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ORIGINAL RESEARCH

OUTCOMES AND QUALITY

Telemedicine Disparities in Ambulatory Cardiology Visits in a Large Academic Health System

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ABSTRACT

BACKGROUND The COVID-19 pandemic prompted rapid expansion of telemedicine to access subspecialty care. However, potential disparities in access to telemedicine in cardiology remain to be fully characterized.

OBJECTIVES The authors aimed to study whether telemedicine visit modality (video or audio only) differed by sociodemographic characteristics in the outpatient cardiology population of a large academic health center.

METHODS We conducted a retrospective cross-sectional study of telemedicine encounter data from all outpatient cardiology telemedicine visits from January 1, 2020, to December 31, 2021. We examined unique patients' first telemedicine encounter during the study period. The primary outcome was visit modality, video versus audio-only visit. Predictors of audio-only visit modality were assessed using adjusted logistic regression analyses.

RESULTS There were 47,961 total adult cardiology telemedicine encounters among 39,381 unique patients. Of all encounters, 20.4% were audio only. Odds of audio-only visit modality increased with age, with the highest odds of audio-only visits in patients aged >75 years (OR: 3.4; 95% CI: 2.8-4.2). Non-White race (OR: 1.2; 95% CI: 1.1-1.3), lack of private insurance (Medicaid OR: 2.8; 95% CI: 2.5-3.1 and Medicare OR: 1.7; 95% CI: 1.5-1.8), and higher social deprivation index quintile (social deprivation index 5, most deprived, OR: 2.0; 95% CI: 1.9-2.2) were also associated with increased odds of audio-only modality.

CONCLUSIONS We identified sociodemographic disparities in telemedicine visit modality in a large outpatient cardiology population. These findings highlight the important role of audio-only visits in accessing telemedicine, and opportunities to narrow the digital health divide. (JACC Adv. 2024;3:101119) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

SDI = social deprivation index

The COVID-19 pandemic led to dramatic changes in the delivery of outpatient cardiovascular care and contributed to the tremendous recent growth of telemedicine.[1-10] This rapid expansion of telemedicine was facilitated by simultaneous changes in telehealth infrastructure and reimbursement,[4,5] and there is increasing evidence that telemedicine will continue to play a role in postpandemic ambulatory cardiovascular care.[10-12] However, while telemedicine has been heralded as a strategy to improve access to care, lower the cost of care, and improve health care outcomes, an important question that remains is whether it has been equitably adopted.[10,13,14]

Telemedicine visits are typically preferentially scheduled as video visits, due to several benefits over audio-only visits. In cardiology, video visits allow examination of key physical exam findings such as respiratory patterns, postprocedural wound sites, jugular venous pressure, and edema.[15] Video visits provide an opportunity to educate patients on appropriate use of a home blood pressure monitor. There are also added psychosocial benefits, including the ability for clinicians to see a patient's home environment, review complex medication regimens with access to pill bottles or boxes, and use nonverbal cues to better establish rapport.[4] There is also limited evidence suggesting that in the heart failure population, audio-only visits may be associated with worse outcomes compared to video visits, including increased 90-day mortality.[16] However, several studies have reported that patients with lower socioeconomic status, older age, and underrepresented racial/ethnic groups experience lower access to technology[16-18]; these represent patient populations already at increased cardiovascular risk.

As telemedicine matures, a key unaddressed concern is whether population differences based on social determinants of health are associated with patient access to video visits, rather than audio-only visits. Indeed, as health systems develop strategies for an enduring long-term approach to virtual care, it is vital that quality and process improvement measures include achievement of the appropriate virtual care encounter.

We therefore examined sociodemographic characteristics and trends associated with telemedicine visit modality in a large academic health system's ambulatory cardiology practice cohort, with an aim to identify potential disparities in access to virtual cardiovascular care and identify opportunities to improve cardiovascular care delivery.

METHODS

This was a retrospective cross-sectional study of deidentified telemedicine encounter data from a large academic health system (Johns Hopkins, Baltimore, Maryland, USA). This analysis was approved by the institution's Institutional Review Board.

STUDY COHORT AND TELEMEDICINE VISIT IDENTIFICATION. The health system's dedicated telemedicine dashboard consists of a limited data set linked to the institution's electronic health record. These data are used to then populate the Telemedicine Equity Dashboard. For the purposes of this study, visits that occurred from January 1, 2020, to December 31, 2021, in a cardiology clinic department were included. The first telemedicine encounter for each unique patient (which accounted for 85% of all telemedicine encounters during study period) was included.

All cardiology clinics had the option of offering telemedicine visits. All telemedicine visits at our institution are prescheduled as video visits. Some are ultimately completed as audio-only visits due to a number of reasons, including patient/clinician preference prior to the visit, digital health access challenges, or technology limitations at the time of visit.

VARIABLES OF INTEREST. The primary outcome of interest was telemedicine visit modality classified as either video or audio-only visit, defined by provider billing at the time of visit. Visit encounter and patient-level data were collected. Exposures of interest were included based on availability in the dashboard and established literature.[6,7,12-14,17-22] These included sociodemographic variables as follows: age (18-30, 31-50, 51-64, 65-74, 75+), sex (male/female), race (White, non-Hispanic Black, Asian, American Indian/Alaska Native, Native Hawaiian/other Pacific Islander, multiracial, other), primary payer (private insurance, Medicaid, Medicare, self-pay, and other), and preferred language (English, Spanish, Korean, Russian, Chinese [Mandarin], other language). Sex was determined by electronic medical record entered biologic sex (rather than patient identified gender), and race was determined by patient identified race entered into the electronic medical record. Social deprivation index (SDI) (1-100, higher score represents a higher deprivation area) was also included as an exposure of interest as it is a validated composite measure of social disadvantage that is associated with health access and outcomes. SDI was assigned to each patient based on zip code data using the Robert Graham Center

methodology.[23,24] The SDI score is based on seven demographic characteristics (poverty rates, education attainment, rates of single-parent households, rates of rented housing units, rates of overcrowded housing units, access to transportation, and unemployment) and was further separated into quintiles using the Jenks Natural Breaks Optimization method.[23-25]

STATISTICAL ANALYSES. To compare rates of video vs audio-only visits across groups, descriptive analyses with chi-square testing was performed.

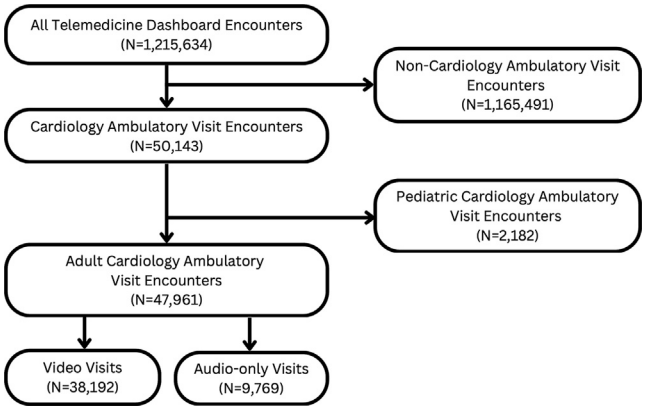
Temporal analysis was conducted to determine the change in rate of audio-only visits over the study period. The data set was grouped into 8 quarter-year time periods spanning from 2020 to 2021: 1) January 1, 2020-March 31, 2020; 2) April 1, 2020-June 30, 2020; 3) July 1, 2020-September 30, 2020; 4) October 1, 2020-December 31, 2020; 5) January 1, 2021-March 31, 2021; 6) April 1, 2021-June 30, 2021; 7) July 1, 2021-September 30, 2021; and 8) October 1, 2021-December 31, 2021. To calculate the rate of audio-only visits, the following 5 variables were tabulated against the 8 time periods: age, race, preferred language, primary payer, and SDI. The rate of audio-only visits was calculated per quarter.

Logistic regression was performed for binary outcome of audio-only vs video visit, and using age, sex, race, primary payer, language, SDI, and time (by quarter) categories as predictor variables. For logistic regression, race and preferred language were further classified into dichotomous variables (White, non-White, and English, not-English, respectively). We performed simple logistic regression for each predictor variable. We then performed a single multivariate model that included all predictors. ORs were calculated examining unique patients' first telemedicine encounter during the study period, rather than all telemedicine encounters. A sensitivity analysis including all telemedicine encounters was performed with adjustment for clustering within patients using a generalized estimating equations model. For logistic regression, encounters with missing data were excluded. For all analyses, StataCorp, 2021 was used (Stata Statistical Software: Release 17, StataCorp LLC). A P value < 0.05 was considered statistically significant.

RESULTS

TELEMEDICINE VISIT MODALITY AND PATIENT CHARACTERISTICS. During the study period, 13% of patients were seen virtually and 87% of patients were seen in-person (Supplemental Figure 1). School of Medicine affiliated clinics accounted for 63.6% of all telemedicine encounters (with a 14.3% rate of telemedicine use) while community affiliated clinics accounted for 36.4% of the telemedicine encounters (with a 11.3% rate of telemedicine use). There were 47,961 cardiology telemedicine encounters during the study period, among 39,381 unique patients. Of these telemedicine visits, 38,192 were video visits and 9,769 audio-only visits (Figure 1). For first telemedicine encounter per unique patient, 78.8% were video and 21.1% were audio-only visits.

FIGURE 1 Flow Diagram Showing Study Inclusion Criteria to Achieve Sample Population of Encounters



Patient-level demographic data are presented in Table 1. Only 3% of patients were aged 18 to 30, while 15%, 27%, 28%, and 28% were aged 31 to 50, 51 to 64, 65 to 74, and 75+ years, respectively. There were roughly equal proportions of male and female patients. The proportion of White patients was 70.2%, while the proportions of non-Hispanic Black, Asian, American Indian/Alaska Native, and Native Hawaiian/other Pacific Islander patients were 19.1%, 4.0%, 0.22%, and 0.1%, respectively. The majority of patients had Medicare insurance (48.2%) and were English speaking (98.2%).

The median SDI score was 31. When broken down into quintiles, the SDI ranges were as follows: 1st SDI quintile (1-10), 2nd SDI quintile (11-22), 3rd SDI quintile (23-38), 4th SDI quintile (39-60), and 5th SDI quintile (61-100). The highest quintile corresponds to areas of highest deprivation. The proportion of patients living in areas of the 1st SDI quintile was 24.3%, while the proportions of patients living in areas of the 2nd, 3rd, 4th, and 5th SDI quintile were 15.7%, 23.7%, 14.0%, and 22.0%, respectively.

When examining the above sociodemographic variables on the encounter-level rather than patient-level, findings were similar (Supplemental Table 1).

TABLE 1 Demographics of Patients With Cardiology Telemedicine Visits: January 2020-December 2021

	Total Number of Unique Patients (N = 39,381)	Patients With Video Encounters (n = 31,065)	Patients With Audio-Only Encounters (n = 8,316)	*P* Value
Age, y				**<0.001**
18-30	1,350 (3.4)	1,205 (3.9)	145 (1.7)	
31-50	5,743 (14.6)	5,067 (16.3)	676 (8.1)	
51-64	10,517 (26.7)	8,646 (27.8)	1,871 (22.5)	
65-74	10,933 (27.8)	8,666 (27.9)	2,267 (27.3)	
75+	10,838 (27.5)	7,481 (24.1)	3,357 (40.4)	
Sex				**0.030**
Male	19,801 (50.3)	15,711 (50.6)	4,090 (49.2)	
Female	19,573 (49.7)	15,347 (49.4)	4,226 (50.8)	
Other/unknown	7 (0.02)	7 (0.02)	0 (0.00)	
Race				**<0.001**
White	27,663 (70.2)	22,117 (71.2)	5,546 (66.7)	
Non-Hispanic Black	7,505 (19.1)	5,406 (17.4)	2,099 (25.2)	
Asian	1,591 (4.0)	1,397 (4.5)	194 (2.3)	
American Indian/ Alaska Native	86 (0.2)	70 (0.2)	16 (0.2)	
Native Hawaiian/ Other Pacific Islander	40 (0.1)	29 (0.1)	11 (0.1)	
Multiracial	571 (1.5)	463 (1.5)	108 (1.3)	
Other	1,231 (3.1)	1,009 (3.3)	222 (2.7)	
Missing	694 (1.8)	574 (1.9)	120 (1.4)	
Ethnicity				**0.001**
Hispanic or Latino	949 (2.4)	780 (2.5)	169 (2.0)	
Non-Hispanic or Latino	37,176 (94.4)	29,254 (94.2)	7,922 (95.3)	
Missing	1,256 (3.2)	1,031 (3.3)	225 (2.7)	
Primary payer				**<0.001**
Medicare	18,990 (48.2)	1,234 (4.0)	605 (7.3)	
Medicaid	1,839 (4.7)	13,743 (44.2)	5,247 (63.1)	
Private	18,340 (46.6)	15,928 (51.3)	2,412 (29.0)	
Self-pay	152 (0.4)	113 (0.4)	39 (0.5)	
Other	60 (0.2)	47 (0.2)	13 (0.2)	
Preferred language				**<0.001**
English	38,683 (98.2)	30,548 (98.3)	8,135 (97.8)	
Non-English	690 (1.8)	510 (1.6)	180 (2.2)	
Spanish	164 (0.4)	112 (0.4)	52 (0.6)	
Korean	118 (0.3)	84 (0.3)	34 (0.4)	
Russian	82 (0.2)	54 (0.2)	28 (0.3)	
Chinese (Mandarin)	52 (0.1)	46 (0.2)	6 (0.1)	
Other language	274 (0.7)	214 (0.7)	60 (0.7)	
Missing	8 (0.02)	7 (0.02)	1 (0.01)	
SDI[a] by quintile				**<0.001**
1st quintile	9,580 (24.3)	7,957 (25.7)	1,623 (19.6)	
2nd quintile	6,172 (15.7)	5,131 (16.6)	1,041 (12.6)	
3rd quintile	9,313 (23.7)	7,386 (23.9)	1,927 (23.2)	
4th quintile	5,503 (14.0)	4,423 (14.3)	1,080 (13.0)	
5th quintile	8,661 (22.0)	6,042 (19.5)	2,619 (31.6)	
Missing	152 (0.4)	126 (0.4)	26 (0.3)	

Values are n (%). Characteristics of patients in the ambulatory cardiology population, first telehealth encounter. $P < 0.05$ was considered statistically significant and is in **bold**. [a]SDI = social deprivation index.

CHANGES IN RATES OF AUDIO-ONLY VISIT ENCOUNTERS OVER TIME. Over the study period, the rate of audio-only visits decreased in the entire cohort (from 44.3% in January-March 2020 to 8.4% in October-December 2021), and also when analyzed over time by age, insurance status, race, and SDI (Figure 2).

Visit encounters with patients age 75+ consistently had the highest audio-only visit rate. The group with the second highest audio-only visit rate was encounters with patients aged 65 to 74, and encounters with patients in the youngest age groups consistently had the lowest audio-only visit rate (Figure 3A). Visit encounters with patients who were non-White consistently had higher audio-only visit rate, though the difference between groups decreased by the end of the study period (Figure 3B). Visit encounters with patients who had Medicaid or Medicare as their primary payer consistently had higher audio-only visit rates across all time periods compared to patients with private insurance (Figure 3C). Visit encounters with patients who lived in areas of the highest SDI (SDI quintile 5) had the highest rate of audio-only visits in all time periods except April-June 2021 (Figure 3D). Differences in rates of audio-only visits between SDI groups also decreased by the end of the study period.

ODDS OF AUDIO-ONLY VS VIDEO VISIT OF FIRST TELEMEDICINE ENCOUNTER BASED ON SOCIO-DEMOGRAPHIC CHARACTERISTICS. Demographic characteristics. Older patients (age groups 51-64, 65-74, and 75+ years), compared to patients aged 18 to 30, had higher odds of audio-only visits on both unadjusted and adjusted analyses (Table 2). When adjusted for sex, race, primary payer, language, SDI, and time period, compared to patients aged 18 to 30, patients aged 51 to 64 had a 2.0 (95% CI: 1.6-2.4; $P < 0.001$), 65 to 74 had 2.1 (95% CI: 1.7-2.6; $P < 0.001$), and 75+ had a 3.4 (95% CI: 2.8-4.2; $P < 0.001$) times higher odds of having an audio-only visit. There was no significant difference between patients aged 18 to 30 and aged 31 to 50.

In unadjusted analyses, female patients had 1.1 times higher odds of audio-only visit (95% CI: 1.01-1.11; $P = 0.023$) (Table 2). However, there was no significant difference between males and females after multivariate adjustment.

Non-White patients, compared to White patients, had higher odds of having an audio-only visit in both unadjusted and adjusted analyses (Table 2). Non-White patients had 1.2 times higher adjusted odds of audio-only visit (95% CI: 1.1-1.3; $P < 0.001$).

Insurance status. Patients with private insurance had the lowest odds of an audio-only rather than video telemedicine visit compared to all insurance groups in both unadjusted and adjusted analyses (Table 2). Compared to patients with private

FIGURE 2 Changes in Rate of Audio-Only Versus Video Visit Encounters Over Time From January 2020 to December 2021 by Quarter

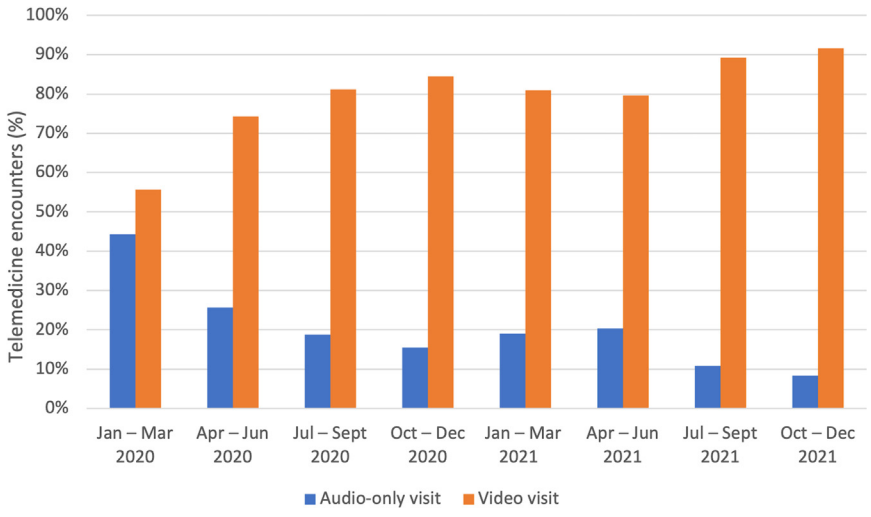
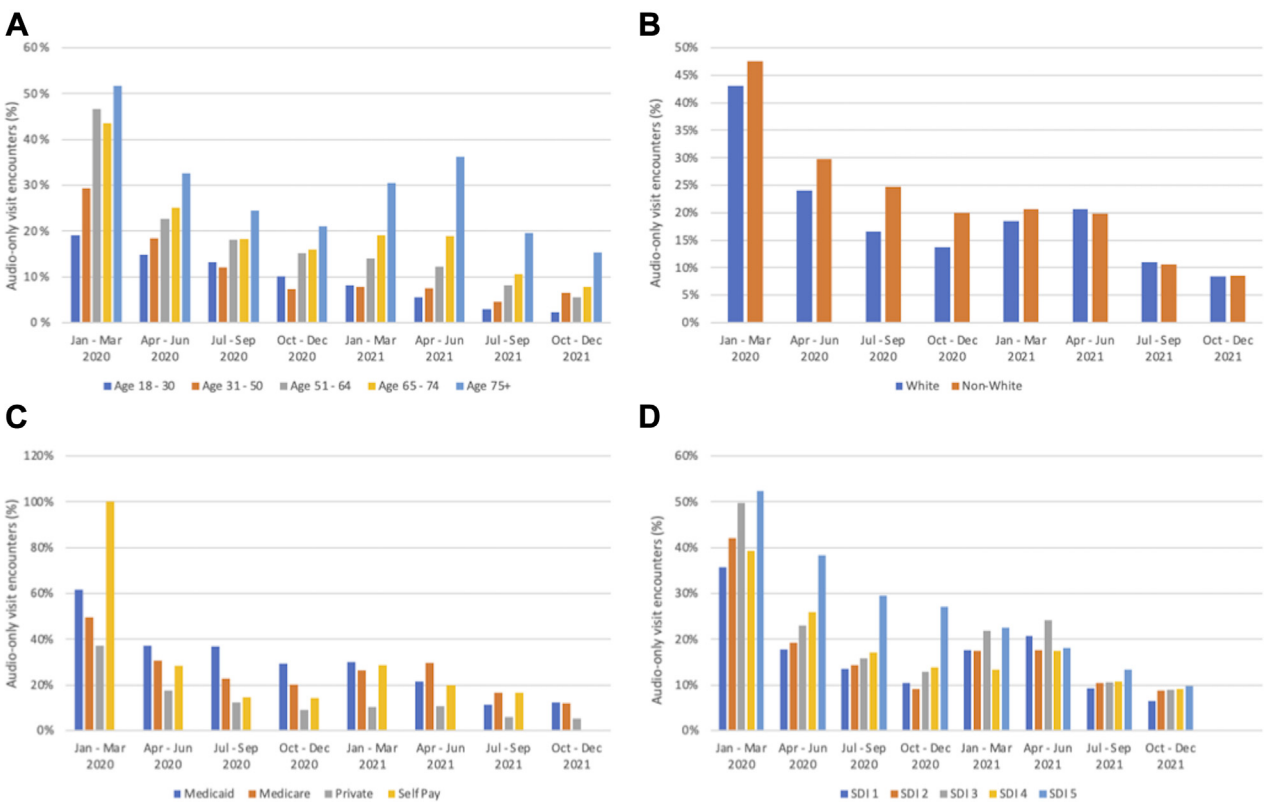


FIGURE 3 Changes in Rate of Audio-Only Encounters Over Time



(A) Age, (B) race, (C) insurance status, and (D) social deprivation index (SDI).

TABLE 2 Logistic Regression Analyses for Odds of First Cardiology Telemedicine Encounter Conducted as Audio-Only Visit Compared to Video Visit

	Unadjusted OR (95% CI, *P* Value)	Adjusted OR[a] (95% CI, *P* Value)
Age (y)		
18-30	Reference	Reference
31-50	1.11 (0.92-1.34, $P = 0.287$)	1.19 (0.97-1.45, $P = 0.090$)
51-64	**1.80 (1.50-2.15, *P* < 0.0001)**	**1.98 (1.64-2.39, *P* < 0.0001)**
65-74	**2.17 (1.82-2.60 *P* < 0.0001)**	**2.09 (1.72-2.55, *P* < 0.0001)**
75+	**3.73 (3.12-4.45, *P* < 0.0001)**	**3.43 (2.81-4.19, *P* < 0.0001)**
Sex		
Male	Reference	Reference
Female	**1.06 (1.01-1.11, *P* = 0.023)**	1.03 (0.98-1.09, $P = 0.221$)
Race		
White	Reference	Reference
Non-White	**1.26 (1.20-1.33, *P* < 0.0001)**	**1.21 (1.14-1.28, *P* < 0.0001)**
Primary payer		
Private	Reference	Reference
Medicare	**2.52 (2.39-2.66, *P* < 0.0001)**	**1.65 (1.53-1.78, *P* < 0.0001)**
Medicaid	**3.24 (2.91-3.60, *P* < 0.0001)**	**2.78 (2.48-3.12, *P* < 0.0001)**
Self-pay	**2.28 (1.58-3.29, *P* < 0.0001)**	**2.10 (1.43-3.08, *P* < 0.0001)**
Other	1.83 (0.99-3.38, $P = 0.055$)	2.14 (1.12-4.08, $P = 0.021$)
Language		
English	Reference	Reference
Non-English	**1.33 (1.12-1.57, *P* = 0.001)**	0.91 (0.75-1.09, $P = 0.315$)
SDI quintile		
1	Reference	Reference
2	0.99 (0.91-1.08, $P = 0.902$)	0.99 (0.90-1.08, $P = 0.800$)
3	**1.28 (1.19-1.38, *P* < 0.0001)**	**1.22 (1.13-1.32, *P* < 0.0001)**
4	**1.20 (1.10-1.30, *P* < 0.0001)**	**1.19 (1.09-1.30, *P* < 0.0001)**
5	**2.13 (1.98-2.28, *P* < 0.0001)**	**2.01 (1.86-2.17, *P* < 0.0001)**
Time (in quarters)		
Jan-Mar 2020	Reference	Reference
Apr-Jun 2020	**0.44 (0.38-0.51, *P* < 0.0001)**	**0.40 (0.34-0.46, *P* < 0.0001)**
Jul-Sept 2020	**0.29 (0.25-0.33, *P* < 0.0001)**	**0.26 (0.23-0.31, *P* < 0.0001)**
Oct-Dec 2020	**0.23 (0.19-0.26, *P* < 0.0001)**	**0.21 (0.18-0.25, *P* < 0.0001)**
Jan-Mar 2021	**0.31 (0.27-0.36, *P* < 0.0001)**	**0.31 (0.27-0.36, *P* < 0.0001)**
Apr-Jun 2021	**0.34 (0.30-0.40, *P* < 0.0001)**	**0.34 (0.29-0.41, *P* < 0.0001)**
Jul-Sept 2021	**0.15 (0.12-0.18, *P* < 0.0001)**	**0.15 (0.12-0.18, *P* < 0.0001)**
Oct-Dec 2021	**0.11 (0.08-0.13, *P* < 0.0001)**	**0.11 (0.08-0.14, *P* < 0.0001)**

$P < 0.05$ was considered statistically significant and is in **bold**. [a]Multivariate logistic regression performed with the following variables: age, sex, race, primary payer, preferred language, social deprivation index quintile (SDI, with the most under resourced patients having the highest SDI), and time (in quarters).

insurance, patients with Medicare, Medicaid, and self-pay had 1.7 (95% CI: 1.5-1.8; $P < 0.001$), 2.8 (95% CI: 2.5-3.1; $P < 0.001$), and 2.1 (95% CI: 1.4-3.1; $P < 0.001$) times higher adjusted odds of audio-only visit.

Language. In unadjusted analysis, non-English speaking compared to English speaking patients had 1.3 times higher odds of audio-only visit (95% CI: 1.1-1.6; $P < 0.01$); however, no significant difference was noted on multivariate adjustment (Table 2).

Social deprivation index. In multivariate adjusted analyses, as SDI severity increased, the odds of patients having audio-only visits increased. Specifically, compared to patients living in areas of lowest social deprivation (the 1st SDI quintile), patients living in areas of the 3rd, 4th, and 5th SDI quintile had 1.2 (95% CI: 1.1-1.3; $P < 0.001$), 1.2 (95% CI: 1.1-1.3; $P < 0.001$), and 2.0 (95% CI: 1.9-1.2; $P < 0.001$) times higher odds of audio-only visit (Table 2, Central Illustration).

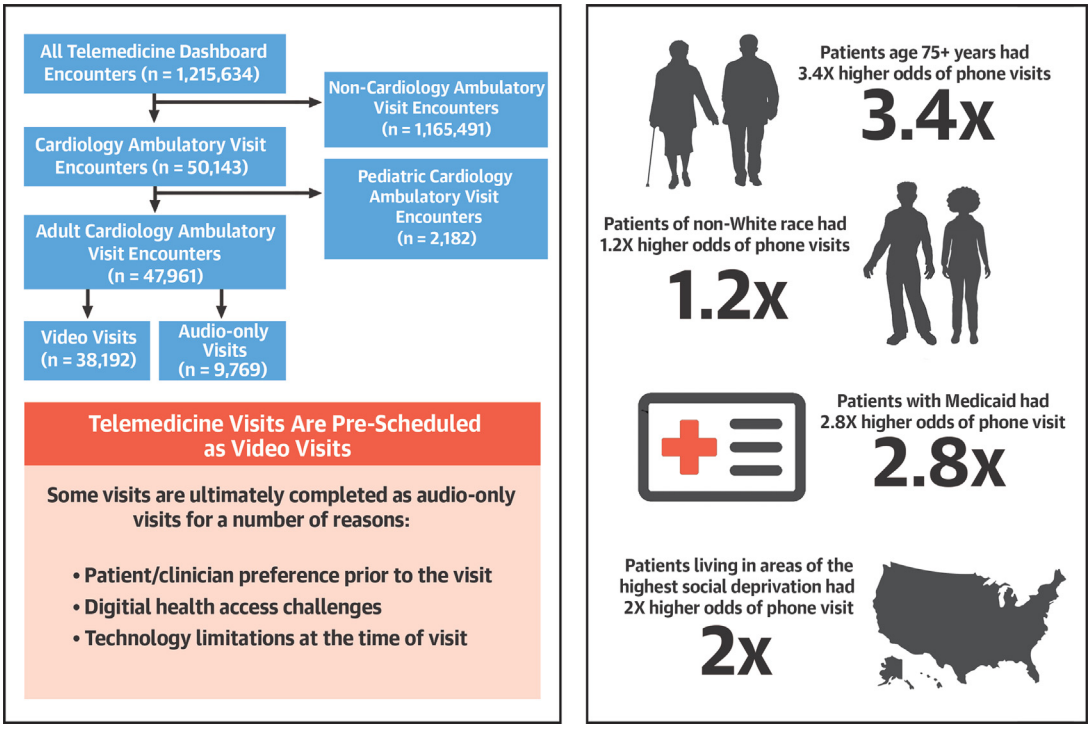
Sensitivity analysis. The above regression analyses were performed with the first cardiology clinic telemedicine encounter each patient experienced during the study period (which accounted for 85% of total encounters). The total number of encounters per patient is summarized in Supplemental Table 2. A sensitivity analysis was performed for all encounters, adjusted for clustering within patients using a generalized estimating equations model. Similar outcomes were demonstrated as shown in Supplemental Table 3.

DISCUSSION

In this study examining 47,961 cardiology clinic telemedicine encounters by 39,381 unique patients at a large academic health system from January 2020 to December 2021, we found significant disparities in telemedicine modality (audio-only compared to video) use, with increased odds of audio-only visits in patients with older age, non-White race, public, and self-pay insurance status, and higher severity SDI quintile. Notably, we found that the rate of audio-only visits decreased over the study period across all patient subgroups. These findings together suggest that patients in disadvantaged sociodemographic groups are less likely to complete a telemedicine visit via video, which may contribute to disparities in care.

Our work is in line with and extends previously described observations of telemedicine visit modality.[18,26] Similar to a study of visit modality in cardiovascular ambulatory care at an academic center and affiliated community practice in northern California, we also found that telemedicine visits for patients that were older, non-White, and with Medicare and Medicaid insurance were more likely to be delivered by an audio-only instead of video modality.[18] This is significant given the difference in population demographics between the 2 studies: they reported 5% of encounters with Black patients, compared to 20% of encounters with Black patients in our study. Their study also included patients in a community practice; ours did not. This suggests that our findings are not isolated to a single large academic center but are more likely to be part of a growing body of evidence that supports sociodemographic differences in the use of telemedicine in

CENTRAL ILLUSTRATION Telemedicine Disparities in Ambulatory Cardiology Patients



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cardiovascular ambulatory care. Notably, while Osmanlliu et al[18] and others conducted analyses at the visit encounter level, we conducted analyses at the patient level and were thus able to avoid any confounding from few high utilizers. To our knowledge, we are the first to have conducted a patient-level logistic regression analysis of cardiology telemedicine data that is able to avoid such confounding from patients who had multiple telemedicine encounters. We found similar results when we used the first telemedicine encounter for each unique patient and when we included all encounters for each patient and adjusted for clustering within patients.

The implications of audio-only vs video visit on cardiovascular health outcomes warrants further investigation. Some studies have found that in the heart failure population, audio-only visits may be associated with worse outcomes compared to video visits, including increased 90-day mortality.[16] In the primary care population, rates of medication prescribing and diagnostic test orders were found to be higher in video than audio-only visits, while rates of emergency department visits and hospitalizations were lower after video compared to audio-only visits.[20] However, there remains a dearth of studies in cardiology examining clinical outcomes based on telemedicine modality, and this area requires further investigation. Adverse outcomes may be challenging to tease out, as some of the variables that we found to be associated with higher odds of audio-only visit (older age, non-White race, social determinants of health) are also associated with a higher risk of clinical outcomes such as hospital readmissions and emergency department visits.[27,28] Furthermore, outcomes likely differ based on the purpose of the telemedicine encounter. In other words, while video visits offer several advantages over audio-only visits, audio-only visits may be sufficient for certain clinical scenarios. Moreover, patient satisfaction and preferences may differ between patients of different demographic groups and should be considered as well.[26] For example, some patients may prefer audio-only over a video visit modality due to unfamiliarity with technology, privacy concerns, or discomfort with a

sensitive topic.[29] Moving forward, as telemedicine matures, it will be imperative to identify if there are specific clinical scenarios that warrant video over audio-only visits, and then develop solutions to help decrease the disparities in video visit utilization that have been highlighted in this study and others.[18,22] Possible interventions include community-based workshops to increase digital health literacy, simplified onboarding for non-English speaking patients with translator assistance, and advocacy for equitable broadband deployment.[21] Regardless, the reliance on audio-only visits by patients that are older, non-White, do not have private insurance, and live in areas with higher SDI has important implications on reimbursement policies, and stresses the necessity of continuing to include reimbursement for audio-only telemedicine visits.[10,19] For example, even in the postpandemic period of January 2022 to December 2023, audio-only visits accounted for 6% of cardiology telemedicine visits and 11% of all clinic telemedicine visits. It is possible that practice patterns changed postpandemic due to changes in reimbursement policies.

There are some limitations to our analysis. First, we were unable to assess reason for audio-only instead of video visits, specifically whether patient/clinician preference or technical/access limitations existed at the time of scheduling or during visit itself resulting in audio-only visit. From a quality-of-care standpoint, a telemedicine visit that was predetermined to be an audio-only visit due to patient preference likely needs to be viewed differently than a telemedicine visit in which a significant portion of the time was spent attempting to connect to a video visit prior to becoming an audio-only visit ("video to audio-only visit conversion"). A related limitation when interpreting our findings is the inherent transition back to in-person visits during later phases of the pandemic; it is possible that the number of audio-only visits decreased as a reflection of an increase in in-person visits for those unable to connect via video. However, there is likely a subset of patients who have both high in-person no-show rates (due to various barriers to care including transportation and mobility challenges) as well as higher odds of video-to-audio visit conversion, and further analyses specific to this patient group is warranted. Additionally, we were unable to assess longitudinal changes to determine if a unique patient who was limited to audio-only visits at the beginning of the pandemic was able to access video visits in subsequent telemedicine encounters. Finally, due to data limitations, we were not able to assess if telemedicine visit modality was associated with differences in cardiovascular clinical outcomes such as adherence to guideline-directed medical therapies, acute care utilization, cardiovascular risk factor control, changes in readmission rates or emergency department visits, or major adverse cardiovascular events including 1-year mortality. Clinical outcomes should be the target of future related studies, and moving forward efforts should be made to include both digital health and clinical variables in data dashboard development to better understand telemedicine's role in the postpandemic health care ecosystem for patients with cardiovascular disease.

CONCLUSIONS

At a large academic health system, significant sociodemographic disparities in telemedicine modality in ambulatory cardiology visits were observed, with higher odds of audio-only visit in patients that were older, non-White, with public and self-pay insurance status, and higher SDI. Given benefits of video visits over audio-only visits in cardiovascular care, current telemedicine strategies would benefit from further analysis of barriers to successful video visit completion and impact on clinical outcomes across telemedicine and in-person care modalities. Additionally, the reliance on audio-only visits by disadvantaged patients to improve access to health care has important policy implications as regulators consider reducing reimbursements for this care modality.

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PERSPECTIVES

COMPETENCY IN PATIENT CARE: Ambulatory cardiology patients of older age, non-White race, without private insurance, and who live in areas of high social deprivation are more likely to complete a telemedicine visit as a phone visit instead of a video visit. These patients should be assessed for barriers to video visit completion to optimize their care.

TRANSLATIONAL OUTLOOK 1: Further interventions and advocacy are needed to increase digital health literacy, improve understanding of barriers to video completion of telemedicine visits, and secure reimbursement for phone visits.

TRANSLATIONAL OUTLOOK 2: Although there are significant sociodemographic disparities in telemedicine visit modality, additional research is needed to examine whether these findings impact quality of care and clinical outcomes.

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APPENDIX For supplemental tables and a figure, please see the online version of this paper.