A cardiovascular clinic patients' survey to assess challenges and opportunities of digital health adoption during the COVID-19 pandemic

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BACKGROUND COVID-19 boosted healthcare digitalization and personalization in cardiology. However, understanding patient attitudes and engagement behaviors is essential to achieve successful acceptance and implementation of digital health technologies in personalized care.

OBJECTIVE This study aims to understand current and future trends in wearable device and telemedicine use in the cardiology clinic patient population, recognize patients' attitude towards digital health before and after COVID-19, and identify potential socioeconomic and racial/ethnic differences in adoption of digital health tools in a New Orleans patient population.

METHODS A cross-sectional survey was distributed to Tulane Cardiology Clinic patients between September 2020 and January 2021. Basic demographic information, medical comorbidities, device usage, and opinions on digital health tools were collected.

RESULTS Survey responses from 299 participants (average age = 54 years, 50.8% female, 24.4% African American) showed that digital health use was more prevalent in younger, healthier, and more educated individuals. Wearable use was also higher among White patients compared to African American patients. Patients cited costs and technology knowledge as primary deterrents for using wearables, despite being more inclined to use wearables for disease monitoring (41%). While wearable use did not increase after COVID-19 (36.6% pre-COVID vs 35.4% post-COVID, $P = .77$), telemedicine use rose significantly (10.8% pre-COVID vs 24.3% during COVID, $P < .0001$). Patients mostly noted telemedicine's effectiveness in overcoming difficult healthcare access barriers. Additionally, most patients are in support of wearables and telemedicine either complementing or replacing routine tests and traditional clinical visits.

CONCLUSION Demographic and socioeconomic disparities negatively impact wearable health device and telemedicine adoption within cardiovascular clinic patients. Although telemedicine use increased after COVID-19, this effect was not observed for wearables, reflecting significant economic and digital literacy challenges underlying wearable acceptance.

KEYWORDS Wearables; Cardiology; Telemedicine; Disparities; COVID-19

(Cardiovascular Digital Health Journal 2022;3:31–39)

Introduction

The SARS-CoV-2 (COVID-19) pandemic increased the need for implementing wearable health devices and telemedicine to supplement the healthcare provided to patients.[1] Digital health technologies offer the ability to continuously monitor physiological parameters of health, engage in frequent patient-physician interaction, and provide valuable opportunities for personalized tailored care, all while addressing potential barriers to healthcare access.[2] They have been particularly booming in the cardiovascular field,[2,3] as electrocardiogram-based wearables allowed for continuous remote rhythm monitoring.

Despite the potential for digital health and wearable devices to augment patient care, there remain challenges regarding collaboration involving all stakeholders, including patients, providers, payers, and technology industries, and subsequent implementation of mobile health tools.[2,4] Given that consumers are the main drivers of the digital health trend, their active and encouraged engagement will be key to maximize health and socioeconomic benefits of wearables. Certain factors, including socioeconomic and cultural factors, may impact patient attitudes toward and adoption of wearables.[5] Therefore, it is essential to understand the patients' attitude toward digital health and wearable devices.

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https://doi.org/10.1016/j.cvdhj.2021.10.007

KEY FINDINGS

- In the cardiology population in New Orleans, significant demographic disparity still exists in the usage of digital health tools.
- While the Covid-19 pandemic greatly enhanced the accessibility and use of telemedicine, it had little impact on accelerating the adoption of health wearables in our population.
- Despite a relatively slow adoption of digital health tools and its related challenges, patients overwhelmingly supported the implementation of these tools in their daily clinical care.

As the pandemic solidified healthcare and physician interest in increasing telemedicine and wearable device usage in patient care, it is important to analyze its impact on patients' care and perceive barriers to adoption and acceptance.

New Orleans, a city with a diverse racial ethnic population and significant healthcare disparities, has been severely impacted by the COVID-19 pandemic. In order to accommodate for the consequences of the pandemic and continue patient care, the healthcare systems have implemented telemedicine and other digital health tools to further personalize and coordinate patient care. As the uptake of digital health tools has been rapidly expanding into New Orleans healthcare institutions, we sought to assess in this study the usage patterns of telemedicine and wearable devices prior to and post-COVID-19; the demographic and participant characteristics that predict telemedicine and wearable device use and potential barriers to digital health tool adoption and acceptance; and the attitudes toward implementation and integration of telemedicine and wearables in clinical practice and healthcare post-COVID-19.

Methods

Study design

We administered an anonymous online digital health survey to cardiovascular clinic patients between September 2020 and January 2021. The survey was administered to all cardiology clinic patients receiving cardiology care at the Tulane University Heart and Vascular Institute (TUVHI) by the study nurse. All patients visiting the TUVHI clinic between September 2020 and January 2021 were included in the study. Potential participants included patients with prior history of cardiovascular disease as well as patients establishing cardiovascular care at TUVHI. The study nurse assisted with promoting the survey, answering questions about the survey, and collecting responses from participants after completion of surveys. Survey participation was extended to all patients who are aged 18 or above and who can read and sign a digital consent. Survey participation was on a voluntary basis and participants were provided reassurance of survey confidentiality. Participants were queried on their use of wearables and telemedicine pre- and post-COVID-19, and March 2020 was defined as the cut-off time point between the 2 periods. The survey included questions regarding patient demographics; socioeconomic and educational status; medical comorbidities; previous and current device/telemedicine use; device type, if any; and opinion about wearables and telemedicine implementation in clinical care. Basic demographic information collected included patient age, racial-ethnicity identification, home residence zip code, highest education attainment, and medical insurance information. Types of devices described as "wearables" included but were not limited to the following: Apple Watch, Fitbit, Garmin, Biostrap, Samsung Galaxy Watch, electrocardiographic smartphone device, and Withings watch. A template of the survey can be found in the Supplemental Appendix. This study was approved by the Institution Review Board at Tulane University.

Data analysis

A descriptive analysis of patients' demographics, clinical characteristics, and opinions on wearables and telemedicine was performed. Continuous variables are described as mean ± standard deviation (SD) and are further assessed for significant departure from normality via the Shapiro-Wilk test. Differences in means for continuous variables are tested via an unpaired, pooled variance *t* test, as the variances between the groups being compared were not significantly different. For categorical variables (clinical conditions, race, etc), proportionality of the variables was tested using a traditional Pearson χ^2 test, or Fisher exact test if some of the expected frequency counts for a particular category were less than 5. These tests assessed if the proportion of subjects with a particular characteristic were similar across the groupings of the subjects. A subanalysis was conducted among subjects whose use of wearable devices changed after COVID-19, either from no device to use of a device or vice versa. Subjects were grouped according to demographic traits or clinical conditions, and the McNemar test was used to determine if there was a significant change in wearable use based on those groupings. We also performed a multivariate analysis with logistic regression modeling using common demographic and clinical variables to examine potential predictors of wearable and/or telemedicine use both pre- and post-COVID-19. Odds ratios were reported with corresponding 95% confidence intervals and *P* values. Results were considered statistically significant when $P < .05$.

Results

Baseline characteristics

Among all the eligible participants, 400 participants were approached for survey completion during the study period. Two hundred ninety-nine (74.75%) participants completed the survey between September 2020 and January 2021. The mean age of participants was 54 ± 17.3 years old. Approximately 14% of the participants self-identified within ages

Table 1 Baseline characteristics of the total population (n = 299 participants)

Baseline characteristic	Result
Age in years, mean ± SD	54 ± 17.3
Age breakdown, n (%)	
18–30	42 (14.0%)
31–50	51 (17.1%)
50–65	75 (25.1%)
65+	81 (27.1%)
Unspecified	53 (17.7%)
Sex	
Female	152 (50.8%)
Male	142 (47.5%)
Unspecified	5 (1.7%)
Race	
African American	73 (24.4%)
White	197 (65.9%)
Asian	16 (5.4%)
Hispanic	4 (1.3%)
Native American/Alaskan Native	1 (0.3%)
Other	1 (0.3%)
Decline to specify	2 (0.7%)
(Missing)	5 (1.7%)
Education level	
No high school	4 (1.3%)
Some high school	24 (8.0%)
Graduated high school	55 (18.4%)
Some college	61 (20.4%)
Associate degree	23 (7.7%)
Bachelor's degree	47 (15.7%)
Graduate degree	73 (24.4%)
(Missing)	12 (4.0%)
Comorbidities	
Hypertension	133 (44%)
Diabetes	58 (19%)
Increased lipids/cholesterol	55 (18%)
Sleep apnea	69 (23%)
Heart rhythm disorders	133 (44%)
Previous stroke	24 (8%)
Current or previous cancer	19 (6%)
Lung disease	18 (6%)
Liver disease	3 (1%)
Kidney disease	23 (8%)

18–30, 17.1% within ages 31–50, 25.1% within ages 51–65, and 27.1% above age 65. A total of 50.8% of participants were female; 24.4% of the participants were African American (AA). Almost half of the patients had heart rhythm disorders (44%) and hypertension (44%). Other notable comorbidities participants noted include sleep apnea (23%), diabetes (19%), and dyslipidemia (18%). All baseline characteristics of participants are summarized in Table 1.

Wearable use in the study population

Disparities in wearable use

The population using wearables was significantly younger (mean age: 49.7 ± 17.7 years old) than the population that did not (mean age: 56.7 ± 16.6 years old; $P = .0019$). Racial/ethnic differences related to wearable use were observed: 42.6% of White subjects used wearables while only 26.4 % of AA subjects did ($P = .0184$). In examining

Table 2 Difference in baseline characteristics and comorbidities between wearable users and nonusers pre-COVID-19

Baseline characteristic	Pre-COVID-19 % using wearables		P value
Sex			
Female	41.7%		.0688
Male	45.8%		
Race			
African American	26.4%		.0184*
White	42.6%		
Other	0.3%		
Age group			
18–30	59.5%		.0068*
31–50	46.0%		
51–65	33.3%		
65+	30.0%		
Education level			
No high school	0.0%		<.0001*
Some high school	12.5%		
Graduated high school	25.5%		
Some college	26.2%		
Associate degree	47.8%		
Bachelor's degree	51.1%		
Graduate degree	50.7%		
Comorbidities	**Yes**	**No**	**P value**
Hypertension	32.3%	40.3%	.1618
Diabetes	22.4%	40.2%	.0120*
Increased lipids/cholesterol	45.5%	34.6%	.6966
Sleep apnea	29.0%	39.0%	.1308
Heart rhythm disorders	36.8%	36.5%	.9487
Previous stroke	33.3%	36.9%	.7253
Current or previous cancer	52.6%	35.5%	.1347
Lung disease	27.8%	37.2%	.4203
Liver disease	33.3%	36.7%	1
Kidney disease	21.7%	37.9%	.1222

*Indicates statistically significant *P* value.

wearable use, 107 participants noted using wearables prior to the COVID-19 pandemic, and 99 patients noted initiating wearable use after COVID-19 pandemic. Among participants previously using wearables, 25 (23.4%) participants noted using Apple Watch, 9 (8.4%) participants use FitBit, and 4 participants noted using Garmin Watch. There was a statistically significant difference in wearable use among patients with different education levels, with patients with lower educational level having the lowest utilization rates ($P < .0001$). However, no difference in wearable tool use was seen among women and men (41.7% and 45.8%, respectively, $P = .0688$). In terms of comorbidities (including hypertension, dyslipidemia, sleep apnea, arrhythmias, history of stroke, history of cancer, lung disease, liver disease, or kidney disease), there was no difference between patients who used wearables and patients who did not, except for a lower diabetes rate in patients with wearables (22.4% vs 40.2%, respectively, $P = .012$). Demographics and comorbidities of patients using wearables vs patients who did not use these devices are provided in Table 2. The use of wearables during the pandemic was not statistically different from the rates reported before COVID-19 (36.6% pre-COVID vs 35.4 post-COVID, $P = .77$, Figure 1).

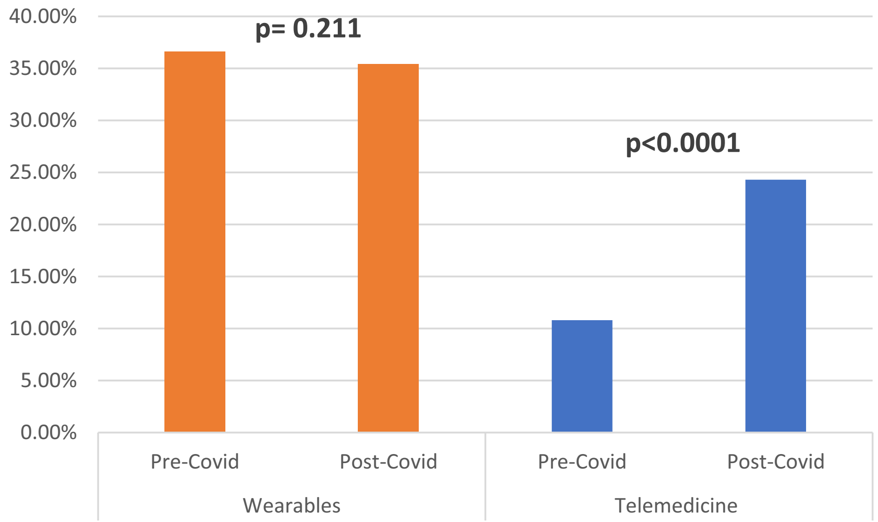

Figure 1 Wearable and telemedicine use pre- and post-COVID-19.

Predictive factors of wearable use after the onset of COVID-19

To determine predictive factors of wearable device use among survey participants, a multivariate analysis including 7 variables (age, sex, race, educational level, COVID-19 diagnosis, history of hypertension, and history of heart disease) was conducted. The multivariate model was composed to compare the most common demographic factors (age, sex, race, education), hypertension, heart disorders, and COVID diagnosis, as these factors were of increased interest in comparing telemedicine and wearable device use patterns. Other heart condition is defined to include history of atrial fibrillation, heart rhythm disorders, and other heart disease conditions enumerated in the survey, since these conditions are pertinent to TRIAD's research focus on heart arrhythmia and heart disease. Hypertension and other heart disorders were specifically chosen as comorbidities of interest, since all except the aforementioned comorbidities were not associated with significant differences in usage prior to and during the pandemic. Results of the multivariate analysis are shown in Figure 2. Younger age, higher educational level, and female sex remained the only significant predictors of wearable use after the onset of COVID-19 in the studied population (odds ratio [OR] = 0.975 [0.955; 0.995], P = .01; OR = 1.479 [1.012; 2.161], P = .04; OR = 1.77 [1.007; 3.135], P = .04, respectively) (Figure 2). A previously positive COVID-19 diagnosis did not predict an increase in wearable adoption (P = .6168, Figure 2).

Patients' opinion on wearable use

Patients' perceptions regarding wearable use in clinical practice are summarized in Figure 3. High levels of costs and lack of technical knowledge were 2 commonly noted reasons for decreased usage of wearable devices (17.1% and 10.0%, respectively) (Figure 3A). However, among users, the primary data participants were interested in was information regarding health monitoring (64.9%) (Figure 3B). Specifically, patients wished to seek information regarding heart rhythm (66.9%), physical activity (49.2%), vital signs (47.8%), sleeping patterns (37.8%), and diet (30.4%) (Figure 3C). Furthermore, most patients had a favorable view toward implementing wearable devices in clinical practice, with 60.1% stating that wearable devices could supplement routine tests and 33% believing that they could replace routine tests (Figure 3D).

Telemedicine use pre- and post-COVID-19

Demographic characteristics and comorbidities of patients using telemedicine before and after the COVID-19 pandemic are summarized in Table 3. Only 30 patients (10.8%) reported using telemedicine for their clinical care before the onset of

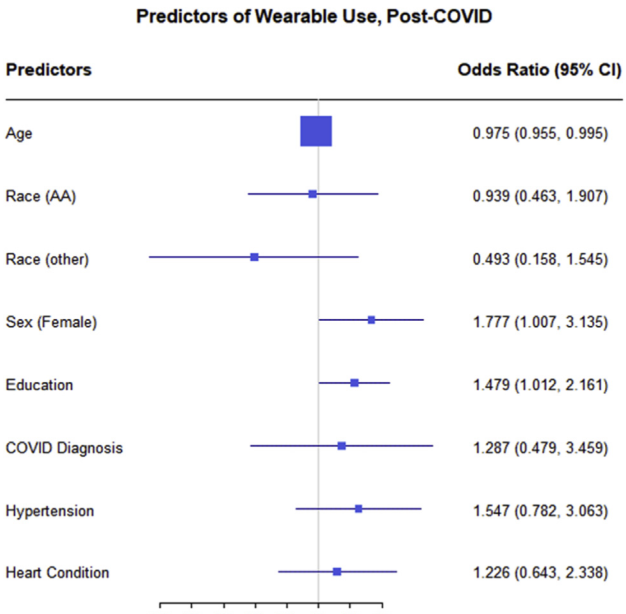

Figure 2 Multivariate analysis for predictors of wearable use after the onset of the COVID-19 pandemic. AA = African American.

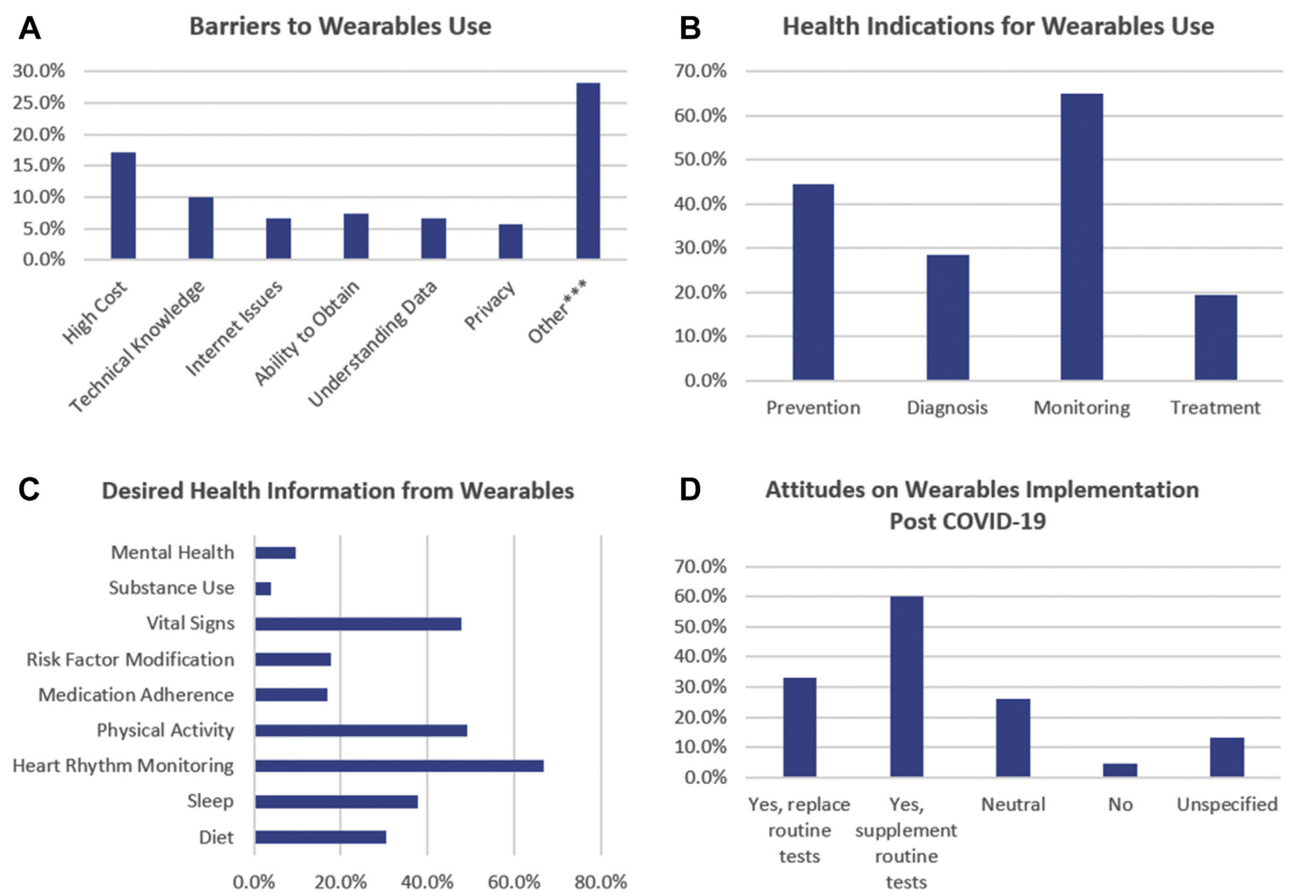

Figure 3 Patients' perspectives on wearable devices for health purposes. Responses are shown to the following questions: **A:** If you do not use wearable health devices, what barriers would you face using a wearable health device? **B:** After COVID-19, what would you want to use wearable health devices or remote monitoring devices for? **C:** What information would you like to receive if you use wearable health devices? **D:** After COVID-19, do you believe wearable health devices or remote health monitoring should be implemented in medicine?

COVID-19. After the onset of COVID-19, there was a significant rise, with 65 participants (24.3%) initiating telemedicine use in their healthcare visits ($P < .0001$, Figure 1). Before COVID-19, there was no statistical difference in telemedicine use between different participant demographics, including sex, race, and age. However, patients with a higher educational status noted increased frequency in telemedicine use ($P < .003$, Table 3). While higher rates of dyslipidemia were correlated with significant difference between telemedicine users and nonusers (19.1% vs 8.1%, respectively; $P = .0114$), there were no significant differences in terms of other self-identified comorbidities. After the onset of the pandemic, patients using telemedicine were more likely to be younger, had a higher educational level, and had fewer comorbidities (Table 3).

When asked about the barriers to care alleviated by telemedicine, most participants recorded that telemedicine helped overcome challenges in finding reliable physicians (75.2%), resolving transportation issues (67.9%), and maintaining social distancing measures (63.3%) (Figure 4A). Through the expansion of telemedicine use during the COVID-19 pandemic, 53.2% of participants believed telemedicine visits should supplement traditional in-person visits, and 24.1% believed telemedicine should replace in-person clinic visits (Figure 4B).

Discussion

Our study demonstrates 3 major findings. First, within the cardiology patient population in New Orleans, there are significant demographic differences in current and previous wearable health device and telemedicine use as well as attitudes toward these digital health tools. Second, while the COVID-19 pandemic greatly enhanced the accessibility and use of telemedicine, the same findings did not translate for wearable health device use and this disparity can be attributable to numerous patient and healthcare characteristics. Third, despite a relatively slow adoption of digital health tools and its related challenges, patients overwhelmingly supported the implementation of these tools in their daily clinical care.

Digital health technology in cardiology has the potential to either exacerbate or alleviate healthcare disparities. Our study suggests that demographic differences in wearable use among cardiology patients in New Orleans exist and have persisted throughout the pandemic. Findings from other digital health surveys[6,7] and studies[8] targeting more general

Table 3 Difference in baseline characteristics and comorbidities between telemedicine users and nonusers pre- and post-COVID-19

	Pre-COVID-19		Post-COVID19	
Characteristic	% using telemedicine	*P* value	% using telemedicine	*P* value
Total	10.8%		24.3%	
Sex				
Female	13.7%	.1095	26.8%	.3492
Male	8.3%		21.9%	
(Missing)	0%		0%	
Race				
African American	7.5%	.3214	23.1%	.0086*
White	11.3%		21.9%	
Other	19.0%		52.4%	
Age group				
18–30	7.3%	.0962	47.5%	<.0001*
31–50	20.4%		27.3%	
51–65	7.2%		23.5%	
65+	9.3%		9.7%	
(Missing)	11.6%		25.6%	
Education level				
No high school	0%	<.0001*	0%	<.0001*
Some high school	9.5%		14.3%	
Graduated high school	7.7%		13.5%	
Some college	13.3%		13.5%	
Associate degree	17.4%		23.8%	
Bachelor's degree	8.7%		38.6%	
Graduate degree	11.9%		33.0%	
(Missing)	0%		0%	
Comorbidities				
Hypertension	13.2%	.2404	19.0%	.0566
Diabetes	9.8%	.794	12.2%	.029*
Increased lipids/cholesterol	19.1%	.0114*	17.4%	.1181
Sleep apnea	13.8%	.3711	21.3%	.5297
Heart rhythm disorders	14.5%	.1142	18.8%	.0409*
Previous stroke	9.1%	.0578	22.7%	.8536
Current or previous cancer	15.8%	1	15.8%	.5789
Lung disease	22.2%	.4437	16.7%	.5752
Liver disease	0.0%	.1159	66.7%	.1479
Kidney disease	4.8%	1	10.0%	.1748

*Indicates statistically significant *P* value.

populations translated similarly when compared to our cardiology clinic population, despite both patients and providers having increased accessibility to numerous useful remote monitoring tools.[9] We demonstrated that wearables and telemedicine use were more prevalent among younger, highly educated, and healthier patients, even though wearables are practically more beneficial in the routine monitoring of older and sicker patient populations. Indeed, chronic conditions were not associated with an increase in use of neither wearables nor telemedicine. Instead, age, educational level, and female sex were significant predictors of wearable use in our population. Younger patients and women, who also have fewer comorbidities, are more likely to be engaged in health-promoting behaviors,[10,11] from investing in wearables to track their fitness to regularly checking with their doctors regarding their general health. The digital health consumer survey conducted by Accenture in 2020 showed that younger patients and highly educated individuals were more likely to trust tech companies for health and wellness services (43% of millennials vs 20% of baby boomers).[7] This demographic stratum also exhibits a higher understanding of digital tools, which translates into higher rates of wearable and telemedicine adoption compared to older or undereducated populations. The digital divide is further amplified by racial disparities, as our survey shows more accessibility to wearable devices in White patients compared to AA patients despite an increased population of AA in New Orleans (according to the US Census tract and the New Orleans Health Department; 59.5% AA and 33.9% White). Our findings are consistent with other national studies documenting lower rates of health-related technology use among racial/ethnic minorities in the general population.[12] This potentially stems from higher economic hurdles, lower educational level, and lower internet accessibility within the minority population in New Orleans.[13,14] Additionally, perceived cost-benefit ratio and digital literacy were the most commonly reported hurdles from the patient's perspective in our study and in other published articles,[15–17] while privacy-related risk was of lesser concern. The current iterations of advertisements for wearables and service design may be simple for younger

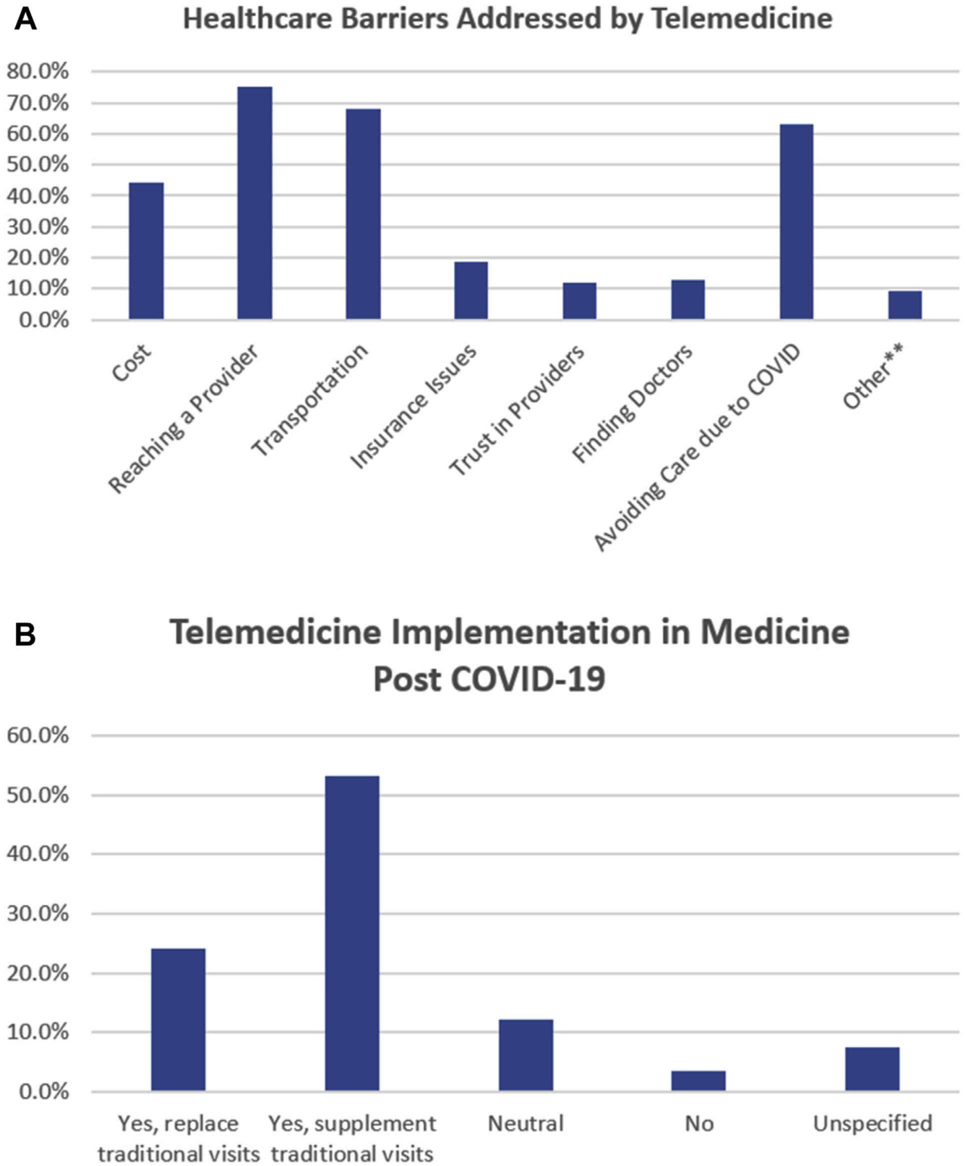

Figure 4 Patients' perspectives regarding telemedicine use after COVID-19. Responses are shown to the following questions: **A:** After COVID-19, which of these barriers do you think telemedicine can provide or already provides help with? **B:** After COVID-19, do you believe telemedicine should be used routinely in healthcare?

generations to comprehend[18] but are not specifically accommodating to older customers' knowledge level about digital health.

To maintain quality care during social distancing measures, the COVID-19 pandemic was accompanied by a significant increase in telemedicine use. As governmental and healthcare systems invested more in telehealth solutions, insurances have also allowed for equivalent reimbursements for in-person and telehealth appointments during the pandemic. Considering the many advantages that telemedicine offers to the patient without increased financial burden, the surge in telemedicine use and the overwhelming subsequently positive feedback toward future implementation in daily clinical practice are favorable. Nevertheless, with social distancing measures and reduced availability of on-site medical staff, there is an increased expectation that both patients and providers would resort to wearable technologies for remote health monitoring. However, our study demonstrates a lack of increase in wearable adoption from the patient's side through the COVID-19 pandemic, despite an overall positive view toward wearable use in clinical care. This finding is in accordance with a significant decrease in the growth of the wearable technology market during 2020 compared to 2019.[19] In fact, the abovementioned barriers were exacerbated by the pandemic, thus potentially explaining the lack of increase in wearable use. The impacts of the pandemic could not solely explain demographic differences in underutilization, but can potentially be attributable to other factors, including job loss, salary cuts, and economic hardships.[20] Moreover, the degree of ease of use of technology (effort expectancy) and social influence have been shown to be key factors guiding an individual's behavioral intention to use health technology.[21–23] From this perspective, social distancing measures implemented during the pandemic directly resulted in lower digital health engagement, specifically in the elderly, which was amplified when paired with further isolation, low social engagement, and hard-to-use consumer-grade digital tools.

Our findings highlight that expanding digital health tools by industry and healthcare systems is not sufficient to fully explore their potential in personalized and remote clinical care. Promoting wearable and telemedicine use in a population that is older, more impoverished, and experiencing more risk factors and comorbidities can generate a much greater public health impact and reduce healthcare costs,[24] especially during challenging healthcare landscapes. Wearables can encourage positive health behaviors,[25] decrease visits to the hospital and emergency room,[26] and increase drug adherence.[27] Therefore, it might be in the best interest of healthcare organizations and payers to further invest in digital health opportunities. Reimbursement plans by insurance companies including digital tool prescriptions in comorbid populations and wearable data review will incentivize their use among patients and providers,[2,8] thus addressing cost barriers. Certain digital technology companies have already initiated collaborations with Medicare plan providers to subsidize the cost of wearable devices, and more industries involved in digital health are likely to follow. On the other hand, consumers'/patients' active engagement will be essential for the digital health trend to continuously enhance clinical practice. Providers should proactively interact with patients and explain the potential benefits of digital tools and assessing digital literacy in their patients as part of their routine clinical practice, a key step in addressing effort and performance expectancies while fostering positive attitudes. Patient-centered designs and concepts can help with developing personalized tools for consumers'/patients' needs. Tech providers and consumers/patients from diverse demographic backgrounds not only can provide valuable input and help brainstorm concepts, but they can also actively utilize and analyze data so user-friendly, clinically relevant, and financially viable wearable and telemedicine tools can become a mainstay in future medicine.[28]

Limitations

Our study has several limitations to consider. First, the single-center nature of the study and the relatively small sample size might not capture wider disparities in the general population and could limit reproducibility. Second, recall bias may arise owing to the nature of the study as a self-reported survey and, therefore, identification of specific devices was limited owing to voluntary survey completion, despite significant effort from the survey coordinator to inform participants of the different aspects of the survey and convey thorough completion of survey questions. Third, in view of the relative autonomy given to the patient when filling the survey, some questions were left unanswered or partially answered, although the number of missing answers was not significant. Fourth, the wearable utilization information was based on current and previous usage; therefore the data collected were not based on physician recommendation, nor were the data analyzed to assess physician impact on patient use. Fifth, the multivariate model to identify predictors was limited, since there was not substantial data for other predictors (income, exercise, sleep apnea, and other variables) to build a comprehensive model. Sixth, compared to the other 299 participants, the 101 individuals who did not participate were patients that received care in the Tulane cardiology clinic, which has a similar pattern of demographic breakdown compared to the participants. However, specific information was not collected to compare the 2 groups. Finally, causation cannot be established, since the results reported are from a single cross-sectional survey.

Conclusion

Age, racial, and socioeconomic disparities in the use of digital health tools exist among the cardiology population in New Orleans. Despite an overall surge in telemedicine use, these disparities seem to have persisted through the COVID-19 pandemic, along with the exacerbation of economic and digital literacy challenges reported by the patients. Given the increasing trend in digital tool implementation in healthcare systems, our data support a swift intervention to minimize digital health disparities before they exacerbate with time and magnify unequal access to quality healthcare.

Funding Sources

No external funding was received in conjunction with this analysis.

Disclosures

Dr Marrouche reports receiving grant support and consulting fees from Abbott, Wavelet Health, Medtronic, Biosense Webster, Boston Scientific, GE Health Care, and Siemens; receiving consulting fees from Preventice; and holding equity in Marrek and Cardiac Design. All other authors have no conflicts of interest associated with the content of this manuscript.

Authorship

All authors attest they meet the current ICMJE criteria for authorship.

Data Availability

The data that support the findings of this study are available from the corresponding author, Nassir Marrouche, upon reasonable request.

Guidelines Statement

The provided research has adhered to the Helsinki Declaration as revised in 2013.

Disclaimer

Given his role as Associate Editor, Nassir Marrouche had no involvement in the peer review of this article and has no access to information regarding its peer review.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.cvdhj.2021.10.007.

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