5-5-2017

Hospital Utilization Rate in The United States: Inpatient, Emergency Department and Outpatient Channels of Care Between 2005 and 2013

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Hospital Utilization Rate in The United States: Inpatient, Emergency Department and Outpatient Channels of Care Between 2005 and 2013

BY

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A Thesis Submitted in Fulfillment of the Requirements for the Degree of

Master of Public Health

The School of Public Health

Georgia State University

GEORGIA STATE UNIVERSITY

2017

Acknowledgement

I would like to thank my thesis chair, Dr. Lee Rivers Mobley for her very useful health economy and policy perspective, with encouraging support and lightning fast feedback for my every draft in completing this thesis. I would also thank my thesis committee, Dr. Dora Il'yasova for her useful support and insight from epidemiologist perspective towards my thesis completion.

I am grateful that Fulbright had given me the opportunity to study in the United States and meet with outstanding staffs and mentors in Georgia State University. Fulbright also provided me with opportunity to meet countless of new friends who are experts in many fields, and had given me a chance to learn new cultures during my stay in this country.

Finally, I want to express my deepest gratitude to my blood family back home and my new family in the United States. To my mother, for her endless understanding and consideration during her day and night prayers. To my father, who supported me with endless encouragement and free flowing expertise, as well as to my new brothers and sisters that I meet in the United States for being available and makes me feel like home.

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Abstract

Objectives: To assess how three channels of hospital care – Inpatient (IP), Emergency Department (ED), and Outpatient (OP) visit rate changes between 2005 and 2013 and which factors are associated with the changes.

Methods: Using nation-wide data from Area Health Resource File (AHRF) 2015-2016 Release, we compare the mean hospital utilization between 2005 and 2013 and perform paired t-test to identify significant changes over time. We perform Wilcoxon two-sample test to determine if utilization changes between Medicaid-expanding states and non-expanding states have significant difference. To explore which factors can affect the utilization rate, we perform a multiple regression with thirteen factors of interest based on available data and the Andersen conceptual framework model. We stacked our 2005 and 2013 data and add time interaction variable with Medicaid expanding status to determine if the interaction between expansion and time is associated with the utilization rate in the adjusted regression model.

Results: We find significant changes in hospital utilization rate between 2005 and 2013. There is a 23.3% decrease in inpatient (IP) days of care rate and an increase of 4.4% in emergency (ED) and 12.9% in outpatient (OP) visit rates. When we separate the counties by Medicaid-expanding status, we find a significant difference on IP, and ED utilization rate between states that did and did not expand Medicaid over time. However, after we test it again by inserting expanding status and time interaction in our adjusted regression model, we did not find any significant association with any of the channels of care.

Factors that influence the utilization rate also vary, we find that area mortality rate, female and non-English Speaker population proportion, residential segregation, poverty, income

inequalities, urban areas, and hospital availability are significantly associated with increased hospital utilization.

Conclusions: There are significant hospital utilization changes in crude, unmodeled hospital utilization rates between 2005 and 2013. However, despite the concerns of hospital overcrowding in Medicaid-expanding states, we find that after adjusting for all other factors, expanding states variable alone is significantly associated with the outpatient care utilization rate (β=-413.09, p = 0.0240), but does not have any significant association with Inpatient and Emergency department utilization rate. Which implies that in the six Medicaid expansion states, the outpatient care utilization rate was significantly lower than in the non-expanding states. Furthermore, when Medicaid expansion is interacted with time, it does not show any significant association with any channels of hospital utilization rate. Thus, the fears that Medicaid expansion would crowd the system are unfounded for these six states.

Keywords: Hospital Utilization, Affordable Care Act, Medicaid Expansion, Emergency Department, Inpatient Care, Outpatient Care

1. Introduction

The implementation of the Affordable Care Act (ACA) on 23rd March 2010 has changed the face of the overall American healthcare system. It introduced some groundbreaking provisions such as individual mandate, health exchange market, coverage guarantee for high risk population (protection from denial due to pre-existing conditions), expanding Medicaid coverage up to 138% Federal Poverty Level, assuring coverage for preventive care and essential benefits, and allowing parents insurance to cover dependents up to the age of 26 years old.[1,2,3] These provisions are made to increase the overall health of the people in the United States, and primarily targeting the 50 million uninsured Americans to get health insurance coverage.[3]

Under the ACA provisions, the availability and cooperation of insurers are important not only to cover more previously uninsured but also to create a competitive market and lower the cost of care. Many insurers were supposed to offer competitive rates to benefit from the sudden growth in new enrollment rate. However, establishing initial rates under this reform was challenging for the insurers because underwriting and pre-existing condition exclusions were no longer allowed. Thus, one-quarter of insurers underestimated their projected medical claims cost where the actual median medical cost was $41 higher than projected. A higher utilization rate is deemed to be the driver of this increase because previously uninsured subscribers might come in to hospital in a sicker condition, and previously underinsured subscribers could unleash "pent-up demand" right after their enrollment in a new, more comprehensive plan[4,5,6].

Recently, many health insurers lost hundreds of millions of dollars on their ACA health coverage plan. Three out of four of the biggest U.S health insurers are planning to quit offering ACA health insurance plans: UnitedHealth said that they would quit offering ACA plans in 31 of the 34 states, Humana will exit from 8 of 19 states, and Aetna plans to stop selling ACA plans

in 11 out of 15 states.[7] Without support of these large health insurance companies, the plan to control the price by creating a competitive market in the exchanges will likely fail.

Furthermore, the implementation of the dependent coverage mandate had increased the price of premium by 2.5 to 2.8%. The marketplace health plans also show that even after subsidies, some individuals between 300% and 400% of the Federal Poverty Level (FPL) still cannot afford or have no choice of affordable health coverage. Despite the effort to persuade healthy people to sign up for the ACA plans, the increase in premium price costs is relatively more expensive than the penalty. A 27-year-old who faces a higher premium of $804 annually vs. $230 annual penalty will more likely to decide to just pay the penalty and not purchase coverage.[9]

When a cost containment plan that relies on market competition does not work, and the enrollment rate of young and healthy population is low in the exchange market, there is another part of ACA that should still help increase the insurance coverage rate. That is, expanding Medicaid was supposed to extend access to care for half of the targeted uninsured 32 million people by 2019 by increasing the eligibility under Medicaid for people with low income of up to 138% Federal Poverty Level (FPL). To help the states in expanding Medicaid eligibility, the federal government would help by paying 100% of the expansion cost in the first three years, phased down to 90% of it by 2020. However, the U.S Supreme Court ruled that states can choose not to expand Medicaid, and to our surprise, despite being subsidized 100% by the federal government, some states were still unwilling to expand Medicaid.[10,11]

There is no clear reason why the non-expanding states declined to accept $50 billion in free federal money to expand Medicaid. One research study found that by decreasing the uninsured rate, Medicaid expansion will reduce the need for the already existing federal funding

for uncompensated care for uninsured patients. Therefore, while expanding states will increase their current federal funding by only about 16%, non-expanding states will still be increasing their federal funding need by 25% during the same first 10-years period of ACA for the uncompensated care. However, the federal government will still cut $18 billion of their existing federal funding for uncompensated care, by assuming every state will expand Medicaid. Therefore, this puts a huge financial pressure on hospitals who were still required to provide charity care in non-expanding states.[12]

Galen Institute proposes 12 reasons of why states should not expand Medicaid. Their first and most concerning reason is that Medicaid will harm the poor by adding 20 million people to the program and causing people to wait longer to get health care. Galen stated that expanding Medicaid will cause people to overcrowd the health care provider, thus causing them to wait longer for the doctor appointment.[13] This thesis will try to evaluate whether such overcrowding is happening in the first 6 states that expanded Medicaid in 2010 compared to non-expanding states by comparing their utilization rate trends over time.

To date, there are many studies done to access the impact of Affordable Care Act (ACA) on the utilization rate of health care facilities. Many of these studies access the impact of ACA separately on either emergency department or inpatient use of hospitals. Others are focusing more on ACA impact on certain population or certain diseases[16,17]. To the author's knowledge, there has not been any paper published to assess all channels of hospital utilization changes after the ACA together, compared side by side. Evaluating all channels of care in hospitals is an important evaluation because examining only one or two channels of care might give an inaccurate assessment of decreasing hospital utilization while ignoring that the same population of patient might come to seek help at other channels of care. To cover this knowledge gap, this

thesis will assess the impact of ACA on all three channels of care that consist of Inpatient (IP) days of care, Emergency Department (ED) and Outpatient (OP) visit rates of the hospitals in the United States. This thesis will also compare the differences in these changes over time between expanding and non-expanding states. To evaluate whether the changes in utilization are significantly associated with the date of implementation of the ACA, the third part of the thesis will explore factors that might affect the utilization rates to give a better understanding of other factors besides insurance rate that can affect utilization rates. Holding these factors constant statistically, the model will test for whether each of the three hospitalization rates changed significantly over time, and whether there was a difference across the expanding and non-expanding states.

2. Literature Review

2.1.Health Insurance and Health Care Demand

Health insurance is one of the best ways to increase access to health. Gaining health insurance coverage can make people feel more confident to visit the hospital or do preventive check-up rather than going uninsured.[15,21] However, many kinds of literature agree that health insurance availability can induce increased unnecessary health care demand. There are many ways to explain why such increase can happen. First cause is the "adverse selection" condition where individuals who are buying the health insurance are more likely coming from a population with greater health needs. When people know that they have a higher health risk, they are more likely to insure themselves compared to the healthier population.

The next reason is "Moral hazard" where people use more health care than what they need because they are covered under health insurance. Without health insurance, people are more likely to think before spending money for health care. But if the payment burden is shifted to third party payer (insurer), people who have insurance will not only more likely to use certain medical service but might also cause them to do more unhealthy behavior compared to those who do not have health insurance.[14]

2.2.Hospital Channels of Care Utilization

Inpatient care

The overall rate of hospitalization in the United States has been decreasing over time. According to data from Health Care Cost and Utilization Project (HCUP), there is an average annual decrease of 0.3% between 2003 and 2008 and an average annual decrease of 1.9% between 2003 and 2012. The cause of hospitalization in 2012 was 56% medical cause, 21.8%

surgical, and 22.2% were maternal and neonatal cause. Medicare patients remains to be the primary use of inpatient care over time between 2003 to 2012 (37.1% to 39.1%), followed by private insurer (36.6% to 30.6%), and Medicaid (18.4% to 20.9%).[18]

Different from the overall inpatient statistic above, when we look at certain subgroup such as young adults which are the target of ACA we can see an overall increase in their inpatient care use. Yaa Akosa (2015) found that ACA had increased inpatient visits in young adults aged 19-25 years by 3.5% while mental illness visits increased by 9%. However, when comparing it with the control group (young adults aged 27-29 years), there seems to be no significant difference in their trend. Yakosa also implied that with moral hazard in place and the fact that inpatient care still increases after the implementation of ACA (which should increase outpatient care as a substitute for inpatient care), we can conclude that inpatient care is a "compliment" rather than a "substitute" for other forms of care.[19]

Leemore (2004) also assess the impact of expanding Medicaid in children population and found that for each ten percentage-point rise in Medicaid eligibility, there is an increase of 8.4% in hospitalizations. However, Leemore also found that the increase in unavoidable hospital care is lower than half of avoidable hospitalization which is a good sign that efficiency is evident in this population.[20]

Emergency Department

One of the goals of ACA is to reduce the unnecessary visit rate to emergency department for specific conditions that can be cared through other channels of care like preventive clinic or other outpatient setting. Hernandez-Boussard (2015) found that this specific goal is achieved in California, Florida and New York where she analyzed the total ED visits between 2009 and 2011

among adults aged 19 to 25 years and found a relative decrease of 0.5% ED visits per 1,000 people compared to older group.[22]

In contrast with Hernandez's study, there are many studies that show increase in ED utilization in the United States over time and after ACA implementation. The latest study by Dresden (2016) using statewide hospital administrative data found that Emergency Department visit of adult aged 16 to 64 years in Illinois had increased by 14,080 visits or 5.7% between 2011 and 2015 after ACA implementation[23]. Similarly, Roberta (2016) analyze the National Emergency Department Survey (NEDS) data set of adults age 18 to 64 years and found an increase of ED visits due to mental health disorder by 8.6% between 2006 to 2011.[24] Even further, Taubman (2014) found that expansion of Medicaid program for uninsured, increases the overall ED use by 0.41 visits per person, or 40% relative to the average control group by following the newly Medicaid-insured patients for 18 months after their win their Medicaid lottery in Portland hospitals.[28]

The increase of ED utilization seems to be not isolated just for young adults but also happened to adults aged 65 and older. According to study by Pines (2013), the annual visit rate of 65 and older adult had a dramatic increase of 24.5% between 2001 and 2009.[25] Furthermore, study shows that the older the population, the more ED becomes their main gateway for hospital admission. Greenwald (2015) study evaluate the ED admissions data from National Hospital Discharge Survey to see the trend between 2003 to 2009 and found that ED was the source of hospital admissions for patients 64 years and younger, 65 years and older, and 85 years and older were 44.4%, 57.3% and 75% respectively.[26]

Regarding utilization rate of ED in correlation with other channels of care, the same pattern with inpatient care from Yakosa study (2015) is found in studies that evaluate the impact

of the availability of PCP to ED visit rate. Hunold (2014) study the implication of the number of available primary care by ZIP code per 100 adults aged 65 years or older with their ED utilization rate in North Carolina and found that PCP availability does not correlate significantly with ED use. Thus, supporting the argument that increasing PCP availability is not an appropriate way to reduce ED visits. [27] Similarly, Widmer (2014) also found that among Medicaid Beneficiaries, OP office-based provider visits cannot reduce ED utilization.[31]

A study conducted by Glover (2016) also supports the notion that PCP availability will not reduce ED visits by looking at the fact that despite the implementation of Medical Home Network (MHN) in Illinois to increase PCP access, MHN patients continued to use EDs. Glover found four main cause that hesitates MHN patient from using MHN service: (1) Visiting PCP requires appointment and scheduling (2) ED use is more practical when it comes to pain or physical pain (3) Lack of willingness to discuss mental health issue, and (4) ED care is a "fast, solution-oriented, team-based, and patient-centered within an environment containing necessary equipment" compared to PCP office.[29]

Outpatient Care

In contrast with inpatient care that has decreased significantly overtime, outpatient care experience an overall increased rate of visits per 1,000 people by 29% between 1992 to 2000.[33] As mentioned in the various studies above, outpatient (OP) care is not a substitute for other channels of care. Fleishman (2008) study the association between OP and IP service use among persons with HIV infection and shows that IP and OP have positive relationship rather than negative. This means that OP care cannot be used as a cost-saving mechanism for IP. However, without OP care, there is a likelihood to increase hospitalization and maintaining regular clinic monitoring is important for the well-being of the patients[30] Even further, Kaestner (2015) provide

an evidence causal-association that a $100 increase in OP spending was associated with 1.9% increase in the probability of having IP care and 4.6% increase in IP spending. This leads to a conclusion that seeing a doctor more often does not keep people out of the hospital.[32]

2.3.Andersen Model of Health Services Utilization

To produce a better health outcome and reduce the cost of health, one of the most commonly used framework to access factors that affects health services utilization is the Andersen Framework. Babistch (2012) compiled a systematic literature review of all studies using Andersen Framework published between 1998 to 2011 to understand what factors can facilitate or impede the utilization rate of health services.[34]

According to the Andersen model, individual utilization of health care services is based on a function of three characteristics: (1) Need factors is the most immediate cause of health service use, (2) Predisposing factors is the socio-cultural factors of the individual that exist, and (3) Enabling Factors is the logistical factors that enables an individual to obtain care.[34]

Need Factor

Mortality Rate

When it comes to need factors, Andersen differentiates between "perceived" and "evaluated" need. Where perceived is based on how people view their own health need and evaluated is an objective measurement of someone's need from health based professional assessment. Another type of need is environmental need which indicates the overall population health condition such as mortality and morbidity.[34] The mortality rate has always been a good measure of the overall environmental health condition in society. It serves well as an overall well-being of the whole society because it does not just measure a partial health problem from

chronic or infectious diseases, it also gives an understanding of the health problems caused by regular and crime-related injuries, homicides and all other factors that might need to be addressed in a hospital.[35] Numerous studies had shown that mortality rates are positively correlated with hospital utilization. Steiner (2013) study shown that multiple chronic conditions were associated with higher mortality rates, use of services, and average cost.[36] Regarding the benefit of hospital utilization with mortality rates, A study done by Mitchell (2012) comparing the mortality rates of Old Order Amish (OOA) that has low medical service use with regular Framingham Heart Study (FHS) population, shown that high hospital and health care service utilization does not cause a lower mortality rate and the longevity of Amish population is actually higher than its non-Amish counterparts. Mitchell speculates that the Amish's healthy lifestyle produces significant gains to their overall well-being.[37]

Predisposing Factors

Sex, Age, Education, Language, and Diversity Index

Sex. Numerous study had shown that women use more health care services than men. Bertakis (2000) test this assumption with a one year cohort study and found that women had significantly lower health status, and have higher use of primary care, specialty care, emergency treatment, diagnostic services, and total annual charges. However, regarding hospitalizations, there are no differences in the means of hospitalization between men and women.[38,39] This result is supported by HCUP 2012 data which shown that females have higher rate of hospitalization but males have a longer length of stay and higher cost per stay.[18]

Age also plays a great role in hospital utilization, HCUP 2012 data shows that the rate of hospitalization for people age 1-17, 18-44, 45-64, 65-84 and 85+ per 1,000 population is increasing by more than twice for every increase of age group.[18]

Education level, in general, had been shown to have an impact on hospital utilization rate. Studies have shown that low education attainment causes people to use less health care compared to the highly educated population.[34,40]

Language. English language proficiency can also influence individual's decision to seek care. A study by Shi (2009) about the influence of English proficiency on access to care shows that before adjusting health and socioeconomic status, people with low English proficiency will significantly forgo their medical need and lower their health care visit. However, after adjusting health and SES, the language barrier is no longer significantly causing them to forgone their health need, but will still significantly limit their visit to health care.[41] In addition, Ka Ming (2016) found that there is no difference in hospital admission rates by language proficiency, but patients with low English proficiency were 24% more likely to be readmitted to ED within 72 hours compared to those without language barrier.[42]

Diversity Index. This study is using Theil diversity index as a measurement of multigroup entropy index. The data is retrieved from United States Census Bureau where it measures the extent of several groups in a metropolitan area.[43] This entropy index is presented on a range of 0 if all areas have the same composition of ethnicity as the entire metropolitan area (maximum integration) to 1 if all areas contain only one group (maximum segregation). In other words, the higher the number, the more segregated the area. To author's knowledge, there has been no study directed to measure the relationship between Theil entropy index with health care utilization. However, some studies had been done to measure the effect of residential segregation with

healthcare utilization. According to Gaskin (2012), racial composition of an area can affect the availability of health facilities in that area. Areas with highly segregated minorities will have less physicians and health care facilities because of lower reimbursement rate. Peers in segregated minority communities can also influence each other to discourage the use of health care facilities due to distrust in health care providers. Furthermore, low community amenities to provide a safe, clean, and healthier community also causes people to have a lower overall health condition.[46]

Enabling Factors

Health Insurance Policy, Financial, and Access Factors

As mentioned above, any introduction of health insurance will cause an increased demand for health care services due to the moral hazard and adverse selection that it caused.[14,15,21] A study conducted by Kondo (2012) about the impact of universal health insurance introduction in Japan shows that insurance coverage will significantly increase health care demand while the number of available beds, medical institutions, physicians, and nurses was "either negligible or inconclusive".[44]

3. Data and Methods

Our data mainly come from the Area Health Resource File (AHRF) 2015-2016 Release which is a computer-based health information system that compiles multiple secondary datasets from different sources into one single database linked by counties. The data contains 32,395 health-related variables from 3230 counties across 50 states with the additional of Washington D.C, Guam, Puerto Rico, and US Virgin Islands. We later include Washington D.C into our analysis because it is considered to be one of the six States and District who adapted ACA from the beginning since it was enacted in 2010. We then exclude Alaska and Hawaii because of missing data from many of our variable of interest. We also removed counties that are located in Guam, Puerto Rico, and US Virgin Islands because of differences in the implementation of ACA in 50 States such as all residents of the territories are automatically exempted from individual mandate (Healthcare.gov).[29]

To categorize the states based on their Medicaid expanding and non-expanding status, we first wanted to base our categorization on data from The Advisory Board Company (ABC) who mapped where the States stand on June 14, 2013. According to ABC, 26 states were registered as "Participating," 1 State was "Leaning toward participating," 4 States were "Pursuing alternative model," 6 States were "Leaning toward not participating," and 13 States "Will not participate." However, since the official start of Medicaid expansion was in 2014 and our data only captures 2013 data, we decided to only take the first 6 states that expanded Medicaid in 2010 as our "Expanding" states. These 6 states are California, Connecticut, District of Columbia, Minnesota, New Jersey, and Washington. They are the only first 6 states who get a jump-start on Medicaid-expansion federal funding since April 2010 while the rest of the states whom decided to expand will receive theirs in 2014[53,54].

We then create a dummy variable from this categorization into "Expanding" that includes counties located in these first six states which includes 214 counties. The rest of the 43 states (excluding Hawaii and Alaska) which consist of 2,895 counties falls into the “Non-Expanding” group.

To evaluate the utilization rate of hospitals channels of care before and after ACA implementation, we use AHRF database data from 2005 as “before” condition and 2013 data as the “after” condition. To ensure that we get the overall hospital utilization rate, we use data from all three channels of care as our dependent variables in our study. These variables are Inpatient (IP) days of care rate, Emergency Department (ED) visit rate, and Outpatient (OP) visit rate. All of them are the total number of days of care in IP and number of visits in ED and OP that was recorded by the American Hospital Association Annual Survey Database. In order to get the total hospital utilization rate, we add all the total recorded visitation number from short term general hospitals, short term non-general hospitals, and long-term hospitals, we then divide it by the total county population and express as a rate of inpatient days of care, emergency department and outpatient visits per 1000 people per county.

The first part of our analysis is to evaluate the overall changes of hospital channels of care utilization rate between 2005 and 2013. We use descriptive statistics to evaluate the rate of IP, ED, and OP percentage changes between the two years. We use a paired t-test at the county level to determine whether the changes over time are significant.

Next, we evaluate whether these changes are different between counties that are located in expanding and non-expanding states. For this, we first separate the expanding and non-expanding counties by making a dummy variable with “0” for non-expanding, and “1” for expanding states (and their component counties). We employ descriptive statistics using a

Wilcoxon two-sample test to determine whether the utilization rate changes between the expanding and non-expanding group had any significant difference.

The third part of our analysis is to evaluate what factors can affect the hospital channels of care utilization rate. Then, holding several confounding predictors constant statistically, we test whether the changes over time were significant for the different channels of care, and whether there were differences across expanding and non-expanding states. To do this, we first select multiple possible explanatory variables based on Andersen's Behavioral Model of Health Services Use and available databases. Andersen's model has three types of factors that influence the utilization of health care, they are divided into Need, Predisposing, and Enabling Factors. Based on this categorization, we first pick 20 potential explanatory variables from AHRF, they are: (1) Poverty Rate derived from Census Small Area Income Poverty Estimates (SAIPE), (2) Percent persons under 65 years old without health insurance derived from Census Small Area Health Insurance Estimates (SAHIE), (3) Percent female population derived from Bureau of Census, we retrieved this value by dividing total population of female with total population of the county multiplied by 100%, (4) Percent non-English Speaking Population over the age of 18 years-old retrieved from 2010-2014 Census ACS, we retrieved the total number of non-English Speaker, divided by total population of the county, multiplied by 100%, (5) Rural-Urban Status of the counties is retrieved the data from Office of Management and Budget 2005 and 2013. To ensure that this categorization can be used in multiple regression functions, we create a dummy variable that simplifies the nine Rural-Urban Continuum Code (RUCC) into two categories. We recoded code 8 and 9 in RUCC into "0" for rural and recoded code 1-7 in RUCC into "1" for the urban area. (6) Percent Population over 25 years-old with less than high school or diploma as an indicator for low education attainment, derived from 2010-2014 Census ACS. (7) Percent

population aged more than 65 years-old derived from Census County Char File (8) Per capita personal income derived from Regional Economic Information System (REIS), (9) Unemployment rate derived from Bureau of Labor Statistics. (10) Medicaid Expanding Status, we make a dummy variable based on the Kaiser Family Foundation report on first six states that expand Medicaid, coding it into 0 for non-expanding, and 1 for expanding. (11) Hospital Rate is the total number of Hospitals per 1000 people derived from AHA Survey Database 2013 (12) Mortality rate per 1000 people retrieved from Estimated Census data 2013 (13) Primary care Practitioners Shortage Status was retrieved from Health Resources and Services Administration (HRSA), we recoded their Health Professional Shortage Area (HPSA) into a dummy variable where we code it 0 if there was no shortage in the area, and code it 1 if there was any (partially or total) shortage in the county. Outside of AHRF database, we retrieve data from outside source such as GeoDa Center Calculation for (14) GINI Index, which represents inequalities of income, where 0 means total equality and 1 means total inequality, (15) Diversity index is an entropy index which represents segregation of the area where 0 means total integration where each ethnicity presents in every area, and 1 means total segregation where each ethnicity live in their own area, (16) Out of State and (17) Out of Country immigrant, and (18) Isolation Index. We also retrieve data from Geographic Service Area File for data about (19) Medicare Managed Care Penetration Rate, and data about (20) Proportion of state population underserved by PCP from Kaiser.

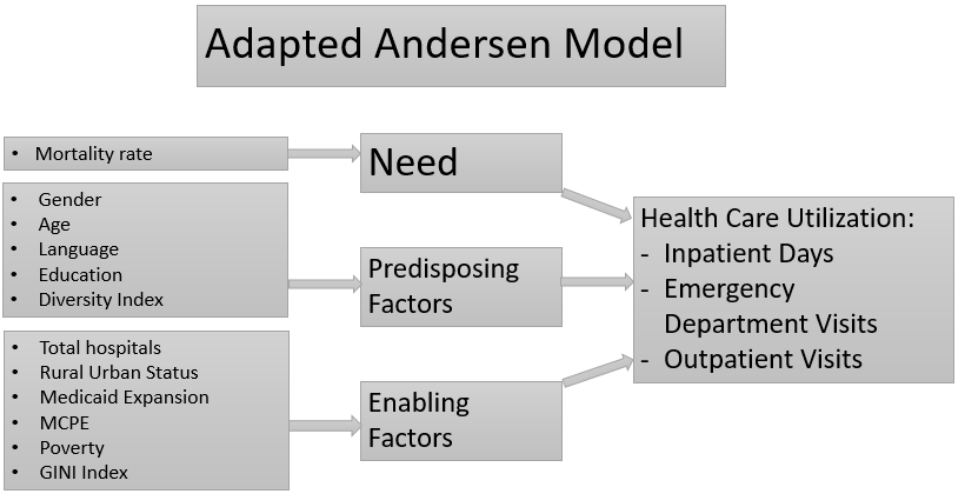

Figure 1. Adapted Andersen Model with selected variables

Before we did our multiple regression, we run a separate Spearman's Correlation test to produce a matrix that will help us determine which independent variables (IV) has a significant correlation with our dependent variables (DV) to be included in the regression. We also use the matrix to see how each IV is correlated to each other to avoid any multicollinearity, we also check the Variance Inflation Factors (VIF) score within every model and make sure that it is below five. Based on the matrix and theories from previous literatures we finally decided to pick only 13 over 20 variables to be included in our regression model. Of the 20 variables mentioned above, we decided to remove Per Capita Personal Income and Unemployment Rate, because both can be represented by Poverty Rate. We also removed PCP shortage status, PCP underserved population proportion, and Isolation index because it can be represented by Rural-Urban status. Finally, we took out the Out of State and Out of Country Immigrant Population Proportion and Isolation Index, but we keep the Diversity Index to represent them.

After choosing the independent variables, we create a stacked dataset from both 2005 and 2013-year data and create a time dummy variable, 0 for 2005 and 1 for 2013. We then create a variable where the expanding Medicaid status of the county is interacted with time.

Subsequently, we run the multiple regression functions with all 13 variables of interest, 1 time variable, and 1 Medicaid expansion status-time interaction variable using SAS 9.4. We run three separate models for each IP, ED, and OP dependent variable and constantly including all explanatory variables into every model. We keep all the explanatory variables across all models to see how each factor can affect each channel of care and make us able to do a side-by-side comparison between all channels.

After running the three models, we run another separate regression model with uninsured rate as our dependent variable and thirteen variables with Medicaid expanding status and time interaction to help us understand what factors affects the changes in uninsured rate.

4. Results

4.1 Overall Hospital Channels Utilization Rate Changes Between 2005 and 2013

In 2005 and 2013, there are respectively 2.53 million and 1.94 million days of IP care, 1.20 million and 1.25 million of ED visit, and 5.7 million and 6.4 million of OP visits. **Table 1** shows that there is significant reduction of IP days of care rate by 23.3% and an increase of 12.9% at OP visit rate. We also notice a slight increase in ED visits by 4.4%. These changes were statistically significant, with all the *p-values* for these comparisons < 0.05. Therefore, we can conclude that there are significant changes in all three channels of hospital care utilization rate between 2005 and 2013.

4.2. Hospital Utilization Changes Between 2005 and 2013 by Medicaid expanding status

The second step in our analysis is to examine whether the observed changes represent a time-trend or are associated with the Medicaid expanding status. **Table 2** shows the result of both paired t-test and Wilcoxon 2-sample test. The paired t-test is to examines if there is statistically significant changes overtime within each group. Wilcoxon 2-sample test examines if the changes overtime in expanding states differs from the changes in non-expanding states. When we separated the counties by their Medicaid expanding and non-expanding status, we found that the trends of changes were similar in both groups. However, we can see more significant changes in both IP and ED visitation rate in counties that expand, compared to counties that do not expand Medicaid. IP days of care rate decreased by 30% ($p = 0.0034$) in expanding counties but only decreased by 22.61% ($p < .0001$) in non-expanding counties. ED visits increased by 13.73% ($p = 0.0015$) in expanding states, but only increased by 3.79% ($p = 0.0093$) in non-expanding counties. However, when it comes to OP visit rate, non-expanding

counties shows a more dramatic increase by 13.14% (p <.0001) compared to only 9.5% increase (p = 0.0990) in non-expanding counties.

The result of the Wilcoxon 2-sample test then proof that there is statistically significant difference of the IP (p = 0.0075) and ED (p = 0.0392) utilization rate changes overtime between expanding and non-expanding states. However, the OP visit rate does not show significant difference between expanding and non-expanding status (p = 0.593). Therefore, we can conclude that expanding Medicaid will make a significant change in decreasing IP and increasing ED visit rate, but there is no evidence that it is correlated with OP visit rate.

4.3 Factors that affect hospital utilization rates

As noted from the Anderson model, there are many factors that can affect how populations are utilizing each of the hospital channels of care. In the process of building the regression model, we examined correlations using Spearman's correlations coefficient between all dependent variables to identify and select between several correlated candidates. We choose the variable least correlated with other constructs to reduce potential multicollinearity while covering all dimensions of the model. From twenty potential factors, we identified twelve factors to be included in the model.

In **Table 3** we present the descriptive statistics of our independent variables of interest between 2005 and 2013. Some demographic factors show noticeable difference. Factors such as mortality rate decrease from 10.28 in 2005 to 9.77 per 1,000 people in 2013. Population of old people age 65 years or older increased by approximately 3%. In terms of financial demographic, poverty rate increased by 12%, However, GINI index that measures the income inequalities mean stays the same at 0.43. The number of counties that were categorized to be urban areas in 2005 has increased by 29 counties in 2013.

In terms of health care, despite many effort, the percent of uninsured people does not show a significant reduction where the mean of uninsured people rate stays around 17%. However, if we focus on the maximum percentage of uninsured people, the maximum percentage of people who are uninsured in a county had decreased by 6.2% from 46.8% to 40.2%. In addition, the Medicare Managed Care Penetration Rate (MCPE) also shows a significant increase from 0.045 to 0.163 in 2013.

Since the characteristic of patients that comes to each channel of care are different, it is understandable that some factors might be affecting significantly in one channel but not on the other. According to our results, IP days of care utilization rate can be explained up to 27.33%, while ED and OP visit rate can be explained up to 20.73% and 19.22% by our selected explanatory variables. As predicted by many previous findings, need factor (mortality rate), female and availability of hospitals and urban location show a consistently positive beta-coefficient in the association with every channel of care utilization rate.

As shown in **Table 4**, when it comes to the 'need' factor, we are using mortality rate as it can serve as a proxy to depict the overall health status in the area. This variable shows a significant positive association with the utilization of all channels of care, especially the OP visitation rate by 87.61 per one unit of increase in mortality rate ($p < 0.0001$). In terms of predisposing factors, some factors show significant association with increase or decrease the visitation rate. In terms of gender, the more female proportion in the county is significantly associated with increase of the use of IP days of care and OP visitation rate by 33.83 ($p < 0.0001$) and 51.05 ($p = 0.0016$) respectively. Diversity index also shows a highly significant ($p < 0.0001$) association with increased all channels of care utilization rate. Surprisingly, language proficiency shows a different trend as compared to previously published results, where 1 increase

in the unit of the proportion of non-English speaker in the population is associated with an increase in the utilization rate in all channels of care especially in outpatient by 133.97 visit ($p <$ .0001).

Old age and low educated population also show different results from previous findings, where one percent increase in elderly population and low educated population shows an association with a reduction in hospital utilization on all channels of care and especially by 56.12 ($p < .0001$) and 97.54 ($p < .0001$) in OP visit rate. When it comes to enabling factors, proportion of uninsured people shows a significant negative correlation with the utilization rate by 77.30 ($p <.0001$), 23.72 ($p <.0001$) and 10.51 ($p < .0001$) in OP, IP, and ED respectively.

The interaction between time with expanding status of the states does not show any significant association with any channels of care. This implies that we cannot reject the null hypothesis that Medicaid expansion will have significant association with Hospital utilization rate. However, the time covariate alone shows some significant negative association with Inpatient days of care rate ($\beta = -208.69$, $p <.0001$) and significant positive association with ED utilization rate ($\beta = 30.01$, $p = 0.0229$). On the other hand, looking at the expansion status covariate alone, only the OP visit rate is significantly associated with expanding status ($\beta =0.0240$, $p = 0.0240$).

Medicare Managed Care Penetration (MCPE) rate shows negative association with OP 156.65 ($p = 0.0038$) but a positive association with IP days of care by 324.19 ($p = 0.030$). Financial factors depicted by percentage of people in poverty level and GINI index both show a positive impact on increasing the utilization rate on all channels of care ($p < .0001$) except the poverty on IP days of care ($p = 0.86$). Access factors also showing predictable result where

people in urban area and with more available hospitals will show a significantly higher utilization rate compared to rural areas and areas with few or no hospital at all.

5. Discussion

Inpatient care has the most changes over all three channels of care with a reduction of IP days of care by 23.3% between 2005 and 2013. The reason might be because there is also a reduction in the overall number of hospital in the United States (6,226 in 2005 vs. 6,175 in 2013) which may cause a reduction in the number of available beds. When we take a closer look, there are more dramatic IP decrease in expanding states (30% reduction) compared to non-expanding states (22.61% reduction), this can be explained because there are more hospital closures in states that expanded Medicaid (25 closures from 855 hospitals in 2005 = 2.9% hospital closure) compared to states that does not expanded Medicaid (26 closures from 5371 hospitals in 2005 = 0.4% hospital closure). However, with the expansion of Medicaid and enhanced Federal Medical Assistance Percentage (FMAP) to fund Medicaid expansion, this hospital closure trend is likely to be reversed in expanding states. More research is needed to follow-up hospital closures[55].

The result from the first paired t-test analysis to look at the difference over time shows that emergency department and outpatient visit rate were increasing over time, despite the implementation of ACA. While ACA should increase accessibility of primary and preventive care, the ED visit rate still increases over time, which is similar to previous studies [23,24,25,26]. The loss of inpatient beds from decreasing number of hospitals might also be a cause of this inevitable increase[17]. Further, other studies also show that the increased accessibility of primary care is not a substitute for ED visit, but rather, it is a complimentary of other channels of care[19,27].

During the study, we also discovered that there is a significant difference in IP and ED channels of care utilization rate between 2005 and 2013 and this significance is still noticeable when comparing the changes of utilization rate between expanding and non-expanding states.

However, OP care utilization rate changes does not show significant changes overtime (p = 0.0990), but that might be because we have only 214 counties in this expanding group which does not give enough power to show significant result.

Our regression model derived from the Andersen Framework shows some findings that are predictable from previous studies. The mortality rate that we use as a proxy to depict the need factor of the population for hospital utilization shows a significant correlation to increase the utilization rate on all hospital channels of care.

Regarding predisposing factors, female population proportion and low education attainment show a consistent result with the previous study, where the female population proportion of our study shows a significant influence on increasing the utilization on all channels of care while low educational attainment will cause lower hospital utilization[18,34,40].

Diversity index which measures the level of residential segregation also shows a significant influence on increasing the utilization rate. Since the index we use in this study cannot specify the index measurement only to minority segregation, we cannot determine whether this finding is truly different from Gaskin (2012) study where they found that segregated minorities will use less care because of the lack of health care facilities, lack of community amenities, and an overall disbelief culture to healthcare provider[46]. However, even after adjusting its rural-urban status and hospital availability, the influence remains positively significant. Based on this, we speculate that since segregation concentrates poverty, and restricts socio-economic opportunity, this creates social inequalities. This inequality is a fundamental cause of disease which reduces the overall health of the community and eventually will increase the overall health care utilization [46,47].

Regarding language barrier, in contrast with previous studies by Shi (2009) and Ka Ming (2016), our result shows that non-English speaker population proportion shows a significantly positive association with hospital utilization on all channels of care. However, since patients with low English proficiency were more likely to be readmitted to hospital within 72-hours discharge, this factor might be the cause of the observed higher hospital utilization.[41,42]

Perhaps one of the most puzzling results in this study is the fact that areas with more percentage of elderly people above 65 years old are associated with less hospital utilization which is inconsistent with previous studies[18]. However, our study is limited because we do not include the utilization rate of other channels of care outside hospitals such as nursing home, one-day care clinic, or simple prescription refill from pharmacy which is becoming a more commonly used services among elderly compared to regular hospital-centric model[48]. Other factors that can cause this result might be because areas with more elderly population tend to be in rural areas, or places that offers more benefit for senior citizens, but has lack of adequate health care facilities[49,50]. While we have controlled the rural and urban status, as well as hospital availability factor in our regression model, we still did not count for the "snowbirds" factor of elderly who are looking for better healthcare facilities or specialist which are not available inside their counties or states[51].

When it comes to enabling factors, some results that we found are consistent with previous studies where high insured rate, poverty, and GINI index along with urban areas, and number of available hospitals per 1000 people are associated with significant increases on hospital utilization[14,15,21,46].

Medicare Managed Care Penetration Rate (MCPE) also shows an interesting result, where when holding everything else constant, it is associated with a significant decrease in ED

and OP utilization but increase the IP days of care. This result is different from previous study by Baicker (2013) who found that greater MCPE does not associated with lower hospitalization, but it is associated with lower costs and shorter stays per hospitalization[52].

Finally, when we put these Medicaid-expanding status and changing-time factors into our time-status interaction regression model, holding everything else constant, we can see that there is no significant association between time-status interaction with all IP, ED, and OP utilization rate. Which means that the changes we saw in IP, ED and OP utilization rate were associated with other factors but not from the Medicaid expansion. Thus, we cannot reject the null hypothesis that Medicaid expansion is associated with changes in utilization rate.

This insignificancy might be explained by Sommers (2013) on his paper about the impact of Medicaid expansion from 6 early Medicaid expanding states. He stated that expanding Medicaid in these first 6 states might not cause a significant effect. The reason is because factors such as barriers to coverage and access remains, administrative issue to enroll Medicaid expansion also requires a lot of effort, and political context also influences greatly how the expansion is translated into practice[10].

This insignificancy can also be a positive indicator that despite having an increase in insurance rate, Medicaid expansion will not necessarily cause an overcrowding and overutilization just because of the newly insured patients. This result agrees with previous study by Shane (2015), who also found that despite an increase in insurance take-up among 19-25 years old after the ACA, they found no significant increases of health services utilization rate between 2006 - 2012. They explain that this insignificancy happened because this targeted population is relatively healthy.[45] The previous study by the Kaiser Family Foundation also found that the overall utilization rate of newly insured patients (64%) are still lower than those

who were previously insured (81%). KFF found that newly insured adults still face the same financial insecurity about their medical bills which is almost at the same rate of the uninsured. However, health insurance coverage had doubled their confidence level to pay the health service (68%) compared to the uninsured (34%), and now they are less worried that medical cost will affect their job, family, and ability to sleep in the future[15].

Other studies showing insignificant results agree that this insignificancy could happen when the efficiency gains were offset by the increased access. The reason is, because Medicaid expansion will not only cause increase access which will potentially increase hospital utilization, but it might also reduce hospital utilization because with overall lower Medicaid reimbursement rate (63% of private insurance reimbursement rate), health care provider will need to practice more cost-effective services to help controlling cost by curtailing unnecessary medical expenses and technology adoption[16,20].

6. Limitation

The result of this study does not account for the possibility of other channels of care outside of the hospital such as the local clinic, nursing home, or alternative medicine care. The available data from AMA for inpatient care only provides data about the total days of care without information about the total number of admission. This limitation prevents us to get an understanding of the overall average length of stay per person. However, we address this issue by turning the data into a rate per 1000 people to get an idea about the collective utilization rate of the whole community.

The wide gap between 2005 and 2013 as our pre- and post- ACA condition is also a prominent limitation in this study. Ideally, the best pre-ACA condition should be in 2009 record and the post-ACA condition should start after 2014 when the individual mandate started to be enforced.

All of the R-square results in our regression models implies that the factors that we choose only explains 19-27% of the factors that affects the overall hospital utilization rate. There are many more factors such as perceptions, preference, and attitudes of the population towards hospital utilization, morbidity rates, and the distance that patients have to go in order to reach the hospital, that we did not include in our model because there is no available data on hand. Finally, the nature of the cross-sectional data that we have also limits us to determine any causal effect relationship.

Conclusions

There is a 23.3% decrease of inpatient days of care rate and an increase of 4.4% of emergency and 12.9% of outpatient visit rate between 2005 and 2013 in the United States. Both expanding and non-expanding states hospital utilization rate changes overtime in similar manner. However, there is more significant IP reduction and ED increase in expanding states compared to non-expanding states.

The regression model shows that holding everything else constant, time factor alone is significantly associated with reduced IP ($\beta = -208.69$) and increased ED ($\beta = 30.01$) utilization rates, while expanding status covariate alone is only significantly associated with a decrease in OP utilization rate ($\beta = -413.09$). Which means that counties located in expanded Medicaid states are associated with lower OP visit rate rather than increasing it. Furthermore, expanding status of the states and time interaction factors are not associated with any hospital channels of care utilization rates. Thus, the fear that overcrowding in hospital due to Medicaid expansion in 2013 is unfounded in this study and policy maker should be encouraged to expand Medicaid in their states.

Tables & Figures

Table 1. Changes of Inpatient, Emergency Department, and Outpatient Utilization Rates per 1,000 People per County between 2005 and 2013 (n = 3109)

	2005		**2013**		***p-value*****	**Estimated Change in Utilization Rate**	
Variables*	Mean	SD	Mean	SD		Δ Mean (%)	Δ SD
IP days of care rate	815.73	1486.09	625.97	11140.17	<0.0001	189.77 (↓23.3%)	949.08
ED visit rate	387.11	437.98	404.24	4186.53	0.0015	17.12 (↑4.4%)	300.43
OP visit rate	1829.42	2611.65	2065.08	29644.65	<0.0001	235.66 (↑12.9%)	2151.60

*Hospital utilization counts/total population x 1,000 people per county, IP= Inpatient, ED= Emergency Department, OP = Outpatient, **= paired t-test

Table 2. Changes of hospital channels of care utilization rate between 2005 and 2013 by Medicaid expanding status

Variables*	**Expanding (n = 214)**				**Non-Expanding (n = 2895)**				**Wilcoxon 2-sample test (*p-value*)**
	2005 Mean (SD)	**2013 Mean (SD)**	**Estimated changes (%)**	***p-value*** (t)**	**2005 Mean (SD)**	**2013 Mean (SD)**	**Estimated changes (%)**	***p-value*** (t)**	
IP days of care rate	1032.43 (1871.12)	722.61 (1074.77)	- 30.00	0.0034	799.71 (1452.70)	618.82 (1116.71)	-22.61	<.0001	0.0075
ED visit rate	356.42 (205.33)	405.36 (297.13)	13.73	0.0015	389.38 (450.36)	404.15 (426.30)	3.79	0.0093	0.0392
OP visit rate	1913.09 (1789.01)	2094.88 (1920.61)	9.50	0.0990	1823.23 (2662.50)	2062.87 (3027.59)	13.14	<.0001	0.593

* Hospital utilization counts/total population x 1,000 people per county, IP= Inpatient, ED= Emergency Department, OP = Outpatient **= paired t-test

Table 3. Summary Statistics of Covariates

Variables	2005			2013			Absolute change (Percentage change) (%)
	Mean (SD)	Minimum Max	25th Percentile 75th Percentile	Mean (SD)	Minimum Maximum	25th Percentile 75th Percentile	
Mortality Rate (per 1,000 people)	10.289 (3.01)	0 38.9	8.3 12.00	9.77 (2.57)	0 20.1	8.2 11.46	-0.51 (-5%)
%Female	50.30 (1.96)	33.23 56.75	49.86 51.26	49.97 (2.18)	29.89 57.03	49.53 51.04	-0.33 (0.65%)
%>65 years old	14.97 (4.05)	2.27 34.64	12.29 17.28	17.22 (4.32)	3.83 51.59	14.41 16.89	2.25 (15%)
%Non English Speaker	1.58 (2.59)	0 24.95	0.23 1.75	1.53 2.5	0 26.93	0.22 1.66	-0.05 (3.1%)
%<High school education	16.93 (7.34)	0.7 52.1	11.5 21.6	15.06 6.75	1.3 53.3	10.0 19.3	-1.87 (-11%)
Diversity Index	0.09 0.086	0 0.79	0.04 0.12	0.11 (0.08)	0 0.69	0.057 0.150	0.02 -
% Uninsured rate	17.99 (6.10)	7.1 46.8	13.4 21.4	17.50 (5.44)	3.0 40.2	13.6 20.9	-0.49 (-2.7%)
Medicaid Expanding Status							
- **Non-expanding**	-			2895 (93.12%)			-
- **Expanding**	-			214 (6.88%)			-
MCPE	0.045 (0.08)	0 0.535	0 0.04	0.163 (0.11)	0 0.65	0.073 0.221	0.118 -
Poverty	15.33 (6.5)	2.5 51	10.8 18.6	17.25 (6.59)	3.0 55.1	12.5 20.9	1.92 (12%)
GINI Index	0.43 (0.037)	0.31 0.60	0.408 0.459	0.438 (0.034)	0.33 0.59	0.33 0.459	0.00 -
Rural – Urban Status							
- **Rural**	656 (21.09%)			627 (20.16%)			-29 (-4.42%)
- **Urban**	2454 (78.91%)			2483 (79.84)			-
Hospital Rate (per 1000 people)	0.057 0.088	0 0.90	0.011 0.064	0.056 0.08	0 0.91	0.010 0.062	0.00 -

Table 4. Multiple Regression Statistical Summary of factors that affects hospital channels of care utilization rate in 2005 and 2013

No.	Variables	IP (Adj. RR = 0.2733)		ED (Adj. RR = 0.2073)		OP (Adj. RR = 0.1922)	
		Parameter estimate (β)	***p-value***	**Parameter estimate (β)**	***p-value***	**Parameter estimate (β)**	***p-value***
Need factors							
1.	**Mortality rate** (per 1,000 people)	19.85*	0.010	11.65**	<.0001	87.61**	<.0001
Predisposing Factors							
2.	**Sex** Female	33.83**	<.0001	21.56**	<.0001	51.05*	0.0016
3.	**Age** > 65 years-old	-17.32*	0.0009	-9.81**	<.0001	-56.12**	<.0001
4.	**Language** Non-English Speaker	13.44	0.078	6.75*	0.0091	133.97**	<.0001
5.	**Education** < High School	-12.94**	<.0001	-3.90*	0.0005	-97.54**	<.0001
6.	Diversity index	760.31**	<.0001	437.23**	<.0001	1681.60**	0.0001
Enabling Factors							
Health Insurance Policy Factor							
7.	Uninsured rate	-23.72**	<.0001	-10.51**	<.0001	-77.30**	<.0001
8.	- Medicaid Expanding Status	119.49	0.1481	-42.57	0.128	-413.09*	0.0240
	- Time factor (t)	-208.69**	<.0001	30.01*	0.0229	119.41	0.165
	- Expanding Status interacted with time (βt)	-158.18	0.161	25.84	0.499	-30.32	0.903
9.	MCPE	324.19*	0.030	-146.91*	0.0038	-445.81	0.179
Financial Factor							
10.	Poverty	0.303	0.935	6.66**	<.0001	55.66**	<.0001
11.	GINI Index	3382.24**	<.0001	1614.61**	<.0001	5119.45**	<.0001
Access Factors							
12.	Rural-urban status	219.62**	<.0001	233.17**	<.0001	738.86**	<.0001
13.	Hospital Rate (per 1000 people)	7928.95**	<.0001	1584.43**	<.0001	11878**	<.0001

***** *p-value* < 0.05, ** *p-value* <.0001

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