

# A Cost Analysis of Cag and Ptca in a Catheterization Laboratory At A Tertiary Care Teaching Hospital

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## ABSTRACT

The Prevalence Of Non-Communicable Diseases (Ncds) Is Increasing Alarmingly Across The Globe And The Burden Of The Disease Was Higher In Developed Countries. The Incidence Is Increasing In Developing And The Underdeveloped Countries Owing To Lifestyle Changes And Stress. (Cardiovascular Disease Incidence And Prevalence Statistics In The World And India To Be Included Here) Even Though It Is More Common In The Urban Population, The Prevalence In The Rural Population Is Also Increasing. Cardiac Catheterization Is An Important Procedure In The Diagnosis And Management Of Coronary Artery Disease And Other Cardiovascular Disorders. Cardiac Catheterization Laboratory Has An Integral Role In The Management Of Patients With Cardiovascular Disorders. Coronary Angiography And Coronary Angioplasty Are The Most Common Procedures Done In The Cathlab To Reduce The Mortality Of The Disease.

Accurately Understanding The Cost Of Healthcare Delivery Important In The Management Of Costing Challenges Facing The Health Care Services In The Current Scenario. Unit Cost Calculation And Activity-Based Costing Information Improves The Knowledge Regarding The Organization Process And About Unused Capacity Resources, So That Managers Can Make Decisions Regarding Use Of Resources. Calculation Of Accurate Unit Costing Of Coronary Angiography And Coronary Angioplasty Is Beneficial To Improve The Efficiency Of The Cardiology Department.

The Main Aim Of This Study Was Calculating The Costing Of Two Important Procedures In Cardiac Catheterization Laboratory In A Tertiary Care Teaching Hospital. It Is A Descriptive And Observational Study. The Objectives Were- To Study The Organization And Staffing Pattern, To Study The Policies, Procedures And Work Flow And To Calculate The Cost Incurred In Performing Coronary Angiography And Coronary Angioplasty And To Suggest Recommendations, If Any. Procedures In The Cath Lab Have Evolved From Purely Diagnostic Techniques To An Array Of Modern Life Saving Interventions.

Activity Based Costing Was Used To Find Out The Unit Cost Of Coronary Angiography And Coronary Angioplasty, With The Cost Drivers Like, Direct Costs, Indirect Costs.

The Results Of The Study Provide Improved Understanding About The Organizational Process Of The Cardiac Cath Lab. The Study Also Gives Cost Information Of The Most Common Services In The Cardiac Cath Lab Which Will Be Helpful For Future Decision Making Regarding Pricing Of Services. This Will Improve Cost Awareness Among Professionals In The Field Of Healthcare And Help The Hospital Managers To Provide Healthcare Services At Least Possible Cost, Maintaining High Level Of Quality.

**Keywords** Cathlab, Coronary Angioplasty, Coronary Angiography, Cost Analysis.

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## Introduction

Cardiovascular Diseases (Cvds) Have Now Become The Leading Cause Of Mortality In India. A Quarter Of All Mortality Is Attributable To Cvd. Non-Communicable Diseases (Ncd) Including Coronary Heart Disease And Type 2 Diabetes Are Rapidly Increasing In India Causing Nearly 5.8 Million Deaths Per Year. The Prominence Of Cvd As A Cause Of Mortality Results In A Major Economic Burden In India. With The Rising Healthcare Costs, Patients Find It Increasingly Difficult To Pay For Hospital Expenses. The First-Ever Cardiac Catheterisation Laboratory For Clinical Studies Was Established In All India Institute Of Medical

Sciences (Aiiims), Delhi, India Under The Stewardship Of Prof. Sujay Bijay Roy.

A Cost Is 'A Resource Sacrificed Or Forgone To Achieve A Specific Objective'. 'It Is Usually Measured In Terms Of The Monetary Amount That Should Be Expended To Procure Goods Or Services. Costs Can Be Actual Or Budgeted. Actual Costs Are Historical Costs Which Are Already Incurred Whereas Budgeted Costs Are Future Costs Which Are Yet To Be Incurred.

Activity-Based Costing (Abc) Is A Costing Methodology That Identifies Activities In An Organization And Assigns The Cost Of Each Activity With Resources To All Products And Services According To The Actual Consumption By Each.

This Model Assigns More Indirect Costs (Overhead) Into Direct Costs Compared To Conventional Costing. Activity Based Costing Saw Its Use In' The Healthcare Industry From The Early 1990. Because Of The Increased Accuracy In Allocating Costs. The Detailed Activity-Driven Description Of The Various Cost Elements Helped The Administrators In Evaluating And Improving Hospital Processes.

### Review Of Literature

Cvd Is The Leading Cause Of Morbidity And Mortality In The World. The Largest Cause Of The Death Worldwide Is Ischemic Heart Disease. Cardiovascular Diseases (Cvds), Especially Coronary Heart Disease (Chd), Have Assumed Epidemic Proportions Worldwide. Globally, Cvd Led To 17.5 Million Deaths In 2012. More Than 75% Of These Deaths Occurred In Developing Countries. In Contrast To Developed Countries, Where Mortality From Chd Is Rapidly Declining, It Is Increasing In Developing Countries. This Increase Is Driven By Industrialization, Urbanization, And Related Lifestyle Changes And Is Called Epidemiological Transition.

India Is A Large And Socioeconomically Diverse Country, And There Could Be Evidence Of All The Stages Of This Transition In The Country. However, This Has Not Been Studied. Other Striking Features Of Cvd Epidemiology In India Are High Mortality Rates, Premature Chd, And Increasing Burden.

The Registrar General Of India Reported That Chd Led To 17% Of Total Deaths And 26% Of Adult Deaths In 2001-2003, Which Increased To 23% Of Total And 32% Of Adult Deaths In 2010-2013. The World Health Organization (Who) And Global Burden Of Disease Study Also Have Highlighted Increasing Trends In Years Of Life Lost (Ylls) And Disability-Adjusted Life Years (Dalys) From Chd In India. In India, Studies Have Reported Increasing Chd Prevalence Over The Last 60 Years, From 1% To 9%-10% In Urban Populations And < 1% To 4 – 6 % In Rural Populations.

Although Cost-Effective Interventions Are Available For The Prevention And Control Of Cardio Vascular Diseases Risk Factors, There Are Major Barriers To Their Widespread Use In India, Including Low Detection Rates, Inadequate Awareness, Poor Use Of Evidence-Based Interventions, And Low Adherence Rates.

### Evolution Of Cardiac Catheterization In India

The First-Ever Cardiac Catheterisation Laboratory For Clinical Studies Was Established In All India Institute Of Medical Sciences (Aiims), Delhi, India Under The Stewardship Of Prof. Sujay Bijay Roy.

### Coronary Angiography

**Angiography** Is The Test Where Dyes That Can Be Seen By X-Rays Are Injected Into Blood Vessels (Either Arteries Or Veins) And Examined Using X-Rays. The Resulting Pictures Are Called **Angiograms**. Angiograms Are Used To Diagnose Narrowing Or Blockages In Vessels Anywhere In The Body, From Head To Toe, Including:

- The Arteries Feeding The Heart Muscle
- The Arteries Going To The Brain
- The Arteries Feeding The Arms And Legs
- The Arteries Feeding The Kidneys
- All Of The Vessels Going To And Coming From The Lungs

In Addition To Finding Narrowing And Blockages, Angiography Can Also Be Used To Find Places Where The Arteries Or Veins Are Bulging Or Ballooning. These Spots Are Called **Aneurysms** And If Not Treated, Can Cause Death When They Rupture.

### Coronary Angioplasty

Coronary Angioplasty Also Called Percutaneous Coronary Intervention Is A Procedure Used To Open Clogged Heart Arteries. Angioplasty Involves Temporarily Inserting And Inflating A Tiny Balloon Where Your Artery Is Clogged To Help Widen The Artery.

Angioplasty Is Often Combined With The Permanent Placement Of A Small Wire Mesh Tube Called A Stent To Help Prop The Artery Open And Decrease Its Chance Of Narrowing Again. Some Stents Are Coated With Medication To Help Keep Your Artery Open (Drug-Eluting Stents), While Others Are Not (Bare-Metal Stents).

Angioplasty Can Improve Symptoms Of Blocked Arteries, Such As Chest Pain And Shortness Of Breath. Angioplasty Can Also Be Used During A Heart Attack To Quickly Open A Blocked Artery And Reduce The Amount Of Damage To Your Heart.

### Costing And Related Concepts.

Hospitals Usually Face Challenges In Tracking The Cost Incurred In Service Delivery. Hence Development Of Proper Cost Information Is Essential For Accurate Pricing Of Services. Healthcare Services Should Be Provided At The Least Possible Cost And At The Best Level Of Quality. Hence It Is Necessary To Get Correct Information On The Actual Cost Of The Services Provided. With The Rising Healthcare Costs, Hospitals Should Focus On Improving Their Efficiency In Service Delivery. Cost Analysis Of A Service Is Useful For Understanding The Various Expenses Incurred While Running The Service.

**Cost:** A Cost Is 'A Resource Sacrificed Or Forgone To Achieve A Specific Objective'. 'It Is Usually Measured In Terms Of The Monetary Amount That Should Be Expended To Procure Goods Or Services. Costs Can Be Actual Or Budgeted. Actual Costs Are Historical Costs Which Are Already Incurred Whereas Budgeted Costs Are Future Costs Which Are Yet To Be Incurred. A Cost Object Is 'Anything For Which A Measurement Of Costs Is Desired'

**Costing:** Costing 'The Technique And Process Of Ascertaining Costs'. According To The Chartered Institute Of Management Accountants (Cima), Cost Accounting 'Involves

The Classification Recording And Appropriate Allocation Of Expenditure For The Determination Of The Costs Of Products Or Services; The Relation Of These Costs To Sales Values; And The Ascertainment Of Profitability’.

#### Activity Based Costing In Healthcare.

Activity Based Costing Saw Its Use In The Healthcare Industry From The Early 1990s. Because Of The Increased Accuracy In Allocating Costs; ABC Was Used By More Than 20% Of Hospitals In The USA And Canada In The 1990s. An Article Published By Baker Jj And Boyd Gp In The Journal Of Healthcare Finance, Gave An Example Of How The Hospital Used ABC In The Cost Analysis Of The Operating Room Procedures. It Explained How The Management Was Able To Benefit From The Improved Costing Data And How It Was Utilised In The Continuous Quality Improvement Process. Canby Ib Used ABC In The Cost Analysis Of The X-Ray Process In An Outpatient Clinic’.

Laurila Et Al Applied ABC In A Paediatric Radiological Unit For Costing Of Radiological Procedures. They Were Able To Obtain More Detailed And Precise Costing Information With ABC Which Enhanced Departmental Management And Facilitated Process Improvement’.

In A Study By Shander Et Al. The Cost Of Blood Transfusions For Surgical Patients Were Calculated. Using ABC In Two US And Two European Hospitals. The Improved Costing Data With ABC Helped Them Conclude That The Blood Costs Were Underestimated. The Detailed ABC-Driven Description Of The Various Cost Elements Helped The Administrators In Evaluating And Improving Hospital Processes’.

#### Costing Of Cardiac Catheterisation Procedures

In India, A Coronary Angiogram Is Estimated To Cost \$250 To \$1000.76. Angioplasty With Implantation Of A Bare Metal Stent In India Is Estimated To Cost An Average Of \$2000 To \$2500, Which May Be Attractive For International Visitors For Medical Tourism, But Is Still Out Of Reach Of Most Indians As An Out-Of-Pocket Medical Expenditure’.

In A Study Conducted By Vergales Je Et Al Comparing The Cost Of Percutaneous Pulmonary Valve Implantation With Surgical Pulmonary Valve Replacement, It Was Found That The Cost For Surgical Valve Replacement Was Found To Be Significantly Higher (\$126,406 Vs. \$38,772 Vs. \$80,328;  $P < 0.001$ ) Percutaneous Valve Replacement Also Resulted In A Shorted Length Of Hospital Stay’.

Faraoni D Et Al Studied The Cost Of Hospitalization In Children With Congenital Heart Disease. The Mean Cost Was Found To Be \$51,302 (\$32,088-\$100,058) In Case Of Cardiac Surgery, \$21,920 (\$13,068-\$51,609) In Case Of Cardiac Catheterization, \$4134 (\$171-\$10,253) In Case Of Non-Cardiac Surgery, And \$3231,06 (\$529-\$71,887) In Children Who Underwent Medical Treatments’.

In A Study Comparing Carotid Angioplasty And Stenting With Carotid Endarterectomy For Revascularisation Of Carotid Stenosis Done By Almekhlafi Ma Et Al. Angioplasty

And Stenting Was Found To Be More Expensive And Had A Lower Utility Compared To Carotid Endarterectomy.

They Proposed That For Carotid Angioplasty To Become The Preferred Option, The Cost Should Fall From More Than \$7300 To \$4350 Or Less And The ~ 80 Outcomes Should Be Similar To Endarterectomy. Dorenkamp M Et Al Did An Analysis Of The Cost Effectiveness Of Paclitaxel-coated Balloon Angioplasty In Patients With Drug-Eluting Stent Restenosis. Even Though The Initial Costs Were Higher When Using A Drug Eluting Stent (63488 Vs. 62782), 6 Month Costs Were Found To Be Lower (64028 Vs. €4169) Compared To Ordinary Balloon Angioplasty. It Was Also Found To Be More Effective In Terms Of Gain Of Life-Years (0.497 Vs 0.489)

In A Study By P’anaich Ss Et Al Comparing The In-Hospital Outcomes And Hospitalization Cost Of Peripheral Angioplasty And Endovascular Stenting, It Was Found That Endovascular Stenting Had Lower Incidence Of In-Hospital Mortality And Post-Procedure Complications Compared To Angioplasty Alone. But Costs Associated Were Found To Be Slightly Higher (\$1,516). The Study Concluded That Endovascular Stenting Was The Better Choice As It Had Better Outcomes With Minimal Increase In Hospitalization Expenses’.

Ailawadi G Et Al Studied The Costs Associated With Transcatheter Aortic Valve Replacement’. Cost Of Endovascular Vs. Open Repair Of Thoracic Aortic Aneurysms Was Analysed By Gillen Jr Et Al. 84. Maru S Performed A Systematic Review Of Cost Effectiveness And Cost Utility Of Cardiovascular Disease Management Programs. Cath Labs Are One Of The Areas With Significant-Capital Investment In Hospitals. Historically Cath Labs Had-Quick Breakeven Time Due To High Contribution Margin For The Procedures Performed. But Recently, Economic Returns From Cath Labs Have Come Down. Many Hospitals Are A Comprehensive Approach Is Essential To Understand The Operations Of A Cardiac Catheterization Laboratory And The Cost Of Performing Coronary Angiography And Coronary Angioplasty. The Present Study Planned To Address These Issues Specifically.

#### Aims And Objectives:

The Main Aim Of This Study Was To Calculate The Costing Of Two Important Procedures In Cardiac Catheterization Laboratory In A Tertiary Care Teaching Hospital.

The Objectives Were- To Study The Organization And Staffing Pattern, To Study The Policies, Procedures And Work Flow And To Calculate The Cost Incurred In Performing Coronary Angiography And Coronary Angioplasty And To Suggest Recommendations, If Any.

#### Methodology

It Is A Descriptive And Observational Study. The Information For The Study Was Obtained From Records Available In The Cardiology Department And By Direct Interaction With The

Staff. The Staffing Pattern And Functioning Of The Department Was Assessed Based On The Documents Available In The Department. The Analysis Of Unit Costing Of Coronary Angiography (Cag) And Percutaneous Transluminal Coronary Angioplasty (Ptca) Was Done Considering The Direct And Indirect Costs Associated With The Performance Of The Two Procedures. Activity Based Costing Was Used For Calculating The Cost Incurred For Performing Of Cag & Ptca. The Study Was Conducted From December 1<sup>st</sup> 2019 To December 31<sup>st</sup> 2019 And All The Above Mentioned Procedures Performed During This One Month Were Considered For Calculation Of The Cost.

#### Results And Outcome:

The Costs For The Procedures Were Calculated Under Various Heads As Mentioned Below. The Various Components Of Costs Observed In The Study Are The Following:

- Direct Labour Cost
- Indirect Labour Cost
- General Stores Consumables
- Pharmacy Consumables
- Sterilisation Of Reusable Consumables
- Linen (Laundry And Sterilization)
- Pre Cath Investigations
- Equipment Depreciation
- Equipment Maintenance
- Building Maintenance Costs
- Air Conditioning Costs
- Electricity Costs
- Lead Aprons
- Tld Badges
- Tld Badge Testing Costs
- Hospital Stay Costs
- Administrative Costs (5% Of Total Cost)

Sl No.	Cost Head	Cag (In Inr)	Ptca (In Inr)
1	Direct Labour Cost	643	1104
2	Indirect Labour Cost	100	263.25
3	General Stores Consumables	2632.1	47180.81
4	Pharmacy Consumables	138.6	138.6
5	Sterilization Of Cathlab Instruments	78.4	78.4
6	Sterilisation Of Reusable Consumables	219.52	219.52
7	Linen (Laundry And Sterilization)	72	64
8	Pre Cath Investigations	1891	1891
9	Equipment Depreciation	1101	1651.5
10	Equipment Maintenance	2562	3843
11	Building Maintenance Costs	27.425	41.14
12	Air Conditioning Costs	357.35	536.03
13	Electricity Costs	63	94.5
14	Lead Aprons	9.875	14.81
15	Tld Badges	0.553	0.83
16	Tld Badge Testing Costs	3.2	3.2
17	Hospital Stay Costs	2812.5	7055
Total		12711.523	64179.59
	Administrative Costs (5% Of Total Cost)	635.57	3208.979
Grand Total		13347.093	67388.569

Table 1: Comparative Cost For Cag And Ptca Considered As In During December 2019.

#### Total Cost Of Procedure

The Total Cost Incurred In Cag And Ptca Are Rs.13347.093 And Rs.67388.569 Respectively. The Highest Cost Drivers

For Cag Are **21%** Hospital Stay And **19%** General Stores. For Ptca The Highest Cost Drivers Are **70%** General Consumables And **10%** Hospital Stay.

Procedure	Cost (In Indian Rupees)
Cag	13347.093
Ptca	67388.569

Table 2: Total Cost Of Procedure For Cag And Ptca

#### Discussion

In The Study By Sareen R. K. Et Al Published In 1997 The Cost For Performing Coronary Angiography Was

Calculated To Be Rs. 4265.21. When Adjusted For Inflation As Per The Cost Inflation Index Figures, The Cost Was Found To Be Rs. 14496.5. This Value Is Higher



Than The Cost Figures Observed In The Present Study. The Main Cost Drivers Identified In This Study Were Consumables (32% Of Total Cost For Angiography And 41% Of Total Cost For Angioplasty) And Manpower (19% Of Total Cost For Angiography And 21 % Of Total Cost For Angioplasty). The Major Factors Which Can Be Attributed To The Increased Cost For The Coronary Angioplasty Procedure Over The Angiography Can Be Attributed To Direct Labour Costs And Increased Requirement Of Consumables. The Main Cost Drivers Identified Were Hospital Stay Is 22% Of Total Cost For-Angiography And General Consumables 70% Of Total Cost For Angioplasty.

### Recommendation

In View

Of The Observations Made During The Study The Functioning Of The Cardiology Department Were According To The Standard Operating Protocol Maintained And Assessed By The Hospital. The Work Efficiency And Knowledge Of The Staff Regarding The Departments Work Flow, Scope Of Services, Roles And Responsibilities Were Found To Be Satisfactory. The Good Practices Can Be Further Reinforced By Orientation And Periodic Training Of Staff At Regular Intervals In Order To Upheld The Knowledge About The Recent Advance Developments.

### Conclusion

The Results Of The Study Clearly Indicated The Cost Drivers For Cag And Ptca In The Tertiary Care Hospital. Analysing The Unit Cost For These Procedures Helps Administrators In Identifying The Major Cost Drivers And Accordingly Plan Pricing As Well As Resource Allocation And Optimum Utilization. The Unit-Wise Cost May Appear Small But When Added Up Will Increase The Overall Cost. Hence, Analysis Of Cost Of Each Procedure And Making Decisions Will Aid Decision Makers In Policy Formulation As Well As Implementation. Procedures In The Cath Lab Have Evolved From Purely Diagnostic Techniques To An Array Of Modern Life Saving Interventions. Affordability For The Patients And At The Same Time The Cost Of Such Procedures For Hospitals Need To Be Ascertained Without Comprising On Either. As The Burden Of Ncds Is Increasing Across Countries And Irrespective Demographic Differences, It Makes It Imperative For Healthcare Policy Makers To Consider All Factors For Decision Making Especially Financial. The Popularity Of Health Insurance Schemes Both Public As Well As Private Varies Across Nations And Hence, Pricing Of Such Lifesaving Procedures Plays A Vital Role In Significantly Reducing The Mortality As Well As Morbidity Of The Disease.

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