

# Optimizing Healthcare Resource Allocation through Visual Analytics

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## INTRODUCTION

The project “Optimizing Healthcare Resource Allocation through Visual Analytics” addresses the critical need for efficient resource allocation in healthcare. Aimed at hospital administrators and medical staff, this initiative leverages data-driven insights to enhance patient care quality, improve staff working conditions, and ensure economic sustainability of healthcare institutions.

## 1 INSIGHT NEEDS

There are various insight needs and they are:

- 1. Optimal Staff Allocation:** This involves visualizing staffing patterns against patient demand to determine the best staffing levels across various departments and shifts.
- 2. Resource Allocation Efficiency:** Analysing the utilization of beds, rooms, and equipment to identify overuse or underuse.
- 3. Patient Flow Management:** Identifying bottlenecks in patient transfers and waiting times, and developing strategies to improve patient flow.
- 4. Cost Control:** Finding cost-saving opportunities without compromising the quality of patient care.

## 2 DATA ACQUISITION

The various data that is contained in my dataset are:

- 1. Patient Admission Data:** This includes records of patient’s admission, diagnoses, care requirements, and outcomes.
- 2. Staff Scheduling Data:** Comprises shift schedules and allocations for doctors, nurses, and support staff.
- 3. Resource Utilization Data:** Details on the usage of beds, rooms, and equipment.
- 4. Patient Demographics:** Information on age, gender, and medical history.

### 2.1 Descriptive Statistics of Data

**Total Records:** 100,000 patient admissions.

**Staff Members:** 1,000 (including doctors, nurses, support staff)

**Resource:** 500 beds, 100 rooms, 50 types of equipment.

**Average Daily Admissions:** 100 patients.

**Patient Age Range:** 0-100 years.

## 3 ANALYSIS METHODS

There are three types of analysis method that I have used to address my stakeholder’s insight needs.

- 1. Time Series Analysis:** To examine patterns in patient admissions and staff scheduling.
- 2. Resource Utilization Analysis:** Identifying trends in hospital resource usage.
- 3. Network Analysis:** Exploring patient flow and staff-resource interactions.

## 4 VISUALIZATIONS

There are various forms of visualizations that I have utilized and they are:

- 1. Line Charts:** Illustrating patient admission trends over time.
- 2. Heat Maps:** Visualizing patient admissions by hospital regions.

**3. Network Diagrams:** Demonstrating interactions between staff, patients, and resources.

**4. Pie Charts:** Showing demographic distribution of patients.

**5. Column Charts:** Identifying overused or Underused Resources.

**6. Tree Map:** To group patients with similar diseases and staff scheduling in various departments.

### 4.1. PROTOTYPE

#### 4.1.1. Prototype 1

**Line chart:** this visualization will track the number of patient admissions throughout the years. Where I have used the sum of admission rates in departments on the y-axis while various departments in the hospital on the x-axis and in the legend, I used the years data.

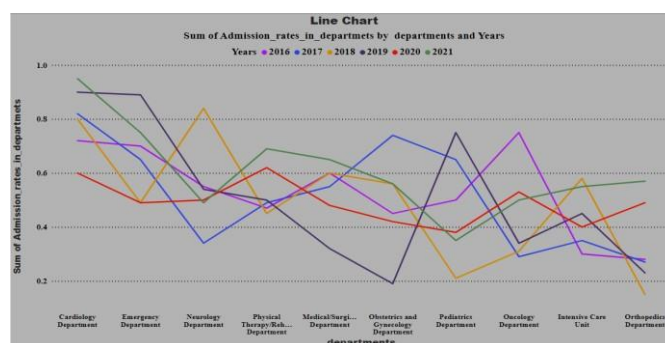


Fig. 1. Line Chart

#### 4.1.2. Prototype 2

**Heat Map:** this visualization is to visually represent the distribution of patient admission within different regions of the hospital. Where I have used health service area in the Location field and count of admission in the values fields.

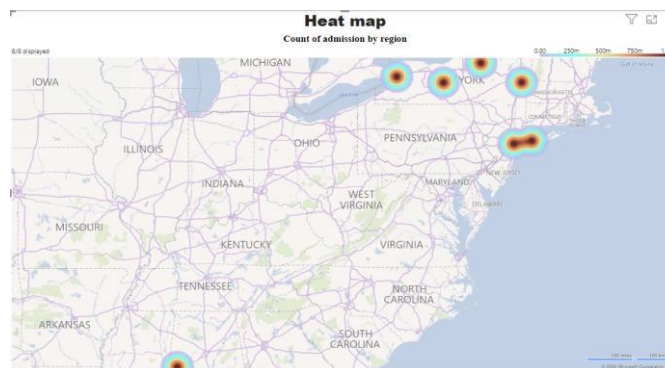


Fig. 2. Heat Map

#### 4.1.3. Prototype 3

**Network Diagram:** this visualization is to illustrate the interactions and flow between different elements of the hospital during patient care. Where I have used the source department and target department

Fig.3. Network Diagram

#### 4.1.4. Prototype 4

**Pie Chart:** this visualization is utilized to visually represent the demographic breakdown of patients based on their ages within a healthcare setting. Where I have used age groups in the legend and gender in the values field.

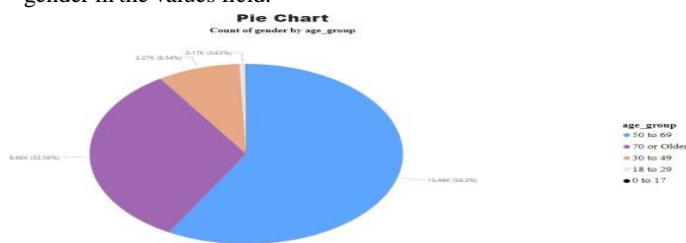
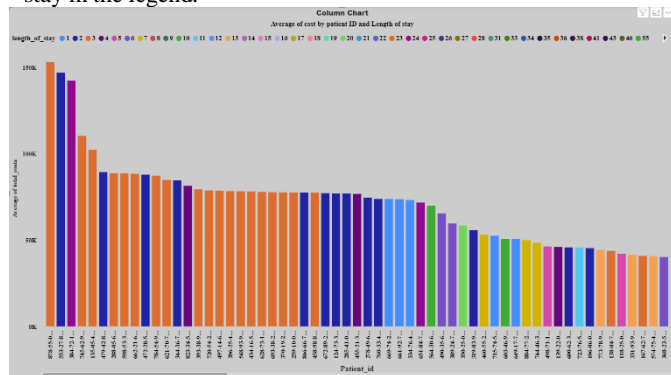


Fig.4. Pie Chart

#### 4.1.5. Prototype 5

**Column Chart:** this visualization is used to analyze and visualize the average of total cost per patient in a healthcare setting. Where I have used patient ID in x-axis, average of total cost in y-axis and length of stay in the legend.



### Fig.5. Column Chart

#### 4.1.6. Prototype 6

**Tree Map:** this visualization is to categorize and visualize patient based on their diagnoses in a comprehensive and compact manner. Where I have used the diagnosed disease in the category label and count of patients in value label.

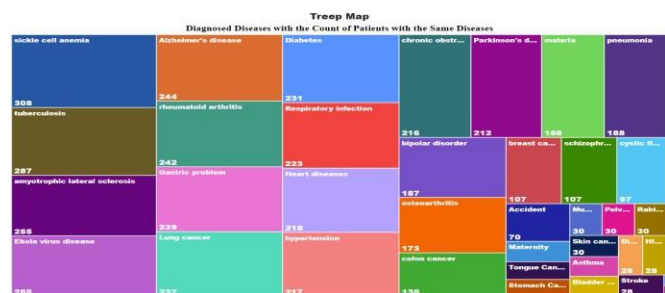


Fig.6. Tree Map

I have also utilized tree map for scheduling staff in various departments. Where I used the department name in the category label and count of staff in values label.



Fig 7. Tree Map

## 5. INTERPRETATION OF RESULTS

**1. Understanding Patient and Resource Dynamics:** By analyzing admission rates and resource utilization, the project aims to provide a clear picture of how patient needs fluctuate over time and how resources are currently being used. This insight is crucial for hospital administrators to make informed decisions about resource allocation and staff scheduling.

**2. Identifying Bottlenecks and Efficiency Opportunities:** Visualizations like heat maps and network diagrams will highlight bottlenecks in patient flow and areas where resources are either overused or underutilized. This information can lead to targeted interventions to improve efficiency and patient care quality.

### 3. Tailoring Services to Patient Demographics:

Insights into the age distribution and diagnosis patterns of patients will help in customizing healthcare services to meet the specific needs of different demographic groups.

**4. Cost Optimization Strategies:** By identifying areas where resources are underutilized or where patient flow can be optimized, the project helps in formulating strategies to control costs without compromising the quality of care.

My Success will be evaluated based on how effectively the visual analytics inform and improve decision-making. This includes:

- 1.Reduced wait times and increased patient throughput.
- 2.More balanced resource utilization across departments.
- 3.Enhanced staff satisfaction due to improved scheduling.
- 4.Cost savings from more efficient operations.

The challenges that I faced was identifying the correct dataset that was required for my project, as considering the fact of patient data privacy and security, it was difficult to get few datasets so I had to identify them and merge them as one dataset.

There's an opportunity to apply sophisticated analytics, like predictive modeling, to forecast future trends in patient admission and resource needs and the project can establish a foundation for a continuous improvement process in hospital operation and patient care.

During the validation and evaluation phase, there were several aspects that was tested like ensuring the visualizations accurately represents the data and are relevant to the stakeholder's needs.

## REFERENCES

- [1] <https://drive.google.com/file/d/1h7SHRhKeP9jPlaxeYRtKg-TE3UldhiYx/view>
- [2] [https://drive.google.com/file/d/1cSek3Is32bjRtOfImf2fuB5\\_5hn0ojh8/view](https://drive.google.com/file/d/1cSek3Is32bjRtOfImf2fuB5_5hn0ojh8/view)
- [3] [https://drive.google.com/file/d/18hpPHgIxyWEIX-rt\\_iru0\\_-fsx9r9vV5/view](https://drive.google.com/file/d/18hpPHgIxyWEIX-rt_iru0_-fsx9r9vV5/view)