Characteristics of Medicare Beneficiaries with Chronic Diseases Utilizing Telemedicine and the Impact on Overall Costs, Outpatient Costs, Inpatient Costs, and Number of Inpatient Admissions

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Characteristics of Medicare Beneficiaries with Chronic Diseases Utilizing Telemedicine and the Impact on Overall Costs, Outpatient Costs, Inpatient Costs, and Number of Inpatient Admissions

BY

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A doctoral project submitted to the faculty of the Medical University of South Carolina in partial fulfillment of the requirements for the degree Doctor of Health Administration in the College of Health Professions

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IMPACT OF TELEMEDICINE ON CHRONIC DISEASE MANAGEMENT IN MEDICARE BENEFICIARIES ON OVERALL COSTS, OUTPATIENT COSTS, INPATIENT COSTS, AND NUMBER OF INPATIENT ADMISSIONS

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Abstract

In the healthcare industry in the United States, utilization of telemedicine to treat chronic and acute care conditions shows promise in increasing access, decreasing costs, and improving patient satisfaction. While telemedicine is not a new idea, only in recent years has there been the culmination of innovation, legislation, and advancement in practice to forge new virtual paths to high-quality treatment of patients through telemedicine utilization. The study design is a retrospective quasi-experimental cohort analysis of secondary patient claims data from 2012 to 2014. Using data from the Medicare Limited Data Set 5% Medicare sample, we compare healthcare costs for two groups of Medicare beneficiaries with chronic disease: those who utilized a telemedicine service and those who had a traditional face-to-face visit. Propensity score (PS) weighting was used to match the groups on age, race, sex, dual eligibility for Medicare and Medicaid. Analysis of the cost outcome utilized a gamma distributed models with log link functions controlling for age, Charlson Score, and Hypertension. When examining a six-month post visit period, results found a cost saving of $1,828 for the Telehealth group compared to the matched group of beneficiaries with an in-person visit. Telehealth is a promising approach to increase access to care and is associated with decreased costs for Medicare beneficiaries with chronic disease.
Background and Need

For many Americans, healthcare costs are a significant barrier to accessing quality healthcare services. In addition, geographic location can create a physical barrier to accessing quality healthcare providers (“Access to Health Services | Healthy People 2020,” n.d.). Since 1910, the medical community has been concerned with the preventable differences across populations in health outcomes and disease prevalence, otherwise known as health disparities. Often these health disparities can be attributed to social, economic, environmental, or geographic factors (CDC, 2015). Disparities in access to healthcare have been an issue in underserved urban and rural areas of the US. Disparities in health are preventable factors impacting equitable opportunities for health driven by socioeconomic differences (Centers for Disease Control and Prevention [CDC], 2015). In 1910, Abraham Flexner published a study of medical education that revolutionized the training of medical students. The Flexner Report initiated the design of a model for medical training in an urban, university-centered setting to allow for more specialized, concentrated education. Unfortunately, this move created a larger gap in access to care for those in rural settings. In 1966, the American Medical Association (AMA) reviewed the impact of the Flexner Report in the Millis Report and found rural areas in the country were experiencing growing physician shortages and worsening quality care delivery. The Millis Report was instrumental in highlighting the need for primary care physicians but failed to identify the need for geographical distribution of these providers in rural areas of the nation. Many physician training models specific to rural, comprehensive care delivery have been created since the Millis Report. Despite these efforts, access to quality medical care is still a daunting issue in underserved urban and rural healthcare areas (Rodgers, Wendling, Saba, Mahoney, & Speights, 2017).

Telehealth has the potential to alleviate the barriers to care caused by the geographic misallocation of qualified healthcare providers. Telehealth services connect patients in rural or remote locations with distant providers via technology. A simple definition of telehealth is the utilization of telecommunications to facilitate health care delivery (Thomas, L & Capistrant, G 2017). In a traditional telehealth interaction, the distant site, also known as a hub, is the location of the physician or other healthcare provider delivering care to a patient by
the utilization of telecommunication technologies. An originating site or spoke is the location of the patient at the time a service is being provided utilizing telecommunication technologies (Medicaid.gov [Medicaid], n.d.). Table 1 identifies a variety of ways telecommunications are used to provide medical services via telehealth.

One example of how telehealth can positively impact healthcare is through the Helmsley Charitable Trust. The Rural Health Program, initiated by the Helmsley Trust, has approved $22 million in funding for telehealth eEmergency Services for 85 counties in the Midwestern U.S. (Stingley & Schultz, 2014). The Helmsley Charitable Trust wanted to focus on providing funding for areas where immediate and sizable healthcare needs were present and where there was an absence of philanthropic funding. The Helmsley Trust focused on connecting rural hospitals in these areas with service/hub hospitals outside of the frontier areas. Services provided through this eEmergency initiative increased access to quality care, with faster transfers to higher level care facilities when needed, while also decreasing the number of unnecessary transfers. Additionally, telemedicine was able to provide trauma care that was absent from these areas without this program (Stingley & Schultz, 2014). In addition to costs and access, multiple articles reviewed reported that telehealth utilization resulted in increased patient engagement, empowerment, and improved mortality (Center of Connected Health Policy, 2014).

Problem Statement

Access to affordable quality medical care is challenged by geography, socioeconomic status, availability of qualified medical practitioners, and other factors. Telemedicine technologies show promise in increasing access to care, improving outcomes, and decreasing costs for chronic disease management, but more evidence is needed. More extensive, large sample research is needed to determine the impact of telehealth as a modality of treatment on costs and outcomes of care.

Research Question and Research Hypotheses

This study will address two primary research questions: 1) What are the demographic characteristics of chronic disease Medicare beneficiaries who utilize telemedicine services? 2) Is there a relationship between the
use of telemedicine services and any of the following healthcare outcomes: healthcare costs, outpatient costs, inpatient costs, or the number of inpatient admissions for Medicare beneficiaries with chronic disease?

- **Hypothesis 1**: Overall healthcare costs will be less for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.
- **Null 1**: There is no difference in overall care costs between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.
- **Hypothesis 2**: Outpatient healthcare costs will be less for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.
- **Null 2**: There is no difference in inpatient care costs between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.
- **Hypothesis 3**: Inpatient healthcare costs will be less for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.
- **Null 3**: There is no difference in inpatient care costs between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.
- **Hypothesis 4**: Inpatient admission rates will be lower for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.
- **Null 4**: There is no difference in the rate of inpatient admissions between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.
Population

The study includes the Limited Data Set of MEDPAR’s 5% sample for Medicare patients who were seen between October 1, 2012 and September 30, 2014. Data were reviewed for beneficiaries with chronic diseases reported on claims data with and without a modifier GT representing the presence or absence of telemedicine.

Assumptions

Assumptions are as follows: Medicare claims data can be effectively matched for beneficiaries for inpatient and outpatient services, the presence of the GT modifier to express the use of telemedicine allowing appropriate grouping of visit types and costs associated with those visit types, and the correct assignment of diagnosis codes for accurate inclusion or exclusion based on the Elixhauser index.

Chapter 2 Literature Review

This literature review examines barriers to accessing quality medical care across the United States, as well as the empirical evidence on the impact of telemedicine on healthcare costs, quality, or access for patients with chronic disease. Search terms used in the review of literature include telemedicine, telehealth, costs, access, quality of care, chronic disease(s), chronic conditions, underserved, and rural health, all written in the English language. Searches were performed in Pubmed, the American Telemedicine Association, South Carolina Telehealth Alliance, Americanhealthrankings.org, and the following government websites: Healthypeople.gov, CDC.gov, Medicaid.gov, and AHRQ.gov.

Barriers to Patient Access to Care

Lack of access to quality healthcare is far reaching and has major implications for chronic disease management. Type 2 Diabetes Mellitus (DM2) is often associated with socioeconomic status and geography. Compared to the national average, the Southern United States has a higher prevalence of DM2. Residing in a rural area and being either white or African-American increased the incidence of DM2. The percentages of patients diagnosed with DM2 in rural areas in the South who had forgone medical care ranged from 13% to 17% between 2011 and 2015 (Towne et al., 2017). Chronic respiratory conditions are another example of chronic disease impacted by access. One study compared access to pulmonologists among urban, urban clusters,
and rural populations using data from 2010 US Census data, the National Provider Identifier Registry, and county-specific data from 2013 based on the Behavioral Risk Factor Surveillance System (BRFSS). Of the 45.6 million rural residents based on 2010 census data, only 10.4% had access to a pulmonologist within 5 miles, 34.5% within 10 miles, and 54.5% within 15 miles. The researchers reported that 95.2% or rural residents had access to a pulmonologist within 50 miles (Croft, Lu, Zhang, & Holt, 2016).

Another example of limited access to care are the Midwestern frontier counties of the United States. A frontier county is defined as a county with fewer than seven residents per square mile. The terrain in these counties are often agricultural and are generally secondary roads that are not well-maintained or highly traveled. Many of these roads are impassable during the winter months and are undergoing construction during the warmer months. Mobile phone service is inconsistent in many of these areas, and the majority of the population are elderly residents. The upper Midwest has the highest population of residents age 85 years and older. This aging population is susceptible to chronic disease and cancer. This population generally has an increased need for many types of healthcare services including elder care. In addition to these factors, there is a shortage of physicians in these counties, especially compared to more urban areas of the country. For example, the upper Midwest state of Wyoming had only 90 primary care providers per 100,000 residents, whereas New England’s Massachusetts had 196 primary care providers for the same number of residents. In 2013, the national average of physicians per 100,000 people was 121. Many rural areas fall well short of that number. For example, in 11 counties covering 23,787 square miles in Montana, over 16,000 residents where there was no primary care provider (Stingley & Schultz, 2014).

Access to Healthcare via Telemedicine

According to the 2015 America’s Health Rankings, Mississippi ranked in the bottom five overall in healthy living and in clinical outcomes in the United States (see Figure 1). Clinical outcomes measured for these statistics included deaths due to cancer, cardiovascular disease, and diabetes, and clinical demographics included measures of health status disparity, infant mortality, premature death, and poor mental and physical health days. Figure 2 displays a comparison of the number of primary care providers per 100,000 people,
ranking Mississippi 49th nationally (Explore Poor Mental Health Days in Mississippi, 2015 Annual Report, n.d.). The social determinants of health within the state, which include where people are born, work, and live, are other contributing factors to the poor health outcomes and lack of access. Mississippi is largely rural, with the lowest physician to patient ratio in the U.S., and a high population of African Americans with more than 1/3 of them living in poverty. Moreover, about 165,000 Mississippi residents are uninsured. Many programs have failed to alleviate the health disparities in the state, including Federally Qualified Health Centers (FQHC) with multiple sites across the state, educational programs, Rural Health Clinics (RHC), and staffing Critical Access Hospitals (CAH) with nurse practitioners. FQHCs, RHCs, and CAHs were created to provide cost-based payments to providers, including hospitals, physicians, physician assistants, and nurse practitioners in rural or underserved areas (Comparison of the Rural Health Clinic and Federally Qualified Health Center Programs, 2006). Developed by Dr. Robert M. Galli, the TelEmergency program in Mississippi that began in 2013 was highly successful at using existing innovation to train clinicians and impact legislation to grow the use of telemedicine and expand services to include more offerings. This pilot program was for a three hospital system leveraging off the shelf, ready to use electronics in intensive specialized training for nurse practitioners. Together, the providers in this system lobbied for needed legislation and created a unique offering of medical services; the first of its kind in the US, it was considered to be highly successful. The telemedicine initiative in Mississippi has grown from being limited to offering emergency and trauma services to a wide range of services including telestroke, intensive care, general hospital medicine, critical care, training and development of clinical staff, cardiology services, and real-time consultations. This initiative has greatly increased access to medical services for identified health disparities in the state. In fact, only 16 of the 82 counties in the state are left without access to telehealth services through this CAH initiative (deShazo & Parker, 2017).

Telemedicine as a modality of treatment shows promise in increasing access to healthcare for patients with chronic disease. A promising exploratory study of patients with heart failure (HF) or chronic lung disease (CLD) was conducted (Martín-Lesende et al., 2017). Patients with at least two admissions for HR or CLD in the prior year were selected for participation. The intent of this exploratory study was to examine the impact of
primary care telemedicine usage for treatment of HF and CLD. Using smart phones and a specified web-based platform, self-reporting of prescribed clinical data was uploaded daily. The primary dependent variable was the number of hospital admissions in the prior year and in the year telemedicine was utilized to manage HF or CLD. Findings were significant for the decrease of hospital admissions for these specific conditions from 1.9 to .06 (p value < 0.001), all-hospital admissions from 2.6 to 1.1 (p value < 0.001), and emergency department visits from 4.2 to 2.11 (p value < 0.001). Other reviewed findings were not significant (Martín-Lesende et al., 2017). One limitation of this study is that no control group was used and therefore it is difficult to determine. While results seem promising, further evidence-based studies of telehealth programs are needed.

Access to care for correctional facility residents can also be improved by the use of telemedicine (Young & Badowski, 2017). Provision of care is expensive and time-consuming for physicians who must travel to correctional facilities. Patients in a correctional setting often have increased wait times to receive health care services. The delay in care can lead to exacerbations of conditions and increase the need for the patient to be taken to a facility for acute or emergency care. Outside of increased medical costs due to the need for emergency services, additional guards and staff must be paid to manage and transport that patient to the emergency facility. Telemedicine has successfully been used in correctional facilities for psychiatric, surgical, emergency, and multi-disciplinary needs. In a study of two adolescent housing facilities, the implementation of telemedicine services led to a 57% decrease in wait time and an increase of 40% in utilization of outpatient visits. In addition, there was a decrease in emergency visits over the course of two years (Young & Badowski, 2017).

**Improvements in Healthcare Outcome via Telemedicine Programs**

The 2015 annual report from the South Carolina Telehealth Alliance gives a detailed look at accessibility of quality care being provided to its patient population via telehealth. Highlighting advances in many areas including, TeleStroke, TelePsych, and other areas of service, this report supports the need for increased access that can be provided by telemedicine. From 2008-2015 a partnership with the Medical University of South Carolina (MUSC), Palmetto Health, and Greenville Health System increased the number of
consultations for TeleStroke from a very small number to about 2500. It is important to note, that after expansion of the Telestroke program, 96% of South Carolina residents are now within one hour of potentially life-saving and cost-saving, quality medical stroke care (“South Carolina Telehealth Alliance: 2015 Annual Report,” n.d.).

Cost Savings via Telemedicine

The University of California Davis Health System (UCDHS) began offering outpatient specialty consultations via telemedicine as early as 1996. The impact of telemedicine consultations on travel and environmental related savings has shown favorable results. The study, which reviewed visits between July, 1996 and December, 2013, compared mileage between the patient’s home, the telemedicine clinic where the patient received care, and the face-to-face clinic at UCDHS. This study reviewed more than 11,000 unique patients and over 19,000 consultations. Results showed more than 5.3 million miles, just under 9 years of travel time, and more than $2.8 million in direct travel costs were saved over this time. The number of consultations in this study excluded the more than 16,000 consultations provided to inmates at correctional facilities (Navjit W. Dullet et al., 2017).

In January, 2015, a study provided by the Telemedicine Services of the Veterans Health Administration completed a retrospective review of a group of veteran patients utilizing care coordination home telemedicine (CCHT) for chronic disease management (CDM) compared to a matched control group (MCG) of similar patients from 2009 to 2012. The outcomes of the study showed decreased costs for patients in the CCHT group. After 12 months of study, CCHT patients had much lower healthcare costs than the MCG matched group. CCHT patients had a slight decrease of 4% in costs while MCG patient costs increased by 48% (p<.001). It was noted pharmacy costs rose for CCHT patients by 22% compared to a smaller rise of 15% for MCG patients. This rise was attributed to the increased compliance with medical treatment. Other significant findings in the study of telemedicine in chronic disease patients included an increase in the mean number of inpatient admissions in MCG patients from .56 to .72 days compared to a decrease in CCHT patients from .76 to .49
days. While emergency visits decreased from .65 to .63 in MCG patients, there was a marked decrease from .84 to .58 in CCHT patients (Darkins, Kendall, Edmonson, Young, & Stressel, 2014).

According to the 2015 SCTA Annual Report, TeleStroke services increased the administration of tissue plasminogen activator (tPA) by 55% from 2014 to 2015 which resulted in a potential cost savings of $642,244. tPA is a blood thinner used in early treatment of strokes and blood clots. In a partnership with Tidelands Health and MUSC in that same time period, the number of TeleStroke consultations grew from less than 25 per year to just under 200 per year for Tidelands Waccamaw and from less than 25 to just under 150 for Tidelands Georgetown. As a result of this partnership, the number of patients transferred from Tidelands Waccamaw to MUSC decreased from 40 at the onset of the program to less than 20 in 2015. The number of transfers peaked in 2009 at around 70 transfers. (“South Carolina Telehealth Alliance: 2015 Annual Report,” n.d.). This partnership was particularly important due to rural setting of each of these Tidelands Health facilities. Rural hospitals rely largely on government payments due to their small size and their low financial reserves and limited assets.

A noteworthy study from the University of Texas Medical Branch (UTMB) touts multiple, observable benefits from their telemedicine services that was partially inspired by a Medicaid mandate to provide quality care for enrolled children (Vo, Brooks, Farr, n.d.). In response to the pediatric psychiatric providers available to this population of patients, UTMB partnered with community entities in 20 clinical sites throughout Texas. Per UTMB, their partners constantly validate the need for these services to continue based on the need for crucial care due to the lack of healthcare providers in those areas. These needs would not be met if the program did not exist. UTMB reports the national average of Medicaid children who do not show up for appointments are as high as 42%. The Texas program has 10% less no-shows than the national average. Additionally, there was more than a 50% reduction in emergency room visits of this population for psychiatric needs. Based on annual data from the year before this program as compared to the same data the year after the program’s implementation, that cost savings ranges from $11,514 to $90,512. That range is based solely on Emergency Room Level I, II, III, IV, or V alone and does not include other services, medications, or supplies provided during those visits. Quality of life improvement and patient/parent satisfaction was also observed by UTMB.
UTMB surveyed 530 parents of this patient population and found that over 88% made access to a specialist easier for their families and over 60% improved overall functioning for their children in terms of psychiatric conditions (Vo, Brooks, Farr, n.d.).

Conclusions

While the use of telemedicine in the United States is on the rise, limited research has been performed to prove that the cost of the programs is worth the value received by the patients, providers, insurers, and health systems. In particular, few national studies have examined telemedicine outcomes with emphasis on chronic disease patients. For these reasons, this study aims to examine the demographic characteristics of current users of telemedicine services who are chronic disease suffers. We will also compare a propensity score weighted group of chronic disease patients who have indication of use of telemedicine services with those that do not, on primary cost and inpatient utilization outcomes.

Chapter 3 Methodology

Research Design

This study design is a retrospective quasi-experimental cohort analysis of a secondary patient claims data from 2012 to 2014.

Research Question and Research Hypotheses

This study will address two primary research questions. 1) What are the demographic characteristics of chronic disease Medicare beneficiaries who utilize telemedicine services? 2) Is there a relationship between the use of telemedicine services and any of the following healthcare outcomes: healthcare costs or the number of inpatient admissions for Medicare beneficiaries with chronic disease?

• Hypothesis 1: Healthcare costs will be less for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.

• Null 1: There is no difference in overall care costs between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.
Hypothesis 2: Outpatient healthcare costs will be less for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.

Null 2: There is no difference in inpatient care costs between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.

Hypothesis 3: Inpatient healthcare costs will be less for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.

Null 3: There is no difference in inpatient care costs between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.

Hypothesis 4: Inpatient admission rates will be lower for chronic disease Medicare beneficiaries who utilize telemedicine services compared with Medicare beneficiaries receiving care in a traditional, face-to-face setting.

Null 4: There is no difference in the rate of inpatient admissions between chronic disease Medicare beneficiaries who use telemedicine and Medicare beneficiaries receiving care in a traditional, face-to-face setting.

**Data Set Description**

Medicare Limited Data Set (LDS) files were the data source obtained for the comparison of the control and study group by reviewing claims information. The LDS file is a sample of claims data containing identifiable health information. The data set does not contain identifiers protected by the Health Insurance Accountability and Portability Act (HIPAA) (Medicare, Baltimore, & Usa, 2018). Researchers can gain access to this from CMS through the executions of a data use agreement. Data for this study were provided by the Medical University of South Carolina (MUSC) and included claims data from the 5% LDS from October 1, 2012 through September 30, 2014.
Data Analysis

We examined the LDS Medicare 5% sample from October 1, 2012 through September 30, 2014 for reporting of chronic disease. Chronic diseases were defined by examining the Elixhauser Comorbidity Index (ECI) for the most prevalent chronic diseases in adults. A list of diagnoses included in the ECI can be found in Table 2. The ECI is a medically accepted list of comorbidities that can predict an increase in the utilization of healthcare resources of hospital inpatient services.

We defined utilization of a telemedicine visit as claims reported with the GT modifier on a procedure. The index date for the study group was defined as the first appearance of modifier GT in claims data. For the control group, a similar diagnostic event was selected. Propensity score (PS) weighting was used to match the groups on age, race, sex, dual eligibility for Medicare and Medicaid. In addition, the presence of depression, DM, and/or opioid use disorder was used as additional variables. The use of propensity score weighting allows weights to be applied to balance baseline characteristics of the comparison groups to control for selection bias. Both the study and control group were followed for 6 months.

After codifying the diseases listed on the ECI, the Medicare 5% LDS was queried and yielded four prevalent categories of chronic disease for inclusion on the study group: CHF, COPD, HTN, and PVD. More than 2,000 individuals were identified, and they could be followed with at least one of the defined chronic diseases and at least one modifier code GT for the same time period. Standardized differences in means and proportions was used to examine the quality of the propensity score model. Covariates in the PS model that have a less than 0.20 standardized difference were considered well-matched. The PS were computed using a multiple logistic regression with comparison group (Telemedicine vs. No Telemedicine) as the dependent variable. PS and outcome models were utilized to account for demographics and clinical characteristics that may have influenced comparison group selection or may have been related to outcome risk. All these designated covariates were included in the PS model and were tested for inclusion in the outcome analyses models to account for a doubly robust analysis methodology for quasi-experimental studies (Harder, Stuart, & Anthony, 2010; Little & Rubin, 2000; Paul R Rosenbaum & Donald B Rubin, 1983). All final analyses were
weighted by using inverse probability of the treatment weighting (IPTW) approaches to create stabilized weights (Cole & Hernán, 2008; Curtis, Hammill, Eisenstein, Kramer, & Anstrom, 2007; Harder et al., 2010; Robins, Hernán, & Brumback, n.d.; Xu et al., 2010). The stabilized weight was the marginal probability of being in the tele-medicine group given no covariates, divided by the propensity score (the probability of being in the tele-medicine group given all covariates). To assess Aim 1, describing the population of telemedicine users, chi-square (for categorical variables) and t-tests (for normally-distributed continuous variables) were used to describe the differences in demographic characteristics across the patient groups who utilized telemedicine services versus those who did not.

After the propensity score weights were developed, a series of multivariable models were constructed to make formal statistical comparisons testing the hypothesized differences between the telemedicine and no telemedicine groups. Generalized linear regression models were used to make these comparisons. Cost outcomes utilized Gamma distributed models with log link functions due to the skewed nature of costs. Due to the count nature of the number of inpatient visits, a Negative Binomial distributed model with a log link function was used to test differences in this outcome. The same covariates used in the PS model were tested for inclusion in each outcomes analysis. In this case, classical model fitting was performed where all covariates were included in the full model and were removed one at a time, and the model refit if covariates were not significant and did not improve model fit, until the most parsimonious statistically significant model was found. Statistical significance was set at $\alpha<0.05$ level of acceptable Type I error.

Analysis was completed in SPSS and SAS.

**Assumptions**

Assumptions were as follows: Medicare claims data can be effectively matched for beneficiaries for inpatient and outpatient services, the presence of the GT modifier to express the use of telemedicine allows appropriate grouping of visit types and costs associated with those visit types, and the correct assignment of diagnosis codes for accurate inclusion or exclusion is based on the Elixhauser index.
Limitations

The study was limited by the potential impact on data validity with inaccurate reporting of modifier GT or diagnosis code on claims. This study focused on the chronic disease categories with the highest frequency of telemedicine visits in the sample data. More evidence-based research on this and other chronic disease management is needed in the Medicare population to further identify increased access, improved outcomes, and any cost savings by utilizing telemedicine as a modality of treatment. Pharmacy costs were not reviewed in this study due to the skewness of data by the associated high costs.

Protection of Human Subjects

Studies using these data have been labelled as non-human research by the MUSC Institutional Review Board (IRB), and thus no review and approval were needed.

Journal Article

Abstract

Utilization of telemedicine as a modality of treatment for chronic and acute care conditions shows promise in increasing access, decreasing costs, and improving patient satisfaction in the American healthcare industry. While telemedicine is not a new idea, only in recent years has there been the culmination of innovation, legislation, and advancement in practice to forge new virtual paths to high-quality treatment of patients through telemedicine utilization. The study design is a retrospective quasi-experimental cohort analysis of a secondary patient claims data from 2012 to 2014. Using data from the Medicare Limited Data Set 5% Medicare sample, we compare healthcare costs for two groups of Medicare beneficiaries with chronic disease, those who utilized a telemedicine service and those with a traditional face-to-face visit. Propensity score (PS) matching was used to balance the groups on baseline age, race, sex, dual eligibility for Medicare and Medicaid, and comorbid disease. Analysis of the cost outcome utilized a gamma distributed models with log link functions controlling for age, Charlson Score, and Hypertension. After examining a six-month post visit period, our results indicated a cost saving of $1,828 for the Telehealth group compared to the matched group of beneficiaries with an in-
person visit. Telehealth is a promising approach to increase access to care and is associated with decreased costs for Medicare beneficiaries with chronic disease.

**Background and Need**

Healthcare costs in the United States are significantly higher than costs in other developed countries, yet the US struggles to improve outcomes and access for patients with chronic disease which have direct impact on costs (Access to Health Services; Healthy People 2020, n.d.). Lack of access to quality healthcare is far reaching and has major implications for chronic disease management. For example, compared to the national average, the Southern United States has a higher prevalence of Type 2 Diabetes Mellitus (DM2). Rural area designation increased the incidence of DM2. Percentages of patients diagnosed with DM2 in rural areas in the South who had forgone medical care decreased from 13% to 17% between 2011 and 2015 (Towne, Bolin, Ferdina, Nicklett, Smith, & Ory, year). Rural patients not only may have a higher disease burden, but also experience inequities in the supply of specialty providers. For example, of the 45.6 million rural residents, 10.4% had access to a pulmonologist within 5 miles, 34.5% within 10 miles, 54.5% within 15 miles, and 95.2% within 50 miles (Croft et al., 2016). There is also a shortage of primary care physicians (PCP) in many rural counties especially compared to more urban areas of the country. For example, Wyoming had 90 PCP per 100,000 residents compared to the 2013 national average of 121 physicians per 100,000 (Stingley & Schultz, 2014).

Telemedicine technologies show promise in increasing access to care, improving outcomes, and decreasing costs for chronic disease management but more evidence is needed. More extensive, large sample research is needed to determine the impact of telehealth as a modality of treatment on costs and outcomes of care. Telehealth has the potential to alleviate the barriers to care caused by the geographic misallocation of qualified healthcare providers. Telehealth services connect patients in rural or remote locations with distant providers via technology. A simple definition of telehealth is the utilization of telecommunications to facilitate health care delivery (Latoya Thomas & Gary Capistrant, 2017). In a traditional telehealth interaction, the distant site, also known as a hub, is the location of the physician or other healthcare provider delivering care to a
patient by the utilization of telecommunication technologies. An originating site or spoke is the location of the patient at the time a service is being provided (Medicaid.gov n.d.). Table 4 identifies a variety of ways telecommunications are used to provide medical services via telehealth.

One example of the positive impact of telemedicine is through the Helmsley Charitable Trust (HCT). The Rural Health Program, initiated by the HCT, has approved $22 million in funding for telehealth eEmergency Services for 85 counties in the Midwestern U.S. The HCT wanted to focus on providing funding for areas where immediate and sizable healthcare needs were present and where there was an absence of philanthropic funding. The HCT focused on connecting rural hospitals in these areas with service/hub hospitals outside of the frontier areas. Services provided through this eEmergency initiative increased access to quality care, faster transfers to higher level care facilities when needed, and decreased the number of unnecessary transfers (Stingley & Schultz, 2014).

However, more research is needed to understand the costs of telemedicine for patients with chronic disease. A few studies that have examined costs show promising cost savings through miles saved, reduced patient transfers, and fewer emergency room visits (citations). In January, 2015, a study by the Telemedicine Services of the Veterans Health Administration completed a retrospective review of a group of veteran patients utilizing care coordination home telemedicine (CCHT) for chronic disease management (CDM) compared to a matched control group (MCG) of similar patients from 2009 to 2012. After 12 months of study, CCHT patients had lower healthcare costs than the MCG matched group. CCHT patients had a slight decrease of 4% in costs while MCG patient costs increased by 48% (p<.001). It was noted pharmacy costs rose for CCHT patients by 22% compared to a smaller rise of 15% for MCG patients. This rise was attributed to the increased compliance with medical treatment. Other significant findings included an increase in the mean number of inpatient admissions in MCG patients from .56 to .72 days compared to a decrease in CCHT patients from .76 to .49 days. Emergency visits decreased from .65 to .63 in MCG patients, there was a marked decrease from .84 to .58 in CCHT patients (Darkins et al., 2014).
According to the 2015 SCTA Annual Report, Tele Stroke services increased the administration of tissue plasminogen activator (tPA) by 55% from 2013 to 2014 which resulted in a potential cost savings of $642,244.00. tPA is a blood thinner used in early treatment of strokes and blood clots (South Carolina Telehealth Alliance, n.d.).

Research Questions

This study will address two primary research questions. 1) What are the demographic characteristics of chronic disease Medicare beneficiaries who utilize telemedicine services? 2) Is there a relationship between the use of telemedicine services and any of the following healthcare outcomes: healthcare costs, outpatient costs, inpatient costs, or the number of inpatient admissions for Medicare beneficiaries with chronic disease?

Research Design

This study design is a retrospective quasi-experimental cohort analysis of a secondary patient claims data from 2012 to 2014. While the use of telemedicine in the United States is on the rise, limited research has been performed to prove that the cost of the programs is worth the value received by patients, providers, insurers, and the overall healthcare system. In particular, few national studies have examined telemedicine outcomes with emphasis on chronic disease patients. For these reasons, this study aims to examine the demographic characteristics of current users of telemedicine services who are chronic disease sufferers. We will also compare primary cost and inpatient utilization outcomes between a propensity score weighted group of chronic disease patients who have indication of use of telemedicine services with those that do not.

Data Set Description

Medicare Limited Data Set (LDS) files were the data source for the control and study group claims information. The LDS file is a sample of claims data containing identifiable health information. The data set does not contain identifiers protected by the Health Insurance Accountability and Portability Act (HIPAA) (Medicare et al., 2018). Data for this study was provided by the Medical University of South Carolina (MUSC) and included claims data from a 5% Sample of the Limited Data Set (LDS) from October 1, 2012 through September 30, 2014.
Population

The study includes the Limited Data Set of MEDPAR’s 5% sample for Medicare patients who were seen between October 1, 2012 and September 30, 2014. Data was reviewed for beneficiaries with chronic diseases, as defined by the Elixhauser Comorbidity Index (ECI) and Charlson Comorbidity Index (CCI) reported on claims data with and without modifier GT signifying the presence or absence of telemedicine.

Data Analysis

We examined the LDS Medicare 5% sample from October 1, 2012 through September 30, 2014 for reporting of chronic disease. Chronic diseases were defined by examining the ECI for the most prevalent chronic diseases in adults. A list of diagnoses included in the ECI can be found in Table 5. The ECI is a medically accepted list of comorbidities that can predict an increase in the utilization of healthcare resources of hospital inpatient services.

We define utilization of a telemedicine visit as a report of the GT modifier on claims data. The index date for the study group was defined as the first appearance of modifier GT in claims data. For the control group, a similar diagnostic event was selected. Propensity score (PS) weighting was used to match the groups on baseline hospital admission, Charlson Score, age, race, sex, dual eligibility for Medicare and Medicaid, the presence of depression, DM, and/or Opioid use disorder, CCI and state of coverage. The use of propensity score weighting allows weights to be applied to balance baseline characteristics of the comparison groups to control for selection bias. Both the study and control group were followed for 6 months from their index date.

After codifying the diseases listed on the ECI, Medicare 5% LDS was queried and yielded four prevalent categories of chronic disease for inclusion on the study group; CHF, COPD, HTN, and PVD (Table 6). The final sample included more than 2,000 individuals that could be followed with at least one of the identified chronic diseases and at least one modifier code GT within the same time period. In addition, we identified subgroups of comorbid patients who also have depression, DM, and/or Opioid use disorder.

Propensity Score matching was performed using a greedy-matching algorithm and was matched in a 1 case to 1 control fashion. Standardized differences in means and proportions were used to examine the quality
of the propensity score model. Covariates in the PS model that have a less than 0.25 standardized difference are considered well-matched. The PSs were computed using a multiple logistic regression with comparison group (Telemedicine vs. No Telemedicine) as the dependent variable. PS and outcome models account for demographics and clinical characteristics that may influence comparison group selection or may be related to outcome risk. All of these designated covariates were included in the PS model and tested for inclusion in the outcome analyses models to account for a doubly robust analysis methodology for quasi-experimental studies (Harder et al., 2010; Little & Rubin, 2000; Paul R Rosenbaum & Donald B Rubin, 1983). To assess Aim 1, describing the population of telemedicine users, chi-square (for categorical variables) and t-tests (for normally-distributed continuous variables) was used to describe the differences in demographic characteristics across those patient groups who utilized telemedicine services and those who did not.

After the propensity score matching, a series of multivariable models were constructed to make formal statistical comparisons testing the hypothesized differences between the telemedicine and no telemedicine groups. Generalized linear regression models were used to make these comparisons. Cost outcomes utilized Gamma distributed models with log link functions due to the skewed nature of costs. Due to the count nature of the number of inpatient visits, a Negative Binomial distributed model with a log link function will be used to test differences in this outcome. The same covariates used in the PS model will be tested for inclusion in each outcomes analysis. In this case classical model fitting will be performed where all covariates are included in the full model and will be removed one at a time and the model refit if they are not significant and do not improve model fit until the most parsimonious statistically significant model is found. Statistical significance will be set at the<0.05 level of acceptable Type I error. Analysis was completed in SPSS and SAS. The study was determined non-human research by the MUSC Institutional Review Board (IRB).

**Results**

The total number of observations in this study was 4798, including 2399 patient encounters in the control (face-to-face) group and the telemedicine group. Table 1 shows the weighted demographic characteristics of the telemedicine and control groups. There were statistically significant differences in the
patient race across the two groups ($p<0.0001$). In addition, the telemedicine group had a higher percentage of
dual eligible patients ($p<0.0001$). In the control group, 35% of the beneficiaries were Dual Eligible (DE) for
Medicare and Medicaid, while 65% of the telemedicine group were DE. The control group had a higher
percentage of patients with hypertension ($p<0.0001$), diabetes ($p<0.0001$) and opioid abuse ($p=0.0184$). The
mean age in the control group was 60.37 years compared to the mean in the telemedicine group at 58.26
($p<0.0001$).

When examining the unadjusted outcomes, we found the telehealth group had a significantly higher use
of inpatient hospital days compared to the control group, 4.7 vs 3.85 days respectively ($p=0.0082$). The
unadjusted total costs were $1503 lower in the telemedicine group ($11,818 vs $13,321). However, this
difference was not statistically significant ($p=0.4127$). Unadjusted outpatient costs were found to have a
significant mean difference of $259.50 ($p=0.0118$) with higher costs in the control group. Inpatient unadjusted
costs were found to have a significant mean difference of $1,181.50 ($p=0.0202$) with lower costs in the study
group.

Before implementing the PS matching (Figure 1), hypertension, age, Charleson Score, and baseline
hospitalization were out of balance between the two groups. Results of the PS matching show no differences
between treatment and control groups for all variables, except for hypertension. The mean difference for
hypertension remains at -0.38. Therefore, we will additionally control for hypertension in the final model.
We compared the total 6-month post index visit cost for the propensity-score matched telehealth group to the control population using a multivariable regression analysis with a gamma-distributed log link model to account for the skewness of cost data. We controlled for HTN in this model, because this variable was not completely accounted for in our matching process. We also controlled for age and Charlson Score to ensure that any small imbalance in these variables that are closely associated with cost did not bias our estimate. The adjusted mean total cost was $10,639 (CI 10,040-11,274) for the Telehealth group, and $12,467 (CI 11,765-13,211) for the comparison group (p=.0002). Thus, we observed a cost saving of $1,828 for the Telehealth group.

Discussion

Our study found a significant 6 months savings of $1828 associated with the chronic disease beneficiaries utilizing a telemedicine visit. To our knowledge, this is the first study to compare Medicare beneficiaries’ healthcare costs when using telemedicine. Telehealth utilization remains a small portion of healthcare delivery. If the savings could be extrapolated across a wider population of chronic disease patients, there is a potential for additional improvements to the costs of healthcare. More research is needed to understand the mechanism for the savings.
We also observed that the Medicare beneficiaries who utilized telemedicine were younger and more likely to be Dual Eligible. This indicates that the young disabled Medicare Beneficiaries are more frequently trying telehealth services. This finding is similar to telehealth studies which indicate that younger patients are more likely to adopt technology (EHRIntelligence, 2014). Therefore, telemedicine may be a promising approach to managing chronic diseases in young or disabled patients.

This study has several limitations. First, there is a potential impact on data validity with inaccurate reporting of modifier GT or diagnosis code(s) on claims. Next, this study focused on the chronic disease categories with the highest frequency of telemedicine visits in the sample data but did not include remote patient monitoring, which is a common telehealth service for chronic disease management. Finally, due to limitations in the dataset, we were unable to assess if the telehealth visit was related to chronic disease management or other healthcare purposes. This study did not consider beneficiaries’ home zip code or treatment zip code. More research is needed to determine locations where telemedicine is used and to compare costs and utilization for locations where telemedicine is not being used. More research is needed to explore the costs associated with utilizing telehealth for chronic disease management.

Conclusion

Telehealth is a promising approach to increasing access to care and is associated with decreased costs for Medicare beneficiaries with chronic disease. All actors in the medical community including clinicians, legislators, payers, businesses, and patients, should continue expanding telemedicine utilization, offerings, capabilities, and reimbursement structures to normalize telemedicine as a modality of treatment.
## Outcomes Tables

### Characteristics of Matched Face-to-Face and Telemedicine Visits for Study Population

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total (n=4798)</th>
<th>Control Group (n=2399)</th>
<th>Telemedicine Group (n=2399)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age mean (std)</td>
<td>59.32(15.39)</td>
<td>60.37(14.55)</td>
<td>58.26(16.12)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Gender, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.5413</td>
</tr>
<tr>
<td>Female</td>
<td>2689(56.04)</td>
<td>1355 (56.48)</td>
<td>1334 (55.61)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2109(43.96)</td>
<td>1044 (43.52)</td>
<td>1065 (44.39)</td>
<td></td>
</tr>
<tr>
<td>Race, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Unknown</td>
<td>26(.54)</td>
<td>9 (0.03)</td>
<td>17(0.7)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>3864(80.53)</td>
<td>1939(80.83)</td>
<td>1925(80.24)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>633(13.19)</td>
<td>325(13.54)</td>
<td>308(12.84)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>29(.60)</td>
<td>15(0.63)</td>
<td>14(0.58)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>43(.90)</td>
<td>33(1.38)</td>
<td>10(0.42)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>130(2.71)</td>
<td>57(2.38)</td>
<td>73(3.04)</td>
<td></td>
</tr>
<tr>
<td>North American</td>
<td>73(1.52)</td>
<td>21(0.88)</td>
<td>52(2.17)</td>
<td></td>
</tr>
<tr>
<td>Native</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual Eligible, No. (%)</td>
<td>4798</td>
<td>1622(67.61)</td>
<td>1479(61.65)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Chronic Disease, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>726(15.13)</td>
<td>374(15.59)</td>
<td>352(14.67)</td>
<td>0.3755</td>
</tr>
<tr>
<td>CHF</td>
<td>319(6.65)</td>
<td>144(6.0)</td>
<td>175(7.29)</td>
<td>0.0724</td>
</tr>
<tr>
<td>HTN</td>
<td>3189(66.47)</td>
<td>1785(74.41)</td>
<td>1404(58.52)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>PVD</td>
<td>312(6.50)</td>
<td>166(6.92)</td>
<td>146(6.09)</td>
<td>0.2415</td>
</tr>
<tr>
<td>Comorbid Conditions No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>1407(29.32)</td>
<td>794(33.1)</td>
<td>613(25.55)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Depression</td>
<td>1003(20.90)</td>
<td>519(21.63)</td>
<td>484(20.18)</td>
<td>0.2140</td>
</tr>
<tr>
<td>Opioid abuse</td>
<td>772(16.09)</td>
<td>416(17.34)</td>
<td>356(14.84)</td>
<td>0.0184</td>
</tr>
<tr>
<td>Charlson Comorbid Score mean(std)</td>
<td>0.57 (1.33)</td>
<td>.56 (1.38)</td>
<td>0.59 (1.27)</td>
<td>0.4089</td>
</tr>
</tbody>
</table>
### Table 2: Unadjusted Non-Cost Outcomes

<table>
<thead>
<tr>
<th>Difference of Means</th>
<th>Control Mean (SD)</th>
<th>Telemedicine Mean (SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissions</td>
<td>0.58 (1.21)</td>
<td>0.59 (1.14)</td>
<td>0.6119</td>
</tr>
<tr>
<td>Days</td>
<td>3.85 (10.78)</td>
<td>4.7 (11.40)</td>
<td>0.0082</td>
</tr>
</tbody>
</table>

### Table 3: Unadjusted Cost Outcomes

<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Control Mean (SD)</th>
<th>Study Mean (SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Costs mean (std)</td>
<td>$13,321 (27,501)</td>
<td>$11,818 (1,791)</td>
<td>0.0298</td>
</tr>
<tr>
<td>Outpatient Costs mean (std)</td>
<td>$2,467 (3,835)</td>
<td>$2,207 (3,282)</td>
<td>0.0118</td>
</tr>
<tr>
<td>Inpatient Costs mean (std)</td>
<td>$6,741 (21,107)</td>
<td>$5,559 (13,213)</td>
<td>0.0202</td>
</tr>
</tbody>
</table>

### Reference Tables

**TABLE 4 Center for Connected Health Policy (CCHP) Definitions**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Live Video (real-time)</strong></td>
<td>Live, two-way interaction between a patient or representative (patient, caregiver, or provider) and a healthcare provider using audiovisual telecommunications technology. This modality may serve as a substitute for an in-person encounter.</td>
</tr>
<tr>
<td><strong>Store-and-forward (asynchronous)</strong></td>
<td>Transmission of recorded health history for example, records, reports and images, through secure electronic exchange via communications system to a practitioner who uses the information to make medical decisions outside of a real-time interaction.</td>
</tr>
<tr>
<td><strong>Remote patient monitoring</strong></td>
<td>Personal health and medical information collection via electronic communication technologies that is transmitted to a provider in a different location used for medical decision making. This type of service allows a provider to continue to track healthcare data for a patient via telecommunication technologies.</td>
</tr>
<tr>
<td><strong>Mobile health (mHealth)</strong></td>
<td>Private and public healthcare practice and knowledge used to support better self-management of care. These telecommunication technologies are supported by mobile devices such as cell phones and tablets.</td>
</tr>
</tbody>
</table>

[http://www.cchpca.org/what-is-telehealth](http://www.cchpca.org/what-is-telehealth)
Table 5: Comorbidity Indices

<table>
<thead>
<tr>
<th>ELIXHAUSER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive Heart Failure</td>
</tr>
<tr>
<td>Cardia Arrhythmia</td>
</tr>
<tr>
<td>Valvular Disease</td>
</tr>
<tr>
<td>Pulmonary Circulation Disorders</td>
</tr>
<tr>
<td>Peripheral Vascular Disorders</td>
</tr>
<tr>
<td>Hypertension</td>
</tr>
<tr>
<td>Hypertension, Uncomplicated</td>
</tr>
<tr>
<td>Hypertension, Complicated</td>
</tr>
<tr>
<td>Paralysis</td>
</tr>
<tr>
<td>Other Neurological Disorders</td>
</tr>
<tr>
<td>Chronic Pulmonary Disease</td>
</tr>
<tr>
<td>Diabetes, Uncomplicated</td>
</tr>
<tr>
<td>Diabetes, Complicated</td>
</tr>
<tr>
<td>Hypothyroidism</td>
</tr>
<tr>
<td>Renal Failure</td>
</tr>
<tr>
<td>Liver Disease</td>
</tr>
<tr>
<td>Peptic Ulcer Disease Excluding Bleeding</td>
</tr>
<tr>
<td>AIDS/HIV</td>
</tr>
<tr>
<td>Lymphoma</td>
</tr>
<tr>
<td>Metastatic Cancer</td>
</tr>
<tr>
<td>Solid Tumors without Metastasis</td>
</tr>
<tr>
<td>Rheumatoid Arthritis/Collagen Vascular Diseases</td>
</tr>
<tr>
<td>Coagulopathy</td>
</tr>
<tr>
<td>Obesity</td>
</tr>
<tr>
<td>Weight Loss</td>
</tr>
<tr>
<td>Fluid and Electrolyte Disorders</td>
</tr>
<tr>
<td>Blood Loss Anemia</td>
</tr>
<tr>
<td>Deficiency Anemia</td>
</tr>
<tr>
<td>Alcohol Abuse</td>
</tr>
<tr>
<td>Drug Abuse</td>
</tr>
<tr>
<td>Psychoses</td>
</tr>
<tr>
<td>Depression</td>
</tr>
</tbody>
</table>

https://bmchealthservres.biomedcentral.com/articles/10.1186/1472-6963-8-12
Table 6: PS Table Condition Variables

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Condition</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>Congestive heart failure</td>
<td>391.80,392.0,398.91,402.01,402.11,402.91,404.91,404.93,428.0</td>
</tr>
<tr>
<td>V2</td>
<td>Peripheral vascular disease</td>
<td>443.22,443.81,443.9,440.2,440.20,440.21,440.22,440.23,440.24,440.29,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>440.30,440.31,440.32,440.32,440.8,440.9</td>
</tr>
<tr>
<td>V3</td>
<td>Chronic (OBSTRUCTIVE) pulmonary disease</td>
<td>491.20,491.21,491.22,493.20,493.21,493.22,496</td>
</tr>
<tr>
<td>V4</td>
<td>Diabetes</td>
<td>250.00,250.01,250.02,250.03</td>
</tr>
<tr>
<td>V5</td>
<td>Diabetes with chronic complications</td>
<td>250.10,250.11,250.12,250.13,250.20,250.21,250.22,250.23,250.30,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250.31,250.32,250.33,250.40,250.41,250.42,250.43,250.50,250.51,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250.52,250.53,250.60,250.61,250.62,250.63,250.70,250.71,250.72,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250.73,250.80,250.81,250.82,250.83,250.90,250.91,250.92,250.93</td>
</tr>
<tr>
<td>V6</td>
<td>Hypertension</td>
<td>401.0,401.1,401.9,402.00,402.10,402.11,402.90,402.91,403.0,403.1,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>403.9,404.0,404.1,404.9</td>
</tr>
<tr>
<td>C1</td>
<td>Opioid Abuse (unspecified, continuous, episodic,</td>
<td>305.50,305.51,305.52,350.53</td>
</tr>
<tr>
<td></td>
<td>in remission)</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Depression (depressive disorder NOS, depressive</td>
<td>311</td>
</tr>
<tr>
<td></td>
<td>state NOS, depression NOS)</td>
<td></td>
</tr>
</tbody>
</table>

*New indicator variables will be developed based on any of the ICD-9 codes listed in any of the Primary (DX1) or Secondary (DX2-DX15) code positions.
Figures

Figure 1: Standardized Variable Differences
Figure 2: Mississippi’s Overall Clinical Outcomes Ranking

Trend: All Outcomes, Mississippi, United States, 2019 Annual Report

Source:
- America's Health Rankings Composite Measure
Figure 3: Mississippi’s Primary Care Providers per 100,000 People

Trend: Primary Care Physicians, Mississippi, United States, 2019 Annual Report

Number per 100,000 population

Edition Year

Number of active primary care physicians (including general practice, family practice, obstetrics and gynecology, pediatrics, geriatrics, and internal medicine) per 100,000 population

Mississippi

United States

SOURCE:
- American Medical Association
- American Medical Association, Special data request for information on active state licensed physicians provided by Redi-Data, Inc. Information on active state licensed physicians provided by Redi-Data, Inc.
References


