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Effects of Medicaid Expansion on Diabetes Related Hospital Utilization in Appalachia

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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
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Member, Project Committee	Kit N. Simpson, DrPH	Date
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Abstract of Doctoral Project Presented to the
Medical University of South Carolina
In Partial Fulfillment of the Requirements for the
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Objective: To estimate the effect of Medicaid expansion subsequent to the Affordable Care Act on changes in diabetes related avoidable hospital utilization by payer and geographic residence.

Study Design: Retrospective, longitudinal analysis to compare demographic characteristics and to present linear regression models reflecting change over time of inpatient and emergency department discharges by payer source and by geographic residence within or out of Appalachia.

Data Sources: Discharges from 2013-2017 State Inpatient Database (SID) and State Emergency Department Database (SEDD) for Kentucky adult residents with a primary diagnosis of diabetes.

Key Results: Medicaid expansion was associated with a decline in the overall use rate of diabetes related hospital encounters for Medicaid beneficiaries, with significantly greater reduction for Appalachians. Patients with other insurance, however, had significant increases in hospital use post-expansion, more significantly in Appalachia. All payers and geographies had significantly greater Ambulatory Care Sensitive Conditions (ACSC). Younger patients with less co-morbidity, African-Americans, and men benefited from gaining Medicaid coverage and utilized hospital services for ACSCs.

Key Words: Medicaid Expansion, Ambulatory Care Sensitive Conditions, Kentucky, Appalachia

Table of Contents

List of Tables

List of Figures

CHAPTER 1 INTRODUCTION

Since the Affordable Care Act (ACA) became law in 2010, 35 states have expanded access to Medicaid to low-income adults, now enrolling 64.1 million as of March 2020 (CMS). Medicaid is the largest health insurance product in the U.S. as measured by covered lives, and total healthcare expenditures for Medicaid enrollees rose 3.0 percent in 2018 to $597.4 billion or 16 percent of health expenditures, roughly 2.8 percent of the nation's gross domestic product.

Approximately 14 percent of non-elderly Medicaid enrollees had diabetes in 2012 (Ng et al., 2018). The economic burden of serving the healthcare needs of diabetics is tremendous upon Medicaid programs, tallying nearly $26 billion in 2013. A 2012 study (Garfield and Damico) found Medicaid expenditures for enrollees with diabetes was roughly three times greater than their non-diabetic counterparts. The CDC (2020) estimates 75,486 Americans over age fifteen died with diabetes in 2013 as the underlying cause of death, and the average quality adjusted life years lost due to diabetes is 11.1 for those 18-44 and 6.5 for persons 45-64 years old. The burden of living with diabetes is substantial in its own right, but the weight of dealing with obstacles of cost and access to appropriate routine chronic care management and preventing avoidable complications adds insult to injury. Such is the disproportionate experience of Appalachian and rural residents who struggle with diabetes.

Ensuring optimal access to healthcare begins with overcoming barriers related to financial resources or insurance coverage. This is the heart of the ACA Medicaid expansion policy. But, that is just the beginning as access further entails a supply of quality providers in a geographically convenient location willing and able to provide the scope of care required of patients seeking access to that care. Access to care may be only partially to explain variation in potentially preventable hospital utilization. To the extent vulnerable patients face greater

socioeconomic challenges, those social determinants likely influence the experience of poorer health status and greater disease burden leading to essentially greater healthcare services utilization.

Other studies have cited the favorable effects of Medicaid expansion on preventable hospital utilization for diabetes related care and improvement in diagnosing and treating the disease as well as lowering spending. The objective of this study is to consider the effect of Medicaid expansion on remediating preventable inpatient admissions and emergency department visits for diabetes conditions in residents of Kentucky, much of which is located in the heart of central Appalachia. Clearly, the infrastructure and socio-economic influences of geographic variation are of profound importance to diabetes health as well as ambulatory care sensitive condition (ACSC) relevant hospital utilization. The study contributes to a better understanding of how Medicaid expansion shapes the delivery of care for those vulnerable low-income adults living with the chronic and debilitating disease of diabetes.

The unique geographic diversity of Kentucky and its policy decision to leverage the ACA provision to expand Medicaid provides an opportunity for a retrospective study to determine the relative changes in preventable inpatient and emergency department discharge rates for Kentucky residents with diabetes prior to and following Medicaid expansion, which occurred in the State on January 1, 2014.

Of particular significance is exploring ways Medicaid expansion has enhanced effective primary care access to manage the health status of those medically vulnerable patients living with diabetes which help them avoid complications arising to the need for hospital care. Effective chronic care management is imperative to eliminating wasted spending associated with

hospital utilization. When patients are afforded access to appropriate preventive care, complications leading to the need for high cost acute care interventions are generally avoidable.

This study is of paramount importance to multiple health care stakeholders, including providers, payers and policymakers. Given the immense cost of delivering healthcare services to Medicaid beneficiaries generally, and to those with a chronic disease such as diabetes specifically, it is imperative to understand various facets of the value proposition associated with our nation's investment in Medicaid. Benefits of this study will accrue to government and private payers, Accountable Care Organizations, and any entity bearing risk for the costs associated with avoidable utilization of hospital services. Hospital administrators will gain insight into opportunities to eliminate waste and optimize hospital capacity. Policymakers, particularly those with significant populations of residents with chronic disease, faced with socioeconomic challenges, and residing in remote rural and Appalachian regions, will benefit from a variety of insights afforded by the study.

CHAPTER 2 LITERATURE REVIEW

Theoretical Construct: The Triple Aim

In 2008, while at the Institute for Healthcare Improvement (IHI), Berwick, Nolan, and Whittington coined a term that has since established a ubiquitous theoretical framework, referred to as the Triple Aim, for improving health system performance. The threefold pursuit sets its sights on implementing strategies to simultaneously improve the patient experience of care, improve the health of populations, and reduce the per capita costs of healthcare.

With respect to improving the patient experience of care, the Triple Aim framework adopts the six objectives outlined in 2001 by the Institute of Medicine (IOM) which suggest all healthcare organizations should bridge what it referred to as a quality chasm between the ideal and the actual care patients were experiencing. Six major goals for healthcare were outlined for pursuit; specifically, that it should be safe, effective, patient-centered, timely, efficient, and equitable. Implicit in IHI's framework is the notion of accessibility; to affordable insurance and to high-quality care.

The concept of accessibility to healthcare for everyone raises a host of complex factors that are at the heart of policy making and span strategic and operational considerations for providers of care. To deliver accessibility to care that meets the IOM standards for patient experience requires considerations for removing financial barriers through access to broadly accepted health insurance, ensuring access to transportation resources, and creating adequate capacity of qualified clinical providers of care to accommodate demand where and when it is needed. Among its recommendations in 2001, the IOM endorsed the collaboration of healthcare stakeholders to redesign care around various rules, including one to ensure effective continuity of

care. The rule goes on to stipulate that systems of care must be designed to ensure patients have access to the services they need at any and all times.

Hence, access to care is a fundamental standard metric for the success of any system whose mission is to improve the health status of a population. Whether that population is inclusive of an entire nation, the respective States within the U.S., or a given healthcare organization accountable for a particular subset of covered lives, the relevant system's access policy position and its effectiveness of execution in delivering access to care must surely be linked to that population's health status. If that is true for the general population, it must be greater still that its members with more vulnerable health conditions will realize the greatest benefit from gaining and sustaining access to the focused care they require.

The IOM (2001) went on to recommend that the Agency for Healthcare Research and Quality (AHRQ) target interventions to improve the system for those suffering from conditions with the greatest potential to relieve the nation's burden of disease and healthcare expenditures. Referencing the Medical Expenditure Panel Survey of the year 2000, the IOM identified diabetes as second only to cancer as the most burdensome health condition facing the nation. Thus, further inquiry is essential to understand how application of the Triple Aim to diabetes specifically might reduce suffering and cost through improvement of access to the optimal healthcare experience.

Thomas, Wedel, and Christopher (2018) cite studies documenting a link between access to diabetes care as measured by the number of visits made to a healthcare provider and the level of diabetes control. They cite the American Diabetes Association (ADA) recommendation for a minimum of four visits annually to sustain well controlled hemoglobin A1c values. Naturally, the goal of diabetes care is not merely to maximize clinic visits, but rather to better manage the

condition through ongoing monitoring, detection of complications, and preventive interventions. The effects of inaccessibility leading to deferred diabetes care is associated with subsequently poor quality of life, increased healthcare expenditures, and decreased productivity. Hence, the Triple Aim's attention to accessibility involves important considerations for management of diabetes in the appropriate setting of care, the utility of insurance as a means of affordability, as well as geographic factors affecting patient capacity to source care where and when needed.

Avoidable Hospital Utilization

Preventing unnecessary utilization of costly hospital resources - including avoidable hospital admissions, readmissions and preventable emergency department visits - is a critical strategy in the fight to control healthcare expenditures. Romano (2009) summarized various objectively verified correlations with potentially unnecessary hospital utilization, including a negative association with household income in a geographic area, a positive association for patients who either lack insurance or have Medicaid coverage, a negative connection with educational attainment of the mother, a negative association to the primary care physician supply in a geographic area, and a strong negative correlation with self-perceptions of access to needed care.

In 2002, the AHRQ released a revised set of its Quality Indicators (QI), a comprehensive array of measures reflecting the quality of healthcare performance relative to provider organizations and patient populations (Farquhar, 2008). While additional modules have subsequently been deployed, the original release included two sets of indicators, the Prevention Quality Indicators (PQIs) and the Inpatient Quality Indicators (IQIs).

The AHRQ's provision of free QI software availability affords researchers the opportunity to calculate PQI rates using readily accessible statistical tools (AHRQ, 2020). Its

utility, while robust, is useful specifically for measuring a complete patient population or a simple random sampling subset and not designed to be used for complex weighted data. The AHRQ PQI measures use coding from publicly available hospital inpatient discharge data sets to identify potential problems with community-based care leading to preventable utilization of hospital resources for so-called ambulatory care sensitive conditions (ACSCs).

The ACSC term was introduced by Billings, Zeitel, Lukomnik, Carey, Blank, and Newman (1993) wherein their medical expert advisory panel stratified patients into 3 groupings based on the root of their hospital admission. A patient with a diagnosis "for which timely and effective outpatient care can help to reduce the risks of hospitalization by either preventing the onset of an illness or condition, controlling an acute episodic illness or condition, or managing a chronic disease or condition" (p. 163) was deemed to have an ACSC. The study findings indicated that appropriate outpatient care access and how effectively the outpatient care model performed was associated with the likelihood of a hospitalization across a wide array of clinical ailments.

While preventable hospital utilization may broadly encompass avoidable inpatient and outpatient encounters from occurring in the first place, it might also incorporate unnecessary resource utilization, non-value-added tests, treatments and incremental days of hospitalization. With respect to the AHRQ PQI measures, the focus of attention is on inpatient admissions (which may include readmissions) and emergency department encounters for acute or chronic conditions that could likely have been avoided with effective management in the home or ambulatory care environment. PQIs can be leveraged to evaluate the effectiveness of a community in eliminating disparities and providing appropriate access and quality outpatient care. Such care assists patients living with chronic disease, such as diabetes, avoid experiencing

complications that result in the need for a hospital admission or emergency department encounter. Naturally, there are extenuating factors beyond the control of the healthcare delivery system which mitigate its effectiveness in preventing all avoidable hospital utilization, including various social determinants of health inherent in serving vulnerable populations, patient adherence to clinical recommendations, as well as elements of the physical environment in which patients reside. Other variables often applied to the stratification of ACSC hospitalizations include the supply of primary care providers, demographic characteristics, and disease incidence (Broussard et al., 2018).

With the retirement of some of the original PQIs, the 2020 AHRQ version identifies 14 in total, four of which are composite measures of diabetes, chronic, acute, and overall conditions (AHRQ, 2020). Among the remaining AHRQ PQIs, a full four of them are relevant to diabetes care. These include uncontrolled diabetes, diabetes short-term complications, diabetes long-term complications, and lower extremity amputations, collectively referred to as the AHRQ Prevention Quality Diabetes Composite (AHRQ-DC). According to Tseng, Soroka, and Pogach (2018), expenditures related to diabetes complications grew 92% over 10 years to reach $176 billion in 2012, with inpatient care accounting for the most significant outlay. The vast prevalence of diabetes, along with its onerous clinical and financial impacts on patients and payers of care, begs for an intense national commitment to optimizing preventive diabetes services and eliminating avoidable hospital utilization. Availability of the PQI toolset affords the opportunity to deploy it as a useful metric to detect community challenges with quality care and access.

Effects of Insurance Status

For individuals lacking access to any form of health insurance, the implications are many. An obvious limitation includes the barrier to accessing certain healthcare services delivered by providers which may voluntarily elect not to serve anyone who lacks the ability to pay. That barrier includes providers of preventive health measures, which in turn, often leads to uninsured patients turning to safety net providers as their usual source of care. Amongst those are hospital emergency departments, which owing to regulatory requirements of the Emergency Medical Treatment and Labor Act (1986) to provide at least a screening examination to anyone presenting, and though they are relatively high cost of care settings, are consigned to be the provider of choice for many ACSCs which would be better served in outpatient primary care settings. All too often, though, primary care is foregone altogether, and progression of a chronic disease or acute condition progresses to the point that an inpatient hospitalization may result. Ultimately, the uninsured patient's lack of access to quality ambulatory care may well lead to a negative health outcome, including the premature advancement of diabetes complications. A growing body of literature considers the offsetting effects of insurance on healthcare access, utilization, quality, and outcomes.

Effects on access to care

With respect to the question, "Does health insurance affect access to care?" there are numerous sources which offer supportive perspective. Sommers, Baicker, and Epstein (2012) examined three states which expanded Medicaid prior to the Affordable Care Act (ACA), finding significant declines in uninsured rates and in delayed care related to cost. Winkelman, Segel, and Davis (2019) found Medicaid enrollment resulted in increased reporting of having access to a usual source of care and a reduction in prevalence of patients foregoing care. A national survey

of physicians (Present et al., 2019) indicated increased panel sizes of Medicaid patients following the ACA's expansion. Goold et al. (2018) reported 56.2 percent of Michigan's primary care providers indicated they had seen new patients post Medicaid expansion that had not visited a primary care physician in years. Finally, Thomas, Wedel, and Christopher (2018) highlight the fact that Medicaid stands alone among major insurers as incorporating free non-emergent medical transportation as a health plan benefit, a critical component of eliminating a key barrier to accessing medical care.

Hypothesizing rural residents would face greater challenges to access, Allen et al. (2018) stated, "Gaining insurance does not necessarily give you access to a resource that does not exist in or near your community" (p. 355). But their study data suggest Medicaid coverage resulted in similar benefits for rural and urban Oregonians on primary care accessibility and preventive screenings. Sommers, Gawande and Baicker (2017) indicated the stronger studies provide evidence that coverage expansions have led to greater primary care access, ambulatory visits and use of prescription medications. Finally, relative specifically to Tennessee, Tarazi, Green, and Sabik (2017) assessed the effects of Medicaid disenrollment on access and established it resulted in significantly greater inability to see a physician due to cost-related barriers.

Effects on ED utilization and avoidable ED utilization

The literature is also rich with evidence that patients, upon becoming established with Medicaid coverage, take full advantage of the access newly afforded to them. As an example, Finkelstein, Taubman, Allen, Wright, and Baicker (2016) studied the effects of Medicaid coverage on emergency department (ED) utilization in Oregon following that State's expansion prior to the ACA. Among their findings was that expansion increased ED visits by forty percent in the first fifteen months following expansion. Some observers opined the increased ED

utilization merely reflected pent-up demand and predicted the visits would slow down as patients became established over time with primary care providers. A subsequent analysis referenced in the same article, however, found the phenomenon continuing a full two years into expanded coverage (Finkelstein et al., 2016). Notably, the ensuing study also found new Medicaid beneficiaries did not substitute physician office encounters for ED utilization but rather there was a complementary increase in utilization in several settings, including the ED, physician office visits, ambulatory hospital visits, and use of prescription medications.

In something of a contrast, a 2016 study by Sommers, Blendon, Orav, and Epstein involving a comparison of Kentucky's Medicaid expansion with Arkansas's private option expansion approach and the no-expansion policy of Texas, discovered that over time expansion resulted in greater primary care access, lower emergency department utilization, less deferral of purchasing medications due to inability to pay, lower personal healthcare spending, and more utilization of outpatient services.

It is well understood that the ED is often the usual source of care in the absence of access to primary care, whether due to lack of insurance coverage or shortage of community providers. The essence of Medicaid expansion was to mitigate these access barriers, connecting vulnerable patients with the care they need, when they need it, and lowering overall cost by alleviating the need for the highest cost setting of the ED to be the necessary default source of care for even non-emergent conditions.

The correlation to higher frequency ED encounters by recently enrolled Medicaid beneficiaries is of particular interest given the ACA's promise of removing a financial barrier to appropriate medical care. Cheung, Wiler, Lowe, and Ginde (2012) predicted that "Although Medicaid expansion will decrease financial barriers to care, other barriers persist, including

limited availability of primary care physicians, clinics not being open at convenient times, and transportation issues" (p.4).

It seems in the wake of ACA implementation that this prediction is proving to be on point, as non-financial barriers to accessing primary care result in higher odds of more ED encounters by Medicaid patients compared to those with private insurance coverage. Cheung et al. (2012) identified specific barriers which reflect transportation challenges and insufficient primary care provider availability for Medicaid beneficiaries driven by inferior payment rates and untimely payments, burdensome administrative efforts required to process claims, and relatively poor patient compliance. Ndumele, Mor, Allen, Burgess, and Trivedi (2014) noted in a post-ACA environment that "as many as 40% of primary care providers are unwilling to add new Medicaid enrollees to their panel" (p. 7). Capp, Rooks, Wiler, Zane, and Ginde (2013) reported that in the face of millions of citizens gaining access to Medicaid under the ACA, these newly-insured patients are finding the doors closed to new Medicaid enrollees, as nearly one-third of physicians are not accepting additional Medicaid patients. Hence leaving affected patients with few alternatives to the ED.

These barriers to access result in Medicaid patients resorting to use of the ED as the more convenient option for primary care needs. More myopic Medicaid policy makers often propose to curtail ED visits among this population by imposing co-payments or payment denials for encounters they judge to be medically inappropriate. Such policies, enforced without also ensuring access to primary care or urgent care clinics, fails to acknowledge the multiple obstacles facing these patients.

Nikpay, Freedman, Levy, and Buchmueller (2017) found Medicaid expansion states experienced higher overall numbers of ED visits following implementation of the ACA.

McConville, Raven, Sabbagh, and Hsia (2018), though, investigated frequent ED user behavior in California, finding the likelihood of visiting the ED four or more times annually dipped significantly for both Medicaid and uninsured patients after Medicaid expansion, while patients in other payer groups remained stable. Gingold, Pierre-Mathieu, Cole, Miller, and Khaldun (2017) studied frequent ED utilization specifically for ACSCs in a Maryland safety-net hospital. They observed a significant ($p<0.001$) reduction in the percentage (from 4.1% in 2013 to 2.4% in 2014) of unique patients who made disproportionately high numbers of ED visits in the year just after Medicaid expansion compared to the year just prior. Finkelstein, Taubman, Allen, Wright, and Baicker (2016) studied the Oregon Health Insurance Experiment (OHIE), estimating Medicaid coverage made it more likely a patient would have visits to both a physician office and an ED by 13.2 percentage points. These research efforts suggest access to Medicaid as a source of insurance may create for patients a sense of freedom to take advantage of complementary care; to use the ED when that level of care is required, as well as benefit from a primary care relationship to appropriately manage ACSCs in lieu of the ED.

The findings of increased utilization of the ED as well as most other healthcare services supports what seems intuitive: low-income populations live with greater vulnerabilities, creating the need for relatively more essential healthcare utilization generally than compared to other populations. Further, the absence of financial support in the form of insurance inhibits utilization and restricts access to optimal sources of care, which when that lack of insurance is remediated results in patients taking advantage of their newfound access to services.

Uninsured patients and those with Medicaid coverage are the most socially and economically vulnerable. As such, they face financial and non-financial barriers to preventive and primary care providers. They also are more likely to be living with one or more chronic

diseases. Hence, it is little wonder they are as likely to have more emergent needs than those ED patients who are privately insured. Ruger, Richter, Spitznagel, and Lewis (2004) concluded patients once believed to be inappropriately accessing the ED for non-emergent needs often are proportionately sick compared to those patients who use the ED less frequently.

A study by Sommers, Boukus, and Carrier (2012) found adults aged 21 to 64 with Medicaid had significantly higher ED use rates per 100 enrollees than privately-insured patients across all levels of triage acuity, spanning emergent, urgent, semi-urgent and nonurgent needs. With use rates approximately double their privately insured counterparts in each of these medical categories, the researchers assert Medicaid beneficiaries carry a greater burden of acuity, disability, and mental health challenges.

Effects on hospitalizations and avoidable admissions

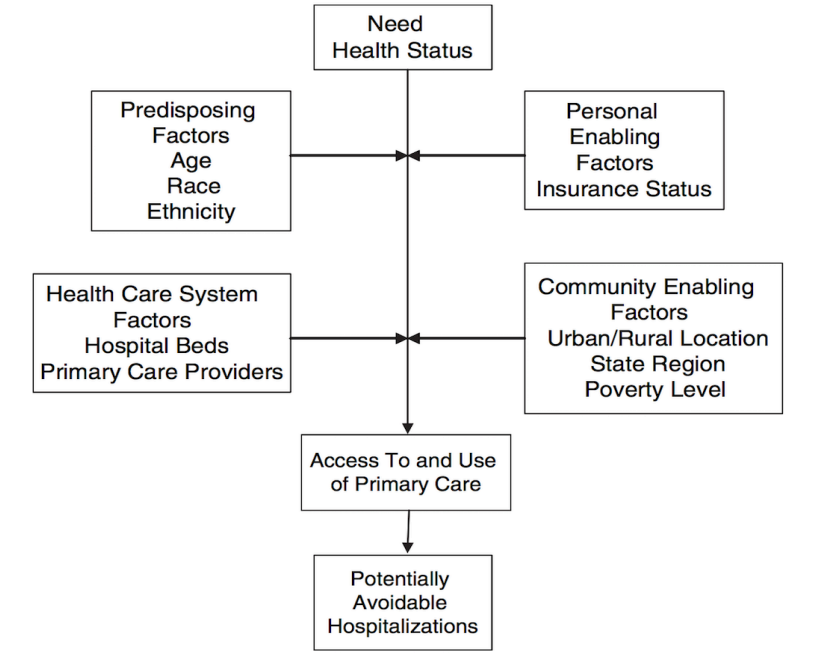
As the costliest segment of the U.S. healthcare system, hospitalization is rightly so a prime target for policy makers when seeking to extract savings. The pervasive use of inpatient admissions for ACSCs is particularly problematic, accounting for more than $30 billion of wasted expenditures (Wen, Johnston, Allen, and Waters, 2019). Hospital admissions for ACSCs provide another indicator of opportunity to improve access to quality primary care and the services aimed to prevent exacerbation of conditions ordinarily managed effectively in an outpatient setting.

A few researchers have investigated the efficacy of Medicaid expansion on previously uninsured persons as a policy tool for remediating avoidable inpatient hospitalization. Wen et al. (2019) concluded Medicaid expansion was associated with meaningfully lower inpatient admissions for ACSCs, and that effect grew stronger over time. This is consistent with a systematic review they cite (Mazurenko, Balio, Agarwal, Carroll, and Menachemi, 2018)

pointing to new Medicaid beneficiaries gaining better primary care access and in particular, access to preventive measures and chronic disease management. The results, however, were heterogeneous across the thirty-six states observed, including no association in Oregon, consistent with other findings related to the OHIE and likely a function of unique policy directives amongst the Medicaid expanding states. A reduction in avoidable hospital utilization linked to Medicaid expansion factors was predominantly realized in specific ACSCs that are strongly correlated to evidence based primary care management. Among the most favorably affected ACSCs are complications arising from diabetes, consistent with other findings of Medicaid expansion being positively tied to initial diagnoses of diabetes and subsequent glucose monitoring.

While acknowledging the literature linking insurance coverage to lower rates of ACSC-related hospitalizations and more primary care visits, Chang, Mirvis, and Waters (2008) developed a conceptual model (Figure 1) recognizing a number of other confounders for which

Figure 1
The Conceptual Model



to control in measuring the insurance effect. Factors inherent in the culture of a community, the supply of primary care providers, geographic location, and personal commitment to healthy behavioral modifications, among others were considered. Their research sought to understand what associations exist in Tennessee for potentially avoidable hospital admissions related to race and insurance status. Their findings agreed with others, noting a correlation between avoidable utilization and lack of insurance coverage, though interestingly the type of insurance coverage affected the relative odds of an ACSC admission. While commercially-insured patients had the lowest risk of avoidable inpatient admissions, Medicare patients had the highest risk, and patients with Medicaid had a higher risk than those with no source of insurance coverage. That last curious finding may be reconciled by relative co-morbidities. As Pickens et al. (2018) conclude, a selection effect accounts for results by payer wherein uninsured individuals who gained Medicaid coverage did so as a result of their recognized risk to need more intensive healthcare interventions in a hospital setting. Inasmuch as young adults are in relatively favorable health, less likely to hold employer sponsored health insurance, and perceive financial barriers to affordability of hospital services, it seems reasonable they would contribute to lower rates of ACSC hospital encounters.

Effects on behaviors affecting health

Other investigators have sought to understand what impact the ACA's Medicaid expansion had on behaviors linked to healthy choices. Cotti, Nesson, and Tefft (2019) explored the economic theory of the ex-ante moral hazard phenomenon, which anticipates individuals will translate the newfound financial security afforded by health insurance into freedom to engage in more risky behaviors. The team assessed if there existed a moral hazard association with Medicaid expansion related to increased volume of purchases of alcohol, nicotine, snack foods

and carbonated beverages, all obviously poor choices from a health perspective. They found no validation of that hypothesis, but in contrast identified compelling evidence that Medicaid expansion in fact facilitated behavioral changes through awareness leading to better health status, including reduction of cigarette purchases by 30% ($p < .01$). The effect is perhaps a function of the ACA's emphasis on preventive care, resulting from recipients receiving counseling on the value of making healthier choices. Goold et al. (2018) established that 69% of primary care providers surveyed experienced new Medicaid enrollees more strictly adhering to their prescription medications following expansion in Michigan, another behavioral based effect that should lead to more optimal health.

Effect of insurance on clinical outcomes

Levy and Meltzer (2004) provide an immensely helpful overview of what is actually known about the effects of health insurance on health. They acknowledge volumes of studies finding associations of uninsured persons with inferior health outcomes in comparison to insured persons. They note, however, that rare does the evidence establish a causal relationship, owing to the dearth of randomized study designs for assignment to health insurance status, which would be necessary, in part, to establish a causal connection. It may be just as plausible that one's favorable health status provides the means to be afforded access to employer sponsored health insurance as it is that the causal relationship might flow in the opposite direction. Furthermore, any correlation of health insurance leading to better health would be indirect at best, as insurance may enhance access to services which in turn may or may not have a constructive effect on health itself.

Arguably, associated with the ACA's perhaps most noble goal of expanding Medicaid is the anticipation that it would lead to citizens living longer and with a higher quality of life. As

Muennig, Quan, Chiuzan, and Glied asked, "If Medicaid does not improve physical health, why are we spending hundreds of billions of dollars a year on this program?" (2015, p. 867). This is surely a key question for researchers and policy makers.

Answering this question is challenging at best given the elusive capacity to conduct the most rigorous study designs which would require randomization or pseudo-randomization. Aron-Dine, Einav, and Finkelstein (2013) acknowledge that, "since the RAND Health Insurance Experiment, there have been, to our knowledge, only two other randomized health insurance experiments in the United States, both using randomized variations in eligibility to examine the effect of providing public health insurance to uninsured populations" (p. 2). The others meeting this high design standard are Michalopoulos et al. (2011) and Finkelstein et al. (2012).

Newhouse (2004) explains how the RAND Health Insurance Experiment (RHIE) randomized households to varying health insurance coverages ranging from zero co-insurance to a very high deductible family plan. Participants in the high-deductible plan used significantly less services, across all income groups, than those in the free plan with fewer office visits per person and less likelihood of being hospitalized. The results fueled significant debate, with liberals and conservatives each claiming the findings supported their relative positions. But the most heated dispute centered not around the role of system savings relative to patient cost sharing, but if reductions in utilization occurred for essential services that would diminish health status with liberals insisting the lower utilization effects were detrimental and conservatives of the mind they were not. The results indicated both sides were partly right. For RHIE enrollees who likely would have otherwise had employer-sponsored insurance, the relative lower utilization resulted in no significant harm to health. But for those who more likely would have

been uninsured or Medicaid eligible, it was estimated to increase the annual risk of death due to inferior hypertension control by nearly ten percent.

Clearly the most influential opportunity for study to date on the effects of Medicaid expansion specifically arises from Oregon's 2008 implementation of a randomized selection of approximately 30,000 citizens to expand its Medicaid population from amongst those otherwise eligible (Finkelstein et al., 2012). A myriad of studies has capitalized on this opportunity for natural experiments or quasi-experimental studies. Winkelman, Segel and Davis (2019) cite the Oregon Health Insurance Experiment (OHIE) as "the most rigorous study to date to examine the impact of gaining Medicaid at the individual level" (p. 298).

Baicker, Taubman, Allen, et al. (2013) specifically sought to understand the effects of Medicaid on clinical outcomes two years following the OHIE's lottery-initiated expansion. The results were disappointing to advocates of Medicaid expansion in that no significant improvements were identified in several clinical measures prevalent in the low-income population and believed to be modifiable in the two-year post-expansion timeframe of the study. Specifically, significance was unrealized in improved diagnosing of hypertension or high cholesterol, nor in the use of prescription medications for either. Similarly, there was no significant decrease in obesity, smoking or cardiovascular risk. The most encouraging clinical result was a significant ($p = .02$) decrease in the probability of new beneficiaries experiencing depression, possibly associated with the finding of decreased financial strain and near elimination of catastrophic out-of-pocket spending.

Winkelman, Segel, and Davis (2019) sought to assess the impact of Medicaid expansion across previously uninsured racial and ethnic groups related to costs, utilization, access and clinical health measures by comparing changes of those who gained Medicaid with those who

remained uninsured. The results were consistent with what has been discussed above, with significant increases in overall spending on healthcare services and reporting a usual source of care, significant decreases in individual out-of-pocket expenditures and decreases in rates of foregone care, proving Medicaid delivered financial and access benefits to patients. As for clinical outcomes, the results were similar to the OHIE findings with no significant findings discovered aside from Medicaid expansion beneficiaries having a significant decrease in severe psychiatric distress, and surprisingly only those who remained uninsured realized a self-reported statistically significant decrease in fair or poor health status.

Whether or not gaining access to health insurance has the effect of saving lives is a principal question. Levy and Meltzer (2004) cite a 1993 study (Ayanian, Kohler, Abe, and Epstein, 1993) which found survival rates were lower among women covered by Medicaid who suffered from breast cancer when compared to either privately insured women or women who were uninsured. It seemed to beg the question if Medicaid is bad for the health of women with breast cancer. To the contrary, Sommers, Baicker, and Epstein (2012) compared states with large pre-ACA Medicaid expansions with neighboring states which did not expand coverage in the early 2000s. Their findings included a significant 6% favorable impact on mortality after 5 years. Furthermore, subsequent analyses indicate the most important declines occurred in heart disease, cancer, and infections, all reasonably influenced by effective healthcare interventions made possible by improved access to medical services.

Effects on care and treatment of diabetes

A number of studies suggest there is growing evidence that gaining access to health insurance through Medicaid expansion has resulted in a relatively favorable impact on the health status of diabetics living in states which adopted expansion policies, as compared to those in

states that did not expand. Medicaid expansion has been tied to a number of significant improvements with respect to diabetes, including among others, improved access to diabetes medications (Myerson, Lu, Tonnu-Mihara, and Huang, 2018), increases in earlier diagnoses and treatment (Kaufmanet, Chen, Fonseca, and McPhaul, 2015), better access to physicians (Present et al., 2019), and lower out of pocket spending (Mulcahy, Eibner, & Finegold, 2016).

Luo et al. (2019) highlight that the poor in our nation experience a relatively high prevalence rate of diabetes. Consequently, Medicaid, as the primary health plan for the socio-economically vulnerable population, is a critically important tool in the nation's fight to address such a burdensome chronic disease. Their study revealed better access to diabetes care for those in states which elected to expand Medicaid following the ACA and they experienced greater progress in diabetes control as measured by hemoglobin A1c tests pre vs. post-expansion. Thus, they conclude that Medicaid expansion contributes to better access to diabetes care and outcomes. To the contrary, Baicker, et al. (2013) reported while Medicaid expansion in the OHIE was associated with an increase of 3.8 percentage points in the probability of diabetes being diagnosed and an increase of 5.4 percentage points in the use of medications to treat it, there was no significant effect found on achieving control of hemoglobin levels.

Lee, Callaghan, Ory, Zhao, and Bolin (2020) evaluated the impact of Medicaid expansion on diabetes care, finding significantly favorable differences in improvement in expansion states compared to those in non-expansion states for self-reported measures of access ($p=0.023$), diabetes management ($p=0.001$), and health status ($p=0.026$). Access to insurance is a precursor of access to diabetes care providers, an essential facet of comprehensive control of what can be a debilitating chronic disease. This same study noted that in 2009, nearly one in seven non-elderly

adult diabetics were uninsured, a contributor to complications stemming from missed opportunities to receive appropriate quality prevention and treatment.

The complexity of the algorithm that is effective management of diabetes, at a minimum, requires the balancing of needs for daily glucose monitoring, routine examination of the eyes and lower extremities, access to medications, proper nutritional counseling and habits, and physician visits. Prediabetics and confirmed diabetics alike clearly will struggle to access all these needed services without insurance coverage. Huguet et al. (2018) confirmed demand among patients with diabetes and prediabetes in a National Community Health Center Network for total clinic visits, primary care visits, and diabetic screening lab tests were higher than the rates for non-diabetics. Following Medicaid expansion, clinics in expansion states experienced significantly increased demand for diabetic screening tests. Thus, the ACA interventions embedded in expanded health insurance access which encourage preventive health and limit patient cost-sharing responsibility seems to have served to incentivize greater utilization of those services. It is likely then that gaining access to health insurance serves to improve the health status of the population by detecting previously undiagnosed cases of diabetes and serves to lower overall expenditures through early and more targeted chronic diabetes disease management.

Effects of Geography

Among the many sources of variation in all measures of healthcare is geography. Where one resides is a primary predictor of the supply of available healthcare services, actual utilization of services available, as well as the outcomes resulting from that care. Whether the interest is comparing urban and rural communities or regions of the country, disparate qualities are routinely found in geographic segmentation.

Urban vs. rural

Nowhere is the impact of Medicaid expansion more acutely felt than in rural communities across the U.S. As is generally understood, rural communities face relatively greater barriers to health: owing to less education and higher rates of unemployment, hence less access to employer related health insurance and lower income; fewer physicians and healthcare facilities; and longer travel distances to reach essential services. Foutz, Artiga, and Garfield (2017) found that for those in rural areas with health insurance, the likelihood that they were insured by Medicaid is much greater than for those in non-rural locations. The percentage of residents with Medicaid coverage varies greatly by state and by rurality – with Kentucky, for example, providing Medicaid to a full 32% of its rural residents compared to 24% and 23%, respectively, for those in its urban and other areas. Gaps in insurance coverage are significant with residents in rural areas of states not participating in Medicaid expansion nearly twice as likely to lack coverage as their rural counterparts in Medicaid expanding states. Nearly six in ten uninsured rural Americans under age 65 reside in the nineteen states which have not expanded their Medicaid rolls (Foutz et al., 2017).

Access for rural Americans is particularly concerning, owing to the unique socio-economic and demographic challenges linked to higher rates of poverty, aging, smoking and poor nutrition. And while rural areas account for 20% of the population, less than 11% of the physicians practice there (Allen et al., 2018).

Though they have a 17% higher prevalence of diabetes, rural residents are more likely than their urban counterparts to defer or lack access to diabetes care services and suffer the consequences of clinical complications (Thomas, Wedel, and Christopher, 2018). With an inferior supply of healthcare providers (Allen et al., 2018), rural community residents face the

need to travel further in search of care, a burden long associated with infrequent physician encounters, lack of access to endocrinology specialists and effective interventions, as well as uncontrolled diabetes. Clearly, rural diabetics face a greater struggle to overcoming their chronic care challenges, hence compelling is the need to focus on improving access in non-urban communities, and particularly those in Appalachia.

Appalachia vs. non-Appalachia

Of particular interest are the substantial differences observed in the Appalachian region when compared to the rest of the nation. The Appalachian Regional Commission's (ARC) report describes in great detail the disparities found in this region, spanning an area touching twelve contiguous states from Mississippi to New York, which is twice as rural as the nation as a whole (Marshall et al., 2017). For the 25 million residents of Appalachia, social and infrastructure determinants are particularly challenging to health status. Relatively inferior employment rates, educational attainment, and income levels only begin to paint the picture of the multiple factors contributing to poorer health.

The ARC report found Appalachians underperformed the nation as a whole in 80% of the health indicators measured, including mortality for the leading causes of death in the U.S. For most every measure studied of morbidity, mental health, child health, smoking, physical inactivity, social determinants of health such as grocery store availability, and access to healthcare providers (including primary and specialty physicians), Appalachians fared worse than others, with rural Appalachians faring even more unfavorably. As for diabetes, the principal interest of this study, compared with non-Appalachians, Appalachians have an 11% higher mortality rate. Rural Appalachians have a 36% higher diabetes related mortality rate than their

urban Appalachian counterparts. And 43% of Appalachian counties were included in the worst national quintile of diabetes prevalence.

Most Americans enjoy convenient access, from a geographic and insurance perspective, to a primary care provider. And yet others, and disproportionately those in Appalachia and rural America, face greater challenges to experiencing the benefits of a primary care physician managing their healthcare needs. The result of lacking access to a personal provider of primary care is a greater likelihood of an essential trip to an emergency department and to being admitted as a hospital inpatient (Freundlich et al., 2013). To the contrary, regular visits to a primary care provider affords the opportunity to receive routine screenings to detect and control chronic diseases such as diabetes from escalating to significant and even life-threatening complications. The difference in annual health expenditures for diabetes care ranges from around $12,000 for the patient whose condition is actively managed to over $100,000 if unmanaged. Starfield, Shi, and Macinko (2005) cite multiple sources of evidence tying health status to the supply of primary care physicians in a geographic area, including at the national, state, county, and local levels. In short, more primary care providers in an area are consistently associated with better healthcare, better health outcomes, and lower ACSC-related hospital utilization rates across the board, including diabetes.

In the heart of Appalachia rests the Commonwealth of Kentucky where nearly half of its counties are in the Appalachian region defined by the ARC and nearly all of these Appalachian counties are rural and economically distressed (Marshall et al., 2017). Perhaps most sobering is the rate of premature deaths, measured as Years of Potential Life Lost (YPLL) prior to age 75, in which the Central Appalachian region (predominantly consisting of the counties within the eastern half of Kentucky) has the highest rate in the region and a 69% higher rate than the rest of

the nation (Ibid). The diabetes-related mortality rate for this central Appalachian region is a full 41% higher than the national rate, and its economically distressed counties are 44% higher (Ibid). As a corollary, it should come as no surprise that the 35.2% rate of obesity in Kentucky's Appalachian counties amounts to a higher prevalence than the nation as a whole and to any other subset of States within the Appalachian region (Ibid).

The incidence of diabetes significantly rises as one migrates from other regions of the country into Appalachia. Subsequently, the deeper into the heart of the Appalachian region a person resides, the greater the prevalence (Ibid). From the Appalachian region generally, to the primarily Kentucky counties known as Central Appalachia, and successively into Central Appalachia's rural counties and finally further into its economically distressed counties, ever increasing rates of diabetes are experienced.

Effects on preventable hospital utilization

Little is known regarding the disparities in avoidable ACSC hospital utilization owing to geographic factors, particularly related to preventable emergency department utilization. Gaining an understanding of the root causes of variation on this measure and which communities in the nation would benefit most from targeted interventions is an important area of inquiry. Busby, Purdy, and Hollingworth (2015), through a comprehensive literature review, confirmed variation in ACSC hospitalization rates by geography is abundant. Such disparity may be a function alternately of supply-side factors of bed availability and incentives to maximize admission volumes, primary and secondary care deficits, lack of patient engagement in self-care, and absence of clinical guidelines.

Sumner and Hagen (2011) suggested small area geographies were very likely to experience significant variation in ambulatory care access and quality, keys to monitoring and

preventing complications of chronic disease. And similar to findings they cite from Missouri and Tennessee, that is what they found in Kentucky, with the highest decile of county-level PQI results measuring 10 times greater than the lowest decile counties. Drivers of variation in ambulatory care results at the county level might predictably be associated with differences in availability of transportation, provider surpluses or shortages, and patient behavior, among others, all of which are unlikely to experience rapid rates of change. Consistent with that presumption, Sumner and Hagen (2011) saw no significant shifts in PQI rates for any Kentucky county over a three-year study period of 2006 to 2008.

One of the most significant predictors of preventable hospitalizations relates to per capita income of the geographic area in which a population resides. In 2013, the Centers for Disease Control and Prevention (Moy, Chang, and Barrett) analyzed data from the AHRQ's Healthcare Cost and Utilization Project (HCUP) database of inpatient discharges across the nation. By segmenting communities into income quartiles, researchers found incrementally higher rates of preventable hospitalizations inverse to income levels. While avoidable utilization rates overall declined each successive year from 2001 to 2009, in every year the relative rates of preventable hospitalizations were consistently correlated to income. In fact, if utilization rates of all segments were equivalent to those of the highest income quartile, the report predicted $6.0 billion in hospitalization cost savings from 810,000 fewer inpatient admissions that would have occurred in 2009 alone.

Effects on care and treatment of diabetes

Gurka et al. (2018) discuss the possible utility of focusing diabetes prevention interventions in geographic areas known to have higher prevalence of obesity and the metabolic syndrome (MetS). With an odds ratio to develop diabetes of 5.16 within two to twenty years,

knowing where people living with MetS reside facilitates implementation of IOM recommendations for targeted investigation and prevention. Diabetes rates vary by region with a low of 4.5% in New England to a high of 9.4% in the East South-Central part of the country. These rates reconcile with greater risk (up to 40%) for MetS, obesity, and diabetes being concentrated in southern and midwestern states. Favorable lifestyle practices leading to lower obesity and health-related risks reportedly vary greatly by geography where states in New England and the West are high performers in contrast to no state in the South or Midwest rising to even the 60th percentile. Improving population health through mitigation of social determinants, lifestyle factors, and limited access to preventive healthcare are essential to curb the tide of increasing incidence of diabetes in these more challenged geographic regions.

Lynch et al. (2015) studied 892,223 diabetic Veterans to document geographic influences in controlling the effects of the disease. As a group with greater vulnerability, Veteran diabetes patients residing in rural areas were confirmed to face greater burden in diabetes control compared to urban dwelling Veterans with an odds ratio of 1.21 to have three or more comorbidities and more likely to have any comorbidity.

Kentucky Medicaid Expansion Experience

According to the Kaiser Commission on Medicaid and the Uninsured, Kentucky has enjoyed a high degree of success in its implementation of the ACA and Medicaid expansion relative to other states (Artiga, Tolbert, & Rudowitz, 2016). After expanding Medicaid in January 2014, the Commonwealth of Kentucky has seen its rate of uninsured citizens decline by half from 16% to 8% in the first year of implementation. Kaiser touts Kentucky's commitment to expansive marketing and a strong network of support providers to aid enrollees as key to the rapid uptake in participation. With relatively lower expenditures per new Medicaid beneficiary than budgeted,

and over $1.1 billion in incremental payments to providers coming from the Federal contributions to the program, the state has reported a favorable economic impact from its expansion efforts.

By the end of 2015, two years into its post ACA experience, nearly 1.2 million persons, representing approximately one in four Kentucky citizens, was enrolled in Medicaid. The Governor's approach to introducing the implementation to Kentuckians, which acknowledged the general mistrust across the State in the ACA, is recognized as having been particularly helpful in marketing the rollout of the expanded coverage options. As one State official said, "the approach that the Governor took on this whole thing was to not talk about it in terms of Obamacare … He talked about it in terms of…Kentucky's health… it's not about politics…. It's about improving the health of our state" (Artiga, Tolbert and Rudowitz, 2016, p. 4). Perhaps the greatest testimony of its success is that 84% of Medicaid beneficiaries indicated the program was providing the assistance they need in accessing needed healthcare.

The Commonwealth of Kentucky Report on Medicaid Expansion in 2014 (Deloitte, 2015) reported new enrollment in the first year of expansion exceeded expectations by an impressive 89 percent with 310,887 actual new enrollees compared to an anticipated total of 164,693. The Kentucky Medicaid population generally, and particularly its expansion population, is heavily concentrated in the Appalachian counties of the State where the total Medicaid population reaches as high as 60% of county residents. The Commonwealth's hospitals realized significant economic benefit from the ACA in the first year following Medicaid expansion with over $1.1 billion less in uncompensated healthcare services compared to the prior year experience.

Ideally, however, the greatest value of the ACA would accrue to the previously uninsured who transitioned to gaining access to Medicaid. Evidence from that population's experience in the first year of participation reflects they benefited by taking advantage of preventative services equal to

or more frequently than those who were in the pre-expansion Medicaid population, including 45,825 who received hemoglobin A1c testing and near double that number screened for cholesterol levels, likely many for the first time. Diabetes, along with hyperlipidemia and hypertension, was among the most common chronic conditions diagnosed in Kentucky's Medicaid expansion population, more than twice as prevalent as the comparative group of patients.

Summary

Accessibility to insurance and to the quality healthcare services it is intended to supply is at the heart of the policy of expanding Medicaid to improve the health status of our most vulnerable citizens. Near the top of the most clinically vulnerable are those with diabetes who lack the access to care to which insurance opens the door. Of even greater importance than access to any care is the priority of ensuring optimal access to appropriate care; the right care, in the right place, at the right time, and at the lowest appropriate price.

The AHRQ's Prevention Quality Indicators have been instrumental in measuring the degree to which inappropriate hospital utilization occurs amongst ACSCs, of which diabetes is predominant. The weight of studies indicates that those who benefit from Medicaid expansion nonetheless continue to experience higher rates of ACSC related ED utilization owing to both non-financial barriers to accessing appropriate care and greater health status vulnerabilities compared to other populations. Over time, however, Medicaid expansion contributes to a decline in ACSC inpatient admissions. Of paramount interest are markers of improvement in specific studies indicating favorable changes in access to services and disease control.

The geographic segmentation of disease generally, and of diabetes specifically, is overwhelmingly relevant to morbidity and mortality. The evidence indicates increasing association with poor health as the geographic focus shifts from the nation as a whole, to the

Appalachian region, to rural communities, and ultimately to those more distressed rural areas within Appalachia. Clearly, the infrastructure and socio-economic influences of geographic variation are of profound importance to diabetes health as well as ACSC relevant hospital utilization.

Finally, the Commonwealth of Kentucky provides a unique population to evaluate the interactive effects of geography and Medicaid expansion. It was among the earliest adopters of an expansionary policy, and by many indicators experienced a relatively successful implementation. The State also has a diverse geography of counties in rural versus urban areas and within and outside of the Appalachian region. Those shared factors should provide a distinctly interesting market for a comparison of the Medicaid expansion experience owing to geography.

CHAPTER 3 METHODS

Problem:

Evidence is mixed relative to the clinical benefits of Medicaid expansion. It is unclear if, for the hundreds of billions of dollars in government expenditures, Medicaid access improves the quality of life for vulnerable populations living with a chronic health condition. What value, if any, Medicaid creates relative to improving the health status of the citizens it is intended to serve is an important area of inquiry.

Research Question:

Has Medicaid expansion provided a relative reduction in the rate of inpatient and emergency department discharges for diabetics, including those deemed preventable by PQI standards, and what role do geographic factors play in the relative pace of improvement?

Study Objective(s):

Understand the effects of Medicaid expansion policy in the geographically diverse State of Kentucky on changes in hospital utilization relative to county of patient residence for patients with diabetes.

Hypotheses:

H0 – hospital utilization for diabetics will decline statewide in the years following the January 2014 expansion of Medicaid

H1 – the change in hospital utilization for diabetics residing in Appalachian counties will not be as favorable as the change for those residing outside of the Appalachian region

H2 – Medicaid patients in Appalachian counties will have higher rates of hospital utilization than other payers and will see no significant decreases in hospital utilization post Medicaid expansion.

Population and Sampling Strategy

The study utilizes two data sources included in the Healthcare Cost and Utilization Project (HCUP) family of databases administered by the Agency for Healthcare Research and Quality (AHRQ). These include inpatient discharges from the State Inpatient Database (SID) and hospital-based emergency department discharges (not admitted for inpatient care) from the State Emergency Department Database (SEDD). Both datasets contain no direct patient identifiers but do include all patients, irrespective of expected source of payment.

The population is inclusive of encounter data from the respective SID and SEDD databases for the State of Kentucky for patients aged 19-64, a segment of the population expected to experience the greatest benefits afforded by Medicaid expansion. The population also targets those encounters where a primary diagnosis code indicated either type 1 or type 2 diabetes was present. These patients are reflected in ICD-9 coding, used prior to October 2015, of 250.0 to 250.99 while ICD-10 codes include those in the categories of E10 and E11. The study includes 2013 as a baseline year prior to Medicaid expansion and, for comparative analysis, includes the years 2014 through 2017 subsequent to expansion. Per AHRQ guidelines, ACSC exclusionary criteria omit maternal/newborn encounters and patients who were transferred from another healthcare facility. Kentucky is of unique interest to this study owing to the relative density of diabetes in its population and the geographic comparisons available; with roughly half of its counties located within the Appalachian region along with a broad range of counties with rural to urban designations.

The AHRQ PQI measures (version 2020) for diabetes use coding from the SID and SEDD data sets to identify patients experiencing potential problems with community-based care

leading to their preventable utilization of hospital resources. Specifically, the following diabetes related PQIs were identified in the relevant patient population:

PQI 01 Diabetes Short-term Complications

PQI 03 Diabetes Long-term Complications

PQI 14 Uncontrolled Diabetes

PQI 16 Lower-Extremity Amputation among Patients with Diabetes

Approach/Study Design:

The study reflects a retrospective approach to determine the relative changes in inpatient and emergency department discharges for Kentucky residents with diabetes prior to and following Medicaid expansion which occurred in the State on January 1, 2014. Statistical techniques will be employed to estimate models using the following independent variable units of analysis:

- Payers are identified in the Expected Payer data element of both the SID and SEDD as the expected source of payment, including Medicare, Medicaid, uninsured (Self-Pay and Charity), private insurance, and Other (including Black Lung, Champus/Tricare, Veterans Administration, and Workers' Compensation). Analyses by payers of interest to the study include Medicaid, uninsured, private insurance, and all payers cumulatively.
- Appalachian geographic variable wherein each encounter is assigned to a category as Appalachian or non-Appalachian based-on location of the patient's county of residence relative to the Appalachian Regional Commission's definition and the approach used by Gehefer, White, and Simpson (2019).
- Quarter/Year time variable

The primary dependent variable is:

- Hospital encounter utilization rates inclusive of inpatient admissions and ED visits

Secondary dependent variables include:

- Preventable hospital events as indicated by ACSC related inpatient and emergency department discharges using AHRQ PQIs 01, 03, 14, and 16, coded where applicable to each potentially preventable encounter as a percentage of total encounters for type 1 and 2 diabetes patients.
- Charlson score for patient severity

Statistical Analysis

A summary table will be presented to describe the population study variables. Our analysis will investigate the hypotheses by estimating changes in dependent variables for the baseline year prior to Medicaid expansion in January 2014 compared to the performance in the years after expansion. Paired *t* tests and analysis of variance (ANOVA) will be completed to produce descriptive statistics of the preventable hospital utilization of the various payer and geographic variables for the period prior to Medicaid expansion compared to the post-expansion years. Linear regression models will be utilized to account for random effects formulate models reflecting trends over time.

Summary

We study all patients in Kentucky between 2013 and 2017 who were discharged from either an inpatient hospitalization or an emergency department visit related to type 1 or type 2 diabetes to understand the differences in the effects of Medicaid expansion. Such an approach, using objective and longitudinal comparisons, minimizes bias and regulates confounding issues between the respective comparison groups. Rates of preventable hospital utilization for diabetes

care by patients were compared based on their payer status and the geographic classification of their county of residence.

A retrospective, case-control study is used to investigate the relationship between preventable hospital utilization and geographic factors of residence for patients with diabetes. Patients living in Appalachian counties are compared to their non-Appalachian counterparts to measure the difference in the effect of Medicaid expansion on the two groups. Finally, the same evaluation is further stratified by the primary expected source of payment for the hospital encounter.

CHAPTER 4 RESULTS

Demographics and characteristics of Medicaid population

Table 1 illustrates that in the five-year study period of 2013-2017, the Kentucky statewide study population totaled 338,902 unique observations of inpatient hospital admissions and emergency department visits for Medicaid patients with diabetes. Those included 38,173 in the pre-expansion baseline year of 2013 and 300,729 cumulatively in the post-expansion period of 2014-2017. The mean age decreased by 1.6 years in the post-expansion years to 47.3 from the baseline year mean of 48.9 years. A significant reduction ($p<0.0001$) in the median age from 50.0 years to 49.0 years was observed following Medicaid expansion attributed to a significant ($p<0.0001$) shift to younger age groups. The 19-54-year-old population rose from a total 63.9% to 69.8% after broader Medicaid eligibility was introduced in January 2014. Hence, Medicaid expansion was associated with a material benefit to younger diabetic patients in Kentucky through greater access to hospital services.

Diabetes generally introduces a substantially greater burden of morbidity into any patient population. Interestingly, Medicaid expansion in Kentucky brought a considerably lower overall co-morbid burden as measured by Charlson score, both in aggregate ($p<0.0001$) and categorically ($p<0.0001$) by score. In the pre-expansion year compared to the post-expansion period, the mean Charlson score declined from 1.0 (s.d.= 1.5) to 0.3 (s.d. = 1.0) in the population of hospital encounters as a whole. Meanwhile, the median Charlson score of 1.0 in 2013 dipped to 0.0 in the 2014-2017 years. On a categorical basis, those patient encounters with a Charlson score of 0, the healthiest of the respective classifications, swelled from 49.4% of hospital events to a remarkable 84.6% of encounters. The percentage of Category 1 patients decreased from 27.2% to 7.6% in the post-expansion years, and the mix of hospital events with Charlson scores

2 through 4 and greater declined by 5.9, 5.8, and 4.0 percentage points, respectively. Clearly, Medicaid expansion in Kentucky is associated with diabetes patients in the State presenting to the hospital in a relatively healthy condition, very likely connected to the younger population for which it afforded access to enrollment taking advantage of newfound financial access to care but using hospital-based services in lieu of more optimal primary care.

Table 1. Demographics and characteristics of Medicaid patients pre- & post-expansion

Characteristic		Pre-Expansion	Post-Expansion	p-value	Comments
n		38173	300729		
Age		48.9 ± 11.6	47.3 ± 11.6		
		50.0	49.0	<0.0001	Wilcoxon-Mann Whitney test
		[41.0 - 57.0]	[40.0 - 56.0]		
Age group				<0.0001	Chi-Squared test
	18-34	4,902 (12.8)	46,658 (15.5)		
	35-54	19,525 (51.1)	163,329 (54.3)		
	55-64	12,444 (32.6)	84,525 (28.1)		
	65+	1,302 (3.4)	6,217 (2.1)		
Charlson score		1.0 ± 1.5	0.3 ± 1.0		
		1.0	0.0	<0.0001	Wilcoxon-Mann Whitney test
		[0.0 - 1.0]	[0.0 - 0.0]		
Charlson score, categorized				<0.0001	Chi-Squared test
	0	18,840 (49.4)	254,476 (84.6)		
	1	10,376 (27.2)	22,800 (7.6)		
	2	3,356 (8.8)	8,774 (2.9)		
	3	3,184 (8.3)	7,637 (2.5)		
	4+	2,417 (6.3)	7,042 (2.3)		
PQI?				<0.0001	Chi-Squared test
	0	30,457 (79.8)	219,480 (73.0)		
	1	7,716 (20.2)	81,249 (27.0)		
Race				<0.0001	Chi-Squared test
	Asian/Pacif	89 (0.2)	1,002 (0.3)		
	Black	4,907 (12.9)	44,514 (14.8)		
	Hispanic	1,001 (2.6)	5,605 (1.9)		
	Native Amer	20 (0.1)	1,637 (0.5)		
	Other/Miss	147 (0.4)	1,553 (0.5)		
	White	32,009 (83.9)	246,418 (81.9)		
Sex				<0.0001	Chi-Squared test
	Female	25,516 (66.8)	183,479 (61.0)		
	Male	12,657 (33.2)	117,209 (39.0)		
	Other/Unknown	—	41 (0.0)		

All values expressed as n(%), mean ±s.d., or median[Q1 - Q3]

The dependent variable, labeled PQI? in Table 1, indicates preventable hospital encounter utilization as a percentage of total encounters for Medicaid patients with types 1 and 2 diabetes experienced a significant increase ($p<0.0001$). Those patients with inpatient and emergency department discharges related to ACSCs using the AHRQ PQIs of 01, 03, 14, and 16 expanded

from 20.2% of all pre-expansion year observations to 27.0% in the years subsequent to Medicaid expansion. While Medicaid enrollment was up an average of 121% per year in 2014-2017, the average number of hospital events in these years post-expansion for Medicaid patients with an associated diabetes related PQI increased a dramatic 163%, doubling the 80% average increase for all Medicaid events without a PQI. As we might anticipate, as the numbers increase of diabetic patients who have not previously enjoyed the relative economic access to care that a form of insurance affords, we see growth in the aggregate of the relative mix of avoidable encounters.

From a racial distribution, a significant ($p<0.0001$) increase in the percentage of blacks and an offsetting decrease in the percentage of whites occurred in those with diabetes and having Medicaid coverage utilizing inpatient and emergency department services following the 2014 expansion. The proportion of hospital events for Blacks with diabetes in the Medicaid population increased from 12.9% to 14.8% in the comparison periods. In contrast, Whites accounted for 83.9% in 2013 compared to 81.9% in 2014-2017. Throughout this five-year study period, the Black population accounted for approximately 8% of Kentucky residents while Whites represented approximately 85% of the Statewide population (University of Louisville, 2020). According to America's Health Ranking (United Health, 2020), 10.2% of Kentucky's Black adults in 2013, compared to 11.0% of White adults, reported being diagnosed with diabetes. In 2014, the first year of expanded Medicaid enrollment, those percentages rose impressively to 15.8% for Blacks and 12.5% for Whites. In subsequent years, the gap in those rates narrowed in each subsequent year with the rate for Blacks closing in 2017 at 11.4% and for Whites at 13.2%. Thus, Kentucky's Black population with diabetes would seem to have benefitted from Medicaid expansion. Any disparities were substantially closed as a qualitatively

significant percentage of the Black population were newly diagnosed with diabetes, and that rate declined in subsequent years, potentially as larger numbers of Blacks benefited from access to primary care providers managing risk factors leading to a diabetes diagnosis.

Finally, Men with diabetes also appear to have benefited from Medicaid expansion in Kentucky. Prior to increasing the eligibility requirements for enrollment, Males represented 33.2% of all diabetes related hospital events in 2013. That percentage increased significantly ($p<0.0001$) to 39.0% in the subsequent years of 2014-2017 following expansion. According to the Annual Report of America's Health Rankings (United Health, 2020), both Men and Women experienced material increases in being diagnosed with diabetes in the years following Medicaid expansion, though the rate increase for Men outpaced that of Women. With a 2013 baseline nearly identical to Women, 10.7% of Men reported being told they have diabetes, and that prevalence was greater in each subsequent year of the study period, peaking in 2015 at 14.4% compared to 12.5% of Women.

Appalachian vs. non-Appalachian

Table 2 describes the comparative experience of Appalachia and non-Appalachian residents. Across the five years included in the study period, Appalachian residents with a diabetes diagnosis accounted for 562,723 total inpatient and emergency department hospital encounters. By comparison, non-Appalachian hospital events over that time totaled 1,048,107, or 86% more, reflecting the greater population. Given the substantial number of observations, the difference in age of the two segments was small but significant ($p<0.0001$) with Appalachian resident patients at a median age of 62 and non-Appalachians at 61. By age group, the greatest number of encounters were predictably in those greater than 65 years old, representing 66.9% of Appalachian encounters and 65.1% of non-Appalachian encounters. Again, small but significant

differences ($p<0.0001$) are present within the age group comparisons. Each of the respective age groups and the sum of the combination of groups under 55 years of age in the non-Appalachian cohort had a greater proportion of hospital encounters with 34.9% compared to the 33.2% of the Appalachian encounters contributed by this relatively younger population. In contrast, the 55-64 and the 65 plus year old age groups each had greater percentages of the total Appalachian encounters than their non-Appalachian counterparts, combining for 66.9% of total Appalachian encounters versus 65.1% of non-Appalachian occurrences.

Table 2. Demographics and characteristics of patients in Appalachian vs. non-Appalachian counties

Characteristic		Non-Appalachian	Appalachian	p-value	Comments
n		1048107	562723		
Age		60.4 ± 15.8	60.8 ± 15.2		
		61.0	62.0	<0.0001	Wilcoxon-Mann Whitney test
		[50.0 - 72.0]	[51.0 - 72.0]		
Age group				<0.0001	Chi-Squared test
	18-34	65,919 (6.3)	29,568 (5.3)		
	35-54	299,299 (28.6)	157,071 (27.9)		
	55-64	241,403 (23.0)	132,526 (23.6)		
	65+	441,486 (42.1)	243,558 (43.3)		
Charlson score		0.6 ± 1.4	0.6 ± 1.4		
		0.0	0.0	<0.0001	Wilcoxon-Mann Whitney test
		[0.0 - 1.0]	[0.0 - 1.0]		
Charlson score, categorized				<0.0001	Chi-Squared test
	0	778,460 (74.3)	412,469 (73.3)		
	1	102,531 (9.8)	59,097 (10.5)		
	2	58,322 (5.6)	31,822 (5.7)		
	3	51,991 (5.0)	29,962 (5.3)		
	4+	56,803 (5.4)	29,373 (5.2)		
Insurance				<0.0001	Chi-Squared test
	Medicaid	209,621 (20.0)	129,281 (23.0)		
	Medicare	566,417 (54.0)	332,267 (59.0)		
	No charge	4,730 (0.5)	2,392 (0.4)		
	Other	20,789 (2.0)	10,150 (1.8)		
	Private	213,321 (20.4)	77,372 (13.7)		
	Self-pay	33,229 (3.2)	11,261 (2.0)		
PQI?				<0.0001	Chi-Squared test
	0	766,279 (73.1)	426,875 (75.9)		
	1	281,828 (26.9)	135,848 (24.1)		
Race				<0.0001	Chi-Squared test
	Asian/Pacif	3,931 (0.4)	300 (0.1)		
	Black	170,181 (16.2)	8,599 (1.5)		
	Hispanic	14,453 (1.4)	9,008 (1.6)		
	Native Amer	2,969 (0.3)	116 (0.0)		
	Other/Miss	4,686 (0.4)	1,638 (0.3)		
	White	851,887 (81.3)	543,062 (96.5)		
Sex				<0.0001	Chi-Squared test
	Female	581,453 (55.5)	309,551 (55.0)		
	Male	466,564 (44.5)	253,090 (45.0)		
	Other/Unknown	90 (0.0)	82 (0.0)		

All values expressed as n(%), mean ±s.d., or median[Q1 - Q3]

Reflecting the relative health status of patients at the time of their hospital encounter, the Charlson score for patients in both geographic regions was an identical 0.6 (s.d. = 1.4). Likewise, the median Charlson score was 0.0 in both Appalachian and non-Appalachian segments with the same inter-quartile range of 0.0 – 1.0. Despite the lack of practical significance, owing to the overall volume of 1,610,830 encounters observed in the study population over the five-year period, a statistically significant difference was observed ($p<0.0001$).

By analyzing the comparative payer mix of the Appalachian and non-Appalachian geographies, unsurprisingly significant differences ($p<0.0001$) are evident. The Appalachian patient population with diabetes is disproportionately dependent on government sources of payment. Combining for 82.0% of all encounters, the primary government sources of payment, Medicare and Medicaid, accounted for 59.0% and 23.0%, respectively, of Appalachian hospital events for inpatient and emergency department care. The non-Appalachian payer mix, by contrast, included 54.0% Medicare and 20.0% Medicaid, for a combined 74.0% of all encounters studied. The next largest payer category was private insurance coverage which covered 20.4% of non-Appalachians but a mere 13.7% of Appalachians, reflecting a typical vulnerability for Appalachian residents in the form of inferior access to employment opportunity and its accompanying access to employer sponsored health insurance coverage. Medicaid expansion, therefore, is associated with benefits for Appalachian residents with diabetes as evidenced by the relatively small percentage of Self-pay or uninsured patient hospital encounters; 3.2% of non-Appalachians and 2.0% of Appalachians.

Preventable hospital encounters as a percentage of total hospital encounters represented a significant difference ($p<0.0001$) between Appalachian and non-Appalachian diabetics.

Diabetes related PQIs were connected to 26.9% of non-Appalachians, compared to 24.1% of Appalachians. In the post-expansion years, the Appalachian patient cohort experienced a 14% annual growth rate in hospital events overall, but that reflected a dramatic difference in the 61% annual growth rate for those with a PQI compared to only a 4% increase for those without a PQI. The non-Appalachian patient cohort had a higher annual growth rate at 18% overall, with a non-PQI event annual increase identical to Appalachians at 4%, but a significantly higher annual growth rate for PQI events totaling 80%, 19 percentage points greater. On its face, this aggregate result introduces an unanticipated result. Given the typically greater challenges of access to primary care for those living in Appalachia, it would have seemed more likely to observe those Appalachian residents with diabetes to need to resort to hospital settings of care. On the other hand, non-Appalachians would presumably have had relatively more convenient access to primary care providers to effectively manage their diabetes care, preventing acute episodes requiring a hospital visit.

Consistent with expectations, racial differences are apparent and significant in non-Appalachian and Appalachian population segments ($p<0.0001$). Hospital encounters by diabetics over the five-year study timeframe were overwhelmingly utilized by White persons at 96.5% of all visits in Appalachian counties, followed by Hispanics at 1.6% and Black patients at 1.5%. In the non-Appalachian counties throughout the State, 81.3% of all hospital events occurred in White patients, followed by 14.7% from the Black community and 1.4% were Hispanic.

Lastly, there is no practical significance in the difference in gender observed. Females represent 55.5% of non-Appalachian diabetic hospital encounters compared to 55.0% of Appalachian visits to the hospital for care.

Pre- and Post-Expansion Effects Comparison

More interesting observations emerge from the study outcomes displayed in the Table 3 comparison of changes occurring within the Appalachian and non-Appalachian patient populations for the baseline period prior to Medicaid expansion in 2013 and the 2014-2017 post-expansion timeframe. With respect to age, no material changes occur in the relative age groups across all comparisons, aside from a reduction in the non-Appalachian 65 plus year old cohort which experienced a decrease from 43.1% to 41.9% of the total. No change occurred in that age cohort for the Appalachian population. Both pre-expansion and post-expansion in both Appalachian and non-Appalachian segments had an overall mean age of 60. Similarly, there was no change observed in median age of 62.0 in Appalachia and 61.0 in non-Appalachia.

Similar to changes described above in the Medicaid population, significant Charlson score reductions in the post-expansion period were present in both geographic regions. The most significant finding was the reduction in co-morbid burden in both segments from identical mean Charlson scores of 1.2 in 2013 to 0.5 post-expansion, and changes in median from 1.0 to 0.0. In every Charlson score category (0 – 4+), similar changes in the percentage of total patients were seen. The largest shift occurred with increases in Charlson score category 0 with increases of 32.7 percentage points and 31.6 percentage points, respectively, rising to 79% of patients post-expansion in both Appalachia and non-Appalachia.

Significant differences are apparent as well in the percentage of hospital encounters observed characterized as PQI events in both comparison regions. Appalachian patient events deemed preventable increased from 18.0% to 25.5% of all encounters, while in non-Appalachia the prevalence increased 2.3 percentage points greater than in Appalachia, from 18.8% to 28.6%,

suggesting Appalachians may have realized a relatively greater benefit of access to preventive care associated with Medicaid expansion.

Table 3. Demographics and characteristics of patients in Appalachian vs non-Appalachian counties, pre- and post-expansion

		Appalachian		Non-Appalachian	
Characteristic		**Pre-Expansion**	**Post-Expansion**	**Pre-Expansion**	**Post-Expansion**
n		101209	461514	182843	865264
Age		60.8 ± 15.2	60.8 ± 15.2	60.7 ± 15.9	60.4 ± 15.8
		62.0	62.0	61.0	61.0
		[50.0 - 72.0]	[51.0 - 72.0]	[50.0 - 73.0]	[50.0 - 72.0]
Age group					
	18-34	5,510 (5.4)	24,058 (5.2)	11,379 (6.2)	54,540 (6.3)
	35-54	28,357 (28.0)	128,714 (27.9)	51,666 (28.3)	247,633 (28.6)
	55-64	23,480 (23.2)	109,046 (23.6)	41,030 (22.4)	200,373 (23.2)
	65+	43,862 (43.3)	199,696 (43.3)	78,768 (43.1)	362,718 (41.9)
Charlson score		1.2 ± 1.6	0.5 ± 1.3	1.2 ± 1.7	0.5 ± 1.3
		1.0	0.0	1.0	0.0
		[0.0 - 2.0]	[0.0 - 0.0]	[0.0 - 2.0]	[0.0 - 0.0]
Charlson score, categorized					
	0	47,036 (46.5)	365,433 (79.2)	88,107 (48.2)	690,353 (79.8)
	1	23,426 (23.1)	35,671 (7.7)	39,561 (21.6)	62,970 (7.3)
	2	11,577 (11.4)	20,245 (4.4)	20,655 (11.3)	37,667 (4.4)
	3	10,341 (10.2)	19,621 (4.3)	18,077 (9.9)	33,914 (3.9)
	4+	8,829 (8.7)	20,544 (4.5)	16,443 (9.0)	40,360 (4.7)
PQI?					
	0	82,950 (82.0)	343,925 (74.5)	148,452 (81.2)	617,827 (71.4)
	1	18,259 (18.0)	117,589 (25.5)	34,391 (18.8)	247,437 (28.6)
Insurance					
	Medicaid	17,275 (17.1)	112,006 (24.3)	20,898 (11.4)	188,723 (21.8)
	Medicare	60,213 (59.5)	272,054 (58.9)	101,245 (55.4)	465,172 (53.8)
	No charge	2,060 (2.0)	332 (0.1)	3,401 (1.9)	1,329 (0.2)
	Other	1,848 (1.8)	8,302 (1.8)	4,399 (2.4)	16,390 (1.9)
	Private	13,973 (13.8)	63,399 (13.7)	37,568 (20.5)	175,753 (20.3)
	Self-pay	5,840 (5.8)	5,421 (1.2)	15,332 (8.4)	17,897 (2.1)
Race					
	Asian/Pacif	47 (0.0)	253 (0.1)	576 (0.3)	3,355 (0.4)
	Black	1,515 (1.5)	7,084 (1.5)	28,308 (15.5)	141,873 (16.4)
	Hispanic	1,418 (1.4)	7,590 (1.6)	3,481 (1.9)	10,972 (1.3)
	Native Amer	17 (0.0)	99 (0.0)	129 (0.1)	2,840 (0.3)
	Other/Miss	249 (0.2)	1,389 (0.3)	802 (0.4)	3,884 (0.4)
	White	97,963 (96.8)	445,099 (96.4)	149,547 (81.8)	702,340 (81.2)
Sex					
	Female	56,394 (55.7)	253,157 (54.9)	102,720 (56.2)	478,733 (55.3)
	Male	44,811 (44.3)	208,279 (45.1)	80,122 (43.8)	386,442 (44.7)
	Other/Unknown	<10 (0.0)	78 (0.0)	<10 (0.0)	89 (0.0)

All values expressed as n(%), mean ±s.d., or median[Q1 - Q3]

Payer mix adjustments to move previously uninsured persons to the Medicaid rolls were an objective of a policy to expand Medicaid. To that end, significant shifts were realized post-expansion in Appalachia as well as non-Appalachia. While Medicaid already accounted for

17.1% of Appalachian patient encounters in 2013, the post-expansion years saw that percentage rise to 24.3%, an increase linked to similar reductions in the mix of uninsured patients. As for non-Appalachia, the baseline 2013 Medicaid payer mix was relatively low at 11.4% of total inpatient and ED hospital visits. Medicaid expansion, however, enabled that payer to account for a substantially higher 21.8% of visits in 2014-2017 and reduced Self-pay visits from 8.4% in 2013 to a mere 2.1% post-expansion. Thus, the mix of non-Appalachian Medicaid visits grew by 10.4 percentage points compared to a growth of 7.2 percentage points in Appalachian Medicaid encounters, a qualitatively significant difference of 3.2 percentage points of Medicaid visit growth. More striking is the magnitude of growth in Medicaid events by geography which saw Appalachian patient encounters grow at an impressive growth rate of 62% in the average post-expansion year compared to 2013 but lagging well behind the 126% increase in the average post-expansion year for non-Appalachians.

From a race and gender standpoint, no appreciable changes are seen in either the Appalachian or non-Appalachian groups over the comparison periods, with any race or sex segment changes amounting to less than one percentage point change. The largest change was an increase in the percentage of the visit population among Black patients from 15.5% to 16.4% of total visits with equal reductions of 0.6 percentage points from Hispanic and White patients in the non-Appalachian visit population. The percentage of females with hospital encounters decreased in Appalachian visits from 55.7% in 2013 to 54.9% post-expansion, and from 56.2% to 55.3% of non-Appalachian visits.

Linear Regression Models

Aside from describing the demographics and characteristics of the relevant patient population segments and how those qualities were different in the pre-expansion and post-

expansion periods, a unique perspective emerged through the development of linear regression models to illustrate trends over time for diabetes related hospital events when adjusted to rates per 1,000 beneficiaries. To do so, unique rates were calculated to measure the effects of being in each of the respective 2,400 county quarter months observed, which is the product of each of the 20 calendar quarters in the 2013-2017 study period for the respective 120 Kentucky counties, 54 of which are in Appalachia and 66 outside of Appalachia. Segmentation was made to distinguish the effects of living in an Appalachian county, and the change in slope for the risk associated with time after 2013 and living in Appalachia.

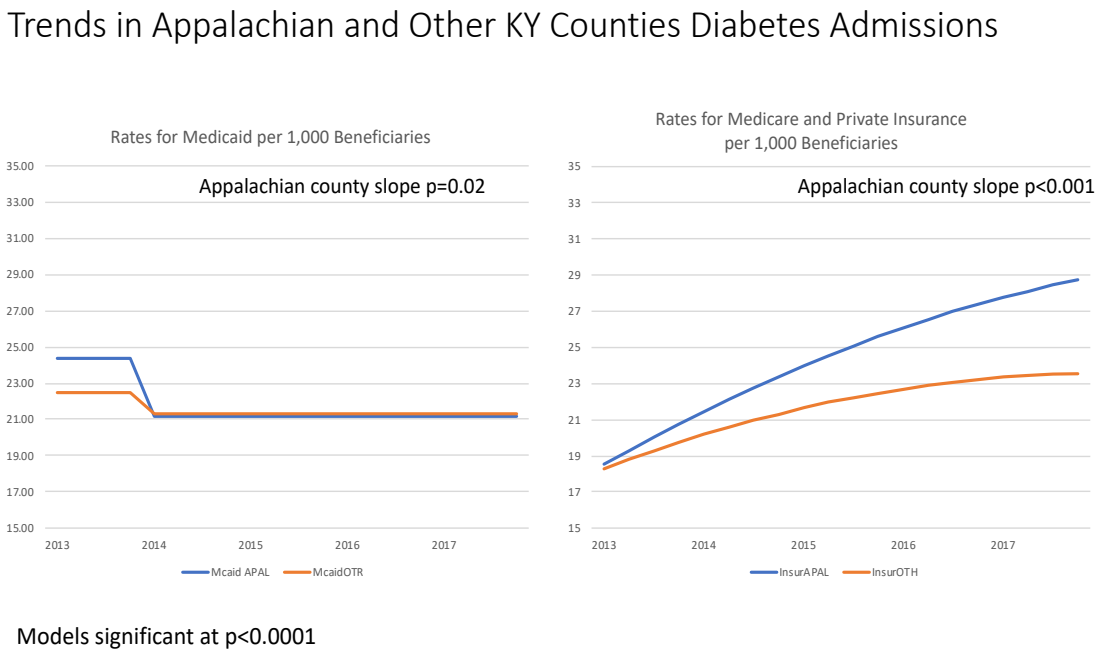


Figure 2: Trends in Appalachian and Non-Appalachian Diabetes Hospital Utilization

Figure 2 reflects the resulting linear regression models of the trends over time, all of which are highly statistically significant models ($p<0.0001$). In summary, the variable for Appalachia post-expansion is significant ($p = 0.0242$) for Medicaid. The left side of Figure 2

indicates the rate of diabetes related inpatient admissions and ED visits for Medicaid in 2013 approaches 25 per 1,000 beneficiaries amongst those living in Appalachia while those outside of Appalachia are approximately 23 per 1,000 beneficiaries. Following a brief uptick in hospital events coinciding with expanded Medicaid enrollment in 2014, the rates for Appalachian and non-Appalachian Medicaid beneficiaries drop precipitously in the third and fourth quarters of 2014 before settling into a stable rate.

Two facts are particularly noteworthy regarding the model for Medicaid beneficiaries. First, the rate of diabetes related hospital events overall dips significantly for all Medicaid patients in the State, well below the pre-expansion baseline. Second, and most interesting, is that those Medicaid patients residing in Appalachian counties experience a greater reduction in hospital events than did their non-Appalachian counterparts, to the point that their rates reflect effectively no difference by the midpoint of 2014, very soon after Medicaid enrollment expansion occurred in Kentucky. While Appalachian diabetics in Kentucky were worse off in terms of requiring more frequent hospital encounters in 2013, after Medicaid expansion in 2014 their utilization matched that for Medicaid enrollees living outside of the Appalachian region. Thus, arguably, Medicaid expansion worked to decrease hospital events for the Medicaid population generally and benefited Appalachian diabetics as such disproportionately.

The next question explored was to determine what sort of comparative effect occurred for beneficiaries of Medicare and private insurance, a cohort presumably unaffected by Medicaid expansion. Hence, the linear regression model on the right side of Figure 2 was developed to examine the change in diabetes related hospital events per 1,000 beneficiaries of Medicare and Private Insurance. The results are striking in their contrast to one another and the experience of Medicaid beneficiaries across the study period.

In this cohort, while there is no effect strictly for pre-expansion compared to post-expansion, there is clearly a significant effect over time. Medicare and Privately Insured patients in Appalachia and non-Appalachian counties effectively begin from a common starting point in 2013 approximating 18-19 events per 1,000 beneficiaries, and they are significantly lower than what was experienced by Medicaid patients in that pre-expansion year. However, over time these Medicare/Private Insurance patients living in Appalachia experience a steep hospital utilization growth rate which by 2015 surpasses the pre-expansion Medicaid rate of Appalachians. While the non-Appalachian Medicare/Private Insurance beneficiaries see growth as well, the rate of that growth is less extreme. These non-Appalachian diabetics experience an increased hospital utilization rate that ultimately surpasses their non-Appalachian Medicaid colleagues but not until late 2016 and then the slope flattens at that point.

These results suggest the indication of what is being observed is the greater proportion of Medicare/Private Insured beneficiaries who are in fact Medicare recipients, which would be expected to have more co-morbid conditions than the relatively younger Medicaid beneficiaries. Likewise, knowing the Appalachian region encompasses a relatively older population, hence a greater percentage of Medicare beneficiaries, generally we would expect to observe greater numbers of diabetes related events in Appalachian counties when compared to non-Appalachian. Hence, the starkly different trajectories observed in Figure 2 for these respective Medicare/Private Insurance patients would seem a predictably natural effect evident in an older population.

CHAPTER 5 DISCUSSION

The noblest ambition for healthcare stakeholders is to see all our neighbors have the best health status and quality of life possible. If for all of the investment in Medicaid being made there is no correlating health improvement, then we should acknowledge it and redirect resources to discover alternative innovations in care. On the other hand, where there is evidence that Medicaid creates health benefits for citizens, it should be celebrated and replicated.

Diabetes is a tremendously burdensome chronic disease for even the least vulnerable person. Barriers to access and care add insult to injury. Many of those barriers are common in Appalachia, including financial obstacles associated with lack of insurance coverage, lack of access owing to the absence of providers, disadvantageous social determinants of poor health, and transportation difficulties within the geography of residence.

The purpose of this study was to gain some insights into the relative changes in hospital events for Kentucky residents with diabetes in the years following the ACA expansion of Medicaid. It is widely accepted that previously uninsured individuals who gain Medicaid coverage benefit from improved primary care access and chronic disease management which serves to prevent avoidable hospital utilization. Certainly, Medicaid coverage contributes to the remediation of a financial obstacle to preventive care. But other impediments remain, including transportation and qualified primary care capacity to provide the right care when it is needed.

Diabetes care access and management is essential to achieving the Triple Aim in any targeted population. Some would argue that all hospital events related to diabetes are preventable with effective chronic disease management to avert the escalation of complications into acute events. The occurrence of any diabetes related hospitalization or ED visit should serve as a warning light on the healthcare system dashboard that there is an opportunity for

improvement in the experience of care for that patient and for those who bear the risk for the care and cost of the patient population. That opportunity for improvement may be related to access to primary care, rooted in various social determinants of health linked to vulnerable populations, or the most troubling problem of patient non-compliance.

This study's results find alignment with several of those in the studies we have cited. We find corroborating evidence with the 2016 study by Sommers, Blendon, Oav, and Epstein involving a Medicaid expansion effect comparison of Kentucky with Arkansas and Texas which determined over time expansion resulted in greater primary care access and lower ED utilization. Our results are also consistent with studies by Wen et al. (2019) which found expansion associated with decreased hospital use over time, and by Chang, Mirvis, and Waters (2008) which discovered Medicare patients had the highest risk of avoidable hospital admissions.

The result observed significant declines in hospital event use rates per thousand beneficiaries for diabetes care among those with Medicaid coverage, giving us cause for optimism: that gaining access to Medicaid coverage will improve the health status of this vulnerable population through identifying underdiagnosed diabetics or pre-diabetics. Intervening with proper chronic disease care management at an earlier age and earlier disease stage should be associated with reductions in wasted expense from preventable hospital care and Years of Potential Life Lost.

Prior to the ACA ramp up of expanded Medicaid enrollment, we found that in 2013 in Kentucky relatively higher rates of diabetes related hospital admissions occurring in the Appalachian counties, consistent with the ARC reports of diabetes-related mortality in this region specifically at 41% greater than the national rate. We know the incidence rates and risk factors associated with diabetes are more prevalent in Appalachian than in non-Appalachian

regions. With that comes greater burden of the disease associated with the lack of chronic care management, as evident in the detected 2013 Appalachian utilization. However, we also see the contribution Medicaid coverage can have in lowering use rates in this population.

While there are multiple factors impacting the decision to embrace Medicaid expansion, findings from our study in Kentucky identify the potential magnitude of benefit to reducing patient suffering and financial waste from avoidable hospital utilization for vulnerable citizens facing financial and non-financial obstacles to primary care access. By augmenting the criteria for Medicaid eligibility to include a chronic disease diagnosis in addition to an income qualifying threshold, States who have yet to expand Medicaid might discover a pathway to balance priorities of resource stewardship and enhanced population health status. Given the rural prevalence of the states who have not yet expanded Medicaid, where higher rates of diabetes and other chronic diseases exist, policymakers in those states could favorably impact their health rankings without substantially compromising their fiscal values.

As Deloitte reported in its 2015 Commonwealth of Kentucky Report on Medicaid Expansion commissioned by the State, enrollment among newly eligible citizens exceeded expectations by 89%. With 84% of new enrollees indicating their new coverage was providing access to the care they needed, including preventive services and hemoglobin A1c testing, diabetes became one of the most common chronic conditions newly diagnosed in the Kentucky Medicaid expansion population.

New Medicaid coverage enrollees benefit from the opportunity to gain access to care needed and have their diabetes diagnosis made earlier when chronic disease management can help prevent complications. As we would expect, the number of visits increased in aggregate, but the overall use rate per 1,000 declined. Interestingly, we also see a relative increase in

hospital events being PQI related as patients are taking advantage of their new access. That PQI rate is even higher in non-Appalachians than Appalachians.

A younger, healthier population in aggregate for the Medicaid population is associated with a lower overall use rate while those covered by Medicare and private insurance saw those rates rise. It is unclear why the rate in Appalachia Medicaid would decrease at a greater rate than non-Appalachians and reach a level of stability with equivalent use rates. Perhaps non-Appalachians are taking relatively greater advantage of their newfound economic access to care while Appalachians continue to face non-financial obstacles to reaching hospital services. Alternatively, perhaps Appalachians are benefiting disproportionately to their newfound access to primary care to the point of appropriately avoiding the escalation of their diabetes to require hospital care.

Irrespective, the fact remains that the greatest potential to enhance the health status of diabetics, regardless of where they reside geographically, is to effectively connect them to a patient-centered primary care home. Eliminating all barriers to a meaningful relationship between patients with debilitating and complex chronic diseases, such as diabetes, and the primary care providers equipped to protect them from acute complications is paramount. As health policymakers seek to make informed decisions regarding policy decisions, consideration should be weighted by the evidence of the cost and benefits of disease management, including bridging all gaps to essential care, financial and otherwise. Surely, Medicaid expansion in Kentucky has contributed to a decline in the use rate of inpatient and ED hospital events for this vulnerable segment of the population.

While overall Medicaid hospital event use rates declined over time, the fact that there was a substantially greater increase in the volume of events associated with a PQI compared to

those without a PQI suggests the new coverage opportunity was attractive to a broad spectrum of diabetics. There is the possibility of a selection effect by some previously uninsured who sought to enroll in Medicaid from their recognized risk to need more intensive healthcare interventions in a hospital setting and took advantage of that access. Also evident is that new Medicaid beneficiaries potentially were otherwise asymptomatic and only became aware they had diabetes as a result of the screening services afforded to them with their new coverage and gained greater disease control benefit over time.

Limitations

For this study, we were not able to determine the extent to which further clinical demand exists and diabetes care needs have remained unmet. Likewise, we are unable to measure if the decline in use rate may be a function of a real decrease in demand for acute care services. By relying on encounter data, we by definition are not accounting for actual demand. How often patients simply choose to forego care altogether is unknown. Personally, I have witnessed residents of Appalachia who have elected to simply "let nature take its course." Whether that choice is a result of the rugged individualism characteristics of Appalachians, acceptance of one's fate, lack of recognition of the care needed, or lack of willingness to make sacrifices to locate care when it is needed, a degree of unmeasured demand exists. Health policymakers must consider how to reach those who remain undiagnosed or are not being actively managed.

We analyzed data from one state regarding the experience of its diabetic population surrounding the period of Medicaid expansion. While the study appreciates and factors the diversity of geography demographics, and access to healthcare provider services in Kentucky, the experience may be different in other geographic locations. Future studies are needed to assess the effects of Medicaid expansion in other states throughout Appalachia, as well as to compare

the experience of those Appalachian states which have and have not adopted a policy of expanding Medicaid eligibility requirements.

Our study was limited to observations from the four quarters of the single year immediately prior to expansion. This presumes the trends of use rates and the characteristics of the population studied were constant in other periods leading up to implementation of Medicaid expansion.

The study benefited greatly from access to Kentucky data for the number of Medicaid enrollees per quarter for each of the respective counties throughout the Commonwealth. Lacking, however, was the capacity to know the census of Medicare and privately insured persons in order to calculate with precision the hospital event use rates for that cohort. The estimates were made with parallel assumptions that we feel do not detract from the validity of the linear regression models depicted.

Conclusion

The answers to the hypotheses tested in our study culminated in mixed results. We confirmed that prior to Medicaid expansion diabetics in Appalachia indeed were experiencing higher rates of preventable hospital use than those in non-Appalachian counties. Likewise, the rate of Medicaid diabetes-related hospital use confirmed an anticipated decline statewide in the years following the January 2014 expansion of Medicaid. On the other hand, unexpectedly, the change in Medicaid covered diabetes-related hospital utilization for patients residing in Appalachian counties was more favorable than the change for those residing in non-Appalachian counties. Also, contrary to our hypothesis, Medicaid patients in Appalachian counties did not have higher rates of diabetes-related hospital utilization than Appalachians with other forms of insurance unaffected by Medicaid expansion, namely those with Medicare and private insurance.

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