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Improved outpatient medical visit compliance with sociodemographic discrepancies in vascular telehealth evaluations

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ABSTRACT

Objective: The COVID-19 (coronavirus disease 2019) pandemic has led to a rapid expansion in the use of telemedicine across all medical fields but has also exposed telehealth care disparities with differing access to technology across racial and ethnic groups. The objective of our study was to investigate the effects of telehealth on vascular visit compliance and to explore the effects of sociodemographic factors on vascular surgery outpatient telehealth usage during the COVID-19 pandemic.

Methods: Consecutive patients who had undergone an outpatient vascular surgery evaluation between February 24, 2020 (the launch of our telemedicine program) and December 31, 2020, were reviewed. The baseline demographic and outcomes were obtained from the electronic medical records. Telehealth and in-person evaluations were defined according to the patient’s index visit during the study period. Medical visit compliance was established on completion of the telehealth or in-person encounter. We used χ² tests and logistic regression analyses.

Results: A total of 23,553 outpatient visits had been scheduled for 10,587 patients during the study period. Of the outpatient visits, 1559 had been scheduled telehealth encounters compared with 21,994 scheduled in-person encounters. Of the scheduled outpatient encounters, 13,900 medical visits (59.0%) had been completed: 1183 telehealth visits and 12,717 in-person visits. The mean travel distance saved for the telehealth visits was 22.1 ± 27.1 miles, and the mean travel time saved was 46.3 ± 41.47 minutes. We noted no sociodemographic differences between the patients scheduled for telehealth vs in-person visits. We found a trend toward a lower proportion of African-American patients in the telehealth group vs the in-person group (7.8% vs 10.6%; P = .116), without statistical significance. A significantly higher rate of medical visit completion was found for the telehealth group compared with the in-person group (79.5% vs 59.4%; P < .001).

Among the patients scheduled for an outpatient medical visit, a scheduled telemedicine evaluation (vs in-person) was associated with 2.3 times the odds of completing the medical visit (odds ratio, 2.31; 95% confidence interval, 2.05-2.61), adjusting for age, sex, race, ethnicity, language, and the distance between the patient’s home zip code and the outpatient vascular center’s zip code. Selecting for scheduled telemedicine visits, African-American race was associated with a decreased odds of telemedicine usage (odds ratio, 0.73; 95% confidence interval, 0.59-0.90) after adjusting for age, sex, ethnicity, language, and visit type.

Conclusions: Use of the vascular surgery outpatient telehealth evaluation appeared to improve medical visit completion in our region with apparent sociodemographic disparities. Further studies are needed to confirm whether telemedicine expansion has improved access to care in other geographic areas. (J Vasc Surg 2022;1-7.)

Keywords: Sociodemographic; Telehealth; Vascular Surgery; Visit Compliance

The coronavirus disease 2019 (COVID-19) pandemic has stressed the capacity of many health care institutions, forcing administrations to seek measures that can maintain social distancing and decrease the risk of virus exposure and infection. Telehealth technology was rapidly adopted to ensure continued medical care and maintain appropriate safety measures. More recently, health care access disparity concerns have been highlighted with the quick increase in telehealth usage.1,2 The predictors of telehealth use have included age, race, education, income level, and geographic location of the patient’s residence.3 Adults aged >65 years and African-American, Hispanic, and non–English-speaking patients were associated with less telehealth usage.4

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compared with younger, White, and English-speaking patients. Similarly, lower education levels, lower income households, and rural residency were associated with less internet access compared with college graduates, higher income earners, and urban residents.

African-American patients have been reported to less likely to complete cardiovascular telehealth video visits. This was demonstrated among vascular surgery patients in the pre—COVID-19 pandemic era, with a similar trend persisting and potentially worsening the digital divide during the pandemic. Because we have been continuously facing new surges in COVID-19 infections, understanding the technology’s shortcomings will be important to recalibrate its usage across all sociodemographic groups in preparation for potential future outbreaks and its integration into regular practice. The objective of our study was to investigate the effects of telehealth on vascular visit compliance and to explore the effects of sociodemographic factors on vascular surgery outpatient telehealth usage during the COVID-19 pandemic. We hypothesized that telehealth encounters would improve outpatient visit compliance and that African-American patients would be less likely to use telehealth technology compared with patients of other races.

METHODS
The institutional review board of the University of Pittsburgh approved the study protocol and waived the requirement for patient informed consent.

Study design. Consecutive patients who had been scheduled for an outpatient vascular surgery elective evaluation between February 24, 2020 (the launch date of our telemedicine program) and December 31, 2020, across 12 outpatient vascular surgery sites were identified from our institution’s electronic medical records. The outpatient offices were mostly located in Pittsburgh, with some offices located within a 30-mile radius of the city. All outpatient sites were a part of the same health care system attended by vascular surgeons from the same academic group. The study exclusion criteria were patients aged <18 years, patients presenting only for noninvasive testing, and patients evaluated and subsequently admitted to the hospital from the outpatient office. Baseline sociodemographic variables, including age, sex, race, ethnicity, and spoken language, were obtained. The outpatient visit diagnosis code was also recorded. The patients were stratified into two groups according to the type of the initial scheduled medical visit (telehealth vs in-person). It was possible for patients to have had a combination of telehealth and in-person visits. The telehealth visits were further stratified into telephone encounters alone and encounters with a video component. Video visits were the preferred mode of telehealth encounters owing to the improved ability to provide care with the visual feedback. Telephone visits were allowed and were typically a fallback option if a video visit could not be arranged. The visit diagnosis codes were classified into eight categories: peripheral arterial disease (PAD), venous disease, aortic aneurysmal disease, dialysis access, carotid disease, wound management, and miscellaneous. Visit diagnosis codes were available for completed medical visits only. The medical encounters could also have received more than one diagnosis code. The health care workers conducting the medical encounters included both physicians and advanced practice providers. The geographic centroids for the zip codes were used to calculate the distances in miles and time of travel in minutes between the patient’s home address and the outpatient vascular surgery clinic.

Telemedicine protocol. Our telehealth program was launched on February 24, 2020. The visits were conducted via Health Insurance Portability and Accountability Act—compatible video platforms such as those in the electronic medical records (Epic, Verona, WI), Zoom (San Jose, CA), or Vidyo (Hackensack, NJ). Before telehealth visit scheduling, the patient’s access to appropriate computer software or smartphone setup was evaluated. Patients with suitable equipment and who were agreeable were scheduled for a telemedicine video visit. Despite the pre—telehealth visit check, broadband issues could still result in failure to complete a medical visit. Verbal consent was obtained before every telehealth visit, and the respective documentation was saved in the medical records. For non—English-speaking patients, translators were available for the telehealth visit. The decision to proceed with a telehealth visit was at patient and provider discretion. The patients must have agreed, and the providers must have ensured that the visit type and objective were conducive to a telehealth visit. During the study period, no consensus guidelines were available regarding the diagnosis or visit types that would qualify a patient for a telehealth evaluation. The rapid adoption of

**ARTICLE HIGHLIGHTS**

- **Type of Research:** A single-center, retrospective analysis
- **Key Findings:** We found that vascular surgery telehealth evaluations in the outpatient setting were associated with 2.3 times the odds of completion compared with in-person visits (odds ratio, 2.3). African-American patients had had a decreased odds of telemedicine usage (odds ratio, 0.7).
- **Take Home Message:** Telehealth evaluations can improve vascular surgery outpatient medical visit compliance. African-American patients had a risk of underusage of telehealth technology.
telehealth evaluations was pressed on us by the COVID-19 pandemic.

The follow-up telehealth visits were typically reserved for those with uncomplicated postoperative courses. New patient telehealth visits were scheduled to evaluate whether the patient should have an in-person visit or the visit could be delayed to a future date. Our primary outcome was medical visit completion, defined as the patient’s compliance with the telehealth or in-person encounter for the full duration of the visit. The reasons for incomplete medical visits included technical difficulties and lack of uniform adoption of telehealth across all providers and outpatient sites. Our secondary outcome was evaluating whether African-American race predicted for the use of telehealth technology.

**Statistical analysis.** Descriptive baseline characteristics are reported as the mean ± standard deviation for continuous variables and frequencies and percentages for categorical variables. Binary data comparisons were performed using the χ² method. Multivariate logistic regression prediction models were constructed. The selection of covariates was determined by the clinical relevance to the primary outcome of medical visit completion. The latter model was used to evaluate the hypothesis that telehealth would improve medical visit completion. Similarly, a multivariate logistic regression model was used to predict telehealth usage, with African-American race as the main predictor. This was used to evaluate the hypothesis that African-American race would predict for telehealth usage. We performed a per patient and per visit regression analysis when appropriate. The geocode statistical package from Stata (StataCorp LLC, College Station, TX) allows for the calculation of the distance (in miles) and travel time (in minutes) between the latitude and longitude of two geographic zip codes; the latter software uses Google route (shortest driving time) with the transport mode a car at the time the command was run. The “geocode” command was run during the day between 8:00 AM and 12:00 PM. Geographic centroids are typically used for zip codes. The time and distance calculations were for one-way trips. Statistical significance was considered present at P < .05. Statistical analysis was performed using Stata, version 16.1 (StataCorp LLC).

**RESULTS**

A total of 23,553 outpatient visits were scheduled for 10,587 patients during the study period. Of these outpatient visits, 1,559 were scheduled telehealth encounters and 21,994 were scheduled in-person encounters. Of the 1,559 scheduled telehealth visits, 843 visits (54.1%) were scheduled video visits and 716 were mobile telephone appointments. The medical visit completion rate was similar between the video (77.3%) and telephone (74.2%) visits (P = .157). For the African-American patients, 67.0% of the telehealth visits were scheduled video visits vs 55.7% for White patients (P = .036). Of the 23,553 scheduled outpatient encounters, 13,900 medical visits (59.0%) had been completed, including 1,183 telehealth visits and 12,717 in-person visits. Most of the visits were for PAD evaluation (37.9%), followed by venous disease (18.5%), aneurysmal disease (13.3%), dialysis access (12.5%), and carotid disease (12.2%). A significant difference was found in the frequency between the visit diagnosis and visit type for each category of vascular disease (P < .05; Table I). The mean travel distance saved for telehealth visits was 22.1 ± 27.1 miles, and the mean travel time saved was 46.3 ± 41.47 minutes. The percentage of missing data for the primary outcome was 0%. The covariate missing data ranged from 0% to 2% for race, ethnicity, and the patient’s spoken language.

We noted no sociodemographic differences between the patients scheduled for telehealth vs in-person visits (Table II). The two groups had a similar mean age at 68 years and a comparable sex frequency and ethnicity. The racial breakdown for the in-person group was as follows: 1062 African American (10.6%), 8674 White (87.3%), 1 Alaska Native (0.01%), 10 Native American (0.1%), 57 Asian (0.6%), 4 Pacific Islander (0.01%), and 139 either refused or did not specify (1.4%). The racial breakdown for the telehealth group was as follows: 46 African American (9.1%), 453 White (89.9%), 1 Native American (0.2%), 1 Asian (0.2%), and 3 (0.6%) had refused to specify. No statistically significant differences were found. A trend was found toward a lower proportion of women and African-American patients in the telehealth group compared with the in-person group (44.9% vs 47.8% [P = .195] and 7.8% vs 10.6% [P = .116]); however, the difference was not statistically significant.

We found a significantly higher rate of medical visit completion among the telehealth group compared with the in-person group (1183 of 1159 visits [79.5%]; vs 12,717 of 21,994 visits [59.4%]; P < .001). The new patient completion rate for the in-person visits was 65.8%, which was significantly higher than the return patient completion rate at 54.4%. Similarly, for the telehealth visits, the completion rate for the new patients was 85.1%, which was significantly higher than that for the return patients at 76.6% (P < .001). On multivariate analysis, of the patients scheduled for an outpatient medical visit, a scheduled telemedicine evaluation (vs in-person) was associated with 2.3 times the odds of completing the medical visit (odds ratio [OR], 2.31; 95% confidence interval [CI], 2.05-2.61), adjusting for age, sex, race, ethnicity, language, and distance between the patient’s home zip code and the outpatient vascular center zip code (Table III). The direction and strength of the association between a scheduled telehealth encounter and medical visit completion was independent of age, sex, and race.
Female sex and the African-American race were associated with a decreased odds of visit completion (OR 0.93; 95% CI, 0.88-0.98; vs OR, 0.90; 95% CI, 0.83-0.97, respectively).

Stratified by race, 70.7% of the African-American patients had completed their telehealth visit compared with 76.4% of the White patients. For patients scheduled for telemedicine visits, African-American race was associated with a decreased odds of telemedicine visit completion (OR, 0.73; 95% CI, 0.59-0.90), after adjusting for age, sex, ethnicity, language, and visit type (PAD, aneurysmal disease, carotid disease, venous disease, dialysis access, and wound management; Table IV).

DISCUSSION

The COVID-19 pandemic led to telehealth’s explosion across specialties, with usage rates 38 times greater than the prepandemic baseline rates. The reimbursement changes initiated by the Centers for Medicare and Medicaid Services and then by other payers and several emergency waivers (ability to use the Health Insurance Portability and Accountability Act–noncompliant applications, waiver of geographic and facility restrictions, and reimbursement for telephone only visits) have aided the rapid expansion of this technology during the pandemic. Thus, societal guidelines have hastened to provide a robust structural framework for medical care continuity. The Society for Vascular Surgery health information technology task force recommended “implementing telemedicine for patient encounters and teleconference for professional interactions to optimize personal safety and continuity of patient care.” Our results have highlighted that telehealth evaluations, potentially because of the convenience and improved patient familiarity with this technology, can improve vascular surgery outpatient medical visit compliance. However, we noted concerning

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Table I. Predictors of scheduled medical visit completion

| Visit diagnosis            | Total (n = 13,900) | Telemedicine (n = 1183 visits) | In-person (n = 12,717 visits) | P value |
|---------------------------|-------------------|-------------------------------|------------------------------|---------|
| Peripheral arterial disease | 5268 (37.9)       | 428 (38.1)                    | 4843 (56.1)                  | .181    |
| Venous disease            | 2571 (18.5)       | 187 (15.8)                    | 2386 (18.8)                  | .013    |
| Aneurysmal disease        | 1844 (13.3)       | 201 (16.8)                    | 1646 (12.9)                  | <.001   |
| Dialysis access           | 1730 (12.5)       | 82 (6.7)                      | 1648 (13.0)                  | <.001   |
| Carotid disease           | 1689 (12.2)       | 148 (12.4)                    | 1544 (12.1)                  | .762    |
| Wound evaluation          | 1358 (9.8)        | 157 (13.3)                    | 1203 (9.4)                   | <.001   |
| Visceral vessel disease   | 273 (2.0)         | 29 (2.5)                      | 244 (1.9)                    | .207    |
| Miscellaneous             | 1113 (8.0)        | 116 (9.8)                     | 997 (7.8)                    | .017    |

Data presented as number (%). Boldface P values represent statistical significance. *Completed medical visits could have received more than one visit diagnosis; comparisons between the two groups were performed using the \( \chi^2 \) test.

Table II. Predictors of telehealth usage among completed medical visits (adjusted for visit diagnosis code)

| Total (N = 10,587) | Telehealth (n = 513) | In-person (n = 10,074) | P value |
|--------------------|----------------------|------------------------|---------|
| Age, years         | 68.4 ± 14.7          | 68.4 ± 14.6            | 68.6 ± 15.3       | .810 |
| Male sex           | 5545 (52.4)          | 283 (55.1)             | 5262 (52.2)       | .195 |
| Race               |                      |                        |                   | .116 |
| African American   | 1098 (10.5)          | 46 (9.1)                | 1062 (10.6)       |      |
| White              | 9127 (87.4)          | 453 (89.9)             | 8674 (87.3)       |      |
| Other              | 216 (2.1)            | 5 (1.0)                 | 211 (2.1)         |      |
| Ethnicity          |                      |                        |                   | .257 |
| Hispanic           | 53 (0.5)             | 5 (1.0)                 | 48 (0.5)          |      |
| Non-Hispanic       | 9895 (95.9)          | 479 (95.9)              | 9416 (95.9)       |      |
| Other              | 367 (3.6)            | 15 (13)                 | 352 (3.6)         |      |
| Language (non-English) | 261 (2.5)      | 12 (2.4)                | 249 (2.5)         | .863 |
| >2 Diagnoses/visit | 130 (1.2)            | 7 (3.0)                 | 123 (3.2)         | .847 |
| Visit completion   | 6396 (60.4)          | 408 (79.5)              | 5988 (59.4)       | <.001 |

Data presented as mean ± standard deviation or number (%). Boldface P values represent statistical significance. *Comparisons between the two groups were performed using the \( \chi^2 \) test.
sociodemographic disparities, especially for African-American patients.

Overall, we found improved vascular surgery visit completion using telemedicine. This finding is particularly relevant given recent data showing high rates of loss to follow-up after vascular procedures that can reach 46.8% after 1 year. Loss to follow-up was associated with worse long-term survival. In a recent cohort study analyzing telehealth and in-person visits of 1,131,722 primary care patients in an integrated health care system, it was shown that the 7-day follow-up after an initial telehealth visit was higher than that after an initial in-person visit (26.0% vs 24.5%). Our results suggest a potentially stronger role for telehealth visits for vascular surgery patients; telehealth increased the odds of medical visit compliance by 2.3 times compared with the odds of an in-person visit (OR, 2.31; 95% CI, 2.05-2.61). The stronger correlation could have resulted from the comorbidities of vascular surgery patients, which have been shown to predict long-term follow-up loss. Coronary artery disease and discharge to a rehabilitation center (frequent occurrences in our vascular population) have been identified as independent predictors of follow-up loss in multivariate models.

Another potential reason for the favorable medical visit completion rates with telemedicine is the high patient satisfaction rate, which reached ≥95.0% during the pandemic era. Convenience factors such as the decreased roundtrip time and cost are among the most common reasons behind the improved usage. A study from the Mayo Clinic health care system across three different sites (and states) demonstrated comparable patient satisfaction between face-to-face and telemedicine vascular surgery encounters in the era of the COVID-19 pandemic. Similarly, studies from other specialties such as general surgery (after cholecystectomy and hernia repair) have shown safe and equally effective postoperative outpatient visits with telehealth technology compared with in-person visits. Some investigators have argued that expedited virtual follow-up visits might identify risk factors for readmission of discharged patients, thus improving the overall care outcomes.

The wide-scale implementation of telemedicine has exposed health care access inequities for older adults and racial and ethnic minorities. In our study, we found a 27% reduction in the odds of telemedicine visit completion for African-American patients. They consisted 91% of scheduled telehealth visits compared with 13.1% of in-person visits (P < .001). This is comparable to one area of the vascular literature showing African-American patients comprising only 5% of telehealth visits compared with 23% of traditional in-person visits for outpatient varicose vein evaluations (P = .073).

Possible explanations include that nearly one quarter of American households lack internet access in rural areas according to a report by the Federal Communications Commission. African-American individuals have been even less likely to use the internet, although this gap has narrowed over more recent years. Similarly, medical care avoidance during the COVID-19 pandemic was 50% more prevalent among minority African-American and Hispanic adults compared with White adults. Additional unique challenges with ethnic minorities include the potential for language barriers and the need for interpreters, which will further complicate the telehealth encounter.

Several other studies have highlighted the underusage of telehealth visits by minority populations across different geographic areas. An early evaluation of patients seeking telehealth care in New York, the epicenter of the U.S. COVID-19 crisis, revealed that African-American and Hispanic individuals had higher odds of emergency room visits compared with telehealth encounters (OR, 4.3; 95% CI, 4.0-4.6; and OR, 2.5; 95% CI, 2.3-2.7, respectively) compared with White individuals. Another analysis of seniors belonging to a large health plan in Northern California showed that African-American, Hispanic, and Filipino patients were less likely to use digital technology to perform health care-related tasks compared to non-Hispanic whites.

Although telehealth visits can improve medical access and visit compliance, the future role of telemedicine in vascular surgery will depend on the patient’s preferences.
consideration was the limited to two distinct ethnicities. Another important the distribution of ethnic groups in our dataset was robust conclusions for this speciportion of Hispanic patients in our cohort did not allow for able (if medically appropriate).

the patient and correct usage of this technology and maintaining education and reassurance will be key to ensuring the safe and correct usage of this technology and maintaining the patient’s choice in deciding which visit type is preferable (if medically appropriate).

Study limitations. The limitations of our study included the retrospective nature of our analysis. Our outpatient population was not representative of the actual racial or ethnic group proportions for our geographic area (Pittsburgh, PA). According to the U.S. Census Bureau, African-American and Hispanic patients constituted 23.0% and 3.2% of the Pittsburgh population (vs 13.0% and 0.5%, respectively, in our cohort). The small proportion of Hispanic patients in our cohort did not allow for robust conclusions for this specific subgroup. In addition, the distribution of ethnic groups in our dataset was limited to two distinct ethnicities. Another important consideration was the fluctuating usage of telehealth technology at our institution during the pandemic in response to the COVID-19 infection surges (Fig).

CONCLUSIONS

The use of outpatient telehealth evaluations appears to improve medical visit completion, with potential sociodemographic disparities, especially for African-American patients, among vascular surgery patients. Telehealth technology will remain an essential component of the vascular surgery patient evaluation despite its occasional challenges. Further studies are needed to confirm whether telemedicine expansion has improved access to care for sociodemographic groups in other geographic areas.

AUTHOR CONTRIBUTIONS

Conception and design: AA, NS Analysis and interpretation: AA, OA, MH, SH, PC, KS, EH, EA, NS Data collection: AA, MH, SH, PC Writing the article: AA, MH, SH, NS Critical revision of the article: AA, OA, MH, SH, PC, KS, EH, EA, NS Final approval of the article: AA, OA, MH, SH, PC, KS, EH, EA, NS Statistical analysis: AA, OA, MH, SH Obtained funding: Not applicable Overall responsibility: NS

REFERENCES

1. Katzow MW, Steinway C, Jan S. Telemedicine and health disparities during COVID-19. Pediatrics 2020;146:e20201586.
2. Veinot TC, Mitchell H, Ancker JS. Good intentions are not enough: how informatics interventions can worsen inequality. J Am Med Inform Assoc 2018;25:1080-8.
3. Perrin A, Duggan M. Americans’ Internet Access: 2000-2015. Pew Research Center, 2015. Available at: https://www.pewresearch.org/internet/2015/06/26/americans-internet-access-2000-2015/. Accessed July 10, 2022.
4. Weber E, Miller SJ, Astha V, Janevic T, Benn E. Characteristics of telehealth users in NYC for COVID-related care during the coronavirus pandemic. J Am Med Inform Assoc 2020;27:1949-54.
5. Vogels EA. Some digital divides persist between rural, urban and suburban America. Pew Research Center. Available at: https://www.pewresearch.org/fact-tank/2021/08/19/some-digital-divides-persist-between-rural-urban-and-suburban-america/. Accessed July 10, 2022.
6. Kavousi Y, Al-Adas Z, Crutchfield JM, Kararamos E, Swanson C, Lin JC. Early clinical experience using telemedicine for the management of patients with varicose vein disease. J Telemed Telecare 2019;25:54-8.
7. Eberly LA, Khatana SAM, Nathan AS, Snider C, Julien HM, Deleener ME, et al. Telemedicine outpatient cardiovascular care during the COVID-19 pandemic: bridging or opening the digital divide? Circulation 2020;141:510-2.
8. Epic. Epic Systems. Available at: https://www.epic.com/ 2019. Accessed July 10, 2022.
9. Ozimek A, Miles D. Sta utilites for geocoding and generating travel time and travel distance information. Statas 2011;11:106-19.
10. Bestsenyy O, Gilbert C, Harris A, Rost J. Telehealth: A Quarter-Trillion-Dollar Post-COVID-19 Reality? McKinsey & Co. Available at: https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality. Accessed July 10, 2022.
11. Centers for Medicare and Medicaid Services. Coronavirus Waivers and Flexibilities. Available at: https://www.cms.gov/coronavirus-waivers#text=In%20certain%20circumstances%2C%20the%20Secretary%20of%20Health%20and%20Human%20Services%20may%20allow%20the%20Secretary%20to%20waive%20certain%20requirements%2C%20called%201135%20waivers. Accessed July 10, 2022.
12. 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.
13. Khanh LN, Helenowski I, Zamor K, Scott M, Hoel AW, Ho KJ. Predictors and consequences of loss to follow-up after vascular surgery. Ann Vasc Surg 2020;68:217-23.
14. Reed M, Huang J, Graetz I, Muelly E, Millman A, Lee C. Treatment and follow-up care associated with patient-scheduled primary care
telemedicine and in-person visits in a large integrated health system. JAMA Netw Open 2021;4:e2132793.

15. Judelson DR, Simons JP, Flahive JM, Patel VI, Healey CT, Nolan BW, et al. Determinants of follow-up failure in patients undergoing vascular surgery procedures. Ann Vasc Surg 2017;40:74-84.

16. Ramaswamy A, Yu M, Drangsholt S, Ng E, Culligan PJ, Schlegel PN, et al. Patient satisfaction with telemedicine during the COVID-19 pandemic: retrospective cohort study. J Med Internet Res 2020;22:e20786.

17. Lin JC, Crutchfield JM, Zurawski DK, Stevens C. Implementation of a virtual vascular clinic with point-of-care ultrasound in an integrated health care system. J Vasc Surg 2018;68:213-8.

18. Smith-Strom H, Igland J, Ostbye T, Tell GS, Hausken MF, Graue M, et al. The effect of telemedicine follow-up care on diabetes-related foot ulcers: a cluster-randomized controlled noninferiority trial. Diabetes Care 2018;41:96-103.

19. 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.

20. Erben Y, Franco-Mesa C, Hamid O, Lin M, Stone W, Meltzer AJ, et al. Telemedicine in vascular surgery during the coronavirus disease-2019 pandemic: a multisite healthcare system experience. J Vasc Surg 2021;74:1-4.

21. Lin JC, McLaughlin D, Zurawski D, Kennedy N, Kabbani L. Comparison of virtual visit versus traditional clinic for management of varicose veins. J Telemed Telecare 2020;26:100-4.

22. Hornick JR, Balderman JA, Eugea R, Sanchez LA, Zayed MA. A telephone call 1 week after hospitalization can identify risk factors for vascular surgery readmission. J Vasc Surg 2016;64:719-25.

23. Federal Communications Commission. Eighth Broadband Progress Report. Available at: https://www.fcc.gov/reports-research/reports/broadband-progress-reports/eighth-broadband-progress-report. Accessed July 10, 2022.

24. Czeisler M, Marynak K, Clarke KEN, Salah Z, Shakya I, Thierry JM, et al. Delay or avoidance of medical care because of COVID-19-related concerns—United States, June 2020. MMWR Morb Mortal Wkly Rep 2020;69:1250-7.

25. Gordon NP, Hornbrook MC. Differences in access to and preferences for using patient portals and other ehealth technologies based on race, ethnicity, and age: a database and survey study of seniors in a large health plan. J Med Internet Res 2016;18:e50.

26. Greiwe J. Telemedicine lessons learned during the COVID-19 pandemic. Curr Allergy Asthma Rep 2022;22:1-5.

27. U.S. Census Bureau. United States Census Bureau 2021. Available at: https://www.census.gov/quickfacts/fact/table/pittsburghpennsylvania#Accessed July 10, 2022.

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