

Evaluating and Mapping Stroke Hospitalization Costs in Florida

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ABSTRACT

Stroke is the fifth leading cause of death and one of the leading causes of disability in Florida[1]. Hospitalization charges related to stroke events have increased over the past ten years while the number of hospitalizations has remained steady. North Florida lies within the stroke belt, the region of the United States with the highest stroke morbidity and mortality. This paper will demonstrate the use of SAS® to evaluate the influence of socio-demographic factors such as sex, and race on total hospitalization charges by payer type in north Florida using data from the Florida Agency for Health Care Administration.

INTRODUCTION

Stroke creates a considerable economic burden and the costs associated with stroke have increased over time. This paper is designed to examine charges incurred from stroke hospitalizations. There number of stroke hospitalizations in Florida from 2008 to 2012 increased. It is estimated that stroke costs exceed \$5.5 billion annually in Florida[2]. This paper discusses how some basic SAS® statements, including PROC FREQ, PROC MEANS, and PROC GMAP, were used to examine stroke hospitalization charges in Florida from 2008 to 2012. This paper will demonstrate how to assess hospital discharge data to determine financial burden and how to generate a map. The objective of this demonstration is to show how SAS can be used as a tool to assess economic burden of chronic conditions.

Hospitalizations with stroke (ICD-9CM codes 430-438) listed as the primary diagnosis were used to create a data set for analysis. This paper will demonstrate how to determine hospitalization charges, number of visits and categories of charges. Charge data will be presented by age, gender, and race/ethnicity. Additionally, stroke charges by payer type, such as Medicare, Medicaid and commercial insurance will be examined. Stroke hospitalization charges add to the overall economic burden of stroke on Florida's health care system.

STROKE HOSPITALIZATIONS

The PROC FREQ statement can be used to generate tables of frequencies. By using PROC FREQ the number of stroke hospitalizations can be determined. If we run the following code:

```
proc freq;  
table reportyear;  
title "Hospitalizations Stroke Primary Diagnosis";  
run;
```

Output 1

Hospitalizations Stroke Primary Diagnosis The FREQ Procedure Report Year				
REPORTYEAR	Frequency	Percent	Cumulative FREQUENCY	Cumulative Percent
2008	69482	19.81	69482	19.81
2009	69435	19.79	138917	39.60
2010	70162	20.00	209079	59.60
2011	70232	20.02	279311	79.62
2012	71504	20.38	350815	100.00

Output 1. Output from a PROC FREQ statement

This output creates a table with the number of hospitalizations from stroke as primary diagnosis for 2008-2012.

PROC FREQ can also be used to assess stroke hospitalizations by age, gender, and race/ethnicity by using simple cross-tabulation. In the following code we grouped three variables of interest in parenthesis to generate three separate cross-tabulations. We included the options NOPERCENT, NOROW, and NOCOL in the TABLES statement to eliminate unwanted calculations. The following code resulted in the following tables:

```
proc freq data=hddstroke;  
table reportyear*(gender whbo age10)/nopercnt norow nocol;  
run;
```

Output 2

Table of REPORTYEAR by GENDER The FREQ Procedure Report Year			
REPORTYEAR	Female	Male	Total
2008	35896	33586	69482
2009	35773	33662	69435
2010	35859	34303	70162
2011	35947	34284	70232
2012	37044	34460	71504
Total	180519	170296	350815

Output 2. Output from a PROC FREQ statement

This output creates a table with the number of hospitalizations by gender from stroke as primary diagnosis for 2008-2012.

Output 3

Table of REPORTYEAR by whbo The FREQ Procedure Report Year				
REPORTYEAR	Hispanic	Non-Hisp. Black	Non- Hispanic Other	Non- Hispanic White
2008	5449	9650	2837	68502
2009	6198	10041	2810	68505
2010	8633	10071	1432	69137
2011	8816	10362	1568	69180
2012	9164	10464	1615	70230
Total	38260	50588	10262	246444

Output 3. Output from a PROC FREQ statement

This output creates a table with the number of hospitalizations by race and ethnicity from stroke as primary diagnosis for 2008-2012.

Additionally a table specifying stroke hospitalizations by age will be generated from the previous code.

PROC MEANS

PROC MEANS produces descriptive statistics that can be used to explore charges associated with stroke. Running simple PROC MEANS will produce a table for all records (all years combined) with the following outputs: N, Mean, Std Dev, Minimum, and Maximum.

```
proc means;  
var tchgs;  
run;
```

Output 4

Hospitalizations Stroke Primary Diagnosis The MEANS Procedure Analysis Variable TCHGS TCHGS				
N	MEAN	Std Dev	Min	Max
350815	48083.16	68759.99	0	7497793.00

Output 4. Output from a PROC MEAN statement

This output creates a table with the mean, min, max, and standard deviation charges of stroke hospitalizations for 2008-2012.

The BY statement allows us to produce means for each year.

Because we were interested in total charges for all stroke hospitalizations we added the SUM option. If you specify any option SAS® will only output the specified option. Therefore we included other options of interest in the code below:

```
proc means n min max median mean sum;
var tchgs;
by reportyear;
run;
```

This code will create tables for each year that displays the number of stroke hospitalizations, min, max, median, mean, and sum of stroke charges for 2008-2012.

The CLASS statement can be used to separate charges by payer type. The code produces charges for payer type BY each report year. We are only showing the output for 2012:

```
/*Payer Grouping: 1=Medicare, 2=Medicaid, 3=Commercial Insurance, 4=Self-Pay,
5=Other*/
proc means n min max median mean sum;
var tchgs;
class npayer;
by reportyear;
run;
```

Output 5

Report YEAR=2012							
Analysis Variable TCHGS TCHGS							
Npayer	N Obs	N	Min	Max	Median	Mean	Sum
Medicare	119493	119493	0	6215798.00	37822.00	59653.72	7128202476
Medicaid	11947	11947	984.0000000	6292062.00	44388.00	94046.36	1123571808
Commercial Ins.	17338	17338	521.0000000	3319082.00	40180.00	74194.03	1286376047
Self-pay	5243	5243	842.0000000	2135713.00	38517.00	66578.43	349070731
Other	5673	5673	347.0000000	2193602.00	34471.00	62325.73	353573851

Output 5. Output from a PROC MEAN statement

This output creates a table with the mean, min, max, and sum charges of stroke hospitalizations for 2008-2012 by payer type.

IMPORTING MAPS

Additionally, maps showing financial burden can be generated to examine the geographic distribution of stroke charges. SAS® provides certain maps within the map library. The PROC MAPIMPORT allows you to import Esri shapefiles into SAS® to create maps. The U.S. Census provides shapefiles at the different demographic levels (county, contract, etc.). Shapefiles can be downloaded from <http://www.census.gov/cgi-bin/geo/shapefiles2010/layers.cgi>.

A Florida shapefile with stroke charge data joined to it was imported into SAS®. The data represents average stroke hospitalization charge by patient county for 2008-2012. PROC MAPIMPORT will need to be run twice. First, the procedure needs to be run to import the shapefile into SAS®. Then again to specify the actual variable so that SAS® can generate the map. See below for the code for the first iteration:

```
proc mapimport datafile="J:\Hsfcd\Epi_Eval\Stroke\SESUGMEANS.shp"
out=my_map;
run;
proc mapimport datafile="J:\Hsfcd\Epi_Eval\Stroke\SESUGMEANS.shp"
out=my_map;
id FIPS;
run;
```

There are many variables in this file. In order to identify the names of variables a PROC CONTENT can be used to examine the variables in a shapefile. Please see code below:

```
proc contents
data=my_map;
run;
```

CREATING CHOROPLETH MAPS

The next procedure will demonstrate how to generate the actual maps. The map below shows the Florida stroke hospitalization mean charges by patient county 2008-2012. The color used in this map was chosen so that geographical areas with higher burden are depicted with darker colors (Figure 1). See example code below:

```
title1 ls=1.5 "Florida Stroke Hospitalization Mean Charges by Patient County
2008-2012";
pattern1 v=s color=vlig;
proc gmap data=my_map map=my_map;
id Meanchg;
choro Meanchg / coutline=blue;
run;
```

Figure 1

Florida Stroke Hospitalization Mean Charges by Patient County 2008-2012

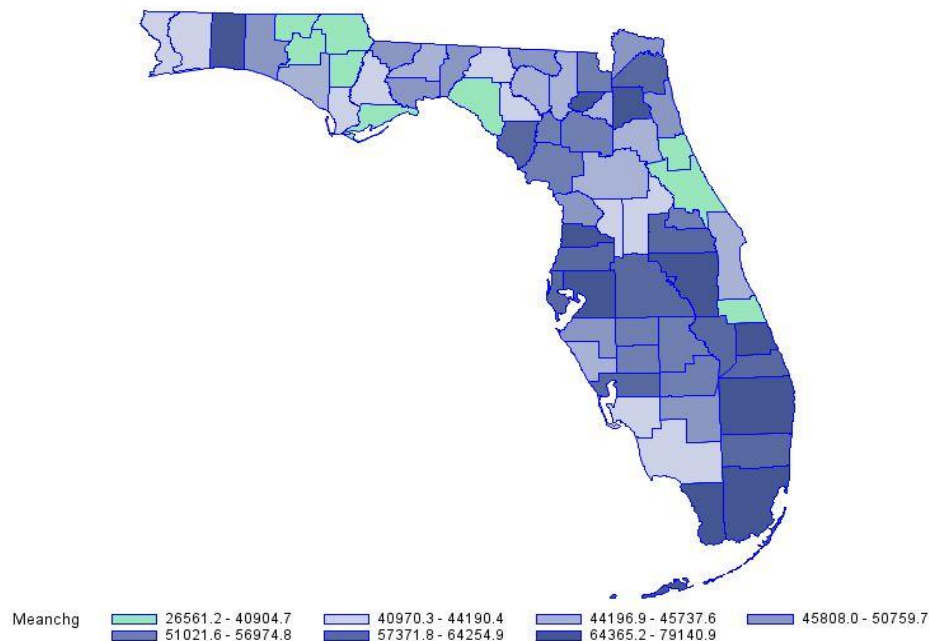


Figure 1. Average Stroke Hospitalization Charge by Patient County 2008-2012

This example produces a choropleth map that shows stroke average charges in Florida for 2008-2012. The legend shows the range of values for each level.

CONCLUSION

Charge data can be used to inform public health officials, and identify target populations for intervention and prevention efforts. These findings demonstrate that stroke hospitalizations place a significant burden on the healthcare system in Florida. Charges related to hospitalizations with stroke listed as the primary cause has increased over the past few years. Future analyses is needed to determine direct medical costs not included in this paper such as physician visits, ambulatory care, and prescription medication costs. In addition, indirect costs should be evaluated to determine productivity loss due to stroke morbidity and mortality.

REFERENCES

1. Florida Department of Health. *Florida Community Health Assessment Resource Tool Set*. 2013; Available from: <http://www.floridacharts.com/charts/SpecReport.aspx?ReplD=7226&tn=33>.
2. Centers for Disease Control and Prevention. *Chronic Disease Cost Calculator Version 2*. 2013; Available from: <http://www.cdc.gov/chronicdisease/resources/calculator/>.

Recommended Reading

- *SAS/GRAPH Beyond the Basics*

CONTACT INFORMATION

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