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The Feasibility of Using Point of Care Ultrasound as a Visual Substitute for Physical Examination During Telehealth Visits: A Pilot Project

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Abstract

Telehealth provides greater opportunity for specialty access but lacks components of the physical exam. Point-of-care ultrasound (POCUS) may assist telehealth as a visual substitute for the provision of palpation. We conducted a prospective observational pilot project to survey oncologists about (1) their expectations of POCUS, (2) their use of POCUS in oncology telehealth visits, and (3) post-project assessment of their experiences. The results of the pre-assessment survey showed an interest among the oncologists in the ability to evaluate structures remotely via POCUS. POCUS was utilized in 6.4% of visits, most commonly for lymph node assessment (60% of use). POCUS was not utilized most often due to not being applicable to the patient's visit. There were 14 instances of technical issues limiting views of the relevant anatomy reported. Oncologists rated the use of POCUS as very satisfied or satisfied in the vast number of recorded responses. This pilot study suggests POCUS can be integrated into oncology telehealth visits for specific applications such as lymph node assessment. The surveys indicated a potential interest and positive responses that provide for the foundation of expansion to subspecialty care access for patients with telehealth supported by POCUS.

Keywords

telemedicine/telehealth, point-of-care ultrasound (POCUS), oncology, implementation

Key Points

1. Telehealth lacks components of the physical exam which are important in areas of subspecialty care to provide a full assessment and expand subspecialty care to remote regions.
2. Point-of-care ultrasound (POCUS) was of interest to oncologists in assessing lymph nodes and was used for this purpose in remote area telehealth.
3. POCUS could benefit from additional studies to effectively target patients who are likely to benefit from this assessment for oncology and, potentially, other areas of telehealth.

Introduction

Telehealth has rapidly evolved over the last decade. It allows providers to reach patients from the comfort of the patient's

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home as well as provide specialty services to critical access regions. Telehealth allows providers to see and hear a patient, but it lacks the ability to palpate and percuss; key elements of a physical examination. Current advances in technology and point-of-care ultrasound (POCUS) provide a means to bridge this gap. Through POCUS, this interface has the potential to provide clinicians with a visual substitute for palpation and percussion.

In parallel with telehealth, POCUS use has grown rapidly over the past 2 decades, allowing physicians the ability to directly visualize anatomy, physiology, and pathology.[1] Ultrasound can be used in the diagnosis of palpable disease and for image-guided biopsies.[2,3] Metha et al[3] found that ultrasound detected additional cervical nodes not detected by clinical examination. With evolving technology, POCUS opens the door for visual supplementation of the physical exam.

We hypothesized the feasibility of POCUS to improve physical assessments and clinical video telehealth visits at remote clinics.

Methods

We performed an observational project with a convenience sample of local oncologists and a remote oncology clinic using pre-, intra- and post-project survey assessments. We conducted semistructured interviews with open-ended questions and Likert-like scales to understand acceptability, feasibility, and barriers among stakeholders (leadership, oncologists, and telehealth nurse practitioners) (Table 1). We asked what they thought of adding ultrasound into the exam: benefits, risks, feasibility, and the reasons for their answers. The questions were developed in conjunction with our implementation science (IS) specialist (EPF), based on IS methodology.[4] However, as the use of POCUS in telehealth medicine for oncology is not currently considered a standard of care, this project was not a true IS study but rather a pilot assessment for the feasibility of this novel application within the context of telehealth.

A subject matter expert (SME) (CKS) with over 10 years of experience teaching POCUS provided initial education in the use of POCUS, with a specific focus on the evaluation of lymph nodes. The SME provided education to both the staff at the local hospital (Pittsburgh, PA) (oncologists, n = 6) and the staff at the remote facility (Altoona, PA) (nurse practitioners [NPs], n = 2). Education was provided to every provider who interacted with patients both locally and remotely. All staff at each site volunteered to participate in this training, serving as a convenience sample. The learners were provided with pre-reading textbook chapters, articles, and prerecorded videos. The SME then met with each provider to demonstrate the use of the POCUS device for image acquisition and interpretation of the relevant anatomy. They continued to use the device for practice during the initial training period. The device was subsequently delivered to the remote site, where the SME provided education, remotely, to the remote site's NPs for device use, interface with the telehealth software, image acquisition and interpretation, to mirror the patient visit experience. During this time, the project leaders and SME would check in to see how comfortable the Pittsburgh providers and Altoona NPs felt with using POCUS, providing any additional training as needed.

Ultrasound examinations were performed by telehealth NPs at the Altoona clinic with the oncologists located in Pittsburgh during a predetermined 6-month pilot period. Each patient visit could be included as an encounter for potential use of POCUS. Teleultrasound was conducted using a Philips Lumify High-Frequency Linear probe (L12-4, 12-4 MHz; Philips North America Corporation, Andover, MA, USA) with remote connectivity through Reacts software (Reacts by Innovative Imaging Technologies, Inc., Montreal, Quebec, Canada). The oncologist in Pittsburgh helped direct the NP to perform the exam in real time during the synchronous telehealth visit.

Upon completion of each clinic visit, the oncologists and the Altoona NPs were asked to complete an after-visit survey (Surveymonkey.com, Momentive Inc, San Mateo, CA). (Supplemental Table 1) There were monthly check-ins with the Pittsburgh oncologists and the Altoona NPs, encouraging the use of POCUS in each visit and inquiring about barriers to implementation. In response to feedback during the interim check-ins, the SME provided additional training for musculoskeletal and deep venous vascular applications via the same educational methods done previously.

After completion of this 6-month pilot, each of the same oncologists (n = 6) and telehealth NPs (n = 2) completed another semistructured interview asking about their experiences. These questions were also developed in conjunction with our IS expert (Supplemental Table 2).

The information from the pre-study training sessions, after-visit surveys, and post-study interviews were gathered and summarized. We performed descriptive analysis on the frequency of POCUS use as well as factors regarding satisfaction, ease of use, pertinence to clinic visits, and barriers to POCUS implementation.

This project was approved as nonresearch Quality Improvement (QI) by the VA Pittsburgh Healthcare System IRB.

Results

The pre-study responses demonstrated that the oncologists were excited about this new technology, specifically as an objective element to the exam. Half of the respondents initially felt unconfident about the use of POCUS to assess lymph nodes via telehealth visits (Table 1).

Between June and December 2021, there were a total of 422 video telehealth visits for the oncology department between Pittsburgh and Altoona. Of these visits, there were 326 after-visit surveys completed by Altoona NPs and 28 from the Pittsburgh oncologists, resulting in 326/422 (77.3%) visit encounters that logged an after-visit response

Table 1. Qualitative Comments From Semistructured Interviews Among Telehealth Oncology Stakeholders.

Question	Stakeholder comments
What do you think of adding teleultrasound to the virtual clinical exam?	• Very positive • I think it's a good idea. • It's great visually. How clear will the images be on our end. The tele-stethoscope was not clear on our end previously • Could be helpful. Have anxiety interpreting the findings. It will be an improvement over someone describing how they are feeling. Interpretation is a different story. Have to build up an idea of the results. Will need serial exams on the same person over time. Have to have confidence in the operator.
What do you like about the idea?	• Thoroughness • More of an objective exam versus someone else palpating remotely • Useful for serial exams (response to therapy vs relapse) • I like technology. It's not just a novelty. I won't have to depend on a nurse on the other end. Reach more veterans. More objectives can be recorded. Have a reference point • The additional benefit is that you can't put your hands on the patient. Get to learn a new skill. An objective way to measure
Where do you think it might go wrong?	• Person doing it • I don't know. I guess it may be operator limitations. It will also depend on my skills/knowledge to interpret things. Perhaps device malfunctions • False positives, false negatives, power failure, placement failure by remote provider, lack of experience with ultrasound • Interpretation, learning curve, equipment malfunction, and operator error
How confident do you feel in the use of POCUS to assess lymph nodes (very confident, confident, neutral, unconfident, and very unconfident)	• Very confident (25%) • Neutral (25%) • Unconfident (50%)
How confident do you feel in the use of POCUS to assess lymph nodes via telehealth visits? (very confident, confident, neutral, unconfident, and very unconfident)	• Confident (25%) • Neutral (25%) • Unconfident (50%)
Do you think you can get yourself to use this routinely for the virtual hem/one visit? Why or why not?	• Yes if available and appropriate patient • Now one can actually see things. • Not appropriate for every person, but think so for the right patients. For a focal exam, it would be helpful but time intensive as general screening. It has to be population-specific or a new complaint. Patient-right ones.

Abbreviation: POCUS, point of care ultrasound.
Stakeholders included division oncologists [n = 6] and telehealth nurse practitioners [n = 2]. The free-response comments are paraphrased to highlight the keywords utilized in the replies to the semistructured interviews in order to identify stakeholder perceptions paired to categories of acceptability, feasibility, and barriers to the novel use of POCUS in telehealth oncology patient encounters.

regarding tele-POCUS use. POCUS was used 21/326 (6.4%) times (Table 2). The most common reason for not using POCUS was "not applicable to the patient's presentation/visit" at 94.4% (288/305). Each of the taught exam types was performed: lymph nodes (60%), musculoskeletal (26.7%), and lower extremity venous (13.3%). 100% of the Altoona team's responses stated "I was able to clearly see all relevant anatomy." Of the 326 logged encounters, there were 14 technical issues reported (13 instances of connectivity issues and 1 device malfunction, assuming the same instance was reported by the MD and NP) (Table 2). Of 21 Altoona team responses, 20 stated they were "very satisfied" (85.7%) or "satisfied" (9.5%) with using POCUS during that visit, reflecting their level of enjoyment with this novel exam.

Five of the 6 Pittsburgh oncologists had used POCUS during at least 1 telehealth encounter, resulting in 12 logged after-visit survey responses. These survey results demonstrate that they were able to see all or most of the relevant anatomy in 11/12 instances (91.7%), although with uncertainty in what they were viewing in 8/10 (80%) responses. They rated the use of telePOCUS as "very satisfied" (7/12, 58%) and "satisfied" (4/12, 33%) with only one (1/12, 8%) "dissatisfied." 3/12 (25%) stated that remote POCUS changed management. Not having direct applicability to the patient's reason for their visit was the most common factor identified as prohibiting the use of telePOCUS by the physicians.

Comparing the data from both Pittsburgh oncologists and Altoona NPs, we believe that the 28 after-visit responses from Pittsburgh were included in the 326 from Altoona. During our check-ins and interviews, it was apparent that the faculty at Pittsburgh would not consistently remember to record their results via the SurveyMonkey link, particularly when POCUS was not utilized. We chose to use the data from the Altoona clinic, as it was entered more consistently.

Table 2. After Visit Survey Responses.[a]

Did you use tele-POCUS for your visit today?		Pittsburgh (n = 6)	Altoona (n = 2)
	Yes	12 (42.9%)	21 (6.4%)
	No	16 (57.1%)	305 (93.6%)
	Total	28	326
Reason POCUS was **not** used for the patient encounter		Pittsburgh	Altoona
	Not applicable to patient presentation/visit	16 (100%)	288 (94.4%)
	Connectivity issues	0	13 (4.3%)
	Not enough time during this visit	0	4 (1.3%)
	Total	16	305
What organ system/anatomy did you use POCUS to examine during this encounter?[b]		Pittsburgh	Altoona
	Lymph nodes	2 (66.7%)	9 (60.0%)
	Lower extremity	0	2 (13.3%)
	Musculoskeletal	1 (33.3%)	4 (26.7%)
		3	15
Were there any issues with using tele-POCUS during your encounter?		Pittsburgh	Altoona
	No issues	0	0
	Device malfunction	1 (100%)	1 (100%)
	Patient declined	0	0
	Unclear images	0	0
	Not enough time	0	0
		1	1
How well were you able to see the relevant anatomy?[c]		Pittsburgh	Altoona
	I was ABLE to clearly see ALL relevant anatomy	6 (50%)	20 (100%)
	I was ABLE to see the MOST relevant anatomy	5 (41.7%)	0
	I was UNABLE to see ENOUGH relevant anatomy	0	0
	I was UNABLE to see ANY relevant anatomy	1 (8.3%)	0
		12	20
What limitations do you feel there were to (clearly) seeing the relevant anatomy?[d,e]		Pittsburgh	Altoona
	Wi-Fi connectivity	0	1 (25%)
	Probe positioning	0	0
	Uncertainty in what was being viewed	8 (80%)	1 (25%)
	Image light/dark due to ultrasound device	0	1 (25%)
	Image light/dark due to computer screen	0	0
	Other—probe would not connect	0	1 (25%)
	Other—could control screen but no measurements	1 (10%)	0
	Other—saw cobblestone pattern with edema	1 (10%)	0
		10	4
Did you enjoy using the ultrasound during this telehealth visit?		Pittsburgh	Altoona
	Very satisfied	7 (58.3%)	18 (85.7%)
	Satisfied	4 (33.3%)	2 (9.5%)
	Neither satisfied nor dissatisfied	0	1 (4.8%)
	Dissatisfied	1 (8.3%)	0
	Very dissatisfied	0	0
		12	21
Did the use of remote POCUS change your management for this encounter? (Only asked of Pittsburgh respondents.)			Pittsburgh
	Yes		3 (25%)
	No		9 (75%)
	Total		12
If "yes" to the prior (ie, using POCUS DID change your patient care/management for this encounter), please describe HOW.	• I will still be checking a CT n/c/a/p with IV contrast (mets thyroid carcinoma) • Not getting CT since clearly this was a cyst. • Not a medical decision but PT and his wife liked looking at the images (head and neck cancer) • Sent patient for knee x-ray		
What would have helped improve the quality of using tele-POCUS for this encounter?	Altoona: • I think being able to use the POCUS on a larger scale with the technology capabilities that I have at hand would be beneficial. • Imaging was slightly difficult for the first time with this patient as images were difficult to see even with an attempt to adjust. Potentially could have been the angle of the patient's neck		

(continued)

Table 2. (continued)

	Pittsburgh: • Ability to integrate the images with the team's app • If the probe was working • My improving education • My learning about appearance of lymph nodes and nodules • My reading about the role of ultrasound for gout/joints/ST swelling • My understanding of anatomy. • What happens with tissue and u/s appearance after radiation • My understanding of what I'm seeing • Need more experience • Read more to review Since PT had RLE edema with a cyst (we used u/s for the cyst) would have been great if Doppler's could be done during the visit. They will be done later that day by radiology in other parts of the hospital
What would help you want to use tele-POCUS more for these encounters?	Altoona: • Assistive tablet device • Different tablet manufacturers as it is more user-friendly • Additional assistive devices or different operating systems for tablet • Additional accessories to help with the handheld camera while conducting the CVT visit and using the probe are often daunting, especially when trying to use the functions on the screen to measure, etc. • Additional assistive devices for the use of holding the tablet. • Having an assistive device with a tablet that allows for the other hand not using the probe to be able to work freely on the screen, as the provider is still viewing the area on camera. • More ease of use with the operating system. I also feel that having an additional tool(s) to assist with the handheld tablet for use during the visit would help with a more productive visit and visualization. • Additional tools or devices for increased stabilization for the tablet. • Software on tablets is not entirely user-friendly. • If there were a portable holder/cart for the tablet to be positioned on that would allow for video viewing but still allow the imager to have one hand available to use functions of ultrasound on the tablet Pittsburgh: • A hybrid didactic/walk-through after doing these for a few weeks/months • Clinical process step reminders are critical with the flow of the clinic (running late, clinic load, etc) • Photo to have radiologist follow up with findings. • Assistance (already improved with sharing screen)—eliminates a few steps • More patients with palpable nodes • Help with identifying blood clots. • Probe working Maybe time?
What factors prohibit you from using tele-POCUS for this, or subsequent, encounter(s)?	Altoona: • It is slightly uncomfortable to use POCUS individually while trying to position the camera for the provider, view the area, and still continue to maintain the accuracy of the location and positioning of the transponder and views and angles. • The probe would not connect. Images were unable to be seen. • It is difficult to hold the probe, or tablet and use the functions of the ultrasound unless there is a second person present to assist with one of the handheld devices. Pittsburgh: • Time • Not remembering! • Light reflections • Probe not working

Abbreviation: POCUS, point of care ultrasound.

[a]Stakeholders included division oncologists [n = 6] and telehealth nurse practitioners [n = 2]. The questions obtained via online survey submissions did not require answers to all questions and did not use skip logic. Hence, numbers may not equal total replies if the answer choice was skipped. The results presented are comprehensive to those received via online survey responses including direct reproduction of the free text responses.

[b]In response to feedback during the interim check-ins, the SME provided education and training for additional musculoskeletal and deep venous vascular system applications. Hence, the total number of replies for this question (n = 15) does not add up to the total number of recorded instances of POCUS use (n = 21).

[c]For this question, the total number of replies (n = 20) does not match the total number of recorded instances of POCUS use (n = 21) due to this question being left blank on a submitted after-visit survey.

[d]For this question, the intention was to inquire about additional technology issues that may have contributed to challenges using tele-POCUS, separate from the previous question on the frequency of being able to clearly see relevant anatomy.

[e]Response to this question was optional on the after-visit survey. Thus, the total number of replies may not equal the total for each site, if left blank on an after-visit survey.

Thus, we felt this would be a better reflection of the frequency and indications for use, while the data from Pittsburgh reflected the local physicians' perception when POCUS was utilized.

The results of the post-pilot semistructured interviews demonstrated that oncologists were able to use POCUS during remote encounters (Supplemental Table 2). Both the physicians and the telehealth team recommended additional training beyond the initial sessions. The telehealth team reported anecdotal comments that patients and their caregivers expressed liking the addition of the POCUS during the clinic visit.

Discussion

The results of this pilot project suggest that POCUS can be used as an adjunct to the physical exam for telehealth encounters. Pre-survey results showed that our local oncologists were excited about the opportunity to use telePOCUS as an adjunct to remote patient encounters. POCUS was able to be utilized in 21 patient visits during this project's pilot period. When applicable, POCUS was able to be used to clearly visualize the desired anatomy with infrequent device malfunction. The qualitative feedback demonstrates that the participants felt its integration was beneficial when needed, requesting additional training to improve the speed or efficiency of use. Based on our aim to evaluate the feasibility of incorporating POCUS into telehealth encounters, we interpreted our results as demonstrating that it *can* be done. However, additional work would be needed for improved implementation.

At present, there is a paucity of studies on the use of teleultrasound to augment the physical exam in the outpatient setting. Courreges et al[5] reported a small study where robotic teleultrasound provided care in a secondary hospital or isolated healthcare settings with an 83% agreement between the remotely obtained diagnosis and one performed directly on-site with the patient. We believe that our work adds to the literature that it is feasible to use POCUS for specific applications during telehealth patient encounters.

There continues to be a need for access to subspecialty care. The 2018 National Oncologists Workforce Study asserts that by 2025 the oncologist shortage will increase to 2200 oncologists.[6] Access to oncologic care is likely to be disproportionately sparser in rural areas. In January 2018, VA Pittsburgh created a Virtual Cancer Care teleoncology clinic in Altoona where video telehealth continues to be used to deliver oncology care for rural veteran patients. Patients reported high levels of satisfaction related to their experiences with the virtual clinic. The teleoncology remote clinic markedly reduced travel costs and time for veterans who previously would have commuted from central Pennsylvania to Pittsburgh for their oncology care.[7] Thus, the addition of POCUS has the potential to help expand subspecialty care access for patients living in rural areas or when access to care may be limited.[8,9] With the rapid expansion of teleoncology and more recently with all telehealth during the COVID-19 pandemic, we expect that POCUS will be an adjunct option for future virtual or remote patient encounters.

TelePOCUS's largest role may be in patient satisfaction. Anecdotal comments from both the Pittsburgh oncologists and Altoona NPs providers stated that patients enjoyed being able to visualize what was being palpated and felt that they were becoming more informed about their disease, findings consistent with the use of POCUS during in-person encounters.[10,11] However, this should be better assessed with future studies.

Limitations

The most notable limitation of our project is the potential for reporting bias due to low survey completion by the oncologists' side compared to the responses completed by the Altoona team. Additionally, we were limited only to the evaluation of superficial anatomy, given the properties of the high-frequency linear probe utilized in our study. The low incidence of POCUS use for superficial structures may also reflect that this portion of the physical exam was not needed, even if it would have been an in-person encounter. Perhaps having additional probes for deeper anatomy assessment would have better alignment with the physical exam components during these visits. This could be an opportunity for future study.

Conclusions

This pilot project suggests that the integration of POCUS into telehealth visits is feasible, based on our limited project population. This provides the foundation for further studies on implementation across other specialties with the aim of expanding subspecialty care access for patients via video telehealth visits.

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Author Contributions

All authors participated in the research and preparation of the manuscript.

Declaration of Conflicting Interests

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Disclaimers

The opinions expressed in this article do not reflect those of the Veterans Healthcare Administration.

Ethical Approval

Ethical approval is not applicable to this article. This project was approved by the VA Pittsburgh Healthcare System IRB as nonresearch Quality Improvement.

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Informed Consent

There are no human subjects in this article and informed consent is not applicable.

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Statement of Human and Animal Rights

All procedures in this study were conducted in accordance with the VA Pittsburgh Healthcare System IRB-approved protocols as nonresearch Quality Improvement.

Supplemental Material

Supplemental material for this article is available online.

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