By Carter H. Nakamoto, David M. Cutler, Nancy D. Beaulieu, Lori Uscher-Pines, and Ateev Mehrotra

# The Impact Of Telemedicine On Medicare Utilization, Spending, And Quality, 2019–22

DOI: 10.1377/hlthaff.2023.01142
HEALTH AFFAIRS 43,
NO. 5 (2024): 691–700


**ABSTRACT** **Telemedicine use remains substantially higher than it was before the COVID-19 pandemic, although it has fallen from pandemic highs. To inform the ongoing debate about whether to continue payment for telemedicine visits, we estimated the association of greater telemedicine use across health systems with utilization, spending, and quality. In 2020, Medicare patients receiving care at health systems in the highest quartile of telemedicine use had 2.5 telemedicine visits per person (26.8 percent of visits) compared with 0.7 telemedicine visits per person (9.5 percent of visits) in the lowest quartile of telemedicine use. In 2021–22, relative to those in the lowest quartile, Medicare patients of health systems in the highest quartile had an increase of 0.21 total outpatient visits (telemedicine and in-person) per patient per year (2.2 percent relative increase), a decrease of 14.4 annual non-COVID-19 emergency department visits per 1,000 patients per year (2.7 percent relative decrease), a $248 increase in per patient per year spending (1.6 percent relative increase), and increased adherence for metformin and statins. There were no clear differential changes in hospitalizations or receipt of preventive care.**

**Carter H. Nakamoto**, Harvard University, Boston, Massachusetts.

**David M. Cutler**, Harvard University and National Bureau of Economic Research, Cambridge, Massachusetts.

**Nancy D. Beaulieu**, Harvard University.

**Lori Uscher-Pines**, RAND Corporation, Arlington, Virginia.

**Ateev Mehrotra** (Mehrotra@hcp.med.harvard.edu), Harvard University and Beth Israel Deaconess Medical Center, Boston, Massachusetts.

The COVID-19 pandemic led to a dramatic increase in telemedicine use.[1–5] Although rates have fallen subsequently, telemedicine use continues to be substantially higher than before the pandemic.[6,7] Telemedicine adoption was facilitated by many temporary regulatory waivers and reimbursement expansions[8] from a range of payers including Medicare,[9] Medicaid programs,[10] and commercial insurers.[11] Congress temporarily extended Medicare's broad coverage of telemedicine, including flexibilities on where patients are located, through December 2024,[12] after which, without any congressional action, broad coverage of telemedicine in the Medicare program will end. A major impediment to long-term coverage of telemedicine has been concerns that it will increase spending or hurt quality. To inform long-term policy, policy makers have called for more research to increase understanding of how the growth in telemedicine during the pandemic affected health care spending and the quality of care that patients received.[13–15]

To address this research need, we quantified the association between greater use of telemedicine and costs and quality by exploiting the variation in the use of telemedicine across health systems. For various reasons, including the type of electronic health record, health system leadership, and local health plan policies, some health systems adopted telemedicine to a greater degree than others early in the pandemic, and those differences extended into 2022.[16–19] We chose to focus on variation at the health system level because this was often the organizational level at which the decision was made to invest in and deploy the necessary technology.

We compared changes between 2019 and 2021–22 in utilization, spending, and quality for patients receiving care from health systems that used telemedicine at higher or lower rates.

## Study Data And Methods

**OVERVIEW** We compared traditional Medicare patients receiving care at health systems that used more telemedicine during the COVID-19 pandemic with patients in systems that relied more on in-person services. We assigned patients to health systems according to their care in 2019, before the pandemic, to address potential selection bias of patients in choice of clinicians who provide telemedicine; few providers had substantial telemedicine usage in 2019. We divided health systems into quartiles on the basis of 2020 telemedicine use and compared changes in outcomes between 2019 (prepandemic) and 2021–22 (postpandemic) across the quartiles. In a sensitivity analysis, we examined only 2022 outcomes for the postpandemic period to further disentangle our results from changes in use resulting from the pandemic. We assessed care received by all patients assigned to health systems, not just those who received a telemedicine visit, as a simple comparison of telemedicine users and nonusers is potentially biased by many omitted factors.[20] An analysis of all patients, not just those who use telemedicine, may also be a better estimate of the societal impact of expanding telemedicine coverage.

**DEFINING HEALTH SYSTEMS** We used the National Bureau of Economic Research's 2018 Health Systems and Provider Database to identify health systems. Details of our methods are provided elsewhere.[21,22] In brief, a health system was defined as a jointly owned or managed group of provider organizations (for example, physician practices and hospitals) with at least one acute care hospital, ten primary care physicians, and a total of fifty physicians. To identify the providers affiliated with a given health system, many data sources were used, including the Centers for Medicare and Medicaid Services (CMS) Provider of Services file, American Hospital Association Annual Survey data, the CMS Provider Enrollment and Chain Ownership System, IQVIA physician and hospital files, and Medicare and commercial claims data. Physicians were assigned to provider networks based on the ownership of their practices.

**ASSIGNING PATIENTS TO HEALTH SYSTEMS** Using a 100 percent sample of beneficiaries in traditional Medicare, we assigned patients to primary care practices, using a method modeled on Medicare's algorithm for attributing beneficiaries to accountable care organizations.[23] We identified all patients with at least one primary care physician visit in 2019, defined by having Healthcare Common Procedure Coding System (HCPCS) codes 99201–15, G0402, G0438, or G0439 and provider specialty code 01, 08, 11, or 38 (see online appendix exhibit A1).[24] Patients were assigned to the physician practices (identified by Taxpayer Identification Number) accounting for the plurality of their primary care visit spending and to the health system of their primary care practice. Using this strategy, we assigned 41 percent of Medicare beneficiaries with continuous 2019–22 fee-for-service coverage and at least one 2019 primary care visit to a health system; the remainder saw physicians without a system affiliation. We excluded health systems with fewer than 100 attributed patients and those without telemedicine visits. Appendix exhibit A2 describes differences between those assigned and those not assigned to a health system.[24] In a sensitivity analysis, we used a different attribution strategy that equally weighted visits from all clinicians, including nurse practitioners.

**CATEGORIZING HEALTH SYSTEMS INTO QUARTILES OF TELEMEDICINE USE** Among patients assigned to health systems, we categorized health systems into quartiles on the basis of outpatient telemedicine visits per capita in 2020. Outpatient visits included visits in clinics and outpatient hospital settings (defined as Berenson-Eggers Type of Service 2.0 codes beginning with E.V. or E.B. found in the Carrier file) and excluded visits in the hospital or other facilities. To address multiple bills for the same visit, we only counted one visit with the same clinician on the same day. Building off prior research,[25,26] we identified telemedicine visits on the basis of place-of-service codes and HCPCS codes and modifiers, including telehealth consultations, virtual check-ins, e-consults, and audio-only visits, among other categories, and excluding remote monitoring (see appendix exhibit A1).[24]

**STUDY SAMPLE AND PATIENT CHARACTERISTICS** We restricted our study cohort to beneficiaries with continuous enrollment in fee-for-service Medicare Parts A, B, and D from the period 2019–22 and with a primary care visit in 2019. We extracted 2019 demographic and prior disease burden information, including age, sex, race and ethnicity, dual eligibility for Medicaid (as a proxy for income), disability, and prior chronic conditions (details are in appendix exhibit A1).[24] Rurality is identified at the ZIP code level according to the Department of Agriculture's rural-urban commuting area codes.[27] We conducted a sensitivity analysis including patients who died during the study period.

We conducted subgroup analyses on patients

**Given concerns that telemedicine's convenience will lead to more visits, the relatively small increase in visits that we observed was surprising.**

with three illustrative chronic conditions (type 2 diabetes, heart failure, and depression) and those with high frailty, as the convenience of telemedicine might translate into more visits, which could improve chronic illness management and help those with difficulty getting to clinician appointments. Patients with diabetes, heart failure, or depression were identified using 2019 Chronic Condition Warehouse codes. Frail patients were identified using a claims-based algorithm developed by Dae Hyun Kim and colleagues and specifically focused on those defined as moderately to severely frail.[28,29]

**OUTCOMES** We measured total outpatient visits (both telemedicine and in-person) per person per year and by modality (telemedicine versus in-person). As a measure of care continuity, we determined the share of each patient's visits at their assigned primary care practice and health system.

Because telemedicine may facilitate improved quality of care and deter acute care, we measured hospital admissions and emergency department (ED) visits, excluding those with COVID-19 diagnoses (International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, codes U07.1 and B97.29).

We identified recommended preventive services, including mammograms, colonoscopies, prostate-specific antigen tests, and Pap tests, for patients in eligible age groups (see appendix exhibit A1).[24] Telemedicine could increase the number of visits, thereby creating more opportunities to encourage patients to obtain preventive care.

We focused on two illustrative medication classes used in chronic disease treatment (metformin and statins) to assess drug adherence. We measured adherence as the proportion of days covered.[30] We hypothesized that greater telemedicine use would lead to more visits, and thus more clinical opportunities to discuss medication use, thereby improving adherence.

We identified imaging and laboratory testing in outpatient claims on the basis of Berenson-Eggers Type of Service 2.0 codes. We hypothesized that greater telemedicine use might reduce imaging and testing. At an in-person visit in some clinics, patients may simply have the test right away. In contrast, at a telemedicine visit, clinicians may be less likely to order tests, or patients may delay these tests because of greater logistical barriers. Details on these measures are in appendix exhibit A1.[24]

We measured total spending and subcategories of spending by setting and service (details are in appendix exhibit A1).[24] Spending included Medicare and out-of-pocket payments adjusted for inflation using the Medical Consumer Price Index, to make it easier for readers to assess changes in spending over time. Given the ongoing debate about whether telemedicine visits should include facility payments, we captured spending on outpatient hospital facility payments (HCPCS codes G0463 and Q3014).[31] To assess whether telemedicine visits may be cheaper because they are less likely to result in laboratory tests or imaging,[32] we measured spending on testing and imaging in the seven days before or after a visit. We captured total spending, as it was unclear whether any potential increases in visit and drug spending could be offset by decreases in imaging, testing, and inpatient spending.

**STATISTICAL ANALYSES** Our primary specification was a difference-in-differences regression analysis. Outcomes were yearly averages measured for each patient in the prepandemic period (2019) and the pandemic period (2021–22). As noted above, in a sensitivity analysis we defined the pandemic period using only 2022 data. For each outcome, the regression included fixed effects for quartiles of health system telemedicine use (including an additional category for non-system patients), period (prepandemic versus pandemic), and period interacted by quartile, with these interaction coefficients being our estimates of interest. We also controlled for age-sex categories, dual Medicaid eligibility, chronic condition count categories, race and ethnicity, sex, metropolitan residence, original reason for Medicare entitlement, and geography, using hospital referral regions[33] (see appendix exhibit A1).[24] In another sensitivity analysis, we included a control for the health system's academic medical center status.

We tested for whether trends were parallel in the prepandemic period across quartiles (appen-

dix exhibit A3).[24] For most outcomes, we observed small but statistically significant differences in trends. Given the potential that these differential trends biased our results, we conducted a sensitivity analysis in which we assumed that the differential trends observed in the prepandemic period extended into our pandemic period[33] (details and an example are in appendix exhibit A1).[24]

The study was reviewed by the Harvard University and National Bureau of Economic Research Institutional Review Boards.

**LIMITATIONS** There were several key limitations of our analyses. First, we used a difference-in-differences framework to study the impact of telemedicine, and the changes we observed may have been subject to time-varying confounders that could have biased our findings. For example, the health systems in the highest quartile of telemedicine use could have differentially responded to the pandemic in other ways that were unrelated to telemedicine, such as changing how they offered preventive services. Second, our analyses were limited to the traditional Medicare population. The use and impact of telemedicine may differ in other populations. Third, we measured outcomes in 2021–22, when ongoing waves of COVID-19 illness may have affected health care–seeking behavior differentially by region. In our study, health systems in the highest quartile of telemedicine use were disproportionately located in the Northeast, and the impact of the pandemic varied by region. These differences in COVID-19 illness by region could have biased our results. For example, differences in hospital congestion could have affected hospitalization rates. We partially addressed these concerns by focusing on non-COVID-19 hospitalizations and conducting a sensitivity analysis including only data from 2022, when the pandemic likely had less of an impact on health care–seeking behavior. Fourth, we did not measure fraud, abuse, or patient travel time. Concerns about fraud and abuse have played a substantial role in the telemedicine policy debate, and savings with patient travel time can affect the spending impact of telemedicine.[34] Finally, our broad evaluation might have missed clinical areas or patient populations where telemedicine was particularly helpful or potentially harmful.

## Study Results

In 2019, 5,510,755 beneficiaries with continuous enrollment in traditional Medicare were assigned to one of 576 health systems. Health systems in the highest quartile of telemedicine use (which we refer to here as high-telemedicine health systems) were more likely than those in the lowest quartile of telemedicine use (low-telemedicine health systems) to be academic medical centers (40.3 percent versus 2.1 percent). Patients of high-telemedicine health systems were more concentrated in the Northeast (51.4 percent of patients) compared with patients of low-telemedicine health systems (1.7 percent of patients; exhibit 1).

**Policy makers have signaled that they are willing to accept small increases in spending due to telemedicine.**

**TELEMEDICINE USE** In 2019 (baseline period), telemedicine use was low (exhibit 2). In 2020, patients assigned to high-telemedicine health systems had an average of 2.5 telemedicine visits per capita (26.8 percent of visits) compared with an average of 0.7 telemedicine visits per capita (9.5 percent of visits) for patients in low-telemedicine health systems (appendix exhibit A5).[24] Although telemedicine use declined through December 2022, patients at high-telemedicine health systems continued to receive more telemedicine through the end of 2022. These trends are mirrored in the share of patients with any telemedicine and the share of visits conducted via telemedicine (appendix exhibits A4 and A5).[24]

When we controlled for patient and geographic characteristics, there was a differential 1.26 increase in telemedicine visits per capita from the baseline to the pandemic period between patients assigned to high- and low-telemedicine health systems (exhibit 3).

**OUTPATIENT VISITS AND CONTINUITY MEASURES** Over time, trends in total outpatient visits (including telemedicine and in-person) were largely similar across the four quartiles of health systems (exhibit 4). We estimated a differential increase of 0.21 visits per patient per year from baseline to the pandemic period between patients in high- and low-telemedicine health systems (a relative increase of 2.2 percent) (exhibit 3). On the basis of these findings, we estimated that 0.21 of the 1.26 additional telemedicine visits, or 16.7 percent, constituted additional utilization, implying that the remaining 83.3 percent of telemedicine visits substituted for in-person visits.

**EXHIBIT 1**

**Characteristics of health systems and traditional Medicare patients in health systems in the highest and lowest quartiles of telemedicine use, 2019–22**

| | Highest quartile (*n* = 144) | | Lowest quartile (*n* = 144) | |
|---|---|---|---|---|
| **Characteristics** | **Measure[a]** | **SD/%[b]** | **Measure[a]** | **SD/%[b]** |
| Share of 2020 visits provided via telemedicine (%) | 26.8 | —[c] | 9.5 | —[c] |
| Share of patients with 1 or more telemedicine visits in 2020 (mean %)[d] | 65.35 | 47.58 | 30.14 | 45.89 |
| No. of primary care physicians billing primarily under a system TIN (mean) | 195.4 | 206.1 | 83.0 | 120.1 |
| No. of physicians billing primarily under a system TIN (mean) | 761.9 | 905.0 | 255.3 | 488.9 |
| System status (no., %) | | | | |
| Academic medical center | 58 | 40.3 | 3 | 2.1 |
| Large for-profit | 2 | 1.4 | 2 | 1.4 |
| Large nonprofit | 22 | 15.3 | 28 | 19.4 |
| Other private | 48 | 33.3 | 72 | 50.0 |
| Public | 14 | 9.7 | 39 | 27.1 |
| No. of patients | 1,356,101 | —[c] | 826,620 | —[c] |
| Age at start of 2019, years (%)[e] | | | | |
| Younger than 65 | 13.3 | 33.9 | 11.5 | 31.2 |
| 65–69 | 22.0 | 41.4 | 24.8 | 43.2 |
| 70–74 | 26.4 | 44.1 | 26.5 | 44.1 |
| 75–79 | 18.8 | 39.0 | 18.4 | 38.7 |
| 80 or older | 19.5 | 39.6 | 18.8 | 39.1 |
| Dually eligible for Medicaid (%)[e] | 18.2 | 38.6 | 13.7 | 34.4 |
| Region (%)[e] | | | | |
| West | 20.1 | 40.1 | 15.0 | 35.7 |
| Midwest | 16.3 | 36.0 | 45.4 | 49.8 |
| Northeast | 51.4 | 50.0 | 1.7 | 12.6 |
| South | 12.2 | 32.7 | 37.9 | 48.5 |
| Urban (%)[e,f] | 92.7 | 26.0 | 55.9 | 49.6 |
| Chronic conditions | | | | |
| No. of chronic conditions | 6.4 | 3.5 | 6.2 | 3.3 |
| Diabetes (%)[e] | 23.8 | 42.6 | 25.8 | 43.8 |
| Hypertension (%)[e] | 58.8 | 49.2 | 62.2 | 48.5 |

**SOURCE** Authors' analysis of Medicare fee-for-service claims data. **NOTES** Health systems were categorized by 2020 telemedicine use into quartiles. Additional patient characteristics as well as data for health systems in quartiles 2 and 3 of telemedicine use are in appendix exhibit A8 (see note 24 in text). TIN is Taxpayer Identification Number. [a]The measure used varies by characteristics, as indicated in the row labels. [b]All values presented in the "SD/%" columns are standard deviations except for the "System status" panel, which presents the distribution across system types in percentage terms. [c]Not applicable. [d]"Mean %" is calculated as the mean value across the 144 systems in the quartile, and the standard deviation corresponds to the distribution of this system-level quantity. [e]"%" here is calculated as the mean value across patients in the quartile, and the standard deviation corresponds to the distribution of this patient-level quantity. [f]Urban is labeled "metropolitan" in the Department of Agriculture's rural-urban commuting area codes for beneficiary ZIP codes.

In terms of continuity measures, compared with patients in low-telemedicine health systems, patients in high-telemedicine health systems had differential increases in the share of their visits within their assigned health systems (3.1 percentage points) and with their assigned practices (3.4 percentage points) (exhibit 3).

**EMERGENCY DEPARTMENT USE AND HOSPITALIZATIONS** There was a differential decrease of 14.4 non-COVID-19 ED visits per 1,000 patients (a relative decrease of 2.7 percent) and an increase of 4.9 non-COVID-19 hospitalizations per 1,000 patients per year (a relative increase of 2.3 percent) between patients of high- and low-telemedicine health systems (exhibit 3).

**ADHERENCE TO MEDICATIONS AND PREVENTIVE CARE USE** Patients assigned to high-telemedicine health systems had differential increases in drug adherence (captured by proportion of days covered) for metformin (1.9 percentage points) and statins (0.4 percentage points) compared with those assigned to low-telemedicine health systems (exhibit 3). These changes reflect relative increases of 2.4 percent and 0.5 percent, respectively.

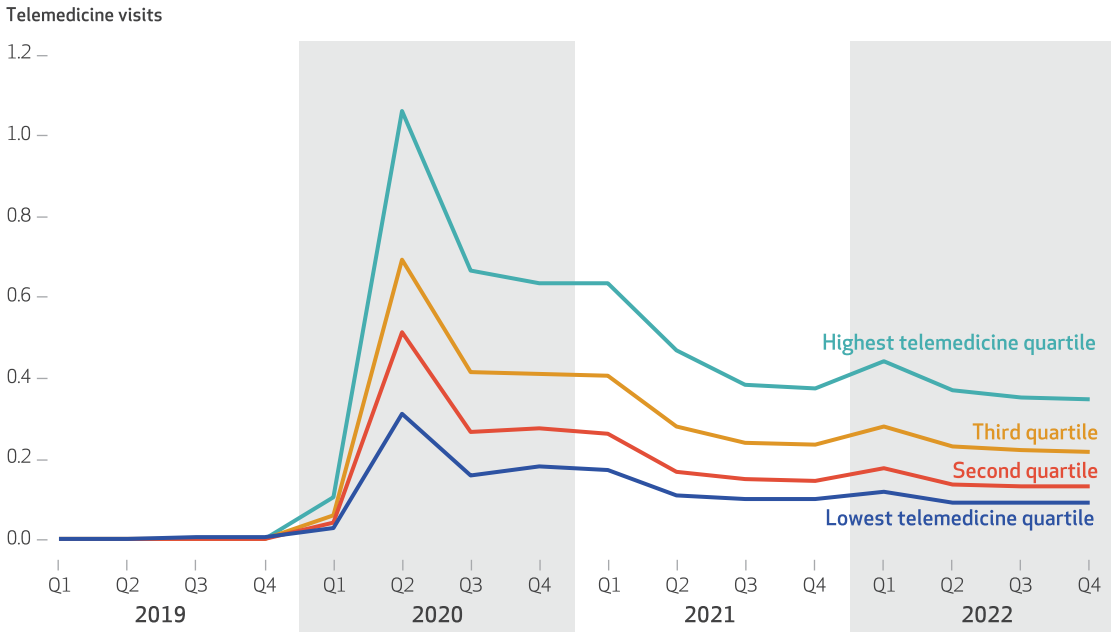
There were no statistically significant differential changes among patients of high-telemedicine health systems in the likelihood of receiving colonoscopies, Pap tests, and mammograms (exhibit 3).

**IMAGING AND TESTING** We found no significant changes in imaging services or laboratory tests per capita per year between patients of high- and low-telemedicine health systems (exhibit 3).

**HEALTH CARE SPENDING** Compared with patients of low-telemedicine health systems, pa-

**EXHIBIT 2**

**Telemedicine visits per traditional Medicare patient per quarter in health systems, by quartile of health system telemedicine use, 2019–22**




**SOURCE** Authors' analysis of Medicare fee-for-service claims data. **NOTES** Telemedicine visits were identified based on place-of-service codes and Healthcare Common Procedure Coding System codes and modifiers. Telemedicine visits include telehealth consultations, virtual check-ins, e-consults, and audio-only visits, among other categories, and exclude remote monitoring.

tients of high-telemedicine health systems had an inflation-adjusted $248 differential increase in spending (a relative increase of 1.6 percent) (exhibit 3). This differential increase was driven largely by inpatient admissions ($172) and pharmaceuticals ($170). This was offset by decreases in outpatient hospital spending (–$196), especially in facility fees for outpatient hospital visits.

**CHANGES IN VISITS BY DIFFERENT PATIENT SUBGROUPS** The relative change in outpatient visits from 2019 to 2021–22 between high- and low-telemedicine health systems was larger among patients without chronic illness or frailty and among lower-income (using the proxy of Medicaid dual eligibility), non-White, disabled, and rural patients (appendix exhibit A6).[24]

**SENSITIVITY ANALYSES** Our sensitivity analysis results were generally qualitatively similar, although the magnitudes of association varied (appendix exhibit A7).[24] For example, the relative change estimates ranged from –1.2 percent to –3.9 percent for non-COVID-19 ED visits and from 0.5 percent to 2.7 percent for metformin adherence. There were two notable exceptions. Across sensitivity analyses, the association between telemedicine use and non-COVID-19 hospitalizations (–0.5 percent to 2.3 percent) and total spending (–0.7 percent to 1.8 percent) was not consistently positive or negative.

## Discussion

To estimate the impact of greater telemedicine use, we exploited the variation in telemedicine uptake across health systems during the COVID-19 pandemic. Patients receiving care from health systems in the highest quartile of telemedicine use had modest increases in office visits, care continuity, and medication adherence, as well as decreases in ED visits, relative to patients of health systems in the lowest quartile. We did not observe differences in testing or preventive service use. The relative increase in visits was larger among patients without chronic illness and among lower-income, non-White patients. However, these changes were accompanied by a 1.6 percent increase in health care spending, largely driven by inpatient and drug spending.

Our results are qualitatively consistent with those of other recent studies. An analysis by the Medicare Payment Advisory Commission found that geographic areas with higher telemedicine uptake through 2021 had a 3 percent relative increase in total clinical encounters and a relative spending increase of $165 per person.[35] A 2021 study in Ontario, Canada, found that greater physician telemedicine uptake was associated with small decreases in ED visits,[36] and prior work has found an association between greater telemedicine use and increased hospital-

**EXHIBIT 3**

**Estimated differential changes in outcomes from 2019 to 2021–22 between the highest and lowest quartiles of health system telemedicine use**

| Outcomes | 2021–22 mean | Absolute difference | | Relative difference (%) | |
|---|---|---|---|---|---|
| | | Estimate | 95% CI | Estimate | 95% CI |
| Outpatient visits per person | | | | | |
| Total | 9.72 | 0.21 | 0.18, 0.24 | 2.2 | 1.9, 2.5 |
| Telemedicine | 1.03 | 1.26 | 1.25, 1.27 | 122.9 | 122.0, 123.7 |
| Share of visits at system (%) | 69.2 | 3.1[a] | 3.0, 3.2 | 4.4 | 4.3, 4.6 |
| Share of visits at practice (%) | 38.0 | 3.4[a] | 3.3, 3.5 | 9.0 | 8.7, 9.3 |
| Acute visits per 1,000 (non-COVID-19) | | | | | |
| Emergency department visits | 535.38 | −14.4 | −19.5, −9.4 | −2.7 | −3.6, −1.8 |
| Inpatient admissions | 210.95 | 4.9 | 2.6, 7.2 | 2.3 | 1.3, 3.4 |
| Medication adherence[b] (%) | | | | | |
| Metformin | 78.5 | 1.9[a] | 1.7, 2.2 | 2.4 | 2.1, 2.7 |
| Any statin | 84.7 | 0.4[a] | 0.3, 0.5 | 0.5 | 0.4, 0.6 |
| Preventive care[c] (%) | | | | | |
| Mammograms | 54.2 | −0.3[a] | −0.6, 0.0 | −0.5 | −1.0, 0.1 |
| Colonoscopies | 20.8 | 0.0[a] | −0.2, 0.1 | −0.2 | −1.0, 0.7 |
| Prostate-specific antigen tests | 53.2 | 0.1[a] | −0.4, 0.6 | 0.2 | −0.7, 1.1 |
| Pap tests | 12.2 | −0.3[a] | −0.7, 0.2 | −2.1 | −5.8, 1.6 |
| Imaging and testing per person | | | | | |
| Imaging services | 5.71 | 0.01 | −0.01, 0.03 | 0.1 | −0.3, 0.5 |
| Laboratory tests | 16.11 | −0.01 | −0.08, 0.07 | 0.0 | −0.5, 0.4 |
| Imaging with visit (%) | 31.0 | −0.3[a] | −0.4, −0.2 | −1.1 | −1.4, −0.8 |
| Laboratory test with visit (%) | 45.4 | −0.4[a] | −0.5, −0.3 | −0.8 | −1.1, −0.6 |
| Spending per person ($) | | | | | |
| Visits | 1,223 | −30 | −34, −26 | −2.4 | −2.7, −2.1 |
| Imaging | 645 | −18 | −21, −14 | −2.8 | −3.3, −2.2 |
| Laboratory testing | 468 | −21 | −24, −18 | −4.5 | −5.2, −3.9 |
| Skilled nursing facility | 791 | 75 | 59, 91 | 9.5 | 7.4, 11.5 |
| Home health | 502 | 26 | 19, 33 | 5.2 | 3.9, 6.6 |
| Pharmaceuticals | 4,382 | 170 | 127, 212 | 3.9 | 2.9, 4.8 |
| Outpatient hospital | 3,098 | −196 | −224, −168 | −6.3 | −7.2, −5.4 |
| Outpatient hospital facility fees | 91 | −47 | −48, −46 | −51.2 | −52.3, −50.0 |
| Inpatient admissions | 3,019 | 172 | 136, 207 | 5.7 | 4.5, 6.9 |
| Total | 15,529 | 248 | 173, 323 | 1.6 | 1.1, 2.1 |

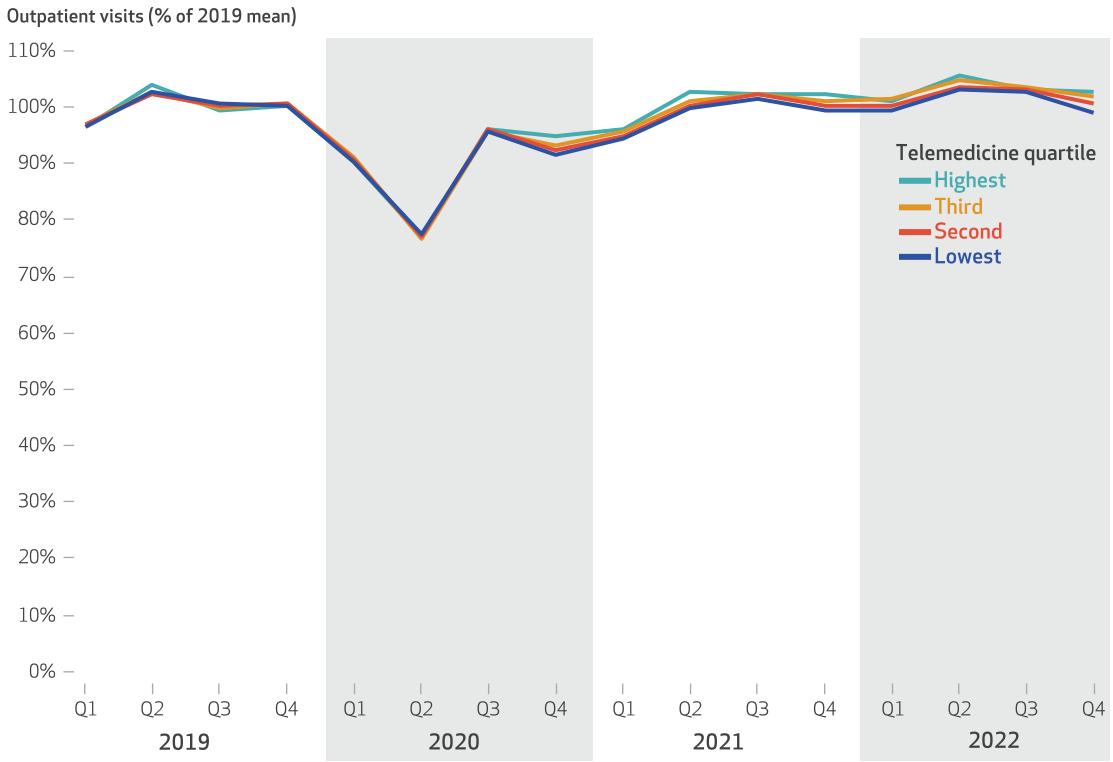
**SOURCE** Authors' analysis of Medicare fee-for-service claims data. **NOTES** The estimates come from coefficients from a difference-in-differences analysis of traditional Medicare patients in 2019 and 2021–22 assigned to health systems that were in the highest or lowest quartiles of 2020 telemedicine use. Results for comparison of health systems in quartiles 2 and 3 of telemedicine use are in appendix exhibit A9 (see note 24 in text). [a]Percentage points. [b]As captured by proportion of days covered. [c]Share of patients who received each service, limited to eligible patient populations (see appendix exhibit A1 for details).

izations in the treatment of serious mental illness.[37,38] Our results also support Congressional Budget Office modeling indicating that selective telemedicine expansions will increase spending because of projected increases in visits.[39] However, our findings contrast with those of other studies in other contexts that find that telehealth is associated with health care spending reductions.[40–43] The strengths of our approach included robust methods to control for selection bias in which patients and clinicians adopt telemedicine, extension of our study period into 2022 (a period with less COVID-19-related illness and more typical health care–seeking behavior), inclusion of a more comprehensive set of outcomes, and examination of differential impact across patient subgroups. Further, these differences were generally robust across many sensitivity analyses. However, this was not true across the board. Most notably, in one sensitivity analysis that included patients who died, we did not see a positive relationship between telemedicine use and spending.

Given concerns that telemedicine's convenience will lead to more visits, the relatively small increase in visits that we observed was somewhat surprising. It may be explained by several factors. Clinicians in the health systems in the highest quartile of telemedicine use may have had limited capacity to provide additional visits. Alternatively, there may have been limited demand from patients for telemedicine as a result of technological barriers or beliefs that telemedicine visits are lower in quality than in-person visits.[34,44] Moving forward, it will be important to continue monitoring telemedicine's

**EXHIBIT 4**

**Outpatient visits per capita for traditional Medicare patients in health systems as percent of the 2019 mean, by quartile of health system telemedicine use, 2019–22**




**SOURCE** Authors' analysis of Medicare fee-for-service claims data. **NOTES** Outpatient visits included visits in clinics and outpatient hospital settings (defined as Berenson-Eggers Type of Service 2.0 codes beginning with E.V. or E.B. found in the Carrier file) and excluded visits in the hospital or other facilities. To address multiple bills for the same visit, we only counted one visit with the same clinician on the same day.

impact on quality and spending. The effects of telemedicine on quality and spending could change as technology improves, health systems optimize telemedicine services, or patient demand grows.

Before the pandemic, many policy makers were concerned that broad telemedicine coverage would lead to more use and that restrictions may be necessary to contain spending. Whether our findings support or refute these concerns hinges on interpretations of the estimated spending impact (a 1.6 percent relative increase) and the clinical benefits of the changes we observed in visits, care continuity, and adherence. Policy makers have signaled that they are willing to accept small increases in spending due to telemedicine. For example, in permanently removing geographic restrictions and allowing audio-only visits for telemental health services in 2022,[45] Congress signaled a willingness to incur some costs for the Medicare program to maintain access to services that were provided during the pandemic. Given the small improvements in access and quality (in particular for chronic disease medications), combined with modest increases in spending along with patients' and clinicians' preferences, we believe that it will be difficult to justify a return to restricting telemedicine payment in Medicare.[46–48] ■

A previous version of this work was presented at the Annual Conference of the American Society of Health Economists in St. Louis, Missouri, June 12, 2023. This research was supported by the Agency for Healthcare Research and Quality (Grant No. U19HS024072) and the Commonwealth Fund. The authors appreciate the assistance of Kaushik Ghosh in programming efforts.

To access the authors' disclosures, click on the Details tab of the article online. [*Published online April 17, 2024.*]

## NOTES


1 Laing S, Johnston S. Estimated impact of COVID-19 on preventive care service delivery: an observational cohort study. BMC Health Serv Res. 2021;21(1):1107.
2 Becker NV, Moniz MH, Tipirneni R, Dalton VK, Ayanian JZ. Utilization of women's preventive health services during the COVID-19 pandemic. JAMA Health Forum. 2021;2(7):e211408.
3 Cassell K, Zipfel CM, Bansal S, Weinberger DM. Trends in non-COVID-19 hospitalizations prior to and during the COVID-19 pandemic period, United States, 2017–2021. Nat Commun. 2022;13(1):5930.
4 Mehrotra A, Chernew ME, Linetsky D, Hatch H, Cutler DA, Schneider EC. The impact of COVID-19 on outpatient visits in 2020: visits remained stable, despite a late surge in cases [Internet]. New York (NY): Commonwealth Fund; 2021 Feb 22 [cited 2024 Feb 28]. Available from: https://www.commonwealthfund.org/publications/2021/feb/impact-covid-19-outpatient-visits-2020-visits-stable-despite-late-surge
5 Patel SY, Mehrotra A, Huskamp HA, Uscher-Pines L, Ganguli I, Barnett ML. Variation in telemedicine use and outpatient care during the COVID-19 pandemic in the United States. Health Aff (Millwood). 2021;40(2):349–58.
6 Uscher-Pines L, McCullough C, Dworsky MS, Sousa J, Predmore Z, Ray K, et al. Use of telehealth across pediatric subspecialties before and during the COVID-19 pandemic. JAMA Netw Open. 2022;5(3):e224759.
7 Mulvaney-Day N, Dean D Jr, Miller K, Camacho-Cook J. Trends in use of telehealth for behavioral health care during the COVID-19 pandemic: considerations for payers and employers. Am J Health Promot. 2022;36(7):1237–41.
8 Verma S. Early impact of CMS expansion of Medicare telehealth during COVID-19. Health Affairs Blog [blog on the Internet]. 2020 Jul 15 [cited 2024 Feb 28]. Available from: https://www.healthaffairs.org/content/forefront/early-impact-cms-expansion-medicare-telehealth-during-covid-19
9 Department of Health and Human Services, Office of Inspector General. Certain Medicare beneficiaries, such as urban and Hispanic beneficiaries, were more likely than others to use telehealth during the first year of the COVID-19 pandemic [Internet]. Washington (DC): HHS; 2022 Sep 2 [cited 2024 Feb 28]. (Pub. No. OEI-02-20-00522). Available from: https://oig.hhs.gov/oei/reports/OEI-02-20-00522.asp
10 Libersky J, Soyer E, Masaoay T, Coit M, Edelberg R. Changes in Medicaid telehealth policies due to COVID-19: catalog overview and findings [Internet]. Washington (DC): Medicaid and CHIP Payment and Access Commission; 2020 Jun [cited 2024 Mar 19]. Available from: https://www.macpac.gov/wp-content/uploads/2020/06/Changes-in-Medicaid-Telehealth-Policies-Due-to-COVID-19-Catalog-Overview-and-Findings.pdf
11 America's Health Insurance Plans. Telehealth coverage during the COVID-19 pandemic [Internet]. Washington (DC): AHIP; 2022 Mar 17 [cited 2024 Mar 19]. Available from: https://www.ahip.org/resources/telehealth-coverage-during-the-covid-19-pandemic
12 Telehealth.HHS.gov. Telehealth policy changes after the COVID-19 public health emergency [Internet]. Rockville (MD): Health Resources and Services Administration; [last updated 2023 Dec 19; cited 2024 Mar 20]. Available from: https://telehealth.hhs.gov/providers/telehealth-policy/policy-changes-after-the-covid-19-public-health-emergency
13 Government Accountability Office. Medicare telehealth: actions needed to strengthen oversight and help providers educate patients on privacy and security risks [Internet]. Washington (DC): GAO; 2022 Sep 26 [cited 2024 Feb 28]. (Pub. No. GAO-22-104454). Available from: https://www.gao.gov/products/gao-22-104454
14 Government Accountability Office. Medicaid: CMS should assess effect of increased telehealth use on beneficiaries' quality of care [Internet]. Washington (DC): GAO; 2022 Mar 31 [cited 2024 Feb 28]. (Pub. No. GAO-22-104700). Available from: https://www.gao.gov/products/gao-22-104700
15 Medicare Payment Advisory Commission. Report to the Congress: Medicare payment policy [Internet]. Washington (DC): MedPAC; 2021 Mar. Chapter 14, Telehealth in Medicare after the coronavirus public health emergency; [cited 2024 Mar 19]. Available from: https://www.medpac.gov/wp-content/uploads/2021/10/mar21_medpac_report_ch14_sec.pdf
16 Zachrison KS, Boggs KM, Hayden EM, Espinola JA, Camargo CA Jr. Understanding barriers to telemedicine implementation in rural emergency departments. Ann Emerg Med. 2020;75(3):392–9.
17 Uscher-Pines L, Sousa J, Mehrotra A, Schwamm LH, Zachrison KS. Rising to the challenges of the pandemic: telehealth innovations in U.S. emergency departments. J Am Med Inform Assoc. 2021;28(9):1910–8.
18 Smith WR, Atala AJ, Terlecki RP, Kelly EE, Matthews CA. Implementation guide for rapid integration of an outpatient telemedicine program during the COVID-19 pandemic. J Am Coll Surg. 2020;231(2):216–222.e2.
19 Uscher-Pines L, Sousa JL, Zachrison KS, Schwamm L, Mehrotra A. Financial impact of telehealth: rural chief financial officer perspectives. Am J Manag Care. 2022;28(12):e436–43.
20 Poeran J, Cho LD, Wilson L, Zhong H, Mazumdar M, Liu J, et al. Preexisting disparities and potential implications for the rapid expansion of telemedicine in response to the coronavirus disease 2019 pandemic. Med Care. 2021;59(8):694–8.
21 Beaulieu ND, Chernew ME, McWilliams JM, Landrum MB, Dalton M, Gu AY, et al. Organization and performance of US health systems. JAMA. 2023;329(4):325–35.
22 National Bureau of Economic Research. The Health Systems and Provider Database, technical documentation [Internet]. Cambridge (MA): NBER; 2021 Jan [cited 2024 Apr 9]. Available from: https://www.nber.org/sites/default/files/2021-03/HSPD%20Technical%20Documentation%20-%20January%202021.pdf
23 Centers for Medicare and Medicaid Services. Medicare Shared Savings Program, shared savings and losses and assignment methodology, specifications, applicable beginning performance year 2016, version 4 [Internet]. Baltimore (MD): CMS; 2015 Dec [cited 2024 Mar 20]. Available from: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/sharedsavingsprogram/Downloads/Shared-Savings-Losses-Assignment-Spec-V4.pdf
24 To access the appendix, click on the Details tab of the article online.
25 Nakamoto CH, Wilcock AD, Schwamm LH, Zachrison KS, Uscher-Pines L, Mehrotra A. Variation in patterns of telestroke usage during the COVID-19 pandemic. J Stroke Cerebrovasc Dis. 2023;32(4):107036.
26 Mehrotra A, Huskamp HA, Nimgaonkar A, Chaiyachati KH, Bressman E, Richman B. Receipt of out-of-state telemedicine visits among Medicare beneficiaries during the COVID-19 pandemic. JAMA Health Forum. 2022;3(9):e223013.
27 Department of Agriculture, Economic Research Service. Rural-urban commuting area codes [Internet].

Washington (DC): USDA; [last updated 2023 Sep 25; cited 2024 Feb 28]. Available from: https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/
28 Kim DH, Schneeweiss S, Glynn RJ, Lipsitz LA, Rockwood K, Avorn J. Measuring frailty in Medicare data: development and validation of a claims-based frailty index. J Gerontol A Biol Sci Med Sci. 2018;73(7):980–7.
29 Kim DH, Glynn RJ, Avorn J, Lipsitz LA, Rockwood K, Pawar A, et al. Validation of a claims-based frailty index against physical performance and adverse health outcomes in the Health and Retirement Study. J Gerontol A Biol Sci Med Sci. 2019;74(8):1271–6.
30 Canfield SL, Zuckerman A, Anguiano RH, Jolly JA, DeClercq J, Wascher M, et al. Navigating the Wild West of medication adherence reporting in specialty pharmacy. J Manag Care Spec Pharm. 2019;25(10):1073–7.
31 Simon S. Telemedicine was supposed to reduce costs. Here's why that's not always the case. NPR [serial on the Internet]. 2023 Apr 8 [cited 2024 Feb 28]. Available from: https://www.npr.org/2023/04/08/1168795014/telemedicine-was-supposed-to-reduce-costs-heres-why-thats-not-always-the-case
32 Reed M, Huang J, Graetz I, Muelly E, Millman A, Lee C. Treatment and follow-up care associated with patient-scheduled primary care telemedicine and in-person visits in a large integrated health system. JAMA Netw Open. 2021;4(11):e2132793.
33 Bilinski A, Hatfield LA. Nothing to see here? Non-inferiority approaches to parallel trends and other model assumptions. arXiv [preprint on the Internet]. 2018 May 8 [last updated 2020 Jan 17; cited 2024 Mar 20]. Available from: http://arxiv.org/abs/1805.03273
34 Snoswell CL, Taylor ML, Comans TA, Smith AC, Gray LC, Caffery LJ. Determining if telehealth can reduce health system costs: scoping review. J Med Internet Res. 2020;22(10):e17298.
35 Tabor L, Cline C, O'Donnell B. Mandated report: telehealth in Medicare [Internet]. Washington (DC): Medicare Payment Advisory Commission; 2023 Apr 14 [cited 2024 Feb 28]. Available from: https://www.medpac.gov/wp-content/uploads/2022/07/Tab-H-Telehealth-April-2023.pdf
36 Kiran T, Green ME, Strauss R, Wu CF, Daneshvarfard M, Kopp A, et al. Virtual care and emergency department use during the COVID-19 pandemic among patients of family physicians in Ontario, Canada. JAMA Netw Open. 2023;6(4):e239602.
37 Wilcock AD, Huskamp HA, Busch AB, Normand ST, Uscher-Pines L, Raja PV, et al. Use of telemedicine and quality of care among Medicare enrollees with serious mental illness. JAMA Health Forum. 2023;4(10):e233648.
38 Wang B, Huskamp HA, Rose S, Busch AB, Uscher-Pines L, Raja P, et al. Association between telemedicine use in nonmetropolitan counties and quality of care received by Medicare beneficiaries with serious mental illness. JAMA Netw Open. 2022;5(6):e2218730.
39 Hall C, Housman L, Osgood H. Cost estimate. At a glance: H.R. 5201, Telemental Health Expansion Act of 2020 [Internet]. Washington (DC): Congressional Budget Office; 2020 Dec 4 [cited 2024 Feb 28]. Available from: https://www.cbo.gov/system/files/2020-12/hr5201.pdf
40 Cigna Healthcare. Convenient, cost-effective, and high-quality virtual care is here to stay [Internet]. Bloomfield (CT): Cigna; c 2024 [cited 2024 Feb 28]. Available from: https://newsroom.cigna.com/convenient-cost-effective-and-high-quality-virtual-care-is-here-to-stay
41 Patel KB, Turner K, Alishahi Tabriz A, Gonzalez BD, Oswald LB, Nguyen OT, et al. Estimated indirect cost savings of using telehealth among nonelderly patients with cancer. JAMA Netw Open. 2023;6(1):e2250211.
42 Rabideau B, Eisenberg MD. The effects of telemedicine on the treatment of mental illness: evidence from changes in health plan benefits. Social Science Research Network [preprint on the Internet]. 2022 Apr 21 [cited 2024 Mar 20]. Available from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4065120
43 Zeltzer D, Einav L, Rashba J, Balicer RD. The impact of increased access to telemedicine. J Eur Econ Assoc. 2023 May 29. [Epub ahead of print].
44 Khilnani A, Schulz J, Robinson L. The COVID-19 pandemic: new concerns and connections between eHealth and digital inequalities. J Information Commun Ethics Soc. 2020;18(3):393–403.
45 Medicare Learning Network. CY2022 telehealth update Medicare physician fee schedule [Internet]. Chicago (IL): American Hospital Association; 2022 Jan 19 [cited 2024 Apr 9]. Available from: https://www.cms.gov/files/document/mm12549-cy2022-telehealth-update-medicare-physician-fee-schedule.pdf
46 Pogorzelska K, Chlabicz S. Patient satisfaction with telemedicine during the COVID-19 pandemic—a systematic review. Int J Environ Res Public Health. 2022;19(10):6113.
47 Walia B, Shridhar A, Arasu P, Singh GK. US physicians' perspective on the sudden shift to telehealth: survey study. JMIR Hum Factors. 2021;8(3):e26336.
48 Beard M. DEA seeks to temporarily extend virtual prescribing for controlled substances. Washington Post [serial on the Internet]. 2023 May 3 [cited 2024 Feb 28]. Available from: https://www.washingtonpost.com/politics/2023/05/03/dea-seeks-temporarily-extend-virtual-prescribing-controlled-substances/