

Variation of Medicare Costs for Intracranial Hemorrhages and
Cerebral Infarctions Across the United States

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Abstract: 150 Word Summary of the Project - To be Done Last

Introduction & Background

Medicare, a nationwide healthcare system for individuals over the age of 65, was formulated as a way of providing health insurance for individuals who were no longer eligible for private health insurance coverage. With a program that costs the United States \$582 billion a year and is utilized by more than 60 million Americans, it's imperative that we ensure that it is fair and universally understandable for all individuals. Currently, "Medicare finances an array of health services. Hospital expenses are the largest single component of Medicare spending, accounting for about 40% of the program's annual spending of \$232 billion. That is not surprising as hospitalizations are associated with high-cost health episodes" (Peterson 2019). Many items typically factor into a hospital bill, including admittance fee, physician costs, laboratory and imaging studies, as well as any procedure a physician performs, amongst other miscellaneous fees. Strokes, in particular account for nearly \$34 billion in healthcare services for the United States each year, and with three-fourths of stroke victims being over the age of 65, and eligible for Medicare, it is essential to look into how different hospitals charge for their services.

With an average of one stroke happening every 40 seconds in the US, and over 140,000 stroke related deaths per year, researchers have been studying different treatment options for years. The American Stroke Association has in recent years set the standard for treatment, utilizing the tissue plasminogen activator, Alteplase IV r-tPA. The treatment works by "dissolving the clot and improving blood flow when administered within three hours to the stroke victim" (ASA 2018). Upon receiving this initial treatment and utilizing a stent to remove the stroke causing clot, patients are typically monitored in an ICU type-setting for at least 24

hours, before being transferred to a standard room. The average time spent in a hospital setting is between 5-7 days, though it can last much longer for severe cases. While in the hospital, many patients need to begin a stroke rehabilitation program, that helps them regain muscle and relearn skills they may have lost, such as speaking, swallowing, and walking. Although no two stroke patients are the same, the standard of care follows a fairly airtight protocol, allowing exceptions for only the severest of cases. In essence, there should be no surprises when the victim is healthy enough to be discharged to their home or another rehabilitation facility, and they receive the bill for their stay. However, many patients find that they are being billed up to three times as much, for the same treatment their friend received for their stroke, at the hospital just 10 miles away.

Although Medicare is perceived to be a universal and accessible form of health insurance for millions of Americans, there are numerous discrepancies between services that are going unnoticed. Utilizing Mathematical Modeling and Spatial Data concepts, we can construct an idea of what hospitals should be charging for the average stroke patient, and where in the country are the largest discrepancies. By implementing these mathematical modeling techniques for medicare costs associated with the third leading cause of death in the United States, we are able to find patterns in healthcare and expose what institutions are unnecessarily overcharging individuals on a limited income, for conventional and necessary medical interventions.

Methods

The Data Society recently compiled a list of over 3,000 US hospitals that billed for the top 100 most common inpatient services. The list was broken down into details of billed charges under the Medicare Inpatient Prospective Payment System (IPPS). From there I narrowed the

data down to the cost of only Intracranial Hemorrhages and Cerebral Infarctions (Strokes) and limited my data to the 48 US Continental States, since Hawaii and Alaska are immediately outliers, in terms of Spatial Data. With 2,677 data points left, I was able to move forward with the following Research Methods:

Spatial Data & Geographic Clustering

In an attempt to ensure the data being used is both accurate and informative of the general United States Population, it was essential to map out the coordinates from every hospital included in the database, and compare it to the spread of US Hospitals nationally. Furthermore, the clustering showed strong groups centered in the North East, as well as the West Coast, but upon investigating the distribution of population across the United States, it became clear that this was only in comparison to the need of hospitals in those areas.



Figure 1: Distribution of Hospitals Throughout the US



Figure 2: Population Distributions Throughout the US

In addition to mapping out every hospital location, I mapped out the locations of hospitals with the lowest costs of service, as well as with the highest costs of service. The distribution of the lowest costs were centered around four central states that needed further investigation into the reasoning for their minimal costs.



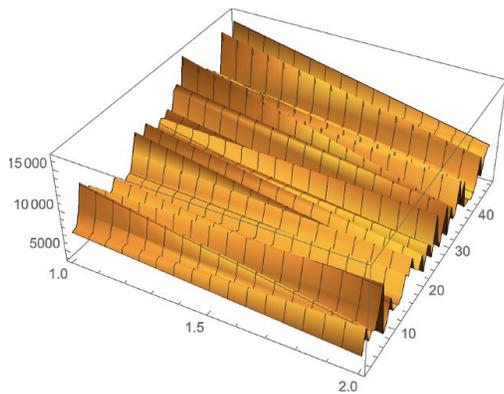
Figure 3: 100 Lowest Costs of Stroke Treatment



Figure 4: 100 Highest Costs of Stroke Treatment

Statistical Analysis

In an attempt to find the reasoning for variation amongst hospitals, it was first essential to determine what the national cost of this service should be. In order to do this, I performed statistical analysis on the data and found the greatest variances, as well as found where each quartile lies, to determine a fair cost of service. It was also helpful to implement scatter plots and lines of best fit for claims made in previous research studies, such as states with a higher spending per capita, tend to pay more for Medicare expenses. Utilizing different forms of statistical analysis helped to validate previous claims and determine what variation, if any, should lie in the cost of treatment for a stroke victim throughout the United States.



Figures 5&6: Different Viewpoints of Average Cost of Treatment vs. Per Capita Spending by State

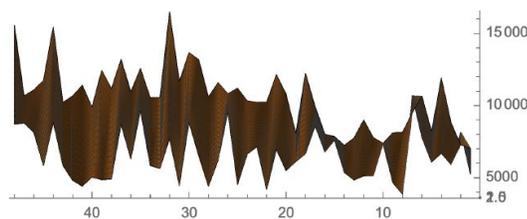


Table 1: 5 Number Summary and Statistical Summary

| | Lowest Values | Highest Values | Overall Values |
|---------------------------|---------------|----------------|----------------|
| Min | \$4,139.52 | \$19,159.40 | \$4,139.52 |
| 1st Quartile | \$4,817.21 | \$19,984.60 | \$6,979.85 |
| Median | \$4,967.09 | \$21,301.30 | \$9,722.56 |
| 3rd Quartile | \$5,079.50 | \$23,895.30 | \$11,688.60 |
| Max | \$5,162.02 | \$48,632.30 | \$48,632.30 |
| Range | \$1,022.50 | \$29,472.90 | \$44,492.78 |
| Standard Deviation | 197.332 | 4102.96 | 4022.79 |

Heat Map

One of the most valuable ways to show the variation in medicare costs for stroke victims, is to illustrate the disparities through a Heat Map. Unfortunately, there were many complications for the set of data that I have, since some areas were so concentrated, the values overlapped one another. Additionally, the variance between the 3rd quartile and maximum value had such a higher range than the rest of the data (as shown through Table 1), the initial heat map showed values within \$5,000 of one another being almost identical, even though they accounted for nearly 50% of the data.

Results

Discussion & Conclusions

References

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