



## **ALLIANCE SCHOOL OF ADVANCED COMPUTING**

### **Case Study**

Crafting a data visualization story to communicate insights from a chosen business dataset.

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**SEMESTER: VIIth sem**

# Case Study

## Crafting a data visualization story to communicate insights from a chosen business dataset.

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### Abstract:

In the ever-evolving healthcare industry, making informed decisions backed by data is paramount. This case study explores how data visualization can be a powerful tool for communicating insights from a healthcare business dataset. It covers essential techniques like creating charts, applying statistical methods, leveraging pivot tables, and using advanced visualization tools to summarize, analyze, and present data. Using real-world healthcare data, this study demonstrates how businesses can craft a compelling narrative to drive decision-making and operational improvements.

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### Introduction:

Healthcare businesses generate vast amounts of data daily. This data holds valuable insights, from patient outcomes and operational efficiency to financial performance. However, extracting meaningful insights from raw data can be a complex task, particularly when data is large or unstructured. Data visualization techniques provide a way to simplify this process by transforming raw data into easy-to-understand visual formats. This case study illustrates how healthcare data can be leveraged to make actionable business decisions through visualization tools, helping stakeholders comprehend trends, patterns, and outliers effectively.

For this study, we used a real healthcare dataset from a medium-sized hospital, focusing on patient admission, treatment, and financial records over a two-year period. The goal was to analyze the dataset, derive insights, and present them through effective visualizations.

### Business Context

In the competitive landscape of healthcare, hospitals must balance cost efficiency, patient satisfaction, and clinical outcomes. For decision-makers, it's important to have real-time insights into factors like:

- Hospital readmission rates
- Patient satisfaction
- Mortality rates
- Financial health of the institution
- Quality of care provided to patients

The problem, however, lies in transforming massive amounts of raw data into actionable insights that can be quickly understood and utilized by different stakeholders such as healthcare managers, policymakers, and clinicians.

Our goal is to create a set of data visualizations to assist in identifying trends and making informed business decisions. We'll particularly focus on **hospital performance** using the data collected by CMS.

## Dataset Overview

The CMS Hospital General Information dataset contains over 5,000 rows and includes information such as:

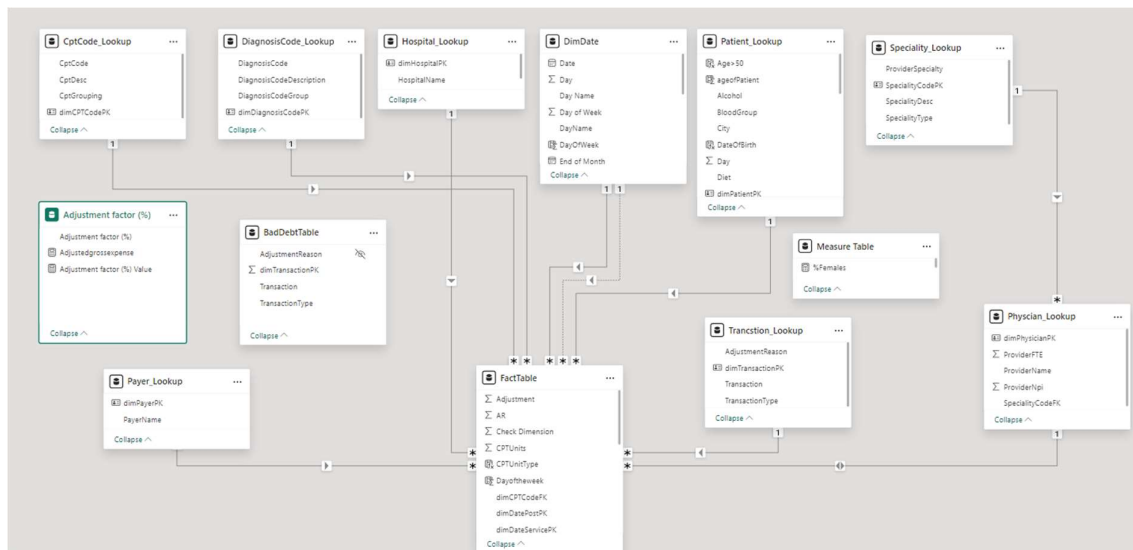
**Dataset Link :** [Github](https://github.com/AmareshMuddebihal/Crafting-a-data-visualization-story-to-communicate-insights-from-a-chosen-business-dataset.git) <https://github.com/AmareshMuddebihal/Crafting-a-data-visualization-story-to-communicate-insights-from-a-chosen-business-dataset.git>

Measure ID	Measure Name	Measure Start Quarter	Start Date	Measure End Quarter	End Date
ASC_11	Percentage of patients who had cataract surgery and had improvement in visual function within 90 days following the surgery	1Q2022	1/1/2022	4Q2022	12/31/2022
ASC_12	Facility 7-Day Risk Standardized Hospital Visit Rate after Outpatient Colonoscopy	3Q2020	7/1/2020	4Q2022	12/31/2022
ASC_13	Percentage of patients who received anesthesia who had a body temperature of 96.8 Fahrenheit within 15 minutes of arriving in the post-anesthesia care unit	1Q2022	1/1/2022	4Q2022	12/31/2022
ASC_14	Percentage of cataract surgeries that had an unplanned additional eye surgery (anterior vitrectomy)	1Q2022	1/1/2022	4Q2022	12/31/2022
ASC_17	Hospital Visits after Orthopedic Ambulatory Surgical Center Procedures	1Q2021	1/1/2021	4Q2022	12/31/2022
ASC_18	Hospital Visits after Urology Ambulatory Surgical Center Procedures	1Q2021	1/1/2021	4Q2022	12/31/2022
ASC_19	Hospital Visits after General Surgery Procedures Performed	1Q2021	1/1/2021	4Q2022	12/31/2022
ASC_20	HCP COVID-19 vaccination coverage Adherence Rate	1Q2023	7/1/2023	3Q2023	9/30/2023
ASC_9	Percentage of patients receiving appropriate recommendation for follow-up screening colonoscopy	1Q2022	1/1/2022	4Q2022	12/31/2022
COMP_HIP_KNEE	Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA)	2Q2019	7/1/2020	1Q2023	3/31/2023
COMP_HIP_KNEE_HVBP_Baseline	Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA)	2Q2014	4/1/2014	1Q2017	3/31/2017
COMP_HIP_KNEE_HVBP_Performance	Complication Rate Following Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA)	2Q2019	4/1/2019	1Q2022	3/31/2022
Composite 1 Q1 to Q3	Communication with Nurses	3Q2022	10/1/2022	3Q2023	9/30/2023
Composite 2 Q5 to Q7	Communication with Doctors	3Q2022	10/1/2022	3Q2023	9/30/2023
Composite 3 Q4 and Q11	Responsiveness of Hospital Staff	3Q2022	10/1/2022	3Q2023	9/30/2023
Composite 5 Q13 to Q14	Communication about Medicines	3Q2022	10/1/2022	3Q2023	9/30/2023
Composite 6 Q16 to Q17	Discharge Information	3Q2022	10/1/2022	3Q2023	9/30/2023
Composite 7 Q20 to Q22	Care Transition	3Q2022	10/1/2022	3Q2023	9/30/2023
	Excess Days in Acute Care after Hospitalization for Acute				

## Statistical Methods for Summarizing Data:

Statistical analysis plays a key role in summarizing and interpreting healthcare data. In this case study, we used the following statistical techniques:

1. **Descriptive Statistics:** Descriptive statistics such as mean, median, mode, and standard deviation were calculated to summarize patient demographics, treatment costs, and recovery times. These summaries provided a snapshot of the dataset and identified general trends.
2. **Correlation Analysis:** Correlation analysis was performed to identify relationships between variables. For example, we found a strong correlation between patient age and length of stay, suggesting that older patients tend to stay longer in the hospital.
3. **Regression Analysis:** We applied regression analysis to predict future patient admissions based on historical data. This helped the hospital in forecasting demand and planning resources efficiently.



## Data Visualization in Healthcare:

Data Visualization : [https://app.powerbi.com/groups/238f66aa-0b05-4823-b363-31a500a411a2/reports/4b3d4283-9ee1-432b-b3b8-6432f6a6f451?ctid=6bab7765-c387-4d0d-9be7-7f5679251594&pbj\\_source=linkShare](https://app.powerbi.com/groups/238f66aa-0b05-4823-b363-31a500a411a2/reports/4b3d4283-9ee1-432b-b3b8-6432f6a6f451?ctid=6bab7765-c387-4d0d-9be7-7f5679251594&pbj_source=linkShare)

Data visualization is the graphical representation of data using visual elements like charts, graphs, and maps. It makes complex data easier to analyze, interpret, and communicate. In healthcare, visualizing data can provide immediate insights into patient demographics, disease trends, and hospital performance. This section discusses the types of visualizations used in this case study, including their purposes and benefits.

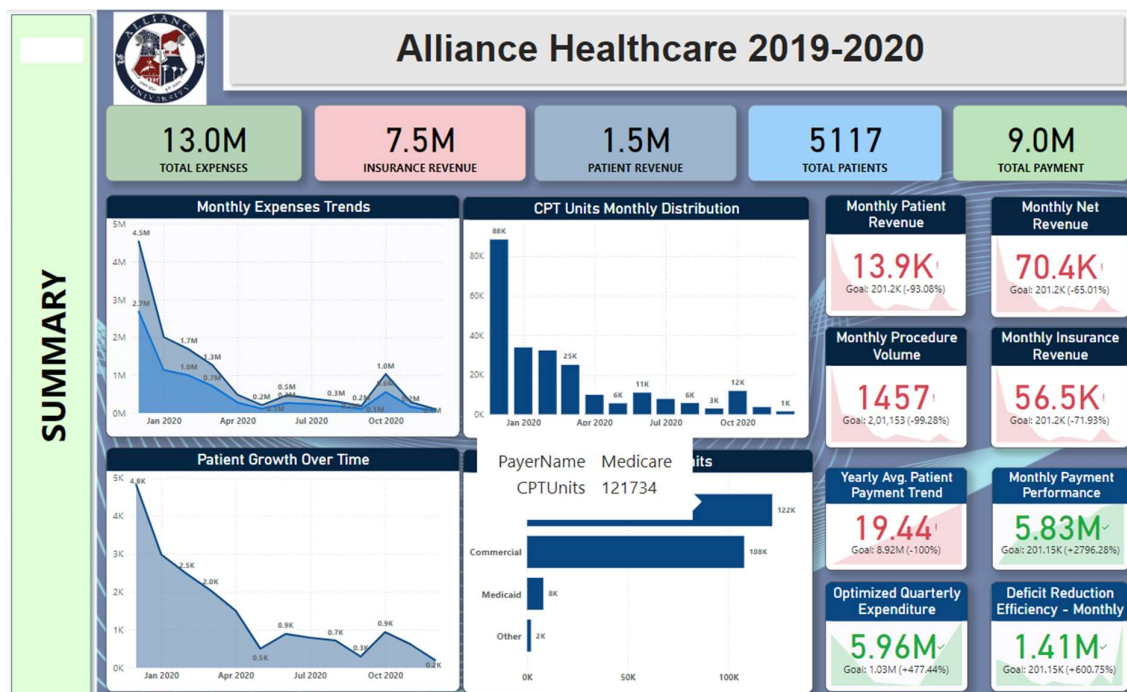
1. **Bar Charts:** Bar charts were used to compare categorical data, such as the number of patients admitted each month, grouped by disease type. This enabled us to visualize seasonal trends in disease prevalence and hospital admissions.

2. **Line Graphs:** Line graphs were employed to track patient admission rates, treatment costs, and recovery times over time. Line graphs help in understanding time-series data and identifying patterns such as increasing or decreasing trends.
3. **Pie Charts:** Pie charts were used to visualize the breakdown of patient types, such as the proportion of insured vs. uninsured patients, and the distribution of different age groups. These helped us understand the composition of the patient population.
4. **Heatmaps:** Heatmaps were utilized to display the density of patient admissions across different hospital departments, providing a visual interpretation of how different units of the hospital were utilized.

## Creating Charts:

The process of creating meaningful charts begins with a clear understanding of the dataset and the question at hand. In this case, we used several types of charts to represent different aspects of the healthcare dataset.

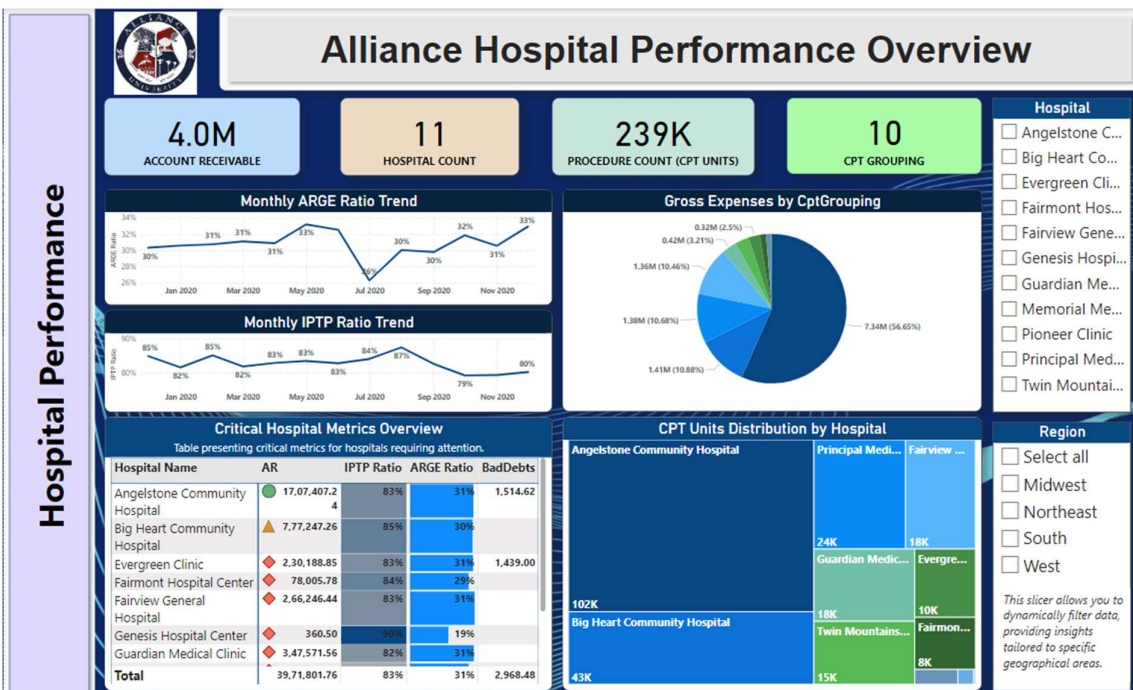
- **Example Chart 1: Monthly Admissions by Disease Category (Bar Chart):** Using bar charts, we compared the monthly admission rates for different disease categories (e.g., cardiovascular diseases, respiratory illnesses, etc.). This visualization revealed that certain diseases, such as respiratory infections, peaked during winter months, while cardiovascular cases remained constant year-round.
- **Example Chart 2: Yearly Revenue from Insured vs. Uninsured Patients (Line Graph):** A line graph showed a steady increase in revenue from insured patients over two years, while revenue from uninsured patients fluctuated more, indicating a reliance on insured patients for consistent income streams.



### Other Data Visualization Techniques:

In addition to traditional chart types, advanced visualization techniques were used to enhance data comprehension:

1. **Scatter Plots:** Scatter plots helped us investigate relationships between variables such as patient age and recovery time. For instance, we found that younger patients generally had shorter recovery times, while recovery times increased with age.
2. **Histograms:** Histograms were employed to show the distribution of treatment costs across different patient demographics. This visualization revealed skewed distributions, with a small percentage of patients incurring exceptionally high costs.
3. **Box Plots:** Box plots provided a summary of the data's distribution and helped identify outliers. We used box plots to visualize patient lengths of stay in the hospital, revealing a few extreme outliers with unusually long stays.



### Data Queries:

Data queries were fundamental in extracting relevant subsets of the dataset. Some of the key queries used included:

- **Query 1: Patient Admissions by Month and Disease Type**
  - This query helped analyze seasonal trends in admissions, allowing hospital management to anticipate periods of high patient volume and allocate resources accordingly.
- **Query 2: Average Treatment Cost per Disease**
  - This query provided insights into the average cost of treatment for different diseases, enabling financial planning and cost-cutting strategies.



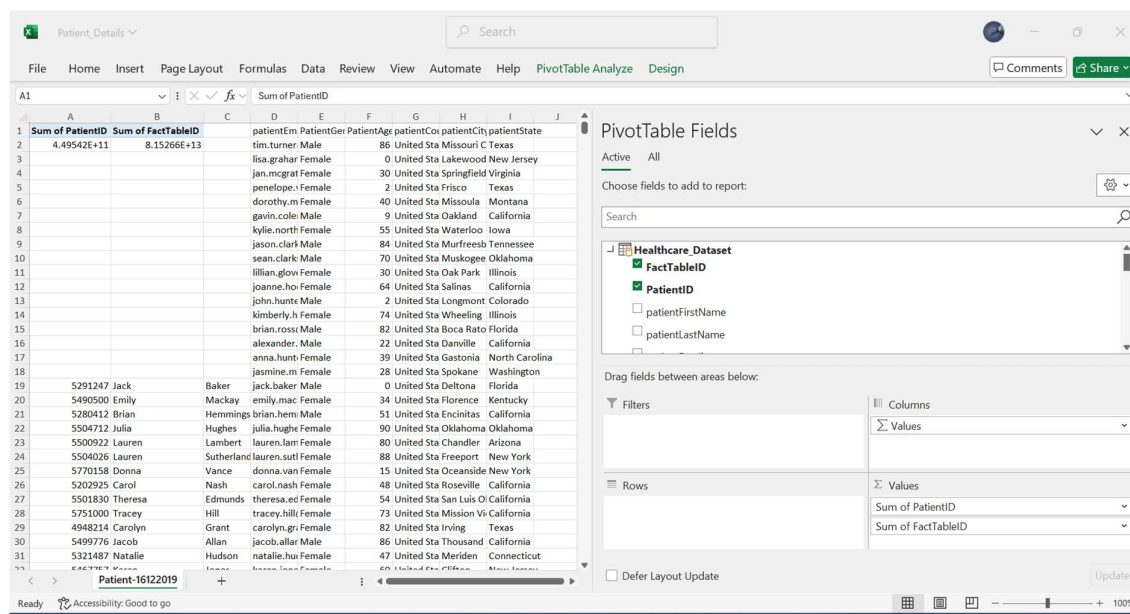
- **Query 3: Total Revenue Generated from Insured vs. Uninsured Patients**
  - This query shed light on the hospital's revenue streams, showing that insured patients contributed more consistently to the hospital's income.

Facility ID	Facility Name	Address	City/Town	State	ZIP Code	County
010001	SOUTHEAST HEALTH MEDICAL CENTER	1108 ROSS CLARK CIRCLE	DOTHAN	AL	36301	HOU
010005	MARSHALL MEDICAL CENTERS	2505 U S HIGHWAY 431 NORTH	BOAZ	AL	35957	MAR
010006	NORTH ALABAMA MEDICAL CENTER	1701 VETERANS DRIVE	FLORENCE	AL	35630	LAUC
010007	MIZELL MEMORIAL HOSPITAL	702 N MAIN ST	OPP	AL	36467	COVI
010008	CRENSHAW COMMUNITY HOSPITAL	101 HOSPITAL CIRCLE	LIVERNE	AL	36049	CREN
010011	ST. VINCENT'S EAST	50 MEDICAL PARK EAST DRIVE	BIRMINGHAM	AL	35235	JEFF
010012	DEKALB REGIONAL MEDICAL CENTER	200 MED CENTER DRIVE	FORT PAYNE	AL	35968	DE K
010016	SHELBY BAPTIST MEDICAL CENTER	1000 FIRST STREET NORTH	ALABASTER	AL	35007	SHEL
010018	CALLAHAN EYE HOSPITAL	1720 UNIVERSITY BLVD STE 305	BIRMINGHAM	AL	35233	JEFF
010019	HELEN KELLER HOSPITAL	1300 SOUTH MONTGOMERY AVENUE	SHEFFIELD	AL	35660	COLB
010021	DALE MEDICAL CENTER	126 HOSPITAL AVE	OZARK	AL	36360	DALE
010022	FLOYD CHEROKEE MEDICAL CENTER	400 NORTHWOOD DR	CENTRE	AL	35960	CHER
010023	BAPTIST MEDICAL CENTER SOUTH	2105 EAST SOUTH BOULEVARD	MONTGOMERY	AL	36116	MON
010024	JACKSON HOSPITAL & CLINIC INC	1725 PINE STREET	MONTGOMERY	AL	36106	MON
010029	THE EAST ALABAMA HEALTHCARE AUTHORITY	2000 PEPPERELL PARKWAY	OPELIKA	AL	36801	LEE
010032	UNIVERSITY OF ALABAMA HOSPITAL	619 SOUTH 19TH STREET	BIRMINGHAM	AL	35222	JEFF
010034	COMMUNITY HOSPITAL INC	805 FRIENDSHIP ROAD	TALLASSEE	AL	36078	ELMO
010035	CULLMAN REGIONAL MEDICAL CENTER	1912 ALABAMA HIGHWAY 157	CULLMAN	AL	35058	CULL
010036	ANDALUSIA HEALTH	849 SOUTH THREE NOTCH STREET	ANDALUSIA	AL	36420	COVI
010039	HUNTSVILLE HOSPITAL	101 SVILEY RD	HUNTSVILLE	AL	35801	MAAD
010040	GADSDEN REGIONAL MEDICAL CENTER	1007 GOODYEAR AVENUE	GADSDEN	AL	35903	ETOW
010044	MARION REGIONAL MEDICAL CENTER	1256 MILITARY STREET SOUTH	HAMILTON	AL	35570	MAR
010045	FAYETTE MEDICAL CENTER	1653 TEMPLE AVENUE NORTH	FAYETTE	AL	35555	FAYE

## Exploring Data Using Pivot Tables:

Pivot tables are a versatile tool for exploring large datasets. They allow for quick data summarization and enable users to slice and dice data across multiple dimensions. In this case study, we used pivot tables to explore data such as:

- **Patient Admissions by Month, Disease, and Age Group:** Pivot tables allowed us to cross-tabulate admissions by month, disease, and age group, providing a deeper understanding of which groups were most affected by specific diseases at different times of the year.
- **Treatment Costs by Disease and Insurance Status:** By cross-tabulating treatment costs by disease and insurance status, pivot tables helped us identify which diseases incurred the highest costs for insured and uninsured patients, allowing the hospital to adjust its pricing strategies accordingly.



## Conclusion:

Data visualization is a powerful tool in healthcare business management. Through effective visualization techniques, complex datasets can be transformed into easily interpretable insights that drive better decision-making. This case study demonstrated the application of several data visualization techniques to a real-world healthcare dataset, including bar charts, line graphs, heatmaps, scatter plots, and pivot tables. In addition to simplifying data analysis, these tools provided healthcare managers with actionable insights into patient demographics, disease trends, resource utilization, and financial performance.

The findings from this study can help healthcare organizations optimize their operations, improve patient care, and manage costs effectively. By leveraging data visualization tools and statistical methods, healthcare businesses can turn their data into a valuable resource for strategic decision-making.

The visualizations created from the **CMS Hospital General Information dataset** reveal key insights about hospital performance across the U.S. By focusing on metrics such as **readmission rates**, **mortality rates**, and **patient satisfaction**, healthcare providers can identify areas for improvement and optimize their operations.

The use of tools like **Choropleth Maps**, **Bar Graphs**, and **Heatmaps** makes complex data more accessible and actionable for a broad range of stakeholders, including clinicians, administrators, and policymakers. Visualization techniques like these are invaluable for decision-making, allowing healthcare businesses to pinpoint inefficiencies, improve patient care, and stay competitive in a rapidly evolving industry.

## Key Takeaways:



1. States with higher mortality rates should be a focus for healthcare improvement initiatives.
2. For-profit hospitals may need to improve quality controls to reduce readmission rates.
3. Offering emergency services can lead to improved patient satisfaction.
4. Reducing readmissions not only boosts patient outcomes but also improves the hospital's reputation.

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**References:**

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