A Comprehensive Study on Optimizing Cardiac Catheterization Laboratory Utilization

Internship Training
at

By
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Under the guidance of
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Partners In Health

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WHOMSOEVER IT MAY CONCERN

This is to certify that **Dr Monalisa Singh** has successfully completed her training, in the Cardiology Department of our organization from **February 10, 2014 till May 05, 2014.**

Topic of her dissertation was **"Comprehensive insight into Cardiac Catheterization Lab".** She has duly submitted her project report in the training department of our hospital.

During her training period she was found to be sincere and efficient in her work.

We wish her all the best for her future endeavors.

For Paras Hospitals

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These three months of dissertation has added a valuable and knowledgeable experience in the development of my career and achievement of my objectives, for which I am highly grateful to the organization.

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LIST OF SYMBOLS AND ABBREVIATIONS

%	Percentage
>	more than
i.e.	that is
≈	Approximate
ASD	Atrial septal defect
AVM	Arterio-venous malformations
BMV	Balloon mitral valvuloplasty
CAD	Coronary artery disease
CAG	Coronary angiography
CAROTID ANGIO	Carotid angiography
CCU	Cardiac care unit
CRT	Cardiac resynchronization therapy
CRT-D	Cardiac resynchronization therapy-defibrillator
Cath Lab	Cardiac catheterization laboratory
dept.	Department
DSA	Digital subtraction angiography
EPS	Electrophysiological study
GOVT	Government
IABP	Intra-aortic balloon pump
ICD	Implantable cardioverter defibrillator
IVC FILTER	Inferior Vena cava filter
NABH	National Accreditation Board for Hospitals and Health care providers
No.	Number
OPD	Outpatient department
PAG	Peripheral artery angiography
PDA CLOSURE	Patent ductus arteriosus closure
PPI	Permanent Pacemaker insertion
PTA	Peripheral Tran luminal angioplasty
PTBD	Percutaneous transhepatic biliary drainage
PTCA	Percutaneous transluminal coronary angioplasty
PTRA	Peripheral transluminal renal angioplasty
RAG	Renal artery angiography
RFA	Radio frequency ablation
TLD	Thermo luminescent dosimeter
TPI	Temporary pacemaker insertion
VSD	Ventricular septal defect
X Ray	X-radiation

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CHAPTER 1 OVERVIEW OF HOSPITAL

1.1 INTRODUCTION:

Paras Hospitals, Gurgaon is a NABH accredited 250 bedded super-specialty hospital. It was the first hospital in Gurgaon region to get NABH accreditation. Since its inception it has aimed to be a preferred healthcare provider for all. Its expertise in advanced medical and surgical treatments has helped thousands of patients receive world class quality treatment at affordable costs. Paras hospitals is equipped with one of the leading neurosciences centers in the region which boasts of all facilities needed for research and surgery in the field of neurosciences. Besides this, it has 55 specialty departments which include medicine, minimal invasive surgery, gynecology, oncology, ophthalmology, dermatology, cosmetic surgery, plastic surgery etc. Paras hospitals is also renowned globally for its specialized international patient services. Customized treatment and surgery plans are designed to benefit international patients.

1.2 VISION:

1. To become preferred healthcare provider for all.

2. Partnership in caring and curing.

3. Providing excellent medical care to our patients through our faith in values, integrity, respect, team work and innovation to achieve complete patient satisfaction.

1.3 MISSION:

- ✓ The mission of Paras hospitals is to provide competitive, innovative and accessible medical care to the patients.

- ✓ To facilitate improving health of the patients by providing quality services through our professionals that is affordable and delivered:
    - Compassionately
    - Appropriately
    - Responsibly
    - Efficiently

- ✓ To exhibit stewardship and creativity in the management of all available resources for patient care.

- ✓ To ensure the delivery of our services enabling patients, families, guests, healthcare professional our associates to make the best use of our facilities and environment consistent with our philosophy and commitment of the patient care, health education and strategic initiatives.

- ✓ To provide excellent family center health care to the entire family and children in an environment that meets or exceeds the expectations of those we serve.

1.4 QUALITY POLICY:

1) We at Paras hospitals believe in partnership with communities we serve.

2) We will fulfill our purpose of providing quality health care services by
   a) Providing uniform patient treatment and care, use of evidence based medicine and excellence in clinical outcomes.
   b) Knowledge enhancement of our staff, clinicians and patients.
   c) Delivering superior customer services and complying with statutory regulations.

1.5 SERVICES OFFERED AT PARAS HOSPITALS, GURGAON

Table 1.1: Services offered at Paras hospitals, Gurgaon

• Anesthesiology • Cardiac Sciences • Dental Surgery • Dermatology • Dietetics and Nutrition • Emergency and Trauma Centre • Endocrinology • ENT • Gastroenterology • Geriatrics • Gynecology • Hematology • Head and Neck Oncosurgery • Internal Medicine • Laparoscopic, Gastrointestinal and Bariatric Surgery	• Neurosciences • Interventional Radiology • Obstetrics • Ophthalmology • Orthopedics and Joint Replacement • Pediatrician • Physiotherapy and Rehabilitation • Plastic and Reconstructive Surgery • Preventive Health Check-ups • Psychiatry and Psychology • Pulmonary and Critical Care • Radiology • Renal Sciences and Urology • Rheumatology • Mother and Child

CHAPTER 2 PROJECT OUTLINE

2.1 INTRODUCTION

Cardiac Catheterization is a complex medical procedure that is used to diagnose and treat a wide variety of heart conditions. During cardiac catheterization, a narrow tube called catheter is inserted into the artery with a plastic introducer sheath. The catheter is guided through the blood vessel to the coronary arteries with the aid of an x-ray. The procedure is performed by a cardiologist in a specially equipped room know as a Catheterization laboratory (Cath lab)

Cardiac catheterization is one of the most common interventional procedures practiced, which leads to high volumes and high revenues for the hospital. However, the highly technical nature of the cath department combined with extremely high technological costs make the department tricky to manage. In order to manage the department well, it is important for managers to be informed and aware of what goes on in a cath lab.

PROBLEM STATEMENT

"To study, Cath lab time utilization, identify bottlenecks and recommend optimum utilization"

RESEARCH QUESTION

What are the reasons that account for under utilization of Cath lab, if any?

OBJECTIVE OF THE STUDY

- To study the workload and trends of Cath lab since inception.
- To study Cath lab time utilization, identify bottlenecks and recommend optimum utilization.

2.2 OUTLINE OF RESEARCH APPROACH

SECONDARY RESEARCH- PHASE I

In the first phase, retrospective study with in depth analysis of the records of the Cath lab related to work load, process flow, and policies was done.

Specific Objectives:

1. To identify workload of Cath lab since inception.
2. To assess patient profile in terms of elective/emergency, route of catheterization, mode of payment.
3. To study overall process flow of Cath lab patients and different phases involved in Cath lab from "Patient In to Patient Out"

PRIMARY RESEARCH – PHASE II

In the second phase, Time motion study was done in Cath lab for the study period. (Cath lab Utilization Study)

Specific objectives:

1. To analyze Cath lab time utilization and patient turnaround time.
2. To assess the functional bottlenecks in optimum utilization of Cath lab.
3. To evaluate Cath lab in terms of quality assurance i.e. patient safety, employee safety, documentation.
4. To propose key metrics for Cath lab.

2.3 REVIEW OF LITERATURE

A Cardiac catheterization laboratory or Cathlab is an examination room used to support the catheterization procedures which further evaluate cardiac diseases, when other less invasive types of diagnostic tests indicate the presence of any of cardiac diseases.

The idea of cardiac catheterization was created in 1844 by Claude Bernard, when he placed a mercury thermometer into the carotid artery of a horse to measure blood temperature. The procedure was soon moved to other animals and used to measure intra-cardiac pressures (Lawrence, N.D.). In 1929 Werner Forssmann established cardiac catheterization procedure by performing the procedure on himself. (Lawrence, N.D.). Soon after the possibility of cardiac catheterization was confirmed, others around the world began to perform the procedure and testing the capabilities of catheterization.

Over the years, there have been significant advances in cardiac catheterization that allow for variety of procedures of today. Although the procedure itself has not changed much over time, the extremely advanced and expensive equipments have made Cath lab a significant capital investment for many hospitals.

In today‟s economy, getting the most value from Cath lab is crucial to survival in the increasingly competitive market for cardiovascular services. To meet the challenges and maintain fiscal health, hospitals are pursuing strategies to improve throughput, maximize equipment utilization and increase efficiency. Thus, understanding the complex workings and inter-relationships within the Cath lab setting is especially important to future success.

A detailed, comprehensive operational assessment of Cath lab can be an invaluable tool for creating a competitive edge in terms of clinical outcomes, operational efficiency, and/or financial performance.

In any assessment process, it is important to understand the base-line performance. Key steps must be taken to evaluate the program from start to finish in order to define areas of outstanding performance and also those that need quality-improvement or process-improvement. Despite the industry-wide focus on quality, and the endless quest for „best practice" at all hospitals, making change can be difficult. Considering cath department as an extremely complicated and important component of hospital, it is important that managers of this department be extremely familiar with the process flow and the technical details of the procedures conducted.

2.4 RESEARCH METHODOLOGY

- Type of study : Descriptive Study
- Location of study: Cath lab, Paras hospital, Gurgaon
- Duration of Study: 1 March 2014 to 31 March 2014
- Study Subjects: Patients in Cath lab, Records in Cath lab
- Sample: 90% of total patients operated in Cath lab during study period.
- Data collection tools: Observation, Review of records
- Data Analysis: MS Excel

CHAPTER 3 CARDIAC CATHETERIZATION LAB

OVERVIEW

Paras Hospitals, Gurgaon, is a 250 bedded tertiary hospital. The Cath lab complex consists of Procedure room, Console room, UPS room, Store. All elective lists are scheduled to run between 8AM and 8PM daily on weekdays (Monday to Saturday). Nights, weekends and holidays are reserved for emergencies. Along with cardiology procedures, few cases of interventional radiology are also performed in Cath lab.

STAFFING

A team of three full time Technicians along with four Nurses support a total of three permanent Cardiologists and a Junior Cardiologist. A medical transcriptionist is dedicated to department for handling reports and discharge summaries of cardiology. Two ancillary staff along with technicians manages all the areas described above.

STAFF TIMINGS

- ✓ **Cardiologists** work in full shift from 8 AM to 8 PM.
- ✓ **Technicians** work for 8 hours in two shifts
    - Moring shift : 9 AM to 5:30 PM
    - Evening shift: 12 PM to 8 PM
- ✓ **Nursing staff** works for 8 hours in two shifts
    - Moring shift : 8 AM to 4:30 PM
    - Evening shift: 12 PM to 8 PM

CHAPTER 4 DATA ANALYSIS – PHASE I

4.1 OVERVIEW

For this study, 72 months (March 2008- March 2014) of Cath lab Records were methodically studied. Analysis of the data collected from the records of Cath lab was perused so as to obtain an overview of workload in Cath lab and also yearly trends.

OBJECTIVES

1. To identify workload of Cath lab since inception.
2. To assess patient profile in terms of elective/emergency, route of catheterization, mode of payment.
3. To study overall process flow of Cath lab patients and different phases involved in Cath lab from "Patient In to Patient Out"

TYPE OF PROCEDURES

Total of 24 types of procedures are carried out in Cath lab

- **CARDIAC PROCEDURES**
- CAG
- RAG/PAG
- PTCA
- CHECK CAG
- EPS
- RFA
- TPI
- PPI
- IABP
- COMBO DEVICE
- BMV
- ASD/VSD/PDA CLOSURE
- IVC FILTER
- PERICARDIAL TAPPING
- ICD

- **NON CARDIAC PROCEDURES**
- CAROTID ANGIO
- DSA
- SPINAL DSA
- COILING
- EMBOLIZATION
- INTRA CRANIAL DRUG THERAPY
- PERMA CATH
- PTA/PTRA/CAROTID PLASTY
- PTBD

4.2 SUMMARY OF CARDIAC CATHETERIZATION LAB PROCEDURES

CARDIAC CATHETERIZATION

Cardiac catheterization is an invasive technique performed to further evaluate coronary artery disease, valvular heart disease, congestive heart failure, and/or certain congenital (present at birth) heart conditions, when other less invasive types of diagnostic tests indicate the presence of one of these conditions.

In cardiac catheterization (often called cardiac cath), a very small hollow tube, or catheter, is advanced from a blood vessel in the groin (FEMORAL ROUTE) or arm (RADIAL ROUTE) through the aorta into the heart. Once the catheter is in place, several diagnostic techniques may be used.

1. **Coronary Angiography (CAG):** Coronary Angiography is performed to diagnose any narrowing or blockage in coronary arteries. The catheter is advanced into the coronary arteries and a contrast dye injected into the arteries. The use of fluoroscopy (a special type of X-ray) assists the doctor in locating any blockages in the coronary arteries as the contrast dye moves through the arteries.

2. **Percutaneous Transluminal Coronary Angioplasty – (PTCA)** is performed to open blocked coronary arteries caused by coronary artery disease (CAD) and to restore arterial blood flow to the heart tissue without open-heart surgery. A catheter with a balloon on its tip is passed through to a coronary blockage. The balloon is inflated, splitting the plaque and stretching the wall of the coronary vessel to allow more blood flow to the heart muscle.

3. **Stenting:** A stent is a small, metal mesh tube that is placed within a coronary artery after balloon angioplasty to prevent the artery from re-stenosis. There are also drug-eluting stents coated with a special medication to further help prevent re-narrowing of the coronary arteries.

4. **Check CAG:** It is an angiography performed in patients with pain after angioplasty and stenting to check for any clotting or blockage.

5. **Intra-Aortic Balloon Pump (IABP)** is a mechanical device that is inserted into the aorta to improve myocardial oxygenation, increase cardiac output and organ perfusion with a reduction in left ventricular workload. After the IABP is placed inside aorta, the balloon is inflated during diastole to increase coronary perfusion and then deflated during systole to decrease after load. IABP is used as a supportive treatment tool.

6. **Temporary Pacemaker Insertion/ Permanent Pacemaker insertion (TPI/PPI)** A pacemaker insertion is the implantation of a small electronic device that is usually placed in the chest (just below the collarbone) to help regulate slow electrical problems with the heart. A pacemaker may be recommended to ensure that the heartbeat does not slow to a dangerously low rate. Temporary pacemakers are used to treat short-term heart problems, such as a slow heartbeat that's caused by a heart attack, heart surgery, or an overdose of medicine. They might be used until the doctor can implant a permanent pacemaker or until a temporary condition goes away. Permanent pacemakers are used to control long-term heart rhythm problems.

7. **Implantable Cardioverter Defibrillator (ICD)** is a battery-powered device placed under the skin that keeps track of heart rate. Thin wires connect the ICD to the heart. If an abnormal heart rhythm is detected the device will deliver an electric shock to restore a normal heartbeat. ICDs have been very useful in preventing sudden death in patients with known, sustained ventricular tachycardia or fibrillation.

8. B**iventricular implantable cardioverter-defibrillator (CRT-D)/ Combo Device** is used for Ventricular dyssynchrony (abnormal pumping pattern of heart) where less blood is pumped by the heart. A biventricular pacemaker paces both ventricles at the same time. This type of treatment is called cardiac resynchronization therapy or CRT. CRT defibrillators (CRT-D) also incorporate the additional function of an implantable defibrillator, to quickly terminate an abnormally fast, life-threatening heart rhythm.

9. **Atrial Septal Defect (ASD)/ Ventricular Septal Defect (VSD)/ patent ductus arteriosus (PDA) Closure** are therapeutic procedure of closing congenital defects of heart that otherwise causes blood flow between two compartments of the heart. The procedure involves placing a percutaneous closure device into the heart through catheters.

10. **Balloon Mitral Valvuloplasty (BMV)** is a therapeutic procedure of correcting symptomatic mitral valve stenosis by dilating the valve using a balloon. Under local anesthesia, a catheter with a special balloon is passed from the right femoral vein, up the inferior vena cava and into the right atrium. The catheter is passed into the left atrium using a "trans-septal technique" and the balloon is inflated in three stages.

11. **Radio frequency ablation (RFA):** It is an invasive procedure in which part of small areas of heart tissue, tumor or other dysfunctional tissue that may be causing your abnormal heartbeat is ablated using heat generated from high frequency alternative current.

12. **Pericardial Tapping/ Pericardiocentesis** is an invasive procedure in which a needle and catheter remove fluid from pericardium. The fluid is tested for signs of infection, inflammation, presence of blood, and cancer. Occasionally, it is performed on an emergency basis to treat a condition called cardiac tamponade, a life-threatening, rapid buildup of fluid around the heart that weakens its pumping ability. The procedure relieves pressure on the heart.

13. **Electrophysiological study (EPS)** is an invasive procedure that evaluated abnormal heart rhythm disturbances. During an EP study, small, thin wire electrodes are inserted through a vein in the groin (or neck, in some cases). The wire electrodes are threaded into the heart, using fluoroscopy. Once in the heart, electrical signals are measured. Electrical signals are sent through the catheter to stimulate the heart tissue to try to initiate the abnormal heart rhythm disturbances for evaluation.

14. **Carotid angiography:** It is an invasive imaging procedure to detect the presence of narrowing or blockage in carotid arteries and determine risk for future stroke.

15. **Renal artery angiography/ Peripheral artery angiography (RAG/PAG**): It is an angiography procedure to detect any narrowing/ blockage in renal arteries and peripheral arteries respectively.

16. **PTA/PTRA/ASA/Carotid Plasty:** It is angioplasty of peripheral arteries/ renal artery/ carotid artery.

17. **Digital Subtraction Angiography (DSA)** is a procedure that uses a contrast material and x-rays to see how blood flows through the brain. In this procedure computer removes the bones and tissues on the images being viewed, so that only the blood vessels filled with the contrast dye are seen.

18. **Percutaneous transhepatic biliary drainage (PTBD)**: It is a procedure to drain the bile ducts in presence of a blockage or damage that prevents normal bile drainage. Fluoroscopy is used to allow visualization during procedure.

19. **Embolization**: Embolization treatment is for arterio-venous malformations (AVMs) of the brain and spinal cord. This procedure involves the injection of glue or other non-reactive liquid adhesive material into the AVM in order to block it off. The result is that the flow of blood through the AVM is blocked off, thus there is no further risk of bleeding.

20. **Endovascular Coiling:** Coiling is a minimally invasive endovascular procedure performed to treat an aneurysm. Endovascular describes the technique of accessing the aneurysm from within the bloodstream, specifically during angiography. A flexible catheter is advanced from the femoral artery to one of four arteries in the neck that lead to the brain. While viewing under fluoroscope, the doctor steers the catheter through the blood vessels. Once the catheter reaches the aneurysm, platinum wire is inserted into aneurysm forming coils over which clot forms and prevent from rupture.

21. **Inferior Vena cava filter (IVC filter)** is a type of vascular filter which is implanted into inferior vena cava to prevent significant pulmonary embolism arising from a deep vein thrombosis. The filter is designed to capture an embolism, a blood clot that has broken loose from one of the deep veins in the legs on its way to the heart and lungs.

22. **Permacath:** is an access device used for haemodialysis. It can provide access to the vascular system for a year, or it can be used as a point of permanent access. Permacath allow for a patient who needs kidney dialysis to avoid multiple catheter insertions. It can also be used to administer caustic medication such as chemotherapy that causes injury to veins.

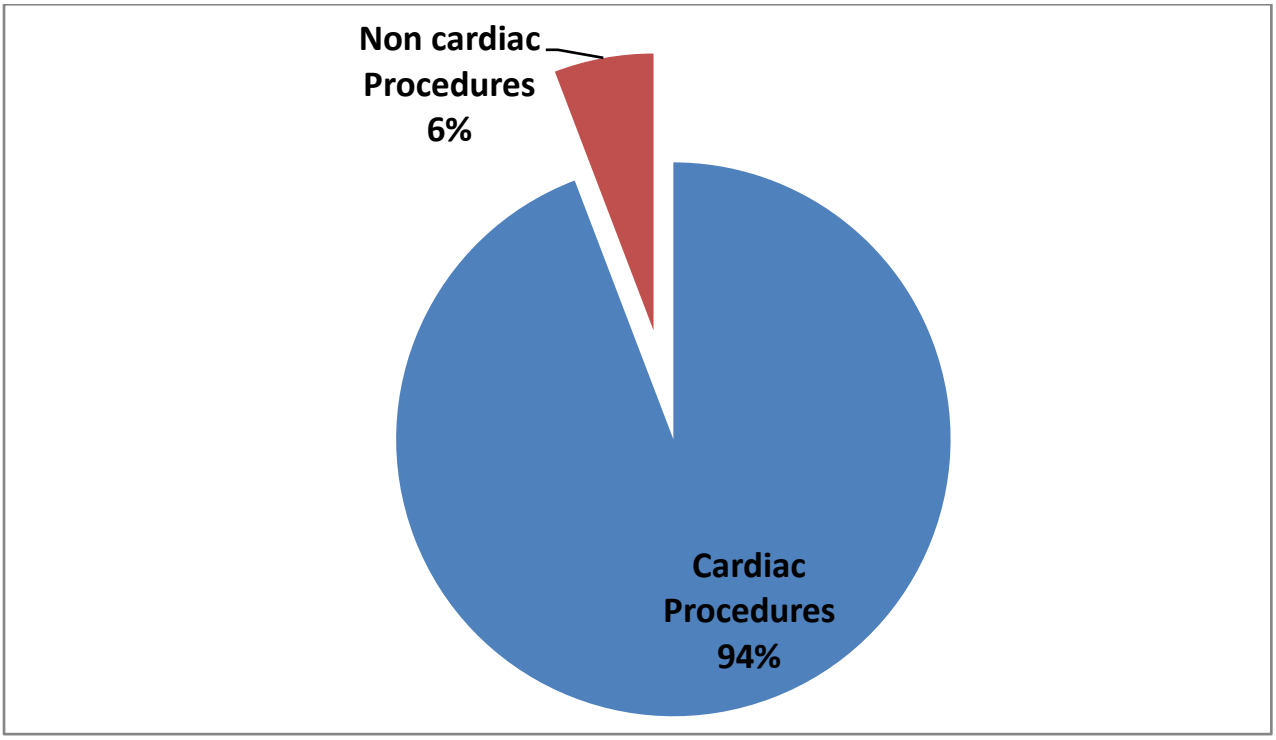
4.3 DATA ANALYSIS

Objective1. To identify workload of Cath lab since inception.

Table 4.1: Year wise utilization of Cath lab (March 2008- March 2014)

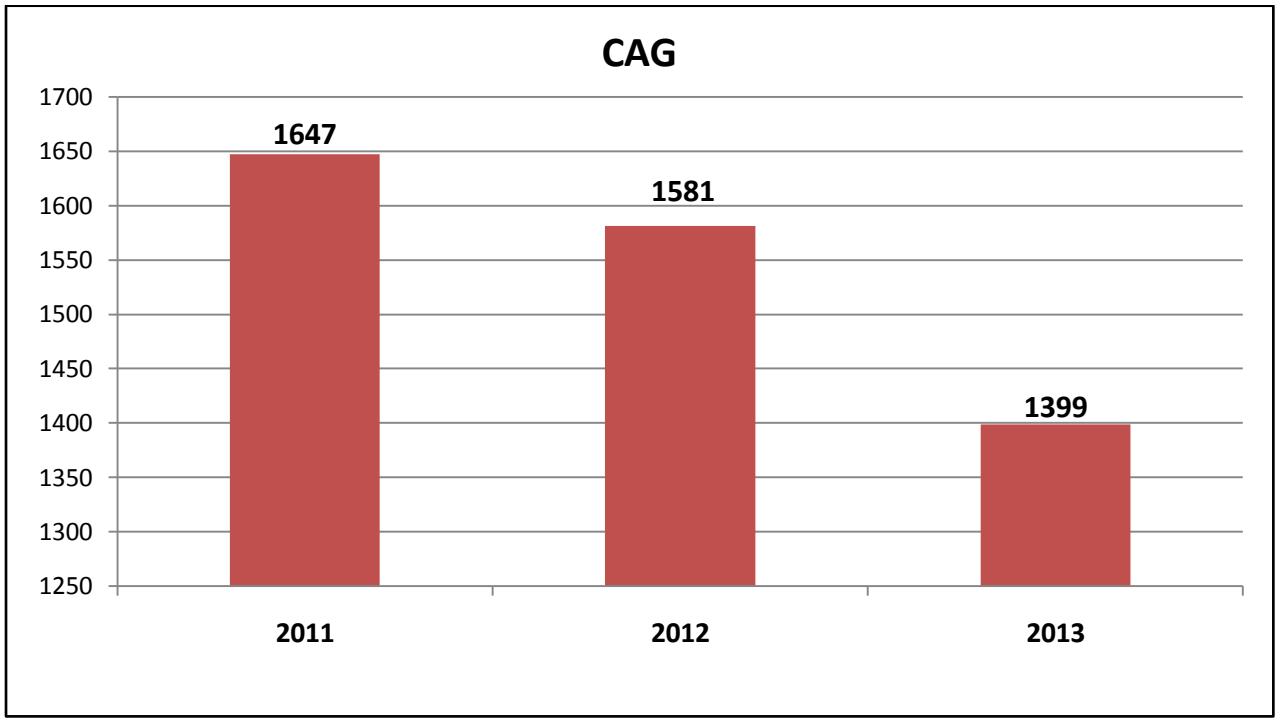
Year	Total cases	Average/ Month
2008 (9 months)	643	71
2009	1148	96
2010	1664	139
2011	3602	300
2012	2895	241
2013	2620	218
2014 (3 months)	451	150

Figure 4.1: Average operated cases specialty wise



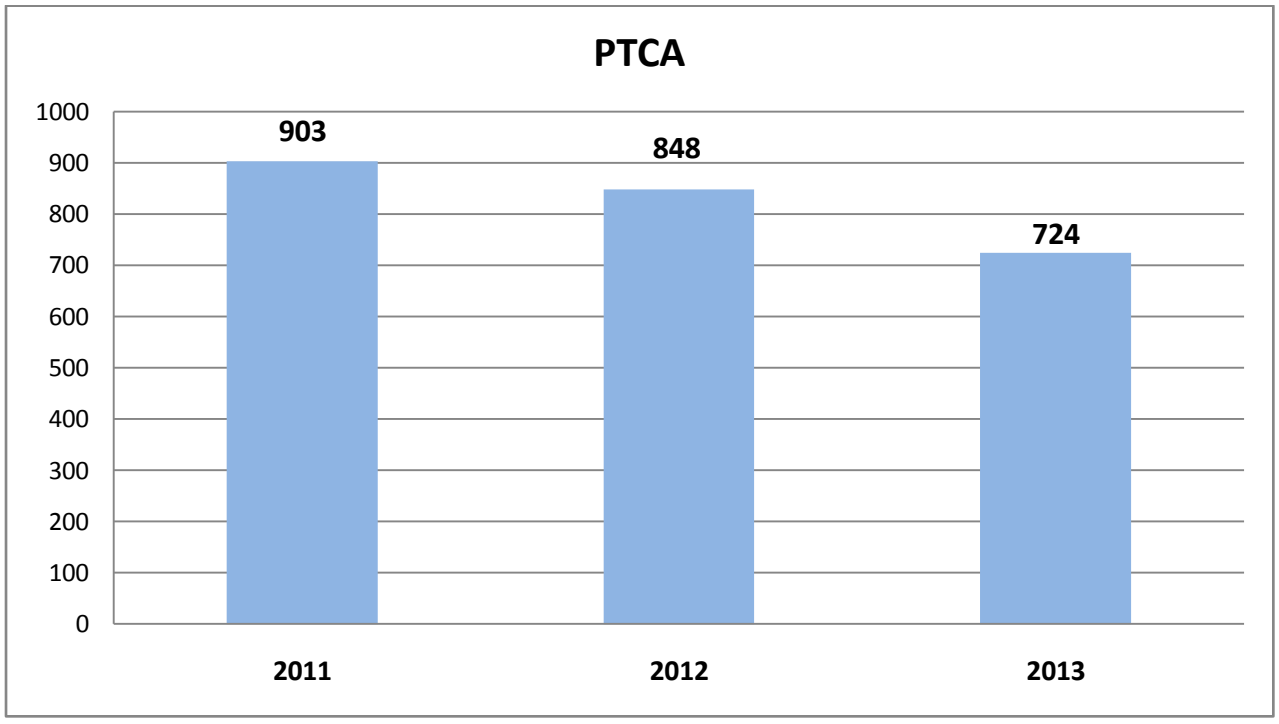
94% of total cases performed in Cath lab are cardiac procedures.

Figure 4.2: Year wise total cases of CAG (2011-2013)



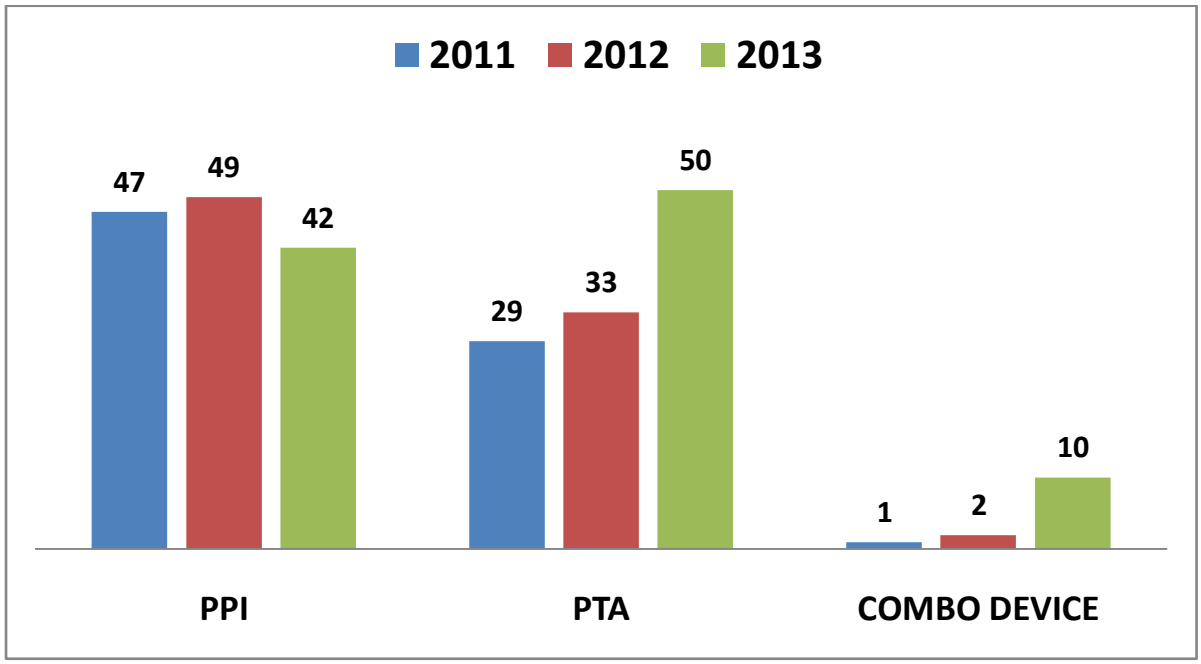
A decline of 4% and 11.5 % amongst CAG cases was seen in 2012 and 2013

Figure 4.3: Year wise total cases of PTCA (2011-2013)



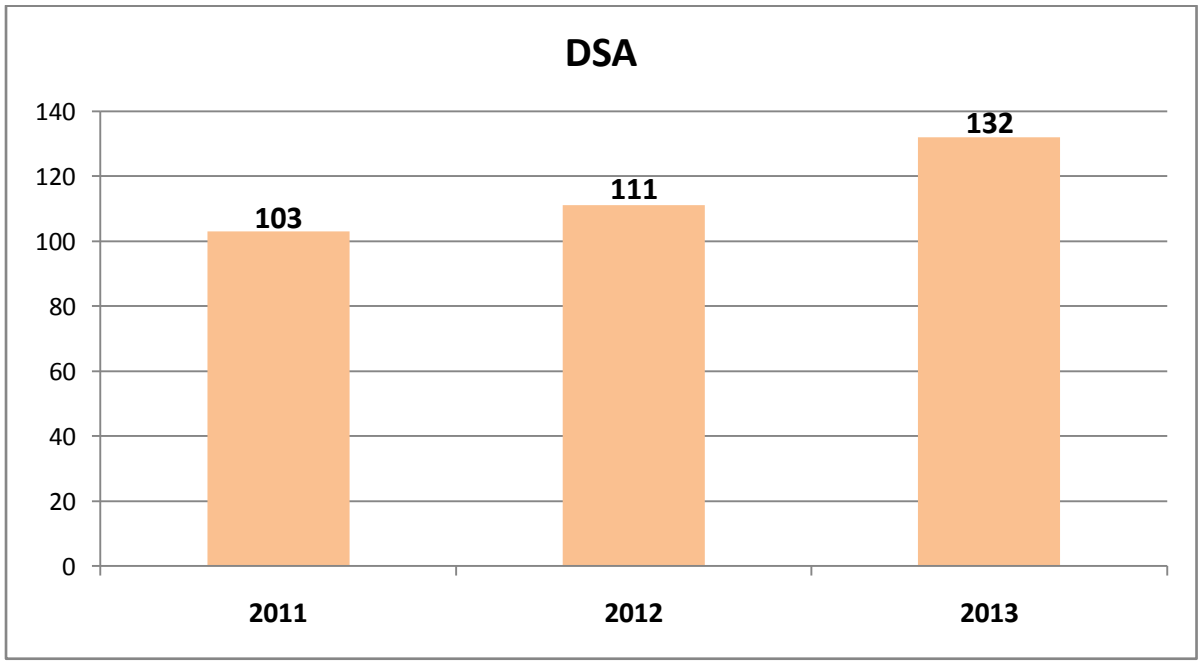
A decline of 6% and 14.6 % amongst PTCA cases was seen in 2012 and 2013

Figure 4.4: Year wise total cases of PPI, PTA, COMBO DEVICE (2011-2013)



It was noted that no significant change was seen in number of PPI cases in last three years where as 34 % and 80% increases was seen in PTA and Combo device cases respectively in year 2013.

Figure 4.5: Year wise total cases of DSA (2011-2013)



A steady increase of 7% and 16% was seen in DSA cases in 2012 and 2013

Figure 4.6: Year wise first quarter procedure trend (2011-2014)

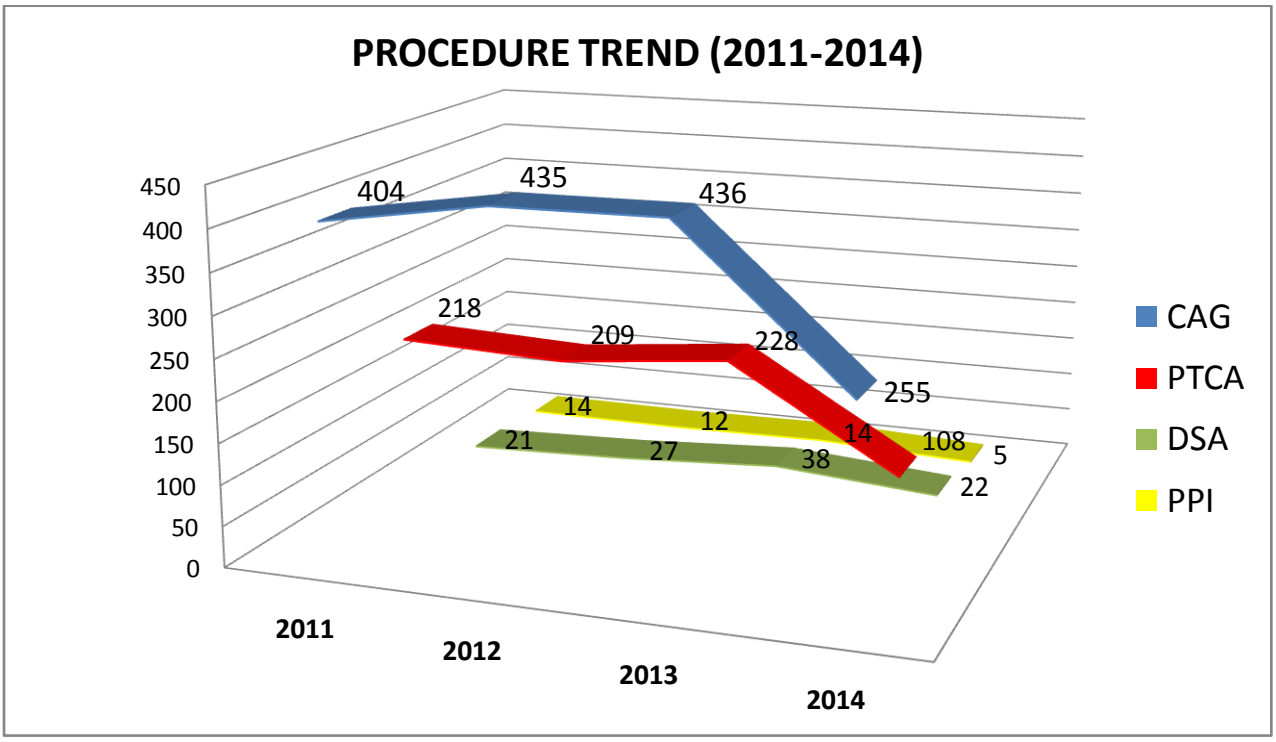


Figure 4.7: First quarter trend of total cases (2011-2014)

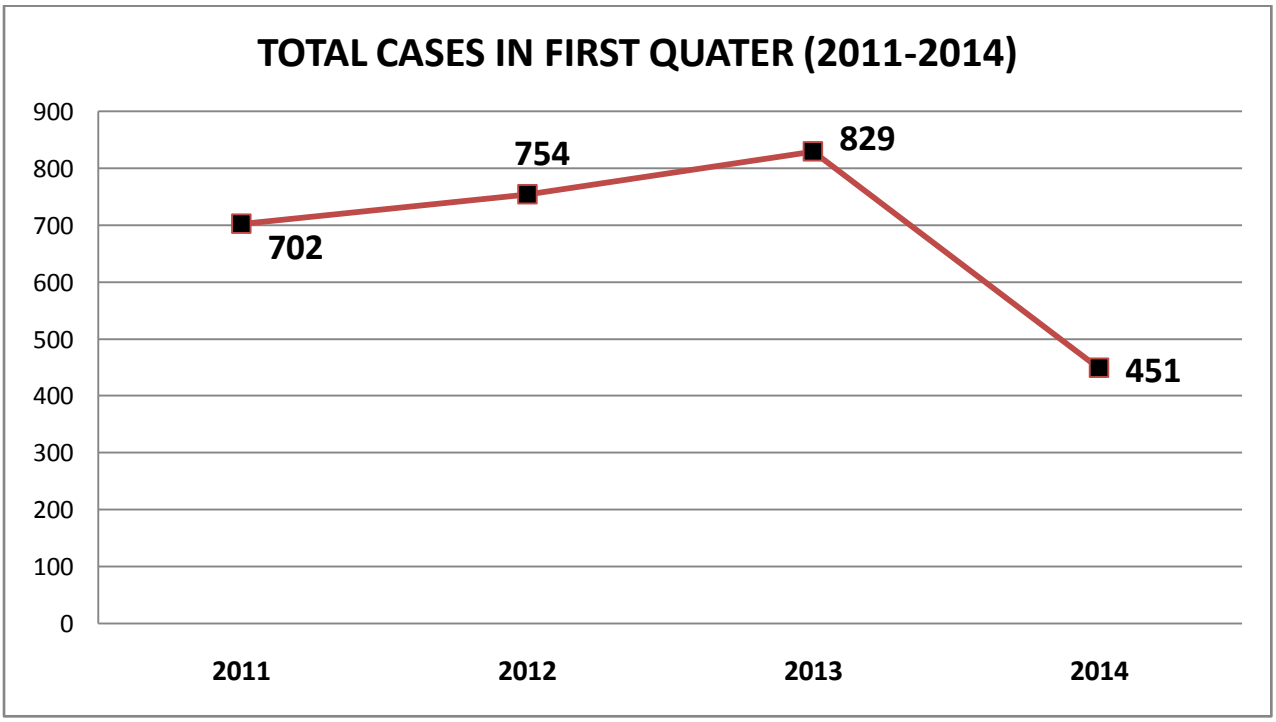


Figure 4.7 shows a significant fall of 45.59% in total number of cases for first quarter of 2014

Objective 2: To assess patient profile in terms of elective/ emergency, route of catheterization, mode of payment.

Figure 4.8: Patient inflow pattern in Cath lab (2013-2014)

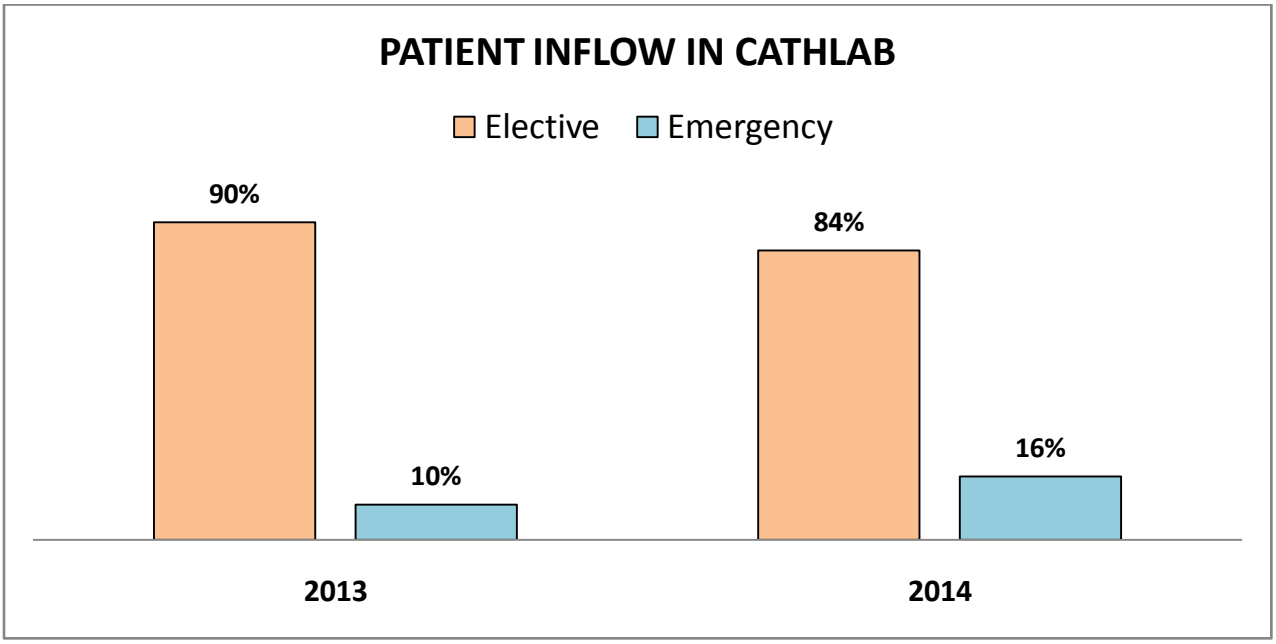
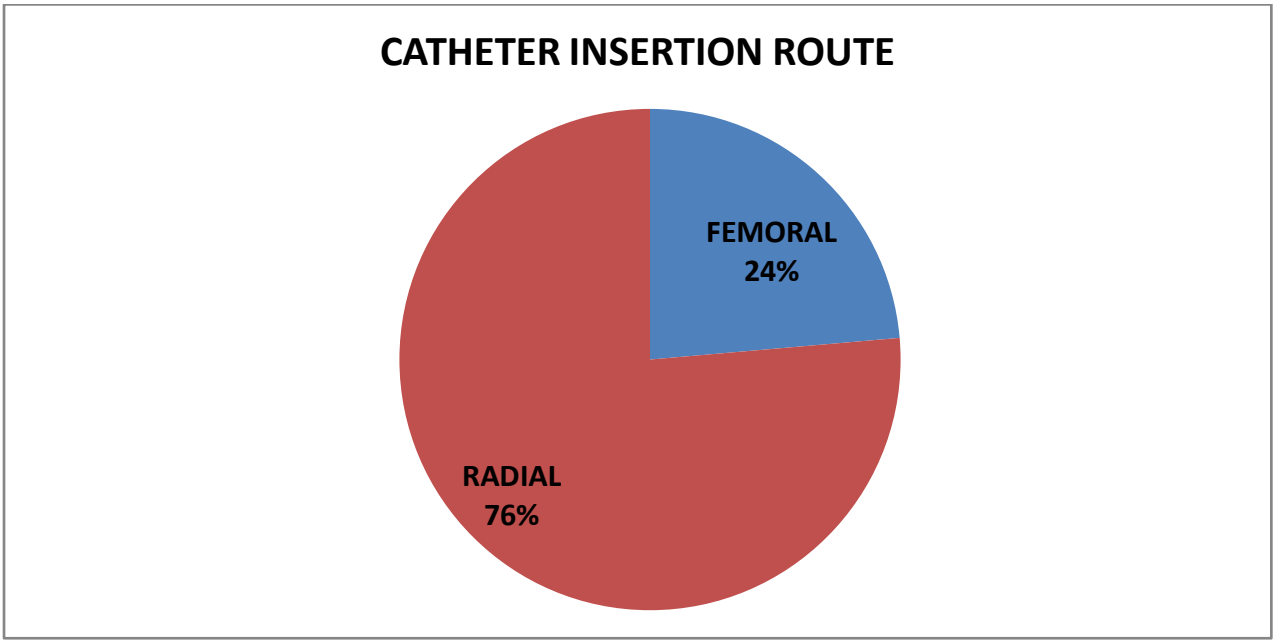


Figure 4.9: Preferred catheter insertion route by cardiologists



Trans-radial (76%) is the preferred procedure route for surgeons since January 2014

Figure 4.10: Patient profile in terms of mode of payment in Cath lab (January 13-March 13)

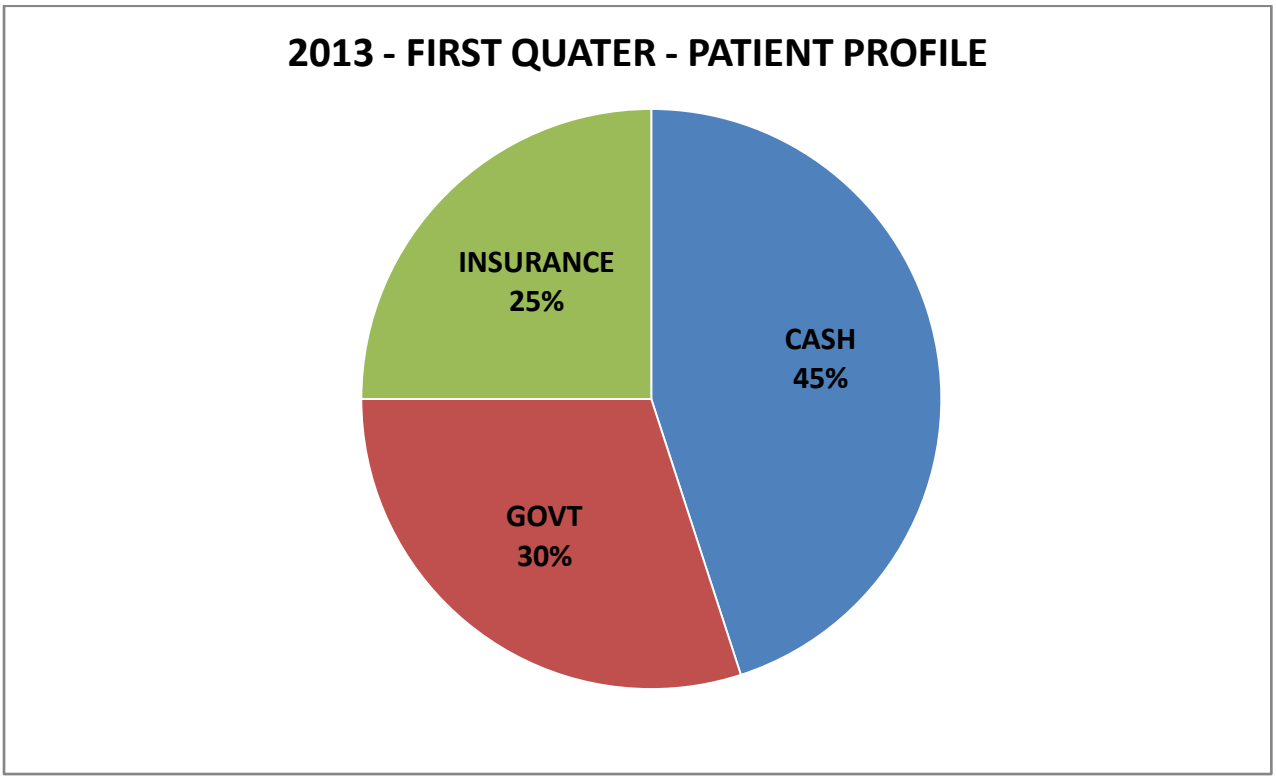
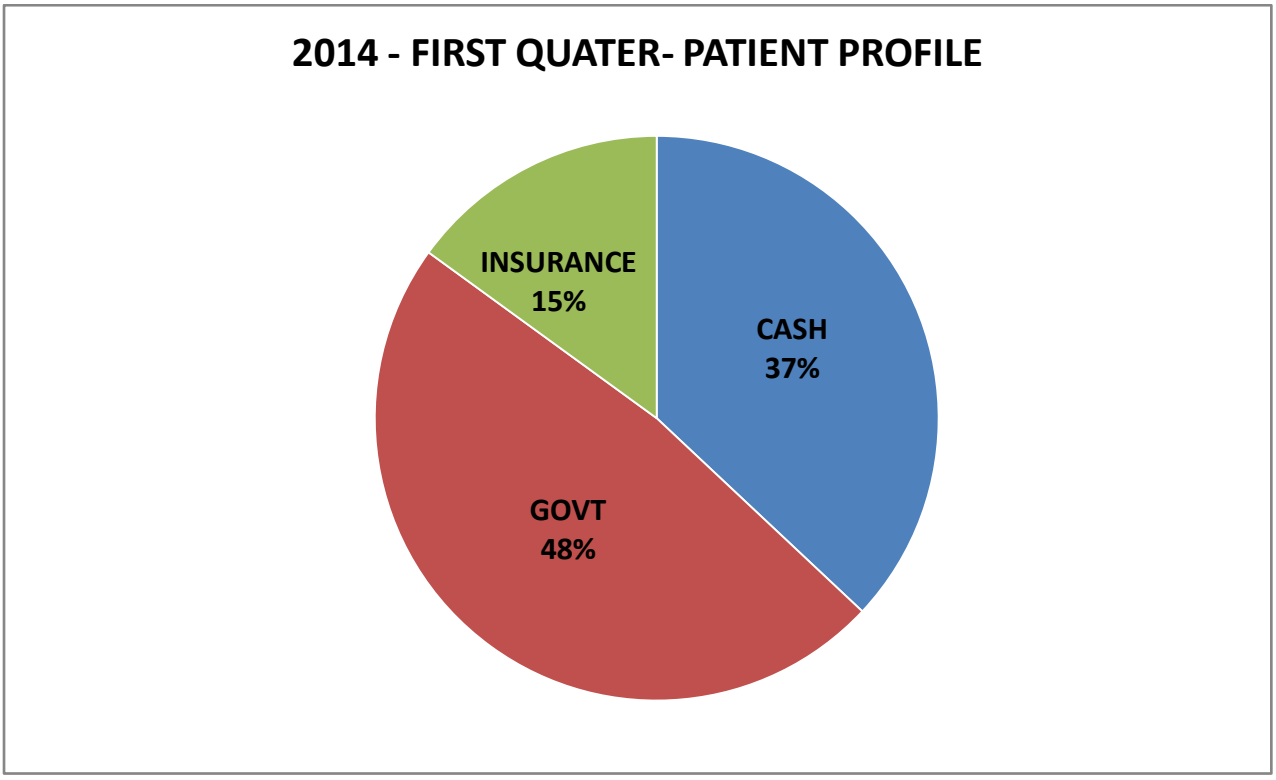


Figure 4.11: Patient profile in terms of mode of payment in Cath lab (January 14-March 14)



Objective 3: To study overall process flow of Cath lab patients and different phases involved in Cath lab from "patient in to patient out"

Figure 4.12: Process map groups of patients in Cath lab

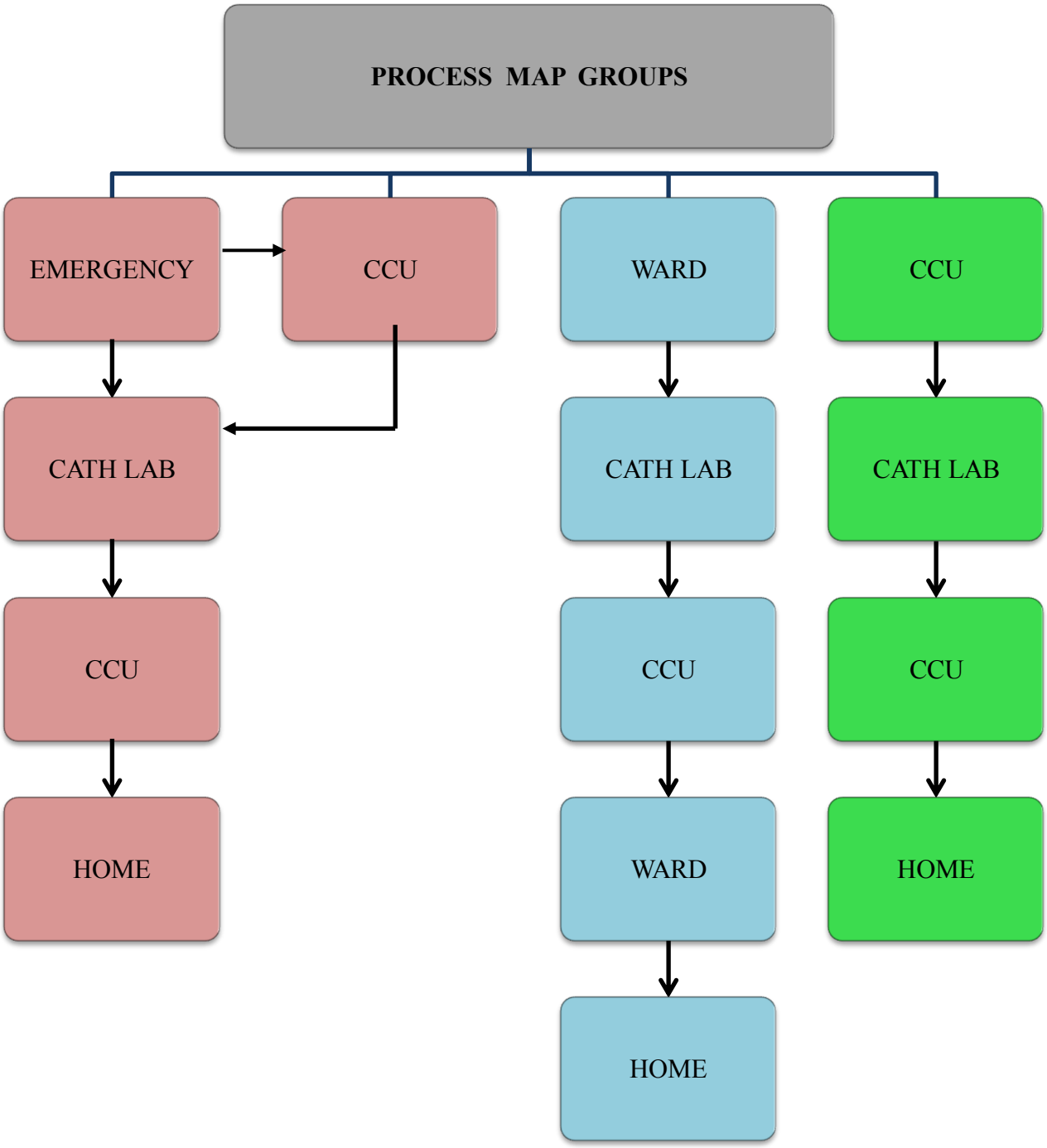
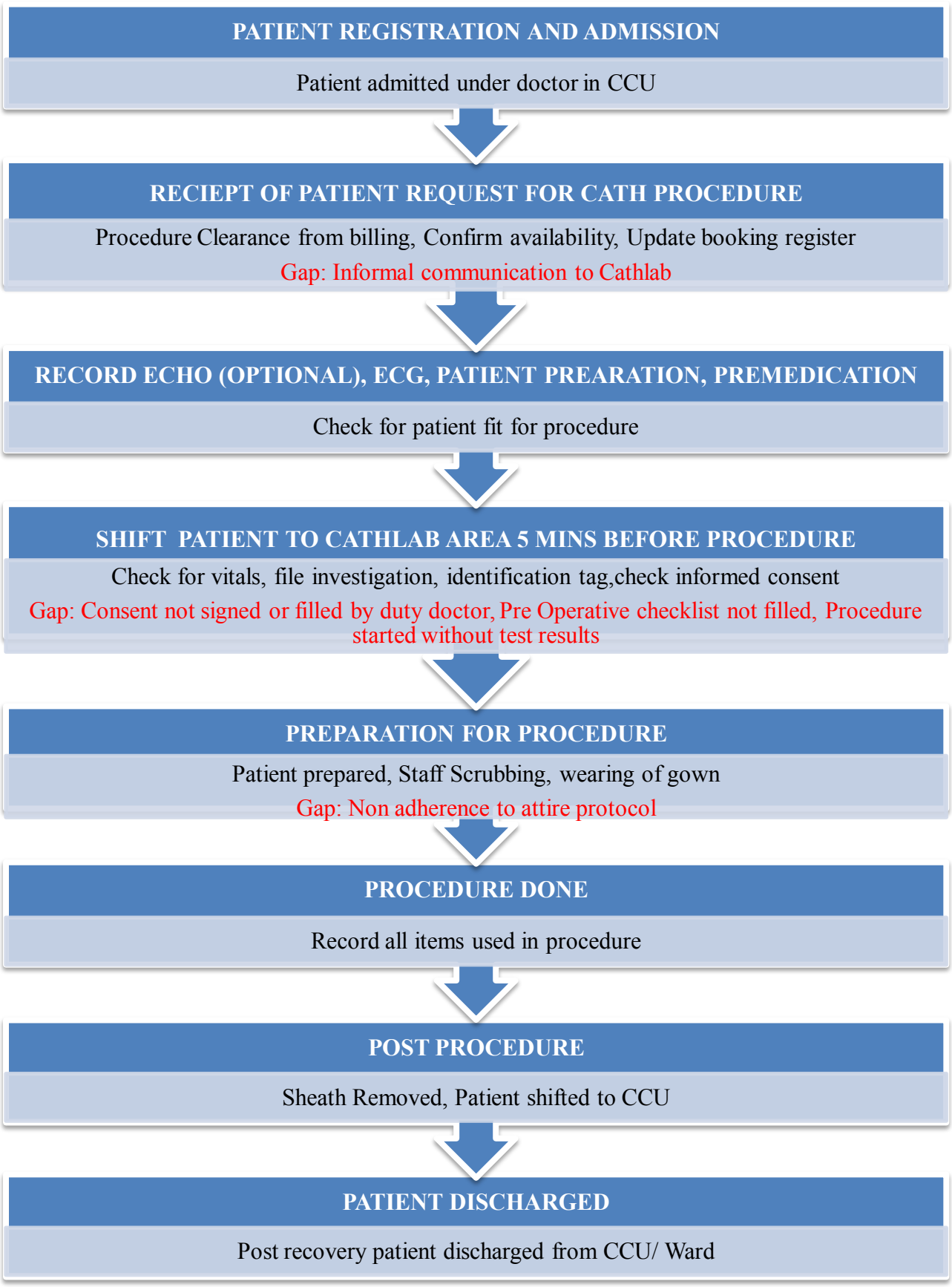


Figure 4.13: Overall process flow for Cath lab procedure



CHAPTER 5 DATA ANALYSIS PHASE- II

OVERVIEW

Data analysis in the second phase was done in Cath lab (Cath lab Time Utilization Study). Cases from 1st March 2014 till 31st March 2014 were observed.

A time and motion study was carried out in phase II. The actual time patients spent in various activities while in the Cath lab were measured such as patient in time, procedure start time, procedure end time, patient out time. In all, 5 stages were identified starting from the time patient entered into Cath lab to the time patient the patient left the Cath lab.

The incidence of and reasons for case delay were also recorded.

OBJECTIVES

- ✓ To analyze Cath lab time utilization and patient turnaround time.
- ✓ To assess the functional bottlenecks in optimum utilization of Cath lab.
- ✓ To evaluate Cath lab in terms of quality i.e. patient safety, employee safety, documentation.
- ✓ To propose key metrics for Cath lab.

DATA ANALYSIS

CALCULATION OF PATIENT TURNAROUND TIME AND CATH LAB TIME UTILIZATION (1ST MARCH 2014- 31ST MARCH 2014)

Total no. of Cath lab: 1

Total no. of procedures done in Cath lab: 133

Total no. of elective procedures done in Cath lab: 114

Total no. of emergency procedures done in Cath lab: 19

Working Hours of Cath lab: 12 hours

No. of Sundays in the study period: 5

No. of working days: 26

Total time available per day: 12 hours = 720 minutes

Total emergency time available per day: 24hours = 1440 minutes

CATH LAB UTILIZATION = $\frac{Number\ \ of\ hours\ used\ \ for\ procedures}{Number\ \ of\ hours\ available\ \ \ for\ procedure}$

PATIENT TURNAROUND TIME = *Patient Out Time – Patient In Time*

AVAILABLE MANPOWER HOURS

TECHNICIAN	NURSING
1x (9am to 4:30pm) = 7.5 hours	2x (8am to 4:30pm) = 17 hours
1x (12pm to 8 pm) = 8 hours	2x (12pm to 8pm) = 16 hours
1x (9:30am to 5pm) = 7.5 hours	TOTAL= 33 hours
TOTAL= 23 hours	

Objective 1: To analyze Cath lab time utilization and patient turnaround time.

Table 5.1: Distribution of cases per hour in a day (Jan 2014- Mar 2014)

TIME	JANUARY	FEBRUARY	MARCH
8am-9am	5	6	5
9am-10am	14	11	9
10am-11am	19	10	11
11am-12pm	12	17	9
12pm-1pm	18	15	15
1pm- 2pm	15	10	9
2pm-3pm	17	20	16
3pm-4pm	13	20	23
4pm-5pm	16	9	6
5pm-6pm	14	16	9
6pm-7pm	5	5	7
7pm-8pm	3	7	5
8pm-8am	4	11	9
TOTAL	**155**	**157**	**133**

Table 5.1 shows that there is uneven distribution of workload during the day with maximum workload between 9 AM and 6 PM.

Table 5.2: Distribution of cases in the month of March 2014

DATE	8am - 9am	9am -10am	10am -11am	11am -12pm	12pm -1pm	1pm - 2pm	2pm - 3pm	3pm - 4pm	4pm - 5pm	5pm - 6pm	6pm - 7pm	7pm - 8pm	8pm - 8am
1-Mar						1	1	1		1		1	1 (ELC)
2-Mar								3					
3-Mar		1			1			2					
4-Mar				1	1			1	1				1 (ELC)
6-Mar		1	1	1	1		1		2				
7-Mar		1	2		2	1					1	2	
8-Mar	1			1	1					2			
10-Mar			1			1	2	1					
11-Mar		1			1								
12-Mar			1		1		2	1		2	1		
13-Mar							1	1					
14-Mar	2						1						
15-Mar					1			1					
17-Mar	1							2					
18-Mar					1	1							1 (ELC)
19-Mar			2		1		1	2					1 (EMR)
20-Mar						1							
21-Mar				1				1		1			
22-Mar				1		1	3		1		3		
24-Mar		2		1			1						
25-Mar			1		1			2					2 (EMR)
26-Mar		1		1	2		1	1	1		1	1	
27-Mar		1				1		1		1	1	1	3 (EMR-2, ELC-1)
28-Mar	1		1	1	1	1	1	2	1	1			
29-Mar		1		1		1	1			1			
31-Mar			2					1					
TOTAL	**5**	**9**	**11**	**9**	**15**	**9**	**16**	**23**	**6**	**9**	**7**	**5**	**9**

Note: Red box indicates emergency cases.

Table 5.2 shows that 4 out of 9 cases done in emergency hours were elective cases indicating inefficient scheduling.

Table 5.3: Daily utilization of the Cath Lab from 8AM to 8PM - March 2014

Date	No. of cases	First Case start time	Last Case end time	Total Room In-Out time (minutes)	Un-utilized time (minutes)	Total time available	% utilized
1/3/2014	5	13:00	21:25	315	405	720	43.75%
2/3/2014	3	15:30	17:00	90	0	720	0.00%
3/3/2014	4	9:15	16:55	340	380	720	47.22%
4/3/2014	4	11:15	18:00	225	495	720	31.25%
6/3/2014	7	9:20	17:05	395	325	720	54.86%
7/3/2014	9	9:00	19:55	355	365	720	49.31%
8/3/2014	4	7:45	18:00	180	540	720	25.00%
10/3/2014	5	10:40	17:15	320	400	720	44.44%
11/3/2014	2	9:30	13:25	85	635	720	11.81%
12/3/2014	8	10:05	19:15	440	280	720	61.11%
13/3/2014	2	14:20	16:05	70	650	720	9.72%
14/3/2014	3	8:35	15:10	150	570	720	20.83%
15/3/2014	2	12:20	16:15	75	645	720	10.42%
17/3/2014	2	7:45	17:20	215	505	720	29.86%
18/3/2014	2	12:10	14:15	90	630	720	12.50%
19/3/2014	6	10:25	17:45	325	395	720	45.14%
20/3/2014	1	13:35	14:40	65	655	720	9.03%
21/3/2014	3	11:55	17:30	275	445	720	38.19%
22/3/2014	9	11:20	19:30	340	380	720	47.22%
24/3/2014	4	9:55	15:15	165	555	720	22.92%
25/3/2014	4	10:50	15:45	145	575	720	20.14%
26/3/2014	9	9:15	19:55	520	200	720	72.22%
27/3/2014	6	9:00	20:00	575	145	720	79.86%
28/3/2014	10	8:05	18:05	495	225	720	68.75%
29/3/2014	5	9:40	17:15	295	425	720	40.97%
31/3/2014	3	10:07	15:54	152	568	720	21.11%
TOTAL	**124**			**6697 111.6hours**	**11393**	**18720 312 hours**	**35.29%**

Analysis of the data collected from Cath Lab with regard to Cath Lab utilization revealed that by and large Cath Lab was not adequately utilized as per the current working schedule.

THE OVERALL CATH LAB UTILIZATION WAS 35.29%

Figure 5.1 Percent utilization trend from 8Am to 8 PM for March 2014

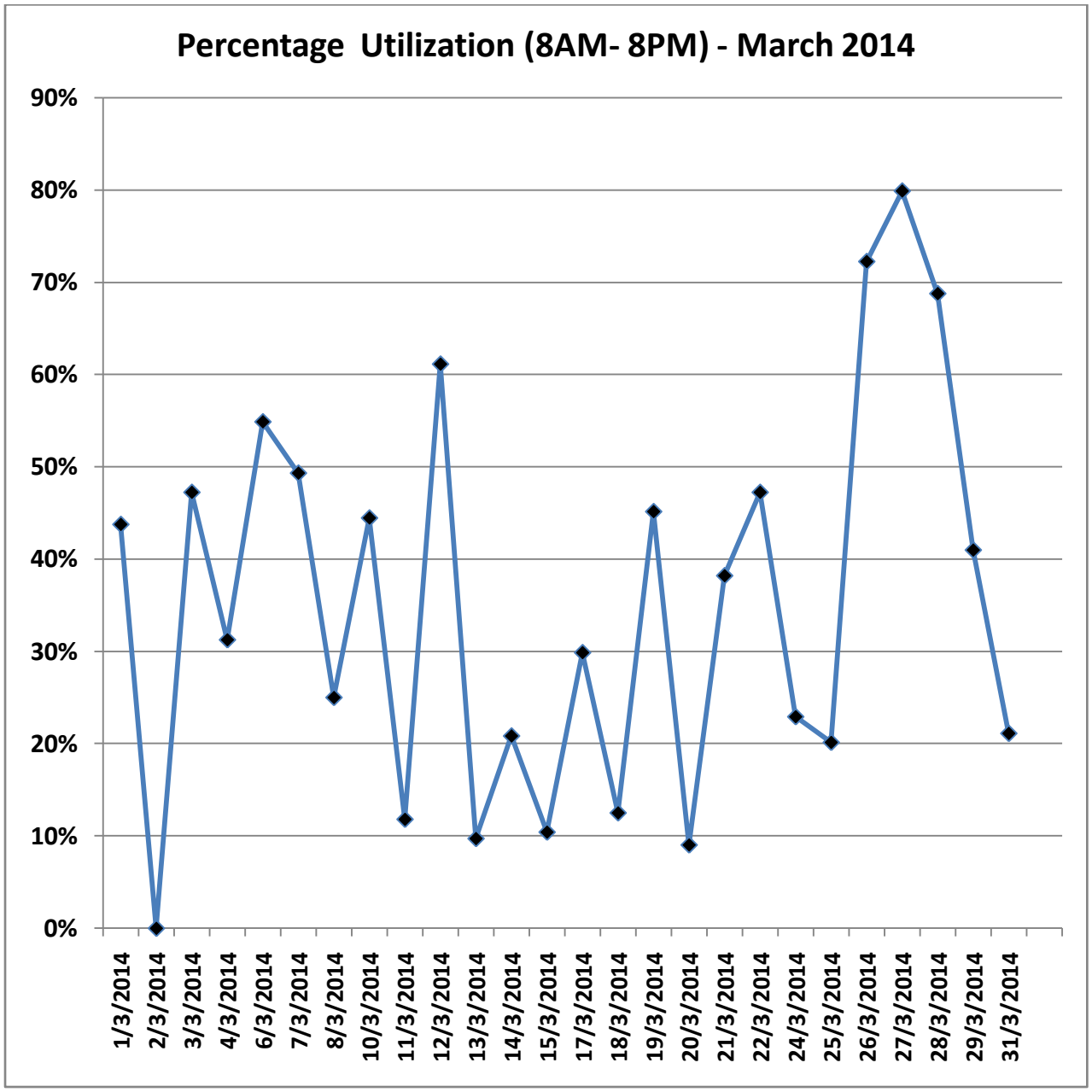


Figure 5.1 shows uneven utilization of Cathlab on daily basis for the month of March. These fluctuations in trend represent an issue of scheduling in Cath lab.

Table 5.4: Daily utilization of the Cath Lab from 8PM – 8AM (emergency) – March 2014

Date	No. of cases	First Case start time	Last Case end time	Time taken (minutes)	Un-utilized time (minutes)	Total time available	% utilized
1/3/2014	1	21:30	22:15	45	675	720	6.25%
2/3/2014						720	0.00%
3/3/2014						720	0.00%
4/3/2014	1	11:15	20:40	35	685	720	4.86%
5/3/2014						1440	0.00%
6/3/2014						720	0.00%
7/3/2014						720	0.00%
8/3/2014						720	0.00%
9/3/2014						1440	0.00%
10/3/2014						720	0.00%
11/3/2014						720	0.00%
12/3/2014						720	0.00%
13/3/2014						720	0.00%
14/3/2014						720	0.00%
15/3/2014						720	0.00%
16/3/2014						1440	0.00%
17/3/2014						720	0.00%
18/3/2014	1	20:00	21:00	60	660	720	8.33%
19/3/2014	1	22:05	22:25	20	700	720	2.78%
20/3/2014						720	0.00%
21/3/2014						720	0.00%
22/3/2014						720	0.00%
23/3/2014						1440	0.00%
24/3/2014						720	0.00%
25/3/2014	2	21:40	23:40	120	600	720	16.67%
26/3/2014						720	0.00%
27/3/2014	3			75	645	720	10.42%
28/3/2014						720	0.00%
29/3/2014						720	0.00%
30/3/2104						1440	0.00%
31/3/2014						720	0.00%
TOTAL	**9**			**355**	**3965**	**25920**	**1.37%**

Cath Lab is available 24/7 for emergency cases. Thus utilization includes 720 minutes (8PM to 8AM) on weekdays along with 1440 minutes (24 hours) of each Sunday of the month

OVERALL EMERGENCY CATH LAB UTILIZATION WAS ONLY 1.37%

Out of these 170 minutes i.e. nearly 48% of time was utilized by elective cases which add to overtime of staff.

Objective 2: To analyze the functional bottlenecks in optimum utilization of Cath Lab.

Following reasons were observed that account for under utilization of Cath Lab

1. Decrease in total number of cases

2. Lack of schedule predictability

a. No scheduling of cases is done for next day.

b. No protocol for case booking of ad on cases from OPD.

c. No formal channel of communication for informing planned cases.

d. Nursing staff of Cath Lab calls CCU and wards in the morning to ask for planned cases

3. Late start

a. Delay due to shifting of patients in Cath Lab from ICU/ward

b. Delay due to surgeon. (No defined time slot for OPD consultation and Cath Lab cases).

4. Delay between procedures

a. Delay due to lack of consent from patient/attendant

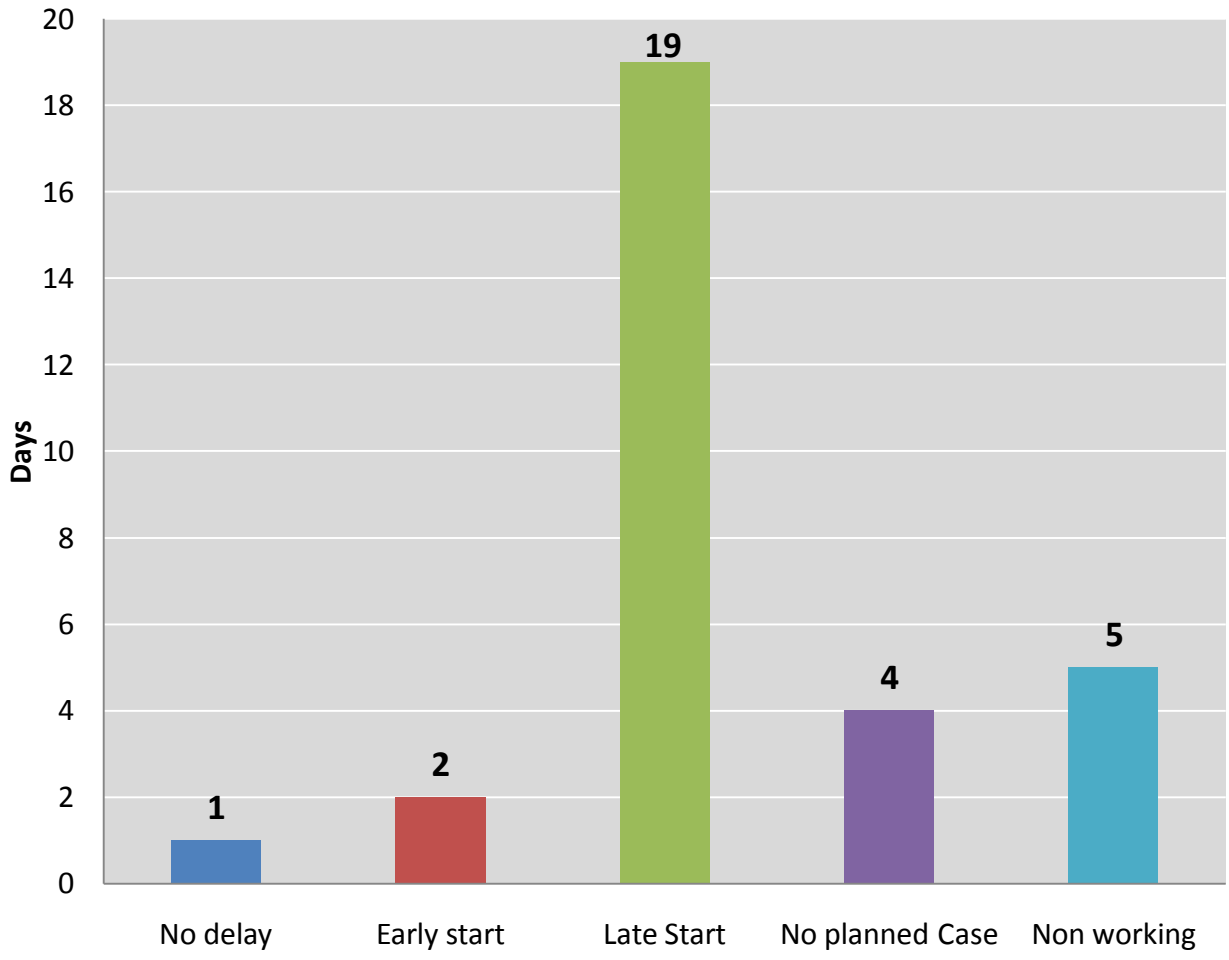
b. Delay in searching for right equipment.

c. Delay due to ongoing case in Cath Lab

d. Delay due to late reporting of patient to the Cath Lab

LATE START OF CATH LAB

Figure 5.2: Delay in first case start time



It was noted that there was a significant late start for Cath Lab. There was a delay on 23 out of 26 working days. Considering that on 4 days out of 23 there was no case planned for the day, 19 days were observed for late start out of 26 working days.

DELAY ON 19 OUT OF 26 WORKING DAYS I.E 73.07%

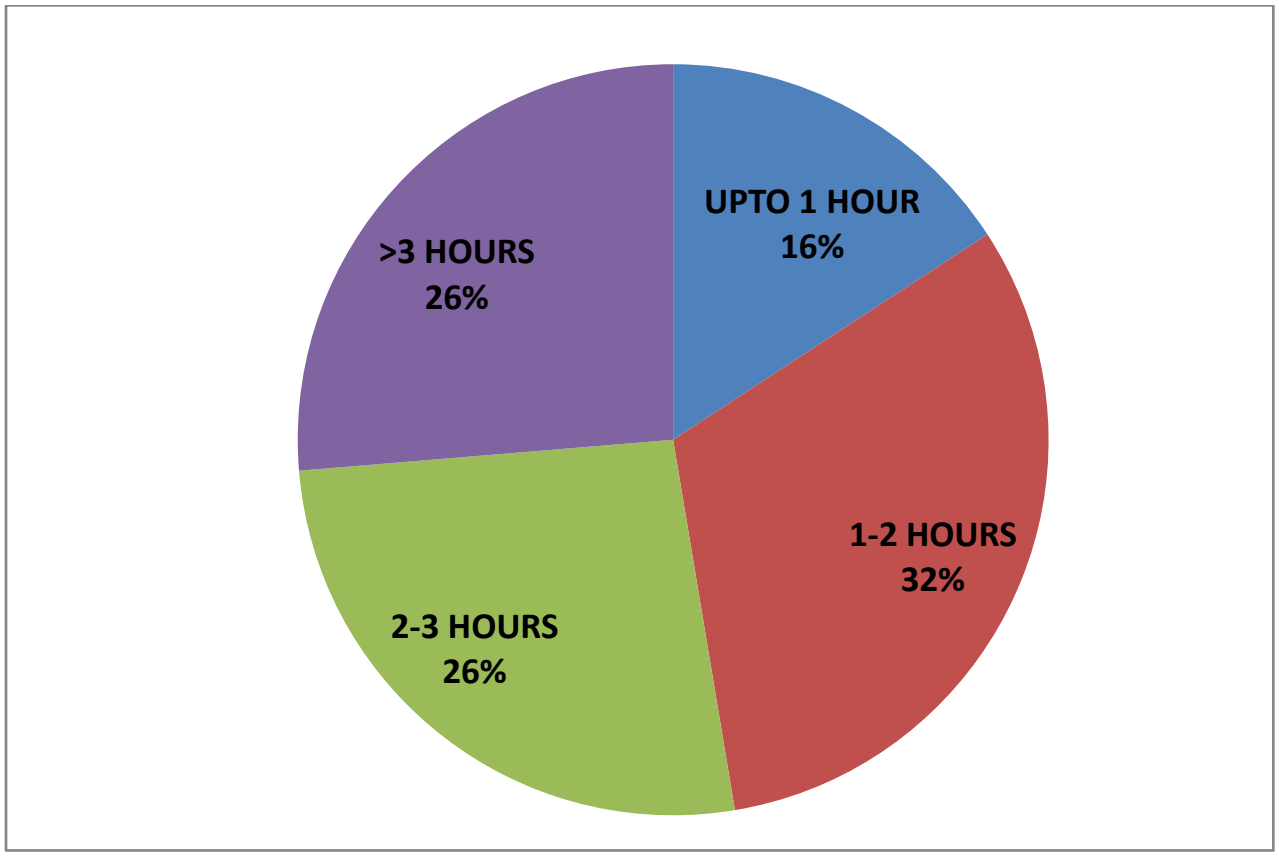
Table 5.5: Delay in first case start in Cath Lab – March 2014

Date	No. of Cases	First Case started	Cath Lab start time	Delay in first case start (minutes)
1/3/2014	6	13:00	8:00	300
3/3/2014	3	9:15	8:00	75
4/3/2014	5	11:15	8:00	195
6/3/2014	7	9:20	8:00	80
7/3/2014	7	9:00	8:00	60
10/3/2014	5	10:40	8:00	160
11/3/2014	2	9:30	8:00	90
12/3/2014	6	10:20	8:00	140
14/3/2014	1	8:35	8:00	35
18/3/2014	3	12:10	8:00	250
19/3/2014	6	10:25	8:00	145
21/3/2014	3	11:55	8:00	235
22/3/2014	9	11:20	8:00	200
24/3/2014	4	9:55	8:00	115
25/3/2014	4	10:50	8:00	170
26/3/2014	9	9:15	8:00	75
27/3/2014	7	9:00	8:00	60
29/3/2014	5	9:40	8:00	100
31/3/2014	3	10:07	8:00	127
TOTAL	**114**			**2612**

Ideally for maximum utilization and better efficiency, Cath Lab should start at 8:00 AM. Therefore considering 8:00 AM as start time, 19 days were analyzed for average delay in first case start. Total time lost due to delay in first case start was 2612 minutes ≈ 43.5 hours

AVERAGE DAILY DELAY IN FIRST CASE START IN CATH LAB: 119 MIN = 2 hours

Figure 5.3: Late Start in terms of hours



A significant late start of 2 hours and above was seen in more than 50% of late start days. Total productive time lost due to delay in first case start was 2612 minutes ≈ 43.5 hours

Table 5.6: Start, end and un-utilized time in Cath Lab during elective procedures- March 2014

Date	No. of cases	First Case started	Last Case ended	Time taken for cases (minutes)	Total utilization of Cath Lab (minutes)	Time lost between cases (minutes)
1/3/2014	s	13:00	21:25	315	505	190
2/3/2014	3	15:30	17:00	90	90	0
3/3/2014	4	9:15	16:55	340	460	120
4/3/2014	4	11:15	18:00	225	405	180
6/3/2014	6	9:20	17:05	395	465	70
7/3/2014	9	9:00	19:55	355	655	300
8/3/2014	4	7:45	18:00	180	615	435
10/3/2014	5	10:40	17:15	320	395	75
11/3/2014	2	9:30	13:25	85	235	150
12/3/2014	8	10:05	19:15	440	550	110
13/3/2014	2	14:20	16:05	70	105	35
14/3/2014	3	8:35	15:10	150	395	245
15/3/2014	2	12:20	16:15	75	235	160
17/3/2014	2	7:45	17:20	215	575	360
18/3/2014	2	12:10	21:00	90	530	440
19/3/2014	6	10:25	17:45	325	440	115
20/3/2014	1	13:35	14:40	65	65	0
21/3/2014	3	11:55	17:30	275	335	60
22/3/2014	9	11:20	19:30	340	490	150
24/3/2014	4	9:55	15:15	165	320	155
25/3/2014	4	10:50	15:45	145	295	150
26/3/2014	9	9:15	19:55	520	640	120
27/3/2014	6	9:00	20:35	575	695	120
28/3/2014	10	8:05	18:05	495	600	105
29/3/2014	5	9:40	17:15	295	455	160
31/3/2014	3	10:07	15:54	152	347	195
TOTAL	**124**			**6697**	**10897**	**4200**

Considering 10 minutes of cleaning between the procedures i.e (121x10= 1210 minutes), it was noted that 2990 (4200-1210) minutes ≈ 50 hours were lost due to delay between the cases.

27.43% OF TOTAL UTILIZED CATH LAB TIME WAS LOST BETWEEN THE CASES

FINDINGS

UTILIZATION RATE

- Normal (8 am to 8pm)– 35.29%
- Emergency (8pm to 8am)- 1.37%

PATIENT TURNAROUND TIME

- CAG- 47 minutes
- PTCA- 82minutes
- CAG + PTCA- 100 minutes

TIME LOST DUE TO LATE START – 43.5 hours

TIME LOST BETWEEN CASES- 50 hours

CLINICAL OUTCOME

- **Mortality (Non Risk adjusted)–** 2%

CONSENT – Non compliance / without signed consent – 17%

PRE PROCEDURE CHECKLIST- Not filled in 36% of cases

RADIATION SAFETY- TLD badges not worn in 100% cases

Objective 3: To assess gaps in Cath Lab in terms of quality i.e. patient safety, employee safety, documentation

PATIENT SAFETY

- Pre Operative checklist not filled before shifting patient from ICU/ward to Cath Lab
- Cases started without checking for consent.

INFECTION CONTROL

- Non availability of changing room and snacks room for staff.
- Masks not worn properly.
- Use of Cath Lab attire and slippers outside sterile area.
- Improper cleaning and maintenance of reusable items.

RADIATION SAFETY

- TLD badges not worn by staff
- Repeated opening closing of door between console and procedure room during procedure

DOCUMENTATION

- "All cases" record register not available from 2008-2010
- No documentation of daily checking of machines.
- Consent forms not filled/ incompletely filled by duty doctor.

Objective 4: To propose key metrics for Cath Lab.

The cath lab tries to monitor specific key metrics in a variety of different groups and then use benchmarking and historical data to find out how they are performing (Wheelus, 2011). These measures can give the department a competitive advantage in how they deliver services and provide for increased profits with decreasing reimbursement (Espanto, 2011). However no key metrics were present for monitoring and analysis of Cath lab at studied hospital. Thus following key metrics described below were proposed for future assessment of Cath lab performance.

PROCEDURAL

- **Door to Balloon time**- The interval starts with the patient‟s arrival in the emergency department, and ends when a catheter guide-wired crosses the lesion in the cardiac cath lab. The benchmark for this should be 90 minutes or less.
- **Average Procedure Time** - The average time a procedure should take. The cath lab must review the amount of time a procedure took and compare it to the average benchmark. The procedures time will vary in length based on complexity.
- **Patient Turnaround Time**- Time taken from patient entry to Cath Lab to exit after the procedure.
- **Fluoroscopy Time** – It is the time during a procedure that fluoroscope is used. It is a measure of radiation dose to patient and thus reflects patient safety

PATIENT FLOW

- **Utilization Rate** - Rate at which the Cath lab is used in regards to each procedure to include allotted time and cleanup.
- **Accurate Scheduling** - Consistent and correct scheduling of the staff to meet the needs of the daily patient schedule as well as the add-on patients (scheduling of cases as per the OPD schedule of doctor)

INVENTORY

- **Supply Amount Control** - Correct control of the supplies available minimizing excess cost in unneeded supplies by following reorder level, inventory days, reusability.

QUALITY ASSURANCE

- **Clinical Outcome**- Mortality, Complication, Readmission rates, length of stay
- **Conversion Rate**- It accounts for % cath referred for medical therapy, % cath referred for PTCA, % cath referred for surgery
- **Accurate Documentation-** Consents, Referral (Inter/intra dept.), and Appropriate reporting with in defined TAT.
- **Patient safety Protocols-** Pre-operative checklist
- **Personnel Safety Protocols-** Radiation safety measure

CHAPTER 6 I RESULTS

1. RESULTS (PHASE –I)

- A total of 13017 cases were performed in Cath lab since inception. An average of 250 cases was done every month in last 3 years. 6% of total cases are non cardiac procedures. There has been a decline in cases in last two years for CAG (4%, 11.5%), PTCA (6%, 14.6%) whereas increase in number of PPI (34%) and Combo device (80%) cases was observed in year 2013.
- A significant drop of 45.59% amongst total number of cases was seen for first quarter of year 2014.
- Trans radial (76%) is the preferred route of catheter insertion by the surgeons since January 2014.
- Almost half of the total patients in first quarter of 2014 belonged to government empanelment as compared to 30% in year 2013.

2. ELECTIVE CATH LAB PERFORMANCE

Total operating time was **35.29%** of total actual Cath lab time.

3. EMERGENCY CATH LAB PERFORMANCE

Total emergency utilization was only **1.37%** of total available Cath lab time. Out of this 48% of time was utilized by elective cases which add for overtime of staff. Emergency hours should be used only for emergency cases thus by proper scheduling and reducing delay between cases this overtime of staff can be eliminated.

4. LATE START

A significant late start was seen in 73% of total working days in Cath lab accounting for almost 43 hours of lost available Cath lab time. On an average **119 minutes** of daily late start was seen. The reason for this (delay in transfer in, late arrival of surgeon) is all correctable. Attention to this will increase the utilization of Cath lab.

5. TIME LOST BETWEEN CASES

It accounted for nearly **50 hours (27.4%)** out of total utilized time of Cath lab. The cause for this (delay in consent from patient/attendant, delay in transfer of patients to Cath lab) can be corrected with better pre procedure counseling and defined responsibility for transfer of patient.

CHAPTER 7 I RECOMMENDATIONS

DAY CARE CATH PROCEDURE

Since Trans radial technique is being used by most of cardiologists in hospital, day care procedures can be started in Cath lab reducing the length of stay of patients by 75%.

SCHEDULING OF CASES

Each morning nursing staff of Cath lab calls CCU and wards for planned cases. This causes late start and also unpredictability of schedule for next day. Communication for planned cases should be from CCU and wards to Cath lab on preceding evening at the end of last shift (8 PM) and OPD cases admitted should be scheduled later for the day. Cath lab cases should also be scheduled in accordance with OPD schedule of doctors to decrease delay between cases.

SINGLE CHANNEL FOR FLOW OF INFORMATION

Information of new patient is communicated to anyone in Cath lab from cardiac coordinator, doctor, or nursing staff. All information should pass through Cardiac coordinator to Head Cath lab so that proper information in received in time and scheduling can be done. Written protocols for communication flow and updating case booking register need to be present to develop accountability among staff.

COUNSELLING OF PATIENT AND ATTENDANT

Financial counseling of patient and attendant should be done together by the cardiologist, so that there is not much of delay in decision making by attendant during the procedure thus decreasing the delay between cases and reducing patient discomfort.

BEST PRACTICES

- Complying with the Benchmark times- from call from doctor/ Cath lab to patient shifting in room, procedure time, and Room preparation time.
- Need for bilingual consent.
- Encouraging documentation accuracy and compliance

INVENTORY MANAGEMENT

- Proper stock area need to be present so that labeled compartmentalization can be done which help in quick retrieval during the case.
- Stock Cards will help in tracking the usage and assist in maintaining Reorder level.

STAFFING AND DUTY PATTERN

Each case engages one scrub nurse, one technician and one circulating nurse. Staff shift timings can be rearranged to decrease the overtime of nursing and technician during emergency cases but only when sufficient number of cases is there in Cath lab.

INFECTION CONTROL

- Scrub area should be nearer to Cath lab
- Absence of changing room and refreshment room for Cath lab staff hamper infection control in console area. There is an acute need for the same
- Two way communication devices should be installed between console room and procedure room to stop repeated opening and closing of door.
- Regular audit by quality and infection control department should be there.

CHAPTER 8 I CONCLUSION

Under scheduling, decreased number of cases, late starts and delays between cases are the main factors that account for inefficient utilization of Cath lab.

Accurate records, weekly analysis of recorded data, better financial counseling before procedure, and strict adherence to and enforcement of approved policies and procedures are essential ingredients for an efficient operation of Cath lab. The correction of above mentioned factors would increase the available operating time in Cath lab.

Despite the constraints, Paras hospital is providing quality health care and is emerging as a key medical service provider to the population of Gurgaon and northern parts of India.

BIBLIOGRAPHY

Cath Labs: On an expansion spree. Medical Buyer. (June 5, 2010): NA. Health Reference Center Academic. Gale. Trinity University. 13 Nov. 2010

Cookie, RN. Interview at the Nix. (October 8, 2010).

Espanto, Franklin. (2011). Cardiac Cath Lab Department Head. University Hospital, San Antonio, Texas. Personal Interview. Web.

Haugh, Richard. "The Rise and Uncertain Future of Cath Labs: New Technology and Treatment Protocols are Forcing Hospitals to Consider Fundamental Changes." H&HN Hospitals & Health Networks. 78.9 (Sept 2004): 54(4).

Haugh, Richard. "The Rise and Uncertain Future of Cath Labs: New Technology and Treatment Protocols are Forcing Hospitals to Consider Fundamental Changes." H&HN Hospitals & Health Networks. 78.9 (Sept 2004): 54(4).

Hospital Process of Care Measures. Centers for Medicare and Medicaid Services (March 2010).

Kuehl, Tyson. "Cut Waste to Curb Costs: Improving Catheterization Lab Efficiency." Sg2 | Health Care Intelligence. 14 Sept. 2010. Web.

Lawrence, C. D. (N.D.) The History of Cardiac Catheterization.

Litvak E. Managing Patient Flow inHospitals: Strategies and Solutions, Second Edition; Beurhaus P, Rudolph M, Prenney B, Fuda KK, Green Vaswani S, Long M, and others; Joint Commission Resources,2009.

Meskan, Tom. "Improving YourCardiovascular Program's Profitability: Economics and Advocacy." Cath Lab Digest 12 (2004). CathLab Digest | Home for the Cath Lab Specialists. 1 Apr. 2004. Web.

Norland S. Containing Costs in the ED: Tired of High Cost Associated with Slow Patient Throughput in the ED? Find out What Several Hospitals Have Done to Improve Their Patient Flow and Optimize Department Performance, Healthcare Financial Management. Healthcare Financial Management 2005

Scalise D. Improving Patient Throughput. Hospitals & Health Networks/AHA (Hosp Health Netw) 2006 Nov;80(11):49-54.

Siegel, Bruce, M.D., M.P.H., Marcia J. Wilson, M.B.A., and Donna Sickler, M.P.H. "Enhancing Work Flow to Reduce Crowding." The Joint Commission Journal on Quality and Patient Safety 33.11 (2007): 61.

Siegrist, Richard B., Martin Gutkin, Osnat Levtzion-Korach, and Susan Madden. "Improving Patient Flow in the Cath Lab: Learn How Kennestone Hospital in Marietta, Ga., Increased Efficiency, Reduced Overtime, and Developed More Predictable Schedules for Patients, Staff, and Physicians in the Cardiac Catheterization Lab. The Lessons Learned Could Apply to Other Hospital Departments." Healthcare Financial Management (2009): 1-6. Small Business Advice and Resources from AllBusiness.com. 1 Apr. 2009. Web

Steinwachs DM, Collins-Nakai RL, Cohn LH, et al. The Future of Cardiology: Utilization and Costs of Care. JACC35:4:1092-1099.

Thwaites, Tim. "The Hybrid Cath Lab: A Revolution in Cardiac Care." AXIOM Innovations: The Magazine for Interventional Radiology and Cardiology, Radiography and Fluoroscopy June 2010: 36-41

VanMilligan, Gloria. “Growth Strategies for Procedural Volumes.” Sg2 | Health Care Intelligence. (August 17, 2009).

Winslow, Edward. "The Expert Is In Conference Call: Cath and EP Lab Issues." 9 June 2008. Web.