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Telemedicine in vascular surgery during the coronavirus disease-2019 pandemic: A multisite healthcare system experience

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ABSTRACT

Objective: To assess the introduction of telemedicine as an alternative to the traditional face-to-face encounters with vascular surgery patients in the era of the coronavirus disease 2019 (COVID-19) pandemic.

Methods: A retrospective review of prospectively collected data on face-to-face and telemedicine interactions was conducted at a multisite health care system from January to August 2020 in vascular surgery patients during the COVID-19 pandemic. The end point is direct patient satisfaction comparison between face-to-face and telemedicine encounters/interactions prior and during the pandemic.

Results: There were 6262 patient encounters from January 1, 2020, to August 6, 2020. Of the total encounters, 790 (12.6%) were via telemedicine, which were initiated on March 11, 2020, after the World Health Organization's declaration of the COVID-19 pandemic. These telemedicine encounters were readily adopted and embraced by both the providers and patients and remain popular as an option to patients for all types of visits. Of these patients, 78.7% rated their overall health care experience during face-to-face encounters as very good and 80.6% of patients rated their health care experience during telemedicine encounters as very good ($P = .78$).

Conclusions: Although the COVID-19 pandemic has produced unprecedented consequences to the practice of medicine and specifically of vascular surgery, our multisite health care system has been able to swiftly adapt and adopt telemedicine technologies for the care of our complex patients. Most important, the high quality of patient-reported satisfaction and health care experience has remained unchanged. (J Vasc Surg 2021;74:1-4.)

Keywords: COVID-19; Telemedicine; Health care system; Connected care

Telemedicine is the use of electronic, digital, Internet-based, or telephone-based communication for direct patient care and it has been a topic of interest for the past 25 years.¹⁻⁴ However, it had not reached generalized implementation owing to a myriad of challenges, including reimbursement, accessibility, monitoring of quality, patient confidentiality, local and national legal oversight and liability, and Internet speed, among others.³⁻⁹ Although there are sufficient

data to suggest that telemedicine positively affects the delivery of preventive health care in multiple areas of medicine,⁹⁻¹² virtual care also provides us with the opportunity to reach those individuals, who would have significant difficulties accessing health care owing to the remoteness of their location or physical inability.⁹⁻¹² Since the declaration by the World Health Organization on March 11, 2020, of the coronavirus disease 2019 (COVID-19) pandemic, there has been an urgent need to build, reinstate, and/or revise telemedicine programs that were previously either nonexistent or dormant. Further, the Centers for Medicare and Medicaid Services enacted emergent legislation allowing telemedicine to flourish.¹³⁻¹⁵ In fact, our own Society for Vascular Surgery recommended during our Town Hall on Telemedicine,¹⁶ the use of technology to allow for efficient communication among physicians, health care professionals, and patients.¹⁷ It has been clear that implementation of telemedicine can optimize personal safety, guarantee continuity of patient care, reduce the use of personal protective equipment, decrease patient travel time and cost during this financially unstable times, and decrease environmental pollutant emissions.¹⁸ The goal of our study was to provide preliminary assessment regarding patient

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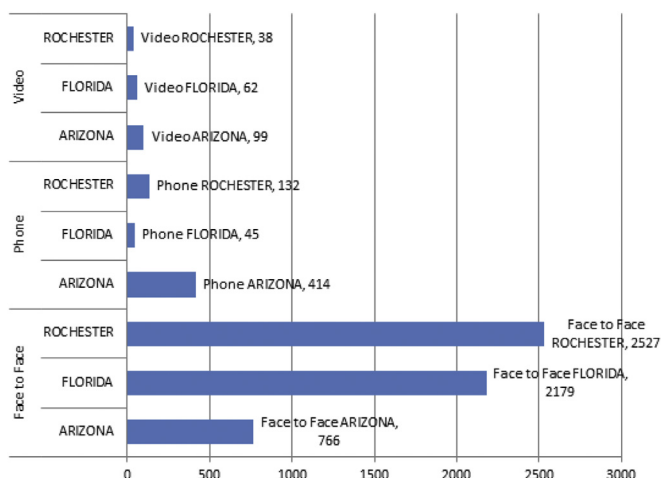


Fig 1. Visits broken down in face-to-face interactions, phone, and video across all three sites (Arizona, Florida, and Minnesota).

satisfaction of their health care needs after the introduction of telemedicine as an alternative to the traditional face-to-face encounters in vascular surgery.

METHODS

The Mayo Clinic Neurological, vascular and neurovascular Events With SARS-CoV-2 (MC NEWS) Study (institutional review board No. 20-003457) is a retrospective study of all patients affected by the COVID-19 pandemic identified within the three major campuses of Mayo Clinic, which includes hospitals in Arizona, Florida, and Minnesota. Informed consent was not required for the study, because it was deemed at minimal risk to patients. Using the shared electronic medical record (Epic; Verona, Wisc) and data obtained from the Enterprise Office of Access, we identified patients within the practice of vascular surgery from January 1, 2020, to August 6, 2020. Our control group included all encounters with patients, who were seen on face-to-face interactions before the declaration of the pandemic on March 11, 2020. Our study group included all encounters with patients, who participated in telemedicine interactions with our vascular surgery practice. The end point is a direct patient satisfaction comparison between face-to-face and telemedicine encounters/interactions before and during the pandemic, which was provided by the Office of Patient Experience Research. All of the data provided are descriptive in nature and comparisons were made using JMP Pro software version 14.1.0 (SAS Institute Inc, Cary, NC).

RESULTS

From January 1, 2020, to August 6, 2020, a total of 6262 patient encounters were completed. Of the total encounters, 790 (12.6%) were via telemedicine, which were initiated on March 11, 2020, after the World Health

ARTICLE HIGHLIGHTS

- **Type of Research:** Multisite health care system review of telemedicine in Vascular Surgery during the coronavirus disease 2019 (COVID-19) pandemic.
- **Key Findings:** The use of telemedicine has escalated as an alternative to face-to-face encounters with patients owing to the COVID-19 pandemic and has been extremely well-received by patients as evidenced by the results of the patient satisfaction surveys.
- **Take Home Message:** Telemedicine has proliferated as an alternative to face-to-face encounters during this COVID-19 pandemic. Telehealth technology is here to stay and has been well-received by patients evidenced by the patient satisfaction surveys.

Organization's declaration of the COVID-19 pandemic. These telemedicine encounters were readily adopted and embraced by both the providers and patients and have remained popular as an option to patients for all visit types across regions. The telemedicine encounters are processed similarly to the live encounters; which are all supported by Epic. As soon as the provider opens the encounter with the patient, a new window with commercially available conferencing software (Zoom, San Jose, Calif) opens that allows for the video consultation to occur. There were regional discrepancies as expected in regards to the number of visits at each site, likely owing to the differential volume of patients seen at each campus (Fig 1). In addition, the higher percentage of telemedicine visits in Arizona as compared with Florida and Minnesota, suggested an apparent trend for early successful adoption and acceptance of telehealth by both patients and providers (Fig 2). As part of our organization's quality metrics, patients received a follow-up survey, which is managed by a third-party provider¹⁹ regarding their level of satisfaction and overall health care experience with virtual care. Overall patient encounter experience was rated as very good for traditional face-to-face encounters 78.7% of the time. In comparison, telemedicine patient encounter experiences rated as very good were 80.6% ($P = .78$; Fig 3). Upon further review of written feedback provided by patients after a telemedicine visit, the inability to appropriately use the technology was a common theme toward dissatisfaction. None of the comments were related to the actual interactions or care received.

DISCUSSION

It is clear that telemedicine, although forced to evolve quickly as a result of the COVID-19 pandemic, has become part of our armamentarium on how to best care for our patients. This technology is here to stay. It has been recognized and embraced by multiple

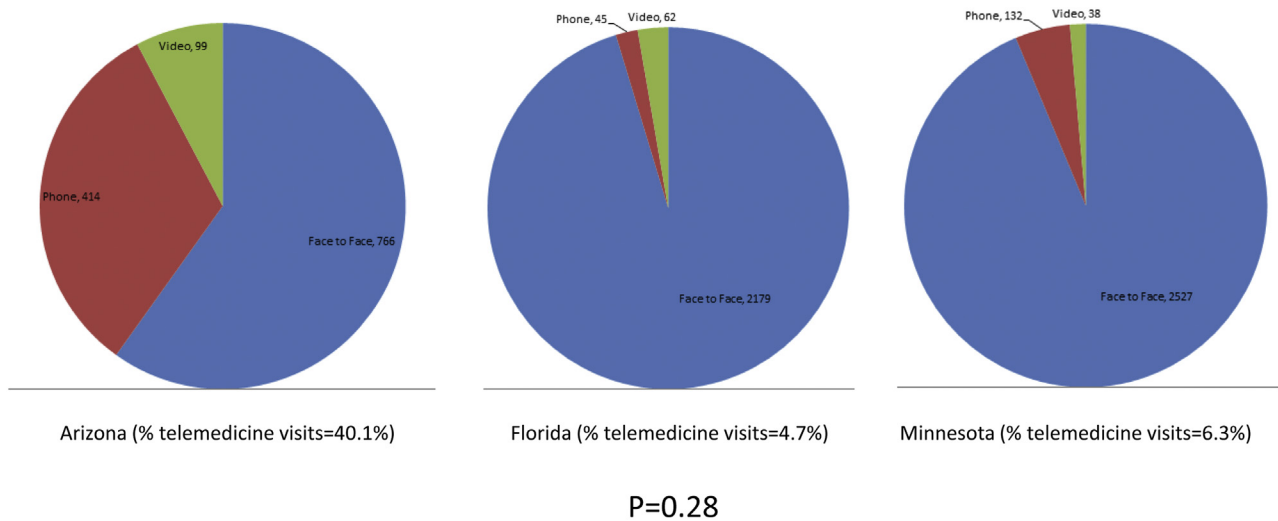


Fig 2. Percentage of telemedicine visits across the three Mayo sites in Arizona, Florida, and Minnesota.

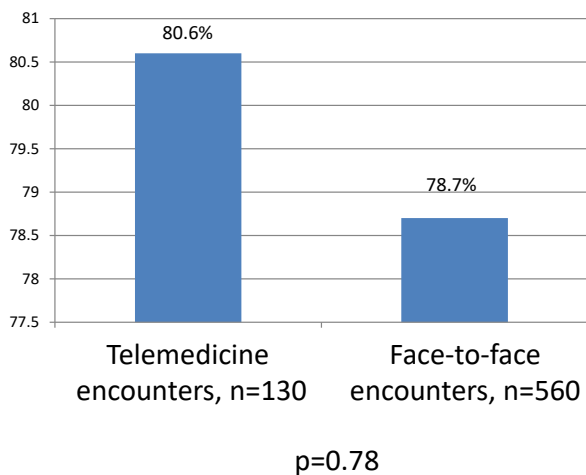


Fig 3. Percentage of patients rating the visit/encounter as very good.

practitioners.^{16,20,21} Lin et al¹⁷ very eloquently spell out how this technology can be included and enhance the care for complex vascular surgery patients, who require longitudinal assessment and frequent follow-ups. Within our own multisite health care system, we had the availability to use this technology as far back as 2012. However, the pandemic was the perfect impetus for this technology to flourish and be adopted by patients and providers across all sites. Telemedicine has expanded to include bedside video communication capability between patients and families²² and patients with members of the care team.²³ Further, remote patient monitoring has been deployed for those individuals who are COVID-19 positive; however, not sufficiently ill to be hospitalized.²⁴ Our descriptive review regarding the status of vascular surgery patient's care

during the COVID-19 pandemic demonstrates how this virtual care technology can be successfully introduced and applied to our complex vascular patients. Indeed, it is early to determine whether objective metrics of patient care/outcomes are met with telemedicine. However, from the patient's perception standpoint, there is no detriment to the care provided using this technology. We are still in the midst of the COVID-19 pandemic and we will continue to follow the evolution of telemedicine to assure that our patient's needs are certainly met.

Limitations. The most obvious limitation is that the COVID-19 pandemic is an ongoing problem and although, patients' perceptions seem to be positive towards the use of telemedicine technology, we currently lack objective metrics of assessing patient's disease progression through this technology. It would be of interest to observe ankle brachial indices in patients with claudication before the pandemic and 6 to 12 months after the pandemic as a surrogate for improvement/worsening of disease process during this unprecedented time. Second, although telemedicine encounters include both telephone encounters and video consultations, the initial demand has been higher in the telephone visits, which we believe will change as much more video visits become popularized. Finally, we are only making assumptions in a very small sample of the population, who has access to the technology and is willing to switch from previous face-to-face encounters. Therefore, these findings may not be generalizable to the rest of the population.

CONCLUSIONS

Although the COVID-19 pandemic has dramatically changed the practice of medicine and specifically of vascular surgery, our multisite health care system has

been able to swiftly adapt and adopt telemedicine technologies for the care of our complex patients. Most important, the high quality of patient-reported satisfaction and health care experience has remained unchanged.

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REFERENCES

- Hahn JS, Lee HL, Choi HS, Shimizu S. Telemedicine system using a high-speed network: past, present, and future. *Gut Liver* 2009;3:247-51.
- Lowe HJ, Lomax EC, Polonkey SE. The World Wide Web: a review of an emerging internet-based technology for the distribution of biomedical information. *J Am Med Inform Assoc* 1996;3:1-14.
- Balas EA, Jaffrey F, Kuperman GJ, Boren SA, Brown GD, Pincioli F, et al. Electronic communication with patients. Evaluation of distance medicine technology. *JAMA* 1997;278:152-9.
- Ricci MA, Knight SJ, Nutter B, Callas PW. Desktop telemedicine in vascular surgery: some preliminary findings. *Telemed J* 1998;4:279-85.
- Damster G, Williams JR. The Internet, virtual communities and threats to confidentiality. *S Afr Med J* 1999;89:1175-8.
- Sanders JH, Bashshur RL. Challenges to the implementation of telemedicine. *Telemed J* 1995;1:115-23.
- Whitten P, Buis L. Private payer reimbursement for telemedicine services in the United States. *Telemed J E Health* 2007;13:15-23.
- Nittari G, Khuman R, Baldoni S, Pallotta G, Battineni G, Sirignano A, et al. Telemedicine practice: review of the current ethical and legal challenges. *Telemed J E Health* 2020;26:1427-37.
- Kahn EN, La Marca F, Mazzola CA. Neurosurgery and telemedicine in the United States: assessment of the risks and opportunities. *World Neurosurg* 2016;89:133-8.
- Batsis JA, Pletcher SN, Stahl JE. Telemedicine and primary care obesity management in rural areas - innovative approach for older adults? *BMC Geriatr* 2017;17:6.
- Davis LE, Coleman J, Harnar J, King MK. Telemedicine: successful delivery of chronic neurologic care to 354 patients living remotely in a rural state. *Telemed J E Health* 2014;20:473-7.
- Demaerschalk BM, Miley ML, Kiernan TE, Bobrow BJ, Corday DA, Wellik KE, et al. Stroke telemedicine. *Mayo Clin Proc* 2009;84:53-64.
- Centers for Medicare & Medicaid Services. Current emergencies: coronavirus disease 2019. Available at: www.cms.gov/About-CMS/Agency-Information/Emergency/EPRO/Current-Emergencies/Current-Emergencies-page. Accessed December 1, 2020.
- Bajowala SS, Milosch J, Bansal C. Telemedicine pays: billing and coding update. *Curr Allergy Asthma Rep* 2020;20:60.
- Calton B, Abedini N, Fratkin M. Telemedicine in the time of coronavirus. *J Pain Symptom Manage* 2020;60:e12-4.
- Society for Vascular Surgery. Telemedicine, digital health focus of April 17 SVS Town Hall. Available at: <https://mailchimp/vascularsociety/learn-about-telemedicine-at-april-17-town-hall?e=19d4d58a0e>. Accessed December 1, 2020.
- Lin JC, Humphries MD, Shutze WP, Aalami OO, Fischer UM, Hodgson KJ. Telemedicine platforms and their use in the coronavirus disease-19 era to deliver comprehensive vascular care. *J Vasc Surg* 2021;73:392-8.
- Paquette S, Lin JC. Outpatient telemedicine program in vascular surgery reduces patient travel time, cost, and environmental pollutant emissions. *Ann Vasc Surg* 2019;59:167-72.
- Press Ganey. Patient experience. Available at: www.pressganey.com/solutions/patient-experience. Accessed November 4, 2020.
- Pollock K, Setzen M, Svider PF. Embracing telemedicine into your otolaryngology practice amid the COVID-19 crisis: an invited commentary. *Am J Otolaryngol* 2020;41:102490.
- Maese JR, Seminara D, Shah Z, Szerszen A. What a difference a disaster makes: the telehealth revolution in the age of COVID-19 pandemic. *Am J Med Qual* 2020. 1062860620933587.
- Mayo Clinic. Updated visitor policy: Mayo Clinic limits number of visitors during COVID-19 response. Available at: <https://newsnetwork.mayoclinic.org/discussion/updated-visitor-policy-mayo-clinic-limits-number-of-visitors-during-covid-19-response-2/>. Accessed December 1, 2020.
- HIMSS. Health information and technology: once a barrier, now a bridge. Available at: <https://www.himss.org/resources/health-information-and-technology-once-barrier-now-bridge>. Accessed October 4, 2020.
- Mayo Clinic. Remote patient monitoring provides patients with comprehensive care at home. Available at: <https://newsnetwork.mayoclinic.org/discussion/remote-patient-monitoring-provides-patients-with-comprehensive-care-at-home/>. Accessed November 4, 2020.

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