Hospital Efficiency and Patient Satisfaction Across Age Groups:
A Comparative Analysis

By: Yodha Pranata, RN

OVERVIEW

Introduction 01

Background 02

Problem Statement 03

Objective 04

Data Understanding 05

Data Preprocessing 06

Dashboard 07

Hypotheses 08

Result & Insight 09

Recommendations 10

INTRODUCTION

Work Experience

- **Critical Care Nurse**
  Public Hospital (2019 - 2024)
- **Career Center Coordinator**
  University of Kepanjen (2018 - 2019)

Education

Bachelor of Data Science
Universitas Terbuka (2024 - Present)

Master of Critical Care
Universitas Padjadjaran (2024 - Present)

Bachelor of Nursing Science & Nursing Profession
Universitas Brawijaya (2012 - 2017)

Yodha Pranata

Data Analyst Enthusiast

LinkedIn:
linkedin.com/in/yodha-pranata

BACKGROUND

- **Operational efficiency:** **Length of Stay** (LOS) and **Total Cost** directly impact bed occupancy, staff workload, and hospital financial health
- **Patient satisfaction** has become a key quality indicator strongly linked to **loyalty, compliance**, and **hospital reputation**.
- The **Relationship between efficiency and satisfaction** is **not consistent**: longer **LOS** often results in **higher costs** and **lower satisfaction**, yet in some contexts, a certain **LOS** can **increase satisfaction** due to more **intensive care**.

BACKGROUND

- **Elderly patients** usually experience **longer LOS** and **higher costs** due to chronic conditions and slower recovery. elderly patients value empathy and direct communication.
- **Adult patients** prioritize **speed and digital access**, whereas elderly patients value empathy and direct communication.
- From a business perspective, these findings emphasize the need for tailored strategies: implementing **discharge planning and geriatric care** pathways for elderly patients, and **providing fast, digital-based services** for Adult patients. Such approaches allow hospitals to **balance operational efficiency with patient-centered quality care.**

PROBLEM STATEMENT

- Are there **differences** in the **length of stay** between adult and elderly patients?
- Are there **differences** in the **total costs** between adult and elderly patients?
- Are there **differences in patient satisfaction** ratings between adult and elderly patients?

OBJECTIVES

To analyze the **differences** in **length of stay, treatment costs,** and **patient satisfaction** between **adult and elderly patient** groups as a basis for managerial **decision-making** in hospitals.

DATA UNDERSTANDING

- Collected from **Kaggle**, **anonymized inpatient**
- Admissions from **Jan 2022 to Dec 2025**
- Dataset size: **984 records** and **15 columns** (≈0% missing)

15 Columns :

Patient_ID, Age, Gender, Condition, Medication, Admission_Date, Discharge_Date, Patient_State, Year_of_Admission, Length_of_Stay, Readmission, Outcome, Satisfaction, Insurance_Claimed, Total_Cost.

***Note:** Satisfaction rating scale ranges from 2 to 5

DATA PREPROCESSING

1

Removing Duplicate

No Duplicate Data Found

2

Handling missing value

No Missing Value Found

3

Outlier Screening

No Outlier Found

4

Converting Data type

Admission_Date & Discharge_Date (object)→ datetime

Hospital Patient Satisfaction & Demographics Dashboard

By: Yodha Pranata, RN

Patient Demographic

Patient Satisfaction

Insurance Claimed Status

- No
- Yes

Gender

- Female
- Male

Gender

- >60 (Elderly)
- 18-59 (Adult)

Total Patient Visit

984

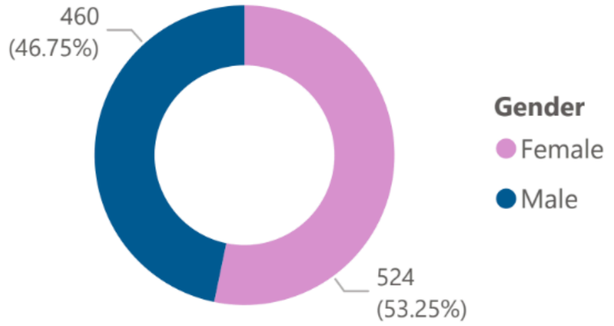
Patient

Average Patient Age

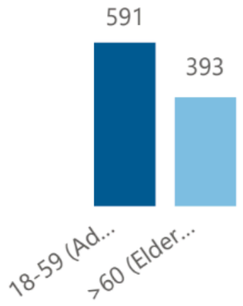
54

Years old

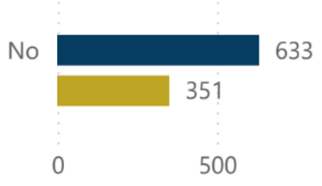
Total Patient by Gender



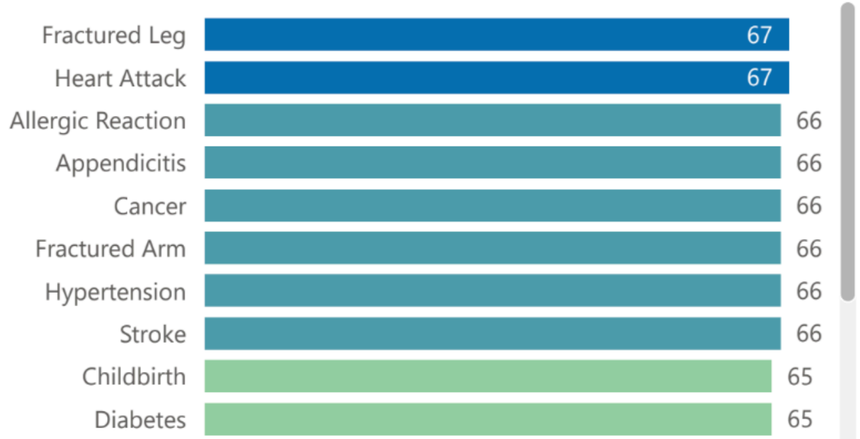
Total Patient by Age Group



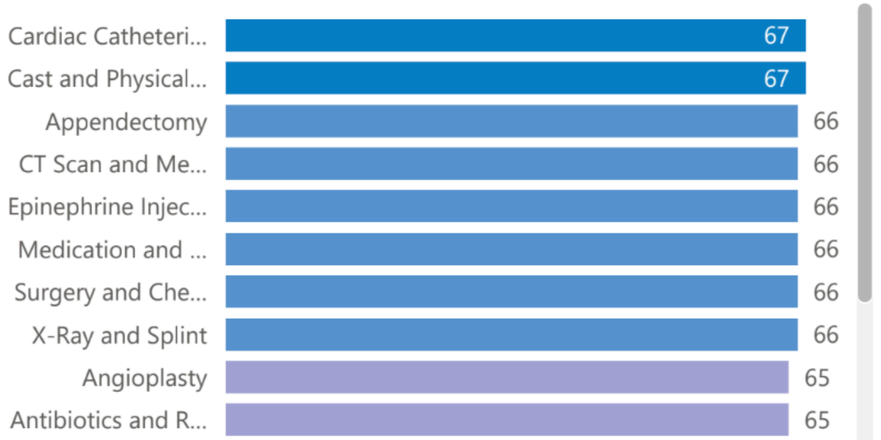
Insurance Claimed Status



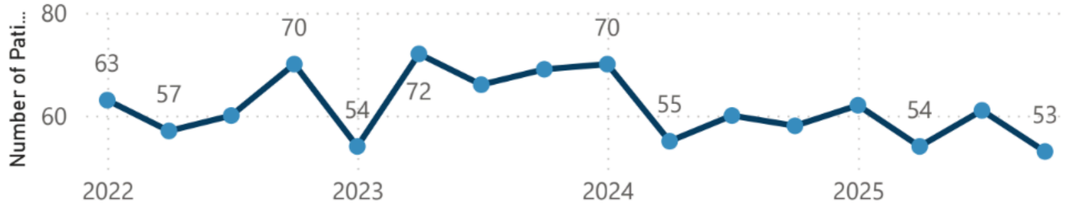
Number of Patient by Condition



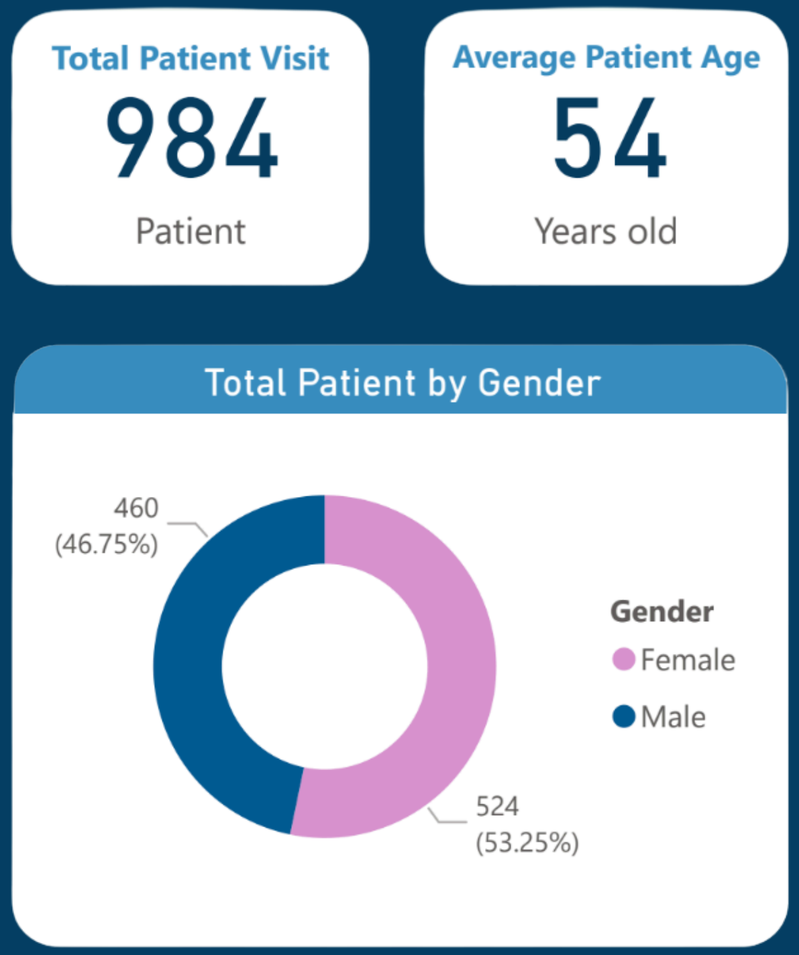
Number of Patient by Therapy



Number of Patient by Year and Quarter

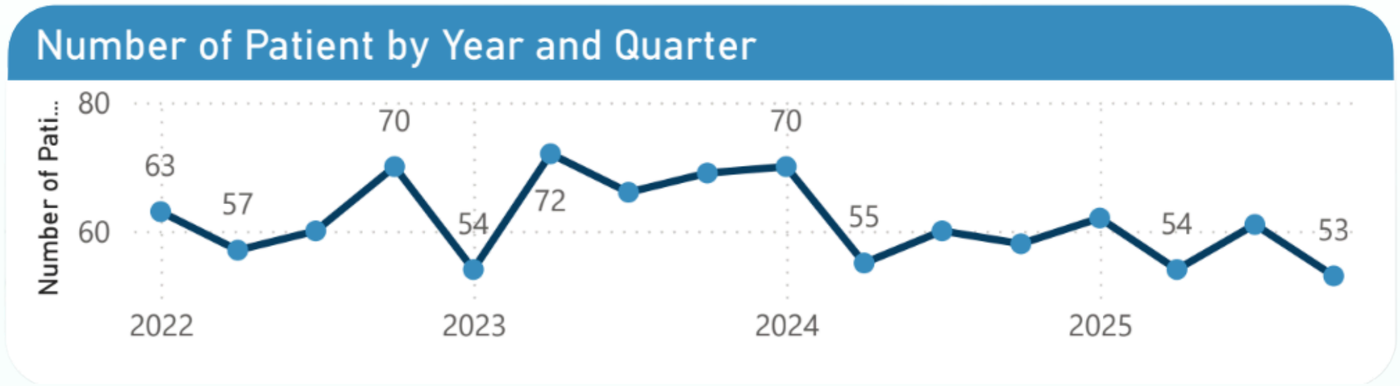


Explanatory Data Analysis



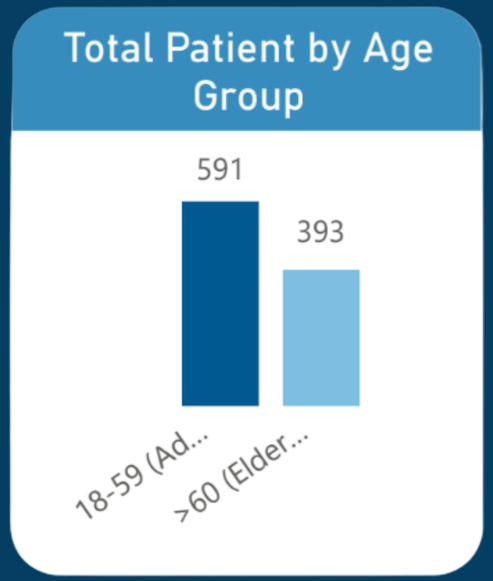
The dataset includes **984 patient visits** with an **average age of 54 years**. Gender distribution is relatively balanced, with **53.25% female and 46.75% male.**

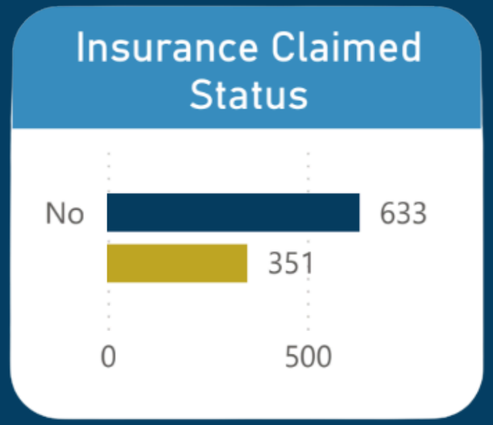
Explanatory Data Analysis



The dashboard shows quarterly patient **visits from 2022 to 2025**, fluctuating between 53 and 72 patients per quarter. The highest point occurred in 2023 (72 patients), while the lowest was recorded in 2025 (53 patients). **Overall, the trend indicates relatively stable patient numbers with moderate variations each year**, suggesting consistent hospital service demand over time.

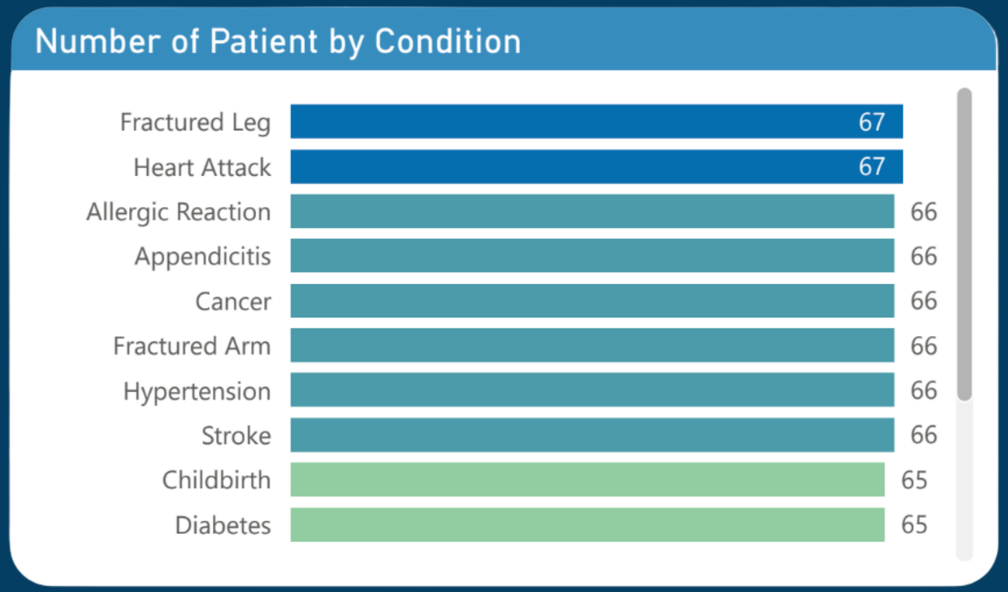
Explanatory Data Analysis

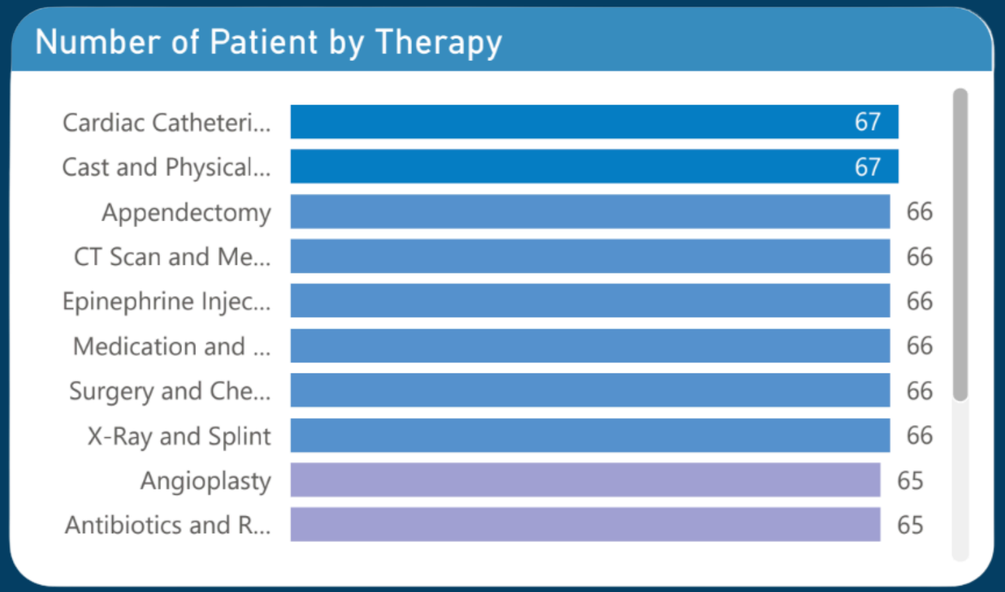




The most patients are **adults aged 18–59 (591 patients)**, while the **elderly group (≥60 years) accounts for 393 patients.**

Regarding insurance, a majority of patients did not claim insurance (633 patients), whereas 351 patients utilized insurance coverage.





Explanatory Data Analysis

The dashboard shows that patient conditions are distributed relatively evenly, with **fractured leg** and **heart attack** being the most frequent (67 cases each).

Therapy data highlights **cardiac catheterization** and **cast with physical therapy** as the most common interventions (67 cases each).

Hospital Patient Satisfaction & Demographics Dashboard

By: Yodha Pranata, RN

Patient Demographic

Patient Satisfaction

Insurance Claimed Status

No

Yes

Gender

Female

Male

Gender

>60 (Elderly)

18-59 (Adu...

Total Patient Visit

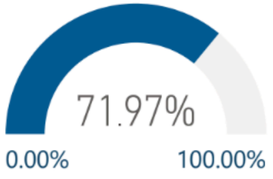
984

Patient

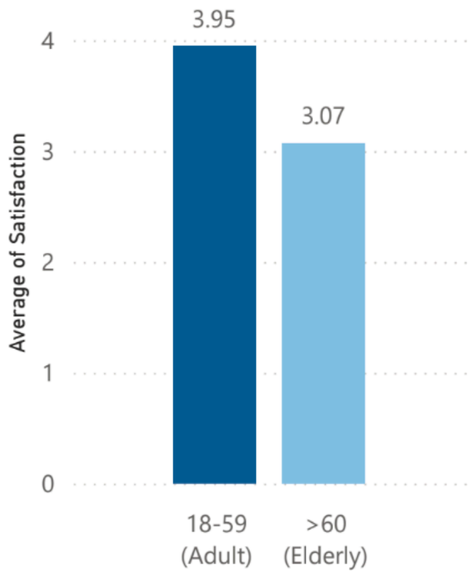
Satisfaction

3.60/5

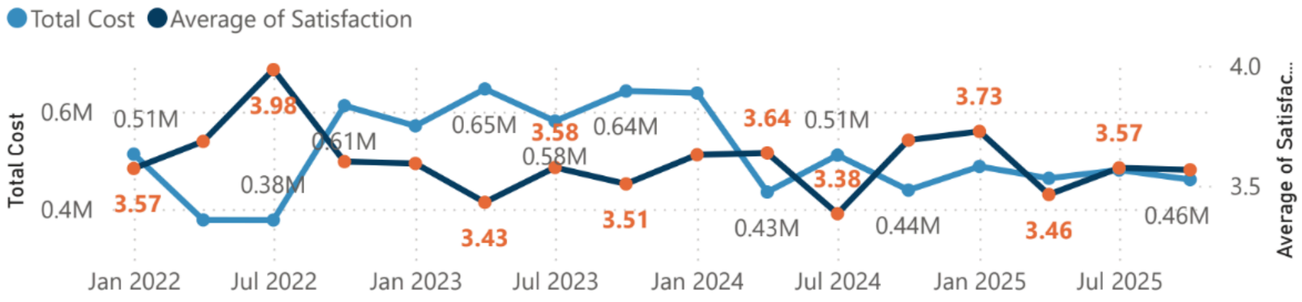
Customer Satisfaction Score



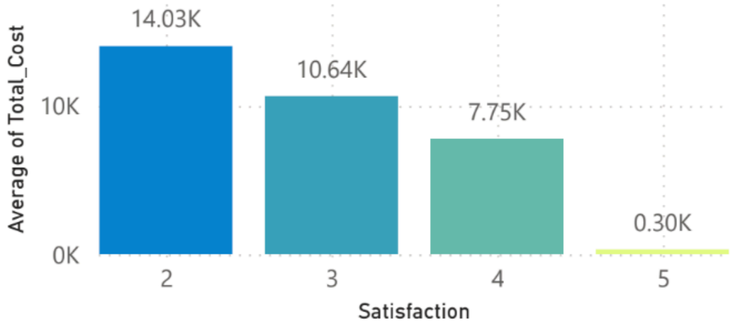
Average of Satisfaction by Age Group



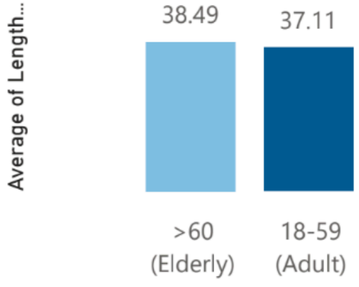
Total Cost and Average of Satisfaction by Year and Quarter



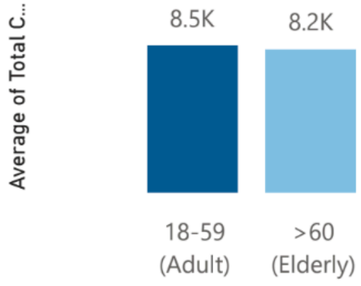
Average of Total Cost by Satisfaction



Average of Length of Stay by Age Group



Average of Total Cost by Age Group

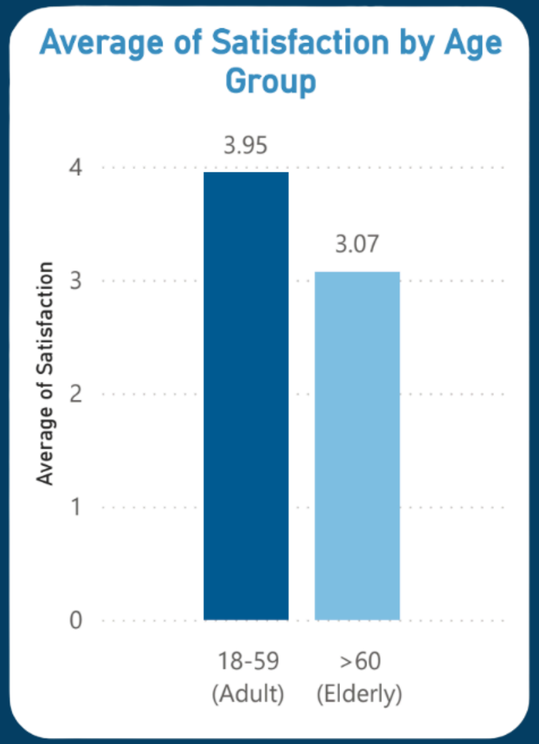


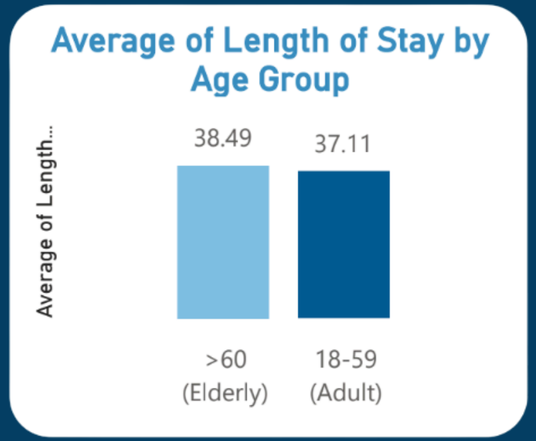
Explanatory Data Analysis

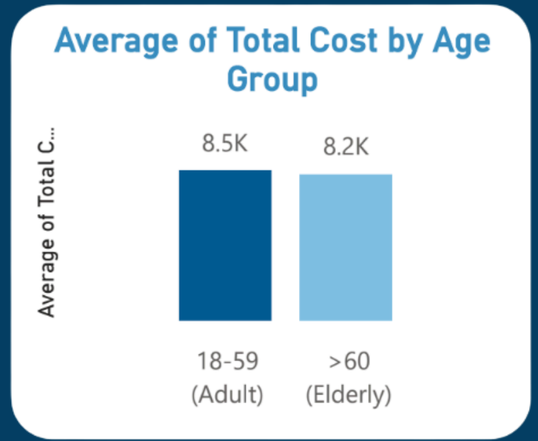
overall **patient satisfaction rating** of **3.6 out of 5**, which indicates a moderate level of satisfaction.

The **customer satisfaction score** is **71.97%,** reflecting that while most patients are reasonably satisfied, there **remains room for improvement in hospital services** and **patient experience.**

Explanatory Data Analysis



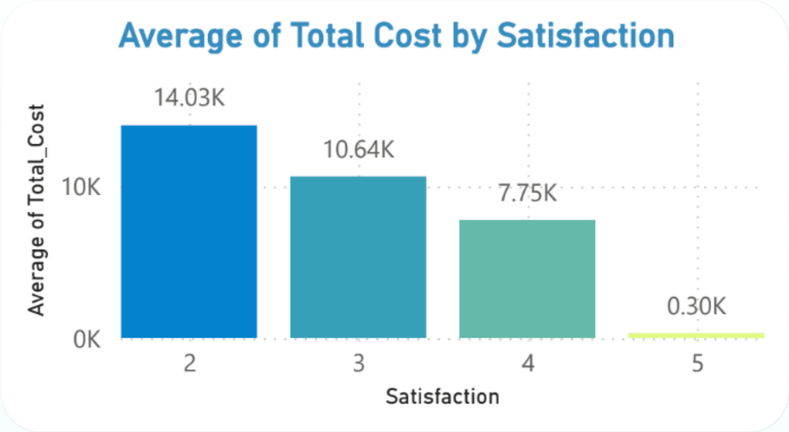


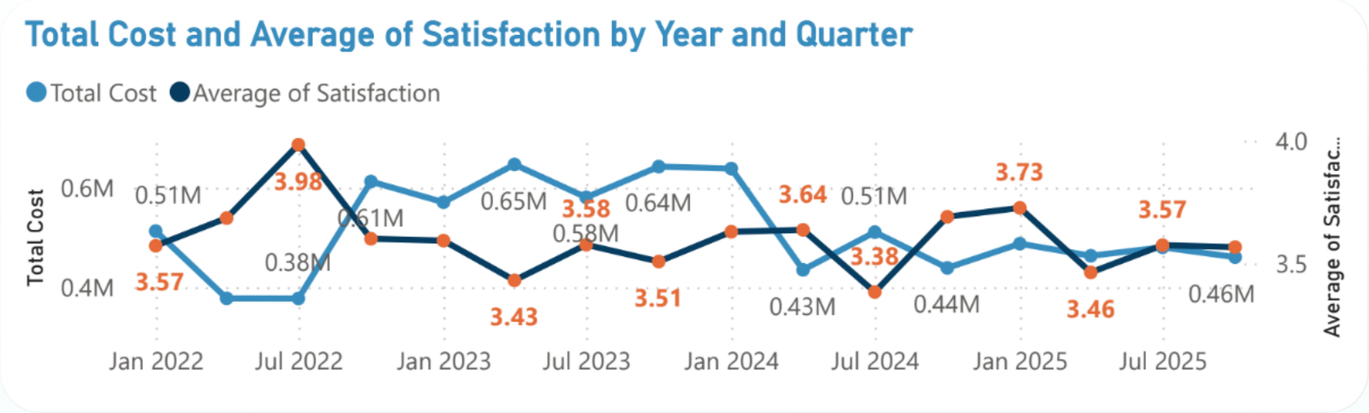


- **Adult patients** (18–59 years) **report higher satisfaction (3.95)** compared to elderly patients (≥60 years) who score lower (3.07).
- The average **length of stay is slightly longer for elderly patients (38.49 days)** than adults (37.11 days), though the difference is minimal.
- The **average total cost is higher for adults (8.5K)** compared to elderly patients (8.2K).

These results suggest that **elderly patients experience lower satisfaction** despite similar hospitalization duration and slightly lower costs.

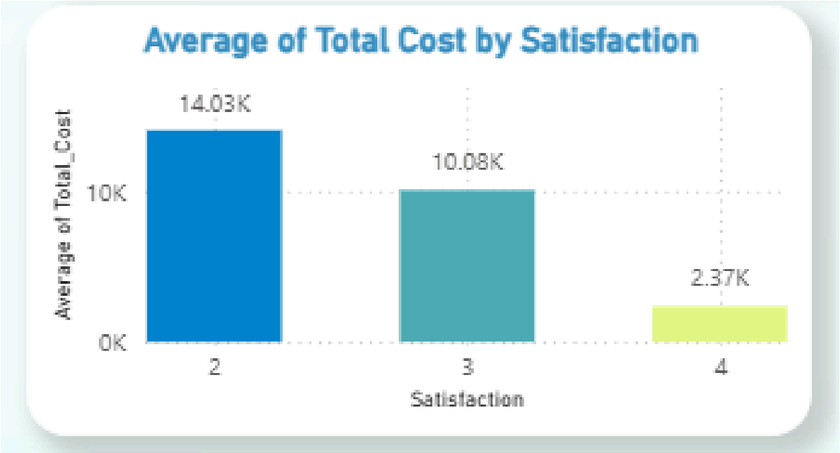
Explanatory Data Analysis

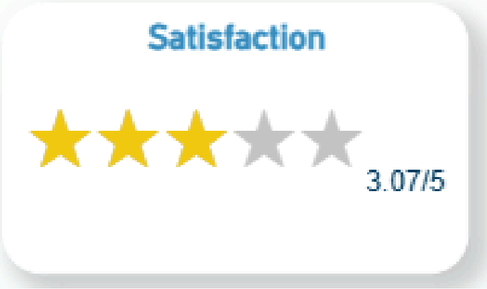


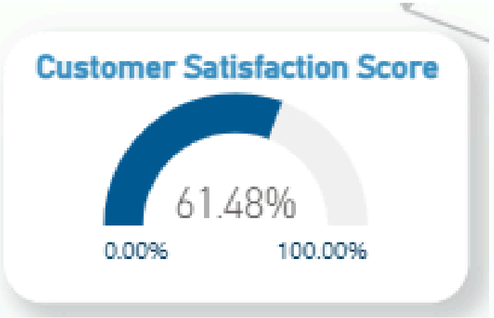


The dashboard indicates that **lower satisfaction may be associated** with **higher total costs**.
Patients with satisfaction level 2 have the highest average cost (14.03K), followed by level 3 (10.64K), while those at level 5 report the lowest cost (0.30K).

Explanatory Data Analysis



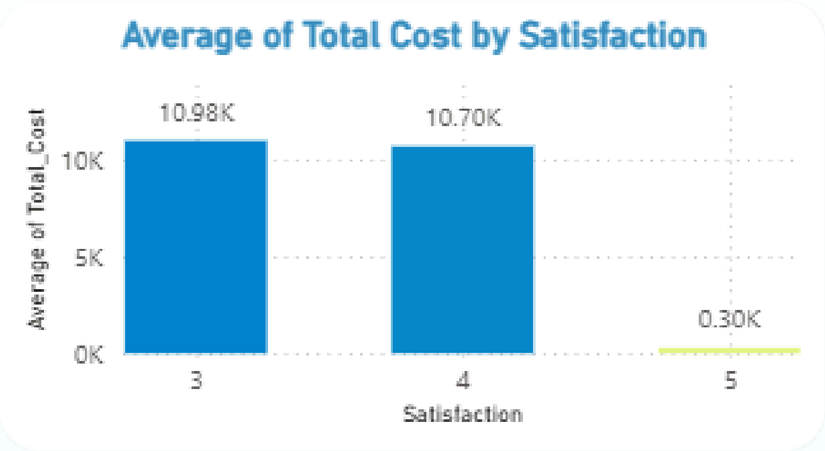




Elderly Patients Satisfaction

A total of 393 elderly patients were recorded, with an **average satisfaction score of 3.07** out of 5 and a **customer satisfaction rate of 61.48%.** Cost analysis shows that patients with lower satisfaction (score 2) had the highest average treatment cost (14.03K), while those with higher satisfaction (score 4) had much lower costs (2.37K). This suggests that **higher dissatisfaction among elderly patients is linked with greater healthcare expenses.**

Explanatory Data Analysis



Adult Patients Satisfaction

A total of 591 adult patients were recorded, with an **average satisfaction score of 3.95 out of 5** and a **customer satisfaction rate of 78.95%**. Cost analysis shows that patients with satisfaction levels 3 and 4 had similar average treatment costs (10.98K and 10.70K), while those with the highest satisfaction level (5) had a much lower cost (0.30K). These findings suggest that **adult patients report higher satisfaction compared to elderly patients**, despite similar cost patterns across satisfaction levels.

Correlation Analysis

- **Age has a strong negative correlation with satisfaction** (-0.75), indicating that older patients tend to report lower satisfaction.
- **Satisfaction is moderately negative with total cost** (-0.47), suggesting that higher treatment costs are linked to reduced patient satisfaction.
- **Age has a positive correlation with total cost** (0.30), meaning elderly patients generally incur higher expenses.
- **Length of stay shows only a weak positive correlation with total cost** (0.11) and almost no correlation with satisfaction (-0.08).

These findings emphasize **that age and cost are key drivers influencing patient satisfaction.**

HEATMAP

HYPHOTESES

Length of Stay

- H0: There is no significant difference in the average length of stay (LOS) between adult and elderly patients.
- H1: There is a significant difference in the average length of stay (LOS) between adult and elderly patients.

Total Cost

- H0: There is no significant difference in the average total treatment costs between adult and elderly patients.
- H1: There is a significant difference in the average total treatment costs between adult and elderly patients.

Patient Satisfaction Rating

- H0: There is no significant difference in patient satisfaction ratings between adult and elderly patients.
- H1: There is a significant difference in patient satisfaction ratings between adult and elderly patients.

Normality Test

```python
#Uji Normalitas

normalitas_LOS = stats.shapiro(df['Length_of_Stay'])
normalitas_cost = stats.shapiro(df['Total_Cost'])
normalitas_satisfaction = stats.shapiro(df['Satisfaction'])
normalitas_age = stats.shapiro(df['Age'])

print(f'p-value LOS: {normalitas_LOS.pvalue:.2f}')
print(f'p-value cost: {normalitas_cost.pvalue:.2f}')
print(f'p-value satisfaction: {normalitas_satisfaction.pvalue:.2f}')
print(f'p-value age: {normalitas_age.pvalue:.2f}')
```

```
p-value LOS: 0.00
p-value cost: 0.00
p-value satisfaction: 0.00
p-value age: 0.00
```

The Shapiro-Wilk test for all variables, including Length of Stay, Total Cost, Satisfaction, and Age, produced p-values <0.05. **These results indicate that none of the variables follow a normal distribution**. The assumption of normality is therefore violated.

Homogeneity Test

Uji Homogenitas

```python
# Uji homogenitas Levene LOS by Age_Group_WHO

levene_LOS = stats.levene(df[df['Age_Group_WHO'] == '18-59 (Adult)']['Length_of_Stay'],
                          df[df['Age_Group_WHO'] == '>=60 (Elderly)']['Length_of_Stay'])

print(f'p-value: {levene_LOS.pvalue:.2f}')
```

```
p-value: 0.78
```

```python
#uji homogenitas levene Total Cost by Age_Group_WHO

levene_cost = stats.levene(df[df['Age_Group_WHO'] == '18-59 (Adult)']['Total_Cost'],
                           df[df['Age_Group_WHO'] == '>=60 (Elderly)']['Total_Cost'])

print(f'p-value: {levene_cost.pvalue:.2f}')
```

```
p-value: 0.00
```

```python
# Uji Homogenitas Satisfaction by Age group

levene_satisfaction = stats.levene(df[df['Age_Group_WHO'] == '18-59 (Adult)']['Satisfaction'],
                                   df[df['Age_Group_WHO'] == '>=60 (Elderly)']['Satisfaction'])

print(f'p-value: {levene_satisfaction.pvalue:.2f}')
```

```
p-value: 0.00
```

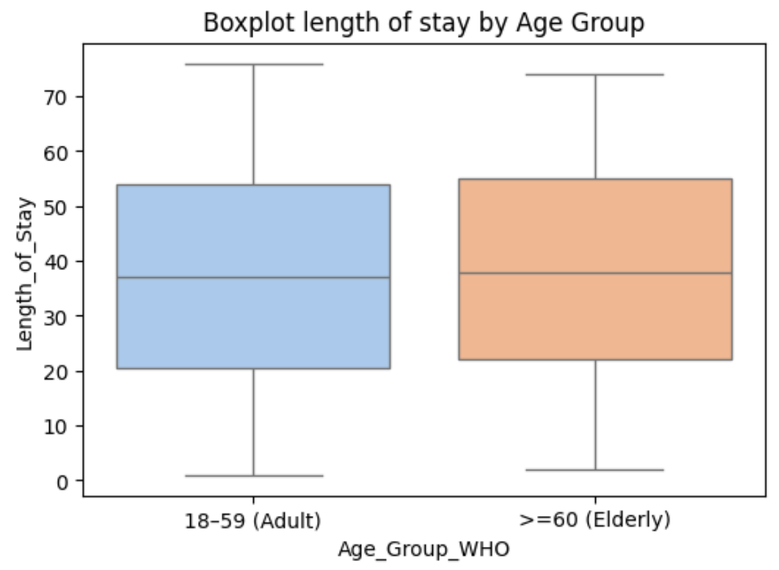
```python
#uji homogenitas levene Total Cost by Satisfaction

levene_satisfaction = stats.levene(df[df['Satisfaction'] == 2]['Total_Cost'],
                                   df[df['Satisfaction'] == 3]['Total_Cost'],
                                   df[df['Satisfaction'] == 4]['Total_Cost'],
                                   df[df['Satisfaction'] == 5]['Total_Cost'])

print(f'p-value: {levene_satisfaction.pvalue:.2f}')
```

```
p-value: 0.00
```

- Length of Stay by Age Group (Adult vs Elderly): p-value = 0.78 (>0.05). Variances are equal across groups, indicating homogeneity.
- Total Cost by Age Group (Adult vs Elderly): p-value = 0.00 (<0.05). Variances are not equal across groups, indicating heterogeneity.
- Satisfaction by Age Group: p-value = 0.00 (<0.05). Variances are not equal across groups, indicating heterogeneity.
- Total Cost by Satisfaction Levels (2–5): p-value = 0.00 (<0.05). Variances are not equal across groups, indicating heterogeneity.

All variables are **non-normally distributed**. Variance equality is violated in most groups except Length of Stay by age. **Non-parametric tests** such as *Mann-Whitney U* and *Kruskal-Wallis* are **appropriate for further analysis.**

Man-whitney u Test



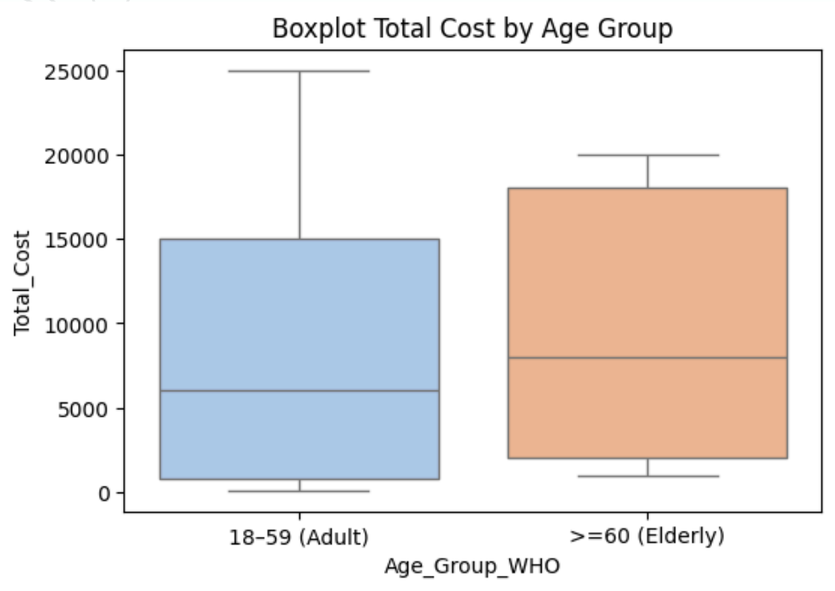

```python
#uji man-whitney u LOS by Age_Group_WHO

stat, p = stats.mannwhitneyu(df[df['Age_Group_WHO'] == '18-59 (Adult)']['Length_of_Stay
                             df[df['Age_Group_WHO'] == '>=60 (Elderly)']['Length_of_Stay'])

print(f'p-value: {p:.2f}')
```

```
p-value: 0.29
```

Are there **differences** in the **length of stay** between adult and elderly patients?

The Mann–Whitney U test showed **no significant difference (p = 0.29)**. This aligns with the dashboard results, where the **median LOS was 37 days for adults and 38 days** for elderly patients, indicating only a marginal difference.

Man-whitney u Test



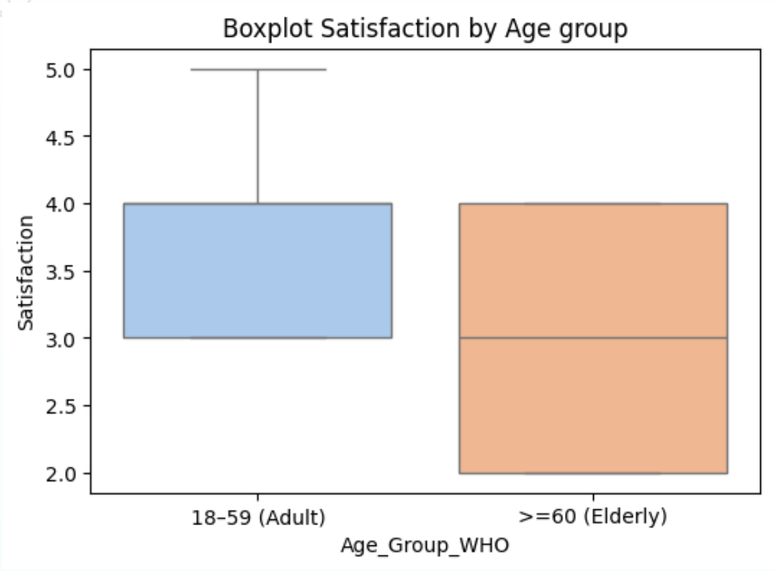

```
uji man-whitney u total cost by Age_Group_WHO

tat, p = stats.mannwhitneyu(df[df['Age_Group_WHO'] == '18-59 (Adult)']['Total_Cost'],
                            df[df['Age_Group_WHO'] == '>=60 (Elderly)']['Total_Cost'])

rint(f'p-value: {p:.2f}')
```

```
p-value: 0.01
```

Are there **differences** in the **Total cost** between adult and elderly patients?

The test indicated a **significant difference total cost between adult and elderly patients (p = 0.01)**. The **median cost for adults was 6,000**, while for **elderly patients it was higher at 8,000**. This reflects that elderly patients tend to incur greater healthcare expenses, likely due to more complex clinical needs.

Man-whitney u Test



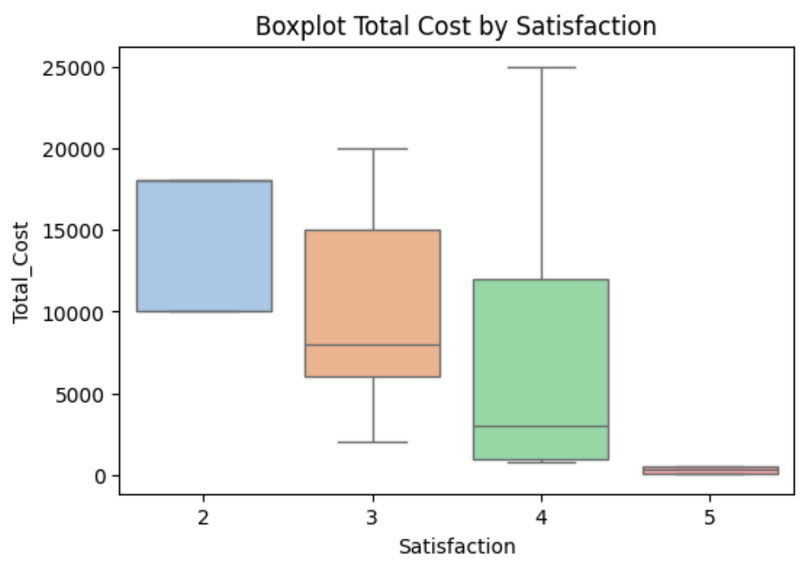

```python
#uji man-whitney u satifaction by age

stat, p = stats.mannwhitneyu(df[df['Age_Group_WHO'] == '18-59 (Adult)']['Satisfaction']
                             df[df['Age_Group_WHO'] == '>=60 (Elderly)']['Satisfaction'

print(f'p-value: {p:.2f}')
```

```
p-value: 0.00
```

Are there **differences** in the **Satisfaction** between adult and elderly patients?

The difference was **highly significant (p = 0.00)**. Adults had a **median satisfaction score of 4, compared to 3 among elderly patients**. This suggests that elderly patients consistently report lower satisfaction levels, pointing to disparities in perceived care quality.

Kruskal Wallis and Post Hoc Test




```python
#Uji Kruskall satisfaction total cost
from scipy.stats import kruskal

stats, p = kruskal(df.loc[df['Satisfaction'] == 2, 'Total_Cost'].values,
                   df.loc[df['Satisfaction'] == 3, 'Total_Cost'].values,
                   df.loc[df['Satisfaction'] == 4, 'Total_Cost'].values,
                   df.loc[df['Satisfaction'] == 5, 'Total_Cost'].values)

print(f'p-value: {p:.2f}')
```

```
p-value: 0.00
```

```python
import scikit_posthocs as sp

posthoc = sp.posthoc_dunn(df, val_col='Total_Cost', group_col='Satisfaction')

print(posthoc)
```

```
              2             3             4             5
2  1.000000e+00  4.122638e-04  2.235263e-18  4.364392e-79
3  4.122638e-04  1.000000e+00  3.993178e-10  1.647906e-73
4  2.235263e-18  3.993178e-10  1.000000e+00  6.650764e-49
5  4.364392e-79  1.647906e-73  6.650764e-49  1.000000e+00
```

```python
print(posthoc <0.05)
```

```
       2      3      4      5
2  False   True   True   True
3   True  False   True   True
4   True   True  False   True
5   True   True   True  False
```

Kruskal Wallis and Post Hoc Test

- **The Kruskal–Wallis** test demonstrated a **significant overall difference in treatment costs across satisfaction levels ($p < 0.05$)**.
- To explore this further, **post hoc Dunn's test** revealed that **almost all satisfaction groups differed significantly from each other**. Median costs showed a clear downward trend: patients with satisfaction level 2 had the highest median cost (18,000), followed by level 3 (8,000), level 4 (3,000), and level 5 with the lowest cost (300).
- These findings indicate that **lower satisfaction is strongly associated with higher hospital expenses**, while **greater satisfaction corresponds with reduced treatment costs**.

Recommendation

Age-Friendly Care (Elderly >60 years)

- **Implementation of the 4Ms Framework (What Matters, Medication, Mentation, Mobility)**
  - **What Matters:** Explore the goals and preferences of patients and families, then align daily care plans accordingly.
  - **Medication:** Conduct medication review and deprescribing to reduce polypharmacy and lower drug-related costs.
  - **Mentation:** Screen for delirium and depression; prevent them through reorientation, promoting good sleep, and correcting sensory impairments.
  - **Mobility:** Ensure safe daily mobilization to prevent complications and maintain functional capacity.

- **Supporting Practices**
  - **Hourly or purposeful rounding:** Regularly check for pain, positioning, toileting needs, and essential items.
  - **Educational communication:** Use the teach-back method, provide simplified materials, and actively involve families in the education process.

Recommendation

Structured Discharge Planning and Care Transition

- Initiate discharge planning at the time of admission; schedule follow-up appointments within ≤7 days for high-risk cases.
- Provide discharge education using the teach-back method along with a checklist of medications, activities to continue, and activities to avoid.
- Arrange follow-up contact within 48–72 hours after discharge (by phone or home visit) to reduce treatment confusion.
- Goal: To improve elderly patient satisfaction without prolonging length of stay, while also preventing costly readmissions.

Recommendation

Value-Based Cost Management

- Audit cases of elderly patients with low satisfaction scores (2–3) to identify key cost drivers (e.g., high-cost medications, repeated testing, ICU utilization, multiple consultations).
- Implement diagnostic and laboratory stewardship: restrict tests that do not change clinical decision-making; apply guideline-based order sets.
- Optimize the hospital formulary: limit high-cost drugs to appropriate indications and substitute with clinically equivalent alternatives.

Recommendation

Cost Transparency and Patient Education

- Provide pre-procedure cost estimates and simple daily cost summaries.
- Offer bedside financial counseling to explain what is covered by the treatment package versus additional charges, thereby reducing dissatisfaction caused by unexpected billing.

Recommendation

Age-spesific Service Segmentation

- Adults: Maintain efficiency in processes and strengthen digital service channels (registration, results, payment) to preserve satisfaction.
- Elderly: Provide administrative assistance, priority queues, sufficient consultation time, and age-friendly physical environments.

Thank You

The Rise of Preventive Medicine: Catching Illness Before It Starts