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Optimizing Hospital Resource Utilization Using Power BI Analytics

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Abstract: *Delivering high-quality patient care while reducing operating costs requires effective hospital resource management. A dynamic, data-driven solution for tracking and maximizing the use of vital resources including beds, medical equipment, personnel, and emergency services is provided by a Power BI-created hospital resource utilization dashboard. The dashboard offers real-time visual insights, such as occupancy rates, patient flow trends, staff workload allocation, and equipment utilization patterns, by combining data from several hospital information systems. Administrators and clinical leaders can foresee resource shortages, make well informed decisions, and increase overall operational efficiency with the help of these insights. Strategic planning is supported and transparency is improved by Power BI's interactive features, which include drill down capabilities, automated alerts, and customizable reports. Ultimately, the implementation of a Power BI based hospital resource utilization dashboard contributes to improved patient outcomes, reduced wait times, and more effective allocation of healthcare resources.*

Keywords: *Hospital Resource Utilization, Hospital Resource Management, Bed Utilization, Healthcare Operations, Data Visualization, Decision Making System.*

I.INTRODUCTION

The population's consumption of the health care services at their disposal in order is measured by health care utilization. However, a significant issue in many health systems is the inappropriate consumption of sophisticated but pointless or inadequate tests and pharmaceuticals in hospitals. Harper (2002) proposed a framework for modelling hospital resources and demonstrated that structured resource utilization reduces overcrowding and improves patient flow. His work emphasizes that mismanagement of bed allocation significantly increases patient waiting time and reduces operational efficiency (Harper, 2002). Similarly, studies by McManus et al. (2003) highlighted the importance of optimal ICU resource use. They found that variability in surgical caseloads directly affects ICU congestion, and implementing proper monitoring tools can reduce mortality and delays (McManus et al., 2003). Dowding et al. (2015) reviewed the use of dashboards in healthcare and concluded that real-time dashboards improve clinical decision-making by presenting critical data in a user-friendly format (Dowding et al., 2015). Their findings show dashboards reduce cognitive load and help users act quickly in high-pressure environments. Prybutok et al. (2018) reported that integrating dashboards into hospital management increased operational efficiency, reduced manual reporting time, and improved overall hospital performance. Their research concluded that dashboards promote transparency and enhance resource allocation (Prybutok et al., 2018). Raghupathi & Raghupathi (2014) emphasized that BI in healthcare enables actionable insights that improve operational efficiency, reduce costs, and enhance patient care. They also highlighted the importance of big data analytics in hospital resource planning (Raghupathi & Raghupathi, 2014). Litvak et al. (2005) found that bottlenecks in patient flow are often linked to poor resource management and recommended analytical tools to reduce variability in patient admission and discharges. They argued that a structured operational dashboard can help manage demand and reduce delays (Litvak et al., 2005). This covers the use of medical, home, personal care, and hospital resources. Health status and health care utilization are indicators of a health care system's effectiveness. Healthcare overuse can be driven by a number of factors, including aggressive marketing to healthcare providers, direct-to-consumer advertising, political pressure from advocacy groups, defensive medical decision making, and fragmentation and discontinuity of care within and between the health and social sectors. Surveys of health care utilization are useful strategies for determining health care needs. Traditionally, out-of-pocket costs have been used to finance health care in India, and since 25% of the population is considered impoverished, these costs could make medical care unaffordable. One of the main causes of the families being forced into poverty is the lack of public health resources, funding, and staff, which forces the impoverished to seek treatment at expensive private clinics. Hospitals might use creative strategies to boost productivity in light of the growing demand for healthcare services. Most significantly, decreasing improper utilization could remove the iatrogenic effects of needless services while enhancing healthcare quality, in addition to saving money and increasing operational, allocative, and administrative efficiency.

II.PROBLEM STATEMENT

Hospitals are complex systems where patient demand, resource availability, and operational activities change frequently. Efficient utilization of resources such as beds, staff, equipment, and patient flow is crucial to maintaining quality healthcare services. However, many hospitals still struggle with outdated manual methods, fragmented data systems, and delayed decision-making. These issues affect operational efficiency, increase patient waiting time, and reduce the quality of care. To address these challenges, there is a need for a centralized system that can provide a real-time, integrated, and data-driven view of hospital resources. A Hospital Resource Utilization Dashboard aims to meet this need by offering visual insights that support strategic and operational decision-making.

Challenges of existing system:
There are some challenges for existing system which are as:

- Lack of real time monitoring
- Fragmented data sources
- Inefficient manual processes
- Poor resource allocation
- Lack of performance visibility, and so on.

Scope of the problem: The problem affects the major areas of hospitals such as:

- Emergency Department
- Operation Theater's
- Intensive Care Units (ICUs)
- Nursing Workload Distribution, and so on.

Objective of the Project: The main objective of developing this project is as follows:

- Real time visibility
- Centralized data integration
- Improve resource allocation
- Reduce overcrowding
- Enhance decision making
- Improve patient experience

III. SOLUTION APPROACH

The proposed system uses Power BI as the analytical platform. The following steps are involved which outline the methodology:
(i) Data Collection: We have to collect data from hospital database. It may be in any format like csv file, excel file etc. We have to connect these sources to Power BI using built in connectors.
(ii) Data Cleaning and Transformation: Use Power query editor to remove null values, duplicate values, and put all the data in their proper format so that we can analyse that data easily.
(iii) Dashboard Development: Create an interactive dashboard for operational efficiency, Patient demographics, staff utilization, and equipment utilization.
(iv) Role Based Access & Security: It means that we have to provide access of data and resources based on role. Like admin have all the access to see the resources, doctors can see only their department resources and patients record, and patients can see only their data.
(v) Predictive Analytics & Alerts: Use DAX functions and built in AI features to forecast resource demand and set alerts for critical threshold.
(vi) Testing and Validation: Verify dashboard accuracy and ensure real time updates reflects actual resource usage.

Resources Required:
(i) Software: Microsoft Power BI, Data Connectors.
(ii) Hardware: Laptop/PC
(iii) Human Resources: Power BI Developer/data analyst, IT staff for integration, and medical & administrative staff for data validation.
(iv) Data: Bed occupancy data, Patient data, Staff data, Equipment data, and so on.

Design of the Project: In this section, we present the analysis of hospital resource utilization using Power BI. A total of seven interactive dashboard has been created to visualize key metrics, trends, and insights from data. Each dashboard focuses on specific aspects of hospital operations.

Dashboard 1: Hospital Resource Utilization Dashboard

Description: The hospital resource utilization is a comprehensive system consisting of six dashboards that monitor key aspects of hospital performance. It tracks patient admissions, bed occupancy, patient outcomes, and operational costs. By providing a real time, holistic view of hospital operations, it helps management make informed decisions, optimize resources, and improve overall patient care.

- We represent total patient, total bed, and total cost by using cards.
- We use six buttons for giving name of dashboards. Each button is connected to their respective dashboards.
- We use different slicers like date, department, hospital branch, and outcome for data interactivity.

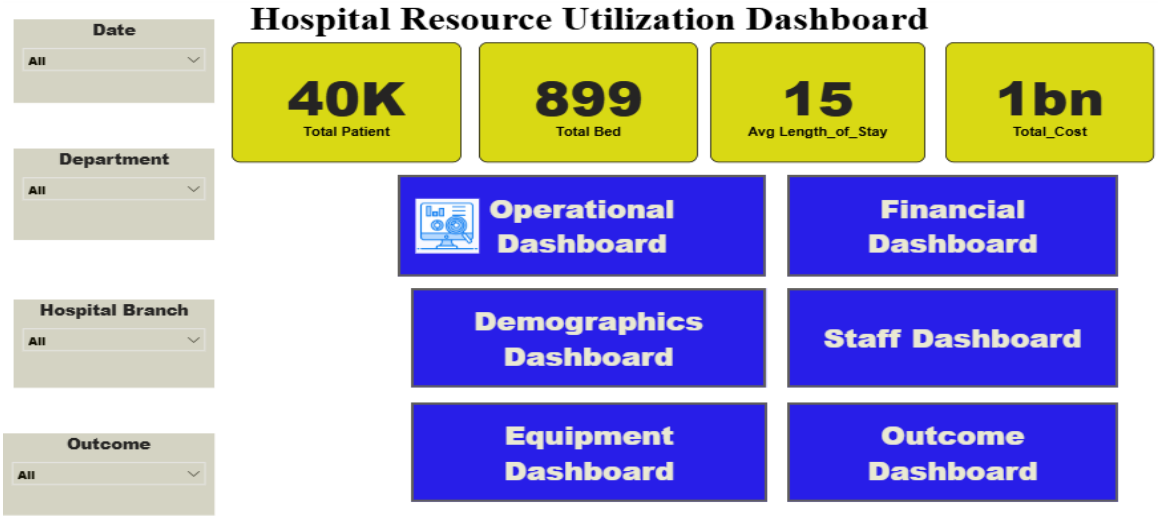

Fig 1: Hospital Resource Utilization Dashboard

Insights: This is the main dashboard and every dashboard is connected from this dashboard. Here we can dynamically see all the operations performed in the hospital. It provides view of patient flow, resource utilization, efficiency, clinical outcomes, and cost management, enabling data-driven decisions to optimize hospital performance and improve patient care.

Dashboard 2: Hospital Operational Dashboard

Description: A comprehensive visual platform that monitors and analyzes all critical hospital operations in real-time. It covers patient admissions, bed occupancy, staff allocation, equipment usage, clinical outcomes, and operational costs, providing a holistic view of hospital performance.

- For showing total revenue, bed occupancy rate, average length of stay, and occupied beds, we use cards.
- We add a home button which connect this dashboard with the main dashboard.
- We use different slicers like date, department, hospital branch, and outcome for data interactively.
- We can see bed occupancy trend over time by line chart.
- We use pie chart for distribution of outcome according to total patients.
- We use donut chart for showing total revenue according to their room type like private, ICU, and general.
- We show total revenue according to their department by using clustered bar chart.

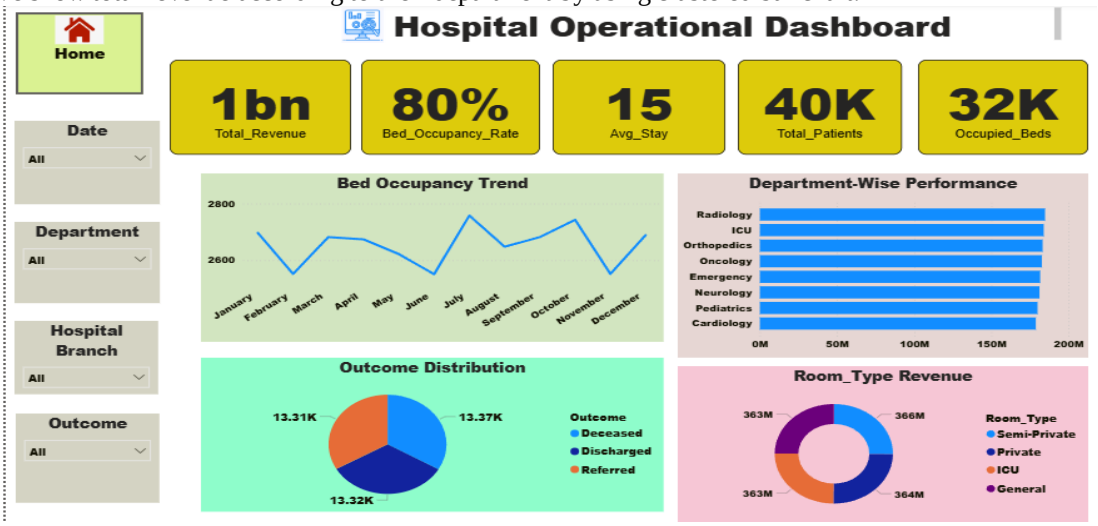

Fig 2: Hospital Operational Dashboard

Insights: Here we dynamically analyse the all operation performed in hospital. It provides a clear view of patient flow, resource utilization, efficiency, clinical outcomes, and cost management, enabling data-driven decisions to optimize hospital performance and improve patient care.

Dashboard 3: Hospital Financial Dashboard

Description: A detailed visual tool that tracks, analyzes, and presents the hospital's financial health. It covers revenue generation, expenses, departmental costs, billing patterns, and reimbursements, offering a real-time snapshot of financial performance.

- We show the total revenue, medication expense, room charges, and average cost per patient by using cards.
- We use different slicers like date, department, hospital branch, and outcome for data interactively.
- We can see total cost by hospital branch by using pie chart.
- Showing average cost per department by using clustered bar chart.
- We represent the total revenue by month wise using line chart.
- We add a home button which connect this dashboard with the main dashboard.
- We also represent total revenue according to department by using stacked bar chart.

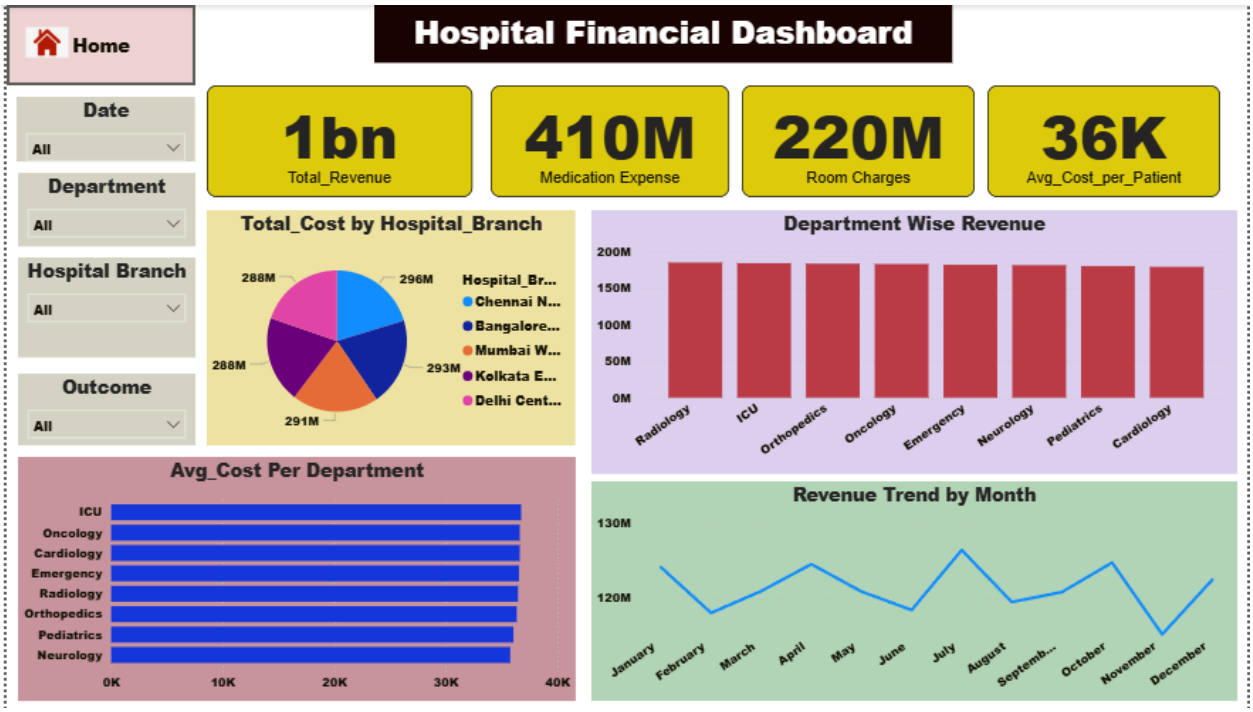

Fig 3: Hospital Financial Dashboard

Insights: It provides clarity on revenue streams, cost distribution, profitability, and budget utilization, enabling management to make informed financial decisions, optimize resources, and improve overall financial efficiency.

Dashboard 4: Patient Demographics Dashboard

Description: A visual dashboard that captures and presents detailed patient information, including age, gender, location, medical history, and department-wise distribution. It helps in understanding patient profiles and population health trends.

- We show total patient, female patient, average age, total admissions, and male patients by using cards.
- We use different slicers like date, department, hospital branch, and outcome for data interactively.
- We show the age group distribution according to total patients by using clustered bar chart.
- We use pie chart for gender distribution by total patients like male, female, and other.
- Use of line chart for showing admission trend over time.
- Use of clustered bar chart for showing total patients according to their department.
- We add a home button which connect this dashboard with the main dashboard.

Insights: It helps identify patient trends, high-demand services, and demographic patterns, enabling hospitals to plan resources, tailor healthcare services, and improve patient engagement.

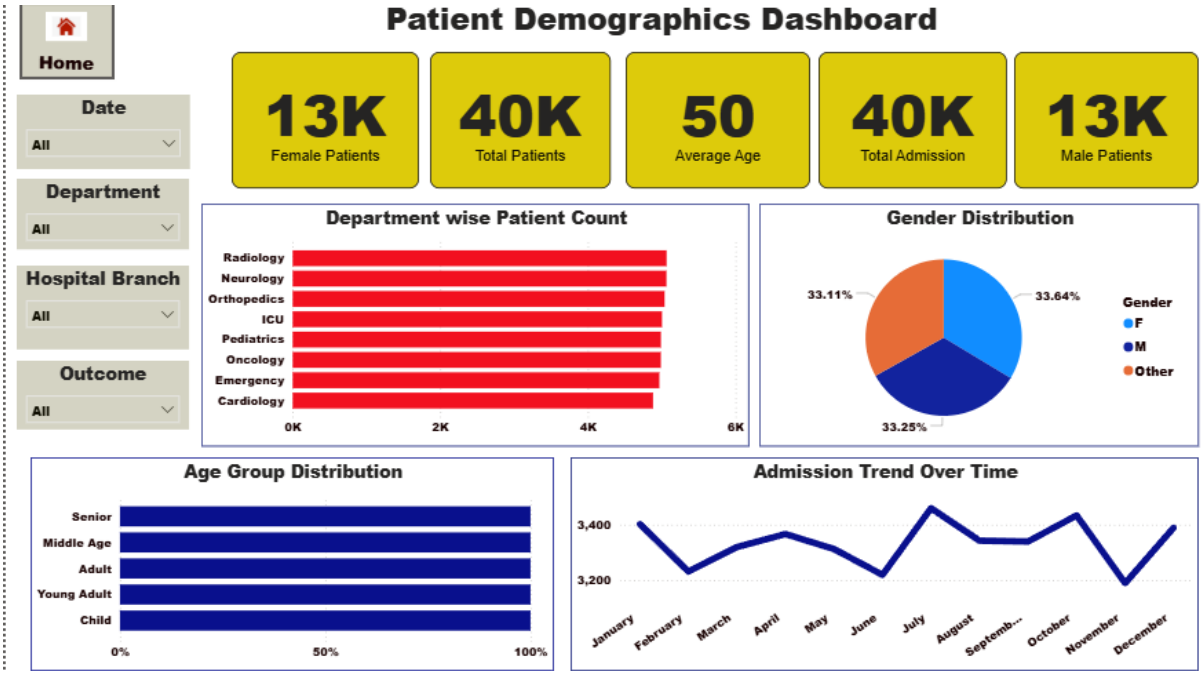

Fig 4: Patient Demographics Dashboard

Dashboard 5: Staff Dashboard

Description: A real-time visual tool that monitors hospital staff availability, shift schedules, role assignments, and department-wise workforce distribution. It ensures effective workforce management and optimal allocation of human resources.

- For showing total staff, utilization percentage, active staff, and average shift hours, we use cards.
- We use different slicers like date, department, and availability status for data interactively.
- We use donut chart showing staff availability by total staff.
- We show the availability of staff according to their shift by total staff by using stacked bar chart.
- Use of line chart for showing trend of staff on duty by total staff.
- We use stacked bar chart to show availability of staff according to their department.
- We add a home button which connect this dashboard with the main dashboard.

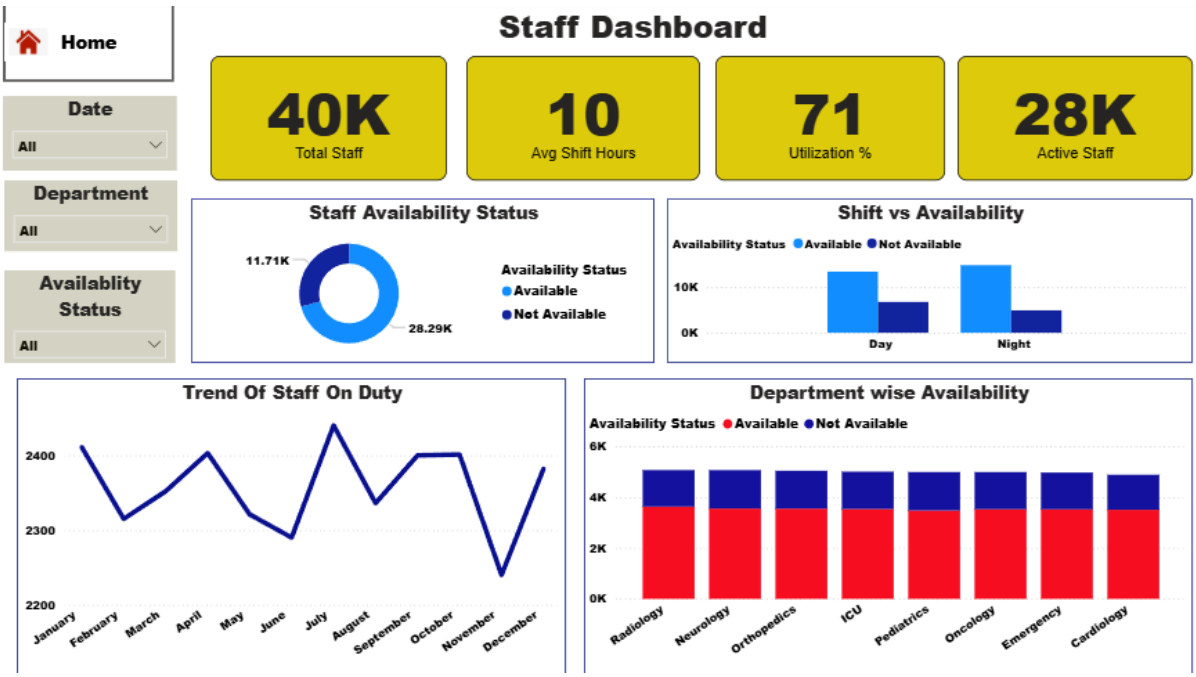

Fig 5: Staff Dashboard

Insights: It provides visibility into staffing levels, identifies shortages or overstaffing, and helps optimize workforce management, ensuring efficient hospital operations and better patient care.

Dashboard 6: Equipment Dashboard
Description: A visual monitoring system that tracks the status, utilization, and maintenance schedules of medical equipment across hospital departments. It ensures that resources are used efficiently and are always ready for clinical needs.

- Use of cards for showing total equipment, total revenue, total staff, and occupied beds.
- We use different slicers like date, department, and hospital branch for data interactively.
- Use of pie chart to show average of equipment used hours by equipment used according to total patients.
- Use of stacked bar chart to show total average cost by room type.
- We use line chart to show equipment usage frequency chart.
- Use of clustered bar chart to show average hours of equipment used.
- We add a home button which connect this dashboard with the main dashboard.

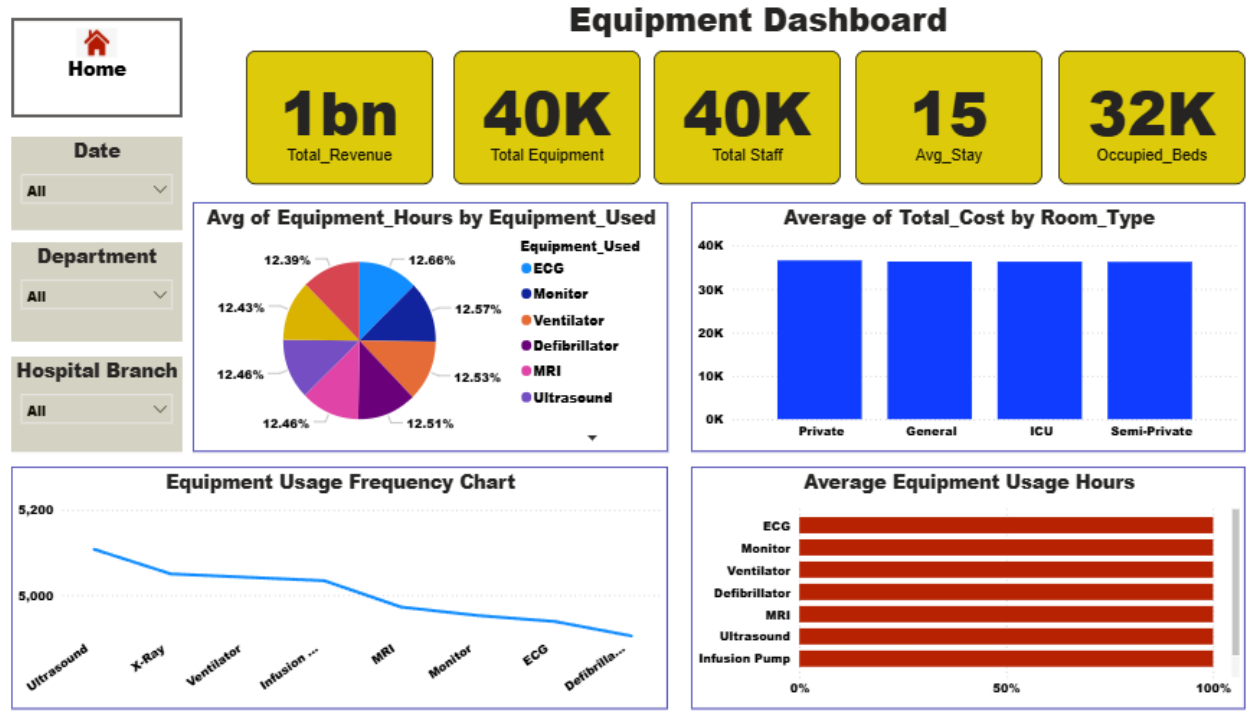

Fig 6: Equipment Dashboard

Insights: It helps identify underused or overused equipment, schedule maintenance proactively, and optimize resource allocation, ensuring operational efficiency and uninterrupted patient care.

Dashboard 7: Patient Outcome & Recovery Dashboard
Description: A comprehensive visual tool that tracks clinical outcomes and patient recovery metrics, including discharge rates, recovery times, mortality rates, and referral statistics. It helps evaluate care effectiveness and treatment efficiency.

- We use different slicers like date, department, and outcome for data interactively.
- Use of cards for showing total patients, discharge patient, discharge rate, mortality rate, and referred rate.
- Use of stacked bar chart to show average length of stay by outcome.
- We use pie chart to show outcome distribution like discharged, referred by total patients.
- Use of stacked bar chart to show average cost by outcome.
- Use of donut chart to show outcome by shift type.
- Use of clustered bar chart to show outcome by department according to total patients.
- We add a home button which connect this dashboard with the main dashboard.

Insights: It helps evaluate the quality of care, identify areas for clinical improvement, track patient recovery trends, and support data-driven decisions to enhance overall patient outcomes.

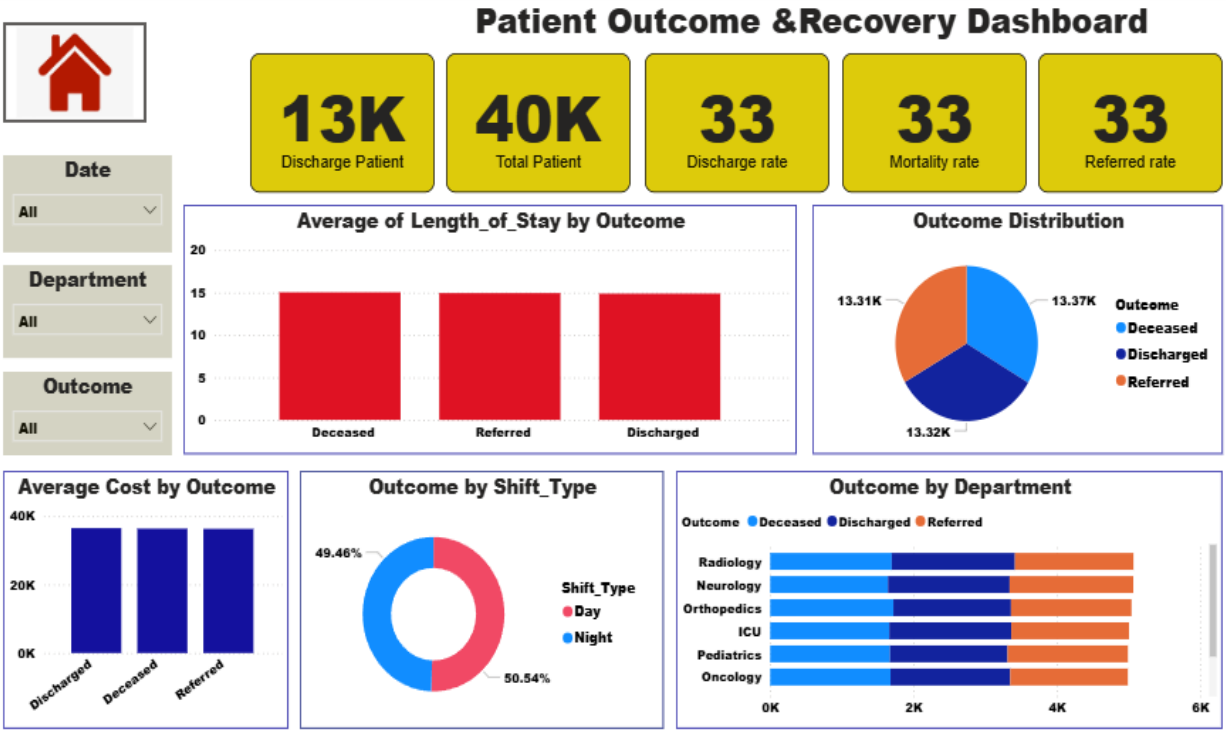

Fig 7: Patient Outcome & Recovery Dashboard

IV. FUTURE SCOPE

In the future, we can concentrate on combining Power BI with AI and ML models to forecast staffing needs and equipment need. Real-time data may be shown in Power BI by integrating IoT-enabled medical devices and hospital systems. By predicting peak resource demand, advanced analytics can help hospitals plan, staff, and inventory more effectively. An automated alert for major shortages may be included in a future edition of Power BI. The system can be expanded to assist corporate or governmental healthcare networks by tracking and comparing utilization patterns across several regions. Hospital resource dashboards can be accessed from anywhere at any time thanks to cloud integration, facilitating management teams' remote monitoring and decision-making. Continuous data analysis can assist in reducing waste, managing operating expenses, and guaranteeing the sustainable use of hospital resources.

V.CONCLUSION

The proposed project provides a modern, affordable, and effective solution for hospital resource management by utilizing Power BI's data integration and visualization capabilities. It addresses key limitations of traditional systems, such as high cost, lack of real-time insights, and integration issues. By implementing this solution, hospitals can transition from manual reporting to automated, data-driven decision-making, leading to improved patient care, efficient operations, and better preparedness for future challenges. In order to sum up, our Healthcare Analytics initiative is a vital step toward modernizing healthcare procedures via data-driven insights and well-informed decision-making. Healthcare procedures don't change. We hope to contribute to the sustainable development and sustainability of healthcare systems by utilizing data, which will ultimately improve patient care and results. We hope that data-driven decision-making will be the cornerstone of healthcare excellence in the future thanks to our Healthcare Analytics project. Hospitals must employ utilization optimization techniques in order to guarantee the provision of effective and efficient healthcare and to lessen the abuse of inpatient and outpatient services. Unintended consequences resulting from financial incentives and disincentives on health care providers' judgments about care can be avoided by using pertinent tactics and interventions.

References

1. Commission P: Impacts of advances in medical technology in Australia. Productivity Commission, Government of Australia Research Reports 2005.
2. Tan L, Ong K. The Impact of Medical Technology on Healthcare Today. Hong Kong J Emerg Med. 2002;9(4):231–6.
3. Verma BL, Srivastava RN. Measurement of the Personal Cost of Illness due to Some Major Water-Related Diseases in an Indian Rural Population. Int J Epidemiol. 1990;19:169–76. doi:10.1093/ije/19.1.169.
4. Pandey A, Ploubidis GB, Clarke L, Dandona L. Trends in catastrophic health expenditure in India: 1993 to 2014. Bull World Health Organ. 2018;96(1):18.
5. Harper, P. R. (2002). A framework for operational modelling of hospital resources. Health Care Management Science.

6. McManus, M. L., Long, M. C., Cooper, A., & Litvak, E. (2003). Variability in surgical caseload and access to intensive care services. Anesthesiology.
7. Dowding, D., Randell, R., Gardner, P., Fitzpatrick, G., & Hardiker, N. (2015). Dashboards for health care professionals: A review of the literature. International Journal of Medical Informatics.
8. Prybutok, V., Spinks, N., & Luo, X. (2018). Implementing dashboards to improve hospital performance. International Journal of Healthcare Management.
9. Raghupathi, W., & Raghupathi, V. (2014). Big data analytics in healthcare: Promise and potential, Health Information Science and Systems.
10. Litvak, E., Fineberg, H. V., Long, M. C., & McManus, M. (2005). Managing patient flow in hospitals: Strategies and solutions. Joint Commission Journal on Quality and Patient Safety.