

# Case Study: Medicare Outpatient Cost & Profitability Analysis (2022 CMS Data)

## Project Overview

This project analyzes U.S. outpatient healthcare services using 2022 Medicare data. Using SQL (PostgreSQL) and Tableau, I explored billing patterns, Medicare reimbursements, and profitability gaps across states and procedures. The dashboard uncovers high-margin services, state-wise charge variability, and mismatches between what hospitals charge and what Medicare pays to support more informed, cost-conscious decision-making across the healthcare ecosystem.

## Industry Context

The U.S. healthcare industry is a complex ecosystem, often marked by inconsistent pricing, opaque billing practices, and wide variations in reimbursement. These challenges are especially visible in Medicare outpatient services, where what providers charge and what they are paid can differ dramatically.

**For those less familiar with the healthcare industry, here are the basic steps involved in the process:**

1. **A patient visits a hospital or outpatient clinic**  
→ The hospital provides a service (e.g., CT scan, radiation therapy).
2. **The hospital submits a bill (claim) to Medicare**  
→ This is called the “submitted charge” — it’s the amount the hospital says the service is worth.  
\*\*This is what you see as `avg_tot_sbmtd_chrgs` in the dataset.
3. **Medicare reviews the claim**  
→ It does *not* pay the full submitted charge.  
Instead, it pays a **predetermined amount** based on CMS rules for that procedure.  
\*\*This is what you see as `avg_mdcr_pymt_amt` (actual payment).  
\*\* `avg_mdcr_alowd_amt` shows what was technically "allowed" for reimbursement.
4. **The difference is either:**
  1. Written off by the hospital OR
  2. Paid by a secondary insurance or the patient (depending on the situation)

I kept asking the same question during this project: why hospitals put extremely high service charges even though Medicare will only pay a fixed amount?

I read a lot about why this happens and came up with following reasons:

### **1. Charge Master List (Sticker Price Mentality)**

- Every hospital has a “chargemaster” — a giant list of all services and their prices.
- These prices are not realistic, but are used as a negotiation anchor with private insurers, a basis for out-of-network billing, a way to inflate discounts.

So, it's like MSRP (Manufacturer's Suggested Retail Price) on a car — no one actually pays that full price, but it sets the ceiling.

### **2. Cross-Subsidization**

- Medicare and Medicaid often **pay less than the actual cost** of treatment.
- Hospitals inflate prices on commercial/private payers to **make up for losses**.
- So, the high charges are part of a **balancing act**: underpaid by Medicare, overpaid by private insurers and trying to land somewhere sustainable.

### **3. Out-of-Network and Uninsured Billing**

- If a patient is uninsured or out-of-network, the chargemaster prices are the starting point for the bill (which is horrible if you are in that situation).
- Even if Medicare pays \$2,000 for a procedure, an uninsured person might see a bill for \$25,000.

### **4. Lack of Standardization**

- In the U.S., there is no national regulation on hospital pricing. So different hospitals, even in the same city, can have wildly different charges for the exact same service.

This pricing complexity is exactly why an objective, data-driven analysis is essential — to identify inefficiencies and potential areas for standardization.

### **Business Objective**

Medicare reimburses hospitals based on fixed rates, but hospitals often submit significantly higher charges. This project aimed to:

- *Identify the most frequently billed outpatient procedures.*
- *Highlight discrepancies between charges and Medicare payments.*
- *Compare cost and profitability across U.S. states.*
- *Surface high-margin procedures for potential cost review.*

### **Tools & Methodology**

**Data Source:** U.S. Centers for Medicare & Medicaid Services (CMS)

## Medicare Provider Utilization and Payment Data: Outpatient

(~23K rows, 18 columns)

**Understanding the dataset:** Early in the project, I realized the importance of clearly understanding and documenting the column definitions. Due to the complexity of the healthcare dataset, I occasionally found it challenging to keep track of what each metric represented, despite prior research. Clarifying these terms early helped ensure accuracy and consistency throughout the analysis.

Column Name	Meaning
Rndrng_Prvdr_CCN	CMS Certification Number — a unique ID assigned to each provider/hospital by Medicare
Rndrng_Prvdr_Org_Name	Name of the healthcare provider (e.g., hospital or clinic)
Rndrng_Prvdr_St	Street address of the provider
Rndrng_Prvdr_City	City where the provider is located
Rndrng_Prvdr_State_Abrvtn	State abbreviation (e.g., NY, CA)
Rndrng_Prvdr_State_FIPS	State FIPS code — a numeric identifier for U.S. states
Rndrng_Prvdr_Zip5	5-digit ZIP code of the provider
Rndrng_Prvdr_RUCA	Rural-Urban Commuting Area (RUCA) code — categorizes how urban or rural a provider's area is
Rndrng_Prvdr_RUCA_Desc	Description of the RUCA code (e.g., "Metropolitan area core")
APC_Cd	Ambulatory Payment Classification Code — a code for a type of outpatient procedure
APC_Desc	Description of the procedure type (e.g., "Level I Echocardiogram")
Bene_Cnt	Number of unique Medicare <b>beneficiaries (patients)</b> who received the service
CAPC_Srvcs	Number of <b>services billed</b> by the provider under that APC code (could be multiple per patient)
Avg_Tot_Sbmtd_Chrgs	Average <b>amount billed</b> by the provider to Medicare per service (the "charge" amount)
Avg_Mdcr_Alowd_Amt	Average <b>amount Medicare allows</b> per service (often lower than what's billed)
Avg_Mdcr_Pyment_Amt	Average <b>actual amount Medicare paid</b> to the provider per service
Outlier_Srvcs	Number of services designated as "outliers" (unusually high-cost cases, sometimes reimbursed separately)
Avg_Mdcr_Outlier_Amt	Average amount Medicare paid for those outlier services

**Tools:** PostgreSQL: Complex SQL queries for data aggregation and transformation

Excel: Minor pre-cleaning

Tableau: Visualization and interactive dashboard development

## **SQL Complexity:**

The analysis involved advanced SQL techniques such as CTEs, window functions, aggregation across dimensions, and calculated profitability metrics. All queries were run in PostgreSQL, and results were exported to Tableau for visualization.

## **Key Insights**

### **Insight 1. *High-Volume Procedures Tend to Have Lower Margins***

The **top 10 most frequently performed outpatient procedures** accounted for **over 40% of total service volume**. However, many of these high-volume services had below-average Medicare reimbursement rates, suggesting hospitals rely on them for throughput rather than profitability.

### **Insight 2. *Significant Gap Between Charges and Medicare Payments***

On average, **providers submitted charges** that were **3 to 6 times higher** than the **actual Medicare payment received**. In some cases, the average submitted charge exceeded \$50,000, while Medicare reimbursed only about \$2,000–\$3,000, indicating a substantial disconnect between billed and reimbursed values.

### **Insight 3. *Large Variations in Charges Across States***

Geographic analysis revealed wide state-level disparities in the cost of the same procedures. States like **California** and **Texas** consistently **reported higher average submitted charges**, while others like Ohio and Minnesota had significantly lower billing for equivalent services.

### **Insight 4. *High-Margin Procedures Are Consistent Across States***

Certain outpatient procedures, such as **advanced imaging** and **specific surgical interventions**, showed consistently **high profit margins** in **nearly every state**. These services represent potential candidates for policy review, pricing standardization, or strategic investment.

## **Actionable recommendations & possible impact:**

Based on these findings, the following strategic recommendations can support cost optimization, risk management, and operational improvement at the provider level.

### **1. Strategic Pricing Audit of High-Volume Procedures**

Hospitals should regularly audit procedures with the highest service volume, especially those with below-average Medicare reimbursement rates. These procedures contribute significantly to overall revenue exposure and must be monitored for financial viability.

**Impact:** Enables cost containment and supports resource allocation toward sustainable, mission-critical services.

### **2. Profit Margin Monitoring for High-Revenue Procedures**

Procedures exhibiting consistently high profit margins across multiple states should be reviewed for pricing standardization and billing compliance. This helps mitigate audit risks and prepares institutions for potential policy shifts in reimbursement structures.

Impact: Reduces risk exposure, enhances pricing transparency, and supports long-term financial sustainability.

### **3. Regional Benchmarking and Rate Normalization**

Hospitals should benchmark their submitted charges against regional and national averages to identify overpricing or underpricing trends. Significant deviations should trigger a review of internal cost structures and payer negotiation strategies.

Impact: Supports competitive pricing, improves payer relationships, and aligns with value-based care initiatives for patients.

### **4. Investment in Reimbursement Analytics Dashboards**

Healthcare analytics teams should implement dynamic dashboards to monitor reimbursement gaps, outlier charges, and profitability metrics in real time. Alerts can be configured for deviations in expected margins or payment rates.

Impact: Improves financial oversight, reduces revenue leakage, and enables faster, data-driven decision-making.

### **5. Ongoing Review of Service Portfolio Profitability**

Hospitals should continuously evaluate which services yield sustainable reimbursement levels versus those that erode margins. Low-margin, high-cost procedures should be flagged for redesign, bundling, or alternative care delivery models.

Impact: Enhances service line profitability and supports long-term operational resilience.

## **Conclusion**

This project highlights how Medicare outpatient data can reveal hidden pricing patterns, regional disparities, and margin opportunities. By combining SQL analysis with visual storytelling in Tableau, I was able to uncover meaningful insights that support cost transparency and strategic planning in healthcare operations.