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Perspective

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Primary care telehealth in a dynamic healthcare environment from digital divide to healthcare outcomes

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With expanded telehealth availability in primary care, its impact on quality of care and associated costs remains debated. Analyzing 199,829 Medicare beneficiaries in Mississippi (2019–2021), we found telehealth utilization associated with significant sociodemographic disparities, reduced inpatient admissions, and lower 30-day readmissions. By accounting for primary care utilization, our findings suggest that the higher absolute costs observed among telehealth users may reflect underlying healthcare needs rather than telehealth utilization.

Primary care is fundamental to functional healthcare systems, contributing to better health outcomes, illness prevention, and reduced per capita healthcare costs[1]. However, transportation barriers pose well-documented obstacles to accessing primary care, especially in rural and underserved areas. The COVID-19 pandemic drastically transformed healthcare delivery through telehealth, allowing remote access to healthcare services. The U.S. Medicare introduced a series of telehealth coverage expansions in 2020, including lifting geographic restrictions for originating sites. These changes enabled many primary care practices to adopt telehealth[2,3].

While telehealth has shown promise as a cost-saving measure for Medicare beneficiaries[4–6], debates continue about its future coverage, particularly regarding its impact on access, quality, and costs of primary care[2,7–10]. Recent studies have highlighted barriers to telehealth access for marginalized populations and have shown mixed results regarding its impact on healthcare costs and health outcomes[2,5–9]. Importantly, the pandemic brought severe disruptions to individuals, especially vulnerable populations, and drastic shifts in healthcare practices[11], making it essential to account for dynamic factors when evaluating its impact. Mississippi, a predominantly rural and underserved state in the U.S., faces additional challenges in primary care access, with one-third of its population residing in primary care health professional shortage areas (HPSAs)[12].

Motivated by these real-world challenges, we conducted a study to illustrate and evaluate the impact of telehealth for primary care on Medicare healthcare resource utilization (HCRU), spending, and medication adherence among Mississippi Medicare beneficiaries before and during the COVID-19 period. By incorporating both time-invariant and time-varying factors of beneficiary sociodemographics and primary care utilization practices, we explore the implications of telehealth in a dynamic healthcare environment. Furthermore, we highlight the digital divide and its influence on healthcare access and economic outcomes, offering nuanced insights to inform future evaluations, policy discussions, and practices.

Methods

Study design and participants

We conducted a retrospective cohort study using Mississippi Medicare claims data (2019–2021), with 2019 as the baseline year, to compare sociodemographic characteristics, healthcare resource utilization (HCRU), spending, and medication adherence between telehealth and non-telehealth primary care users. The study included adult beneficiaries (aged 18 and older) continuously enrolled in Medicare Parts A, B, and D who accessed primary care services. Beneficiaries with Part C coverage or entitlement due to end-stage renal disease were excluded. Details on the identification of primary care and telehealth services are provided in Supplementary "1.1 Telehealth for Primary Care Services."

Variables

Demographic characteristics were treated as time-invariant, while socioeconomic and primary care utilization factors were considered time-varying. Primary outcomes included HCRU and spending. HCRU metrics comprised outpatient visits, Emergency Department (ED) visits, inpatient admissions, and 30-day readmissions. Spending was measured for medical and pharmacy expenditures, with each categorized into Medicare (Part D for pharmacy spending), out-of-pocket (OOP), and gross spending. Secondary outcomes focused on adherence to antidiabetic, antihypertensive, and antilipidemic medications among the multi-condition subgroup, comprising participants with diabetes, hypertension, and hyperlipidemia.

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Detailed definitions and calculations of variables are provided in Supplementary "1.2 Variables."

Statistical analysis

Descriptive statistics, along with Wilcoxon rank-sum tests, X^2 tests, and odds ratio estimations, were used to summarize sociodemographic and primary care utilization differences between telehealth participants and non-telehealth participants from 2019–2021. We calculated the number and percentage of participants who accessed each provider type, along with the mean and standard deviation of the proportion of services provided by each provider type across participants.

To evaluate the effect of telehealth utilization on primary and secondary outcomes, we created a telehealth utilization indicator for each respective year and employed the Marginal Structural Modeling (MSM). Previous studies have shown that telehealth is often utilized by patients who require frequent primary care visits[13,14]. To address this, we applied Inverse Probability of Treatment Weighting (IPTW) to account for both sociodemographic and primary care utilization covariates[15]. This was followed by weighted mixed-effects models to control for time-invariant and time-varying confounders, incorporating individual-level random effects. A log link function was applied for HCRU and spending outcomes, with a Poisson distribution used for HCRU outcomes and a Gamma distribution for spending outcomes. The MSM analysis was conducted for the entire study population and the multi-condition subgroup (see details in Supplementary "1.3 Marginal Structural Modelling (MSM)"). Covariate balance was assessed using absolute standardized differences[16]. All absolute standardized differences were reduced to below 0.25 post-weighting, indicating sufficient balance (Fig. 1 and Supplementary Table 6).

Two-tailed statistical tests with an alpha level of 0.05 were used to determine significance. All analyses were conducted using SAS (version 9.4, SAS Institute Inc., Cary, NC) and R statistical software.

This study was approved by the University of Mississippi Medical Center institutional review board with a waiver of informed consent and Health Insurance Portability and Accountability Act (HIPAA) authorization.

Results

Sociodemographic disparities

Among 199,829 identified Medicare beneficiaries, 73,252 (36.65%) utilized telehealth services in primary care during 2019–2021, including 1201 (0.60%) in 2019, 62,636 (31.34%) in 2020, and 32,431(16.22%) in 2021. Telehealth was more commonly accessed by participants who were younger (under 55 years), female, White, entitled due to disability, dually enrolled in Medicaid, residing in non-rural nor non-HPSA designated areas, and had a higher CCI (all P values < 0.001). Telehealth users had a higher Bice-Boxerman COCI and more primary care visits in 2019 (both P values < 0.001). Additionally, telehealth users accessed a broader range of primary care providers, though with a lower proportion of services from primary care physicians, surgeons, and other physicians (all P values < 0.001) (Table 1).

With overall trends reflecting fluctuations in the dynamic healthcare environment, primary care telehealth users consistently exhibited higher HCRU and spending compared to non-telehealth participants (Fig. 2, Supplementary Figs. 1, 2, Supplementary Tables 3–5). However, after applying the IPTW to account for time-invariant and time-varying confounders of sociodemographics and primary care practices, telehealth usage was significantly associated with a 2.3% increase in outpatient visits and a 5.4% increase in ED visits, but a 4.3% decrease in inpatient admissions and a 2.4% decrease in 30-day readmissions. Additionally, telehealth was associated with significant decreases in all spending outcomes: a 10.8% decrease in Medicare medical spending, a 27.0% decrease in beneficiary OOP medical spending, and an 11.6% decrease in gross medical spending. Decreases were also noted in all pharmacy spending categories, with a 14.9% decrease in Medicare Part D spending, a 0.8% decrease in beneficiary OOP pharmacy spending, and a 2.8% decrease in gross pharmacy spending (all P values ≤ 0.001) (Table 2).

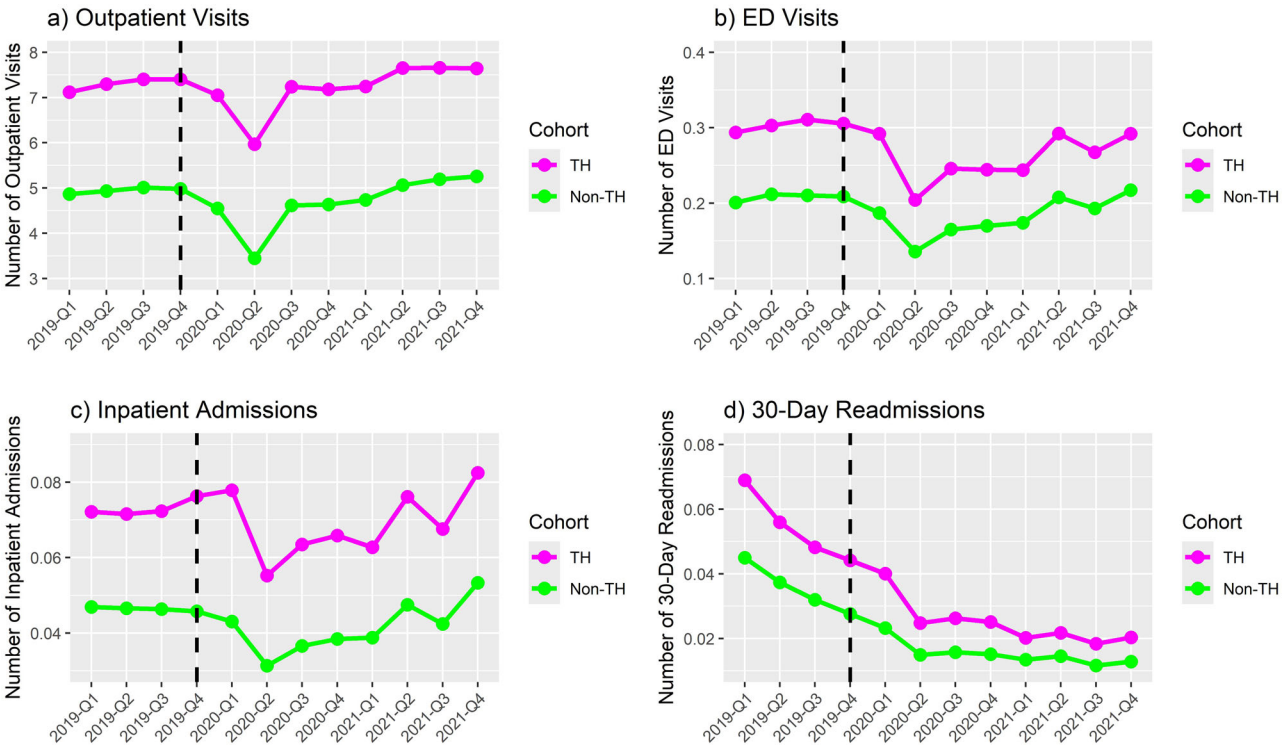

Fig. 1 | Trends in healthcare resource utilization among telehealth (TH) and non-telehealth (Non-TH) Participants from 2019 to 2021. Panels **a**, **b**, **c**, and **d** illustrate the quarterly trends in outpatient visits, Emergency Department (ED) visits, inpatient admissions, and 30-day readmissions of telehealth (TH) and non-telehealth (non-TH) participants. The vertical dashed line indicates the last quarter (2019-Q4) prior to the onset of the public health emergency.

Table 1 | Baseline sociodemographic characteristics and primary care utilization of all study participants

	TH participants, No. (%) (*n* = 73,252)	Non-TH participants, No. (%) (*n* = 126,577)	Odds ratio (95% CI)	*P* value
Sociodemographic characteristics				
Age group, yr				<0.001
< 55	7825 (10.68)	9476 (7.49)	Ref	
55–64	7560 (10.32)	9772 (7.72)	0.94 (0.90, 0.98)	
65–74	33,918 (46.30)	61,328 (48.45)	0.67 (0.65, 0.69)	
75–84	18,851 (25.73)	36,137 (28.55)	0.63 (0.61, 0.65)	
≥ 85	5098 (6.96)	9864 (7.79)	0.63 (0.60, 0.66)	
Sex				<0.001
Male	28,066 (38.31)	52,751 (41.68)	Ref	
Female	45,186 (61.69)	73,826 (58.32)	1.15 (1.13, 1.17)	
Race				<0.001
White	56,473 (77.73)	95,862 (76.33)	Ref	
Black	15,680 (21.58)	28,679 (22.84)	0.93 (0.91, 0.95)	
Other	501 (0.69)	1043 (0.83)	0.82 (0.73, 0.91)	
Original reason for entitlement				<0.001
OASI	47,396 (64.70)	91,751 (72.49)	Ref	
DIB	25,856 (35.30)	34,826 (27.51)	1.44 (1.41, 1.47)	
Medicare-Medicaid dual enrollee	21,165 (28.89)	34,025 (26.88)	1.11 (1.08, 1.13)	<0.001
Rurality	42,472 (57.98)	87,058 (68.78)	0.63 (0.62, 0.64)	<0.001
HPSA designated	13,424 (18.33)	24,017 (18.97)	0.96 (0.94, 0.98)	<0.001
CCI, mean (SD)	2.52 (2.60)	1.85 (2.25)	1.12 (1.12, 1.12)	<0.001
Primary Care Utilization				
Bice-Boxerman COCI, mean (SD)	0.40 (0.29)	0.37 (0.32)	1.33 (1.30, 1.37)	<0.001
Number of primary care visits, mean (SD)	12.14 (8.39)	7.49 (6.39)	1.09 (1.09, 1.10)	<0.001
Access to provider types				
Primary care physician	54,630 (74.58)	77,054 (60.88)	1.89 (1.85, 1.92)	<0.001
Nonphysician Practitioner	53,077 (72.46)	68,945 (54.47)	2.20 (2.16, 2.24)	<0.001
Medical specialist	52,465 (71.62)	70,027 (55.32)	2.04 (2.00, 2.08)	<0.001
Surgeon	42,739 (58.35)	61,496 (48.58)	1.48 (1.46, 1.51)	<0.001
Other physicians	20,094 (27.43)	25,704 (20.31)	1.48 (1.45, 1.52)	<0.001
Proportion of services provided, mean (SD)				
Primary care physician	0.29 (0.27)	0.30 (0.32)	0.97 (0.94, 1.00)	<0.001
Nonphysician Practitioner	0.27 (0.27)	0.22 (0.29)	1.80 (1.75, 1.86)	<0.001
Medical specialist	0.23 (0.23)	0.21 (0.26)	1.52 (1.47, 1.58)	<0.001
Surgeon	0.14 (0.17)	0.16 (0.23)	0.61 (0.58, 0.64)	<0.001
Other physicians	0.05 (0.12)	0.06 (0.15)	0.82 (0.77, 0.88)	<0.001

TH telehealth, *CI* confidence interval, *SD* standard deviation, *OASI* Old Age and Survivor's Insurance, *DIB* Disability Insurance Benefits, *HPSA* Health Provider Shortage Area, *CCI* Charlson comorbidity index, *COCI* continuity of care index.

Subgroup analysis of 43,257 participants with multiple chronic conditions, of whom 18,653 (43.12%) used primary care telehealth, revealed consistent patterns (Supplementary Table 8). Post-IPTW, primary care telehealth usage was associated with an increase in ED visits, but decreased all other HCRU and spending outcomes (all *P* values < 0.001) (Supplementary Table 11). Moreover, telehealth was also associated with a 1.6% decrease in antidiabetic medication adherence, a 1.0% decrease in antilipidemic medication adherence, but a 1.2% increase in antihypertensive medication adherence (all *P* values < 0.001) (Supplementary Table 12).

Discussion

Our findings demonstrate that telehealth in primary care is associated with reduced inpatient admissions, 30-day readmissions, and medical and medication spending, while highlighting persistent sociodemographic disparities in telehealth utilization. By accounting for time-invariant and time-varying factors, particularly primary care utilization patterns that reflect the dynamic healthcare environment during COVID-19 pandemic, we provide a nuanced yet thought-provoking perspective on its healthcare resource utilization, economic, and access implications.

Impact on healthcare access, resource utilization, and medication adherence

Telehealth was more commonly accessed by younger beneficiaries, females, White individuals, those entitled to Medicare due to disability, Medicaid enrollees, those residing in non-rural, non-HPSA regions, and individuals with a higher CCI. These findings align with existing literature[6,17], highlighting a significant digital divide and suggesting that certain sociodemographic groups, particularly older adults, racial minorities, and those

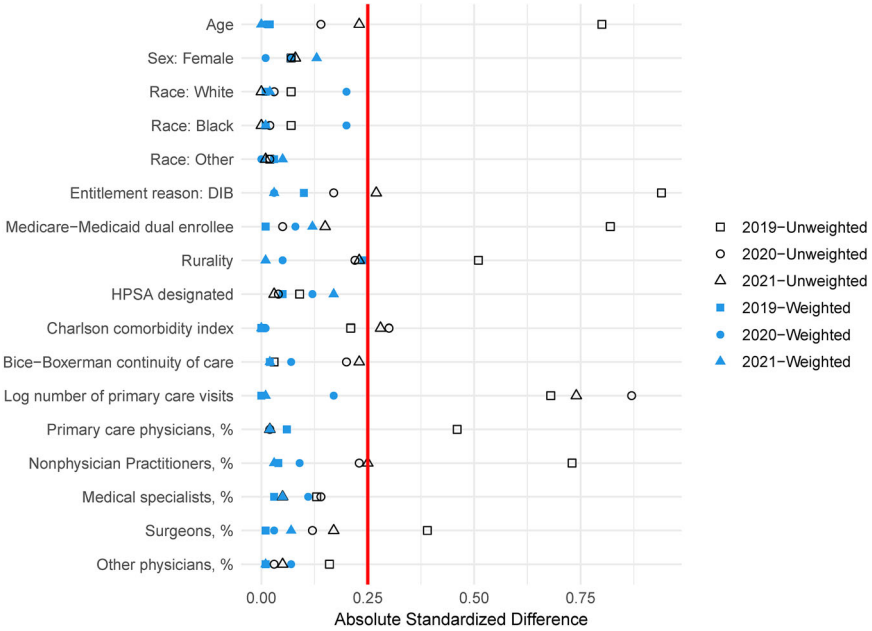

Fig. 2 | Absolute standardized differences for covariates in the mixed-effects models, pre and post weighting. The vertical red line marks the 0.25 threshold for absolute standardized differences, indicating covariate balance.

Table 2 | Mixed-effects model results for HCRU and spending outcomes after weighting

Outcome	Estimates (Std Err)	Exponentiated Estimates (95% CI)	*P* value
HCRU, PPPY			
Outpatient visit	0.023 (0.000)	1.023 (1.022, 1.024)	<0.001
ED visit	0.052 (0.002)	1.054 (1.049, 1.058)	<0.001
Inpatient admission	−0.044 (0.004)	0.957 (0.949, 0.965)	<0.001
30-day readmission	−0.025 (0.006)	0.976 (0.964, 0.987)	<0.001
Medical spending, PPPY			
Medicare	−0.114 (0.003)	0.892 (0.887, 0.898)	<0.001
Beneficiary OOP	−0.314 (0.005)	0.730 (0.723, 0.737)	<0.001
Gross	−0.124 (0.003)	0.884 (0.878, 0.889)	<0.001
Pharmacy spending, PPPY			
Medicare Part D	−0.161 (0.004)	0.851 (0.844, 0.858)	<0.001
Beneficiary OOP	−0.008 (0.002)	0.992 (0.988, 0.997)	0.001
Gross	−0.029 (0.002)	0.972 (0.967, 0.977)	<0.001

TH telehealth, *HCRU* healthcare resource utilization, *ED* emergency department, *OOP* out-of-pocket, *PPPY* per-person-per-year, *Std Err* standard error.

in rural or underserved areas with poor health status may face greater barriers to accessing telehealth.

The observed increase in outpatient and ED visits post-weighting for the entire sample suggests that telehealth may facilitate triaging and expanded access to care, enabling earlier interventions, which could ultimately reduce hospitalizations. Driven by convenience and the patient-perceived need for immediate medical attention, patients may use ED visits as a substitute for outpatient care, sometimes after contacting the office of primary care physicians[18–20]. However, these increases did not translate into higher inpatient or readmission rates. These were actually reduced, potentially indicating improved care coordination or more effective chronic condition management.

Subgroup analysis among beneficiaries with multiple chronic conditions further supported the robustness of most findings, while revealing nuances in outpatient utilization patterns for those with more complex healthcare needs. Unlike the entire sample, telehealth use in this subgroup was associated with a decrease in outpatient visits, likely reflecting both the more complex medical needs and telehealth-facilitated medication reconciliation or titration[21], thus reducing the need for outpatient care.

The subgroup analysis also showed that telehealth was associated with improved adherence to antihypertensive medication but reduced adherence to antidiabetic and antilipidemic medications. This may reflect the relative ease of managing hypertension compared to diabetes, which often requires more frequent monitoring and treatment adjustments that are harder to achieve remotely[22,23]. Additionally, the COVID-19 pandemic limited in-person outpatient services, potentially affecting medication adherence. Future work should further examine how telehealth can complement in-person care to enhance service quality and medication adherence. Hyperlipidemia, in contrast, is typically asymptomatic, yet antilipidemic medications can cause side effects requiring closer follow-up and in-person consultations, potentially impacting adherence[24]. Moreover, antidiabetic and antilipidemic medications are generally more expensive than antihypertensive medications. As medication adherence often involves out-of-pocket costs, financial strains may further hinder adherence, particularly for patients managing multiple chronic conditions[25].

While telehealth enhances access to primary care services, it may not fully address sociodemographic barriers or alleviate the financial burdens that impact medication affordability, which are crucial for effective chronic disease management. Together with the observed sociodemographic disparities in accessing telehealth, these findings underscore the urgent need to optimize the future telehealth policy to better address the complex needs of underserved populations and ensure the access to care for all.

Reconsidering quality and cost narratives

Some studies have linked telehealth services to lower quality, citing increases in hospitalizations for ambulatory care-sensitive (ACS) conditions[9], including chronic and acute conditions such as hypertension and diabetes, for which hospitalization can be potentially preventable. However, ACS metrics were originally designed to assess access to care for the uninsured rather than the quality of care provided. Their widespread misuse as proxies for quality of care in recent years has raised concerns among many researchers[26]. Careful selection of outcomes and thoughtful interpretation are essential when translating statistical significance into practical policy recommendations[7,8].

Contrary to recent studies that link telehealth to lower quality and higher costs[8,9], our results indicate that telehealth use was associated with reductions across all medical and pharmacy spending categories. This difference may stem from our focus on telehealth within the primary care context, emphasizing accessibility, continuity, coordination, comprehensiveness, and whole-person care[1]. Unlike prior studies[7–9], we adjusted for dynamic primary care utilization factors as confounders, serving as proxies for the key dimensions of primary care. As highlighted by a previous study[13], telehealth was mostly utilized by patients whose medical needs required multiple primary care visits, further supporting the importance of these adjustments. By incorporating time-invariant and time-varying sociodemographic and primary care practice factors, our approach accounts for key aspects of the evolving healthcare environment during the COVID-19 pandemic, providing a more nuanced understanding of telehealth's impact.

The persistent upstream of health disparities

Social determinants of health (SDoH) often drive patients' healthcare needs, prompting them to use telehealth to fulfill primary care needs. Our findings, coupled with increased disparities, healthcare utilization and spending reported in other studies[11,17], may reflect a higher underlying healthcare need rather than a direct consequence of telehealth usage itself. By careful adjustments, our findings suggest the need for future research to disentangle whether increased healthcare utilization is driven by patients' needs leading to telehealth use, rather than telehealth use driving increased utilization and costs.

Equity efforts should span every level from the upstream of SDoH to access equity, service equity, and ultimately health equity. By focusing on these interconnected dimensions, future telehealth policies and interventions can better support underserved populations while ensuring that telehealth fulfills its promise of equitable and effective care. As recommended by Nakamoto et al., given the dynamic nature of the healthcare landscape, it is imperative to continuously monitor the policy impacts on quality and spending[8]. Before COVID-19, telehealth was primarily designed to provide accessible care for underserved populations. With its expansion during the pandemic, future efforts should carefully consider how to broaden access while addressing pre-existing disparities across the spectrum, from upstream SDoH to downstream health outcomes.

Limitations

Several limitations of this study should be noted. First, our focus on Medicare beneficiaries in Mississippi may limit the generalizability of our findings to other states or populations, particularly those in more urbanized or resource-rich regions. Second, although we controlled for time-invariant and time-varying sociodemographic and primary care practice confounding factors, the findings rely on the no unobserved confounders assumption. Provider-level information within primary care practices that was not captured may have influenced our findings. The rapid expansion of telehealth during the pandemic may have introduced temporary shifts in healthcare practices that are not fully reflected in our data.

Conclusions

Given the high demand for primary care in medically underserved regions, this perspective deepens the understanding of the effectiveness and equity of telehealth in primary care. By accounting for dynamic primary care utilization factors as proxies for key dimensions of primary care practices, our analysis provides a nuanced evaluation of telehealth's impact. Our findings challenge the recent notion that observed increased costs are a consequence of telehealth use, suggesting they may instead reflect patients' underlying healthcare needs. However, the persistent SDoH disparities in telehealth access underscore the need for targeted interventions to bridge the digital divide. As healthcare policies continue to evolve, further research is warranted to continuously explore how telehealth can be integrated into the healthcare system in a cost-effective, sustainable, and equitable manner that prioritizes quality care for all[8,27,28].

Data availability

Data were obtained from the Centers for Medicare & Medicaid Services (CMS) under a data use agreement and are not publicly available.

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Author contributions

Y.Z. conducted the analysis and prepared the initial draft. All authors contributed to the conceptualization and investigation of the study, and reviewed and approved the final manuscript.

Competing interests

L.S.L. is an employee of Immunovant, Inc. Other authors (Y.Z., S.C., and J.M.S.) declare no competing interests.

Additional information

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