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Age and socioeconomic status affect access to telemedicine at an urban level 1 trauma center

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Abstract

Objectives: Despite clinical and economic advantages, routine utilization of telemedicine remains uncommon. The purpose of this study was to examine potential disparities in access and utilization of telehealth services during the rapid transition to virtual clinic during the coronavirus pandemic.

Design: Retrospective chart review.

Setting: Outpatient visits (in-person, telephone, virtual—Doxy.me) over a 7-week period at a Level I Trauma Center orthopaedic clinic.

Intervention: Virtual visits utilizing the Doxy.me platform.

Main Outcome Measures: Accessing at least 1 virtual visit ("Virtual") or having telephone or in-person visits only ("No virtual").

Methods: All outpatient visits (in-person, telephone, virtual) during a 7-week period were tracked. At the end of the 7-week period, the electronic medical record was queried for each of the 641 patients who had a visit during this period for the following variables: gender, ethnicity, race, age, payer source, home zip code. Data were analyzed for both the total number of visits (n = 785) and the total number of unique patients (n = 641). Patients were identified as accessing at least 1 virtual visit ("Virtual") or having telephone or in-person visits only ("No virtual").

Results: Weekly totals demonstrated a rapid increase from 0 to greater than 50% virtual visits by the third week of quarantine with sustained high rates of virtual visits throughout the study period. Hispanic and Black/African American patients were able to access virtual care at similar rates to White/Caucasian patients. Patients of ages 65 to 74 and 75+ accessed virtual care at lower rates than patients ≤64 ($P = .003$). No difference was found in rates of virtual care between payer sources. A statistically significant difference was found between patients from different zip codes ($P = .028$).

Conclusion: A rapid transition to virtual clinic can be performed at a level 1 trauma center, and high rates of virtual visits can be maintained. However, disparities in access exist and need to be addressed.

Keywords: access, disparity, telehealth, telemedicine, virtual

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1. Introduction

The 2019 to 2020 coronavirus pandemic has resulted in the need for social distancing, as well as extensive infrastructure adaptations to minimize viral exposure of health care professionals and patients.[1] Remote telehealth orthopaedic consultation and virtual fracture clinics have been recommended as considerations to minimize staff and physician exposure.[1] Telehealth has been implemented in the past to improve access to subspecialty care in neuromuscular and musculoskeletal disorders.[2–9] Multiple studies, including randomized controlled trials, support that orthopaedic telehealth consultation is safe and effective, results in similar plans of care and patient-reported outcomes, and creates significant cost reduction with noninferior patient satisfaction.[10–19] In orthopaedic trauma, the institution of virtual fracture clinics has been shown to improve rates of follow-up within 72 hours, to decrease mean wait times and no-show rates, to decrease rates of discharges after a single visit (a marker of unnecessary referrals), and to limit increases in spending.[20–22] Despite the clinical and economic advantages, routine utilization of telemedicine remains uncommon.

Telehealth was initially touted as reducing health care disparity in geographically underserved areas[23] and for managing chronic diseases.[24] Our center, like many regional trauma centers, draw patients from several hours away. Advantages of telehealth follow-up could include less travel for patients and convenience for multiple extremity injured patients. However, recent studies on the use of telehealth smartphone "apps"[25] and electronic internet-based patient portals[26] demonstrate significant disparities in access/utilization based on age, race/ethnicity, and socioeconomic status. With respect to orthopaedic surgery at large, several recent studies have demonstrated differences in the treatment of patients based on racial and socio-demographic factors.[27–34] To date, we are unaware of any studies examining health care disparities based on socio-demographic factors specifically in telehealth for orthopaedic trauma.

One question that remains regarding telehealth in orthopaedic trauma is whether there are disparities between socio-demographic groups in utilization of telehealth services, and how factors such as gender, race/ethnicity, socioeconomic status, and insurance status affect patients' ability to access orthopaedic trauma telehealth care. Based on the need for extreme social distancing and the apparent efficacy of virtual clinic in the literature, the decision was made to rapidly transition orthopaedic trauma clinic at our level 1 trauma center to a virtual workflow. This shift presented the opportunity to examine potential disparities in access and utilization of telehealth services in a patient population prone to health care disparities.[33,34]

2. Methods

The virtual visits were hosted on the Doxy.me platform, which is cost free for the patients, but does require internet access, as well as the use of some form of webcam technology. The Doximity video call feature was used as a backup platform primarily on smartphone. Modern smart phone technology provides adequate imaging quality and techniques for physical examination using telehealth have been described.[35–41] For patients whose primary language was not English, a virtual interpreter was utilized to ensure effective and clear communication. To minimize in-person visits, radiographs were obtained at a remote site, surgical wounds were closed exclusively with absorbable sutures when appropriate, and patients were provided educational packets and suture/staple removal kits for home use when nonabsorbable sutures/staples were used.[42] When virtual visits were not possible due to technological limitations (inability to access or effectively utilize internet/web camera technology), only then were phone visits utilized as they were considered a lower standard of care due to inability to perform physical examination. All outpatient visits during the 7-week period of alternative scheduling due to coronavirus restrictions (March–May, 2020) were tracked on a daily and weekly basis and recorded as in-person, telephone, or virtual visits. The ability of patients to access virtual care was then studied after the changes in protocol.

At the end of the 7-week period when the reopening phase began, a total of 785 visits for 641 patients had been recorded. Following Institutional Review Board approval (Atrium Health IRB; Protocol #04-20-30E; PI: Rachel Seymour, PhD) including approval of waived consent, the electronic medical record was queried for each of the 641 patients who had a visit during this period for the following variables:

1. Gender (male, female)
2. Ethnicity (Hispanic or Latinx, Not Hispanic or Latinx)
3. Race (Black, White, Other)
4. Age (<65, 65–74, 75+)
5. Payer source (Commercial/Military [VA+Tricare], Medicare, Medicaid and Self-pay)
6. Home zip code.

Data were analyzed for both the total number of visits (n = 785) and the total number of unique patients (n = 641). Visits were classified and tracked as virtual, phone visits, or in-person visits. For analysis, patients were identified as accessing at least 1 virtual visit ("Virtual" group) or having telephone or in-person visits only ("No virtual" group). Although telephone visits are certainly not in-person visits, our study included the 2 visit types together for analysis as the goal of our study was to specifically elucidate patients' ability to access virtual care utilizing internet and web camera technology (due to the previous publications demonstrating disparities in access to web based portals and smart phone "app" based telehealth solutions[25,26]). Telephone visits do not require use of this technology at any level. In addition, we believe telephone visits are a lower level of care due to inability to perform physical examination/wound inspection, and only offered telephone visits when virtual visits were impossible for the patient.

The minority racial and ethnicity groups had small numbers of visits of each type and thus these groups were combined for analysis of access versus non-Hispanic White/Caucasian patients. All commercial insurance plans, worker's compensation claims, and patients with military payer sources (VA/Tricare/DoD) were combined into a single group for analysis. Medicare patients were their own group for analysis, and patients with Medicaid insurance were combined into a group with self-pay patients for analysis. Home zip code data from our patients were compared with publicly available Internal Revenue Service data to determine the percentage of zip code inhabitants who earned less than $50,000 per year. The patients were then separated into zip code groups in which 0% to 25% (no ZIP codes), 25% to 50%, 50% to 75%, or >75% of inhabitants earned below the $50,000 threshold for analysis. The threshold of $50,000 was assigned as it is roughly the median income for the state of North Carolina (~$53,000). Descriptive statistics were used to report frequencies and percentages of in-person, telephone and virtual visits for each demographic group. Chi-square and Fisher exact test were conducted for bivariate analysis, with an alpha of 0.05. All variables except payer source were included in a logistic

Table 1
Types of visits by week

	Week							
	1	2	3	4	5	6	7	Total
In-person	33 (32.3%)	13 (18.1%)	10 (11.0%)	12 (8.8%)	15 (11.3%)	15 (12.0%)	20 (16.0%)	118 (15.0%)
Phone	66 (64.7%)	33 (45.8%)	30 (33.0%)	46 (33.6%)	40 (30.1%)	48 (38.4%)	46 (36.8%)	309 (39.4%)
Virtual	3 (2.9%)	26 (36.1%)	51 (56.0%)	79 (57.6%)	78 (58.7%)	62 (49.6%)	59 (47.2%)	358 (45.6%)
Total	102	72	91	137	133	125	125	785

regression model to predict access to virtual care, as payer source was found to have no effect on access. All analyses were conducted using SAS 9.4 (SAS Institute Inc, Cary, North Carolina). No funding was received for this study.

3. Results

The weekly totals of in-person, telephone, and virtual visits for each of the 7 weeks were calculated (Table 1). These totals demonstrated a rapid increase from our baseline of 0 to greater than 50% virtual visits during the third week of the 7-week study period (Fig. 1). High rates of virtual visits were then sustained throughout the study period. A large number of telephone visits were utilized during the first transitional week of the study period (64.7%) and during the third through seventh weeks of study the rates of telephone visits were consistently lower, between 30% and 38%. A total of 785 visits were conducted during the 7-week period, with 45.6% of those visits being virtual rather than in-person visits.

Gender, age, and payer source data were available for all 641 patients. Ethnicity/race data was available for 595/641 patients, zip code data was available for 636/641 patients. Statistical analysis as described above demonstrated no statistically significant differences in rates of virtual and in person visits based on gender, ethnicity/race, or payer source (Table 2). A statistically significant difference was found between groups in age ($P = .003$) and patients from zip codes of different income categories ($P = .028$) (Table 2).

When controlling for all demographic variables in a multiple logistic regression model, there was a statistically significant difference in odds of accessing virtual care based on age, but no other factors (Table 3).

4. Discussion

The increase from 0 to greater than 50% virtual visits by the third week of quarantine with sustained high rates of virtual visits throughout the last 5 weeks of our study period illustrates the rapid transformation of our clinic workflow from in-person to virtual clinic. The continued need for >30% of visits to be conducted via telephone however may represent difficulty in virtual care access throughout the orthopaedic trauma population, across patient groups.

As demonstrated above, there was no statistically significant difference between male and female patients in their ability to access virtual and in person care. High rates of patients in both groups were seen for virtual visits.

Multiple previous publications have demonstrated disparities in access to care including telehealth services[25,26] as well as disparities in actual orthopaedic treatment performed based on

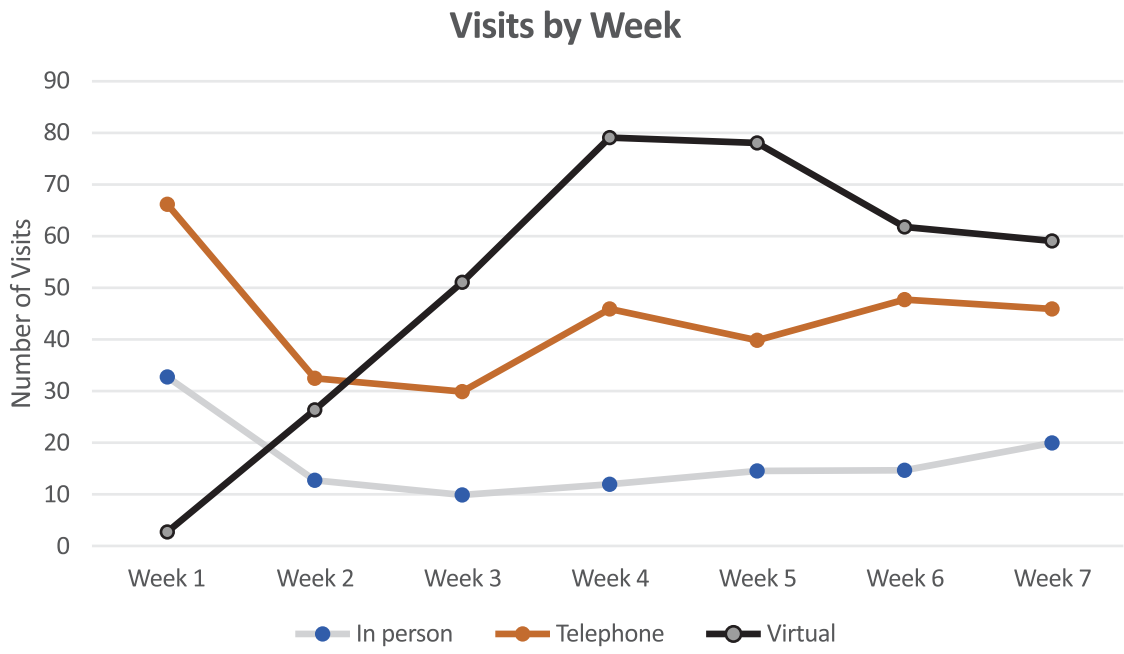

Figure 1. Types of visits by week.

Table 2

Type of visit in all categories

Patient category	No virtual visit	Virtual visit	*P* value
Gender (n = 641)			
Female	130 (41.9%)	130 (39.3%)	.493
Male	180 (58.1%)	201 (60.7%)	
Race/ethnicity (n = 595)			
Non-Hispanic White	169 (59.7%)	170 (54.5%)	.198
Other	114 (40.3%)	142 (45.5%)	
Age (n = 641)			
<65	232 (74.8%)	283 (85.5%)	.003
65–74	51 (16.5%)	34 (10.3%)	
75+	27 (8.7%)	14 (4.2%)	
Payer source (n = 641)			
Commercial/military	178 (57.4%)	185 (55.9%)	.909
Medicaid/self-pay	107 (34.5%)	117 (35.4%)	
Medicare	25 (8.1%)	29 (8.8%)	
ZIP code income category (n = 636)			
25%–49% below $50,000	56 (18.1%)	48 (14.7%)	.028
50%–75% below $50,000	191 (61.8%)	234 (71.6%)	
>75% below $50,000	62 (20.1%)	45 (13.7%)	

race and ethnicity.[27,28,33,34] In the current study, no statistical difference in virtual care access was found based on race or ethnicity. In our cohort, non-Hispanic White/Caucasian patients and the combined "Other" group (a combination of patients who identified as Hispanic, Black/African-American, American Indian, or an "Other" race) accessed virtual care at similar rates. There were multiple groups combined into the "Other" category for race/ethnicity analysis and it is difficult to be confident how this combined category, and the many specific and unique racial groups within the category (described above) are able to access virtual care. This represents a limitation in our study, although some of this may be attributed to limited diversity in the region.[43] In addition, 46 patients did not provide any race or ethnicity information and it is impossible to know if this had any effect on data analysis.

A common concern in telehealth, as discussed previously,[25,26] is the ability of older adults to access virtual care, as they are thought to have less experience with, or to be less adept in using new technology. One previous study noted that adults aged 70 and older were significantly less likely than their younger counterparts to be enrolled in a patient portal or to use the portal to send and receive messages or review results.[26] In our cohort, our findings between age groups were consistent with the previous literature, with rates of virtual care decreasing as age increased. Patients of age 65 to 74 and age 75 and older were 40.4% and 55.2% less likely respectively to access virtual care than those age less than 65 (Table 3). Our findings demonstrate the continued disparity in access to virtual care that older adults face, and it is difficult to know how their outcomes will suffer due to decreased access during the shift to virtual care as a result of the coronavirus pandemic.

Table 3

Odds ratio estimates by category

Odds ratio estimates			
	Point estimate	95% CI	
Gender			
Female	0.917	0.653	1.287
Male	Ref	–	–
Race/ethnicity			
Other	1.198	0.841	1.707
Non-Hispanic White	Ref	–	–
Age			
<65	Ref	–	–
65–74	0.596	0.366	0.970
75+	0.448	0.224	0.898
ZIP income category			
25%–49% below $50,000	Ref	–	–
50%–75% below $50,000	1.463	0.926	2.312
>75% below $50,000	0.871	0.481	1.575

As discussed previously, insurance status and other socioeconomic factors have been shown to result in disparities in accessing telehealth technologies[25,26] as well as disparities in rates of elective and fracture surgeries performed.[29,31,33,34] In our study, we used income level of patient zip code and payer source as surrogates for socioeconomic status. We combined the patients into 3 payer source groups: commercial or military insurance (including worker's compensation), Medicare insurance, and Medicaid/self-pay patients. There was no statistically significant difference in rates of virtual access between the 3 groups. Certain groups with unique payer sources such as worker's compensation, Veterans Affairs and Tricare represented small numbers and thus were combined into the commercial insurance group, so it is difficult to determine how each of these unique payer groups accessed care.

The second surrogate measure of socioeconomic status in our study, the income category of the zip code of the patient, was also analyzed. There were statistically significant differences in ability to access virtual care based on zip code; however, they are difficult to interpret. Patients from zip codes with >75% of inhabitants earning less than $50,000 per year (more impoverished zip codes) accessed virtual care at rates which were the lowest (42.1% of patients accessing virtual care), which is consistent with concerns in access related to socioeconomic status in the literature. However, the patients from zip codes in which 25% to 49% of inhabitants earned less than $50,000 per year (most wealthy zip codes) had lower rates of accessing virtual care than patients from zip codes in which 50% to 75% of inhabitants earned less than $50,000 per year (moderate wealth zip codes), which is difficult to interpret. These findings may be due to differences in the numbers of patients from zip codes of each category, with 66.8% of patients living in zip codes in which 50% to 75% of inhabitants earn less than $50,000 per year. Regardless, the lowest rates of virtual access occurring in patients from the lowest income zip codes are concerning for disparity in access related to poverty.

Strengths of the study and analysis are that all patient visits with encounters in the electronic medical record were recorded on a daily and weekly basis by clinic staff throughout the 7-week period (as were the visit types) to allow for full capture of patient visits. Gender, payer source, and age information was available for all patients, and race/ethnicity and zip code information was available for analysis for 92.8% and 99.2% of patients respectively, helping to improve the internal validity of the study. Limitations of the study have previously been eluded with respect to the small size of many racial groups and patient groups of unique payer sources, requiring aggregation of the patients into larger groups to allow for analysis. The external validity of the study may be limited in terms of extrapolation to other fields of orthopaedic surgery, to other institutions that are not academic level-1 trauma centers, and to other geographic regions

(including regions with more diverse populations and/or those regions more harshly affected by coronavirus). In addition, although virtual fracture clinics have been shown to be safe and cost effective in the past,[20,21,22] there is no outcome data available at this time to evaluate how our rapid transition from 0 to a large percent of virtual visits will affect our patients in the short and long terms, which is a meaningful but unavoidable limitation. Also, it was not recorded whether access to technology was specifically the limiting factor for patients unable to access telehealth, and the injury burden and weightbearing status of patients was not analyzed to determine if this played a factor in need for telephone or in person visits.

The final significant limitation of this study is that although analysis can be performed on rates of virtual, telephone, and in-person visits to evaluate for disparities in virtual access, we are unable to evaluate for disparities between groups in the number of patients who are not able to access any type of care/visit. The total percentage of non-Hispanic White/Caucasian patients in our cohort of 57.0% is slightly higher than our community inhabitants at 46.8%, which may represent a decrease in overall access (all visit types) for racial and ethnic minorities, although it is impossible to determine.[37] In the face of the unprecedented public health crisis that coronavirus has presented, in addition to the shutdown of much public transportation and record-setting rates of unemployment, it is difficult to illuminate disparities between racial groups, age groups, and socioeconomic groups in access to orthopaedic care and health care as a whole.

As coronavirus cases continue to increase with nationwide reopening, it is likely that virtual clinic will continue to be a mainstay of orthopaedic trauma clinic at our institution to allow for continued social distancing and to minimize risk to patients and staff. Further study will be performed at our institution to monitor for any differences in our patients' long-term outcomes after this rapid transition in outpatient practice structure. As demonstrated by the age data in our study, difficulty for older adults in utilizing telehealth must be recognized. And although no differences were found based on race/ethnicity in our study, on a national level, continued awareness of persistent health care disparities in orthopaedic surgery and throughout health care is needed, as is further study regarding the extent of these disparities and methods to limit their effect on patients. Pursuit of telehealth solutions tailored to these groups of patients is warranted, although clear solutions for how to get the necessary technology into the hands of the groups that cannot access it are beyond the scope of this paper. In the interim, to address the disparities noted in our study, patient and family education should be performed for those who have access to internet/web-cam technology but may not know how to use it, either prior to hospital discharge or by office staff when scheduling virtual appointments. In addition, in-person but COVID-safe solutions for care should be found for patients who do not have access to the technology regardless of ability to use it.

Our study demonstrates that a rapid transition from 0 to a large percentage of virtual clinic can be performed at a level 1 orthopaedic trauma center, and high rates of virtual visits can be maintained as needed to allow for social distancing and patient/staff safety. During our 7-week quarantine period, advanced age significantly decreased ability to access virtual care, as did inhabiting zip codes from certain income categories. However, there was no statistically significant difference in access to virtual care based on race/ethnicity, gender, or payer source.

References

1. Viswanath A, Monga P. Working through the COVID-19 outbreak: rapid review and recommendations for MSK and allied heath personnel. J Clin Orthop Trauma. 2020;11:500–503.
2. Greenhalgh T, Shaw S, Wherton J, et al. Real-world implementation of video outpatient consultations at macro, meso, and micro levels: mixed-method study. J Med Internet Res. 2018;20:e150.
3. Caffery LJ, Farjian M, Smith AC. Telehealth interventions for reducing waiting lists and waiting times for specialist outpatient services: a scoping review. J Telemed Telecare. 2016;22:504–512.
4. Wallace P, Haines A, Harrison R, et al. Virtual Outreach Project GroupJoint teleconsultations(virtual outreach) versus standard outpatient appointments for patients referred by their general practitioner for a specialist opinion: a randomised trial. Lancet. 2002;359:1961–1968.
5. Waibel KH, Cain SM, Hall TE, et al. Multispecialty synchronous telehealth utilization and patient satisfaction within regional health command Europe: a readiness and recapture system for health. Mil Med. 2017;182:e1693–e1697.
6. Lee RH, Pearson M, Lyles KW, et al. Geographic scope and accessibility of a centralized, electronic consult program for patients with recent fracture. Rural Remote Health. 2016;16:3440.
7. Taylor M, Caffery LJ, Scuffham PA, et al. Economic modelling of telehealth substitution of face-to-face specialist outpatient consultations for Queensland correctional facilities. Aust Health Rev. 2018;42:522–528.
8. Howard IM, Kaufman MS. Telehealth applications for outpatients with neuromuscular or musculoskeletal disorders. Muscle Nerve. 2018;58:475–485.
9. Mackenzie SP, Carter TH, Jefferies JG, et al. Discharged but not dissatisfied: outcomes and satisfaction of patients discharged from the Edinburgh Trauma Triage Clinic. Bone Joint J. 2018;100-B:959–965.
10. Vuolio S, Winblad I, Ohinmaa A, et al. Videoconferencing for orthopaedic outpatients: one-year follow-up. J Telemed Telecare. 2003;9:8–11.
11. Buvik A, Bugge E, Knutsen G, et al. Patient reported outcomes with remote orthopaedic consultations by telemedicine: a randomized controlled trial. J Telemed Telecare. 2019;25:451–459.
12. Buvik A, Bugge E, Knutsen G, et al. Quality of care for remote orthopaedic consultations using telemedicine: a randomised controlled trial. BMC Health Serv Res. 2016;16:483.
13. Abboud JA, Bozentka DJ, Beredjiklian PK. Telemedicine consultation for patients with upper extremity disorders is reliable. Clin Orthop Relat Res. 2005;250–257.
14. Grandizio LC, Foster BK, Klena JC. Telemedicine in hand and upper-extremity surgery. J Hand Surg Am. 2020;45:239–242.
15. Sinha N, Cornell M, Wheatley B, et al. Looking through a different lens: patient satisfaction with telemedicine in delivering pediatric fracture care. J Am Acad Orthop Surg Glob Res Rev. 2019;3:e100.
16. Buvik A, Bergmo TS, Bugge E, et al. Cost-effectiveness of telemedicine in remote orthopedic consultations: randomized controlled trial. J Med Internet Res. 2019;21:e11330.
17. Harno K, Arajärvi E, Paavola T, et al. Clinical effectiveness and cost analysis of patient referral by videoconferencing in orthopaedics. J Telemed Telecare. 2001;7:219–225.
18. Ohinmaa A, Vuolio S, Haukipuro K, et al. A cost-minimization analysis of orthopaedic consultations using videoconferencing in comparison with conventional consulting. J Telemed Telecare. 2002;8:283–289.
19. Williams M, Amin A, Getgood A, et al. Telephone clinic follow-up following carpal tunnel decompression. J Hand Surg Eur Vol. 2008;33:641–644.
20. Holgate J, Kirmani S, Anand B. Virtual fracture clinic delivers British Orthopaedic Association compliance. Ann R Coll Surg Engl. 2017;99:51–54.
21. McKirdy A, Imbuldeniya A. The clinical and cost effectiveness of a virtual fracture clinic service: an interrupted time series analysis and before-and-after comparison. Bone Joint Res. 2017;6:259–269.
22. Jenkins P, Morton A, Anderson G, et al. Rymaszewski Fracture clinic redesign reduces the cost of outpatient orthopaedic trauma care. Bone Joint Res. 2016;5:33–36.
23. van Veen T, Binz S, Muminovic M, et al. Potential of mobile health technology to reduce health disparities in underserved communities. West J Emerg Med. 2019;20:799–802.
24. Gonzalez BD. Promise of mobile health technology to reduce disparities in patients with cancer and survivors. JCO Clin Cancer Inform. 2018;2:1–9.

25. Ernsting C, Dombrowski SU, Oedekoven M, et al. Using smartphones and health apps to change and manage health behaviors: a population-based survey. J Med Internet Res. 2017;19:e101.
26. 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.
27. Singh JA, Lu X, Rosenthal GE, et al. Racial disparities in knee and hip total joint arthroplasty: an 18-year analysis of national Medicare data. Ann Rheum Dis. 2014;73:2107–2115.
28. Hausmann LRM, Mor M, Hanusa BH, et al. The effect of patient race on total joint replacement recommendations and utilization in the orthopedic setting. J Gen Intern Med. 2010;25:982–988.
29. Dodwell E, Wright J, Widmann R, et al. Socioeconomic factors are associated with trends in treatment of pediatric femoral shaft fractures, and subsequent implant removal in New York state. J Pediatr Orthop. 2016;36:459–464.
30. Jancuska JM, Hutzler L, Protopsaltis TS, et al. Utilization of lumbar spinal fusion in New York state: trends and disparities. Spine (Phila Pa 1976). 2016;41:1508–1514.
31. Sood A, Gonzalez-Lomas G, Gehrmann R. Influence of health insurance status on the timing of surgery and treatment of bucket-handle meniscus tears. Orthop J Sports Med. 2015;3:2325967115584883.
32. Day CS, Makhni EC, Mejia E, et al. Carpal and cubital tunnel syndrome: who gets surgery? Clin Orthop. 2010;468:1796–1803.
33. Schairer WW, Nwachukwu BU, Warren RF, et al. Operative fixation for clavicle fractures-socioeconomic differences persist despite overall population increases in utilization. J Orthop Trauma. 2017;31:e167–e172.
34. Zelle BA, Morton-Gonzaba NA, Adcock CF, et al. Healthcare disparities among orthopedic trauma patients in the USA: socio-demographic factors influence the management of calcaneus fractures. J Orthop Surg Res. 2019;14:359.
35. Tanaka MJ, Oh LS, Martin SD, et al. Telemedicine in the era of COVID-19: the virtual orthopaedic examination. J Bone Joint Surg Am. 2020;102:e57.
36. Pinnamaneni S, Lamplot JD, Rodeo SA, et al. The virtual shoulder physical exam. HSS J. 2021;17:59–64.
37. Lawton CD, Swensen-Buza S, Awender JF, et al. The elbow physical examination for telemedicine encounters. HSS J. 2021;17:65–69.
38. Wright-Chisem J, Trehan S. The hand and wrist examination for video telehealth encounters. HSS J. 2021;17:70–74.
39. Swensen Buza S, Lawton CD, Lamplot JD, et al. The hip physical examination for telemedicine encounters. HSS J. 2021;17:75–79.
40. Lamplot JD, Pinnamaneni S, Swensen-Buza S, et al. The knee examination for video telemedicine encounters. HSS J. 2021;17:80–84.
41. Hansen OB, Eble SK, Ellis SJ, Drakos MC. Adaptation of the foot and ankle physical exam for telehealth. HSS J. 2021;17:85–90.
42. Stinner DJ, Lebrun C, Hsu JR, et al. The orthopaedic trauma service and COVID-19: practice considerations to optimize outcomes and limit exposure. J Orthop Trauma. 2020;34:333–340.
43. 2019 Mecklenburg County Community Health Assessment. Available at: https://www.mecknc.gov/HealthDepartment/HealthStatistics/Documents/Mecklenburg%20CHA%202019.pdf. Accessed July 12, 2020.