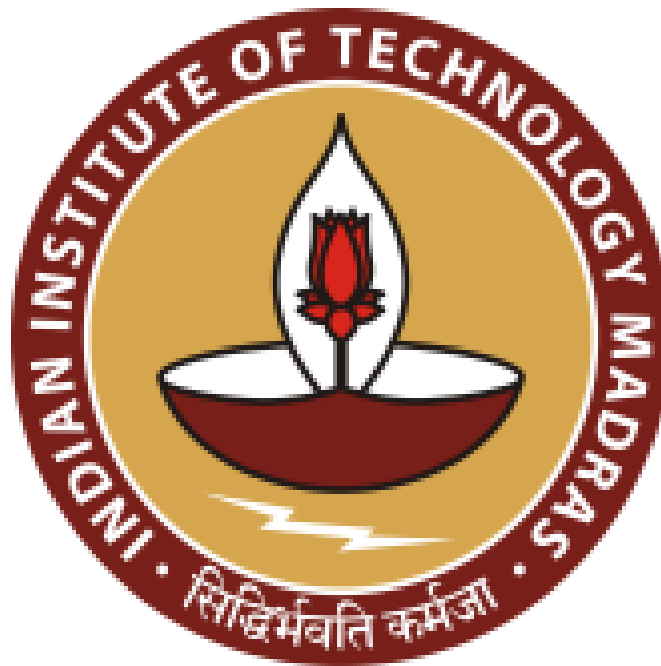# Business Data Management Project Final Submission

Case study of Tulip Hospital: A Data-Driven Approach

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Contents

TITLE: Enhancing Operational Efficiency and Financial Stability In Tulip Hospital: A Data-driven Approach

EXECUTIVE SUMMARY

Tulip Hospital, located in Sonipat, Haryana, remains committed to providing affordable and high-quality healthcare services to the community. However, the hospital continues to face several operational and financial challenges, as highlighted in previous analyses. These challenges include liquidity challenges, uneven resource allocation, and capacity management issues, all of which complicate the hospital's ability to meet patient needs efficiently.

This study, covering April 2023 to March 2024, provides a data-driven analysis aimed at enhancing Tulip Hospital's operational efficiency and financial stability. Key findings identify peak patient volumes during June and the winter months, underscoring the need for better capacity planning to maintain service quality during periods of high demand. Inconsistencies in procedure documentation have led to data inaccuracies, hindering operational efficiency and decision-making.

The hospital's financial performance is heavily impacted by delayed insurance payments, which account for the majority of its revenue, causing cash flow challenges. Additionally, the uneven distribution of procedures, particularly in the Cardiology and Orthopaedics departments, has led to resource imbalances, placing strain on certain departments and affecting overall staff well-being.

Key recommendations include:

- **Standardization of data entry processes** to improve accuracy and reduce operational inefficiencies.

- **Implementation of a robust revenue cycle management system** to address cash flow challenges stemming from delayed insurance payments.

- **Adoption of data-driven strategies** for optimizing resource allocation and balancing workload distribution across departments.

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By addressing these critical issues, Tulip Hospital can enhance its operational efficiency, improve patient care, and achieve financial stability, ensuring long-term success.

Detailed Explanation of Analysis Process/Method

1. **Data Collection and Preparation**: The first step involved collecting patient records from Tulip Hospital, Sonipat, for the period between April 2023 and March 2024. The data included information such as the year, month, department, patient count, procedures performed, billing information, and payment methods. All records were meticulously organized in Microsoft Excel to ensure accuracy and consistency, providing a solid foundation for further analysis. During this phase, data cleaning was performed to handle any inconsistencies or missing values.

2. **Data Preprocessing and Statistical Analysis**: After arranging the data, a statistical analysis was conducted to explore its distribution and key characteristics. Important metrics such as the mean, median, mode, standard deviation, range, minimum, maximum, sum, and count were calculated for variables like patient count and revenue. This process provided a detailed snapshot of hospital operations, revealing critical insights about performance and operational trends, which were instrumental in decision-making.

3. **Formulation of Strategic Decisions**: Insights from the statistical analysis led to the formulation of key strategies aimed at improving hospital efficiency. These strategies focused on assessing the impact of payment methods (self-paid, insurance, and government benefit) on cash flow, optimizing resource allocation among doctors and departments, and improving capacity planning based on patient influx patterns. The main objective was to enhance patient care, increase revenue, and promote sustainable growth.

4. **Data Visualization**: To make the data insights more accessible, various visual representations such as pie charts, bar graphs, and line charts were created. These visuals depicted the hospital's cash flow based on different payment methods, the workload distribution across doctors and departments, and monthly patient inflow trends. The visualizations helped simplify the complex data, making it easier to interpret and communicate findings to stakeholders, supporting data-driven decision-making.

5. **Strategic Planning and Implementation**: Based on the insights from the analysis and visualizations, strategic actions were planned to improve hospital services, manage peak patient influx, and enhance resource utilization. These strategies included optimizing resource allocation, improving operational efficiency, and better managing workloads. The visual data helped in identifying key areas for intervention and guided the planning process effectively.

6. **Formulas Used:** In this report, the following formulas were used for analysis and deriving key insights. These formulas are relevant for the metrics being studied:

- **Total Revenue**:

$$\text{Total Revenue} = \sum \text{Revenue from each payment method}$$

This includes self-payments, insurance, and government payments.

- **Doctor's Workload**:

$$\text{Workload} = \frac{\text{Total Procedures}}{\text{Number of Weeks}} \times \frac{1}{\text{Working Days per Week}}$$

This formula helps calculate how many procedures a doctor is handling on average per working day.

- **Percentage of Payments by Type (Cash vs Credit)**:

$$\text{Percentage of Payment Type} = \left(\frac{\text{Amount from Payment Type}}{\text{Total Amount Received}} \right) \times 100$$

This formula is used to calculate the proportion of total payments made via cash or credit.

- **Total Procedures by Department**

$$\text{Total Procedures by Department in Year} = \sum (\text{Procedures done by Department throughout the Year})$$

- **Capacity Utilization each month**:

$$\text{Capacity Usage for Month} = \sum (\text{Procedures by all Departments in Month})$$

- **Bed Occupancy Rate:**

$$\text{Occupancy Rate(\%)} = \frac{\text{Total Inpatient Days}}{\text{Available Bed Days}} \times 100$$

- **Days stayed by Patient:**

$$\text{Days Stayed by Patient} = \text{Discharge Date} - \text{Admission Date} + 1$$

- **Total Inpatient Days:**

$$\text{Total Inpatient Days} = \sum_{i=1}^{n} \text{Days Stayed by Patient}_i$$

- **Available Bed Days:**

$$\text{Available Bed Days} = \text{Number of Beds} \times \text{Number of Days in Period}$$

7. **SWOT ANALYSIS**

STRENGTHS

1. **Prominent Healthcare Provider in Sonipat**: Tulip Hospital is well-established in the Sonipat region, recognized for delivering comprehensive medical services, which positions it as a trusted healthcare provider.

2. **Commitment to High-Quality Patient Care**: The hospital has a strong focus on maintaining high standards of care, reflected in its state-of-the-art facilities and dedicated medical staff.

3. **Wide Range of Specialized Departments**: Tulip Hospital offers specialized services in various medical fields, including Cardiology, Orthopaedics, and Radiology, ensuring a broad service offering to the community.

4. **Diversified Payment Sources**: The hospital has a diversified revenue stream, receiving payments from private insurance, government insurance, and cash, which helps mitigate financial risks and ensures stable revenue

WEAKNESSES:

1. **Inconsistent Documentation Practices**: Variations in how procedures are documented create operational inefficiencies and inaccuracies in data collection. This limits the effectiveness of analysis and decision-making.

2. **Cash Flow Challenges**: The reliance on delayed insurance payments causes cash flow issues, which can affect the hospital's ability to procure essential supplies and manage day-to-day operations.

3. **Workload Imbalance Among Doctors**: Disparities in workload distribution lead to overburdening in certain departments (e.g., Cardiology, Orthopaedics), causing stress and potentially affecting care quality.

4. **Underutilized Data Potential**: While the project uses a wide range of data points, there may be further opportunities to leverage more advanced predictive analytics or machine learning techniques to gain deeper insights.

OPPORTUNITIES:

1. **Standardization of Processes**: Implementing standardized procedures for data entry and documentation could significantly improve data accuracy, operational efficiency, and overall performance.

2. **Improved Financial Management**: Adopting a more robust revenue cycle management system could address the cash flow challenges, ensuring quicker insurance reimbursements and better financial stability.

3. **Advanced Resource Allocation**: Leveraging the data on patient inflows and procedure volumes allows for more strategic resource allocation, ensuring that departments are adequately staffed and equipped during peak times.

THREATS:

1. **Delays in Insurance Payments**: Continued delays in receiving payments from insurance providers could worsen cash flow issues, putting pressure on hospital operations and leading to potential service disruption.

2. **Staff Burnout**: Overworked staff in high-demand departments could lead to burnout, affecting staff retention and the quality of patient care.

3. **Unpredictable Healthcare Trends**: External factors like pandemics, regulatory changes, or shifts in healthcare demand could impact hospital operations and the applicability of the strategies outlined in this analysis.
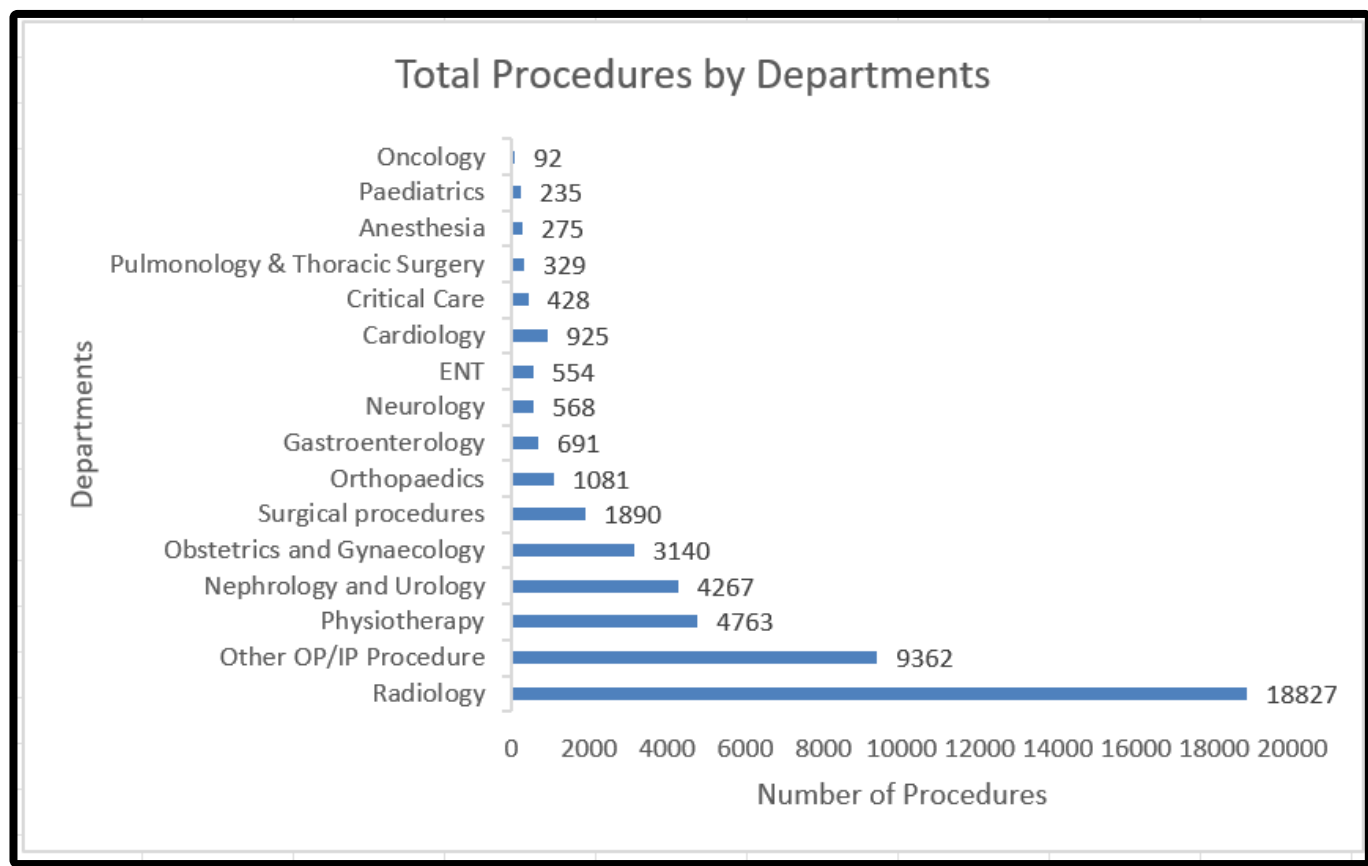
Results and Findings

Figure 1: Total Procedures done by all departments in a year

Description(Figure 1): This bar chart provides a breakdown of the total number of procedures conducted across various departments within the hospital. It highlights which departments handle the most procedures.This graph shows us the departmental workload all over the year. Radiology leads significantly with 18827 procedures performed between April 2023 to March 2024, , followed by Other OP/IP Procedures which includes procedures like dressing , bandaging,cleaning of wounds etc.. which cannot be classified under any one department and then Physiotherapy with 4763 procedures performed. The data helps in identifying key operational areas and the distribution of workload among departments.
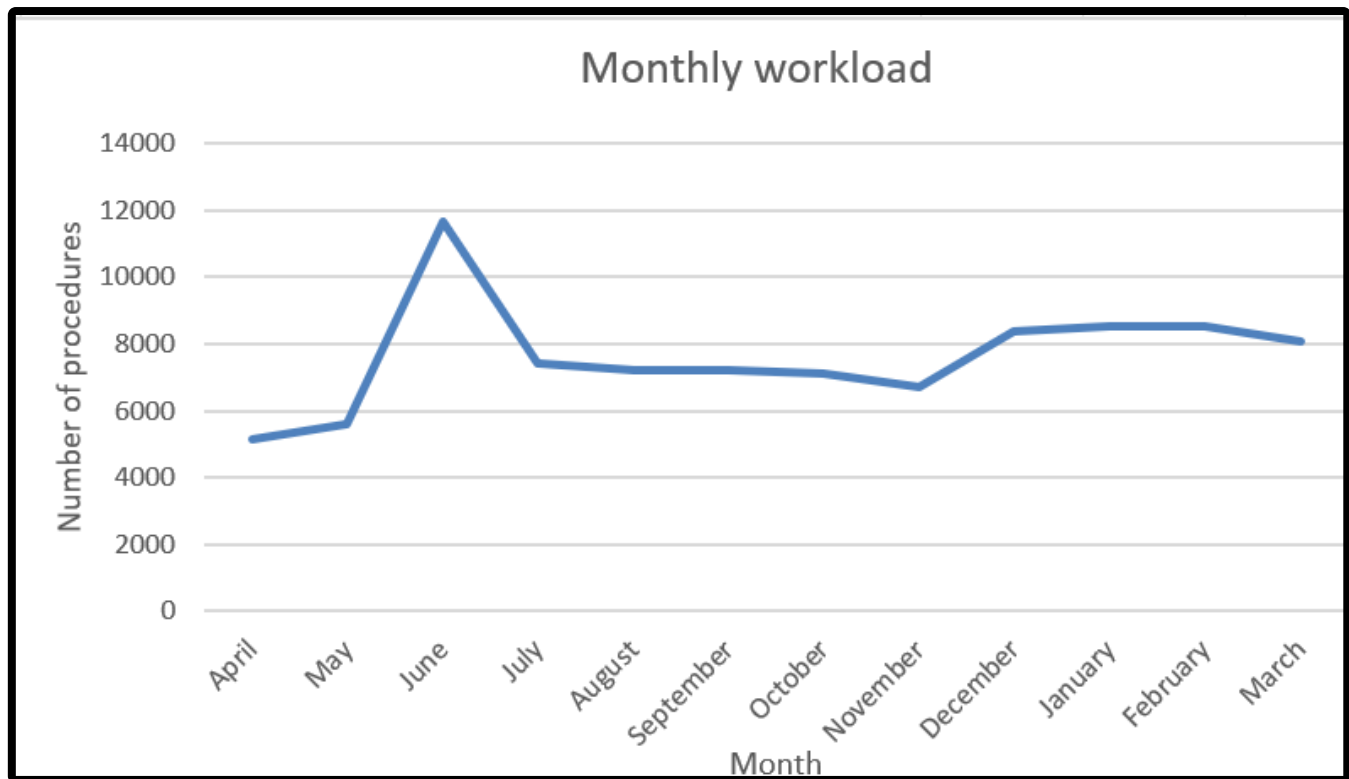

Figure 2:Total Procedures done by the hospital each month

Description(Figure 2): The line chart shows the monthly trend of the total number of procedures performed in the hospital. A significant peak is observed in June, followed by a decline, with the workload stabilizing around 7,000 to 8,000 procedures per month from July onward. This trend can be used for resource planning and understanding seasonal variations in hospital activity.
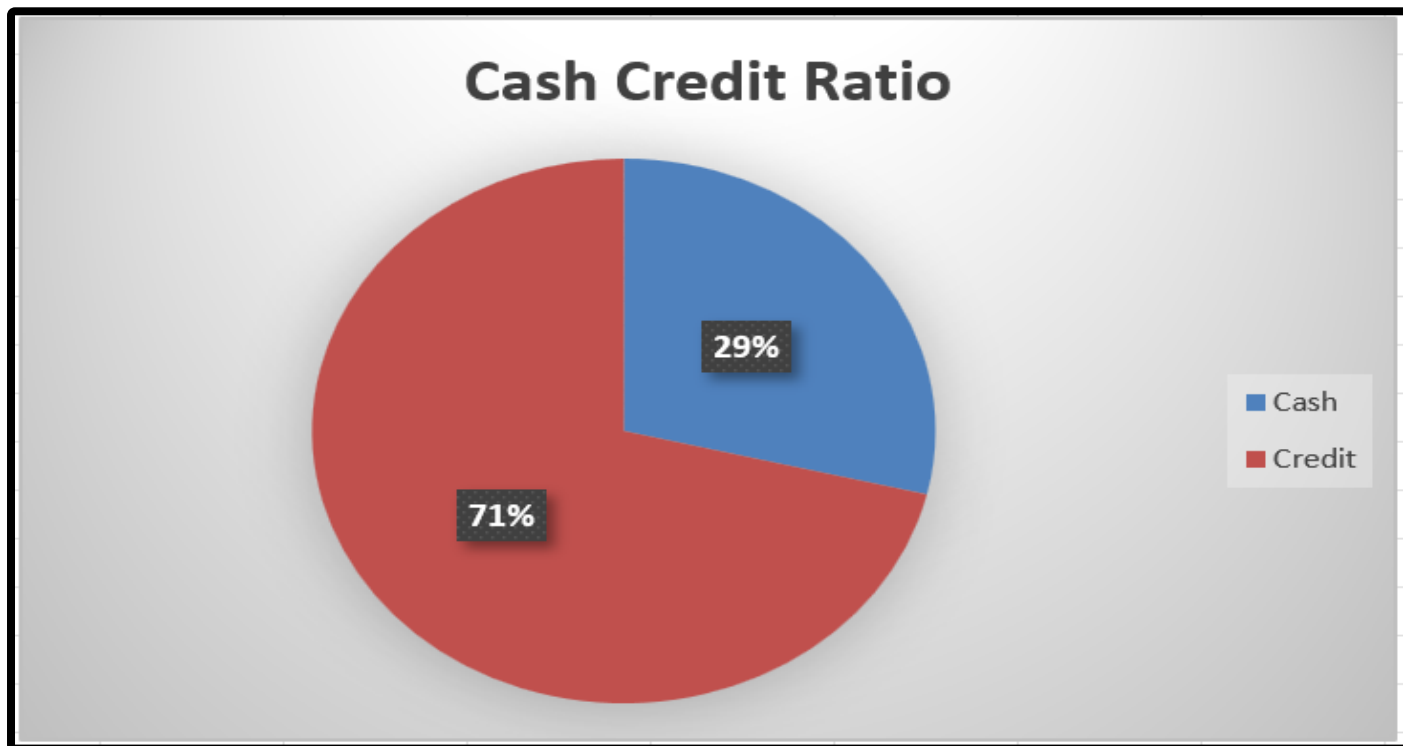
Figure 3:Percentage of payments received by hospital in the form of cash and credit

Description(Figure 3): This pie chart illustrates the proportion of procedures paid for via cash versus credit. The chart reveals that a majority of payments (71%) are made on credit, while 29% are settled in cash. This information is vital for financial planning and understanding the hospital's cash flow dynamics.
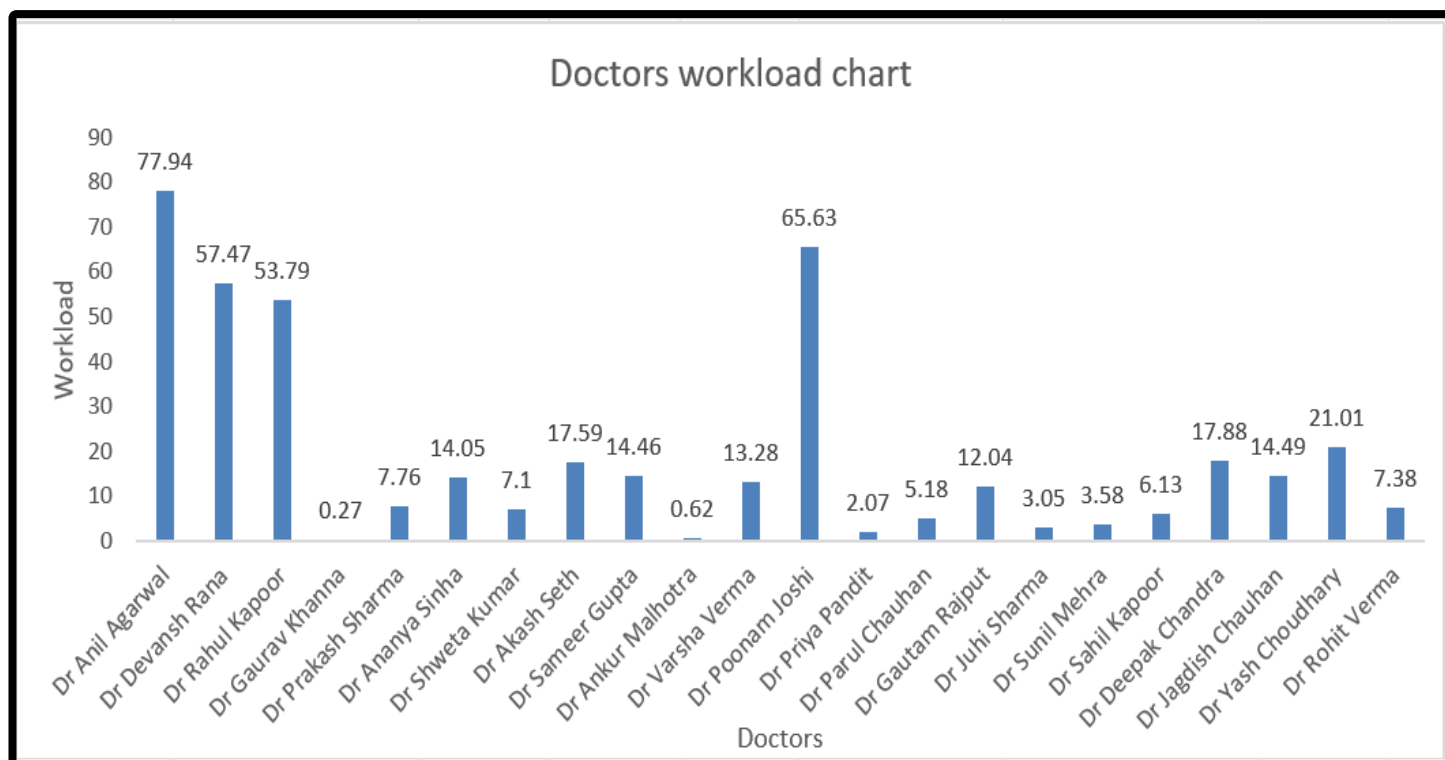

Figure 4:Workload of doctors

Description(Figure 4): This chart illustrates the workload of various doctors within the organization, calculated by dividing the total number of procedures attributed to each doctor over the course of a year by the number of weeks and further by the number of working days for each doctor per week. Dr. Anil Agarwal shows the highest average workload at 77.94, followed by Dr. Priya Pandit at 65.63.

While this chart provides insight into workload distribution, it also highlights the need for a closer review of procedure attribution. The figures suggest that some doctors may be assigned an unusually high number of procedures per day, which could be an indication of discrepancies in how procedures are attributed. Ensuring accurate and fair distribution of procedures is essential for maintaining balanced workloads and supporting the medical staff effectively.
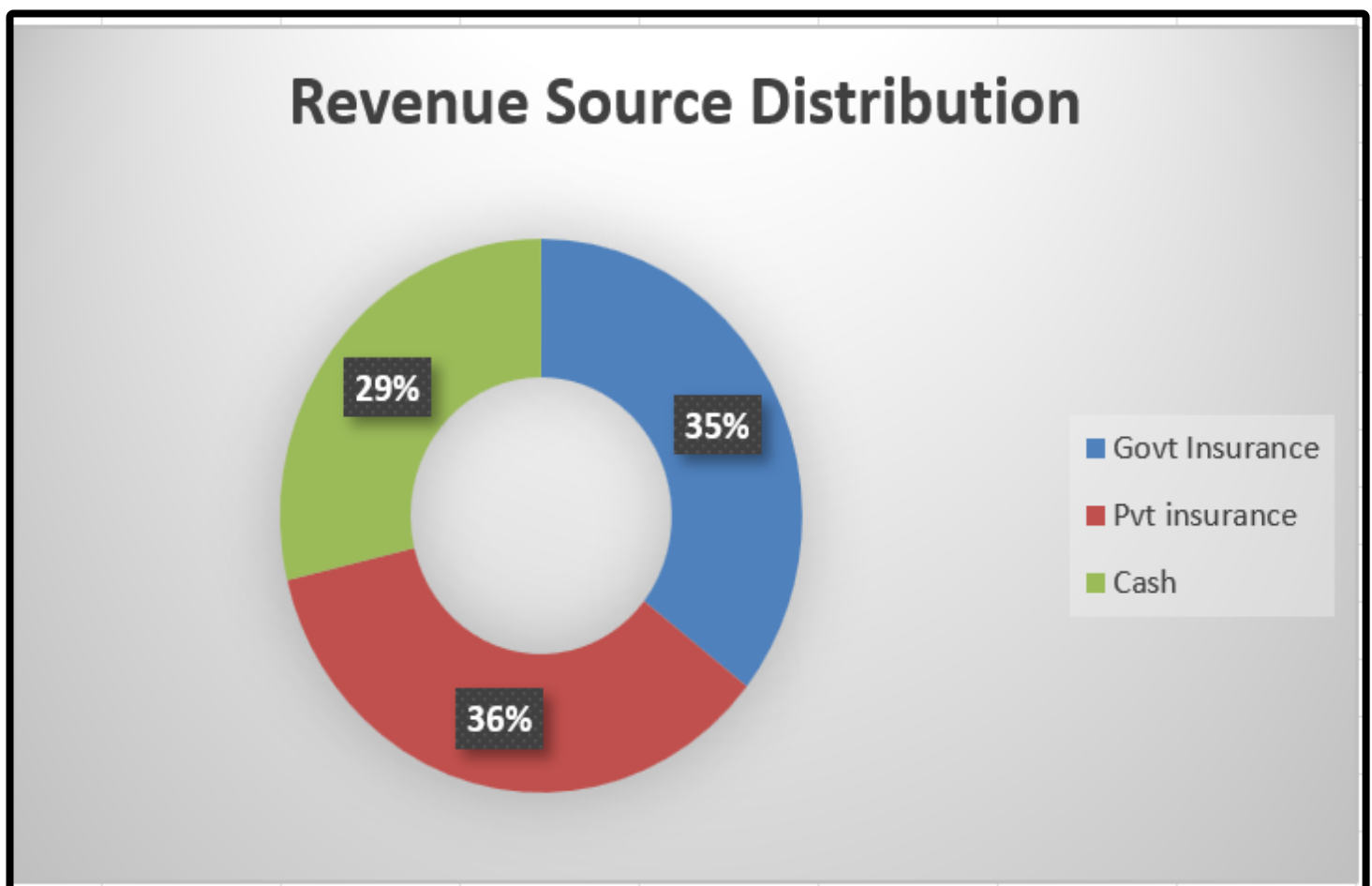
Figure 5:Percentage of amount received by hospital through various sources

Description(Figure 5): This chart illustrates the distribution of revenue across three major sources: Government Insurance, Private Insurance, and Cash. It shows that 36% of the revenue comes from Private Insurance, 35% from Government Insurance, and 29% from Cash payments. This breakdown provides insight into the financial structure and reliance on different payment methods within the organization.

1. **Government Insurance**: This refers to health coverage provided by the government, either at the national or regional level. In India, examples include schemes like Ayushman Bharat or Employees' State Insurance (ESI), which provide low-cost or free healthcare services to eligible citizens, such as low-income groups or government employees.

2. **Private Insurance**: Private insurance is coverage provided by private companies where individuals or employers pay premiums in exchange for healthcare coverage. These plans often offer a wider range of services and quicker access to care compared to government schemes, but the cost can be higher.

3. **Cash**: This payment method involves patients paying out-of-pocket for medical services without any form of insurance coverage. It is typically the most direct form of payment, where patients bear the entire cost of treatments, consultations, and procedures themselves at the time of service.
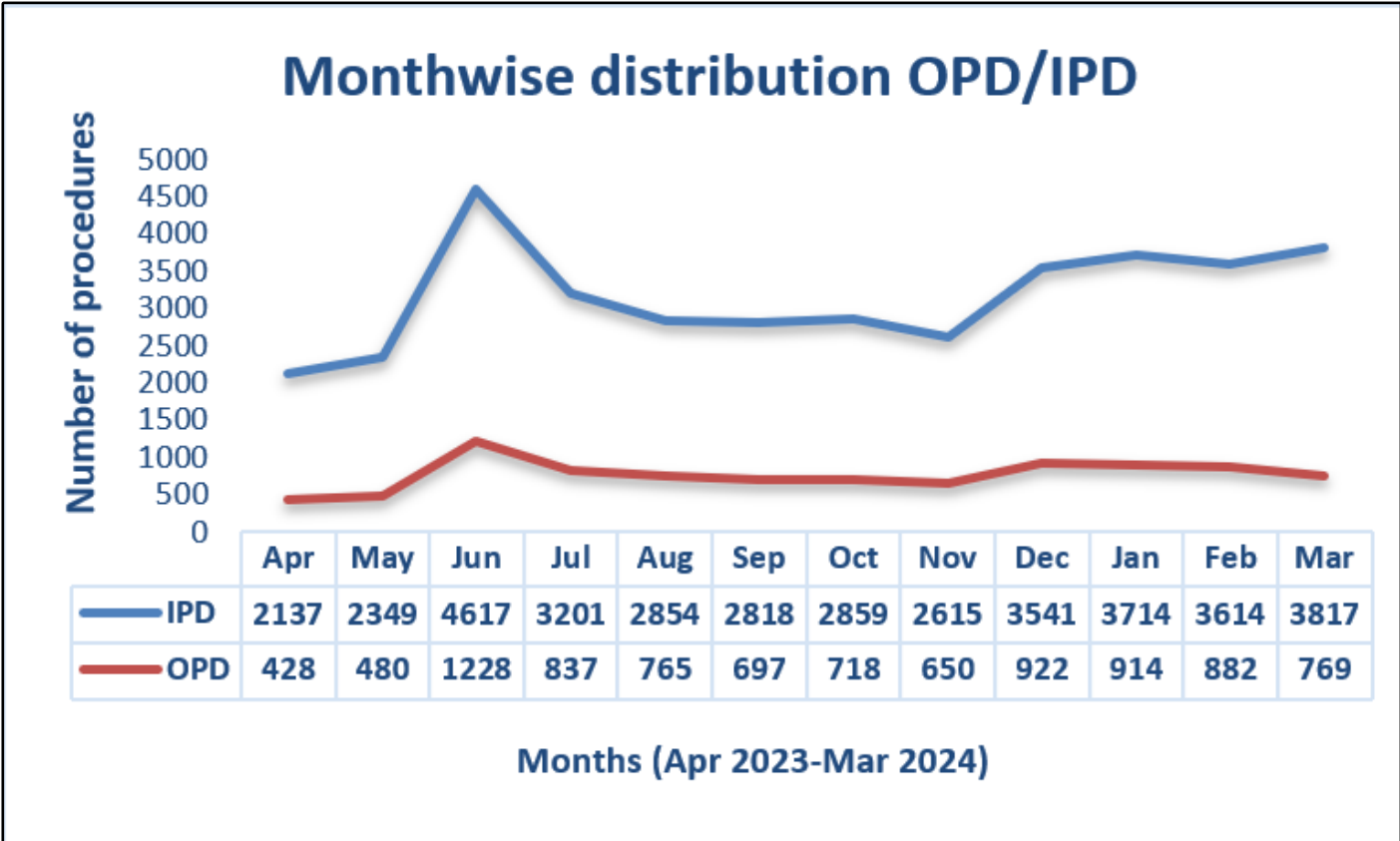

Monthwise distribution OPD/IPD

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
IPD	2137	2349	4617	3201	2854	2818	2859	2615	3541	3714	3614	3817
OPD	428	480	1228	837	765	697	718	650	922	914	882	769

Months (Apr 2023-Mar 2024)

Figure 6: Monthwise Distribution of Procedures done on OPD and IPD patients

Description(Figure 6) This line graph presents the month-by-month distribution of outpatient (OPD) and inpatient (IPD) procedures from April 2023 to March 2024. IPD procedures, represented by the blue line, consistently dominate, peaking in June with 4,617 procedures. In contrast, OPD procedures, represented

by the red line, remain lower, with a maximum of 1,228 procedures in June. The graph helps visualize trends in hospital activity across both OPD and IPD, revealing seasonal variations in patient inflow.

OPD (Outpatient Department) refers to the section of a hospital where patients receive medical consultations, treatments, or diagnostic services without being admitted for an overnight stay. These services include check-ups, minor procedures, and routine care.

IPD (Inpatient Department), on the other hand, involves patients being admitted to the hospital for treatment or observation. They stay in the hospital for one or more nights, undergoing more intensive care, surgeries, or treatments that require continuous monitoring or extended medical attention.

In essence, OPD is for patients who visit and leave the same day, while IPD is for those requiring longer-term care and hospitalization.
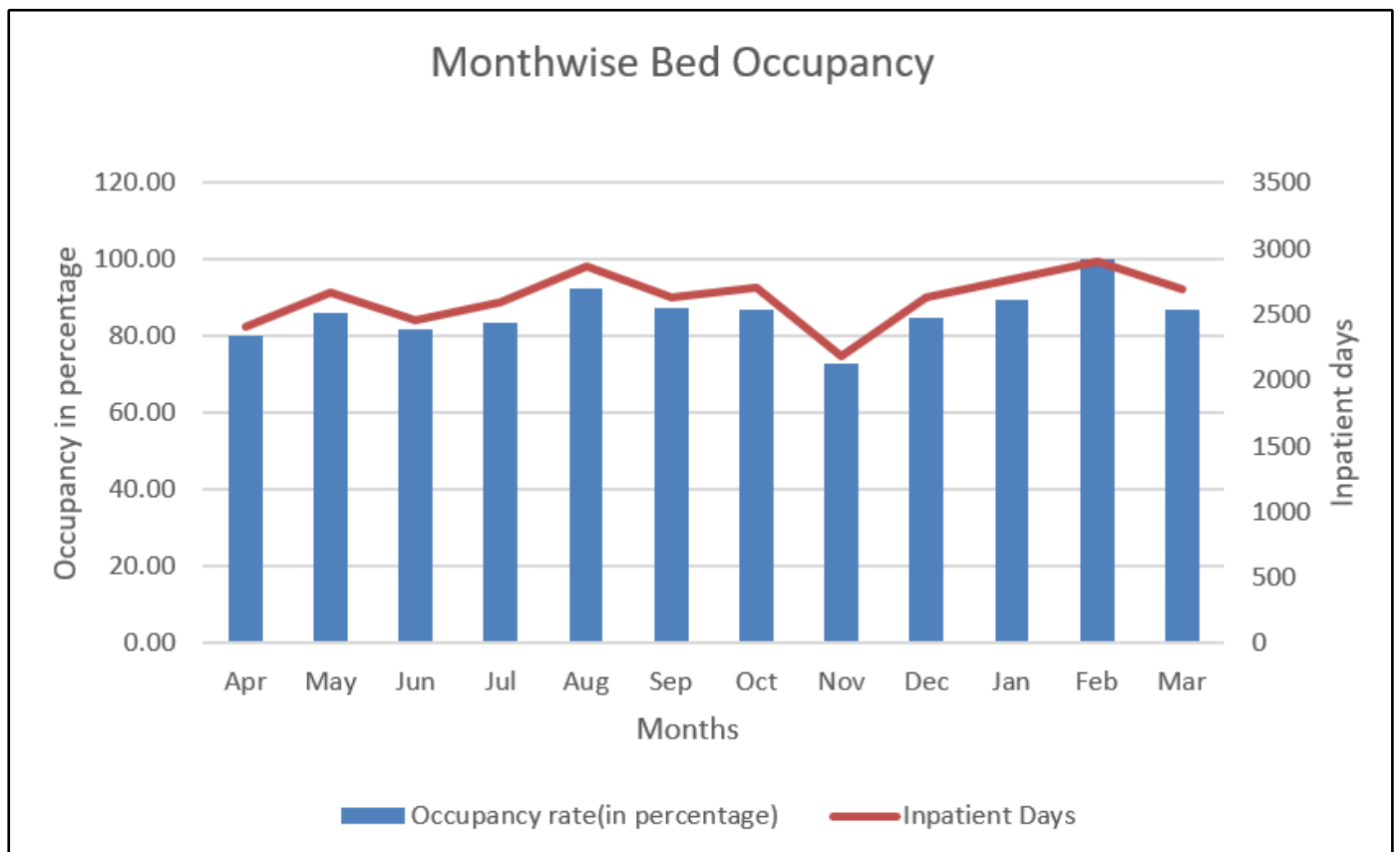

Figure 7: Monthwise Bed Occupancy of Inpatients and Occupancy Rate

Description(Figure 7) This graph illustrates the hospital's bed occupancy rates and inpatient days on a monthly basis. The blue bars represent the occupancy rate percentage, which consistently hovers around 80% or higher, peaking in February 100.12 %. The red line represents inpatient days, with a notable peak

in February. This data emphasizes the hospital's capacity utilization and inpatient load throughout the year.

- **Inpatient Days**: This refers to the total number of days that all admitted patients spend in the hospital over a specific period. Each day that a patient stays in the hospital counts as one inpatient day. It helps measure the hospital's workload and is used to assess hospital utilization. For example, if a hospital has 10 patients who each stay for 5 days, that results in 50 inpatient days.
- **Occupancy Rate**: The occupancy rate is the percentage of hospital beds that are occupied by patients at any given time. It is calculated by dividing the total number of inpatient days by the total number of available bed days (the number of beds multiplied by the days in a period) and then multiplying by 100 to get a percentage. A higher occupancy rate indicates that more hospital beds are being used, while a lower rate suggests less utilization. For example, if a hospital has 100 beds and 90 are occupied, the occupancy rate is 90%.
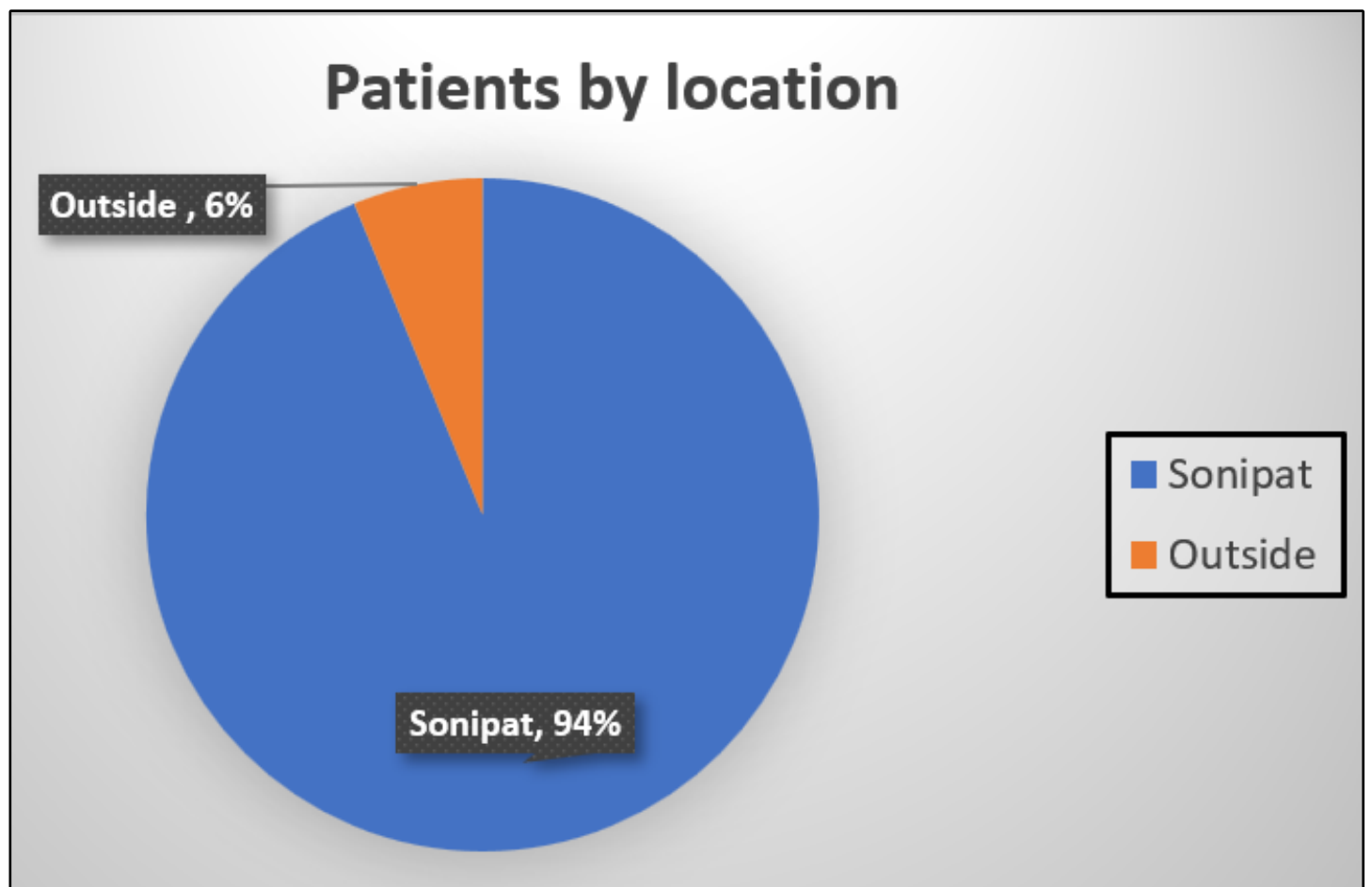

Figure 8: Percentage of local patients and patients from outside Sonipat

Description(Figure 8) This pie chart displays the proportion of patients based on their location. It highlights that 94% of patients come from Sonipat, while 6% come from outside the city. This data indicates that the hospital primarily serves the local population, with a smaller percentage of patients coming from external areas.

Outside refers to patients coming from areas outside of Sonipat, which may include nearby towns, districts, or even neighboring states.

Interpretation of results

The comprehensive analysis of hospital data from Sonipat yielded several pivotal insights, each critical for enhancing operational efficiency, financial management, and patient care.

Total Procedures by Departments

Interpretation(figure 1): The distribution of procedures across departments shows significant variation, indicating an imbalance in workload. Radiology performed the highest number of procedures (18,827), which highlights its central role in hospital operations.Other OP/IP Procedures includes all procedures that cannot be attributed to a particular department like dressing,bandaging etc. In contrast, departments such as Oncology (92 procedures) and Paediatrics (235 procedures) handled fewer cases, reflecting lower patient . The data suggests that resources in departments like Radiology, Other OP/IP Procedures (9,362), and Physiotherapy (4,763) need to be optimized to manage the high demand effectively.

Monthly Workload

Interpretation(figure 2): The monthly workload graph shows the number of procedures from April to March.There is a steady increase in workload from April to June, peaking in June with approximately 12,000 procedures.After June, there is a significant drop in procedures by July, falling to around 7,000.The workload remains relatively stable from July to December, fluctuating between 6,000 and 8,000 procedures.There is a slight increase in activity in January and February, with numbers rising to around 7,000-8,000 procedures, before dropping slightly again in March.The data indicates that June experienced the highest workload, while there is relatively less activity for the remainder of the year, with a small recovery in the early months of the following year.

Cash Credit Ratio

Interpretation(figure 3): The Cash Credit Ratio is represented as a pie chart.71% of the total transactions or amounts are handled through credit.Credit here means the payments that are covered by insurances or employee benefit schemes.29% of the total transactions or amounts are handled through cash.This clearly indicates that in the hospital significantly larger proportion of the transactions are processed via credit compared to cash, showing a strong preference for credit transactions.

Doctors Workload

Interpretation(figure 4): The workload distribution among doctors is highly uneven. Dr. Anil Agarwal, Dr. Devansh Rana, and Dr. Priya Pandit have the highest workloads, with Dr. Anil Agarwal handling 77.94 procedures on average in a day . followed by Dr. Priya Pandit (65.63 procedures per day). On the other hand, doctors like Dr. Shweta Kumar (7.76 procedures per day) and Dr. Parul Chauhan (2.07 procedures per day) are significantly underutilized. The uneven workload suggests a need for rebalancing patient assignments or departmental responsibilities to improve operational efficiency and avoid overburdening key personnel.

Revenue Source Distribution

Interpretation(Figure 5): The revenue distribution is relatively balanced among the three sources: government insurance (35%), private insurance (36%), and cash payments (29%). However, the reliance on insurance payments makes up 71% of the revenue .This shows that the hospitals primary mode of revenue is insurance payments both private and government and Cash payments make up a relatively small portion of the hospital's revenue

Monthwise Distribution of OPD/IPD Procedures

Interpretation(figure 6): The line graph reveals that IPD procedures are consistently higher than OPD procedures throughout the year. IPD peaks in June (4,617 procedures) and declines after that, with a relatively steady trend from August to March., on the other hand, OPD shows much lower numbers, peaking in June (1,228 procedures) and maintaining a fairly consistent level with a slight decline towards the end of the year. This suggests that inpatient services dominate hospital operations, while outpatient services remain stable but comparatively lower.

Monthwise Bed Occupancy

Interpretation(figure 7): The bed occupancy graph shows that the occupancy rate remains consistently high, generally around or above 86%, with a peak of 100.12% in February. This suggests that the hospital

is operating at high occupancy throughout the year as 80% occupancy is high as compared to the Indian average as The average occupancy rate for hospitals in India is expected to be between 63–65% in 2024 .Inpatient days shows a notable peak in February and a dip can be seen during the month of November

Patients by Location

Interpretation(figure 8): The pie chart shows that 94% of patients are from Sonipat, with only 6% coming from outside. This indicates that the hospital predominantly serves the local population, with minimal reliance on patients from external regions.

RECOMMENDATIONS

After observing Workload of doctors(figure 4), it was observed that Dr. Anil Agarwal handled 77.94 procedures on average in a day followed by Dr. Priya Pandit (65.63 procedures per day) whereas some doctors like Dr. Shweta Kumar (7.76 procedures per day) and Dr. Parul Chauhan (2.07 procedures per day) performed significantly less procedures.This uneven distribution of workload was found out to be due to the fact that all procedures are attributed to the doctors without taking into consideration whether the doctor referred the patient for a procedure , performed the procedure himself/herself or assisted another doctor during the procedure.Hence the attribution of procedures has to be standardized.

To **improve the data entry process** for documenting procedures in the hospital, it is recommended to establish a clear and standardized framework for recording each doctor's contribution. This can be achieved by implementing a structured data entry form that includes designated fields for identifying the primary doctor, as well as secondary and tertiary contributors. Each role should be explicitly defined, with guidelines for capturing specific tasks performed by each doctor during the procedure. Additionally, incorporating a drop-down menu or checklist for common procedures can streamline the entry process, making it easier for staff to accurately document contributions.

Standardization Guidelines for Doctor Attribution

Primary Doctor:

Definition: The lead physician responsible for the procedure.

Responsibilities:

- Performs the majority of the surgical tasks or interventions.
- Makes critical clinical decisions during the procedure.

- Oversees pre-operative assessments and post-operative management.

Examples of tasks:

- Leading the surgical team during the procedure.

- Performing the main surgical intervention (e.g., resecting a tumor).

Secondary Doctor:

Definition: The assisting physician who supports the primary doctor.

Responsibilities:

- Assists with specific tasks during the procedure.

- Provides support in technical aspects and patient management.

Examples of tasks:

- Assisting in suturing or closing incisions.

- Monitoring the patient's vital signs during the procedure.

Tertiary Doctor:

Definition: A consultant or specialist who provides expertise but is not directly involved in the procedure.

Responsibilities:

- Offers specialized knowledge relevant to the procedure.

- Consults on specific clinical decisions or aspects of patient care.

Examples of tasks:

- Advising on imaging techniques or results.

- Providing insights on complex cases related to their specialty.

Referring Doctor:

Definition: The doctor who refers the patient to another department or refers the patient for a procedure.

While attributing procedures to various departments to find out the workload of all departments in the hospital (as seen in Figure 1) It was observed that procedure names were not entered in a standardized manner for example the procedure "Coronary Angioplasty" was recorded as "coronary angioplasty," "Coronary Angio," or "C.A." which made it difficult to work on the data.Thus, standardizing the naming conventions for procedures is crucial. This includes creating a comprehensive list of procedure names with consistent formatting—ensuring that names are recorded in a uniform style and avoiding abbreviations or short forms unless they are widely recognized.

Additionally it was observed that 94% of patients in Tulip hospital were from Sonipat itself and the rest 6% were from various places like Delhi ,Uttarakhand, Uttar Pradesh etc.After visiting the hospital it was observed that even in the cases when patients were from outside Sonipat but were residing with a family member or a friend in Sonipat itself were recorded as patients from Sonipat hence more attention should be paid to where the patients are from to accurately observe the Percentage of local patients visiting the hospital.

Regular training sessions for staff on these standards and the importance of precise attribution will enhance the quality of data collected. By fostering a culture of accountability and clarity in data entry, the hospital can ensure accurate representation of each doctor's involvement and improve the overall integrity of its data management system, ultimately leading to better performance evaluation and resource allocation.

Suggestions for tackling liquidity challenges

Enhance Credit Collection Processes: Since 71% of the hospital's transactions are handled through credit (primarily insurance payments), ensuring timely collections from both government and private insurance is crucial. Delayed payments from insurance providers can exacerbate liquidity issues. The hospital should:

- Implement stricter follow-up processes for pending insurance claims.
- Negotiate faster payment terms with both government and private insurers.

Diversify Payment Methods for Cash Transactions: While cash payments constitute 29% of the total, the hospital could encourage more timely cash payments by:

- Offering discounts for immediate cash or digital payments.
- Implementing an installment plan for patients who cannot pay in full upfront, helping ensure steady cash flow.

Insurance Payment Optimization: Since insurance payments make up 71% of the hospital's revenue, reliance on these payments requires proactive management:

- Review insurance coverage agreements to ensure they are financially beneficial and that reimbursement rates are optimal for the services provided.

- Explore new insurance partnerships or expand existing ones to reduce the risk of revenue delays from a single provider.
- Track and analyze insurance payment delays to identify bottlenecks in claim approvals.

Focus on Cash Flow Management: Given that liquidity is a challenge, the hospital should:

- Maintain a buffer fund from cash transactions to cover short-term expenses, ensuring that liquidity does not depend solely on insurance payments.
- Analyze the timing of cash payments (e.g., daily, weekly) to predict and optimize cash flow cycles more efficiently.

Increase Patient Volume for Cash Payments: Since cash payments account for 29% of the revenue, attracting more cash-paying patients can boost liquidity. The hospital could:

- Run targeted campaigns offering affordable care packages for non-insured patients.
- Partner with employers for direct care agreements outside insurance, where companies pay cash for employee healthcare services.

Suggestions to manage seasonal influx of patients

As observed from the monthwise bed occupancy (figure 7) it can be observed that from April 2023 to March 2024 the hospital has operated consistently on 80% or greater occupancy with peak occupancy in February slightly over 100% ,thus to manage the high amount of patient influx especially during the Peak months for procedures , June(as seen in figure 2) , the peak months for bed occupancy, February (as seen in figure 7) and Peak months for overall OPD and IPD procedures , June(as seen in figure 6) the hospital should consider taking the following measures:-

Expand Temporary Bed Capacity During Peak Months:
- Since bed occupancy exceeds 100% during peak months, the hospital should explore adding temporary beds, in February,to accommodate the patient influx.
- Convert underutilized spaces (like recovery rooms, meeting rooms) into temporary patient care areas during peak times

Optimize Procedure Scheduling:
- With June being the peak month for overall OPD and IPD procedures, the hospital can implement a dynamic scheduling system to better distribute non-emergency procedures to non-peak months.

- Offer incentives or discounts to patients who are willing to schedule elective surgeries or procedures during less busy periods, reducing strain during peak months.

Increase Staffing Levels During Peak Months:
- To handle the surge in patient volume, the hospital should hire temporary or part-time staff (nurses, doctors, support staff) during February and June when occupancy and procedures peak.
- Provide cross-training to existing staff so they can support multiple departments (e.g., OPD and IPD) during high-influx periods.

Improve Discharge Processes:

- Since February and June see peak bed occupancy, speeding up discharge processes can free up beds more quickly. This may include:
- Establishing a fast-track discharge process for patients with simpler cases.
- Enhancing coordination between departments (doctors, nurses, billing) to minimize delays in discharge.

Enhance Patient Flow Management for OPD and IPD:
- Since OPD and IPD procedures peak in June, the hospital can optimize patient flow by:
- Implementing digital appointment scheduling with staggered timings to reduce crowding.
- Expanding operating hours for the OPD, allowing patients to come in earlier or later in the day.
- Introducing telemedicine options for follow-up visits to reduce the in-person patient load during peak times.