

# **Unequal Costs, Unseen Burdens: A Deep Dive into America's Hospitals**

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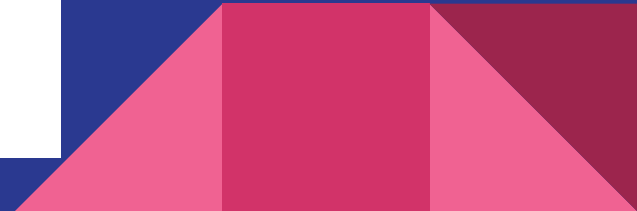
## Research Question?

How do facility type, geographic location (region), and trends in charity care influence hospital costs and discharge rates, and how do these relationships differ between rural and urban settings?

## Dataset?

“CostReport\_2021\_Final” dataset from the Centers for Medicare & Medicaid Services (CMS) [link](#)

*6,035 rows and 117 columns  
CCN Facility, Total Costs, Cost of  
Charity Care, Total Discharges,  
Bad Debt Expenses, Cost per  
Discharge, R vs U, Region*



## Before Imputation

```
missing_values = df.isnull().sum()
print(missing_values[missing_values > 0])
```

```
Street Address      3
County             557
Medicare CBSA Number  75
Rural Versus Urban  75
FTE - Employees on Payroll 104
```

```
...
Cost To Charge Ratio 1411
Net Revenue from Medicaid 1629
Medicaid Charges    1630
Net Revenue from Stand-Alone CHIP 5062
Stand-Alone CHIP Charges 5045
Length: 106, dtype: int64
```

## After Imputation

```
# Imputing missing values for categorical variables with 'Unknown'
categorical_columns = ['Street Address', 'County', 'Medicare CBSA Number',
                       'Rural Versus Urban']
df[categorical_columns] = df[categorical_columns].fillna('Unknown')
# Impute missing values for the rest of the numerical columns with mean
numerical_columns = ['FTE - Employees on Payroll', 'Total Other Expenses',
                     'Net Income', 'Cost To Charge Ratio', 'Net Revenue from Medicaid',
                     'Medicaid Charges', 'Net Income', 'Total Other Expenses']
df[numerical_columns[2:]].fillna(df[numerical_columns[2:]].mean(), inplace=True)

# Check the missing values again to confirm handling
print(df.isnull().sum())
```

```
rpt_rec_num      0
Provider CCN     0
Hospital Name    0
Street Address   0
City            0
..
Cost To Charge Ratio 0
Net Revenue from Medicaid 0
Medicaid Charges    0
Log Total Costs     0
Year               0
```

## Data Cleaning

## Data Transformation

```
# Calculate Cost per Discharge
selected_data['Cost per Discharge'] = selected_data['Total Costs'] / selected_data['Total Discharges Title XVIII']

# Print the updated DataFrame to see the new column and one-hot encoded variables
print(selected_data.head()) # Display the first few rows of the updated DataFrame
```

```
# defining regions based on state codes
regions = {
    'Northeast': ['NY', 'NJ', 'PA', 'MA', 'CT', 'RI', 'NH', 'VT', 'ME'],
    'Midwest': ['IL', 'IN', 'OH', 'MI', 'WI', 'MO', 'MN', 'IA', 'ND', 'SD', 'NE', 'KS'],
    'South': ['TX', 'FL', 'GA', 'NC', 'SC', 'VA', 'AL', 'KY', 'LA', 'MS', 'AR', 'TN', 'WV', 'MD', 'OK'],
    'West': ['CA', 'OR', 'WA', 'NV', 'AZ', 'NM', 'CO', 'ID', 'UT', 'MT', 'WY']
}

# Create a new column 'region' by mapping the state codes to regions
selected_data['region'] = selected_data['State Code'].map(
    lambda x: next((k for k, v in regions.items() if x in v), np.nan)
```

## *Handling Outliers*

```
# Log transformation of the 'Total Costs' column
```

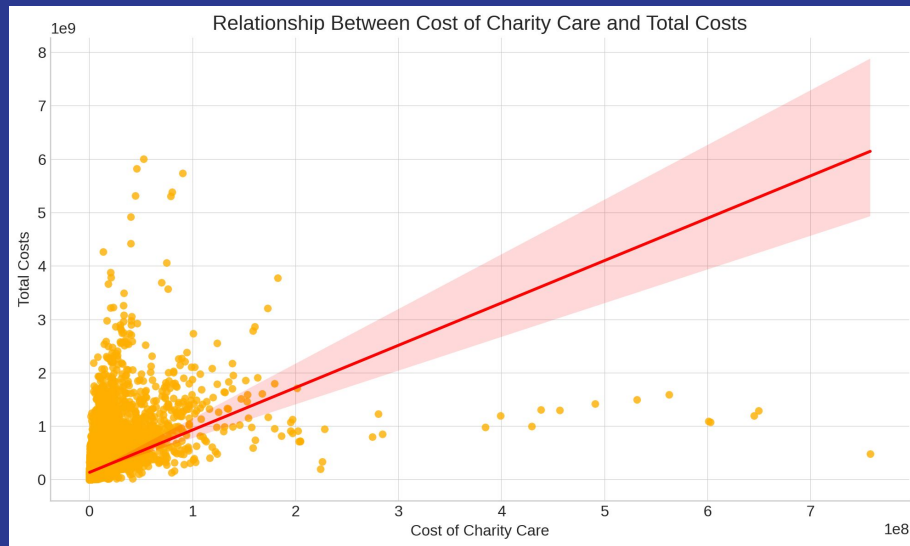
```
df['Log Total Costs'] = df['Total Costs'].apply(lambda x: np.log(x + 1))
```

## *Key Variables*

1. *Total Costs*
2. *Total Discharges*
3. *Total Cost Per Discharge*
4. *Total Charity Care*
5. *Total Bad Debt Expenses*

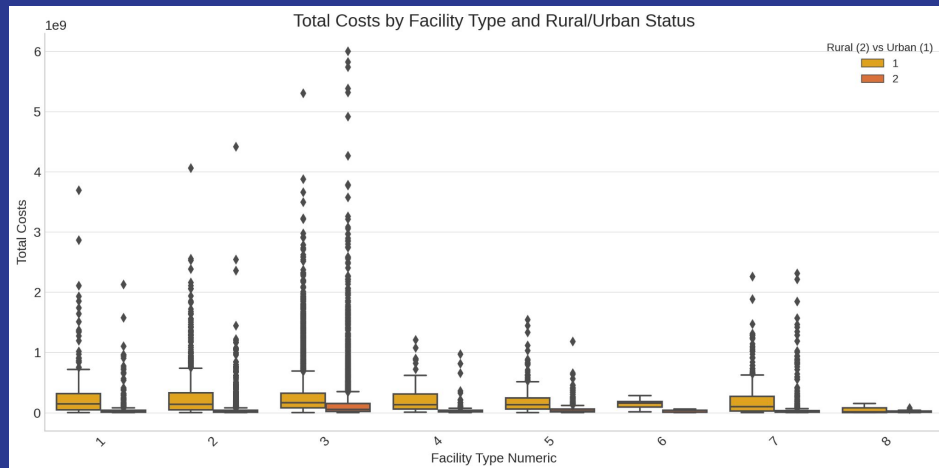
## *Exploratory Data Analysis*

1. *Facility Type Analysis*
2. *Geographic Distribution Analysis*
3. *Rural vs Urban Area Analysis*

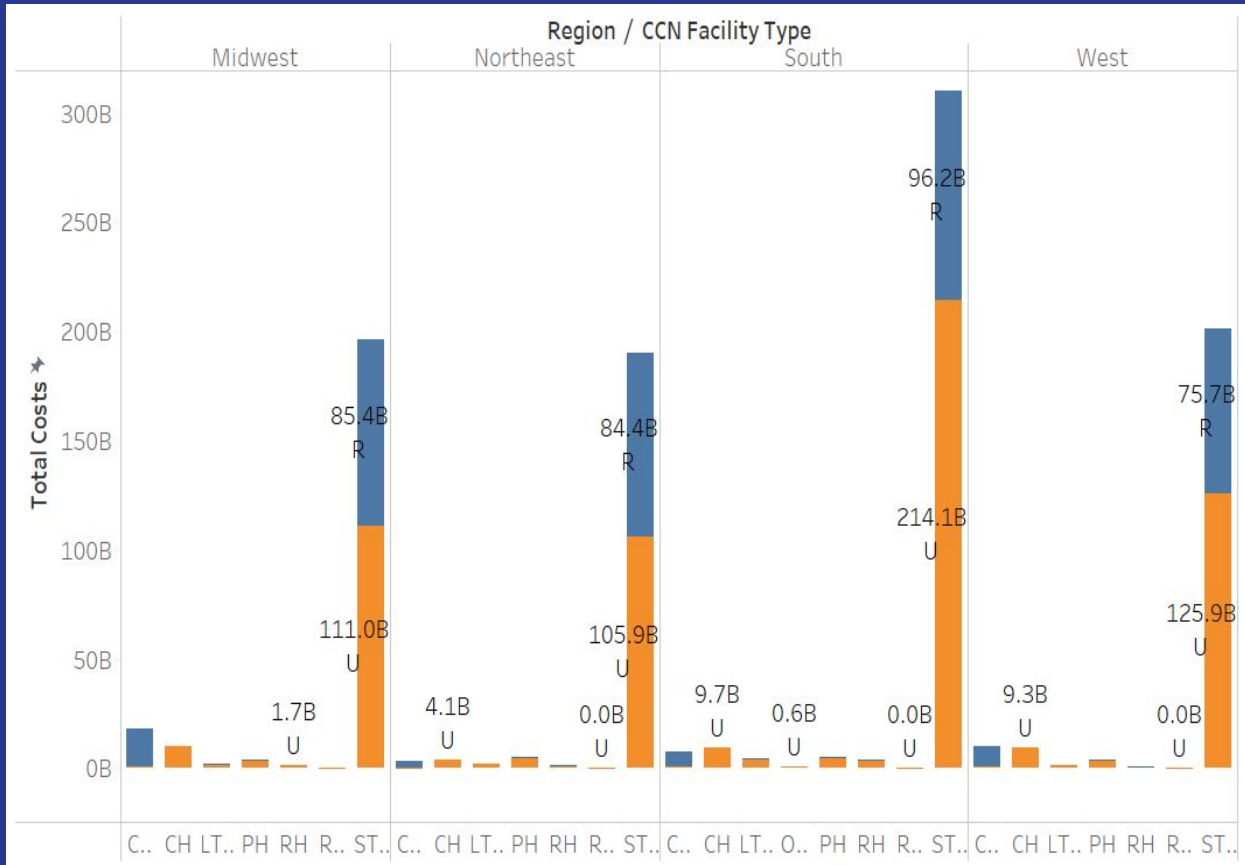


## Relationship Between Cost of Charity Care and Total Costs

## Total Costs by Facility Type and Rural/Urban Status



# Total Costs by Facility, Region & R vs U



LTCH: Long-Term Care Hospital

CAH: Critical Access Hospital

STH: Short-Term Hospital

CH: Community Hospital

RH: Rehabilitation Hospital

ORD: Orthopedic Hospital

PH: Psychiatric Hospital

RNMHC: Residential Nursing and Mental Health Care

- ★ South dominates: Highest total costs, with 96.2B (Rural) and 214.1B (Urban).
- ★ Urban > Rural: Urban facilities have significantly higher costs across all regions.
- ★ Midwest and Northeast comparable: Similar total costs with 111.0B (Urban Midwest) and 105.9B (Urban Northeast).
- ★ West moderate: Costs lower than the South but substantial at 125.9B (Urban) and 75.7B (Rural).
- ★ Facility focus: Short-term hospitals (STH) drive the majority of costs in all regions.



















































# Total Discharges by Facility, Region & R vs U

| Rural V.. | CCN Fa.. | Midwest  | Northeast | South    | West     |
|-----------|----------|----------|-----------|----------|----------|
| R         | CAH      | 233.9K   | 41.9K     | 109.5K   | 125.0K   |
|           | LTCH     | 0.1K     |           | 4.9K     |          |
|           | PH       | 36.4K    | 11.5K     | 11.3K    | 2.8K     |
|           | RH       |          | 1.9K      | 6.0K     | 0.1K     |
|           | STH      | 2,546.1K | 2,121.6K  | 3,544.1K | 1,882.1K |
| U         | CAH      | 13.7K    | 4.4K      | 15.2K    | 10.8K    |
|           | CH       | 137.5K   | 56.9K     | 175.0K   | 144.0K   |
|           | LTCH     | 31.9K    | 18.8K     | 70.1K    | 22.1K    |
|           | ORD      |          |           | 14.3K    |          |
|           | PH       | 199.8K   | 113.7K    | 485.0K   | 236.2K   |
|           | RH       | 63.1K    | 55.6K     | 202.1K   | 48.1K    |
|           | RNMHC    | 0.0K     | 0.0K      | 0.0K     | 0.1K     |
|           | STH      | 3,587.2K | 3,196.0K  | 8,407.1K | 3,628.1K |

- ★ **South leads:** Highest discharges (8,407.1K), dominating across all facility types.
- ★ **Urban > Rural:** Urban facilities consistently have higher discharges across regions.
- ★ **STH dominates:** Short-term hospitals have the largest discharge numbers in all settings.
- ★ **West > Northeast:** West outperforms Northeast in urban and rural discharges.
- ★ **Facility trends:** CAH and PH show significant urban-rural variation; LTCH contributes more in urban South.

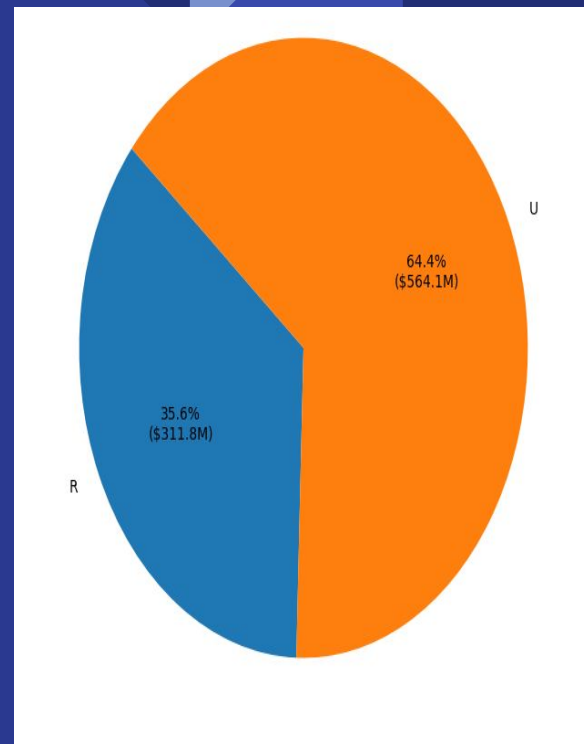
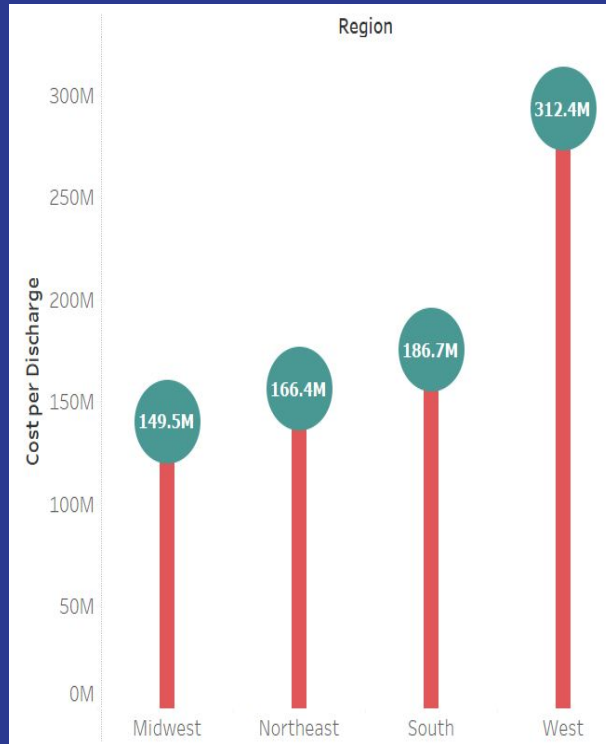
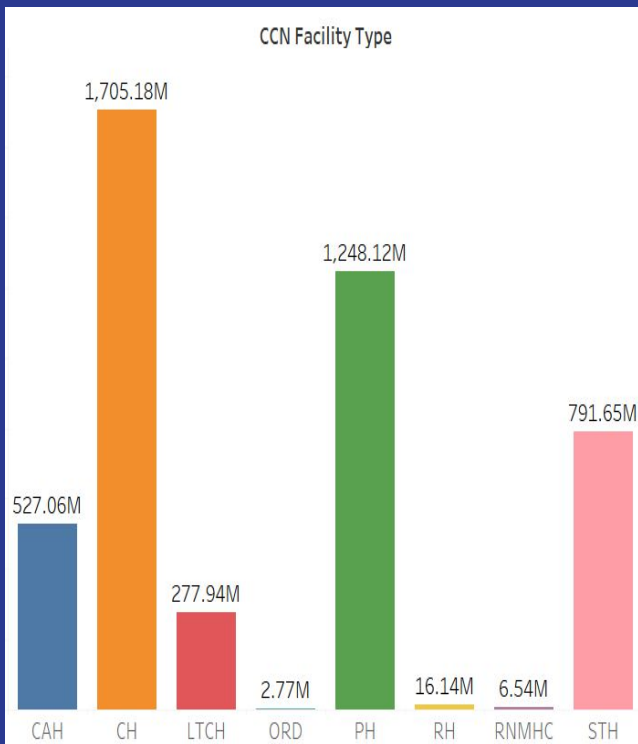


# Charity Care by Facility, Region & R vs U

| Rural V.. | CCN Fa.. | Midwest                                                                            | Northeast                                                                          | South                                                                             | West                                                                                 |
|-----------|----------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| R         | CAH      |   | 0.0B                                                                               |  |   |
|           | LTCH     |   |   |  |   |
|           | PH       |   |   |  |   |
|           | RH       |   |   |  |   |
|           | STH      |   |   | 4.6B                                                                              |   |
| U         | CAH      |   |   |  |   |
|           | CH       |   |   |  |   |
|           | LTCH     |   |   |  |   |
|           | ORD      |   |   |  |   |
|           | PH       | 0.0B                                                                               |   |  |   |
|           | RH       |   |   |  |   |
|           | RNMHC    |   |   |  |   |
|           | STH      |  |  | 11.0B                                                                             |  |










- ★ **South leads:** Highest charity care in both rural (4.6B) and urban (11.0B) settings.
- ★ **Urban dominance:** Urban facilities significantly outperform rural in charity care across all regions.
- ★ **Minimal in Northeast:** Northeast has negligible charity care contributions in rural and urban settings.
- ★ **STH focus:** Short-term hospitals are the primary contributors to charity care across all regions.
- ★ **West and Midwest:** Charity care contributions are minimal compared to the South.

# Cost Per Discharge by Facility, Region, R vs U



**PH highest:** Psychiatric hospitals lead with 1,248.12M cost/discharge. **Urban > Rural:** Urban contributes 64.4% of costs.  
**West tops:** Highest regional cost/discharge at 312.4M. **STH & CH notable:** Significant costs from short-term and community hospitals.

# Bad Debt by Facility, Region & R vs U

| Rural V.. | CCN Fa.. | Region                                                                             |                                                                                    |                                                                                   |                                                                                      |
|-----------|----------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|           |          | Midwest                                                                            | Northeast                                                                          | South                                                                             | West                                                                                 |
| R         | CAH      |   | 0.1B                                                                               |  |   |
|           | LTCH     | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | PH       | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | RH       | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | STH      |   |   | 8.7B                                                                              |   |
| U         | CAH      | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | CH       | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | LTCH     | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | ORD      | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | PH       | 0.0B                                                                               | .                                                                                  | .                                                                                 | .                                                                                    |
|           | RH       | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | RNMHC    | .                                                                                  | .                                                                                  | .                                                                                 | .                                                                                    |
|           | STH      |  |  | 18.4B                                                                             |  |

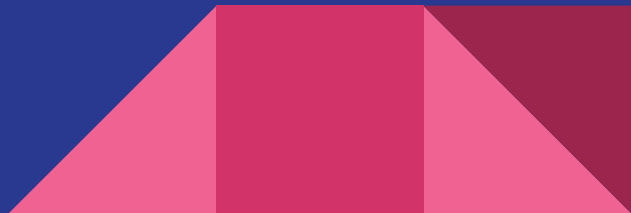
- ★ **South leads:** Highest bad debt in rural (8.7B) and urban (18.4B) settings.
- ★ **Urban dominance:** Urban bad debt significantly higher than rural across regions.
- ★ **Minimal in Northeast:** Almost negligible bad debt (0.1B) in both rural and urban settings.
- ★ **STH focus:** Short-term hospitals are the primary contributors to bad debt.
- ★ **Low in Midwest and West:** Relatively minimal bad debt compared to the South.

## *Conclusion:*

- ★ Urban areas have higher overall costs but better financial management and healthcare access.
- ★ Rural areas face rising charity care, bad debt, and limited healthcare access.
- ★ Short-Term Hospitals (STH) account for the highest costs and discharges across all regions.
- ★ The South has the highest costs and discharge rates, while the Midwest and Northeast manage costs more efficiently.

## *Policy Recommendations:*

- Expand Medicaid coverage.
- Implement sliding scale payment programs.
- Strengthen rural healthcare funding.
- Promote affordable insurance access.
- Expand telehealth services.
- Encourage value-based care models.



A top-down photograph of a workspace. A silver laptop is partially visible in the background. In the foreground, a brown paper envelope is open, and a black pen with a silver clip lies diagonally across it. A white card with the words "Thank you" written in a black cursive script is placed on top of the envelope. The entire scene is set on a light-colored wooden surface.

Thank you