Abstract

Telemedicine increased dramatically during the COVID-19 pandemic introducing the modality to many patients and providers. To understand how exposure to telemedicine affects subsequent utilization, I examine persistence with telemedicine in pre-COVID Medicare. I analyze patient and provider telemedicine visits in Medicare from 2006 to 2016, a sample where telemedicine was predominantly used in rural areas and for mental health conditions. I measure patient persistence by the share of care provided via telemedicine over time and compare this to in-person persistence with a unique provider. Similarly, I evaluate provider persistence by the share continuing to provide telemedicine. Patients were somewhat persistent: for mental health visits in particular, the share via telemedicine fell from over 60% at the first visit to 40% the next quarter and subsequently to 20% three years later, while in a matched comparison group, the share of in-person visits to the same provider fell by roughly half as much from 64% to 44% over three years. The selected subset of patients whose initial providers continued to provide any telemedicine, a group more likely to retain access, were quite persistent. Providers were somewhat more persistent than the average patient though results varied by specialty. If telemedicine were a valuable experience good then exposure should lead to increased or persistent utilization in the absence of other constraints. My results suggest this is not the case and that supply constraints were a limiting factor. The policy implication is that COVID’s impacts on future telemedicine may stem from changes in the supply side regulations and reimbursement rather than from exposing potential patients to the modality, so maintaining those changes is likely necessary to maintain higher telemedicine levels.

1 Introduction

Telemedicine expanded rapidly during the COVID-19 pandemic introducing many patients and providers to the modality firsthand and raising the question of how they will use telemedicine in the future. One study estimated that at the peak, 14% of outpatient visits were converted to telemedicine, and the Council of Economic Advisors estimated that telemedicine for upper respiratory tract infections increased by a factor of twelve from February 2020 to the end of March (Council of Economic Advisors, 2020; Mehrotra et al., 2020).

Understanding historic utilization patterns—especially how patients and providers used telemedicine after they have a first experience with it—can inform what the limiting constraints to telemedicine were and how exposure to telemedicine during COVID may influence telemedicine use in the long run. Pre-COVID Medicare offers an opportunity to study this since telemedicine in Medicare has been growing...
rapidly, introducing many people to the modality. Telemedicine in Medicare increased 10-fold from 2006 to 2016, though utilization was low in absolute terms—in 2016, only about 0.3% of beneficiaries used any telemedicine and approximately 0.1% of Part B claims were via telemedicine.

Understanding telemedicine utilization patterns can also provide evidence about which barriers to telemedicine may have been the limiting constraints. There are several potential explanations for the historically low telemedicine take-up: one possibility is that patients or providers prefer in-person care, so telemedicine would only be used if in-person care is unavailable or exceedingly costly. Another possibility is that telemedicine was suppressed by regulations and low reimbursement: historically the Centers for Medicare and Medicaid Services (CMS) tried to contain costs by limiting telemedicine to rural areas, requiring patients to contact the distant provider from a local clinic, and limiting allowed procedures. Also supply side regulations like state licensure rules may have suppressed telemedicine. These supply side constraints and low reimbursement may have created a situation of excess demand where patients who wanted telemedicine were unable to find willing providers. Another potential reason for the historically low telemedicine use is that there were information barriers or high entry costs for patients or providers. Providers may lack information or capital or may generally not want to disrupt their standard operational practices. Patients likewise may not have the necessary internet or devices to connect remotely or may not realize that telemedicine can deliver useful care.

Fee-for-service (FFS) Medicare beneficiaries between 2006 and 2016, who I focus on in this study, needed to show up to a clinic or provider’s office (the originating site) to contact the distant provider for the telemedicine service—thus, any telemedicine depended on the patient, distant provider, and local originating site all participating. Potential patients could use telemedicine at one originating site when that was all that was available or forgo care or look for in-person care at an otherwise less preferable location (for example, one with a longer drive or wait time). The clinics or providers potentially serving as originating sites could decide whether to refer their patients for telemedicine and host the patients during their remote visits: for example, clinics may not have hosted patients for telemedicine visits if the clinic had the expertise to serve them in-person, in which case patients desiring telemedicine would have needed to find an alternative originating site or forgo telemedicine. And clinicians potentially providing care via telemedicine may have more or less leeway to choose telemedicine depending on whether they practice independently or work for a health care organization.

I focus on patients and distant providers in this analysis omitting originating site providers because Medicare now allows telemedicine visits from patient residences so the choices of providers potentially serving as originating sites are less relevant for current policy. Medicare began to allow the home as an originating site for the general patient and provider population during COVID, though there were exceptions for risk-bearing accountable care organization and special patient populations like substance and opioid abuse patient before then. But it is still important to consider how originating sites affected telemedicine use in the past.

Different limiting constraints to telemedicine would result in different utilization patterns. If information barriers or entry costs were the limiting constraints to telemedicine, then exposure to telemedicine would lead to persistently higher telemedicine use after patients and providers overcame the barriers and learned firsthand about telemedicine’s usefulness. If supply constraints—either regulations or low reimbursement—were the limiting factor, then there would be excess demand so patients would differentially persist with telemedicine depending on whether they had continued access to telemedicine. And if patients simply preferred in-person care, then persistence with telemedicine would be low regardless of whether supply was
available. Likewise, distant providers would be persistent with telemedicine provision if entry costs were a limiting constraint. Though distant providers may also be limited by a lack of referrals from originating sites if the originating sites stopped hosting patients.

Evaluating patient utilization patterns and persistence has several challenges. First, mean reversion affects the interpretation of what is persistent use: patients recover and no longer need care. A partial solution is to look at the share of visits that are provided via telemedicine—this focuses on the modality used to provide care (in-person versus telemedicine) rather than whether the patient receives care. The telemedicine share of visits falls from around 30% the quarter of the first visit to less than 10% a year later. I also restrict the analysis to mental health care since 82% of telemedicine is mental-health-related (as of 2016 in Medicare) and find that the telemedicine share of mental health visits is over 60% in the first quarter a patient uses telemedicine, but falls to 20% three years later. A second challenge is how to benchmark both the level and changes in the telemedicine share: I compare telemedicine persistence to persistence with an individual provider—the share of mental health visits that in-person users have with the same provider starts at over 60% the quarter of their first visit with that provider and remains over 40% for the next three years. The aggregate results suggest that patients who start using telemedicine are only moderately persistent.

Whether the lack of patient persistence with telemedicine stems from patient choice, supply constraints, or other barriers has different implications for the policy levers to change telemedicine levels. To investigate the extent to which the incomplete persistence stems from supply barriers I restrict to patients whose distant providers and originating sites continue to provide care, a group that plausibly retains telemedicine in their choice set. This is necessarily a selected sample since fewer than half of the telemedicine distant claims have a matching originating site claim, these patients who plausibly have telemedicine remain in their choice set are far more persistent—continuing with telemedicine at similar rates that the benchmark group of in-person patients continued with the same provider.

Any provider analysis using Medicare claims is necessarily limited because it will miss non-Medicare patients and my study only contains 20% of Medicare beneficiaries, so my estimate of how persistent providers are with telemedicine will be a lower bound (since providers may continue to provide telemedicine to people outside my sample). I find that three years after a providers’ first visit, less than 50% of providers continue to provide telemedicine. Though again this decrease in telemedicine could stem from either provider choice or a lack of referrals—I explore this by restricting to providers whose initial patient had a matched originating site that continued to act as an originating site.

This paper builds on a descriptive literature on telemedicine in Medicare. The literature has not looked at persistence to my knowledge, but it robustly finds that telemedicine in Medicare has grown quickly since its introduction in 2000, but remained small in 2016. The population using telemedicine was predominantly rural, younger than the general Medicare population, and more likely to have had mental illness or other chronic conditions, and use tended to be focused on treating mental illness. The literature has discussed potential barriers to telemedicine—low reimbursement, interstate licensure, internet access, confidentiality concerns, disruption to standard operations, and capital equipment. But there has been little empirical work informing which of these are the limiting barriers except one study that found that commercial parity laws and Medicaid telemedicine coverage increased telemedicine in Medicare suggesting that the small scale of telemedicine was a limiting constraint to providers.
2 Data

I use the Medicare Carrier Part B claims and the Master Beneficiary Summary File from 2006 to 2016 for a 20% sample of Medicare beneficiaries. I select beneficiaries enrolled in fee-for-service Medicare and determine their place of residence, age, disability status, and chronic conditions (via the chronic condition supplement).

Medicare allows two types of telemedicine claims: the distant claim from the remote provider who treats the patients and the originating site claim for the clinic or office where the patient is located when they call the provider (in my sample period, FFS Medicare never allowed patients to receive telemedicine in their homes though an audit by the Office of Inspector General found that some did)(Jarmon, 2018). Distant telemedicine claims in the carrier claims file are identified by the “GT” Healthcare Common Procedure Coding System (HCPCS) modifier code or a telemedicine specific HCPCS code. I do not include claims with the "GQ" HCPCS modifier code since those are store and forward claims from demonstration projects and are less comparable to typical in-person care. The telemedicine specific HCPCS codes through 2016 were: "G0425", "G0426", "G0427", "G0406", "G0407", "G0408", and "G0459".

I drop denied claims, claims with a payment less than or equal to zero, and duplicate claims by the same national provider identifier (NPI) for the same beneficiary on the same day since CMS only allows one such claim per day.

I define a provider to be an NPI—this abstracts from multiple individuals filing claims under one institutional NPI or nurse practitioners or physicians assistants filing with the NPI of their supervising physician. My sample matches other work showing that (1) telemedicine use was low but growing quickly; (2) it was predominantly used for mental health—82% of the claims in my sample in 2016 had a diagnosis of mental health and 53% were to psychiatrists and psychologists; and (3) it was a poor (over half were dual eligibles), rural, and chronically ill (64% are disabled and 90% have at least one chronic condition) population that received most of the telemedicine (Mehrotra et al., 2017; Centers for Medicare & Medicaid Services, 2018).

I identify claims that are mental health related as those with a primary diagnosis of mental health (ICD9 codes 290 through 319 and ICD10 codes F00 to F99), have a provider who is either a psychiatrist or psychologist, or the procedure was psychotherapy.

I use the Area Health Resources Files (2018 sample) from the Health Resources and Services Administration on county characteristics, which I merge to the Medicare data using the beneficiary county of residence.

I also use the Medicare Outpatient Part B claims to identify originating site visits—these appear in both the outpatient and carrier files depending on whether the originating site is a institutional provider. I identify these claims by the “Q3014” HCPCS code.

3 Patient Persistence: Methods and Results

To evaluate how persistent patients are with telemedicine I look at how the share of care provided via telemedicine changes over time. A simpler measure of persistence using telemedicine would be the share of people still using it over time. However, some lack of persistence is mean reversion—sick people get better and stop needing care. I thus evaluate the share of care that is received via telemedicine—the share is less subject to mean reversion since both the denominator of total visits and the numerator of telemedicine visits go down as people recover from their condition.

I define an index visit to be a patient’s first time using telemedicine and calculate the share of visits via
telemedicine for each subsequent quarter. Persistent telemedicine would be a stable series of shares each quarter after the index visit, while decreasing series would represent incomplete persistence with the extreme of no persistence being a drop off to zero telemedicine after exposure in the index quarter. To find standard errors for the estimates, I regress the shares on indicators for quarters since the index visit and cluster at the beneficiary level. Note that this is not a balanced panel, but when I restrict to a smaller sample with a balanced panel, results are similar (see the appendix for detail on the regression and results for balanced panels).

The two series of circles in figure 1 shows the primary finding of the paper—the red circles show that the first quarter a patient uses telemedicine, it accounts for almost 30% of their visits, but that immediately falls to around 10% the following quarter and gradually decreases thereafter. The series of blue circles restricts to the mental health related claims. This narrows in on the claims where telemedicine is most likely feasible. It shows that the telemedicine share fell from over 60% to around 40% the first quarter and then decreased by half to 20% over three years.

Figure 1 shows that the telemedicine share declines after the index visit, yet there are several challenges in interpreting that decline. First, mean reversion may still explain some of the decrease even though I try to avoid it by using share of care. Second, a benchmark, would help to contextualize both the level and increase. And third, the raw decrease is not informative about why the patient stopped using telemedicine—whether it is a patient choice, a supply shortage, or some other reason.

Mean reversion may cause some of the drop in telemedicine share from the index quarter to the subsequent quarter because of the timing of the visits. For example, if all telemedicine users had a 25% chance of using telemedicine each quarter, my method would line up the quarters when all users had a visit as the index quarter and then utilization would fall by 75% for subsequent quarters. A conservative way to avoid contamination from this sort of mean reversion is to ignore the index quarter and only consider telemedicine utilization patterns after the index quarter. This still yields substantial decreases in telemedicine shares—the share falls by half from around 40% to 20% over three years (likewise from around 10% to 5% for all care).

3.1 Benchmarking Patient Persistence with Telemedicine

Comparing the persistence of telemedicine to a benchmark helps with the interpretation by further allaying concerns of mean reversion and by providing a way to contextualize the size of the decline. The first benchmark I compare telemedicine to is the persistence of care with a specific in-person provider. I next compare the level that telemedicine seems to stabilize at to several telemedicine rates from the literature.

I compare persistence with telemedicine to persistence with a unique in-person provider There is no perfect benchmark for telemedicine persistence—comparing the telemedicine modality to the in-person modality does not make sense since almost all care is in-person. Persistence with the same procedure is too strict since telemedicine covers many procedures; for example, a psychological diagnostic exam followed by psychotherapy. The specific provider benchmark is especially apt since most patients receive telemedicine from only one provider so stopping telemedicine is usually equivalent to changing providers.

For each telemedicine index visit, I search for another visit in the same year that matches the index visit on provider specialty, procedure type, diagnosis category (ICD9 and ICD10 codes grouped using the Healthcare Cost and Utilization Project Clinical Classification Software), hospital referral region, urbanicity, dual status, sex, disability status, race (indicator for white), age (indicator for less than 65), and the presence of any chronic conditions, mental illnesses, or depression. I successfully match 41% of the telemedicine index visits to at least one claim and keep the matches with the minimum age difference. I attempt to match the
Figure 1: Patient Persistence with Telemedicine

**Note:** The circles show the share of visits via telemedicine over time since the index visit. The diamonds show the share with the same provider. The divergence between the telemedicine and provider comparison represents the increased persistence of a particular provider relative to telemedicine. I calculate the shares in a regression to get standard errors for the estimates—regressing share on an indicator for quarters since the index visits interacted with an indicator for the telemedicine or provider group and clustered at the beneficiary level. The vertical lines represent 95% confidence intervals. Data from CMS Part B claims, 2006-2016.
remaining 59% of telemedicine index claims by relaxing the match requirements to only match on provider specialty, procedure type, diagnosis category, state, urbanicity, and the presence of any chronic conditions or mental illnesses. In total, this procedure generates matches for 64% of the 54,257 telemedicine index visits. For each matched in-person claim, I define the index visit as the first visit with that provider (truncating the search to the past 5 years) and calculate the share of subsequent visits that are with the same provider.

I restrict the comparison of telemedicine and in-person persistence to only telemedicine beneficiaries that have a matched in-person claim, and weight the claims so that the sum of the weights for in-person claims matching each telemedicine index visits sums to one (since telemedicine visits can have multiple matches). Restricting to telemedicine beneficiaries with a matched in-person claim does not affect my results (see the unrestricted sample in the appendix). Differential persistence would be represented by a series of shares that diverge from each other, while any difference in share levels would simply represent different concentrations of care among providers versus modalities.

Figure 1 shows that telemedicine care is less persistent than care from an individual provider. The blue diamonds show share of mental health care with the same provider: in the index quarter, a similar share of mental health care is via telemedicine and with the same provider in the matched provider sample. Going forward the telemedicine share drops off much more sharply. Mean reversion affects the drop off after the index quarter, but even focusing just on the quarters after the index quarter, we see that telemedicine is far less persistent than care with a consistent provider. The red diamonds show the result for all claims which are relatively similar.

The telemedicine share of visits falls by almost half over the year following the first visit, which is much more than a matched set of in-person relationships. But the telemedicine share is somewhat persistent—it stays well above the share for all rural beneficiaries (0.003). Another benchmark for the share of care via telemedicine comes from a study of about fifty thousand providers across all payers which estimated that at the telemedicine peak during COVID, 14% of outpatient visits were converted to telemedicine—this could be interpreted as the share of visits that can be converted to telemedicine(1). The share of care via telemedicine in my sample falls to well below 14%, and my sample is likely selected to be more appropriate for telemedicine than average.

3.2 Distinguishing Demand versus Supply Barriers

To explore, the extent to which demand versus supply side barriers contribute to the incomplete persistence, I evaluate persistence for a subset patients who likely have telemedicine remain in their choice set. I do this by evaluating persistence with telemedicine for patients whose providers continue to provide care via telemedicine.

Telemedicine may leave a patient’s choice set if they are unable to find a distant or originating site provider willing to serve them. I first explore the extent to which distant providers ceasing telemedicine may explain patient persistence. I restrict to patients whose distant provider for their index visit are still providing, assuming that the patient would likely still have access to that same provider and hence not be limited by the supply of distant providers. This increases my measure of patient persistence slightly. The decrease in share of care via telemedicine is slightly smaller falling from 29% in the index quarter to 13% in the second quarter and 6% after 3 years (compared to a fall from 27% to 11% in the second quarter and 5% after 3 years in the baseline sample). Similarly restricting to distant providers who provide a high number of telemedicine visits slightly increases the shares of care via telemedicine (see the appendix figure A.4).

Similarly, a patient may lose telemedicine from their choice set if all originating sites nearby stop hosting
telemedicine visits. I perform a similar exercise as for distant providers and restrict to only patients with a matched originating site whose index originating site continues to host originating site visits. Unfortunately, most originating sites do not file claims, so only 46% of the telemedicine claims in my sample have an originating site claim on the same day, and there is selection into which types of patients go to originating sites that do file claims. The telemedicine claims with “missing” originating site claims are on average from lower volume distant providers, and when I restrict to only those index visits with a non-missing originating site, even without restricting to originating sites that continue to file claims, the initial level of telemedicine falls and persistence increases (see figure A.5 in the appendix).

When I restrict to only patients for whom both the index originating site and the index distant provider continue to provider care persistence further increases. Figure 2 shows an analog of Figure 1 restricting to only patient with continuing index providers. The telemedicine share is at a lower level than the in-person comparison, but has a parallel trend indicating that telemedicine for this group that presumably has telemedicine in their choice set is just as persistent as in-person care with a particular provider. In this figure I have restricted the in-person comparison sample to only those individuals matching the 34% of my sample of index visits that have a matched originating site claim. The finding that patients whose distant providers and originating sites continue to provide care are just as persistent as the in-person comparison group suggests that the incomplete persistence with telemedicine in aggregate may be driven by a lack of supply.

4 Provider Persistence: Method and Results

Since supply constraints of telemedicine provision seem to be a limiting constraint on telemedicine utilization, I evaluate provider persistence with telemedicine after they provide a first visit. I evaluate provider persistence with telemedicine by looking at changes over time in the share of total claims provided via telemedicine and the share still providing any telemedicine after a providers’ first telemedicine visit (the index visit). The share of total claims measures persistence without confounding from the fact that I cannot see a provider’s non-Medicare claims or observe provider retirement—when a provider retires the share becomes missing since the denominator is zero. The share of a provider’s claims via telemedicine does not distinguish between a case where all providers continue using telemedicine but at a lower share and a case where most providers stop completely and others decide to specialize in telemedicine. Thus, I also look at the presence of any current or future telemedicine claims among providers with any claims of either modality (this restriction eliminates retired providers). I regress the shares on quarter indicators to generate standard errors and weight each provider by their number of total claims in the index quarter (see the appendix for details on the regression and for an unweighted version, which is relatively similar, but has generally higher levels of telemedicine).

The left panel of figure 3 shows the share of telemedicine over time by provider specialty. Conditional on providing at least some telemedicine, psychiatrists, psychologists, nurse practitioners, and physicians assistants provide a higher share of their claims via telemedicine, but the share they provide drops off continuously. And generalists and medical specialists have a lower level of telemedicine provision, after a year, the share they provide via telemedicine doesn’t change much indicating high persistence (at a low level). As in the beneficiary analysis the drop after the index quarter may be partly mean reversion.

The right panel of figure 3 shows the aggregate results for share of providers who persistent with telemedicine at all. Some providers do not persist at all with telemedicine after a few years—the most
Figure 2: Patient Persistence with Telemedicine (Active Providers only)

Note: This figure is the analog of Figure 1 (see notes there) except that I restrict to patients with active distant and originating site providers. I define both distant and originating site providers to be active if the provider has any telemedicine claims in that quarter or any future quarter. I restrict to telemedicine index visits that have a matched originating site claim. And I omit from the regression patient quarter observations after the last claims when the distant and originating site providers filed telemedicine claims. The provider comparison set is restricted to the patients who matched the telemedicine users with an originating site claim for their index visit.
Figure 3: Provider Persistence: All Providers

![Graph of Share Claims via Telemedicine](image)

**(a) Share visits via telemedicine**

![Graph of Share still providing Telemedicine](image)

**(b) Share still providing telemedicine**

Note: The left panel shows the share of claims different provider specialties provide via telemedicine, and the right panel shows the share of providers with claims who are still providing telemedicine (or will continue in the future). The decreasing series represent incomplete persistence. The divergence between the series represents differential persistence between the specialties. I calculate the shares in a regression to get standard errors for the estimates—regressing telemedicine share or indicator on an indicator for quarters since the index visit interacted with an indicator for the provider specialty and clustering at the provider level. The vertical lines represent the 95% confidence intervals. The top row includes the results for the full sample. The bottom row restricts to providers whose index visit was to a patient with a matching originating site claim—I omit provider quarter observations after the last originating site claims filed by that originating site provider. Data from CMS Part B claims, 2006-2016.

Persistent specialty by this metric (psychiatrists and psychologists) has just under 60% persist for 3 years. Generalists, in particular, do not persistent with telemedicine as fewer than half of them continue with telemedicine one year after the index quarter.

Similarly to the patient case, some of the fall off in provider use of telemedicine may not be the result of provider preference, but may be driven by an inability to find interested patients. Since the results from the first section suggest that patients persist with telemedicine when they have the option to, the most likely limitation on distant provider choice would be a lack of any originating sites to refer patients to them. Figure 4 explores this possibility by restricting the analysis to only distant providers whose index patient had a matching originating site claim and only including the providers as long as that originating site is submitting claims. This set of distant providers is more likely to have a source of referrals if they are interested in continuing to practice telemedicine. This sample restriction includes only 24% of the providers in the full sample, resulting in a selected sample that has lower average levels of telemedicine (see figure A.7 in the appendix, which restricts to the providers with a matched index originating site, but not restricting to continuing originating sites). Also, there are not enough generalists who have a matching originating site claims to include in the analysis.

Restricting to providers whose referring originating sites remain open suggests that gaining referrals for telemedicine may have been a barrier for providers. Figure 4 shows that psychiatrists, psychologists, nurse practitioners, and physicians assistants are quite persistent in their provision of telemedicine both in terms of the share of care via telemedicine and continuing with any telemedicine at all. This increased persistence relative to the full sample suggests that these providers may be limited by the referrals they receive (though this may also be an artifact of the selected sample). Medical specialists in this selected sample provide a very low level telemedicine, and tend to stop providing telemedicine completely, suggesting they do not face
5 Discussion and Limitations

An impediment to generalizing these results from Medicare claims to the general population or the COVID telemedicine expansion is that the Medicare population is different than the general population. Two key differences are that the Medicare population is elderly (the only non-elderly Medicare beneficiaries are disabled), and in my study period, Medicare limited telemedicine to rural areas. I look at variation in persistence by age group and county population density to elucidate how important these differences may be.

Low population density was associated with higher persistence—the left panel of figure 5 shows that the lowest quartile of population density has higher persistence and the highest quartile has much lower persistence than then others—this is true for both the full population (represented by circles) and the selected population with active providers (represented by diamonds). Low population density would be expected to make telemedicine more valuable because of fewer nearby providers, so this would be consistent with generally higher telemedicine demand in low density places. It is interesting to note that the pattern of increased persistence when the index providers remain available is present across all three groups, though the impact of population density on telemedicine utilization and persistence is larger than the impact of providers remaining active.

Obviously since this study uses Medicare data the applicability to the commercially insured and other populations is limited because of age differences—it is easy to imagine that younger people could be more tech savvy so that the cost of figuring out how to connect to the remote provider is lower. Medicare does cover non-elderly who are disabled, which provides some evidence about how the young (albeit disabled) use telemedicine. The right panel of figure 4 shows that there is little impact of age, which means that the age difference between Medicare and the rest of the population may not be a particularly large issue.
5.1 How these results relate to the COVID telemedicine expansion

The results in figure 4 show that predominantly elderly and rural population that uses telemedicine in Medicare may be a reasonably representative of the population as a whole. But the regulatory and reimbursement landscape have also changed since my study period, which may impact relevance to the COVID expansion. Notably, in my sample period, the home was not allowed as an originating site for any Medicare telemedicine, but this restriction was removed in March, 2020 allowing unlimited use of the home as an originating site (Centers for Medicare & Medicaid Services, 2020). On the supply side, forty-nine states made some sort of waiver to allow providers licensed in other states to practice in them and the Office for Civil Rights decided to waive penalties for HIPAA violations by providers serving patients in good faith using common communications technologies such as FaceTime (Centers for Medicare & Medicaid Services, 2020; Federation of State Medical Boards, 2020).

And possibly most importantly, telemedicine since COVID is quite different from the telemedicine of four years ago: technology has improved, video conferencing applications are getting faster and better at filtering background noises, and providers are investing in better hardware and applications to improve the patient experience.
5.2 Limitations

A limitation to the interpretation of my results is that I have no exogenous variation in who uses telemedicine, thus my results cannot distinguish selection from treatment. While I have shown that persistence doesn’t vary much with age and population density, the individuals who use telemedicine may be quite different from those who do not to.

The key limitation to internal validity is measurement of telemedicine in Medicare, which tends to be noisy. The home was not allowed as an originating site in 2016, so each visit should have generated both a distant and an originating site claim; however, only 46% of distant claims have a matching originating site claim and 26% of observed originating site claims do not have a matching distant claim. Many studies have used the distant telemedicine claims to understand telemedicine use in Medicare, but the comparison with originating site claims suggests that many distant claims are missing. Similarly, the poor data quality for originating sites could generate selection biases in my results, since the difference between patient and distant provider with active index originating sites could be driven either by differences when originating sites are still available or different types of patient and providers going to originating sites that do and do not submit claims. For example, the patients with matched originating sites likely go to higher volume originating sites that may be higher quality, so that these patients find it worthwhile to return and persist with telemedicine while patients at smaller, less formal originating sites do not.

6 Conclusion

This paper shows that while many Medicare patients and providers from 2006 to 2016 persisted with telemedicine after exposure some did not. It also shows that patient with originating sites and distant providers who continue to submit claims are far more persistent. This suggests that low supply of telemedicine may have played a role in the low telemedicine take-up and persistence and that the fixed costs of entry to telemedicine, though possibly large, were not the only or limiting constraints. It also suggests that the increase in telemedicine during COVID may have a limited role as a catalyst moving us permanently to a high telemedicine equilibrium simply by encouraging patients and providers to learn about the modality. It seems likely that the largest role that COVID may have had in increasing telemedicine long term, may have been its role triggering the switch away from requiring originating sites outside the home and easing other supply side restrictions. The implication is that if policy makers want to keep telemedicine high, they need to extend the coverage expansions and other regulations they changed to facilitate telemedicine. This study leaves open the question of why telemedicine was so low in Medicare through 2016, so more research is necessary to understand what the limiting barriers are and how they are changing with the COVID expansion.

References


A Data Appendix

To estimate the shares and standard errors for different groups, I run:

$$Share_{it} = \sum_{g} \sum_{\tau=0}^{15} \beta_{\tau g} 1_{(QuartersSinceIndex_{it}=\tau)} * 1_{(Group=g)} + \epsilon_{it}$$  (1)
Where \( i \) indexes individuals, \( t \) indexes quarters, \( \text{Share} \) is the share of either total or mental health related visits that are via telemedicine (or for the in-person comparison group with the same provider), and \( \text{QuartersSinceIndex} \) is the number of quarters since a patient’s index visit, and \( \text{Group} \) can be the age group, the population density quartile, the provider specialty, or telemedicine versus comparison. I clustered standard errors at the beneficiary level (for the provider persistence section, \( i \) indexes provides and standard errors are clustered at the provider level).

**B Additional Figures for Beneficiary Persistence**

Figure A.1 is the analog to figure 1 in the paper with all telemedicine recipients includes, not just the 64% with a matched in-person claim in the comparison group.

![Figure A.1: Patient Persistence with Telemedicine](image)

*Note:* This shows that the share of visits via telemedicine falls off after the first quarter; i.e., telemedicine is not persistent. I calculate the shares by regressing telemedicine share on indicators for quarters since a beneficiary’s first telemedicine visit to get standard errors for the estimates (clustered at the beneficiary level). The shares are precisely estimated so the 95% confidence intervals represented as vertical bars are barely visible.

Adding beneficiary fixed effects and other time invariant controls would simply shift the whole persistence curve vertically without changing its shape. Year fixed effects in principle can change the shape since they are not constant within person, but in practice have almost no effect (compare figure A.2 in the appendix to figure 1 in the paper).
Figure A.2: Patient Persistence with telemedicine

Note: This shows that the share of visits via telemedicine falls off after the first quarter showing that telemedicine is not persistent. I calculate the shares by regressing telemedicine share on indicators for quarters since a beneficiary’s first telemedicine visit to get standard errors for the estimates (clustered at the beneficiary level). The 95% confidence intervals are represented as vertical bars.

Figure A.3 is the analog to figure 1 in the paper with different cohorts of beneficiaries split by the year of their index visit so that the panels are balanced. This shows that the result is not driven by changes in aggregate level of telemedicine over time with the earlier people to take up telemedicine using it less.

Figure A.3: Patient Persistence with Telemedicine by year of index visit

Figure A.4 explores the extent to which the type of provider a patient sees for their first telemedicine visits may influence future utilization. In particular it explores whether providers stopping to provide telemedicine may force their patient out of telemedicine. The restricts to beneficiaries whose index provider continues to provide telemedicine claims in Medicare—this means that the provider ceasing telemedicine
Figure A.4: Telemedicine use by provider qualities

(a) Restricting to beneficiaries whose provider continues to provide telemedicine

(b) Separating by provider telemedicine volume

delivery would not cause the patient to stop telemedicine. The right hand panel splits patients by the number of telemedicine visits that their index provider had—the idea is that larger volume providers are more committed to telemedicine and less likely to cause the patient to stop telemedicine by forcing them to find another provider.

Figure A.5 has the analog of Figure 2 in the paper but does not restrict to the matched originating sites continuing to file claims.

Figure A.5: Patient Persistence with Telemedicine for Index Visits with Originating Site Matches

C Additional Figures for Provider Persistence

Figure A.6 has provider persistence analysis analogous to those in figure 3 in the paper, but unweighted. Figure A.7 has provider persistence analysis analogous to those in figure 3 in the paper, but restricts to
Figure A.6: Unweighted Provider Persistence

(a) Share of visits via telemedicine

(b) Share continuing with telemedicine

Figure A.7: Provider Persistence: Originating Site Matches

(a) Share of visits via telemedicine

(b) Share continuing with telemedicine

providers who have a matching originating site for the index visit (but does not restrict to that originating site continuing to file claims).