

**A STUDY ON FACTORS AFFECTING THE CATH LAB
SCHEDULING PROCESS USING DMAIC APPROACH IN
THE MISSION HOSPITAL, DURGAPUR**

Dissertation Submitted to



The IIHMR University, Jaipur

for the partial fulfilment for the award of

the degree of Master of Business Administration (MBA)

in

Hospital and Health Management by

Alka Rai

Under the Supervision and Guidance of

Dr. Vinod Kumar SV

Professor & Dean In-Charge

SD Gupta School of Public Health

IIHMR University, Jaipur

2023

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled “A Study on factors affecting the Cath Lab scheduling process using DMAIC Approach in the Mission Hospital, Durgapur” is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

(Signature)

Alka Rai

MBA Hospital and Health Management

2021-23



Ref: TMH/HRD/Per.F/May-23/123

Date-31.05.2023

TO WHOM IT MAY CONCERN

This is to certify that Ms. Alka Rai student of M.B.A in Hospital & Healthcare Management at IIHMR University, Jaipur, has undergone Dissertation Program in the department of Quality Assurance at The Mission Hospital, Durgapur from 01.03.2023 to 31.05.2023. Her topic for Dissertation was "A Study On Cath Lab Scheduling Process using DMAIC Approach".

During the period of dissertation she has been found sincere.

We wish her all the very best for her future endeavors.

For The Mission Hospital, Durgapur

Ramesh Lall
President- HR & Admin.

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Certificate from Faculty Guide and School Dean

CERTIFICATE

This is to certify that dissertation titled “A Study on factors affecting the Cath Lab scheduling process using DMAIC Approach in the Mission Hospital, Durgapur” is a record of the research work undertaken by **Alka Rai** in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management from the IIHMR University, Jaipur under my guidance and supervision and his approach to the research study has been sincere, scientific, and analytical.

Dr Vinod Kumar SV

IIHMR University, Jaipur

Date:

Dr (Col) Mahender Kumar

IIHMR University, Jaipur

Date:

Abstract

Background: “Cath lab scheduling is a critical component of healthcare facilities that provide cardiac care services. Catheterization labs (Cath labs) are specialized diagnostic and treatment facilities for patients with heart conditions. These facilities offer a wide range of services. Efficient scheduling of these procedures is essential to ensure patient safety, optimize resources, and minimize wait times”.

Objective: “The main objective of this study was to understand the process of appointments and scheduling of cases in the cardiac Cath labs. To identify the problems faced by Cath Labs in scheduling of cases and to propose solutions for better scheduling process”.

Materials and Methods: “This study is a cross-sectional observational study. The research work was conducted at the Mission Hospital, Durgapur (a unit of Durgapur Medical Centre Pvt. Ltd.), a state-of-the-art super specialty hospital located in Durgapur, West Bengal. DMAIC/Fishbone/Pareto, and a structured format were used to collect data on patient demographics, appointment scheduling, wait times, and outcomes”.

Results:

“Patients’ waiting time was non-consistent, which completely depends on the doctors’ availability. Doctors were arriving late than the scheduled time due to that there is delay in the start of the first case of scheduled cases. Less no. of scheduled cases in adds to the one of the factors for the non-productive in Cath lab. Due to the unavailability of beds in the wards, or ICU, patients had to wait in the post-Cath area for longer duration.

Conclusion:

“Scheduling of cases contributes to improving the operational efficiency of the hospital and also ensures timely care to patients with minimal waiting time. Hence it is important that the staff are supported with the right tool to make efficient schedules”.

Key Words: Cath lab, Schedules, patients

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“Firstly, I extend my heartfelt appreciation to Mission Hospital located in Durgapur, West Bengal, for providing me with the opportunity to undertake my internship with them. A special mention goes out to Dr. Partha Pal, the Medical Director of Mission Hospital, for his unwavering support and guidance throughout my internship”.

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“Last but certainly not least, I would like to express my sincere appreciation to my IIHMR faculty mentor, Dr. Vinod Kumar SV, who has been instrumental in guiding and motivating me throughout my dissertation journey”.

Once again, thank you to all the aforementioned individuals and organizations for their contribution towards the successful completion of my dissertation.

Sincerely,

Alka Rai

Batch 26th

IIHMR University

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List Of Abbreviations

- CATH LAB: -CARDIAC CATHETERIZATION LABORATORY
- CTVS: -CARDIOTHORACIC & VASCULAR SURGERY
- CSSD: -CENTRAL STERILE SUPPLY DEPARTMENT
- CCU: - CRITICAL CARE UNIT
- ECG: - ELECTROCARDIOGRAM
- EEG: - ELECTROENCEPHALOGRAM
- EMG: -ELECTROMYOGRAPHY
- HDU: -HIGH DEPENDANCY UNIT
- HEPA: -HIGH-EFFICIENCY PARTICULATE AIR
- ITU: -INTENSIVE TREATMENT UNIT
- MRI: -MAGNETIC RESONANCE IMAGING
- PFT: -PULMONARY FUNCTION TEST
- TMT: -TREADMILL TEST

Chapter 1

1.1 INTRODUCTION:

Cath labs are an important part of treating heart conditions. A physician may refer a patient to a Cath lab for the purpose of diagnosing and healing coronary artery disease, myocardial infarction, chest discomfort and also heart failure, pulmonary hypertension, and even pulmonary embolisms, also known as blood clots. Interventional cardiologists collaborate with a team of nurses, procedural X-ray technicians, and other support staff in the Cath lab to rapidly assess cardiovascular conditions and treat blockages and other issues in the arteries.



LAB -1



Lab-2

Three things to complete prior to going for a Cath lab procedure:

- i. Provide records of allergy and current drug to healthcare staff. Certain drug may need to be discontinued one week prior to the procedure.
- ii. Adhere to any instructions regarding abstaining from food or drink before the case to be performed..
- iii. A family member should be there to help.

A visit to the Cath lab for medical purposes can help in preventing more invasive or costly treatments in the future. The Cath lab's minimally invasive technique can provide doctors with valuable information on managing existing heart conditions and preventing new ones from developing.

Preventive Measures: -

Training individuals for cardiac emergencies, for acute coronary syndromes, such as severe bradycardia, is an effective preventive measure for identifying early heart disease. Despite the increase in cardiovascular disorders like ptca.

1.2 Protocols of Cath Lab: -

Doctors and anesthesiologists adhere to following protocols:

- Wearing gloves and a hair cap.
- Practicing proper hand hygiene.
- Wearing masks that cover their lower face.
- Wearing glasses, including colored glasses with different lasers. A fiber-optic headlight is also attached for better visibility.
- Wearing gowns that do not go than six inches to the ground.
- Using proper storage containers.
- Wearing long pants and shoes that completely cover the top of the foot at all times.

Why would a patient be sent to a Cath lab by their care team?

CL plays an important role in the treatment of heart diseases. Doctors may refer a patient to a CL for the diagnosis, treatment of artery disease, heart attack, chest pain, congestive heart failure, peripheral (limb) vascular disease, pulmonary hypertension, and even pulmonary embolisms, also known as blood clots.

1.2.1Cath Lab Scheduling: -

Ineffective scheduling can lead to extended waiting times and exacerbate patients' conditions, underscoring the need for effective scheduling to enhance hospitals' reputation and performance.

Another aim is to reduce Cath lab expenses, such as staffing and overtime costs, as hospitals have to allocate significant resources to meet patients' needs. Cath lab scheduling can be categorized.

Open scheduling is used by doctors to schedule the Cath lab cases by their convenience.

Block scheduling involves allocating specific time blocks to individual doctors or groups of doctors for several weeks or more, enabling them to organize their Cath lab procedures.

1.2.3AFFECT ON HOSPITAL DUE TO CATH LAB SCHEDULING: -

Imbalanced Schedule

» Surgeons arriving late.

High frequency of additional cases.

Shuffling of procedures.

Prolonged patient wait times.

Decreased motivation due to overtime pressure.

Last-minute cancellation of surgeries.

1.2.4 Elements of Schedule Planning

Equitable Allocation of Resources to Meet Case Demands.

Inconsistent availability of Cath labs.

Proper Management of Necessary Materials.

Precise Estimation of Procedure Duration.

Guidelines for Scheduling and Rescheduling Procedures.

1.2.5 Planning for Scheduling Policies –

Objectives of Scheduling

- Definitions of Scheduling
- Start Time of Schedule
- Time Required for Turnaround.

1.3 PROCEDURE PERFORMED IN CATH LAB: -

Diagnostic Procedure: -

Coronary Angiography

Peripheral Angiography

Renal Angiography

Digital Subtraction Angiography

Intra Vascular Ultrasonography

Fractional flow reserve

Cath Lab study

Electrophysiological Study

Head Up tilt test

Therapeutic Procedure: -

Carotid Angioplasty

Peripheral Angioplasty

Transcatheter Aortic Valve Implantation (TAVI)

Intra Vascular Lithotripsy (IVL)

Rotablation

Balloon Mitral Valvuloplasty (BMV)

Aortic Stenting

IVC filter

Percutaneous Trans Hepatic Biliary Drainage (PTBD)

Cardiac Resynchronization Therapy (CRT)

Lead Less pacemaker.

Pericardial Tapping

Radio Frequency Ablation (RFA)

Pulse Generator Replacement

HIS Bundle Pacemaker

Lead Less Pacemaker (MICRA)

Implantable Loop Recorder (ILR)

Coronary Chy moral Fistula Device Closure (CCF Device Closure)

Balloon Pulmonary Valvuloplasty (BAV)

Balloon Atrial Septostomy (BAS)

Coil Embolization

Right Ventricular Outflow Tract Stenting (RVOT Stenting)

Keratoplasty

Keratoplasty

1.3.1 Equipment's used in Cath lab: -

Defibrillator

ACT Machine

Tilt Table

IABP

UPS (120KVA)

Anesthesia Workstation

IVUS+FFR

Patient Monitor

Diathermy

Syringe Pump

Pressure Injector

ECHO

1.3.4 Traffic Flow: -

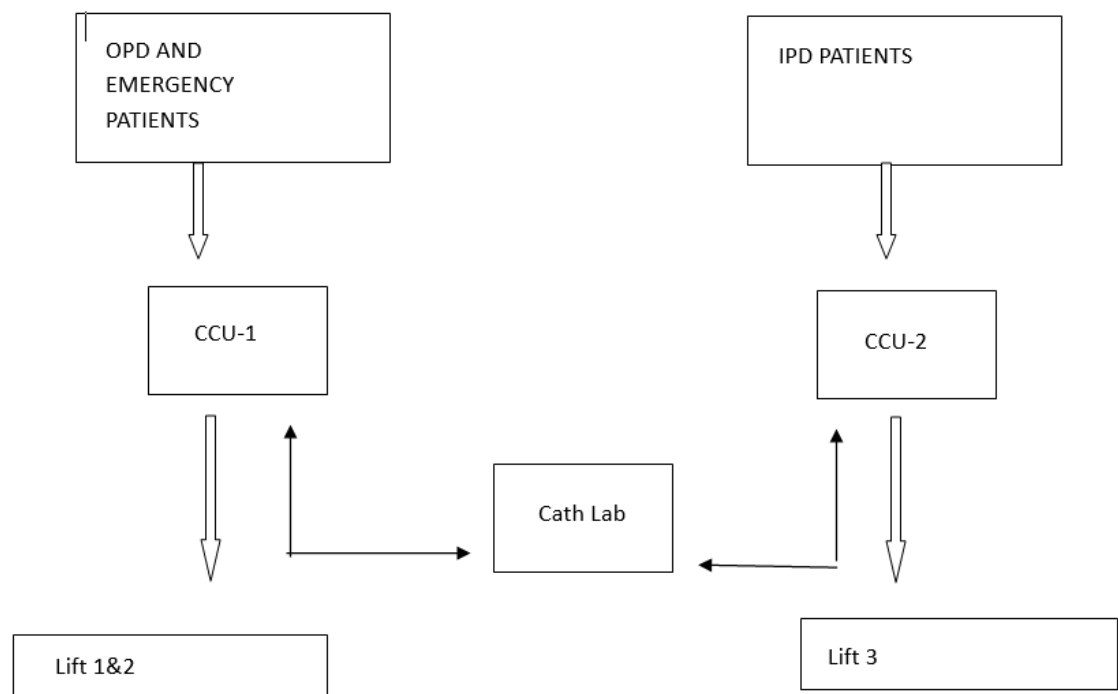


Figure 1.1: Traffic Flow

1.3.5 STANDARD PRECAUTIONS TO BE FOLLOWED IN CATH LAB:

- Technique for Hand Washing
- Protective Gear such as Gloves and Gowns
- Measures for Hair, Eye, and Face Protection
- Equipment Used for Patient Care
- Disposable Linen for Cath Lab Use, to be Discarded Promptly

- Health and Safety Measures for Blood Borne Pathogens, including Proper Handling of Sharp Instruments

- Needles, Syringes, Scalpel Blades, and Other Sharp Items to be Disposed of in Designated Puncture-Resistant Containers, with Containers Located Nearby

Cardiac Cath Lab Procedure:

Post-procedure care: Following the treatment, the patient will commonly have a follow-up consultation with their physician or cardiologist to review the outcomes of the procedure and create a plan for continued care and therapy.

Case cancellation: If there is a cancellation of cases, the nursing staff responsible will notify the doctors about the case, and the subsequent case will be taken prior to that.

Catheterization lab procedure: The patient is then escorted to the Cath Lab for the procedure.

Cath lab scheduling involves the allocation of time slots to doctors for the Cath lab. In the healthcare sector, whether in government or private hospitals, Cath lab scheduling plays a vital role in achieving organizational objectives. Therefore, an efficient scheduling system for the Cath lab must be established to enhance hospital performance and reputation.

1.3.6 OBJECTIVES OF THE STUDY

- i. To assess the factors affecting the Cath lab scheduling process by using DMAIC approach in The Mission Hospital, Durgapur
- ii. To improve the scheduling process of Cath lab in The Mission Hospital, Durgapur.
- iii. To identify the process flow of Cath lab in The Mission Hospital, Durgapur.

Chapter 2: REVIEW OF LITERATURE: -

Authors (Year)	Study Location	Sample Size	Sampling Techniques	Salient Features
Pieter S. et al. (2014)	Netherlands	6,135 procedures	Retrospective analysis	Statistical models can improve the accuracy of case duration estimates, which can help management make cost-effective use of expensive surgical resources. An appropriate match for electrophysiology (intervention) methods is the 3-parameter lognormal model. The 3-parameter lognormal model performs better than the 2-parameter lognormal model, which in turn performs better than the normal model, according to Friedman test statistics. Additionally useful for modeling Cath Lab procedures, lognormal models can help optimize the use of Cath Labs by helping to improve Cath Lab schedules.
Reed et al. (2018)	Austria	25,200 Total cases	Observational study	By adopting a systematic approach to quality improvement in the Cath lab, operational inefficiencies can be minimized, and workflow processes can be streamlined. Process

				improvements can lead to an increase in the percentage of cases starting on time, a decrease in room turnaround time, and an improvement in lab utilization.
Anandhi B. et al (2019)	India	NA	Descriptive study	This system (CLASS) was created by integrating two knowledge-based technologies, namely opportunistic planning and reason maintenance. CLASS offers two modes of operation, expert mode
Mohamed A. et al (2016)	The Netherlands	5,121 procedures	Retrospective study	Efficient scheduling of Cath Lab procedures is crucial as it maximizes the utilization of scarce resources and minimizes the risk of overused Cath Lab time or cancelled cases. Poorly scheduled cases may result in patient cancellations and extended hospital stays. Lognormal models are effective in modeling Cath Lab procedures, which can aid in scheduling and optimizing their usage.

Chapter 3: METHODOLOGY

3.1 RESEARCH QUESTION

- i. What are the factors affecting the Cath Lab Scheduling Process?
- ii. What measures should be taken to improve the Cath Lab Scheduling process?

STUDY DESIGN: Cross-sectional and observational study

STUDY LOCATION: The Mission Hospital, Durgapur

DURATION OF STUDY: Three s (From 1-03-2023 to 31-05-2023)

SAMPLE SIZE: All the patients admitted in Cath Lab during the study period with complete medical records between 8 AM to 8PM.

DATA COLLECTION: -

Sample Technique: - Convenient Sampling

inclusion Criteria: - patients admitted in Cath lab between 8 AM to 8 PM

Exclusion Criteria: - procedures after 8 PM

Primary Data: - Collection through observation

Secondary data: - By document Review

Statistical Tools: -Bar chart, MS Excel

- Quality Tool: -FISH-BONE Analysis/Pareto Chart/CAPA.

3.2 DMAIC APPROACH: -

This methodology widely used in the field of Six Sigma and process improvement. It can also be applied to various domains, including healthcare and specifically Cath lab scheduling.

Using the DMAIC approach for Cath lab scheduling enables healthcare providers to systematically identify and address the challenges faced in scheduling procedures. It promotes a data-driven and evidence-based approach to process improvement, resulting in

more efficient resource utilization, improved patient outcomes, and enhanced overall performance of the Cath lab.

3.3 DEFINE PHASE: - Process Flow of Cath lab is seen.

PROBLEM: - late execution of procedures that causes in the increase in patient waiting time in cathlab.

Unavailability of doctors on time.

Lack of communication and coordination among staff.

3.4 MEASURE PHASE: -

3.4.1 Process flow of OPD Patients: -

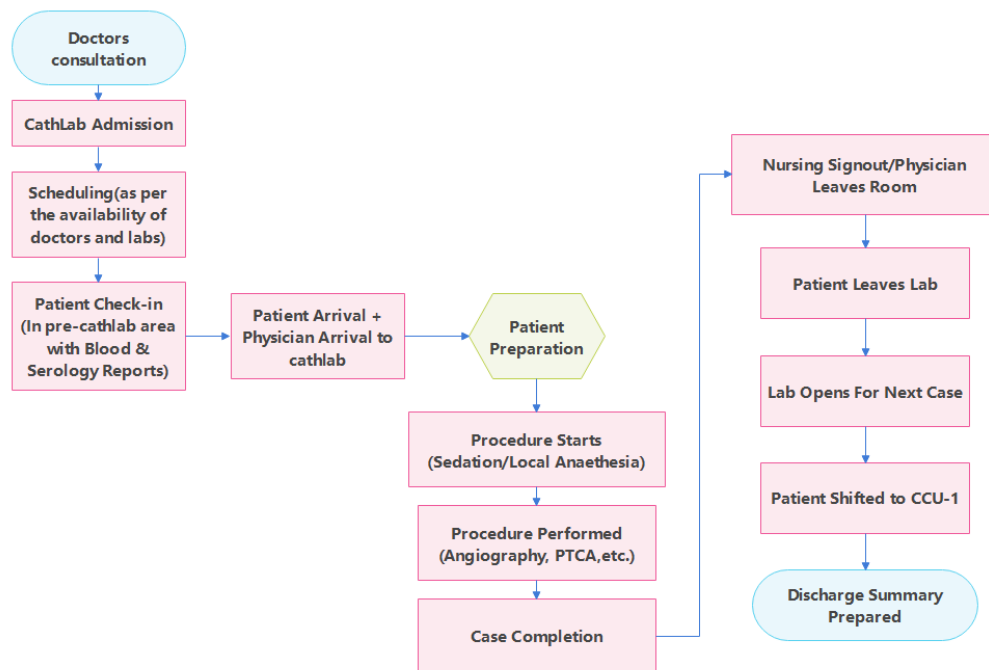


Figure 3.1: Process flow of OPD Patients

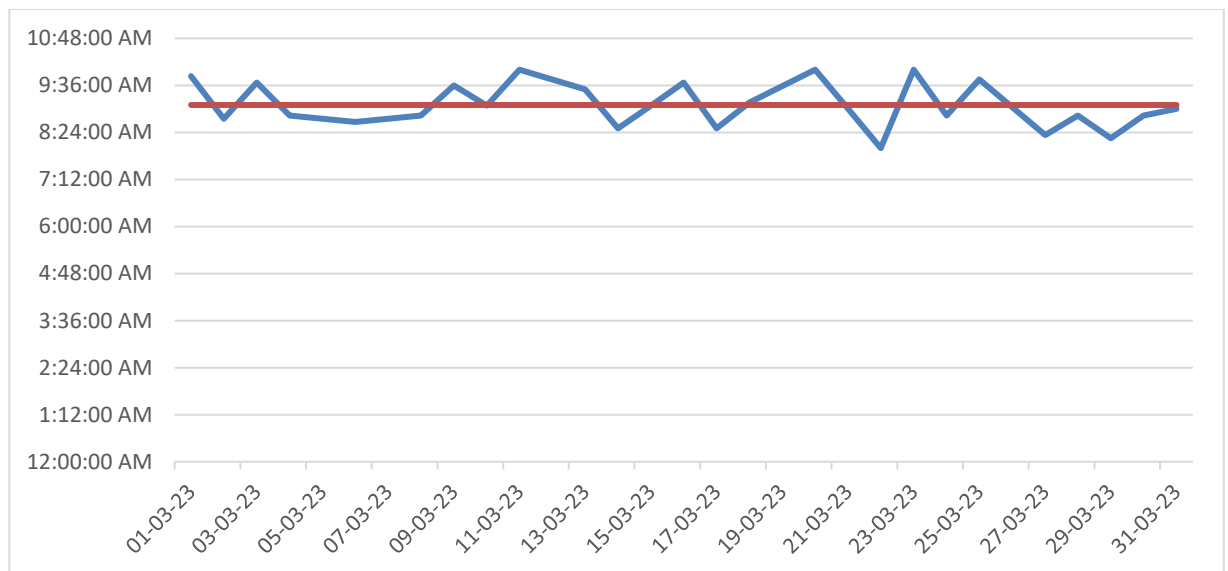
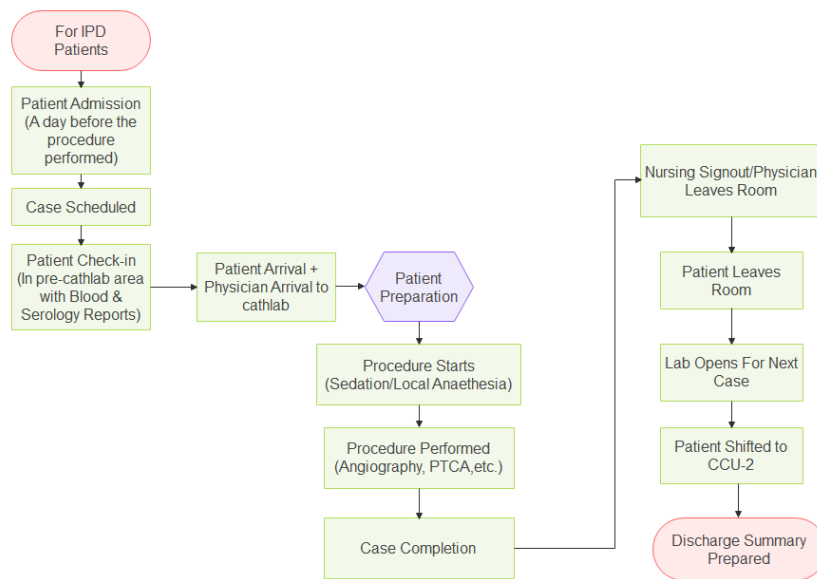


Figure 3.3 Average delay in the of March

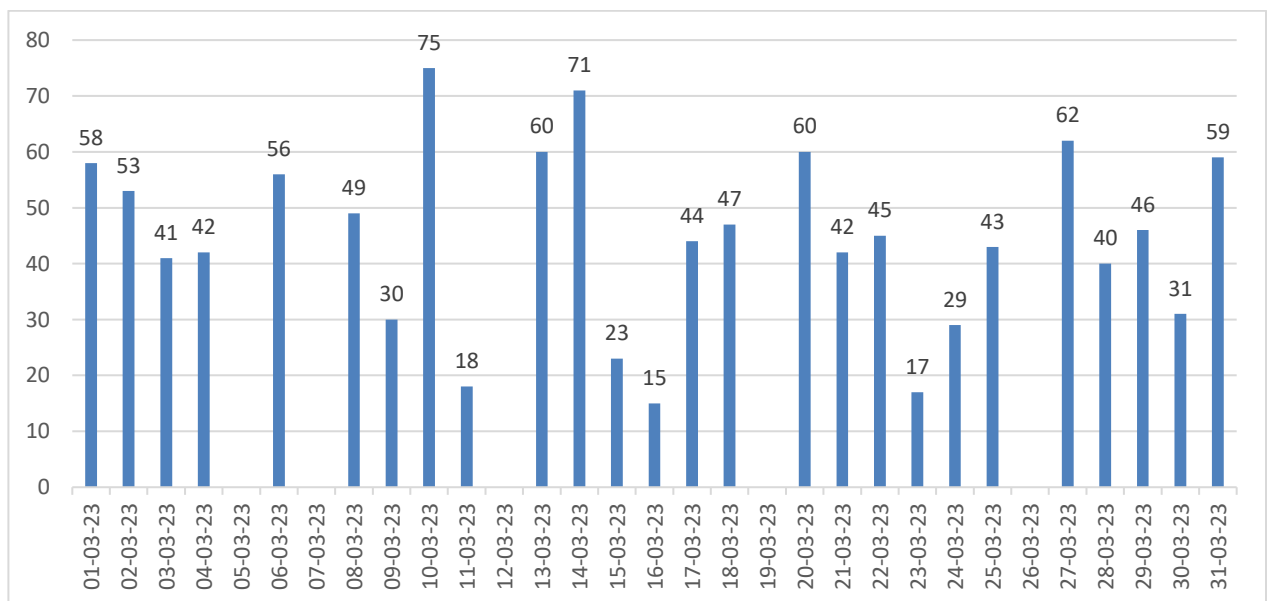
Based on the graph, it is clearly that average delay in the start of the first case in the of March is 60 minutes. The Cath Lab opens 8 AM each day. But it appears that there is delay in the first case, as the maximum number of cases tend to start at 9 AM every day.

Delays can cause inefficiencies in Cath lab.



Fig 3.4 Average delay in first case starting time in the of April.

According to the graph provided, it is visible that the average delay in the start of the first case during the of April is 120 minutes.



Average waiting time in the of march is 44 minutes. This delay indicates the amount, patients spend waiting between these two critical stages of their medical procedure. The data from

the graph underscores the importance of efficient patient flow management within the healthcare facility, as reducing this delay can lead to improved patient outcomes and overall operational effectiveness. By implementing strategies to streamline the process, such as optimizing scheduling, enhancing communication between departments, and ensuring adequate resources are available, healthcare providers can work towards minimizing delays and enhancing the overall experience for patients undergoing catheterization procedures.

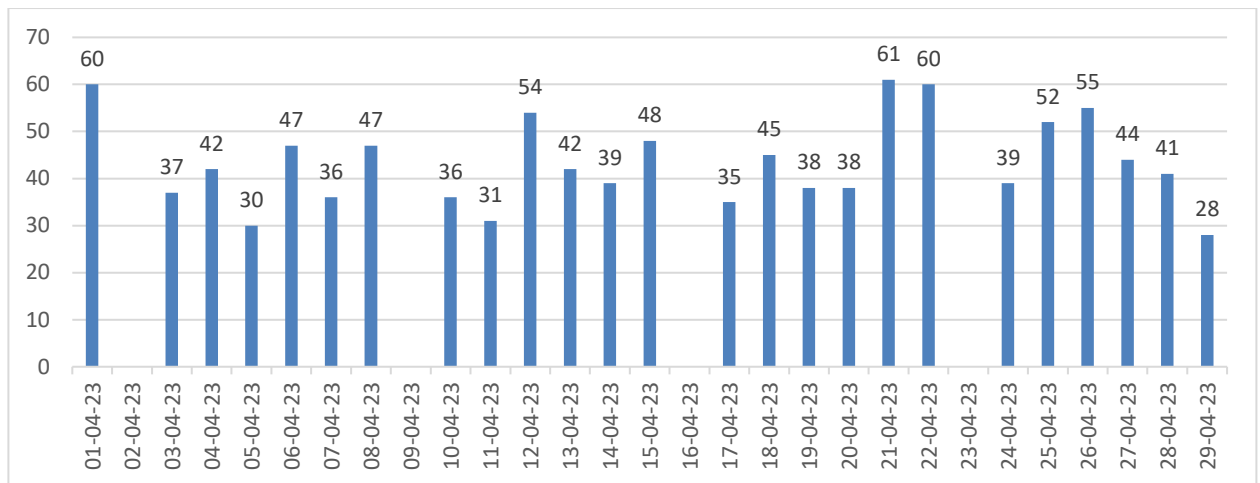


Figure 3.6 Average waiting time in the of April

Average delay between patients wheeled inside the pre-Cath area and entering the Cath lab is 40 in the of April.

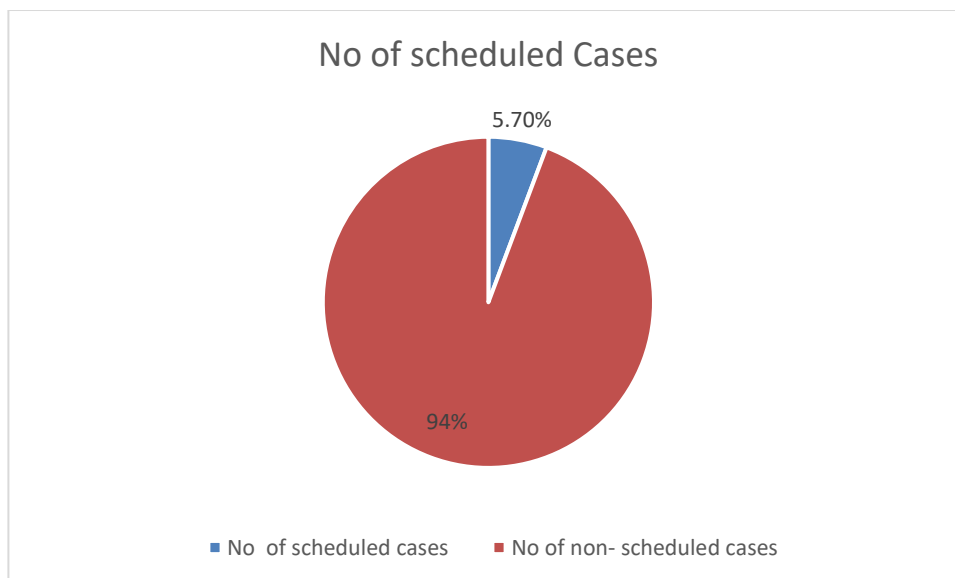


Figure 3.7 No. of scheduled cases and non-scheduled cases.

No. of scheduled and non-scheduled are 5% and 94% respectively.

The allocation of scheduled and non-scheduled activities is an essential aspect of effective planning and management. In this particular scenario, it is observed that 5% of the cases are scheduled, while the remaining 94% fall under the category of non-scheduled Cases.

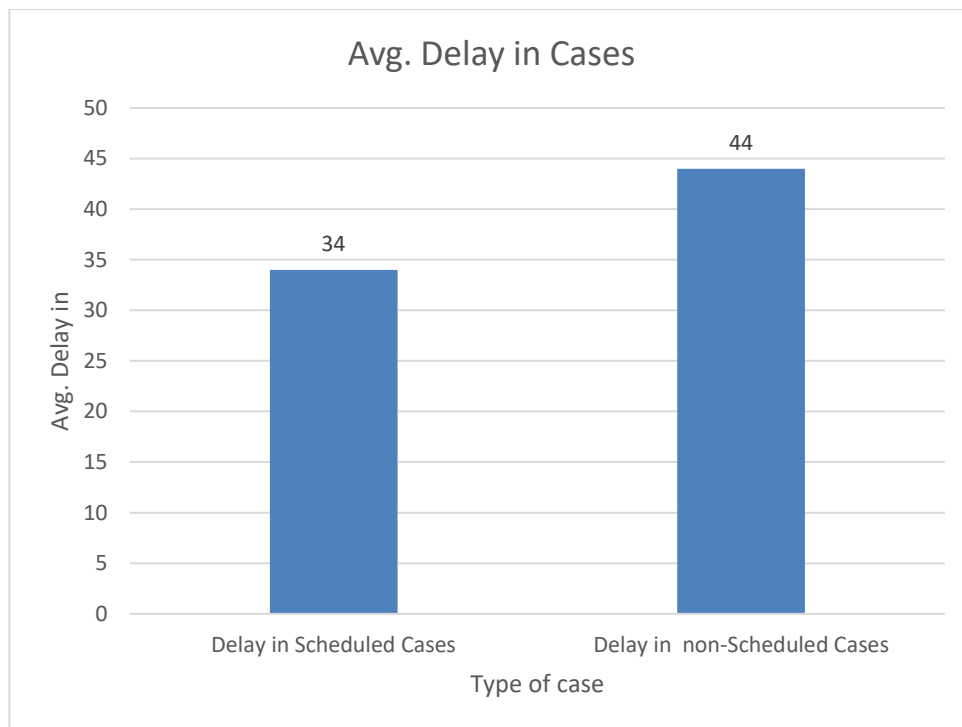
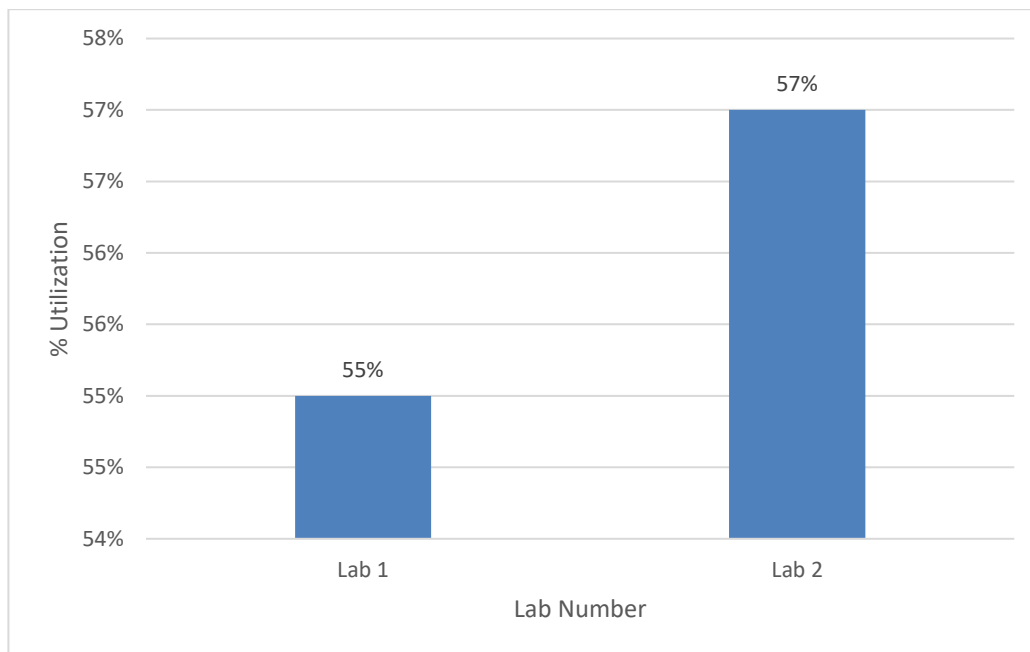


Figure 3.8 Avg. Delay in scheduled and non-Scheduled Cases: -

This fig clearly shows delay in scheduled and non-scheduled cases is 43 and 44 respectively. It clearly shows delay in scheduled cases is less than the nonscheduled cases. So, it is better to have proper scheduling system to have more number of scheduled cases.

Utilization rate: -

Figure 3.9



The optimal utilization rate for cardiac catheterization laboratories (Cath labs) can vary depending on several factors, including the hospital's caseload, available resources, and operational considerations. While there is no fixed or universally agreed-upon utilization rate, it is generally recommended to aim for a reasonable balance between maximizing the Cath lab's efficiency and ensuring patient access to necessary procedures.

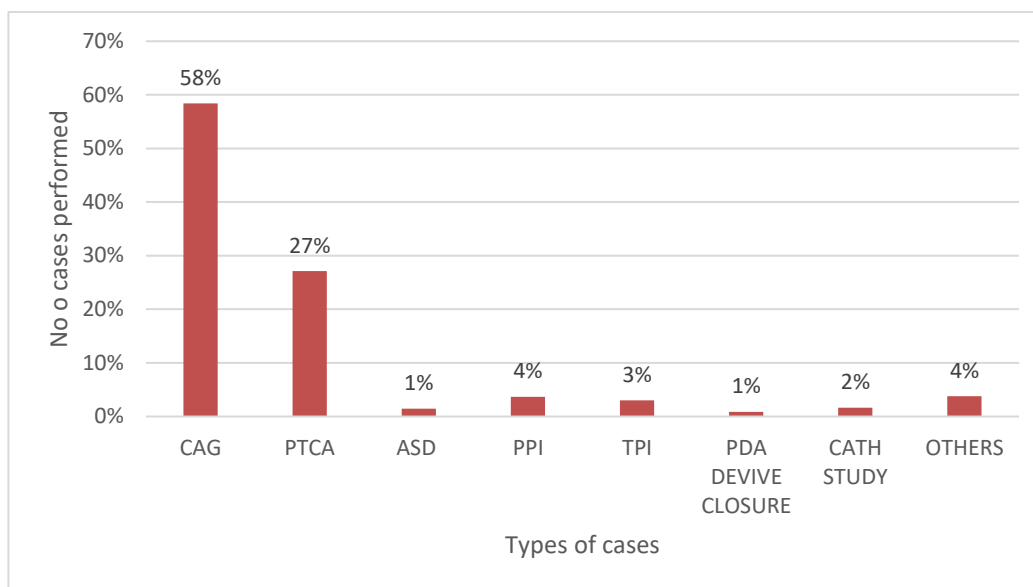
So here, current utilization of both Cath labs is inefficient, with little noticeable difference between them.

The current situation reveals that both Cath labs are not being utilized efficiently, and there is minimal disparity in their utilization rates of both the Cath labs. The lack of efficient usage indicates that these facilities are not maximizing their potential to serve patients effectively.

Avg. Utilization Rate of Lab-1 is 55%.

Avg. Utilization Rate of Lab-2 is 57%.

Figure 3.10 Category of Cases Performed: -



Procedure Time: -

PROCEDURES PERFORMED	BENCHMARK	Avg. Time taken to perform procedures
CAG	15 to 30 minutes	15
PTCA	30 120	56
BALLON ANGIOPLASTY	45 120	54
ASD DEVICE CLOSURE	40 60	54
BALLON COARETOPLASTY	60 150	90
BMV	45 90	55
BPV	60 120	120
TPI	15 30	20
AICD	120 150	120
PPI	45 75	70
PDA DEVICE CLOSURE	60 90	70 -
COIL CLOSURE	60 180	101
VSD DEVICE CLOSURE	60 120	66
CRT-P	90 180	165
LEAD REPLACEMENT	60 120	55
PG REPLACEMENT	45 90	65

PERICARDIAL TAPPING	20 40	35
CATHOXYMETRY	40 to 60	35
CATH STUDY	60 120	60
PDA STENTING	60 90	85
RVOT	180 to 300	180

Table No. 3.1 - Average time taken to perform the Cath-lab procedures.

Procedure time: - Avg time taken to perform the Cath-lab procedures.

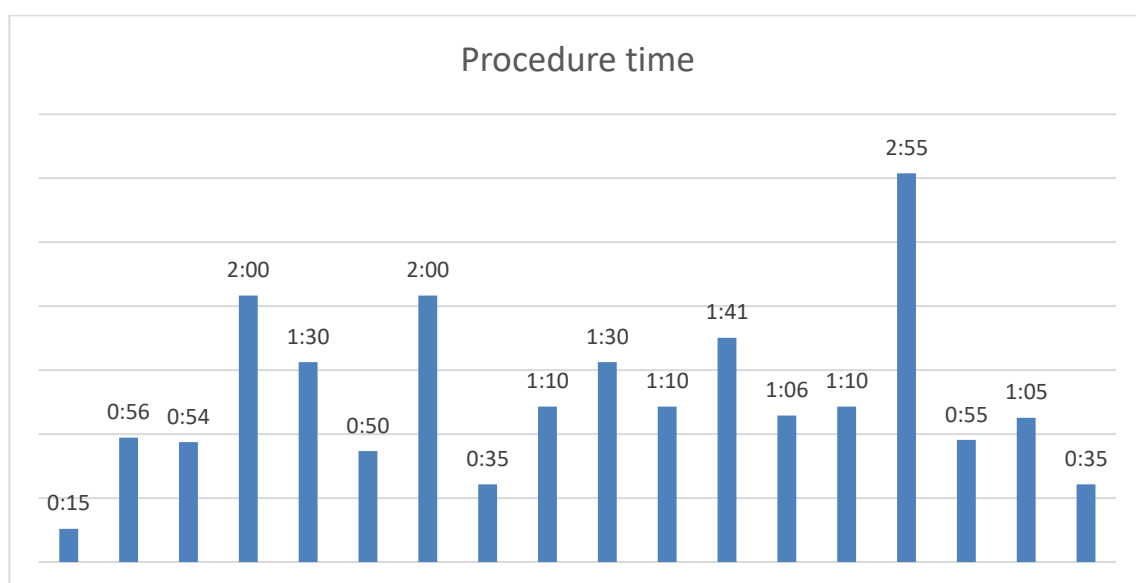


Figure 3.11 Average time taken to perform the Cath-lab procedures.

Based on the graph presented, it is evident that the procedures such as Cag (coronary angiography), Lead replacement, and RVOT (right ventricular outflow tract) And Cathoxymetry are surpassing the benchmark set by the doctors of the cath lab in terms of time taken for completion. The graph clearly depicts that these procedures are being performed more efficiently and swiftly, suggesting an improved performance compared to the established standards .

The data presented in the graph indicates that the time required for Cag, Lead replacement, and RVOT procedures is notably lower than the benchmark. This signifies that the medical team involved in these interventions has achieved a higher level of proficiency and effectiveness, allowing them to complete the procedures in a more time-efficient manner.

Rest of them are lying between the benchmarks.

No. of cases performed in the month of March

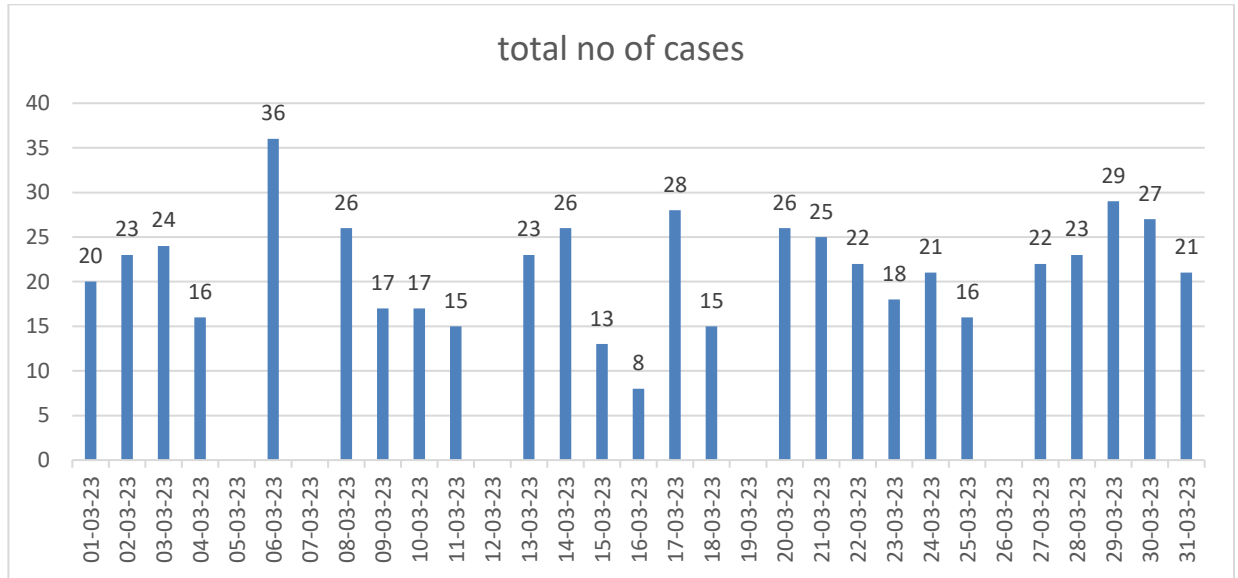


Figure 3.12 Case Distribution as per days in of march.

-These are the case distribution as per day in the of march.

-The average number of patients in the of march is 21 patients per day.

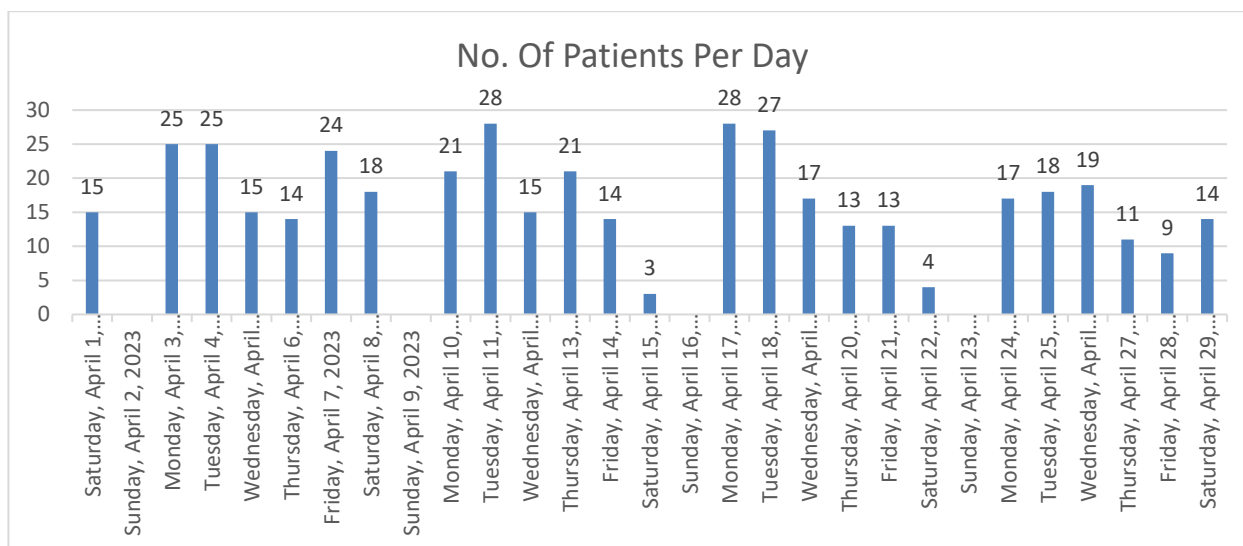


Figure 3.13 Case Distribution as per day in the of April

These are the case distribution as per day in the of April.

The average patients in the of April is 17 patients per day.

3.5 ANALYSIS PHASE:

fishbone analysis is significant for Cath lab scheduling as it provides a structured and collaborative approach to identify root causes, generate potential solutions, and drive continuous improvement. By leveraging this tool, Cath labs can enhance their scheduling efficiency, optimize patient throughput, and improve overall workflow.

Employing a fishbone diagram as a problem-solving tool offers several benefits. It promotes a structured analysis of potential causes, encourages diverse perspectives, and facilitates a comprehensive examination of the problem's root causes. By leveraging this visual aid, enhance problem-solving capabilities and ultimately gives more effective solutions.

Fish Bone analysis is done to know the root cause for the Cath lab procedure delay.

Fish Bone Analysis: -

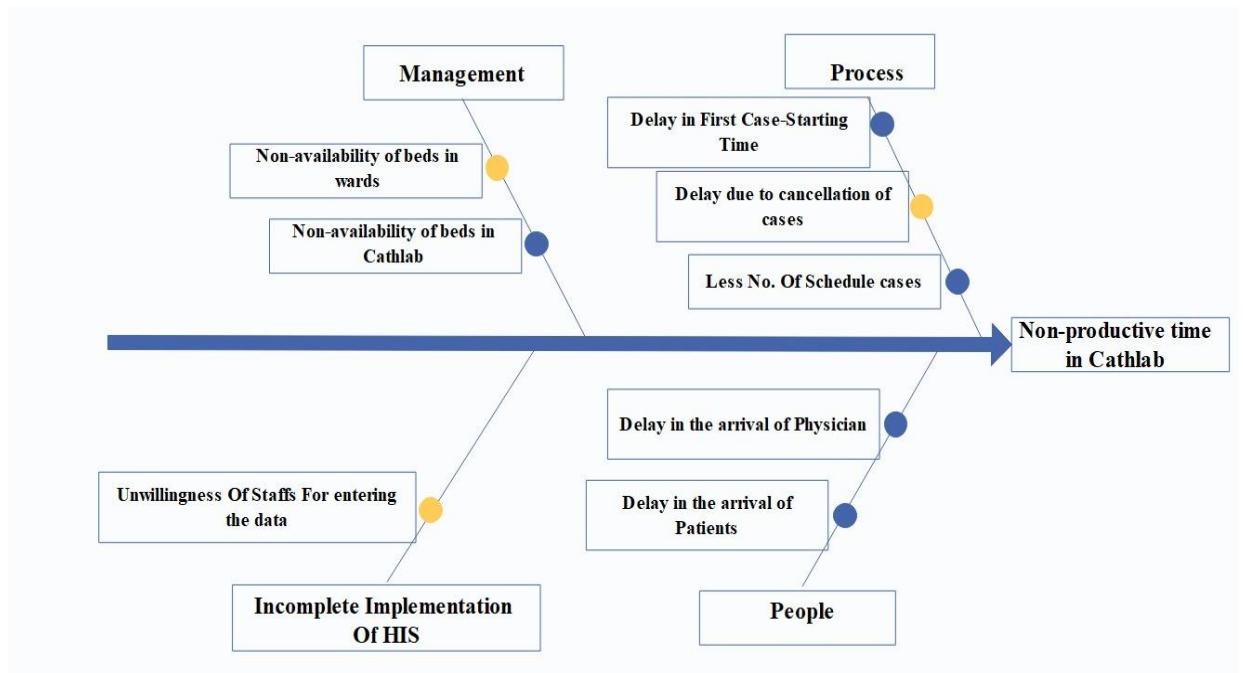


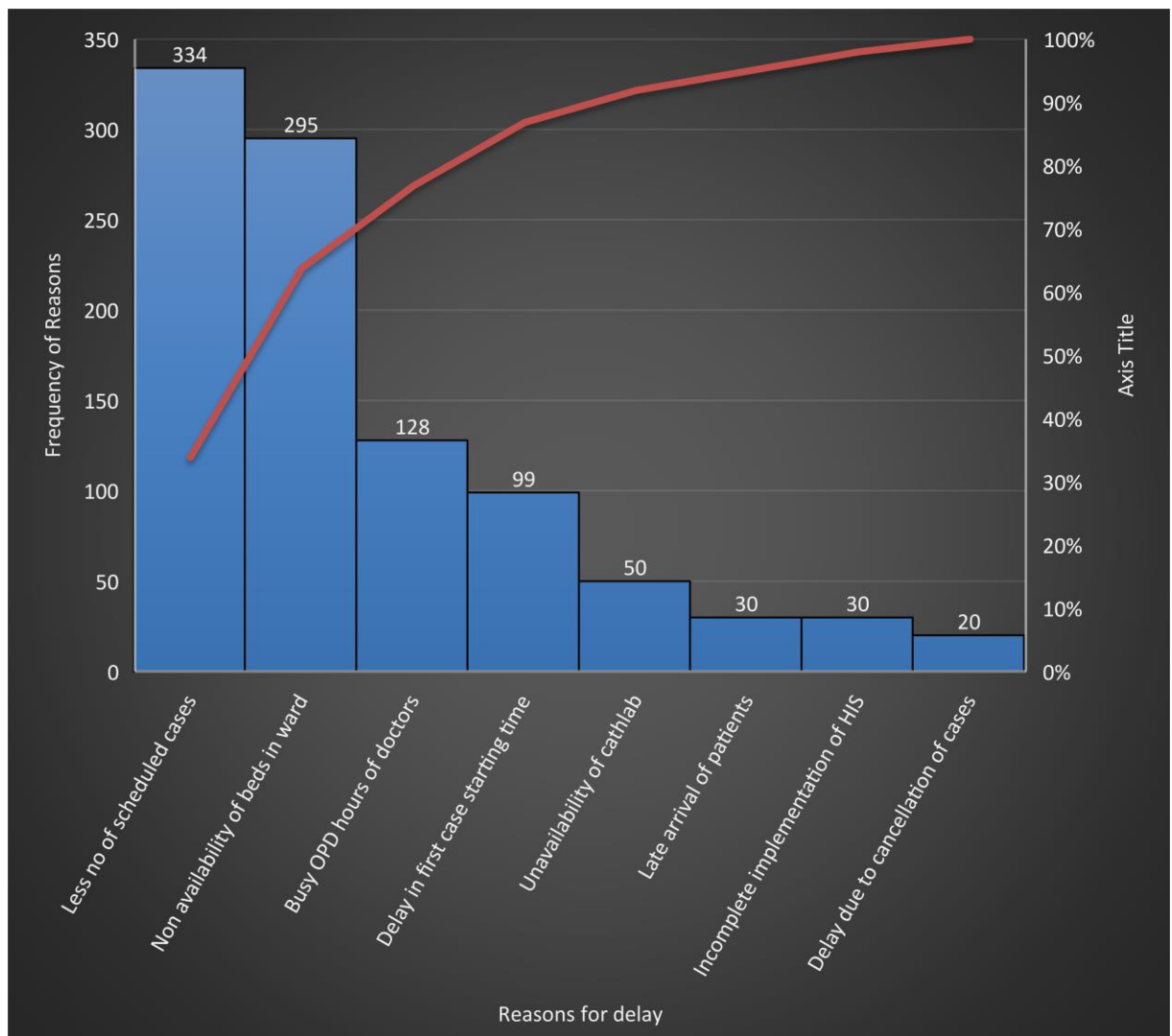
Figure 3.14 Fish Bone Analysis.

BY FISHBONE analysis, the major causes behind the delays in Cath lab are as follows: -

1. Non-availability of beds in wards
2. Insufficient number of scheduled cases
3. Delay in the first case starting time.
4. Late arrival of physicians
5. Incomplete implementation of HIS

FIGURE: - 3.15 Pareto Analysis.

Pareto analysis can be employed to identify and prioritize the most significant factors or causes that contribute to delays, inefficiencies, or bottlenecks in the scheduling process. By focusing on these key factors, it helps to allocate their resources more effectively and make targeted improvements to enhance the overall efficiency and productivity of the Cath lab.



Based on Pareto analysis, it is evident that several factors contribute to the overall challenges in a healthcare setting. The factors have a higher frequency and thus require attention:

1. number of scheduled cases: this is one of major reason for delay.
2. Non-availability of beds in wards: The lack of available beds in the wards is the also one of major reason for delay.
3. Busy OPD hours of doctors: No proper scheduling system cases are scheduled as per the availability of doctors.
4. Delay in the first case starting time: It disturbs the flow of all the scheduled cases.

By addressing these key areas of concern identified through Pareto analysis, healthcare organizations can prioritize efforts and implement targeted interventions overall performance and provide better patient care.

CAPA: -

CAPA (Corrective and Preventive Action) is a systematic approach used to identify, investigate, and address the root causes of issues or nonconformities in various processes within an organization. CAPA is commonly employed such as healthcare, manufacturing, and quality management systems.

Table: - 3.4

Reasons for Delay	Corrective Action	Preventive Action
1. Less number of scheduled cases: -	• Review the scheduling process and identify any flaws or inefficiencies. • Coordinate with the relevant departments to ensure accurate and adequate scheduling. • Analyse the historical data to determine the average number of cases and make necessary adjustments to the schedule. • Monitor and track the number of scheduled cases regularly to identify any deviations and take prompt action.	• Maintain an updated database of patient appointments and historical data for better forecasting and scheduling. • Regularly review and analyse the patient flow and demand patterns to adjust the scheduling process accordingly. • Establish effective communication channels with referring physicians to ensure timely referrals and proper scheduling.
2. Non-availability of beds in the ward:	. Improve communication	• Conduct regular capacity planning assessments based on

	and coordination between the different departments involved in bed management to ensure efficient utilization of available beds. Implement a robust bed allocation system that prioritizes critical patients and optimizes bed turnover. Regularly review the bed occupancy rate and take proactive measures to address any shortages or bottlenecks.	patient demand projections. - Establish a system for proactive bed management, including early discharge protocols and efficient patient transfer processes. - Collaborate with other healthcare facilities to arrange for temporary beds or alternative accommodations during peak periods.
3. Busy OPD hours of doctors: -	- Analyse the OPD schedule and identify peak hours and bottlenecks. - Optimize the appointment booking system to evenly distribute patient appointments throughout the day. - Consider extending the OPD hours or opening on additional days to accommodate the increased demand.	- Implement a efficient appointment management system that allows for batter scheduling system. - Analyse historical data to identify peak hours and allocate sufficient resources and staff accordingly.

4. Delay in first case starting time:	- Identify the root cause of the delay, such as inadequate preparation, physician unavailability, or communication issues. - Monitor and measure the first case starting time regularly and address any delays promptly.	- Standardize and optimize the pre-surgical preparation process to minimize delays. - Ensure timely availability of physician before the scheduled procedure. - Conduct regular audits and performance reviews to identify areas.

3.6 IMPROVE PHASE: -

- Documentation be completed and maintained properly.
- Under-utilization of physicians should be taken into consideration.
- Over-utilization of cases should also be considered.
- There should be an effective scheduling system.
- No proper infrastructure for pre and post Cath lab area.
- Complete implementation of HIS should be there.
- Proper training should be given to the technicians.
- Awareness about high quality care among nursing staff should be taken into consideration.

- Average door to balloon time should be improved as per the standard that is 20 minutes.
- Patient selection for the day care and non-scheduled cases should be improvised that should result in less chaos and confusion.
- There should be more scheduled cases and less non-scheduled cases.
- There should be proper communication and coordination among staff.

3.7 Control Phase: -

- Optimize scheduling software: One of the most significant factors affecting the Cath lab scheduling process is the scheduling software. The software should be user-friendly, efficient, and able to handle complex scheduling needs. Look for scheduling software that can prioritize cases, identify scheduling conflicts, and quickly reschedule cases if needed.
- Streamline communication: Communication between all parties involved in the scheduling process is essential. Ensure that the scheduling process is streamlined and clear, with all relevant parties receiving notifications in a timely manner. Implement a system for real-time communication and updates miscommunications and ensure that everyone is on the same page.
- Define policies and procedures: Clearly defined policies and procedures for the scheduling process can help ensure that all stakeholders understand their roles and responsibilities. Develop policies that outline case priority, booking guidelines, and cancellation procedures. This will help conflicts and reduce the number of cancelled procedures.
- Reduce wait times: long wait times can be frustrating for patients and impact their overall experience. Consider implementing a just-in-time scheduling system that allows for more flexibility and can reduce wait times for patients.
- Monitor and analyse data: Regularly monitoring and analysing data related to the scheduling process can help identify areas for improvement. Use data to track wait times, cancellations, and scheduling conflicts. Analysing this data can help identify trends and areas for improvement.

- By implementing these strategies, healthcare organizations can improve the cath lab scheduling, resulting in better patient care and outcomes.

Chapter 4: Result

- Firstly, it is noticed that from **fig 3.7** that there is a less number of scheduled cases, that means hospital resources are not effectively utilized.
- Secondly, the study identified from **fig 3.14** an incomplete implementation of the hospital management information system.
- Another significant finding from **fig 3.14** is the busy outpatient department (OPD) hours of doctors. This finding implies that the doctors' are busy with large number of OPD cases, which challenges the potential for managing patient appointment, which leads to patient dissatisfaction.
- Delay in the first case starting time which disturbs the flow of all the scheduled cases. **From (Fig. 3.3 and 3.4).**
- Longer waiting times in the Pre-Cath Area. which may disturb the patient flow and cause patient dissatisfaction. It is necessary to identify the factors that lead to the inconsistency and longer waiting times and to implement measures for improvement. **(Fig 3.5 and 3.6)**
- Additionally, it is noted that there is no proper Pre-Cath and Post-Cath area available. This finding raises concerns about patient safety, comfort, and privacy during the catheterization procedure. Developing suitable Pre-Cath and Post-Cath areas is essential to ensure optimal patient care and satisfaction.
- The Cath lab are underutilized as compared to the benchmark which is 60 to 80% as we can clearly see from **fig 3.9** the utilization rate for both the Cath labs are 55% (lab-1) 57% (lab-2).
- Delay in the availability of beds in wards. This delay may result in longer waiting times for patients for patients who are supposed to receive care on a day basis **(Fig 3.14)**

Chapter 5: Discussion

Cath Lab Scheduling process plays a important in a hospital. If not paid proper attention leads to poor quality of care and can result in decreased efficiency of hospital and satisfaction of patients. To, maintain a proper scheduling process all the doctors including nurses and anesthesiologists, should arrive at time, also the increase in number of planned cases and all other factors helps in reducing delays in the Cath Lab.

Chapter 6: CONCLUSION

After the study it was noticed that that was a lack of proper scheduling practices which result in patient dissatisfaction and due to a smaller number of scheduled cases, it was difficult to manage the cathlab's process flow. Due to high number of unplanned cases the hospital staffs had to work for longer hours and the organization had to pay for their over time which is eventually a loss for the organization.

Chapter 7: RECOMMENDATIONS

- The Cath Lab computers must be equipped with the HIS system and doctors as well as Anesthesiologists should adhere to the punctuality.
- The lifts should be customized as per the requirements, and the entry registers must be maintained accurately. The OT must have a well-organized storage area and proper documentation should be completed and maintained systematically.
- Implementing a centralized scheduling system: In this system, a centralized scheduling team is responsible for scheduling appointments and procedures across multiple Cath labs. This ensures that the schedule is done in a consistent manner and avoids double booking or overbooking.
- Utilization of predictive analytics can aid in predicting the upcoming demand for Cath lab procedures based on past data. This can aid in scheduling optimization by ensuring the availability of adequate resources to accommodate the expected demand.
- Optimizing time slots: Scheduling can be optimized by identifying the most efficient time slots for procedures. This could involve scheduling more complex procedures during off-peak hours to minimize disruption to other procedures.
- -Real-time scheduling: Real-time scheduling can help to optimize resource utilization and reduce wait times for patients. In this system, schedules are continually adjusted based on actual procedure times and other factors such as delays or cancellations.
- -Electronic scheduling: Moving to an electronic scheduling system can improve efficiency by reducing the need for manual processes. This can also improve communication and coordination among staff involved in Cath lab scheduling.

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Annexure: -

Data of Scheduled Cases

Date Admission	Of Ip No.	Cath lab (1/2)	Procedure Performed	Scheduled time	Sign In the Cath lab	Delay in the procedure
01-04-2023	323-45304	1	PDA STENTING DONE	09:00	09:35	00:35
01-04-2023	323-45588	1	CATH STUDY DONE	12:45	13:00	00:15
01-04-2023	323-45583	1	CAG/ASD DEVICE CLOSURE	16:35	16:50	00:15
06-04-2023	323-45909	1	CAG/ASD DEVICE CLOSURE	10:45	10:55	00:10
07-04-2023	323-46009	1	VSD DEVICE CLOSURE	09:55	11:25	01:30
08-04-2023	323-46066	1	VSD DEVICE CLOSURE	09:00	09:20	00:20
08-04-2023	323-46067	1	PDA DEVICE DONE	09:00	10:30	01:30
08-04-2023	323-46080	1	VSD DEVICE CLOSURE	09:05	11:35	02:30
13-04-2023	32346418	1	Cath	08:10	09:05	00:55
13-04-2023	32346380	1	ASD DEVICE CLOSURE	11:50	12:00	00:10
13-04-2023	32346385	1	VSD Device	12:50	13:00	00:10
21-04-2023	323-46931	1	CATH STUDY DONE	09:20	09:30	00:10
21-04-2023	323-46053	1	PDA DEVICE CLOSURE	10:30	11:05	00:35
21-04-2023	323-46929	1	ASD DEVICE CLOSURE	11:55	12:00	00:05
22-04-2023	323-47012	1	PDA DEVICE CLOSURE	10:20	10:25	00:05
25-04-2023	323-47180	1	PDA DEVICE CLOSURE	09:45	10:00	00:15
26-04-2023	323-47281	1	VSD DEVICE CLOSURE	10:20	10:40	00:20
26-04-2023	323-47278	2	CATHOXIMETRY	12:55	13:00	00:05

Date Admission	Of Ip No.	Cath (1/2)	lab	Procedure Performed	Scheduled Time	sign in in the Cath lab	Delay in the procedure
01-03-2023	333-43337	1		Bpv	11:00	11:15	00:15
02-03-2023	323-43420	1		Cath Study	10:25	13:10	02:45
02-03-2023	323-43435	1		PDA Device closure	11:20	11:30	00:10
03-03-2023	323-43515	1		RVOT	10:15	10:20	00:05
03-03-2023	323-43533	1		PDA Device	14:40	14:45	00:05
04-03-2023	323-43562	1		ASD Device	08:50	09:50	01:00
04-03-2023	323-43563	1		VSD Device	10:05	10:45	00:40
06-03-2023	323-43656	1		PDCA Device closure	09:30	09:40	00:10
08-03-2023	333-43807	1		PDA Stenting	08:50	09:15	00:25
08-03-2023	323-43784	1		VSD Device Closure	11:15	11:30	00:15
08-03-2023	333-43768	1		ASD Device Closure	12:40	12:45	00:05
09-03-2023	323-43871	1		CAG-Cath Oximetry	10:10	11:15	01:05
10-03-2023	323-43951	1		Cath Study	09:40	10:25	00:45
10-03-2023	323-43943	1		CAG	22:15	22:25	00:10
13-03-2023	32344118	2		CAG	10:00	12:05	02:05
13-03-2023	32344177	2		PDA	12:10	12:20	00:10
14-03-2023	32344199	1		PDA	09:50	10:10	00:20
17-03-2023	32344462	1		VSD	10:15	12:30	02:15
17-03-2023	32344461	1		ASD	10:25	11:30	01:05
17-03-2023	32344470	1		ASD	13:05	13:50	00:45
18-03-2023	32344522	1		ASD	13:20	13:45	00:25
18-03-2023	32344501	1		VSD	09:10	09:20	00:10
18-03-2023	32344521	1		VSD	10:10	10:25	00:15
21-03-2023	323-44731	1		PDA DEVICE CLOSURE	09:00	09:05	00:05
21-03-2023	323-44698	1		BALLON COARETOPLASTY	09:10	10:00	00:50

21-03-2023	323-44725	1	PDA DEVICE CLOSURE	09:20	12:10	02:50
22-03-2023	323-44813	1	ASD DEVICE CLOSURE	09:45	10:10	00:25
23-03-2023	323-44825	1	ASD DEVICE CLOSURE	11:00	11:00	00:00
23-03-2023	323-44882	1	VSD DEVICE DONE	10:25	10:30	00:05
23-03-2023	323-44880	1	ASD DONE	12:30	12:40	00:10
24-03-2023	323-44998	1	BALLON ANGIOPLASTY	08:50	09:00	00:10
25-03-2023	323-45046	1	PDA DEVICE CLOSURE	11:10	11:35	00:25
27-03-2023	323-45150	1	BPV+COIL CLOSURE DONE	10:00	10:30	00:30
28-03-2023	323-45255	1	ASD	09:10	09:25	00:15
28-03-2023	323-45254	1	PDA DONE	10:00	10:10	00:10
29-03-2023	323-45259	1	ASD	10:00	10:30	00:30
30-03-2023	323-4509	2	BPR	09:45	09:55	00:10
30-03-2023	323-45418	2	CAG	11:35	11:45	00:10
31-03-2023	323-45513	1	PDA	09:00	09:40	00:40