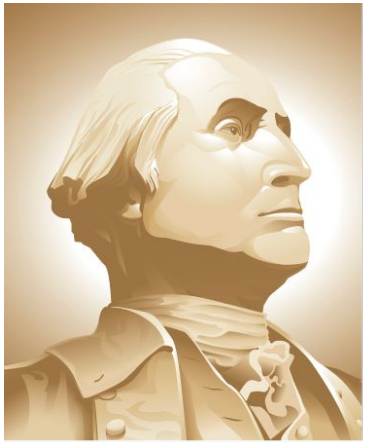
Deloitte.



THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC

Medicare Cost Saving Strategy

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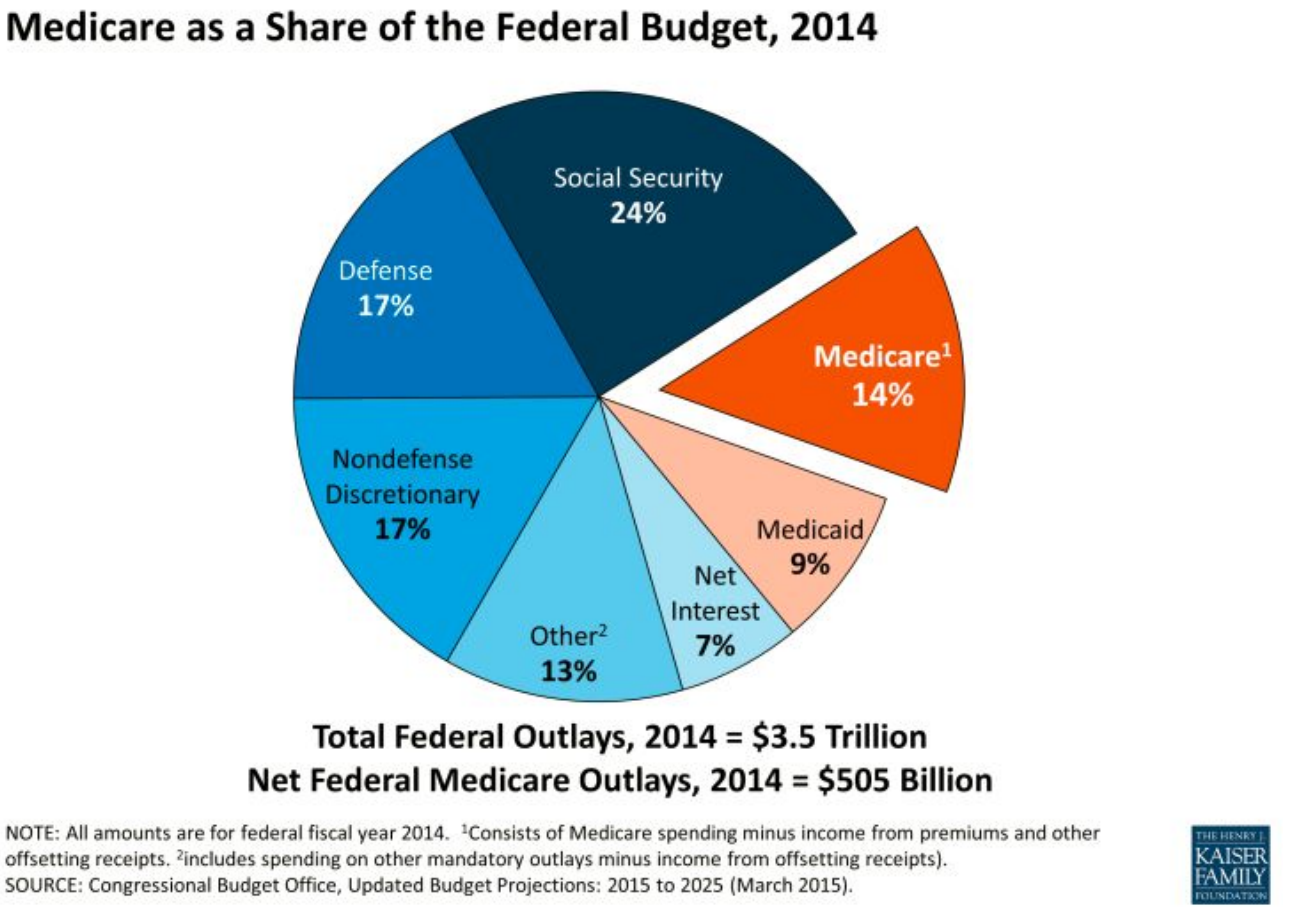
Objective: Apply analytical techniques to publicly available health care data sets in order to define a cost savings strategy for a chosen subset of US government medical care.

US Government Medical Care

- In 2014, national health expenditures (NHE) accounted for **17.5%** of the United States Gross Domestic Product (GDP) and totaled **$3.0** trillion.
  - Medicare spending represented **20%** of total NHE (**$618 billion**).
  - Medicaid spending represented **16%** of total NHE (**$496 billion**).
- National health expenditures are projected to grow at an average rate of **5.8%** per year between 2014 and 2024, **1.1%** faster than the projected GDP growth rate.

Source: National Health Expenditures Fact Sheet. Centers for Medicare & Medicaid Services. CMS.gov

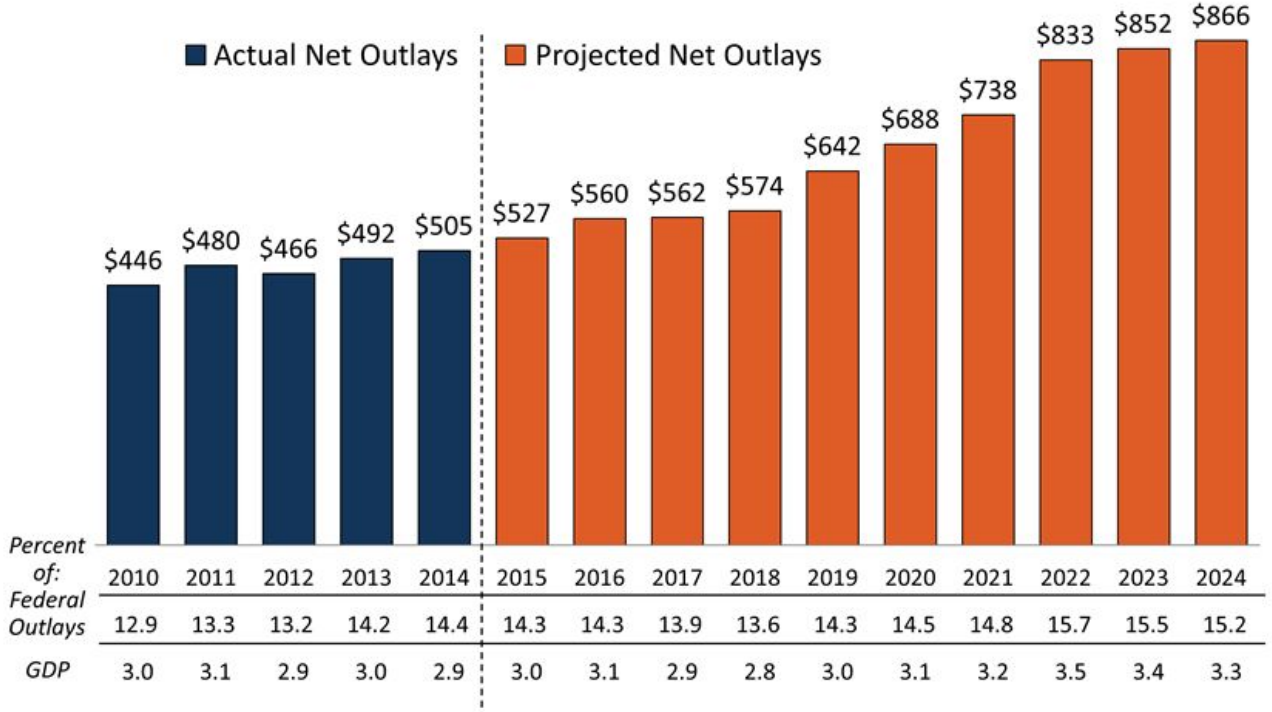
Medicare, the US Federal health insurance program for individuals aged 65 years or older and individuals under 65 with certain disabilities, accounted for ***14% of the total US Federal Budget in 2014***.



Source: "The Facts on Medicare Spending and Financing." The Kaiser Family Foundation. July 2015. KFF.org

Medicare spending growth is expected to accelerate after 2018 due to aging beneficiaries in the baby-boomer generation.

Actual and Projected Net Medicare Spending, 2010-2024



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Percent of: Federal Outlays	12.9	13.3	13.2	14.2	14.4	14.3	14.3	13.9	13.6	14.3	14.5	14.8	15.7	15.5	15.2
GDP	3.0	3.1	2.9	3.0	2.9	3.0	3.1	2.9	2.8	3.0	3.1	3.2	3.5	3.4	3.3

NOTE: All amounts are for federal fiscal years; amounts are in billions and consist of Medicare spending minus income from premiums and other offsetting receipts.
SOURCE: Congressional Budget Office, Updated Budget Projections: 2015 to 2025 (March 2015); The 2015 Long-Term Budget Outlook (June 2015).

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Source: "The Facts on Medicare Spending and Financing." The Kaiser Family Foundation. July 2015. KFF.org

Why is Medicare so expensive?

In 2015, the Kaiser Family Foundation found evidence of geographic variation in per capita Medicare spend:

"Our analysis shows that geographic variation in Medicare per capita spending persists … ***deep differences in per capita Medicare spending in different parts of the country remain and are likely to persist due to underlying differences in beneficiary characteristics related to poverty and poor health****, along with differences in the prices that Medicare pays for services, that contribute to variations in spending."*

Source: "The Latest on Geographic Variation in Medicare Spending." The Kaiser Family Foundation. October 2015. Kff.org

How does poor health impact Medicare cost?

We evaluated the trends and relationships between the following 19 chronic conditions and average Medicare cost per beneficiary.

Alzheimer's Disease/Dementia	Arthritis	Asthma	Atrial Fibrillation
Autism Spectrum Disorders	COPD	Cancer	Chronic Kidney Disease
Depression	Diabetes	HIV/AIDS	Heart Failure
Hepatitis	Hyperlipidemia	Hypertension	Ischemic Heart Disease
Osteoporosis	Schizophrenia/ Psychotic Disorders	Stroke	

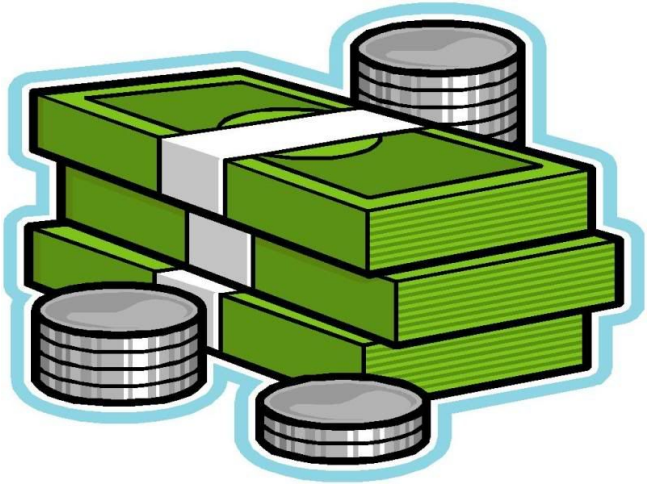
Data File Details

- **Source:**
  - Center for Medicare and Medicaid Services (CMS) website
- **Scope:**
  - Annual county-level statistics for all United States counties and territories (2007-2014)
- **Population:**
  - Beneficiaries enrolled in the Medicare fee-for-service (FFS) program
- **Target:**
  - Medicare standardized cost per FFS beneficiary (taken from the CMS Public Use Geographic Variation data file)
- **Inputs:**
  - Prevalence rates of 19 chronic conditions (taken from the CMS Chronic Conditions data file)

Guiding Research Questions

Which conditions drive increases in Medicare spending?

Can we identify states or counties that treat certain conditions more efficiently than others?

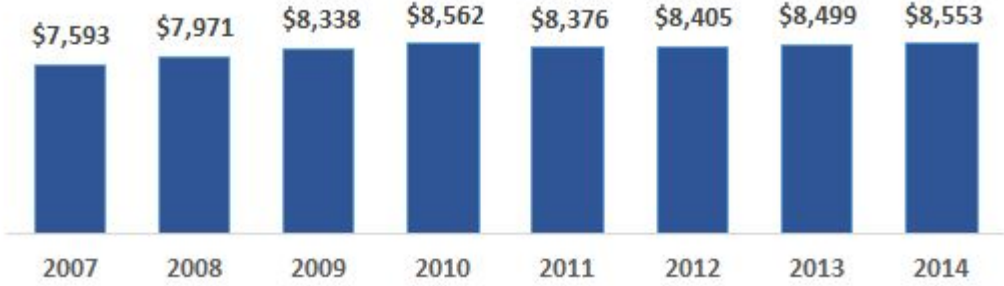


Exploratory Analysis

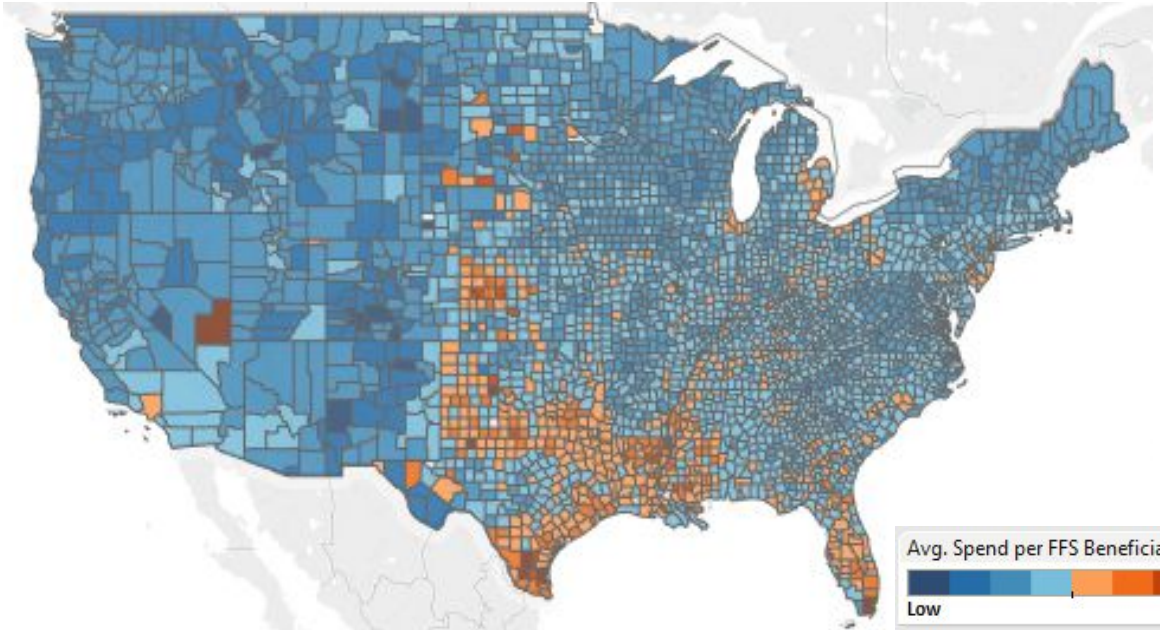
Annual Medicare cost per FFS beneficiary has risen slowly but steadily over the past 8 years.

Annual cost varies at the county level, with some counties spending significantly more per FFS beneficiary than others.

Average Cost Per FFS Beneficiary by Year ($)



Average Cost Per FFS Beneficiary by County ($)



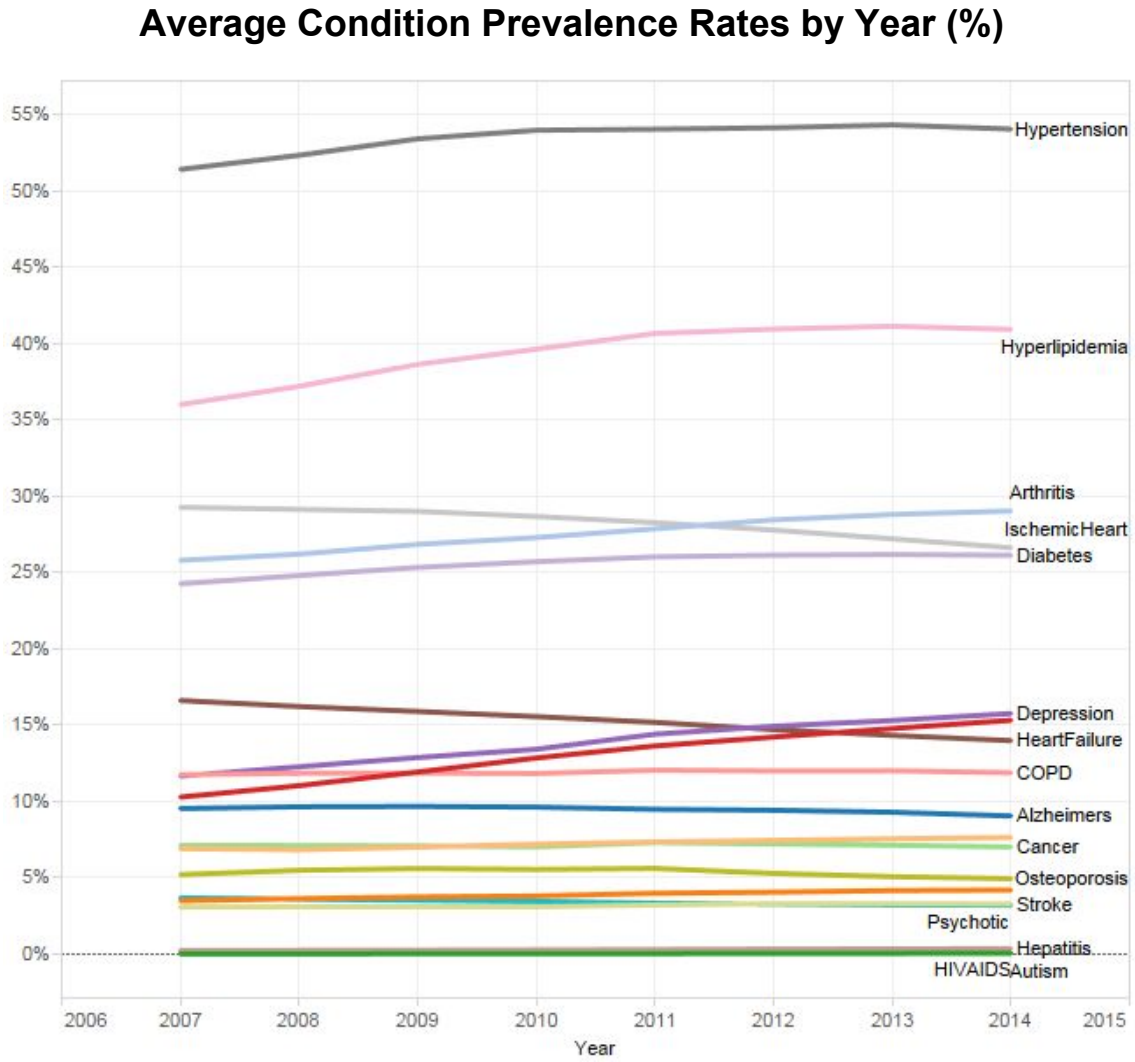
Condition prevalence rates also show yearly variation.

Most Prevalent:

- Hypertension
- Hyperlipidemia

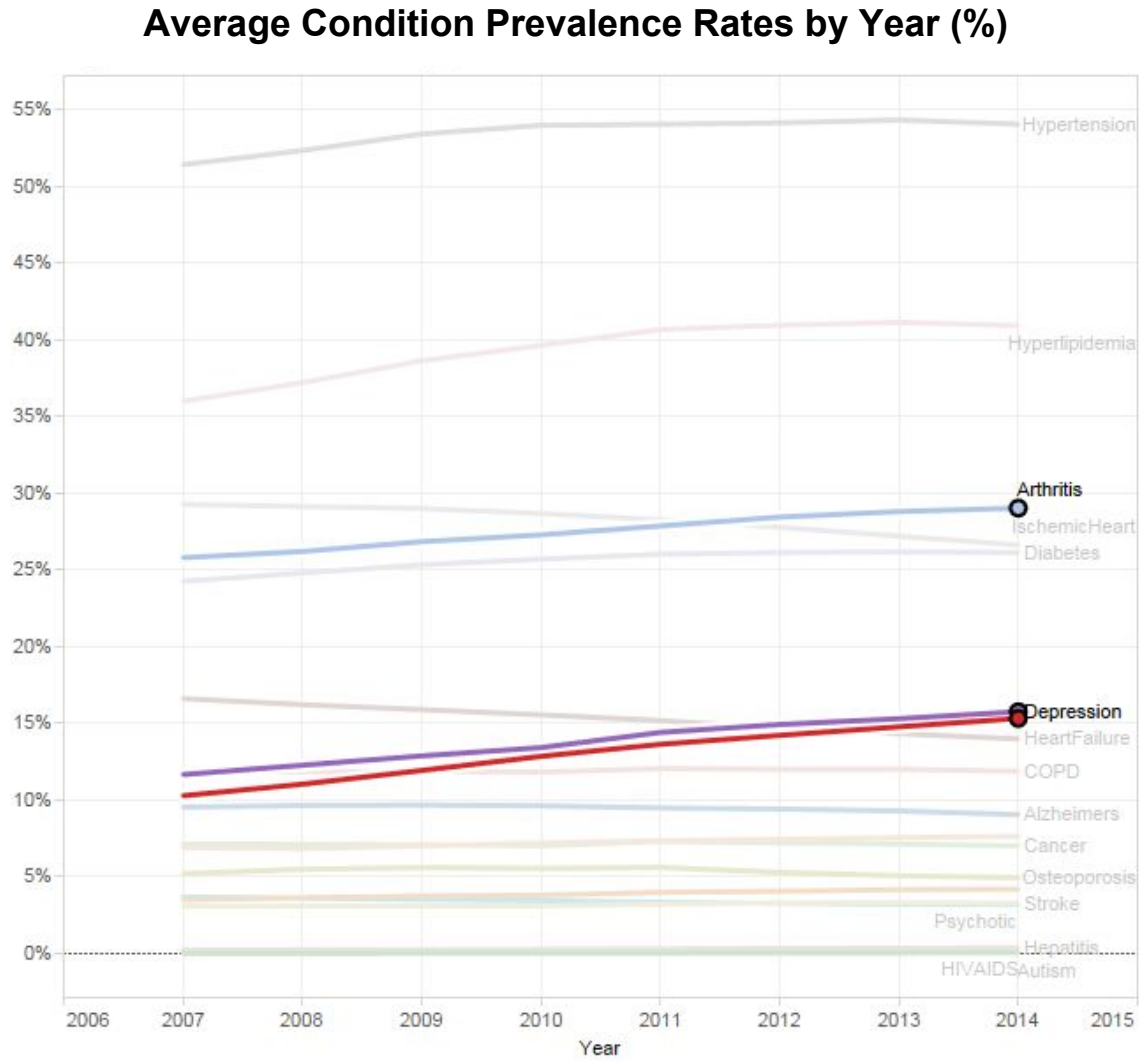
Least Prevalent:

- Autism
- HIV/AIDS



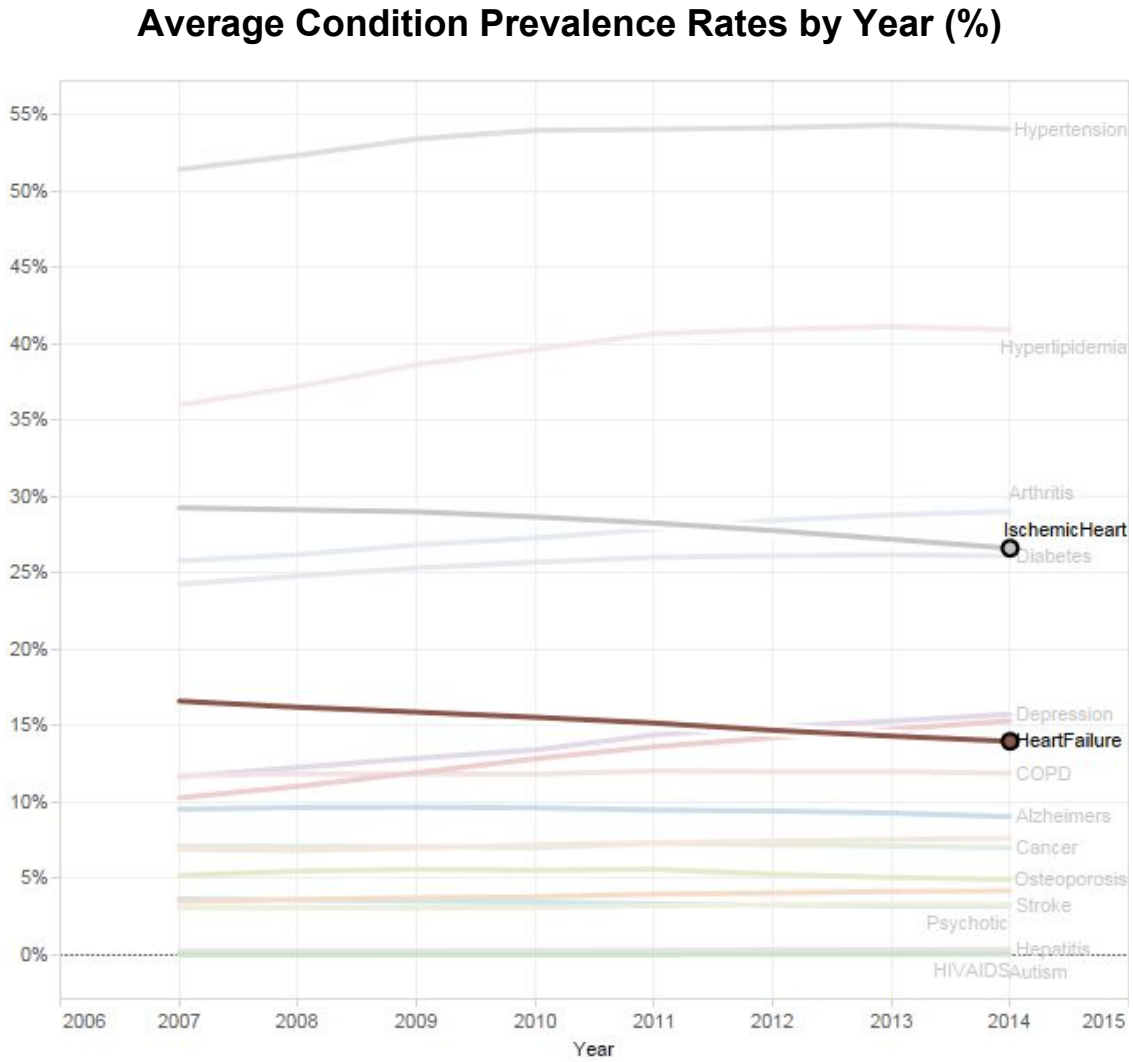
Increasing trend

- Arthritis
- Depression
- Chronic Kidney



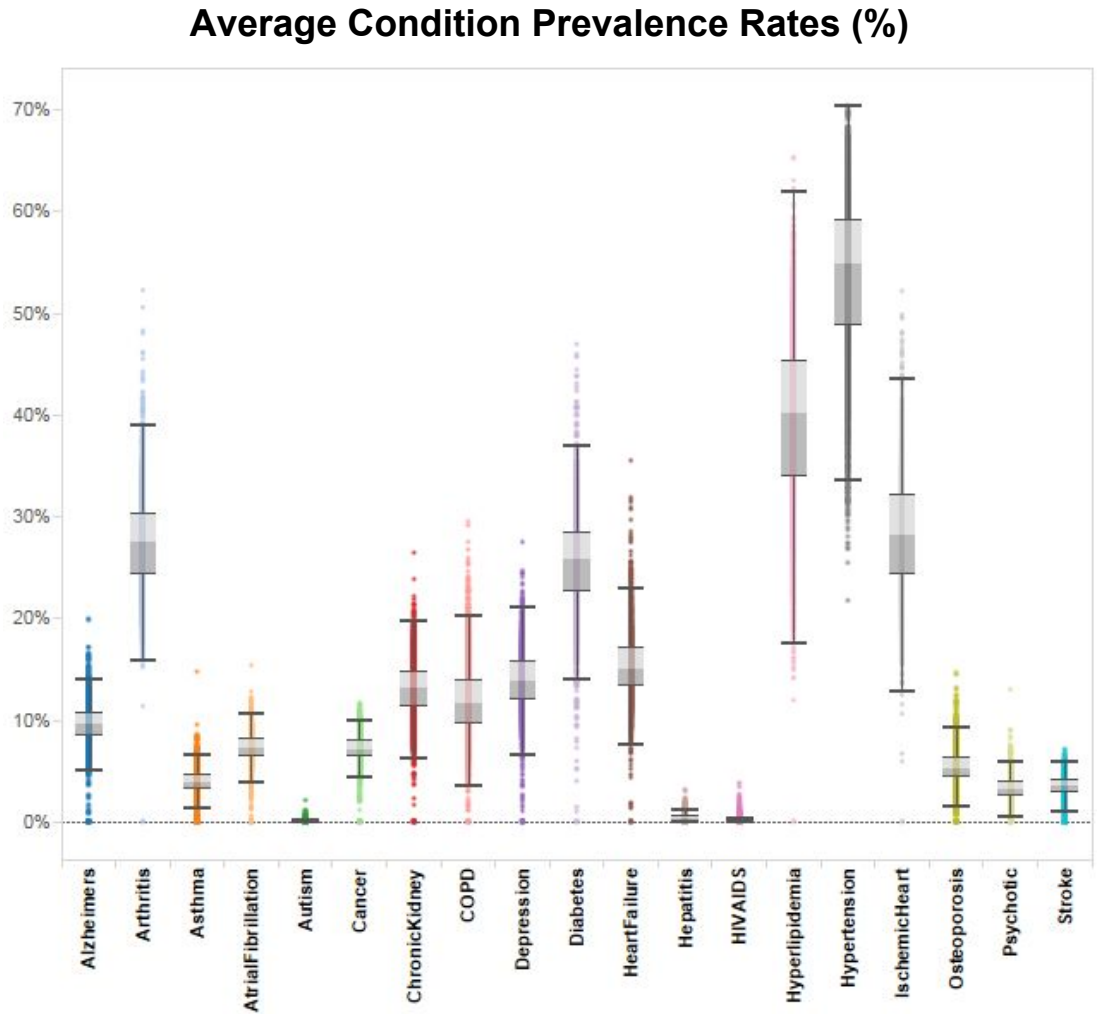
Decreasing trend

- Ischemic Heart
- Heart Failure



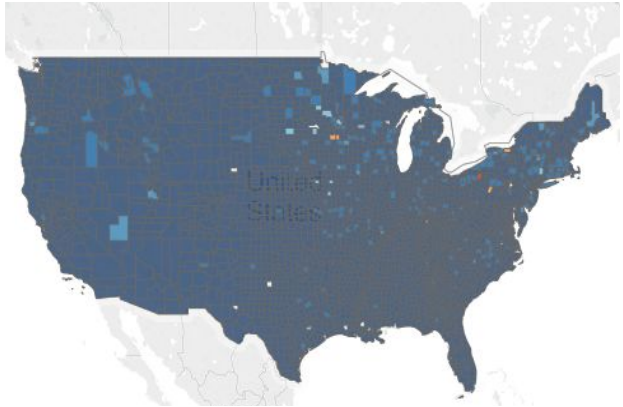
Condition prevalence rates vary across counties.

Hypertension, Hyperlipidemia, and Ischemic Heart have a very wide range whereas Autism, HIV/AIDS, and Hepatitis have a very narrow spread.

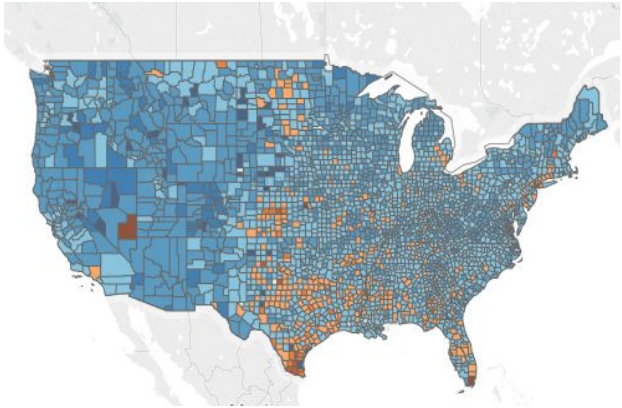


Condition Prevalence by County

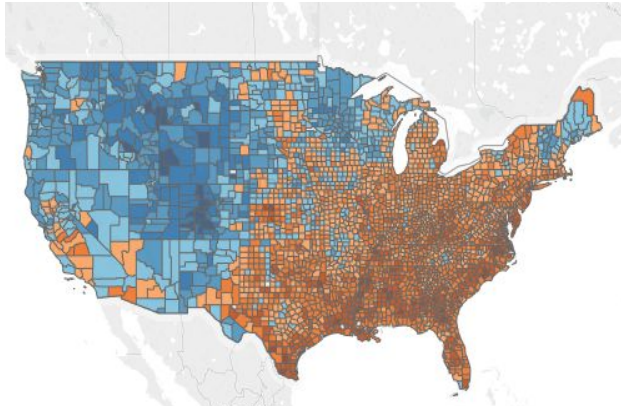
Autism

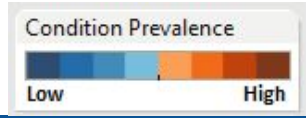


Alzheimer's



Hypertension



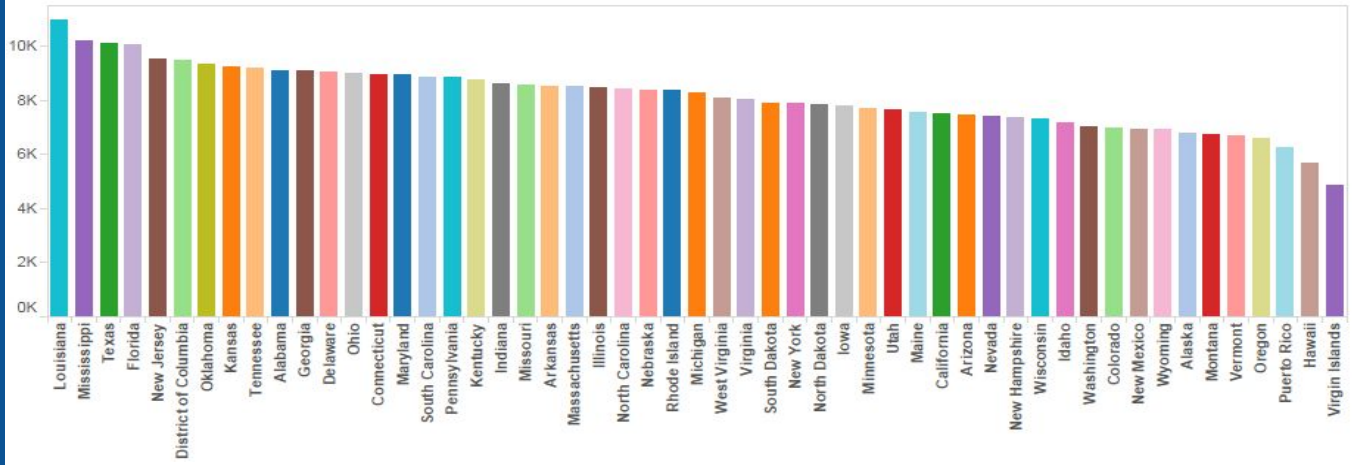


Conditions have very different geographical distributions.

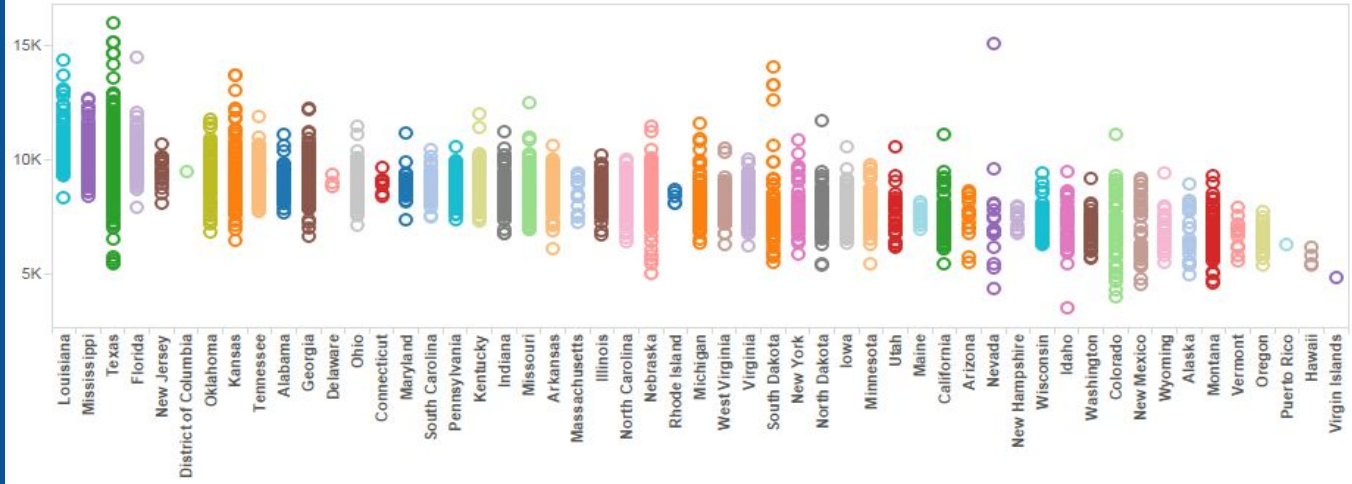
While there is some variation in average state-level cost, the differences are relatively small.

However, county-level differences in cost per FFS are much more extreme.

Average Cost per FFS Beneficiary by State ($)



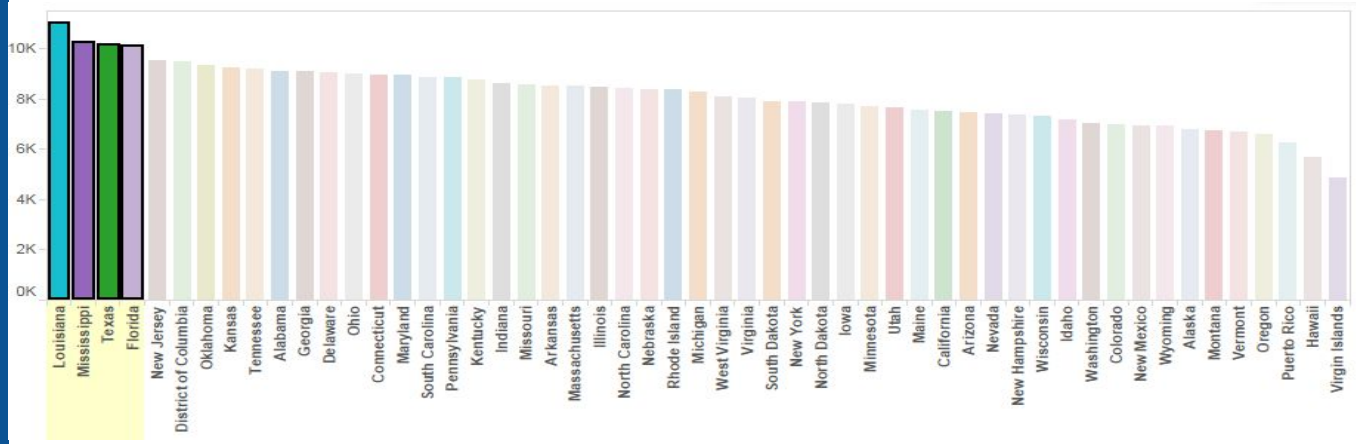
Average County-Level Cost Per FFS Beneficiary by State ($)



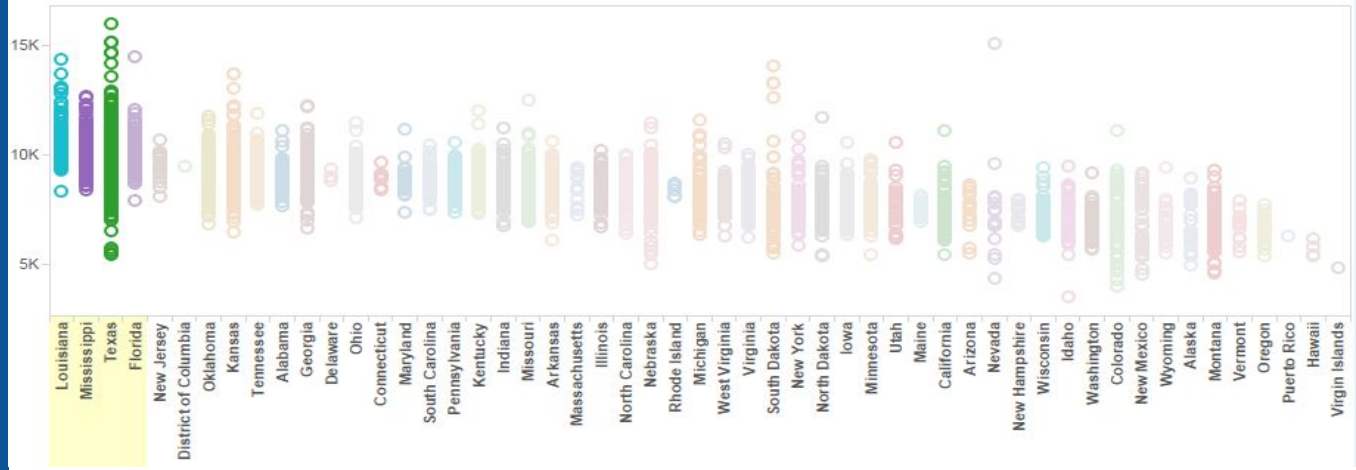
Louisiana, Mississippi, Texas, and Florida have the highest average cost per FFS beneficiary.

Despite its high average, Texas demonstrates an extremely wide range of county-level cost values.

Average Cost per FFS Beneficiary by State ($)

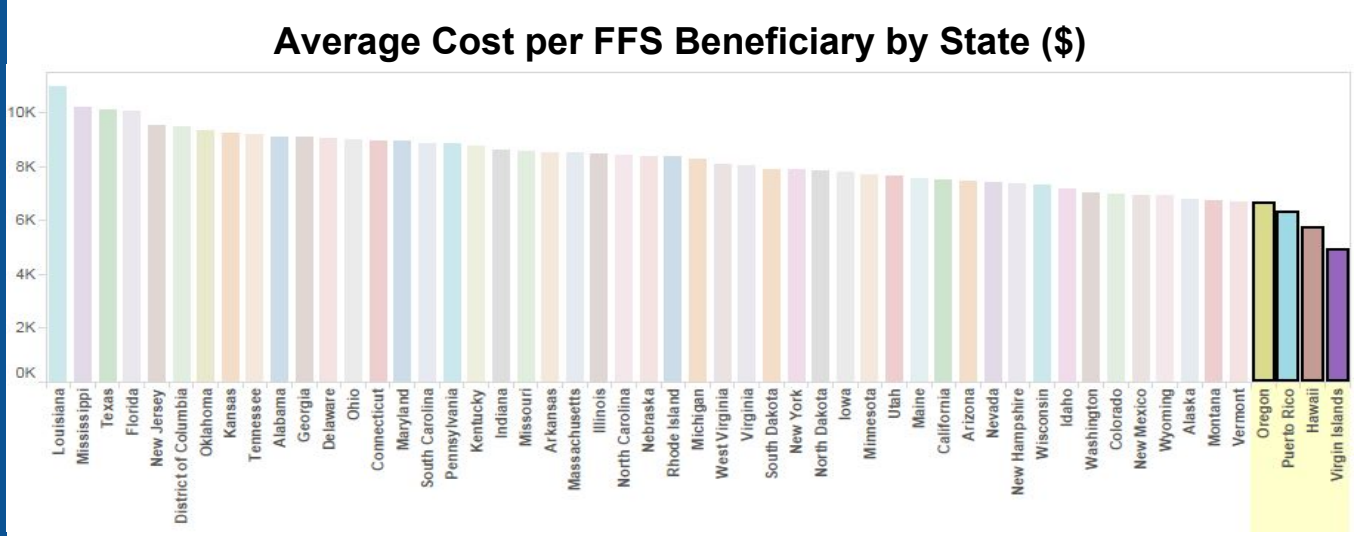


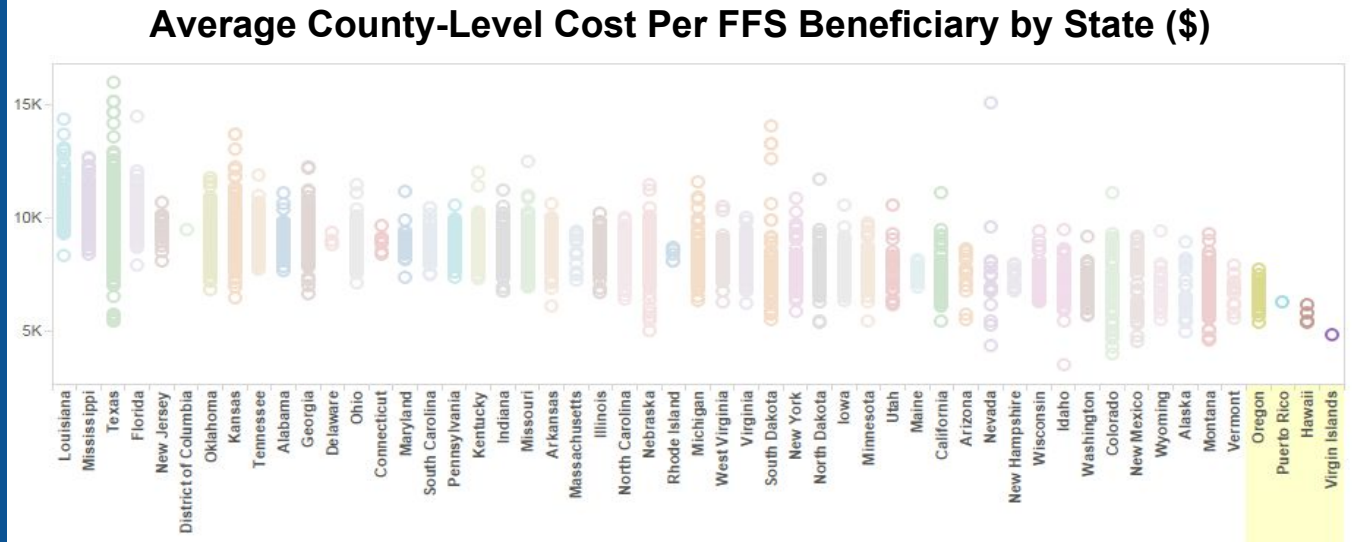
Average County-Level Cost Per FFS Beneficiary by State ($)



Oregon, Puerto Rico, Hawaii, and the Virgin Islands have the lowest average cost per FFS beneficiary.

These areas also display a narrower range of county-level values.

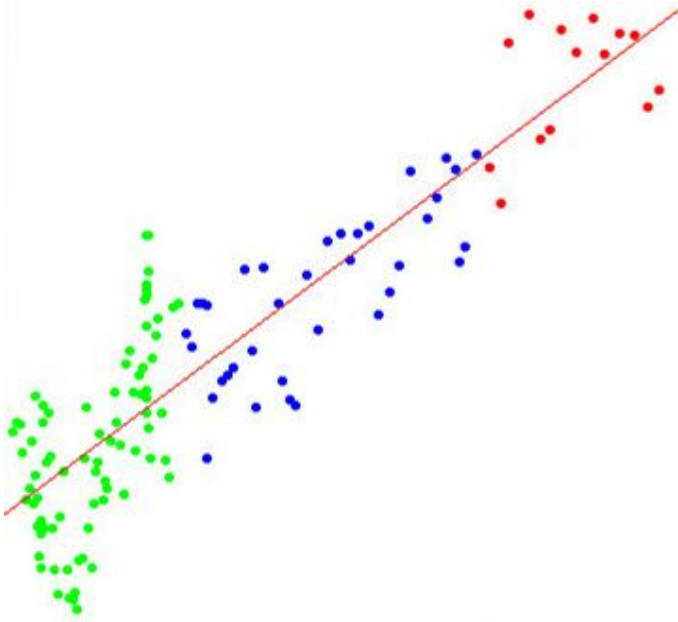




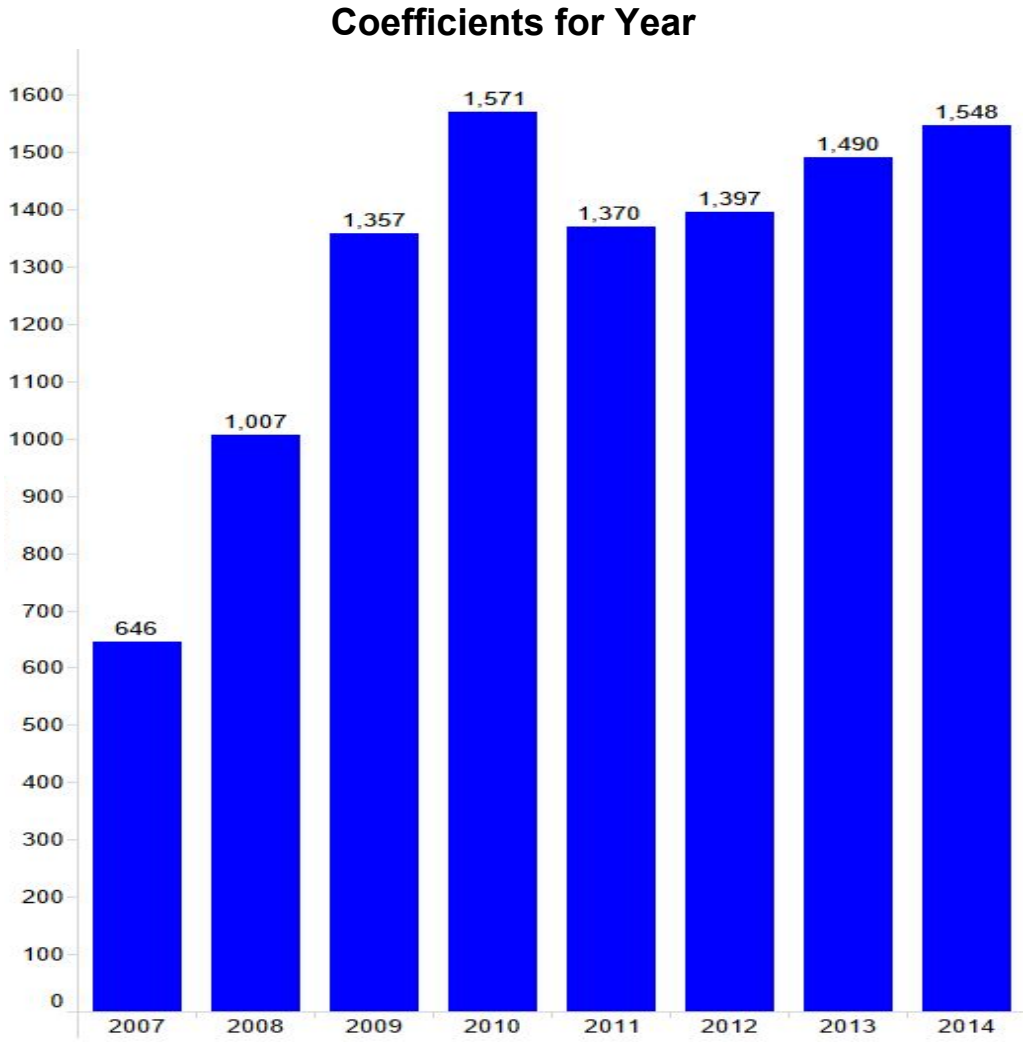
Exploring Variation by Year, Condition, and State

Regression Analysis

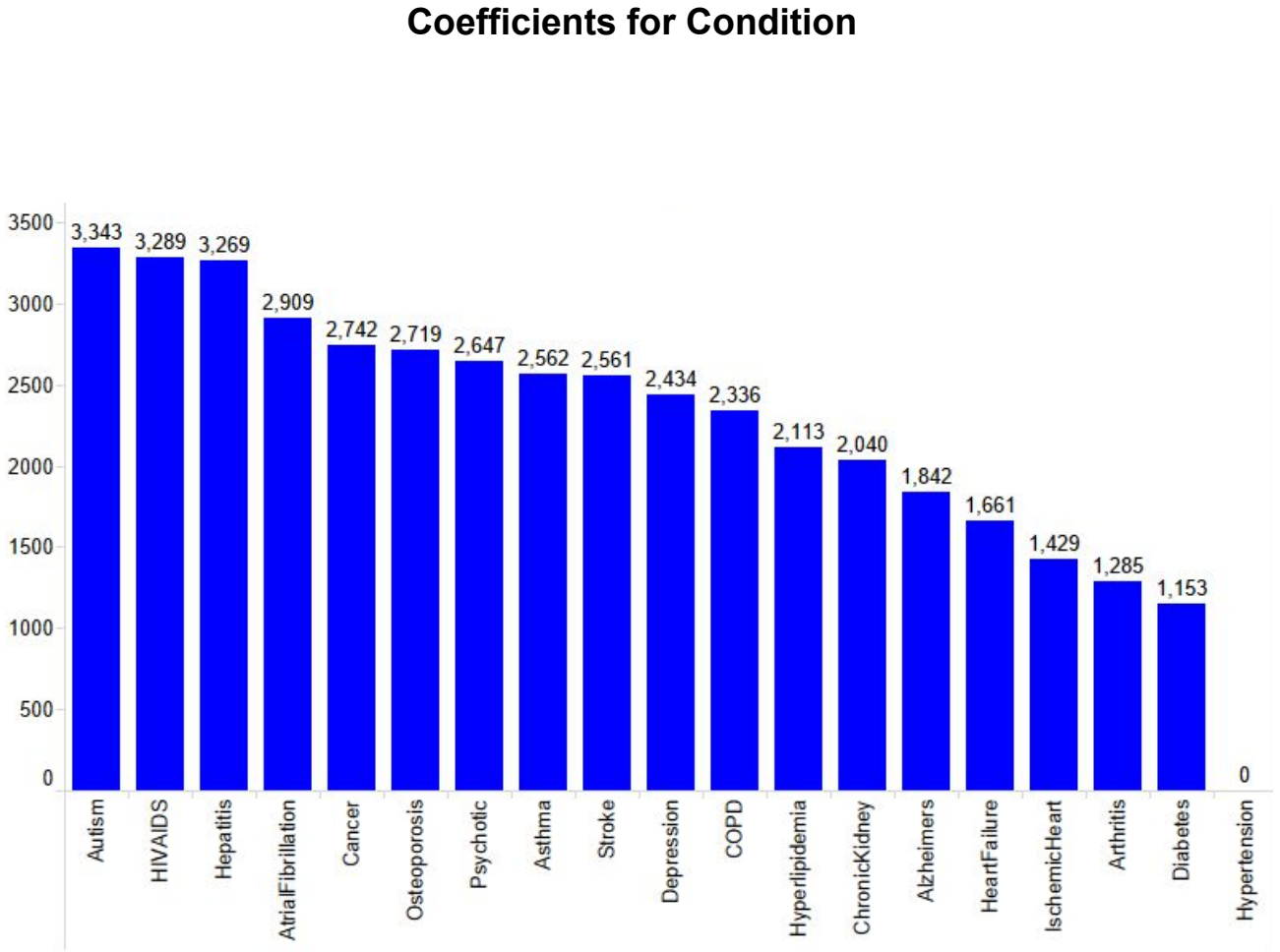
- Target:
  - Medicare Cost per FFS beneficiary
- Inputs:
  - Year
  - Condition
  - State
  - Condition * Prevalence Rate
  - State * Prevalence Rate



The yearly coefficients mirror the trend observed in the earlier analysis: Medicare cost per FFS beneficiary has been slowly but steadily rising, except for a dip between 2010-2011.

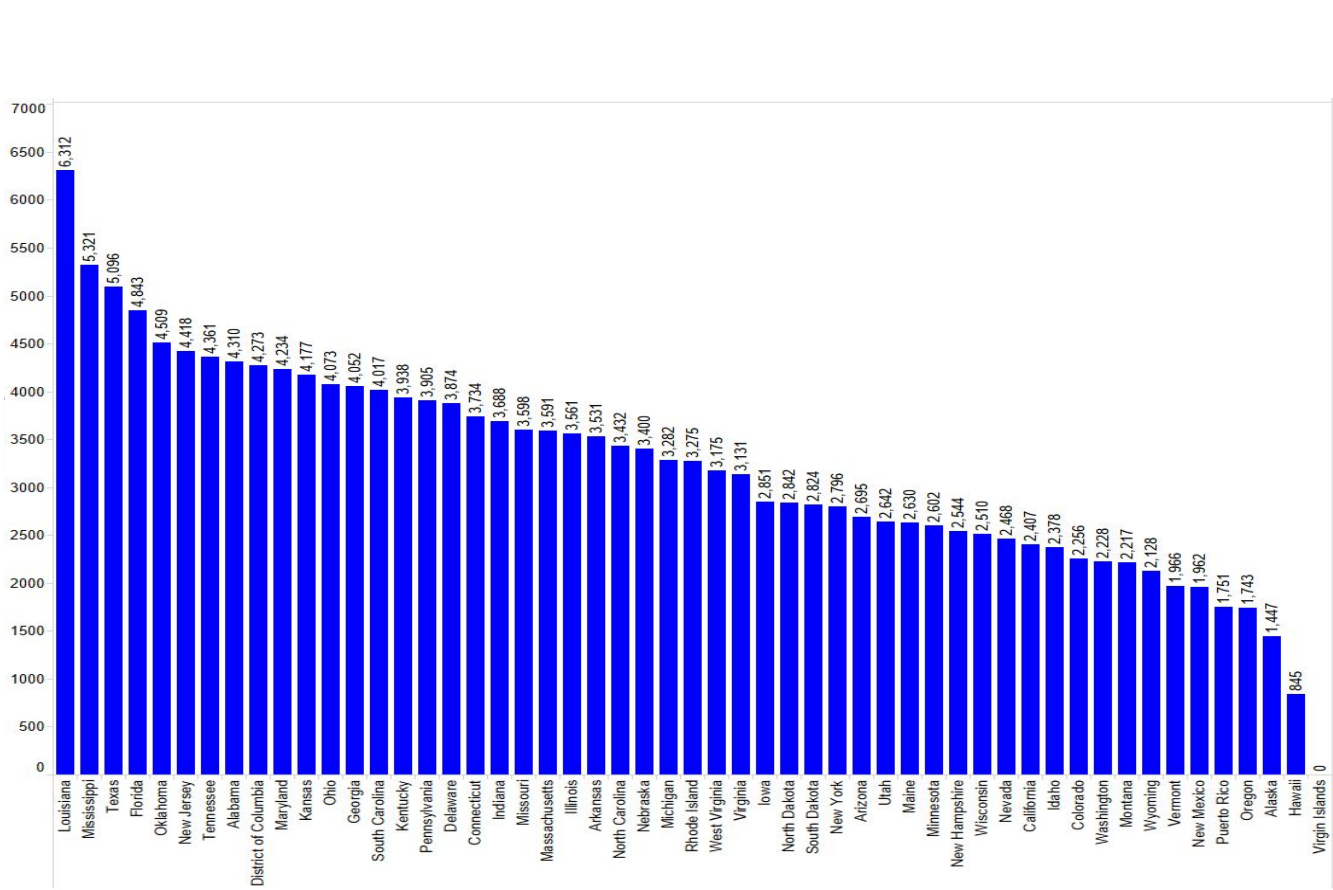


Rare conditions, such as Autism and HIV/AIDS, have higher coefficient values than more common conditions such as Hypertension.



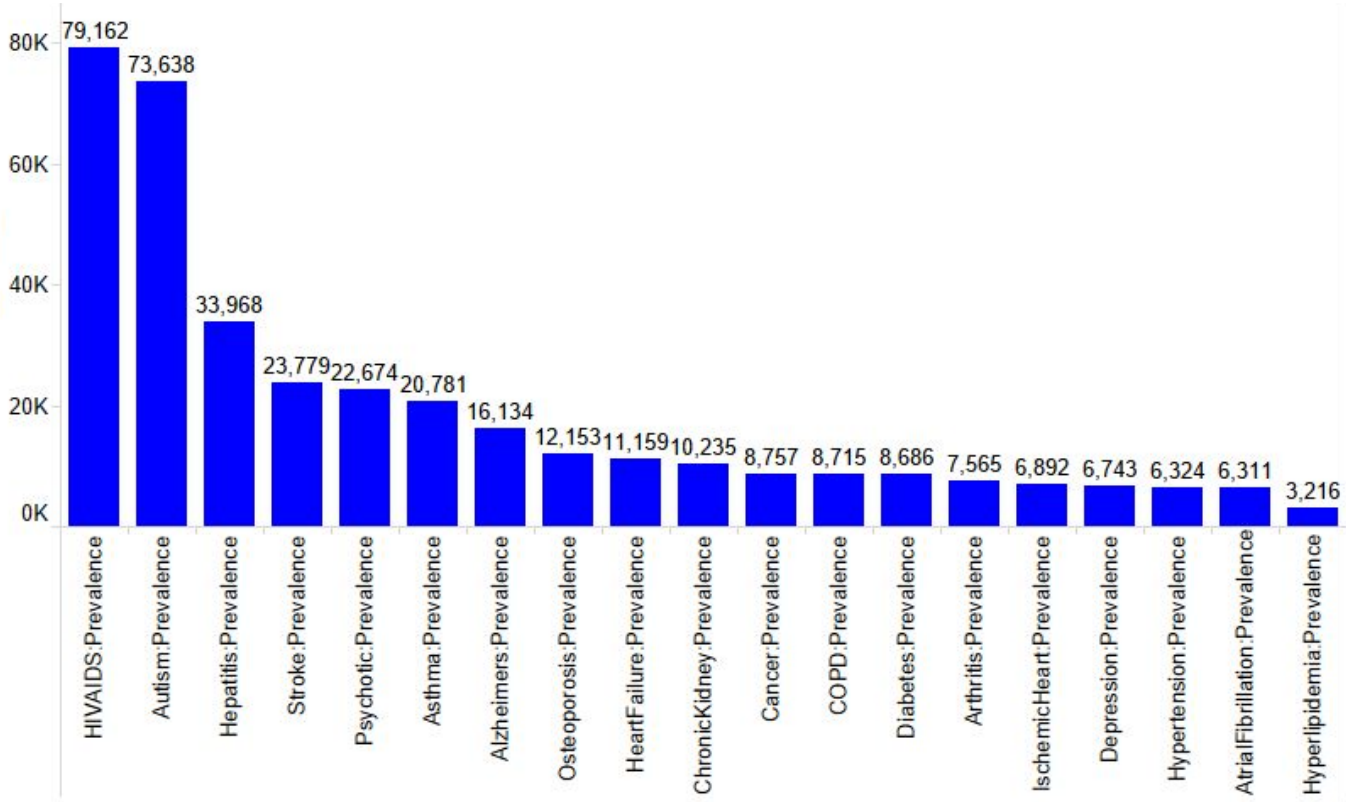
High-cost states such as Louisiana, Mississippi, Texas, and Florida have high coefficient values.

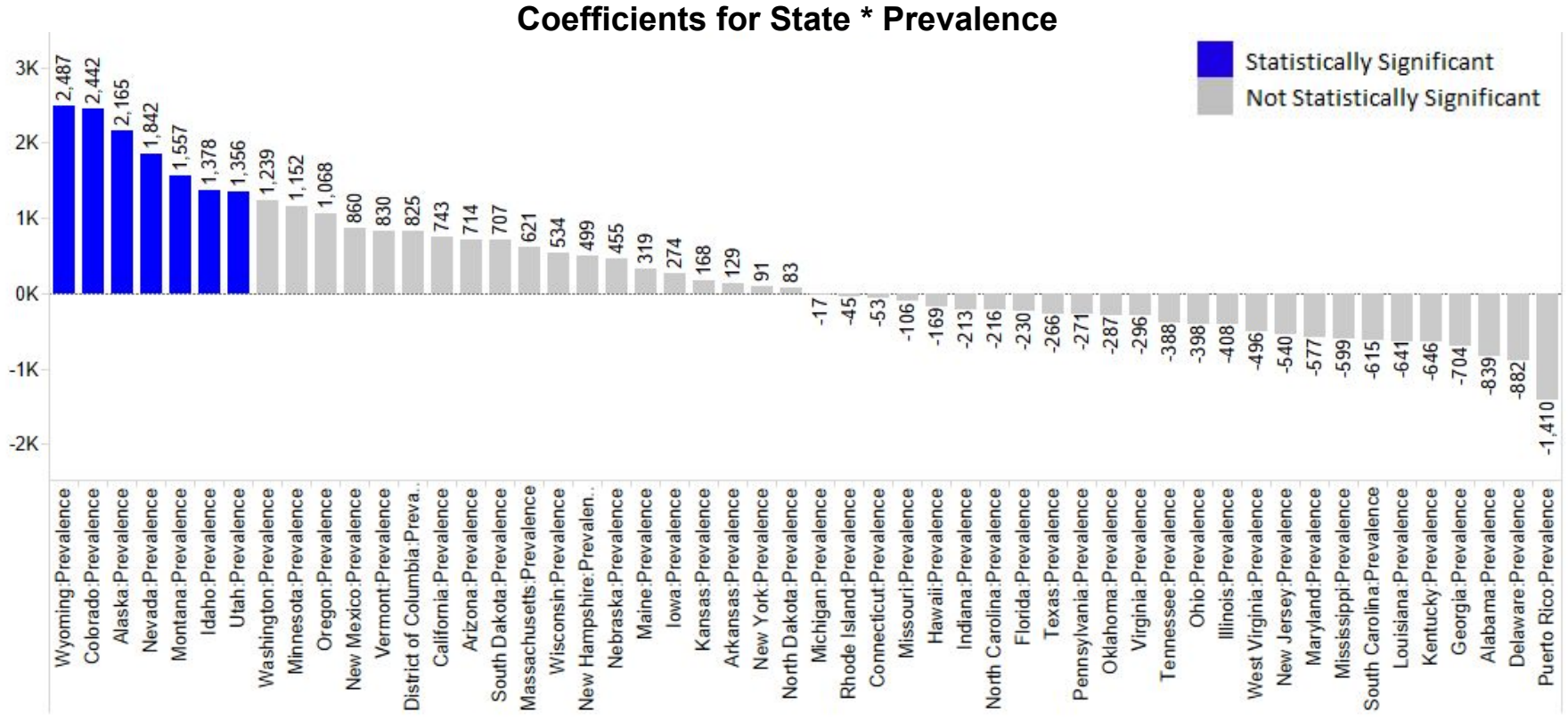
Low-cost states like the Virgin Islands, Hawaii, and Alaska have low coefficient values.



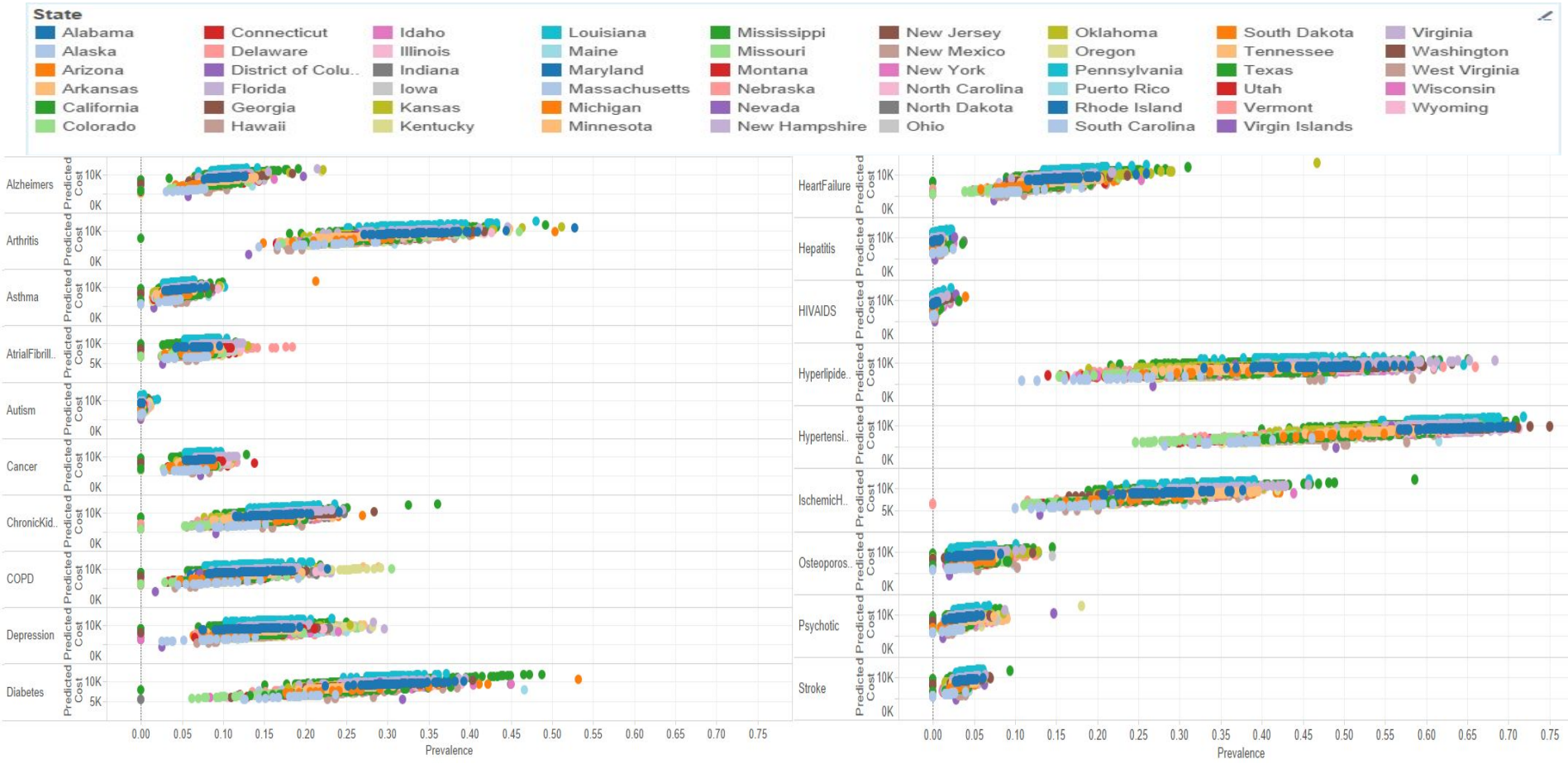
The condition * prevalence term demonstrates the rate at which cost changes as condition prevalence increases.

An increase in prevalence of HIV/AIDS causes a greater cost impact than an equivalent increase in prevalence of Hyperlipidemia.





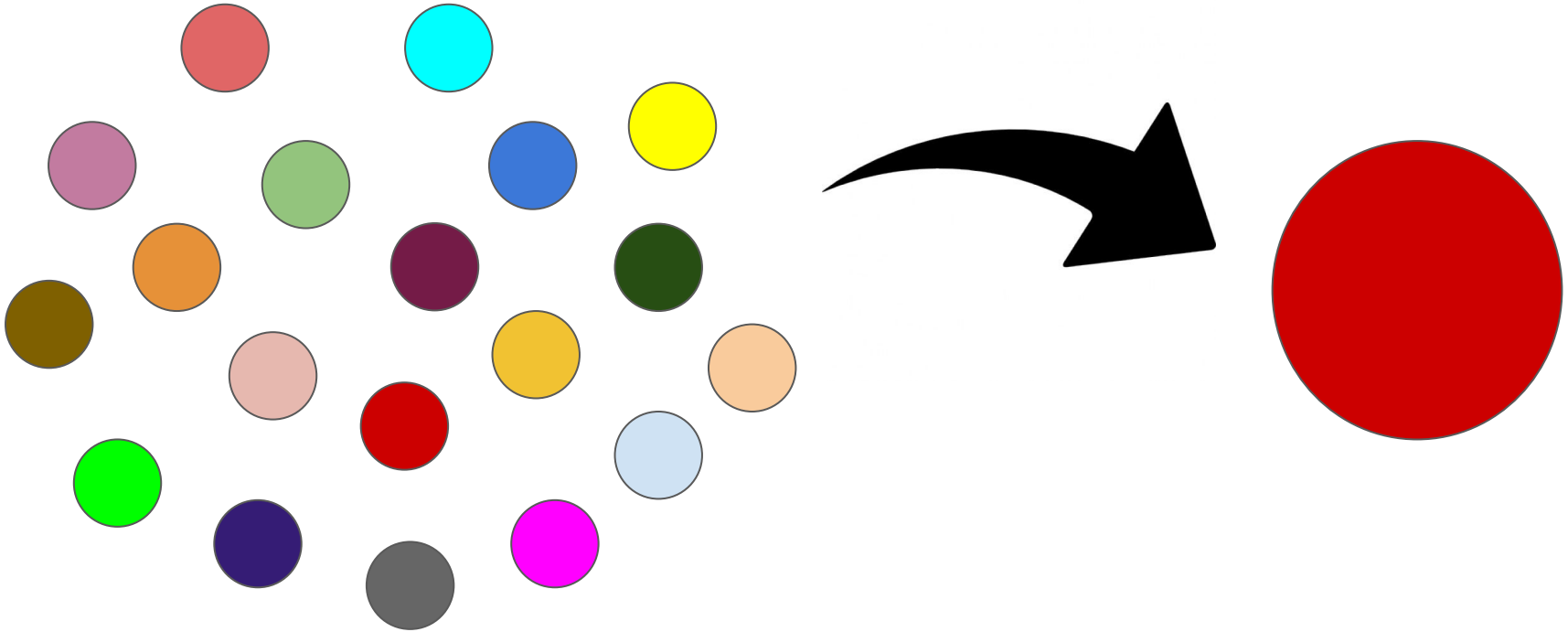
Low-cost states have some impact on cost as prevalence rates increase. However, these coefficients are negligible when compared with the scale of other coefficients. The effect of change in prevalence rates in most states is insignificant.



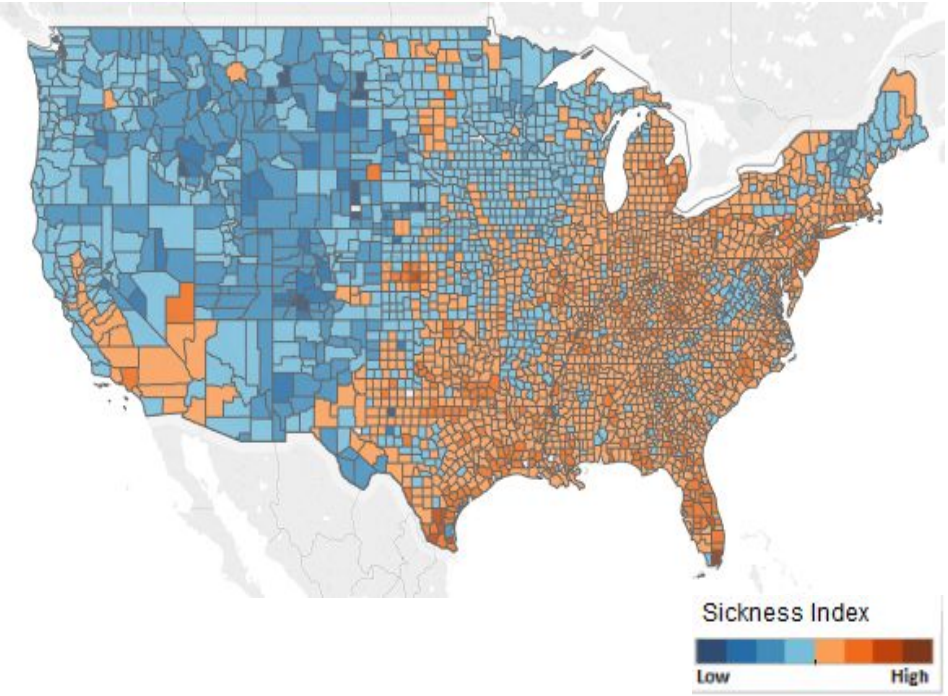
Slope patterns are different across conditions but very similar across states.

Sickness Index

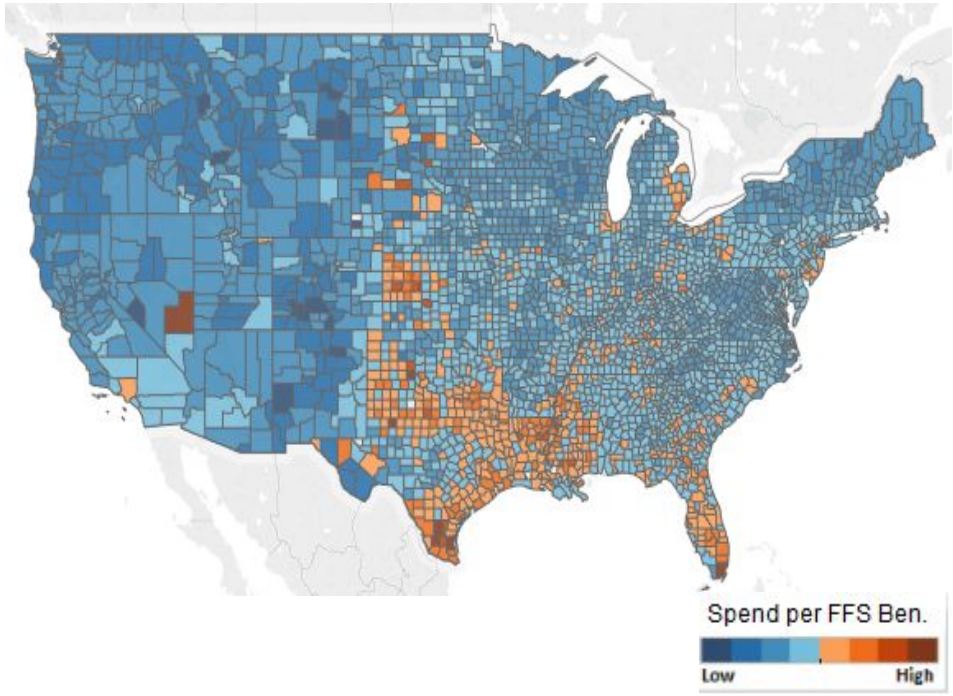
Since cost increases with prevalence for all conditions, we grouped the 19 conditions into a single index.



Sickness Index by County



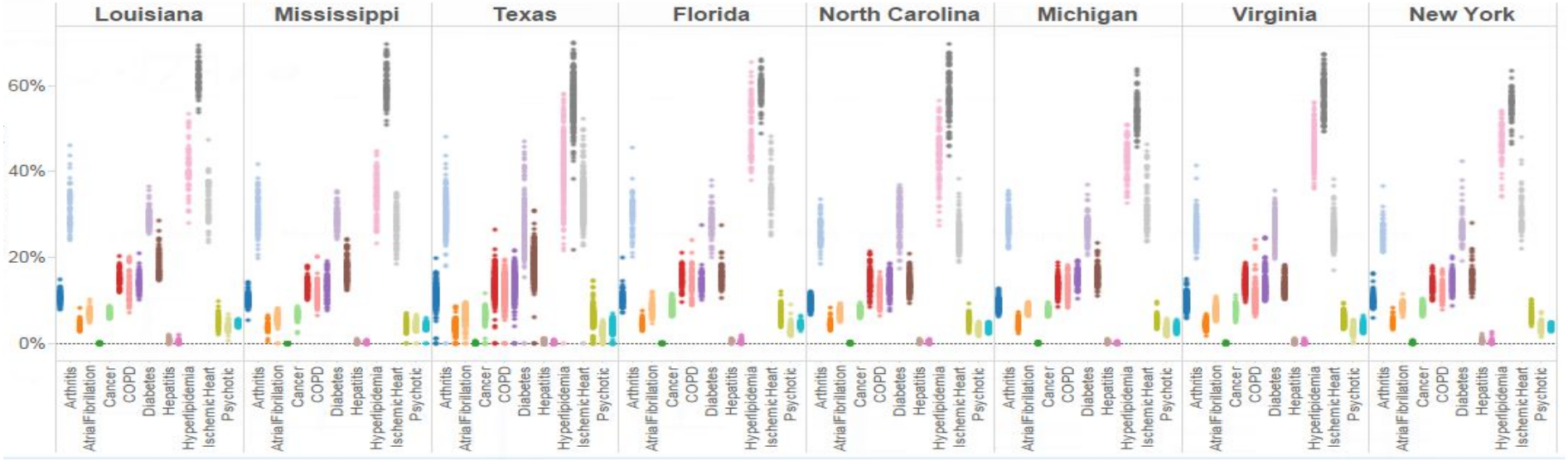
Cost per FFS Beneficiary by County



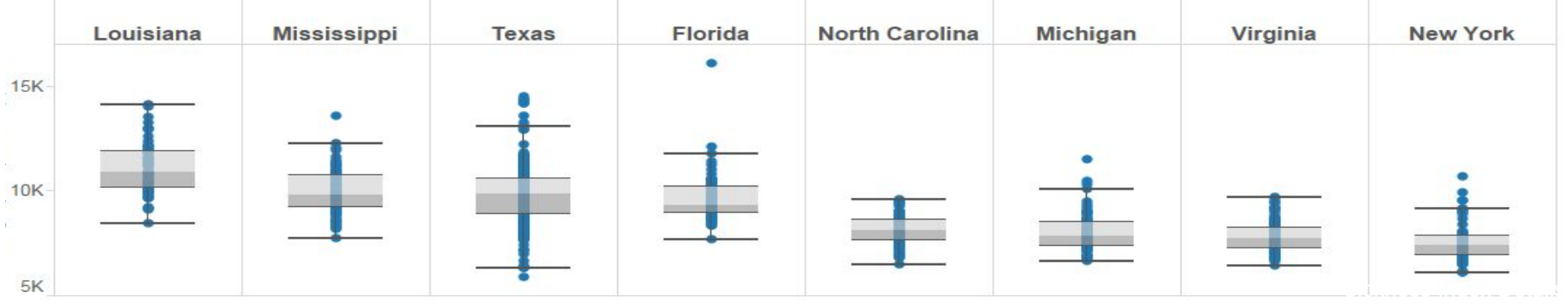
Counties with high sickness index scores demonstrate high variation in cost.

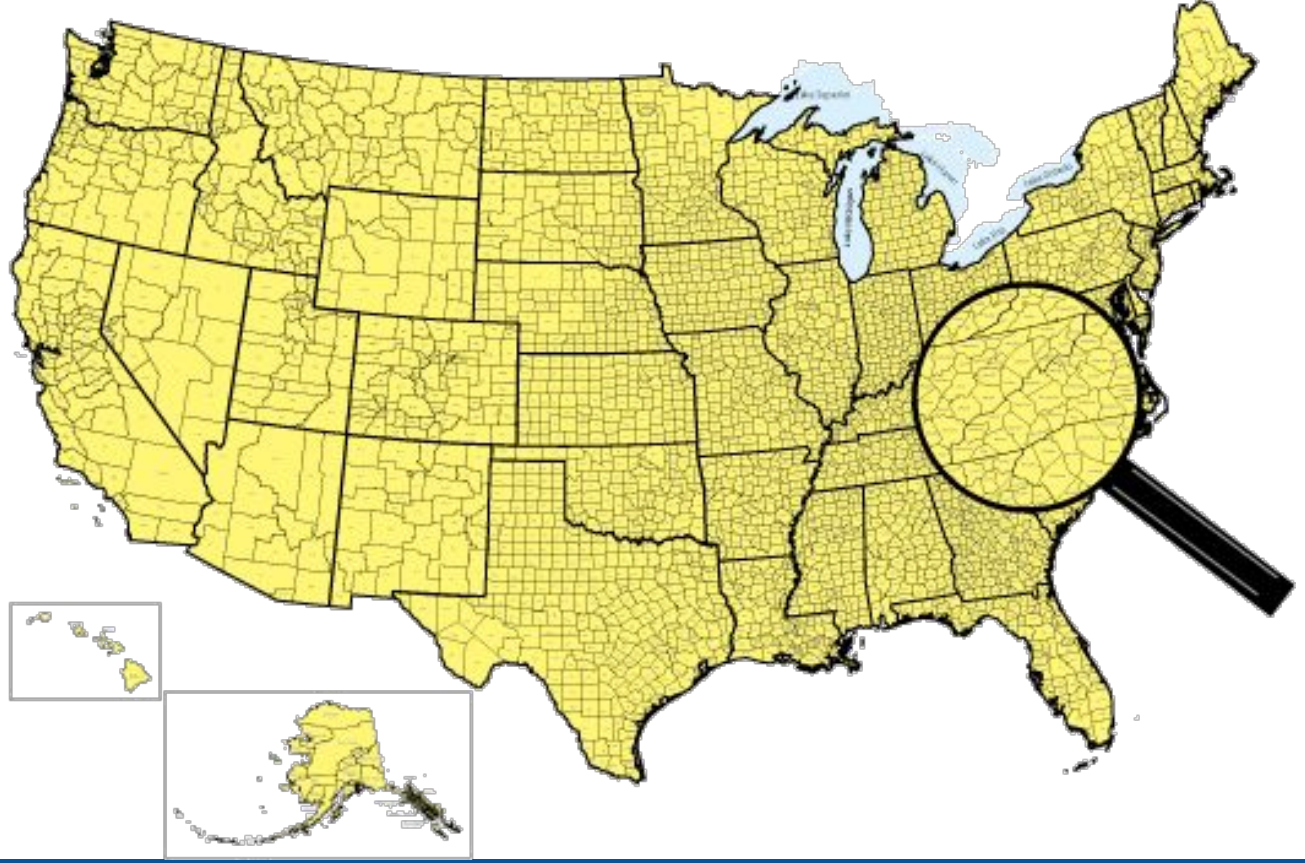
Condition Prevalence Rates by State (%)

One dot represents one county average value across years.



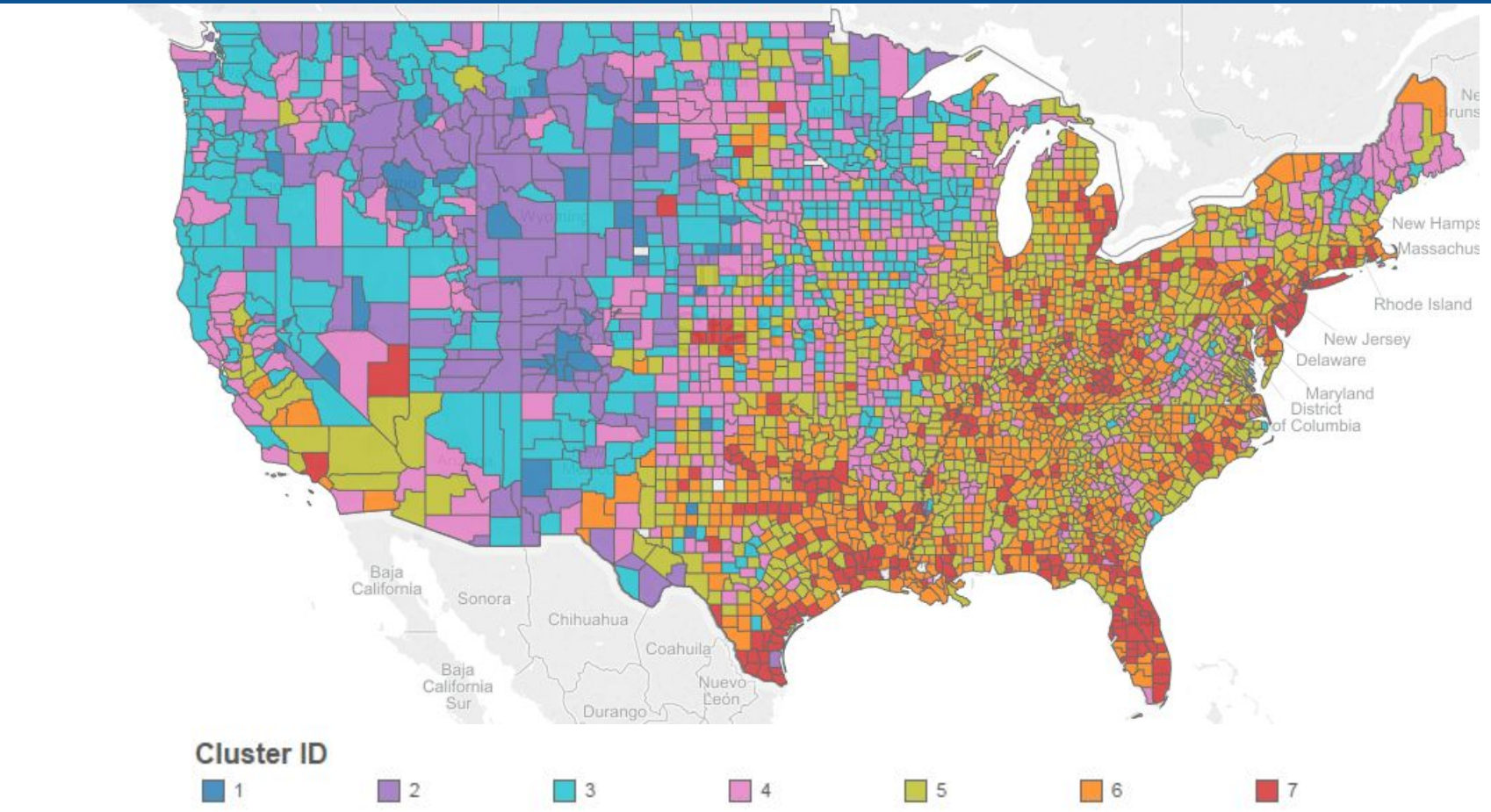
Average Cost per FFS Beneficiary by State ($)





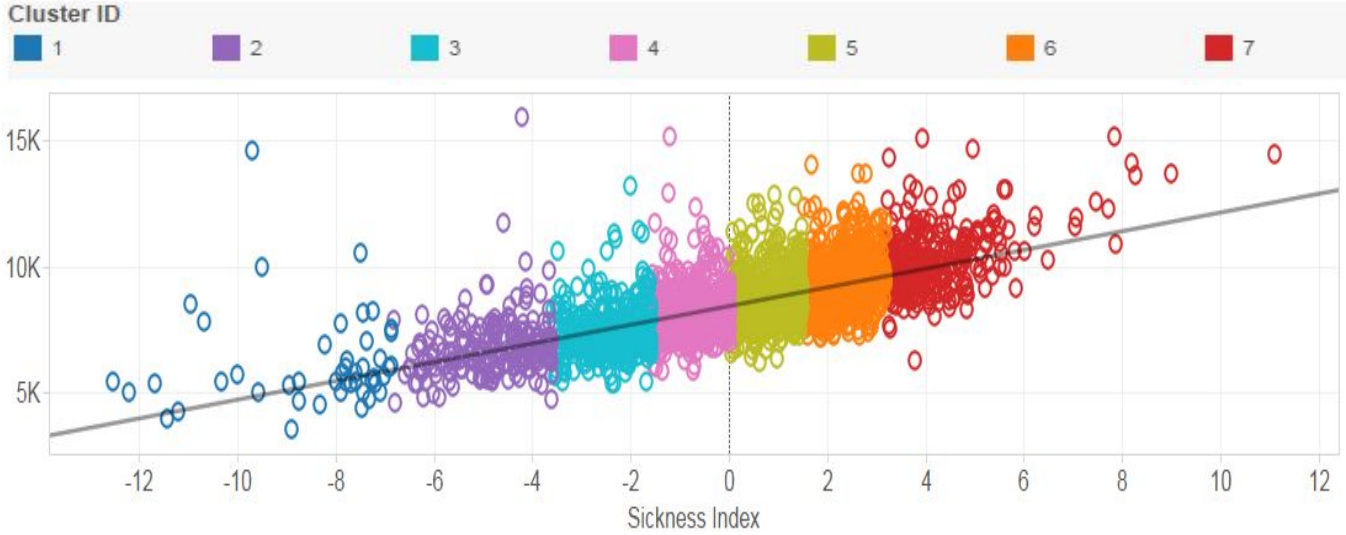
Exploring Variation by County

Clustering Counties by Sickness Index

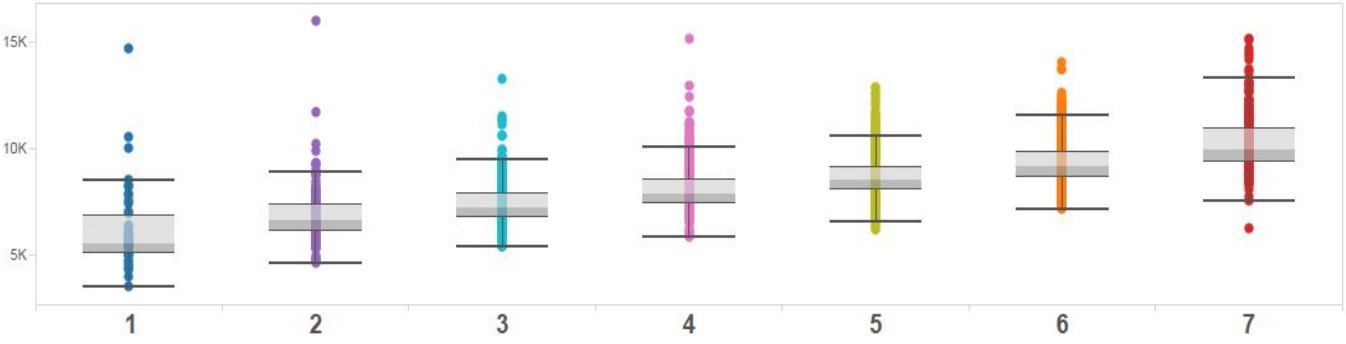


On average, counties with a higher sickness index score demonstrate higher cost.

Cost per FFS Beneficiary by Sickness Index ($)

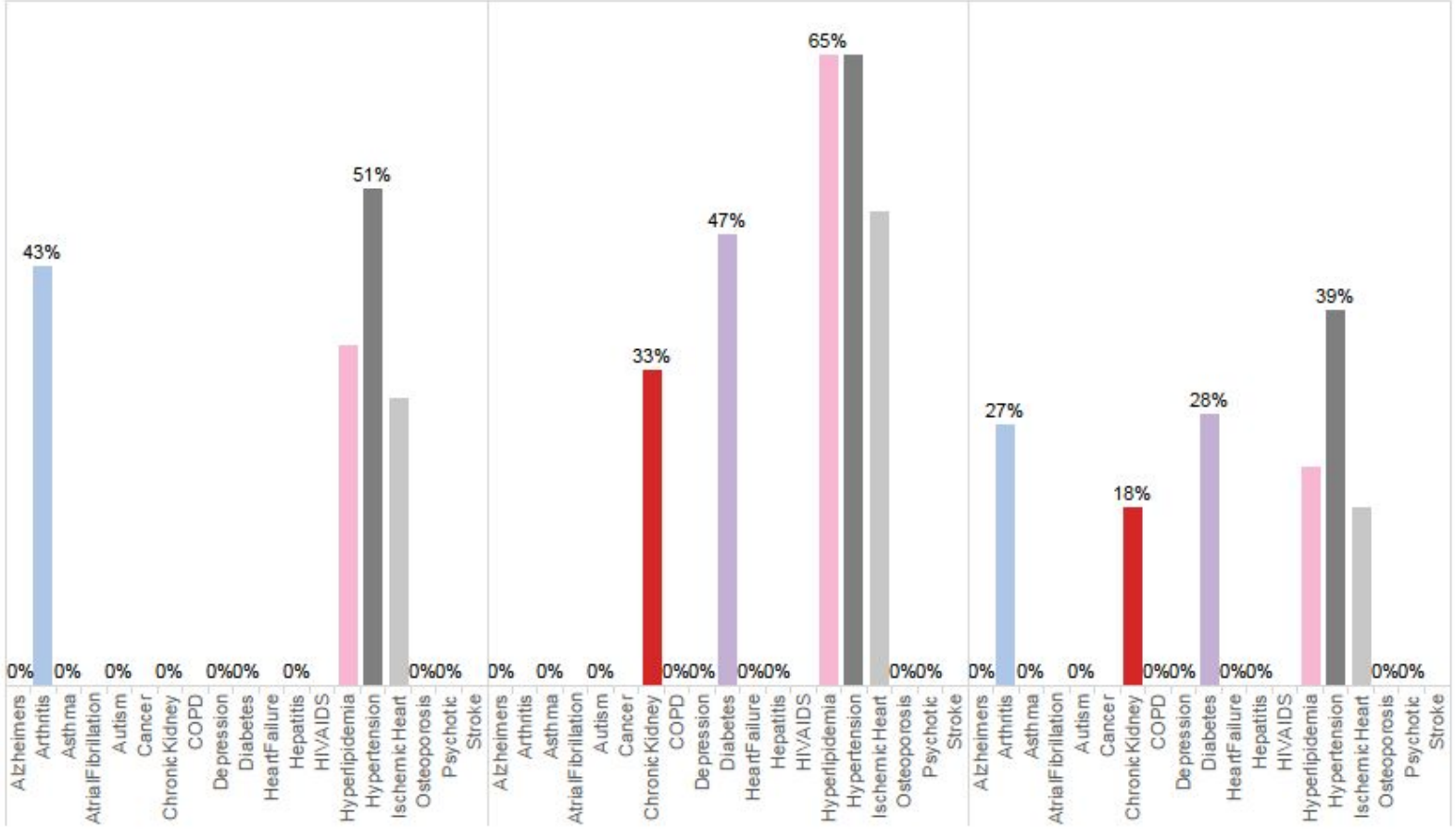


Cost per FFS Beneficiary by Cluster ID ($)

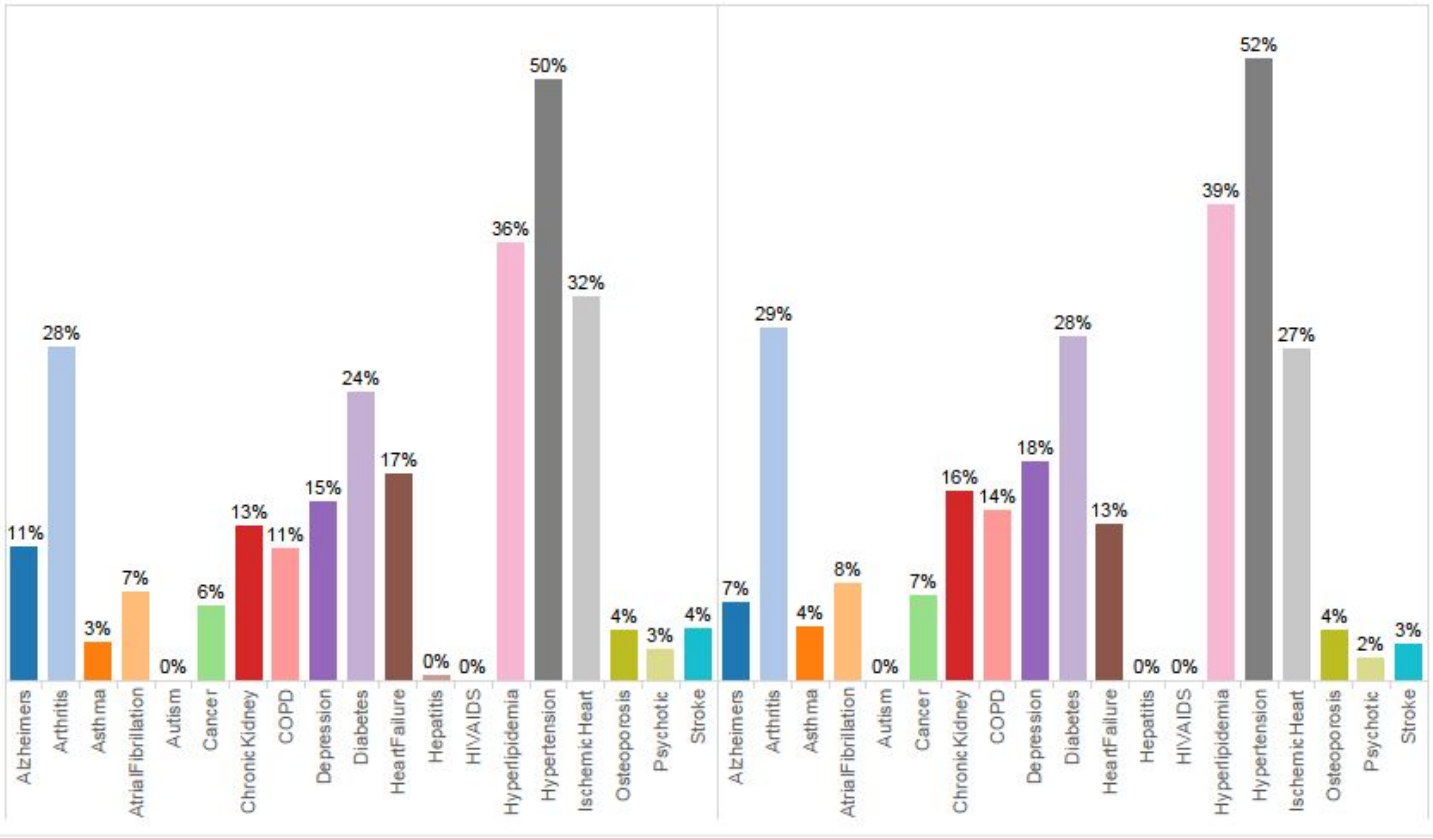


One dot represents one county in a single year (2007-2014 represented)

Borden	Clark	Kenedy
Texas	**Idaho**	**Texas**
$14,620	$3,550	$15,921

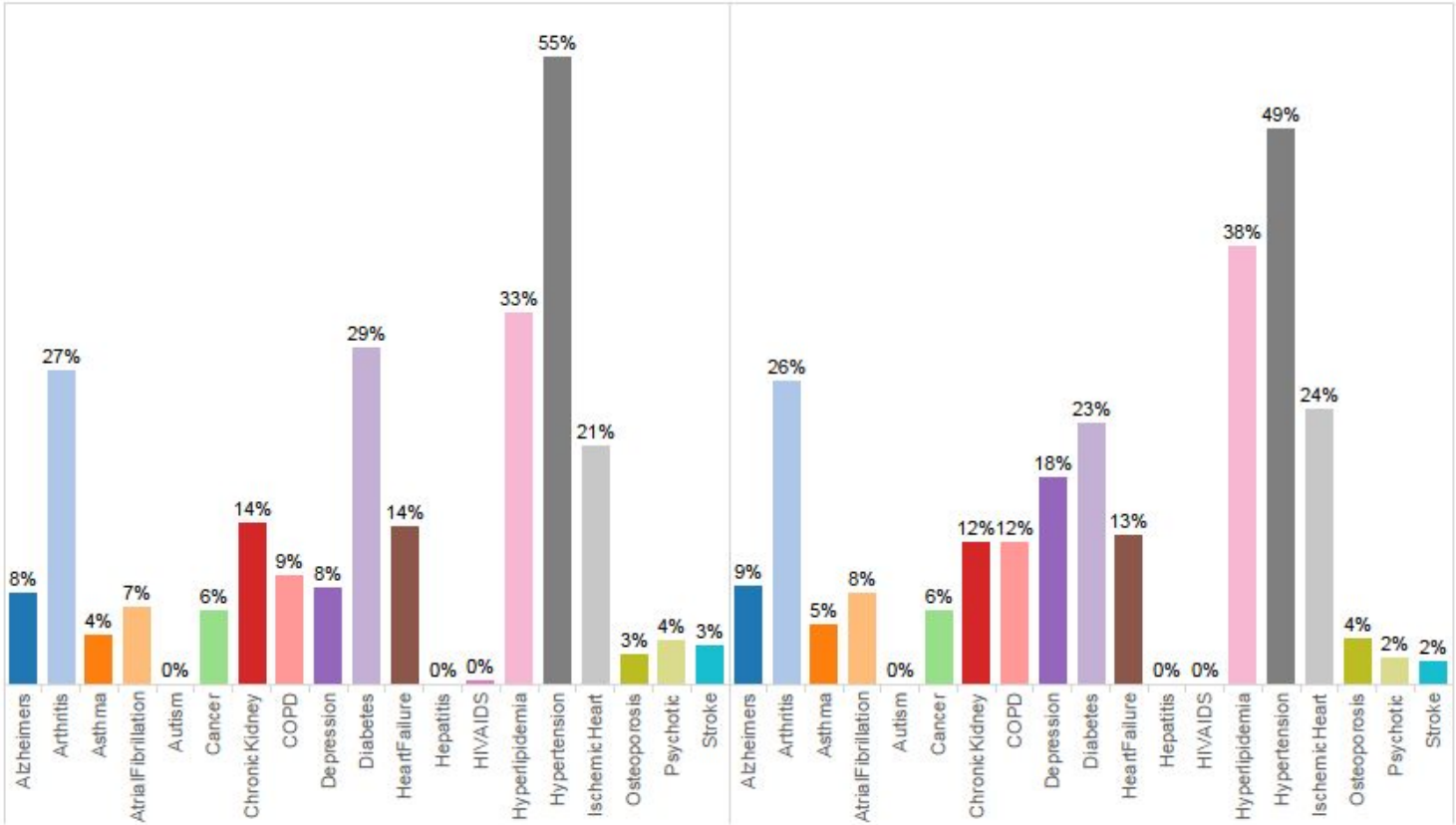


Kalkaska **Michigan**	Montague **Texas**
$7,440	$10,035



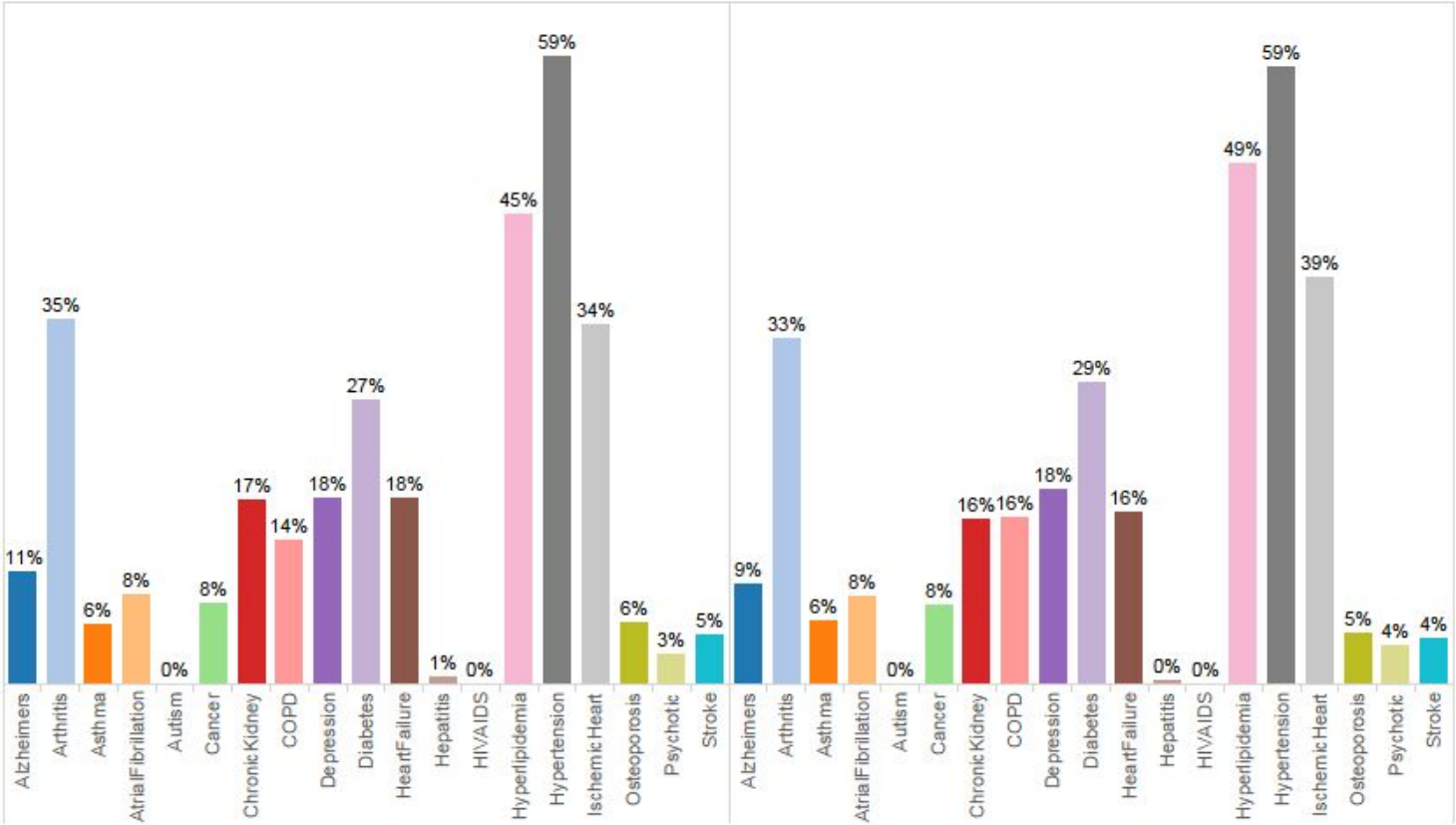
Difference = $2595; Cost Saving Opportunity = $10.72 million per year

Alger **Michigan**	Clay **Mississippi**
$6,904	$9,233



Difference = $2329; Cost Saving Opportunity = $8.01 million per year

Tuscola **Michigan**	Wise **Texas**
$9,308	$11,090



Difference = $1782; Cost Saving Opportunity = $88.42 million per year

Conclusions & Next Steps

Back to our research questions...

- ? Which conditions drive increases in Medicare spending?
- ? Can we identify states or counties that treat certain conditions more efficiently than others?

What did we find?

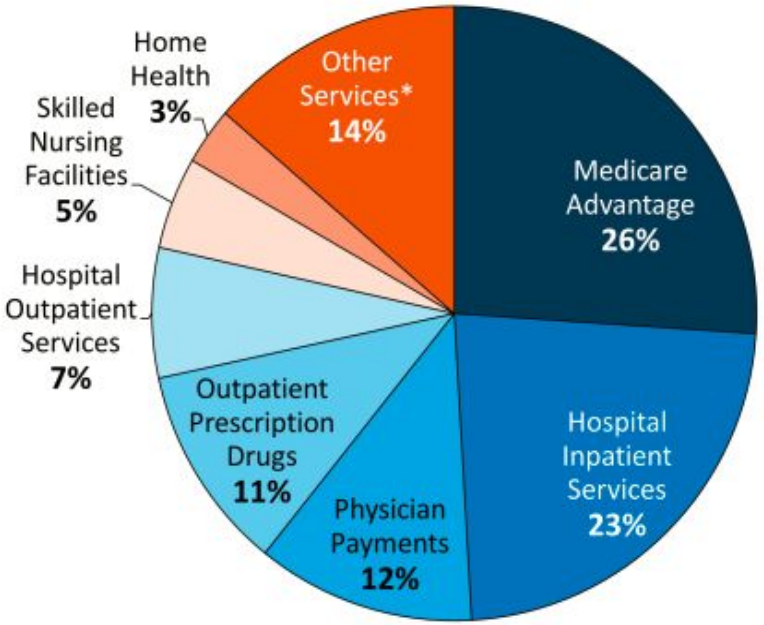
- ✓ At a state level, the average Medicare cost per beneficiary tends to be similar. Cost differences are more meaningful at the county level.
- ✓ While there is a clear relationship between the sickness profile of a county's population and that county's Medicare cost, no single condition overwhelmingly drives up the cost.
- ✓ Several counties exhibit similar sickness profiles but different very cost levels.

Recommended Next Steps

- Medical researchers should continue to delve into county-level analyses. Comparisons of counties with similar sickness profiles but different spending patterns may reveal effective cost-savings strategies aimed at specific patient populations.
- Researchers should also analyze the spending on treatments associated with individual chronic conditions.
- Future research should explore factors aside from patient characteristics, including medical practices, insurance, fraud, infrastructure, medical equipment, and expenditures.

Medicare Advantage accounts for almost a quarter of Medicare Benefits Payments and should also be explored in detail.

Medicare Benefits Payments in 2014



Total Medicare Benefit Payments, 2014 = $597 billion

NOTE: *Consists of Medicare benefit spending on hospice, durable medical equipment, Part B drugs, outpatient dialysis, ambulance, lab services, and other Part B services; also includes the effect of sequestration on spending for Medicare benefits and amounts paid to providers and recovered.
SOURCE: Congressional Budget Office, 2015 Medicare Baseline (March 2015).

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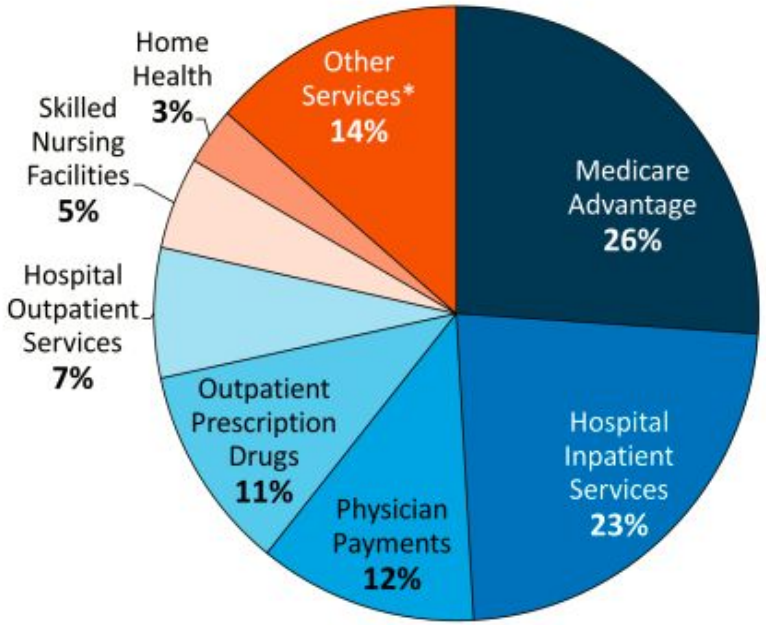
Source: "The Facts on Medicare Spending and Financing." The Kaiser Family Foundation. July 2015. KFF.org

Between 2014 and 2024, per capita spending growth is projected to be higher for Part D, which covers prescriptions, than for Parts A and B (the fee-for-service components examined in this project).

Medicare Benefits Payments in 2014



Total Medicare Benefit Payments, 2014 = $597 billion

NOTE: *Consists of Medicare benefit spending on hospice, durable medical equipment, Part B drugs, outpatient dialysis, ambulance, lab services, and other Part B services; also includes the effect of sequestration on spending for Medicare benefits and amounts paid to providers and recovered.
SOURCE: Congressional Budget Office, 2015 Medicare Baseline (March 2015).

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Source: "The Facts on Medicare Spending and Financing." The Kaiser Family Foundation. July 2015. KFF.org

Questions ?

Appendix

Data Preparation

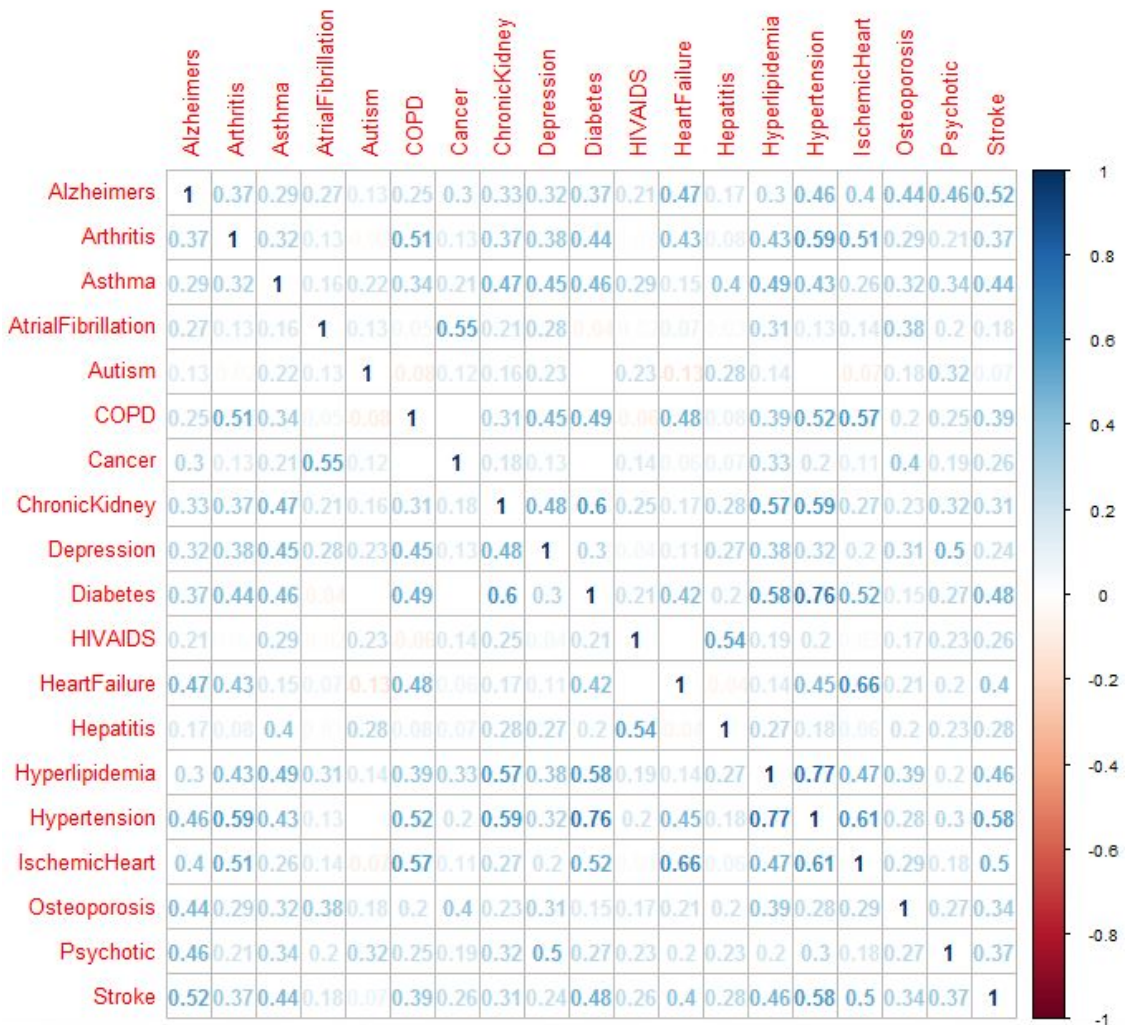
- Standardized Cost accounts for cost variations of different regions such as salaries, and medical practitioner's fees.
- Prevalence rates are between 0 and 1 for all Chronic Conditions.
- Standardized Cost Per FFS is generated by dividing Standardized Cost by number of FFS beneficiaries in each county to remove the effects of population size.
- Prevalence rates in counties where number of beneficiaries is less than 11 have been obscured in the data. These obscured values are imputed with 0s since they are small compared to other values.
- Data where county is "Unknown" have been removed from analysis.
- Data where the annual cost per FFS beneficiary is $0 have also been removed.

Correlation

- Hypertension is highly correlated with multiple conditions

Hypertension and Hyperlipidemia	0.77
Hypertension and Diabetes	0.76
Hypertension and Ischemic Heart	0.61
Hypertension and Chronic Kidney	0.59
Hypertension and COPD	0.52

- Majority of conditions are positively correlated



Regression Analysis

- Inputs
  - Year
  - State
  - Condition
  - Prevalence Rate
- Interaction Terms
  - Condition * Prevalence
  - State * Prevalence
- Target
  - Standardized Cost Per FFS Beneficiary
- Regression Model

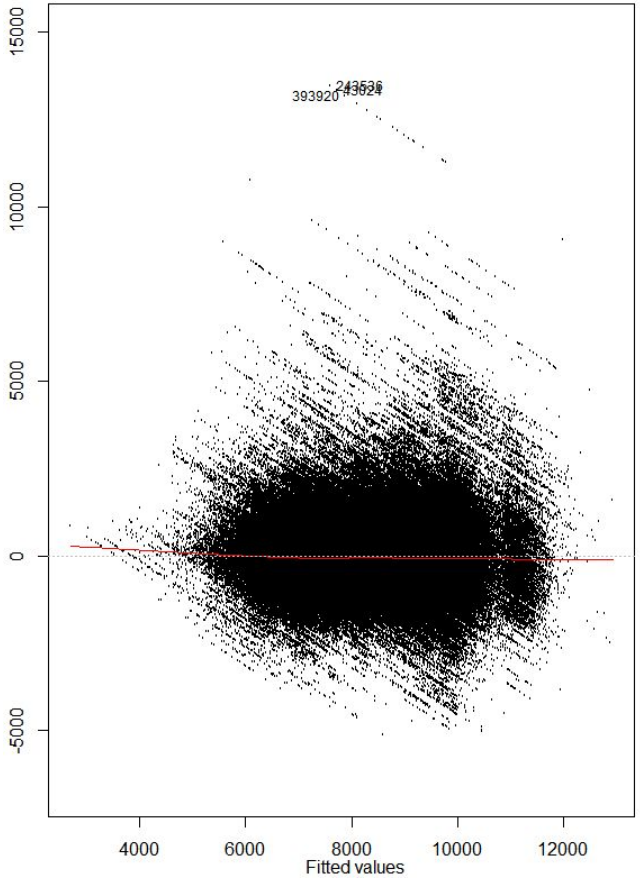
  Predicted Cost ~ Year + State + Condition + (Condition * Prevalence) + (State * Prevalence)

Regression Analysis Diagnostics

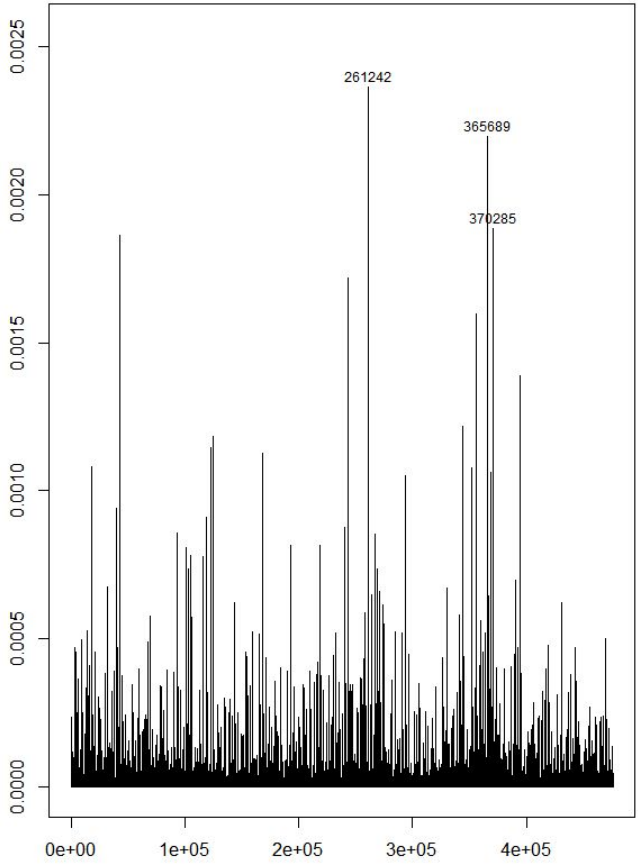
R-Squared	0.5708
Adjusted R-Squared	0.5706
Residual Standard Error	954.4

- Residuals vs. Fitted plot shows consistent and reasonably even distribution of residuals.
- Cook's Distance plot shows that no observation has high leverage on the model.

Residuals vs. Fitted Plot



Cook's Distance Plot



Principal Components Analysis

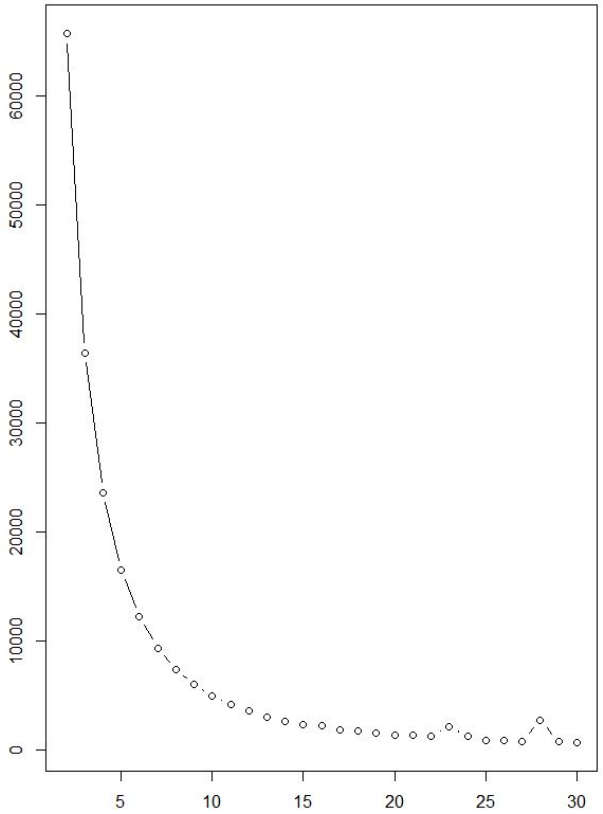
- Principal Components have been generated using centered and scaled prevalence rates of the 19 chronic conditions.
- Each county has been assigned a Principal Component Score for each year.
- The First Principal Component explains 34.22% of variation in the data and has been used as a Sickness Index. A higher sickness score indicates generally higher prevalence rates in that county.
- First Principal Component loadings:

Alzheimers	Arthritis	Asthma	Atrial Fibrillation	Autism	COPD	Cancer	Chronic Kidney	Depression	Diabetes
0.254	0.256	0.253	0.127	0.000	0.245	0.136	0.265	0.228	0.288
HIV/AIDS	**Heart Failure**	**Hepatitis**	**Hyperlipidemia**	**Hypertension**	**Ischemic Heart**	**Osteoporosis**	**Psychotic**	**Stroke**	
0.118	0.206	0.143	0.295	0.327	0.264	0.205	0.205	0.278	

Clustering of Sickness Index scores

- K-means clustering was performed on sickness index to group counties with similar sickness profiles into the same cluster.
- The final number of clusters used was 7.

Scree Plot



Within Cluster Sum of Squares (SS)

Cluster ID	Within Cluster SS
1	1255.35
2	1134.90
3	1187.68
4	1184.45
5	1164.57
6	1438.75
7	1958.24

Between Cluster SS: 153639.9

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CMS Chronic Conditions File.
https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/CC_Main.html

CMS Public Use Geographic Variation File.
https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Geographic-Variation/GV_PUF.html