the VHA: provider perspectives. *Fed Pract* 2015; 32 (7): 42–8.
- Kim EJ, Orlander JD, Afbale M, et al. Cardiology electronic consultation (e-consult) use by primary care providers at VA medical centres in New England. *J Telemed Telecare* 2019; 25 (6): 370–7. doi: [10.1177/1357633X18774468](https://doi.org/10.1177/1357633X18774468)[published Online First: Epub Date].
- Cowper Ripley D, Ahern JK, Litt ER, Wilson LK, eds. Chapter 2: rural, highly rural, and insular island patients treated at each VA medical center. In: *Rural Veterans Health Care Atlas FY 2015*. 2nd ed. Washington, DC: VHA Office of Rural Health, Department of Veterans Affairs; 2017.
- Department of Veterans Affairs. Pending Appointment and Electronic Wait List Summary for the period ending: 10/1/2018. Veterans Health Administration Website. https://www.va.gov/HEALTH/docs/DR103_102018_Public_Data_Pending_Appointments.pdf. Accessed July 12, 2021.
- Department of Veterans Affairs. Completed Appointment Wait Times National, Facility, and Division Level Summaries for the reporting period ending October 2018. Veterans Health Administration Website; 2018. https://www.va.gov/HEALTH/docs/DR106_112018_Public_Data_PDF_Completed_Appointments.pdf. Accessed July 12, 2021.
- Elo S, Kyngas H. The qualitative content analysis process. *J Adv Nurs* 2008; 62 (1): 107–15.
- Lewiecki EM, Jackson A 3rd, Lake AF, et al. Bone Health TeleECHO: a force multiplier to improve the care of skeletal diseases in underserved communities. *Curr Osteoporos Rep* 2019; 17 (6): 474–82.
- Huddleston P, Zimmermann MB. Stroke care using a hub and spoke model with telemedicine. *Crit Care Nurs Clin North Am* 2014; 26 (4): 469–75.

35. Switzer JA, Demaerschalk BM, Xie J, Fan L, Villa KF, Wu EQ. Cost-effectiveness of hub-and-spoke telestroke networks for the management of acute ischemic stroke from the hospitals' perspectives. *Circ Cardiovasc Qual Outcomes* 2013; 6 (1): 18–26.
36. Brives C, Le Marcis F, Sanabria E. What's in a context? Tenses and tensions in evidence-based medicine. *Med Anthropol* 2016; 35 (5): 369–76.
37. Timmermans S, Kolker ES. Evidence-based medicine and the reconfiguration of medical knowledge. *J Health Soc Behav* 2004; 45 Suppl: 177–93.
38. Mykhalovskiy E, Weir L. The problem of evidence-based medicine: directions for social science. *Soc Sci Med* 2004; 59 (5): 1059–69.
39. Dopson S, Locock L, Gabbay J, Ferlie E, Fitzgerald L. Evidence-based medicine and the implementation gap. *Health (London)* 2003; 7 (3): 311–30.
40. Massarweh NN, Itani KMF, Morris MS. The VA MISSION Act and the future of veterans' access to quality health care. *JAMA* 2020; 324 (4): 343–4.
41. Greenhalgh T, Wherton J, Papoutsis C, *et al.* Beyond adoption: a new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *J Med Internet Res* 2017; 19 (11): e367.
42. Greenhalgh T, Swinglehurst D, Stones R. Rethinking resistance to 'big IT': a sociological study of why and when healthcare staff do not use nationally mandated information and communication technologies. *Health Serv Deliv Res* 2014; 2 (39): 1–86.
43. Zheng K, Padman R, Krackhardt D, Johnson MP, Diamond HS. Social networks and physician adoption of electronic health records: insights from an empirical study. *J Am Med Inform Assoc* 2010; 17 (3): 328–36.[published Online First: Epub Date]].
44. Rogers EM. *Diffusion of Innovations*. 4th ed. New York: Free Press; 1995.
45. Friedberg MW, Chen PG, Van Busum KR, *et al.* Factors affecting physician professional satisfaction and their implications for patient care, health systems, and health policy. *Rand Health Q* 2014; 3 (4): 1.
46. Freeborn DK. Satisfaction, commitment, and psychological well-being among HMO physicians. *West J Med* 2001; 174 (1): 13–8.
47. Anderson E, Solch AK, Fincke BG, Meterko M, Wormwood JB, Vimalananda VG. Concerns of primary care clinicians practicing in an integrated health system: a qualitative study. *J Gen Intern Med* 2020; 35 (11): 3218–26. doi: 10.1007/s11606-020-06193-3.
48. Scott P. Meeting the challenges of healthcare interoperability. *Healthcare IT Management* 2009; 4 (3): 24–5.
49. Weiner BJ. A theory of organizational readiness for change. In: Nilsen P, Birken SA, eds. *Handbook on Implementation Science*. Northampton, MA: Edward Elgar Publishing; 2020: 215–33.