**Does Telehealth Effect Rural Costs?**

**Abstract**

Telehealth has the potential to increase health care access in rural areas, which could change the way rural individuals receive care. Because telehealth is relatively new, we do not know much about the effects it will have on costs. This paper compares the costs of episodes of care in rural areas between individuals that have a telehealth visit and those that do not. Using the claims for the 5% sample of Medicare beneficiaries, telehealth usage is identified for rural individuals and cost data are collected for the year after the initial telehealth event. Rural individuals with similar services and diagnoses are used as the comparison group with the same episode construction. Initial results using a generalized linear model with a gamma distribution and log link function show an increase in costs for episodes that begin with a telehealth visit, but further adjustment to the model are ongoing. If this result stands after adjustment, this suggests that telehealth might not be a cost effective alternative for rural individuals.

**Significance**

In a recent executive order, President Trump requests that network adequacy of Medicare Advantage (MA) plans should account for, “enhanced access to health outcomes made possible through telehealth services or other innovative technologies” (Trump, 2019). About one-fifth of the population live in a rural area, which amounts to about 65.44 million people in 2018 (Health Policy Institute, nd). Rural residents are more vulnerable because they are usually sicker, with more chronic conditions, less insured than their urban counterparts, and more likely to engage in risky behaviors, such as smoking (Health Policy Institute, nd). They also have to travel farther for healthcare services. In addition, rural residents have less access to medical care: twenty percent of the population resides in rural areas but only eleven percent of physicians practice in rural areas (Health Policy Institute, nd). Therefore, the rural population demand more services while also having less access. This combination of issues makes the rural population more vulnerable. Telehealth is recently starting to get some attention as way to mitigate this problem because it would allow people to receive recurring specialty care at a facility closer to them that may not have access to that physician specialty (Health Policy Institute, nd).

In addition, the specialty care and services that can be provided via telehealth could potentially help manage care for chronic conditions, which are costly over one’s lifetime. For example, using 2007 data, it is estimated that direct costs for diabetes are $11,917 per patient per year (Condliffe, 2013). This is only going to become more of an issue as people live longer and have more time to acquire more chronic conditions over their lifetime. If people are able to manage these long-term conditions betters, they could decrease the chances the problem becomes more complicated and more costly.

It is important to examine the outcomes of using telehealth services, because outcomes could have both positive and negative outcomes. Telehealth is a more convenient, reliable option for beneficiaries than traveling to get services they need. Yet, it could also perturb beneficiaries because it is less personable and potentially less accountable than traditional person-to-person services. There are also potentially two different effects on costs as well. If people are able to use telehealth more because of its convenience, it could increase utilization past where marginal benefits exceed marginal costs. But it could also make individuals healthier overall, because they are keeping some of their chronic conditions, such as diabetes or obesity, in check with regular evaluation and management services. It is unclear whether the utilization effect will outweigh the potential cost effect without statistical analysis. It is even harder to know if increased costs could also translate into better health. This paper is merely examining whether telemedicine raises costs for rural beneficiaries and not making any conclusions on its impact on increased utilization or health outcomes.

**Literature Review**

Using the American Medical Association’s 2016 Physician Practice Benchmark Survey, Kane and Gillis (2018) found that only about 11 percent of physicians worked in practices that used telehealth for direct-to-consumer communication. It seems that there are still some barriers to entry, such as start up costs, in order to use telehealth, which is causing the take-up to be lower than expected. The authors also found that firm size influenced the chances of a physician’s practice using telehealth, which supports this claim. Exploring the quality of care aspect of telemedicine, Shigekawa et al (2018) found that the quality of care for telehealth visits is comparable to in person visits. However, the authors admit that more analysis needs to be done because telehealth has many different applications, which should be evaluated differently.

Wamble et al. (2019) studied the cost effectiveness of investing in care for seven different chronic conditions and found that although there is variability across conditions, “additional spending is both cost-effective and a source of high value creation.” Telehealth is potentially a way to invest in specialty care, such as chronic care management, while also helping those in rural areas.

 Using commercial claims data on over 300,000 patients for 2011 to 2013 and focusing on acute respiratory infections, Ashwood et al. (2017) found that telehealth tapped “into an unmet demand for health care,” causing new utilization which increased overall health care spending by $45 per telehealth user. The authors originally thought that telehealth might decrease costs for this condition (which they found to be the most common condition treated by telemedicine) because it would decrease the need for physician and emergency department visits, but the analysis found the opposite.

**Theoretical Framework**

As mentioned above, telehealth could potentially affect costs in a couple of different ways. Whether it decreases or increases costs could depend on whether the utilization effects outweigh the efficiency effects. On one hand, if telehealth increases utilization for services that an individual was previously not able to have because of access limitations, but are important to his/her health, then it is good for that service to occur. Yet, it is hard to determine whether these new services are necessary or not.

Outside of new utilization that is necessary, there could be increased utilization above the efficient level. If individuals are able to receive care easier, they may overuse the service. This type of utilization effect would increase costs.

There is the potential that the utilization effect could be outweighed by an efficiency effect, where if individuals were better able to manage their care for a chronic condition, they would become less expensive over a certain period of time. For example, if an individual is receiving chronic care management for obesity, and they are able to get it when they need it via telehealth, they could potentially lose weight and spend less on medical expenses in the long run.

Therefore, in the theoretical model there are two potential effects: 1) a utilization effect due to increased access for necessary or unnecessary services 2) an efficiency effect or cost effect associated with increased assistance for the management of certain conditions. If the utilization affects bridges into an increase that is up and beyond what is necessary, it would likely outweigh the potential savings from the increase in managed care. In this case, the marginal increase in health for the additional service no longer makes it worth it. If individuals are only receiving the necessary services that make them healthier, and the marginal increase in health for the additional service has a positive effect on health, then there is the potential to decrease costs.

**Data**

Limited Data Set (LDS) data are maintained by the Centers for Medicare and Medicaid Services (CMS) as a way to study the use and cost patterns of Medicare beneficiaries, without supplying Personally Identifiable Information. It is collected in order to support the agency’s operations. Medicare claims data from 2010 – 2018 will be used for the 5% sample of Medicare beneficiaries. This dataset, known as the LDS holds all claims for 5% of the Medicare population and is chosen from a random sample. The claims are available for each claim type: Inpatient, Outpatient, Skilled Nursing Facility, Home Health Agency, Carrier and Durable Medical Equipment. In addition to the claims data, the LDS has a Medicare Beneficiary Summary File portion that has information on beneficiaries’ demographics characteristics, such as age, dual eligibility, and End-Stage Renal Disease (ESRD) status. Although the beneficiary identity is protected by encryption and suppression or rollup of some characteristics, claims can be linked across services types and over time.

**Descriptive Statistics**

Since the analysis is done using a dataset that is a 5% sample of Medicare beneficiaries, it is important to remember that any counts are based on 5%, but since the sample is random, you can multiply these cells by 20 in order to scale it up to the Medicare population. Therefore, with the tables shown it is more important to focus on the percents and averages, because they represent what would, in theory, be captured in the population of Medicare beneficiaries. The counts reflect the occurrences of the telehealth service as identified using the methodology described above. In Table 1 (Appendix A) most of the columns with statistics on telehealth data also have a breakdown for the whole Medicare population in order to compare the two. The analysis is broken into beneficiary and claim level information. These tables are helpful when determining if telehealth beneficiaries are different from the Medicare population as a whole. These data include both rural and urban telehealth visits.

The most important takeaway is that use of telehealth is increasing year after year as it becomes more and more popular and common, even though the percentage of beneficiaries using telehealth as a whole is quite low. The average age of an individual using telehealth is consistently lower than that of the Medicare population. Telehealth claims have a much higher chance of having dual status and being an ESRD patient. The analysis here is going to focus on FFS beneficiaries because they are the individuals that any Medicare interventions or demonstrations usually focus on. Medicare itself is not financially responsible for people in the MA plans – CMS pays MA plans a flat rate to cover beneficiaries, so the MA plan itself pays for a beneficiaries’ individual services. Also, individuals that have ESRD are usually expensive beneficiaries because they are on dialysis until they have a transplant.

The statistical analysis will be done based on episodes. An episode comprises all care received within a year after a “trigger” event (defined below). As a results, the count of episodes is less than the count of telemedicine claims in Table 1 to the extent that a given beneficiary has more than one claim during the year. In addition, this analysis is going to focus on rural beneficiaries, and will not include episodes for urban beneficiaries, which this tabulation does.

**Methodology**

First, FFS beneficiaries are identified based on their Medicare eligibility for Part A and Part B and will not be enrolled in Part C. Urban and rural distinction is then mapped onto the beneficiaries based on their state and county code combinations. The treatment group in this analysis are episodes, as described below, that are triggered by a telehealth visit and the comparison group is episodes not triggered by a telehealth visit, but are similar to one. Only rural episodes are looked at, since that is where telehealth could be the most beneficial.

For the treatment group, the Outpatient, Inpatient, and Physician claims data are used in order to identify which beneficiaries used a telehealth service, the specifications of which are detailed in Appendix B. For telehealth visits, there should be two claims when a telehealth service is performed. There should be an institutional claim (in outpatient or inpatient files) where an originating telehealth visit occurred. This is where the beneficiary is physically receiving the service via a computer screen. These are identified by a Healthcare Common Procedure Code System (HCPCS) code of ‘Q3014’ which is the “Telehealth originating site facility fee”. The second claim should show up in a non-institutional claim (physician file) for the same beneficiary on the same day at a different provider. This is where the physician who is providing the service is physically located. The HCPCS code here must be one that is on a CMS approved list of HCPCS codes that can be billed with telehealth services. The HCPCS code itself does not identify the claim as a telehealth visit, but the modifier for the HCPCS should be a ‘GT’ or ‘GQ’. This methodology is largely based on an education piece on telehealth provided by the Medicare Learning Network (2019) for CMS.

All claims that are identified with either of the above methodologies (either an originating or distant telehealth claim) will be pulled. The originating and distant claims that can be linked will be counted as one visit. The link will be done based on a match of beneficiary number and date on the claim. In theory, there should be 100% overlap between the originating and distant claims, because each originating claim should also have a distant one. Because of the way billing works at different hospitals, it is not always easy or possible to link these two outcomes; if hospitals do not bill in a timely manner, or forget to use modifiers on the claim, then a distant claim will not come up. Those that cannot be linked will be counted as a visit on their own. Because of the way the episodes are constructed (explained below), this should not affect the results.

The episodes for the comparison group are based on the types of services that can be provided under telehealth. Therefore, the episode triggers must be for a service that could be provided via telehealth, but in this particular case was not, and was in the Outpatient, Inpatient, or Physician files. CMS creates a list of services that can be billed under telehealth by the distant provider, which was used to determine what was eligible (CMS, 2018). The 2019 version was used for this analysis. In addition to having a similar service, the comparison group episodes also had to have a diagnosis code that matched a diagnosis code for a telehealth visit for the rural individuals. There is no overlap between the treatment group and comparison group. If an individual had a telehealth episode, they were left out of the comparison group analysis.

 The Urban or Rural distinction for each of these claims is determined by the beneficiary’s state and county as listed on the denominator file provided with the 5% sample following classification used by the Social Security Administration. The Urban or Rural distinction is made using Core Based Statistical Areas (CBSA) areas that do not map to a CBSA are considered a rural area for this analysis. The CBSA was mapped on using the 2017 list on the National Bureau of Economic Research (NBER) website (NBER, 2019). The CBSA will capture if an individual is close enough to a metropolitan center to benefit from the health care offered there. For this analysis, we do not care if an individual lives directly in the city center, only if they are able to easily access services there; living in a CBSA increases the chances that transportation does not hinder you from getting seen by a health care provider. The group of interest for analysis is the beneficiaries who are determined to not be in a CBSA and have a telehealth usage. The costs for their episodes will be compared to those of individuals who are determined to not reside in a CBSA and did not have a telehealth usage. Therefore, all individuals analyzed are determined to be in a rural area (in this case, outside of a CBSA). We will be comparing the costs of episodes that trigger with a telehealth event and those that do not to see if there are differences between the two types of episodes.

Episodes are created for the beneficiaries based on a yearly length using a telehealth service as a trigger date (beginning date) of the episode. If a beneficiary has more than one telehealth visit with a diagnosis of interest, they may have multiple episodes if they have another visit outside of the year window. If there is another telehealth visit within the year, then it will be included in the analysis of the original episode. Because of this, even if the distant and originating claim are not linked, they will be picked up in the episode costs, because the first telehealth type claim will start the episode. If a beneficiary has a telehealth visit, which in this case is the treatment group, they will not have an episode in the comparison group, even if it matches the qualifications for the comparison group.

After a yearly period is constructed for each beneficiary and episode pair, all of the costs from all of the types of services will be captured for that beneficiary between the episode trigger to the episode end (one year later). Only the costs associated with the same diagnosis category as the initial triggering event are captured. This will create the dependent variable for the regression analysis of yearly costs.

Demographics for the beneficiaries are determined using the denominator file that is provided with the 5% sample. These variables are created based on a 1-year-period, so the demographic information will match what status the beneficiary had for the year in which the trigger date occurred. Indicators for sex and ESRD are gathered. In order to approximate if a beneficiary is a FFS beneficiary (versus a MA beneficiary) that had both A and B coverage, checks are done that the beneficiary had coverage for an equal number of months in A and B and they had no months in MA coverage. We want the beneficiary to have both A and B coverage because we do not want coverage issues to impact costs. We do not want the beneficiary to have any MA coverage because cost and utilization patterns are different for MA beneficiaries; the coverage is different and we do not want it to affect the study outcomes. If a beneficiary dies within an episode, it will be determined using if the beneficiary death date is between the start and end of the episode. The only time an episode will be less than 1 year is when the beneficiary has died within the year. In that case, the episode will end on the date of death.

**Economic Model**

 The purpose of this statistical analysis is to determine if episodes for beneficiaries have different costs based on if the episode began with a telehealth visit or it began with other care. The thought here is that telehealth could potentially decrease costs because individuals are able to get care via telehealth that they would not be able to get otherwise, at a lower cost. It would save them travel to a more expensive facility in urban areas. Using the indicators mentioned above, beneficiaries will only be included in the statistical analysis if they are determined to have FFS coverage in the year that the episode triggered and if that beneficiary lived in a rural area.

As outlined above, the model used will be a normal regression linear model with the following variables:

$$Episode\_{Cost}=B\_{0}+TH\*Sex(B\_{1})+DUAL(B\_{2})+ESRD(B\_{3})+AGE(B\_{4})+Death(B\_{5})+Female(B\_{6})+Diagnosis\\_Cat(B\_{7})+Race(B\_{8})$$

Where:

 **EpisodeCost Per Day:** The dependent variable

$TH\*Female, TH\*Male$: Variables of interest; dummy variable for whether the episode was initiated by a telehealth visit or not and whether the individual was male or not.

$DUAL$: Dummy variable for whether the beneficiary is enrolled in both Medicare and Medicaid (usually those beneficiaries that are dually eligible are associated with higher costs)

$ESRD$: Dummy variable for whether the beneficiary has End Stage Renal Disease or not

$AGE$: age of the beneficiary – it is assumed that as a beneficiary gets older they would cost more

$Death$: whether the beneficiary died within the episode or not – costs at the end of death are much higher than other costs, inflating the cost of the episode if the beneficiary is to die

$Diagnosis\\_Cat$**:** The type of diagnosis category. The categories are: Infectious parasitic, neoplasms, endocrine, blood, mental disorders, nervous system, circulatory, respiratory, digestive, genitourinary, pregnancy, skin, musculoskeletal, congenital, perinatal, symptoms, injury poisoning, V codes, External causes. There were no telehealth visits in rural areas for external causes, so that dummy variable was removed from the model.

$Race$**:** The race of the beneficiary. The race categories are: unknown, White, Black, Other, Asian, Hispanic, and Native American.

The hypothesis test is that TH=0. Per day costs were used for the dependent variable. Data was only available through 2018, so any episodes that ended after 12/31/2018 were dropped. Therefore, the only time an episode does not last the full year is for those who died within the episode, and in that case the episode ends on the date of death, as explained above. In the analysis, average cost per day was used, instead of total cost, so the amount of time does not artificially decrease average cost.

The variable of interest is the independent variable included to flag if the episode was started with a telehealth service or was not started with a telehealth service. Since this is dealing with costs of care for healthcare, a log link and gamma distribution is used because the dependent variable is episode costs per day, which can only be positive. The errors will therefore also be skewed positive, so this link and distribution will help mitigate this issue.

**Results**

The regression output table is in Appendix D below. The variable of interest, whether the episode was initiated by a telehealth visit is highlighted. For the disease categories, the different estimates are in comparison to a Circulatory disease. For the age variables, the estimate is in comparison to the group aged 75 to 79.

All of the variables are statistically significant except for the diagnosis group skin and the 70 to 74 age group at the 95th significance level. Dying during the episode and having ESRD were strongly associated with costs, increasing episodes costs. Both of these make intuitive sense – it is known that costs close to the end of life are higher and ESRD patients are known to be some of the costliest in Medicare. Blood disorders, pregnancy, musculoskeletal, perinatal and injury poisoning disorders were cheaper episodes than episodes triggered by circulatory diseases. The most expensive age group when compared to the 75 to 79 category is people under 65. This is potentially because individuals under 65 that are in Medicare are disabled or have ESRD, which are a costlier group of diseases.

The race categories are compared to white individuals. Episodes for Asian individuals were less expensive than those for White individuals while episodes for Black, Hispanic, and Native American individuals were more expensive.

The variables of interest are the TH variables integrated with sex. The three variables are in comparison to females without a telehealth visit. The TH variables showing whether the episode was triggered by a telehealth visit is positive and significant at the 99th percentile (p=<0.0001). This suggests that the hypothesis that TH(variables)=0 can be rejected, and suggests that episodes triggered with a telehealth visit are more expensive than those that were not for rural beneficiaries.

These coefficients can be interpreted multiplicatively when you take the exponent of them. The exponent of the female\_TH variable is equal to 2.014, suggesting that episodes for females that are initiated with a telehealth visit are twice as expensive as those for females without a telehealth visit. The multiplicative for male\_TH is even higher at 2.1468. It is much lower for men without a telehealth-initiated episode at 1.075 multiplicative.

**Conclusions**

The outcomes of the regression suggest that telehealth episodes are more expensive than those that are not started by telehealth for rural areas. From a theoretical standpoint, this suggests that the quantity change for these individuals could be outweighing the cost change. Yet, this does not suggest anything about the health of these individuals, as the increased costs could be associated with better health outcomes. This is outside the scope of this analysis.

**Limitations**

The biggest limitation of the data is that there are no variables in the regression that account for health previous to the episode, such as risk score. Risk scores are used by Medicare in order to determine how costly an individual is going to be in the upcoming year based on the previous year’s diagnoses. Each diagnosis that is included in the algorithm for a risk score is associated with a certain coefficient that increases or decreases an individual’s costs above or below the average. For example, if the average individual costs $4,000/month, then everyone that is expected to cost that much has a risk score of 1. Anyone with a score of 1.05 is expected to spend 5% more than the average person and anyone with a score of .95 is expected to spend 5% less, based on the previous year’s diagnoses. They are used largely in order to determine the payments that Part C Medicare Advantage plans will receive per beneficiary per month for a given insurance plan, but they are also a good benchmark for potential sickness in the future. Since it is usually the case that sicker people tend to cost more, risk scores can also be a good indicator of previous sickness.

For this analysis, since the population for the treatment group is known to be sicker (as shown above), it is important to be able to control for this in the analysis. The telehealth episodes could be more costly because they are dealing with a potentially sicker population from the start, not because there is an inherent difference between the costs. This analysis would not be capturing that health difference in the current selection of variables used. Yet, because only a rural population is used between the treatment and control group, this could effect both populations equally, but it is hard to tell without including it in the regression.

Appendix A: Table 1





Appendix B: Claims Analysis

* Treatment Group Episodes
	+ Using the Inpatient, Outpatient, and Physician claims
		- The overwhelming bulk of triggers were in the outpatient and physician claims
	+ Triggered in three ways
		- HCPCS code of Q3014
		- Telehealth billable HCPCS code designated by a CMS list with a HCPCS modifier code of ‘GQ’ or ‘GT’
		- Both 🡪 Have a claim for each of these on the same day for the same beneficiary
	+ The location of the beneficiary is determined to be rural (i.e. in this case, not in a CBSA)
* Comparison Group
	+ Using the Inpatient, Outpatient, and Physician claims
	+ Triggered using 3 criteria
		- The location of the beneficiary is determined to be rural (i.e. in this case, not in a CBSA)
		- HCPCS code that is telehealth billable (but not telehealth) designated by a CMS list
		- Has a diagnosis that matches a diagnosis of a Treatment group telehealth episode
			* This is done in order to create episodes that are as similar as possible

Appendix C: Demographic variables

* ESRD\_indicator: Beneficiary has End Stage Renal Disease in the year if variable = ‘Y’
* (Hi\_coverage=SMI\_coverage and HMO\_coverage=0): Beneficiary has A & B coverage and is considered FFS for the year when the amount of A months and B months is equal and they have no HMO months.
* Age
* Sex\_code: 1 for male and 2 for female
* State\_buy\_in\_coverage: Beneficiary is considered a dual beneficiary for the year if they have any months in a state buy in program

Appendix D: Table 3 (Regression Output)



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