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Telemedicine in the Wake of the COVID-19 Pandemic: Increasing Access to Surgical Care

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Background: The COVID-19 pandemic has brought seismic shifts in healthcare delivery. The objective of this study was to examine the impact of telemedicine in the disadvantaged population.
Methods: All consecutive patients with outpatient appointments amongst 5 providers in the Plastic and Reconstructive Surgery Department between March 2, 2020, and April 10, 2020, were retrospectively reviewed. Appointment and patient characteristics collected include visit modality, reason for visit, new or established patient, history of recorded procedure, age, sex, race, insurance provider, urban/rural designation of residence, Social Vulnerability Index, and income. The primary outcome of interest was whether or not a patient missed their appointment (show versus no-show).
Results: During the study period, there were a total of 784 patient appointments. Before the COVID-19 pandemic, patients with a higher Social Vulnerability Index were more likely to have a no-show appointment (0.49 versus 0.39, $P = 0.007$). Multivariate regression modeling showed that every 0.1 increase in Social Vulnerability Index results in 1.32 greater odds of loss to follow-up ($P = 0.045$). These associations no longer held true after the lockdown.
Conclusions: This study indicates a reduction in disparity and an increase in access following the dramatically increased use of telemedicine in the wake of the COVID-19 pandemic. Although drawbacks to telemedicine exist and remain to be addressed, the vast majority of literature points to an overwhelming benefit—both for patient experience and outcomes—of utilizing telemedicine. Future studies should focus on improving access, reducing technological barriers, and policy reform to improve the spread of telemedicine. *(Plast Reconstr Surg Glob Open 2021;9:e3228; doi: 10.1097/GOX.0000000000003228; Published online 22 January 2021.)*

INTRODUCTION

The COVID-19 pandemic has resulted in unparalleled shifts and strain in care delivery. Outside of natural disasters, implementation of telehealth and telemedicine has progressed at a slow and fragmented pace.[1] Growth in usage between 2005 and 2017 was focused primarily amongst psychiatrists and primary care physicians and utilized by younger patients in urban environments.[2] In an effort to curtail the spread of COVID-19, governments and the medical community have responded with a broad shift away from hospital-based care, with cancelled elective surgery and rapid deployment of telemedicine. To mitigate concerns of privacy violations and to broaden use, on March 17, 2020, the Office of Civil Rights at the Department of Health and Human Services issued a statement waiving potential penalties against healthcare providers for Health Insurance Portability and Accountability Act (HIPAA) violations.[3] In particular, clear language states that these penalty waivers will apply to "widely available communication platforms, such as FaceTime or Skype, when used in good faith for any telehealth treatment or diagnostic period, regardless of whether the telehealth service is directly related to COVID-19."

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As the pandemic evolved, it also became apparent that a disproportionate number of cases have affected the elderly, men, and those with comorbidities such as hypertension, diabetes, obesity, cardiovascular disease, and minority populations,[4–7] mirroring the H1N1 experience in 2009.[8,9] Although there is a need to limit exposure, reconstruction patients (particularly those with active wounds) require a frequent follow-up to prevent wound recurrence and amputation. Delays in such follow-ups lead to prolonged healing times and increased risk of amputation.[10,11] Furthermore, several studies have identified worse disease presentation and higher rates of amputation in minority and disadvantaged populations.[12–15] In a systematic review of studies examining barriers in telehealth adoption, Kruse et al identified that the top 3 barriers for patients were age, level of education, and computer literacy.[16] These underlying challenges, coupled with the rapid deployment of telehealth, call into question the effectiveness of technological modalities in caring for disadvantaged patients.

The strategies to limit contact during the current COVID-19 pandemic may be in place for 18 months or longer until widespread vaccination is seen.[17] Therefore, it is necessary to ensure equitable distribution of resources and attention to the vulnerable. The objective of this study was to examine how the acute expansion of telemedicine during the COVID-19 pandemic may have impacted access to surgical care in the disadvantaged population. In particular, we sought to investigate whether patient demographics were associated with missed in-person appointments. Special attention was given to the Social Vulnerability Index (SVI), which was created and is maintained by the Geospatial Research, Analysis, and Services Program (GRASP) at the Center for Disease Control and Prevention (CDC). We hypothesize that in the wake of the COVID-19 pandemic, the rapid deployment of telemedicine enhanced access to surgical care for more vulnerable populations.

METHODS

All consecutive patients with outpatient appointments among 5 providers in the Plastic and Reconstructive Surgery Department between March 2, 2020, and April 10, 2020, were retrospectively reviewed. These providers were selected as (1) the 5 highest volume providers and (2) those with the highest percentage of patient visits at our hospital-based practice and not at affiliate hospitals or off-site outpatient clinics. In the District of Columbia, a public emergency was announced on March 11, 2020, and stay-at-home orders were enforced beginning on April 1, 2020. Our system began a multi-phase expansion of its telemedicine platform beginning on March 23, 2020. This date served as an anchor for data collection to capture patients seen by our service before and after the expansion of telemedicine in our system. Patient groups were primarily wound care, general reconstruction, and breast reconstruction.

Data Collection

Data on the following domains were collected from the electronic health record. Appointment characteristics included visit modality (in-person, phone appointment, and video appointment), reason for visit, new or established patient, and history of recorded procedure. Patient characteristics included demographics such as age, sex, race, insurance provider, urban/rural designation of the location of residence, SVI, and median income by location of residence. The primary outcome of interest was whether or not patients missed their appointment (show versus no-show).

For city/suburb/town/rural designation and median income by area of residence, Zone Improvement Program (ZIP) Codes were converted to Zip Code Tabulation Areas (ZCTA), as used by the Census Bureau. ZIP codes are designed to represent linear mail delivery routes, whereas ZCTAs represent more generalized spatial codes that are assigned by census block. For locality designation, the National Center for Education Statistics 2019 data were utilized.[18] For median income by ZCTA, the S1901 table from the American Community Survey in 2019 was obtained.[19]

The overall SVI is derived from census tract-level data, which account for increased granularity of neighborhoods. This is especially important, given the heterogeneous nature of communities in the District of Columbia and its surrounding areas. Census tracts were obtained from the Federal Financial Institutions Examination Council geocoding system, which is used by financial institutions to report information on mortgages as well as business and farm loans.[19,20] For addresses that were developed after the census was performed, census tract information was extrapolated based on the longitude and latitude of the address derived from the Google Maps API.

The SVI refers to the socioeconomic and demographic characteristics of a community that impact its resilience when faced with external stressors to human health, including disease outbreaks. The SVI ranks census tracts based on 15 social factors, grouped into 4 themes (Socioeconomic Status, Household Composition and Disability, Minority Status and Language, and Housing Type and Transportation), for an overall SVI score.[21] For this study, the overall SVI score was used. A pre-published study suggests that the SVI is associated with higher COVID-19 case fatality.[22]

Definitions and Exclusion Criteria

Patients from outside the District of Columbia, Maryland, and Virginia regions were eliminated from analysis. A "no-show" was defined as any appointment that a patient did not attend and was both (1) not intentionally rescheduled before the appointment date and (2) the patient was not hospitalized other reasons. Insurances were categorized as commercial (HMO/PPO), Medicaid, or Medicare. Self-pay and other insurances were excluded due to small numbers. Ethnicity was categorized as White, Black, or Other due to the low representation of American Indians, Asians, and Pacific Islanders in our region.[23]

Statistical Analysis

The statistical analysis was broadly separated into pre-lockdown and post-lockdown to determine the differences between no-show characteristics. Continuous variables were described by means and SDs. The student *t*-test was used to examine statistically significant differences between continuous variables when normality assumption was satisfied; the Wilcoxon rank sum test was used when normality assumption was not satisfied. Categorical variables were described by frequencies and percentages. Chi-square and Fisher exact tests (n < 10) were used as appropriate to examine statistically significant differences between categorical variables. To test for spatial autocorrelation and clustering of no-show appointments, Moran's I test for autocorrelation was used.[24,25] Two multivariate models before and after the COVID-19 lockdown were constructed with variables selected based on the purposeful selection method, as described by Hosmer and Lemeshow.[26–28] Multicollinearity was tested to assess the effects of certain variables on others within each model.[29] Statistical analysis was performed using STATA, v.15 (StataCorp, College Station, Tex.), with significance defined as $P < 0.05$.

RESULTS

Table 1 describes the characteristics of the study cohort. During the study period, there were 506 patients seen before the lockdown and 278 patients were seen after, which amounts to a 45% decline in overall visits. Before the lockdown, the composition of our patient population was overrepresented by the elderly and Medicare (42.69% versus 8%) and underrepresented by Medicaid (15.02% versus 28%) when compared with the DC area population.[23] Moreover, the average median income is higher for the study group compared with that in the DC area ($99,002 versus $82,372). However, racial composition is similar. The majority of the cohort have active wounds. There is no difference in the SVI or median income by ZCTA before and after COVID-19. Video and phone visits went from comprising 0.59% and 0.79% of visits, respectively, to representing 26.26 and 18.35% of visits, whereas outpatient visits declined 43.2% ($P < 0.001$). New patient visits declined from 23.52% to 9.35% ($P < 0.001$). There was a decrease in patients seen without a history of surgery from 48.81% to 31.65% ($P < 0.001$). There were no significant changes in the number of no-show appointments.

Tables 2 and 3 demonstrate characteristics of patients who showed or missed their appointment before and after the lockdown, respectively. Before the lockdown, younger ($P = 0.006$), male ($P = 0.032$), and established ($P = 0.035$) patients with Medicaid ($P = 0.027$) were more likely to have a no-show appointment. Patients with a higher SVI were also more likely to have a no-show appointment (0.49 versus 0.39, $P = 0.007$). After the lockdown, neither age, nor sex, nor established status, nor insurance, nor SVI were any longer significant.

Table 4 examines the SVI characteristics by visit type. Before the lockdown, the SVI of patients with a no-show in-person appointment was 0.50 compared with 0.39 ($P = 0.007$) for patients who showed for their in-person appointments. There was no difference in SVI after the lockdown between patients who had shown for their appointment and those who did not. Figure 1 demonstrates that the SVI of new patients (0.44 versus 0.45) and established patients (0.39 versus 0.41) increased after the lockdown versus before the lockdown, although this association was not statistically significant ($P = 0.382$).

Table 5 reports the findings of the 2 multivariate regression models for no-show appointments before and after lockdown. Before lockdown, every year decrease in age resulted in a 2% increased chance in missing their appointment (OR = 0.98, $P = 0.01$). Similarly, male patients had a 1.94 increased odds of missing their appointment ($P = 0.02$). For socially vulnerable patients, every 0.1 increase in SVI results in 1.32 greater odds of loss to follow-up ($P = 0.045$). These associations no longer held true after the lockdown. In-person appointments were 3.72 times more likely to be a no-show compared with phone appointments ($P = 0.039$). There was no clustering of no-show appointments before ($P = 0.335$), after ($P = 0.458$), or amongst all patients ($P = 0.387$).

DISCUSSION

Telemedicine has seen rapid expansion in the wake of the recent pandemic. Telehealth refers to the broad use of health-related digital services, including monitoring wearables or patient education videos.[30] Telemedicine refers

Table 1. Sample Characteristics Pre-COVID and Post-COVID Lockdown

	Pre-lockdown		Post-lockdown		P
No. patients	506		278		
Age	59.40 ± 15.67		61.04 ± 14.76		0.154
Gender					0.315
Men	241	47.63%	122	43.88%	
Women	265	52.37%	156	56.12%	
Ethnicity					0.086
White	210	41.50%	115	41.37%	
Black	231	45.65%	141	50.72%	
Other	65	12.85%	22	7.91%	
Insurance type					0.669
Commercial	214	42.29%	114	41.01%	
Medicaid	76	15.02%	37	13.31%	
Medicare	216	42.69%	127	45.68%	
Locality					0.353
City	232	45.85%	114	41.01%	
Suburb	193	38.14%	111	39.93%	
Rural	81	16.01%	53	19.06%	
History of wounds					0.713
Yes	404	79.84%	225	80.94%	
No	102	20.16%	53	19.06%	
SVI	0.40 ± 0.29		0.41 ± 0.29		0.559
Median income by ZCTA	$98,881.18 ± $38,228.90		$99,222.17 ± $41,316.30		0.908
Visit type					<0.001
In-person	499	98.62%	154	55.40%	
Video	3	0.59%	73	26.26%	
Phone	4	0.79%	51	18.35%	
Patient status					<0.001
New patient	119	23.52%	26	9.35%	
Established patient	387	76.48%	252	90.65%	
History of surgery					<0.001
Yes	259	51.19%	190	68.35%	
No	247	48.81%	88	31.65%	
No-show					0.544
Yes	65	12.85%	40	14.39%	
No	441	87.15%	238	85.61%	

Percentages are expressed by columns. Numbers are accompanied with ± 95% SD. An SVI score of "0" denotes the lowest vulnerability, and that of "1" denotes the highest vulnerability.

Table 2. Demographic Characteristics of No-show Appointments before Lockdown

	Pre-lockdown				
No-show Appointment	**Yes**		**No**		***P***
No. patients	65		441		
Age	54.38 ± 15.43		60.14 ± 15.58		0.006
Gender					0.032
Men	39	16.18%	202	83.82%	
Women	26	9.81%	239	90.19%	
Ethnicity					0.075
White	19	9.05%	191	90.95%	
Black	35	15.15%	196	84.85%	
Other	11	16.92%	54	83.08%	
Insurance type					0.027
Commercial	24	11.21%	190	88.79%	
Medicaid	17	22.37%	59	77.63%	
Medicare	24	11.11%	192	88.89%	
Locality					0.968
City	29	12.50%	203	87.50%	
Suburb	25	12.95%	168	87.05%	
Rural	11	13.58%	70	86.42%	
SVI	0.49 ± 0.31		0.39 ± 0.28		0.007
Median income by ZCTA	$98,920.51 ± $34,886.35		$98,875.39 ± $38,733.93		0.993
Visit type					0.620
In-person	64	12.83%	435	87.17%	
Video	0	0%	3	100%	
Phone	1	25%	3	75%	
Patient status					0.035
New patients	43	11.11%	344	88.89%	
Established patients	22	18.49%	97	81.51%	
History of surgery					0.006
Yes	23	8.88%	236	91.12%	
No	42	17.00%	205	83.00%	
History of wounds					0.174
Yes	56	13.86%	348	86.14%	
No	9	8.82%	93	91.18%	

Percentages are expressed by columns. Numbers are accompanied with ± 95% SD. An SVI score of "0" denotes the lowest vulnerability, and that of "1" denotes the highest vulnerability.

Table 3. Demographic Characteristics of No-show Appointments after Lockdown

	Post-lockdown				
No-show Appointments	**Yes**		**No**		***P***
No. patients	40		238		
Age	63.86 ± 14.11		60.56 ± 14.84		0.192
Gender					0.235
Men	21	17.21%	101	82.79%	
Women	19	12.18%	137	87.82%	
Ethnicity					0.527
White	14	12.17%	101	87.83%	
Black	24	17.02%	117	82.98%	
Other	2	9.09%	20	90.91%	
Insurance type					0.243
Commercial	12	10.53%	102	89.47%	
Medicaid	5	13.51%	32	86.49%	
Medicare	23	18.11%	104	81.89%	
Locality					0.746
City	18	15.79%	96	84.21%	
Suburb	16	14.41%	95	85.59%	
Rural	6	11.32%	47	88.68%	
SVI	0.40 ± 0.31		0.42 ± 0.29		0.780
Median income by ZCTA	$101,590.60 ± $45,629.108		$98,824.11 ± $40,637.767		0.696
Visit type					0.050
In-person	29	18.83%	125	81.17%	
Video	8	10.96%	65	89.04%	
Phone	3	5.88%	48	94.12%	
Patient status					0.307
New patients	2	7.69%	24	92.31%	
Established patients	38	15.08%	214	84.92%	
History of surgery					0.111
Yes	23	12.11%	167	87.89%	
No	17	19.32%	71	80.68%	
History of wounds					0.044
Yes	37	16.44%	188	83.56%	
No	3	5.66%	50	94.34%	

Percentages are expressed by columns. Numbers are accompanied with ± 95% SD. An SVI score of "0" denotes the lowest vulnerability and that of "1" denotes the highest vulnerability.

to remote diagnosis and treatment using digital technology. Before COVID-19, telemedicine's expansion was curtailed due to several factors relating to reimbursement, licensure, and infrastructure. Medicare narrowly defined applications to select rural populations. Payments under Medicaid were defined by individual state legislation. Only 10 states (Arkansas, Delaware, Georgia, Hawaii, Kentucky, Minnesota, Missouri, New Mexico, Utah, and Virginia) have laws on true payment parity between telemedicine and in-person visits, whereas 16 states have a provision on the payment structure.[31,32] When 104 health care organizations were surveyed, 50% of them reported reimbursement as a significant cause of limitation to deployment.[30] There were also limitations in cross-state licensure, limiting providers' ability to utilize telemedicine to conduct visits with patients outside of their own state.[33] As a result of these obstacles to licensure and payment, there was little investment in infrastructure by health providers and organizations alike.

On March 6, 2020, Medicare expanded telehealth services as a temporary and emergency effort under 1135 waiver authority and the Coronavirus Preparedness and Response Supplemental Appropriations Act. Telehealth services were previously limited to designated rural areas.[34] In these provisions, Medicare telehealth visits for new and established patients are considered the same as

Table 4. SVI by Visit Type before and after Lockdown

	Pre-lockdown			Post-lockdown		
No-Show	**Yes**	**No**	***P***	**Yes**	**No**	***P***
In-person	0.50 ± 0.30	0.39 ± 0.28	**0.007**	0.42 ± 0.32	0.41 ± 0.30	0.818
Video	N/A	0.29 ± 0.18		0.37 ± 0.27	0.41 ± 0.29	
Phone	0.17 ± 0	0.46 ± 0.39		0.32 ± 0.28	0.44 ± 0.29	

An SVI score of "0" denotes the lowest vulnerability, and that of "1" denotes highest vulnerability.
Values in bold denote significant p-values ($P < 0.05$).

in-person visits and are reimbursed at the same rate in all areas of the country for all settings.[34] Furthermore, most states have relaxed licensure requirements for physicians with out-of-state licenses who wish to practice telehealth.[35]

Broadly speaking, the Centers for Medicaid and Medicare Services categorizes virtual services into 3 main types: televisits, virtual check-ins, and e-visits. Medicare televisits involve interactive audio and telecommunication systems with healthcare providers for new and established patients. Virtual check-ins are 5- to 10-minute communications conducted via telephone or other communication modalities (secure text messaging and email). These are scheduled in response to specific patient concerns that are not related to a medical visit within the previous 7 days or do not result in a visit within the following 24 hours. Although virtual check-ins are generally initiated

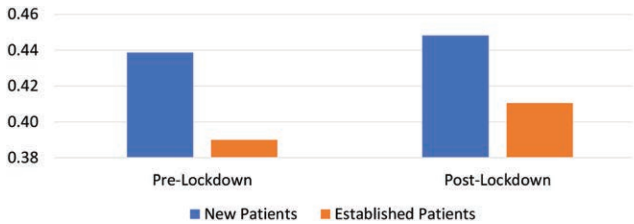

Fig. 1. Mean SVI for new and established patients, before and after COVID-19 lockdown.

by patients, providers can educate patients on the availability of these services. Similarly, e-visits are communications that are initiated by established patients through an online portal and are intended to save patients' trips to physician offices.

The rapid expansion of telemedicine has created a natural experiment on access to care in the vulnerable population. Access to care, as defined by Shi and Singh, "can be defined as the ability to obtain needed, affordable, convenient, acceptable, and effective personal health services in a timely manner."[36] Prior examination of the benefits of telemedicine has demonstrated improvements in access to care for rural patients across multiple healthcare specialties.[37,38] Recent research also indicates that telemedicine increases access to care for patients with acute illness in socially disadvantaged populations, which more appropriately distributes healthcare resources.[39] However, few studies examine the impact of telemedicine in the surgical subspecialties, especially in the face of the national pandemic.

Despite general improvements in healthcare in America, avoidable access issues are pervasive amongst disparate populations.[40] In the previous office-based model, patients of higher SVI were more likely to miss their appointments. The results of this study demonstrate that expansion of telemedicine in the COVID-19 pandemic resulted in improved reach of new and established surgical patients. Anecdotally, patients have been very satisfied with the new format. People who were unable to take "off from work" or arrange childcare, or have difficulties in mobility and arranging transportation are now being seen at greater rates. These finding are in line with a study on the CVS MinuteClinics telehealth program.[41] In these visits, physician and patients communicate through 2-way audio and video, and diagnoses are made through history and physicals, and via digital audioscopes and otoscopes. Amongst surveyed patients, 94% reported being very satisfied with the experience, with over half citing the absence of waiting time as their primary motivator for use. Similar high levels of satisfaction were achieved in underserved, rural plastic surgery patients in Vermont and New Hampshire.[42]

Telemedicine has also proved to have benefits on patient outcomes. One study examining utilization of telemedicine by a wound specialist in conjunction with home health nurses found improved rates of healing, faster healing time, decreased number of home health visits, and fewer hospitalizations for wound complications after telehealth implementation.[43] A high level of correlation between in-person and photograph evaluation for the diagnosis and treatment of wounds has been confirmed in the literature.[44,45] Systematic review indicates telemedicine increases efficiency, decreases cost, and increases access of microsurgical monitoring, burn evaluation, and cleft lip/palate consultations.[42,46]

Despite the potential benefits in patient experience and outcomes that may be offered by telemedicine, there are also challenges that must be addressed. Although not statistically significant, we have found that elderly patients and those with limited access and understanding of technology still have difficulty accessing our established online portal. Creative solutions, such as use of FaceTime, the patient's video conferencing application of choice, or text message, have had to be employed in many instances. It will be critical to establish easy-to-use, HIPAA-compliant technologies to scale. Furthermore, there are limitations in assessing surgical incisions and

Table 5. Multivariate Regression Models: Impact of Telemedicine before and after Lockdown on No-show Appointments

	Pre-lockdown			Post-lockdown		
	Odds Ratio	Confidence Interval	*P*	Odds Ratio	Confidence Interval	*P*
Age	0.98	0.96, 0.99	0.01	1.02	0.99, 1.04	0.21
Gender						
Men	1.94	1.11, 3.37	0.02	1.34	0.67, 2.69	0.41
Women	Reference			Reference		
Ethnicity						
White	Reference			Reference		
Black	1.26	0.64, 2.46	0.50	1.72	0.75, 3.94	0.20
Other	1.50	0.65, 3.47	0.35	0.85	0.16, 4.33	0.85
Locality						
Urban	Reference			Reference		
Suburb	1.23	0.67, 2.25	0.51	0.89	0.41, 1.94	0.76
Rural	1.30	0.59, 2.83	0.51	0.77	0.27, 0.18	0.63
Patient status						
New patient	1.64	0.91, 2.95	0.097	0.50	0.11, 0.32	0.38
Established patient	Reference			Reference		
SVI	2.85	1.02, 7.94	0.045	0.59	0.15, 2.38	0.46
Visit type						
In-person	N/A			3.72	1.06, 13.0	0.039
Video				1.86	0.46, 7.54	0.382
Phone				Reference		

wounds with current telemedicine platforms. Picture and video quality can be poor, especially if online networks are strained. Patients have to be coached to show the involved body part for context. Commonly, we receive pictures of areas of interest they deem important. This is particularly germane in new patient consults, as a patient–provider relationship is established with transmission of the image.[45] The provider assumes legal responsibility, without having met the patient. In the absence of a home health aide, we have to rely on patient's assessment of warmth, which can be limited. This is particularly salient in the wound population, where decline in warmth can indicate a threatened extremity. Other issues identified in the literature include misdiagnosis, inefficient use of provider time due to technological difficulties, and delays in diagnosis.[45]

Limitations of this study include the limited number of providers practicing in an urban, academic setting. Our findings may not be generalizable to different localities, including community or rural environments. Furthermore, outcomes such as complications arising from telemedicine use were not directly examined. It is unknown whether the completed telemedicine visits in more vulnerable patients are equitable from a quality perspective. Future study will require an in-depth evaluation of provider and patient factors, barriers to use, reliability of diagnosis and treatments recommended, patient satisfaction, and the workflow of the telemedicine visit, with a focus on elderly and disadvantaged patients.

CONCLUSIONS

Overall, expansion of telemedicine in the COVID-19 era represents a dramatic and, possibly, permanent shift in the way we practice medicine. The results of this study indicate a disparity reduction and increased access in an urban population. The majority of the literature, despite issues with technology and lack of physical contact, cites overwhelming benefits.[41–47] Future studies should focus on the barriers to use, reliability, patient satisfaction, and workflow in elderly and disadvantaged patients. Sustained meaningful adoption of telemedicine and telehealth will require multi-faceted regulatory flexibility and reform, as seen in the temporary and emergent measures enacted due to the COVID-19 pandemic.[48]

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