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Understanding Variability in Hospital-Specific Costs of CABG Represents an Opportunity for Standardizing Care and Improving Resource Utilization

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Background

Healthcare spending in the United States is of interest to every citizen in this country

Cardiac surgery continues to have a heavy cost burden on overall healthcare spending in the United States, with approximately 1% of all healthcare dollars, or $15 billion, spent on inpatient cardiac surgical care

Despite higher costs, the quality of CABG care in the United States has not been demonstrated to be measurably superior to that in other countries

Study Aim

To examine the cost of CABG in the United States, and to specifically determine what variables drive its cost, including that which is due to the independent effect of the hospital itself

This variable, the independent effect of the hospital, may represent opportunities for cost savings

Study Design

Data Source

Nationwide Inpatient Sample

Study Population

Adult patients (>17 years of age)

Isolated CABG

Redo and non-elective CABG included

Study period: January 1, 2005 to December 31, 2008

Data and Statistical Analysis

Primary Outcome

Inpatient costs of CABG

Variation in Hospital-Specific Costs

Mixed effect linear regression model incorporating variables associated with cost of CABG in univariate linear regression analysis (exploratory p-value < 0.20)

Mixed Effect Linear Regression Model

Patient

Age, sex, primary payer status, Charlson comorbidity index

Operative

Elective versus non-elective, number of vessels bypassed, CPB, use of IMA, same admission cardiac catheterization, IABP, pacemaker or AICD, VAD, ECMO, same admission angioplasty or coronary stent, redo CABG

Complications

Respiratory failure, pneumonia, acute renal failure, sepsis, stroke, pulmonary embolism, gastrointestinal bleed, wound complication, hemorrhage, cardiac shock or arrest

Hospital

Hospital region, teaching status, urban versus rural, annual CABG volume

Other

Length of hospitalization, in-hospital mortality, year of operation

Patient Characteristics

Variable	Study Population (n=183,973)	Missing Data
Age (years)	65.2 ± 10.8	14 (0.008%)
Male Sex	133,573 (73%)	14 (0.008%)
Payment Status		260 (0.1%)
Medicare	95,287 (52%)	
Private Insurance	73,367 (40%)	
Medicaid	8,912 (5%)	
Other	6,147 (3%)	
Charlson Comorbidity Score		0 (0%)
Zero	38,420 (21%)	
One	59,675 (32%)	
Two or Greater	85,878 (47%)	
Comorbidities		0 (0%)
Atrial Fibrillation	45,959 (25%)	
Myocardial Infarction	71,663 (39%)	
Congestive Heart Failure	39,412 (21%)	
Peripheral Vascular Disease	21,096 (11%)	
Cerebrovascular Disease	16,072 (9%)	
COPD	38,493 (21%)	
Diabetes Mellitus	56,365 (31%)	
Chronic Renal Insufficiency	15,790 (9%)	
Liver Disease	762 (0.4%)	

Operative Characteristics

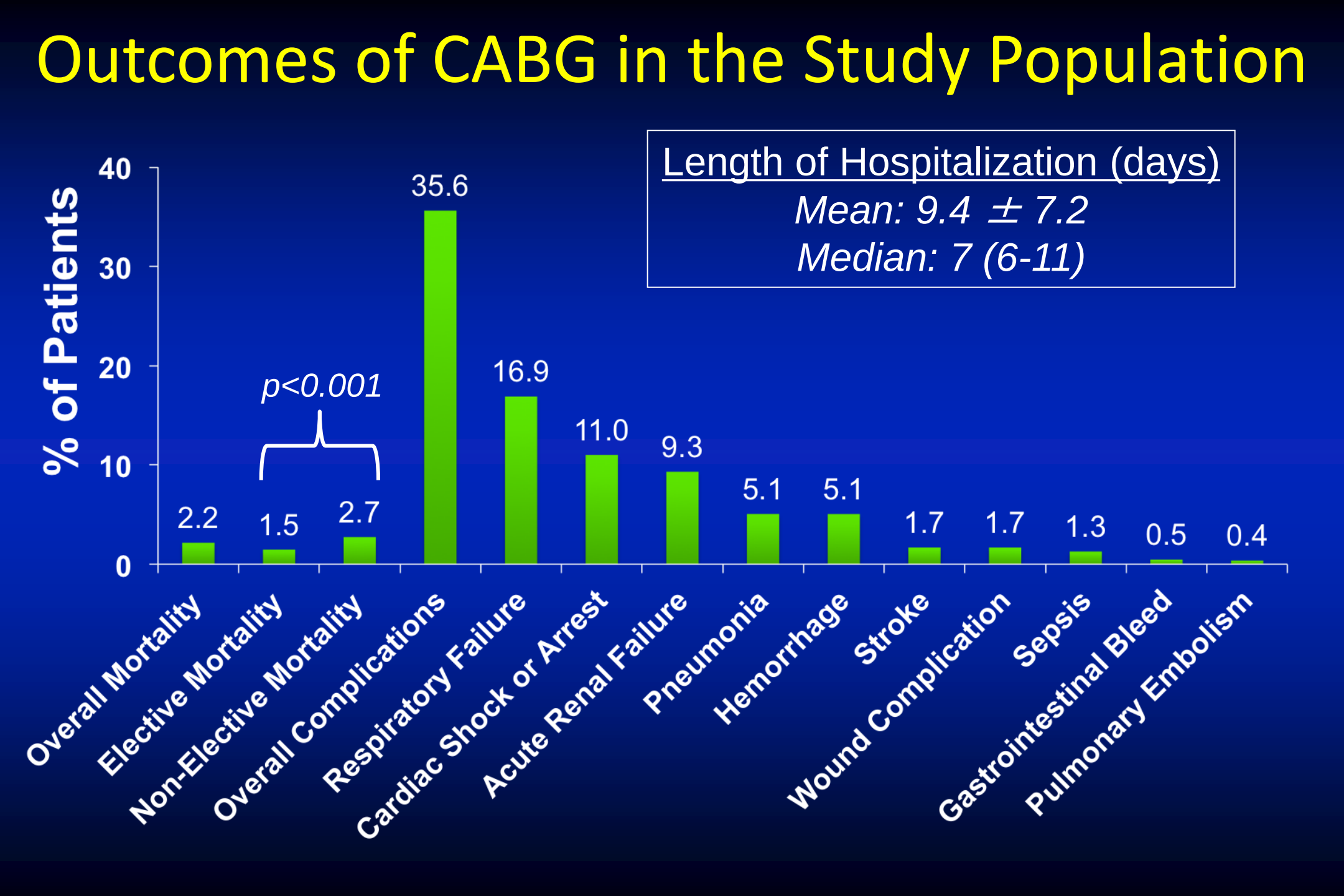
Variable	Study Population (n=183,973)	Missing Data
Urgent or Emergent Case	100,178 (55%)	306 (0.2%)
Number of Coronary Vessels Bypassed One Two Three Four or More	 26,255 (15%) 64,201 (36%) 57,728 (33%) 28,039 (16%)	7,750 (4%)
Use of Cardiopulmonary Bypass	133,748 (73%)	0 (0%)
Use of Internal Mammary Artery	163,136 (89%)	0 (0%)
Cardiac Catheterization During Admission	101,052 (55%)	0 (0%)
Intra-aortic Balloon Pump	17,366 (9%)	0 (0%)
Permanent Pacemaker or AICD	3,133 (2%)	0 (0%)
VAD as Postcardiotomy Support	203 (0.1%)	0 (0%)
Extracorporeal Membrane Oxygenation	37 (0.02%)	0 (0%)
Coronary Angioplasty During Admission	5,601 (3%)	0 (0%)
Non-Drug-Eluting Stent During Admission	1,355 (0.7%)	0 (0%)
Drug-Eluting Stent During Admission	1,587 (0.9%)	0 (0%)

Hospital Characteristics

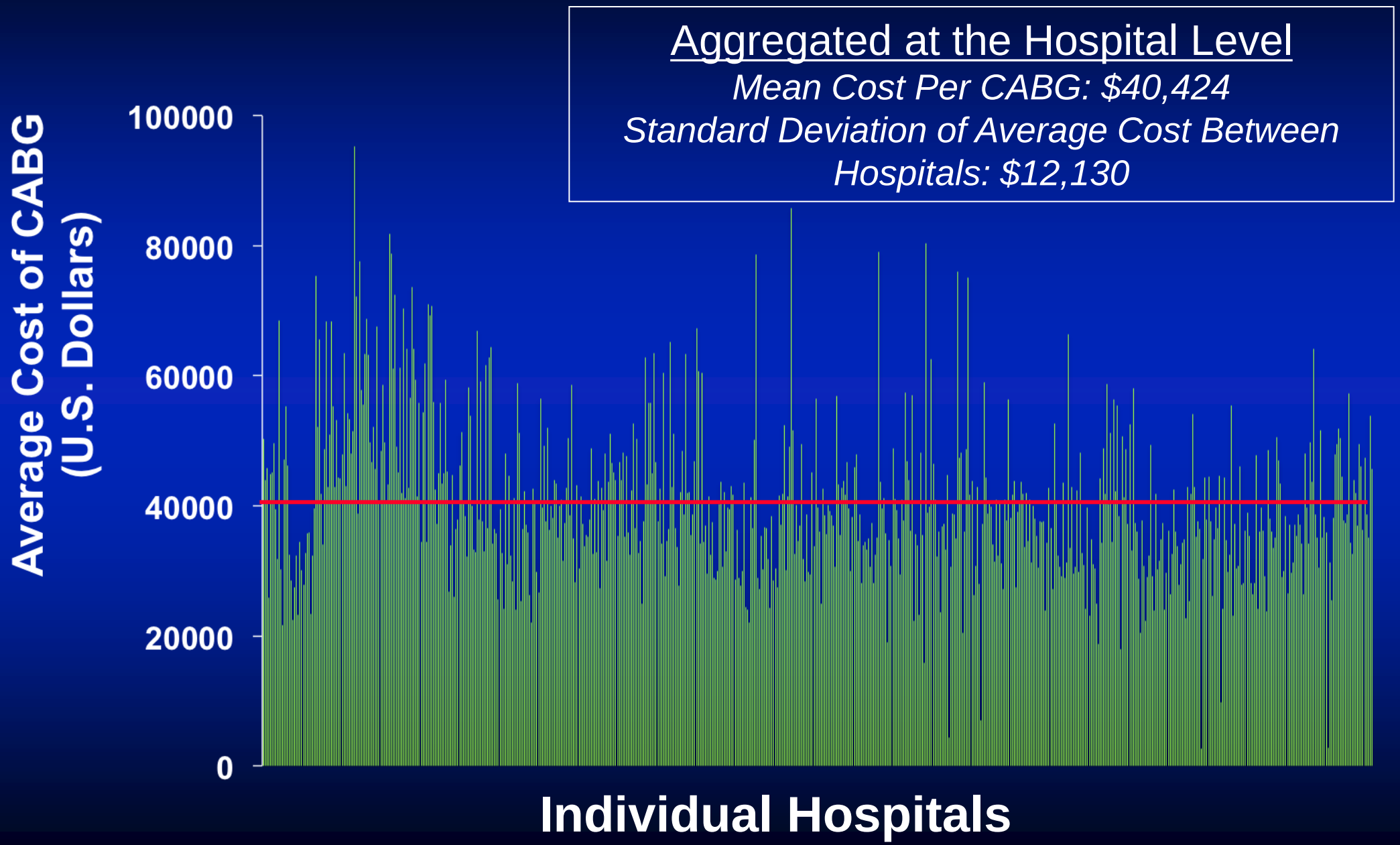
Variable	Study Population (n=183,973)	Missing Data
Teaching Hospital	104,259 (57%)	0 (0%)
Region Northeast Midwest South West	 27,108 (15%) 45,625 (25%) 81,249 (44%) 29,991 (16%)	0 (0%)
Rural Location	6,351 (3%)	0 (0%)
Annual Hospital CABG Volume*	441 ± 340	0 (0%)

*inclusive of all CABGs, including those performed concomitant with another major procedure

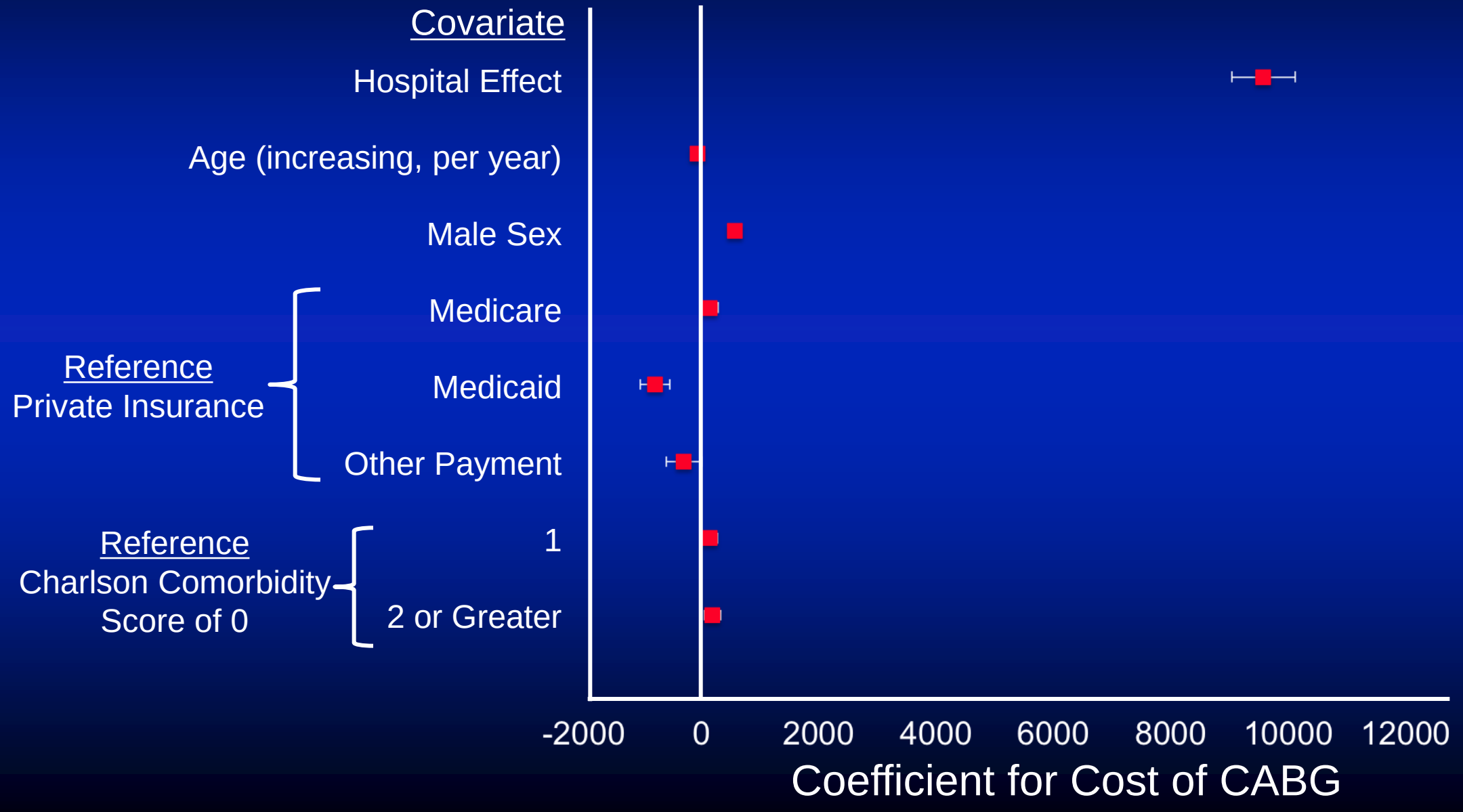
Outcomes of CABG in the Study Population



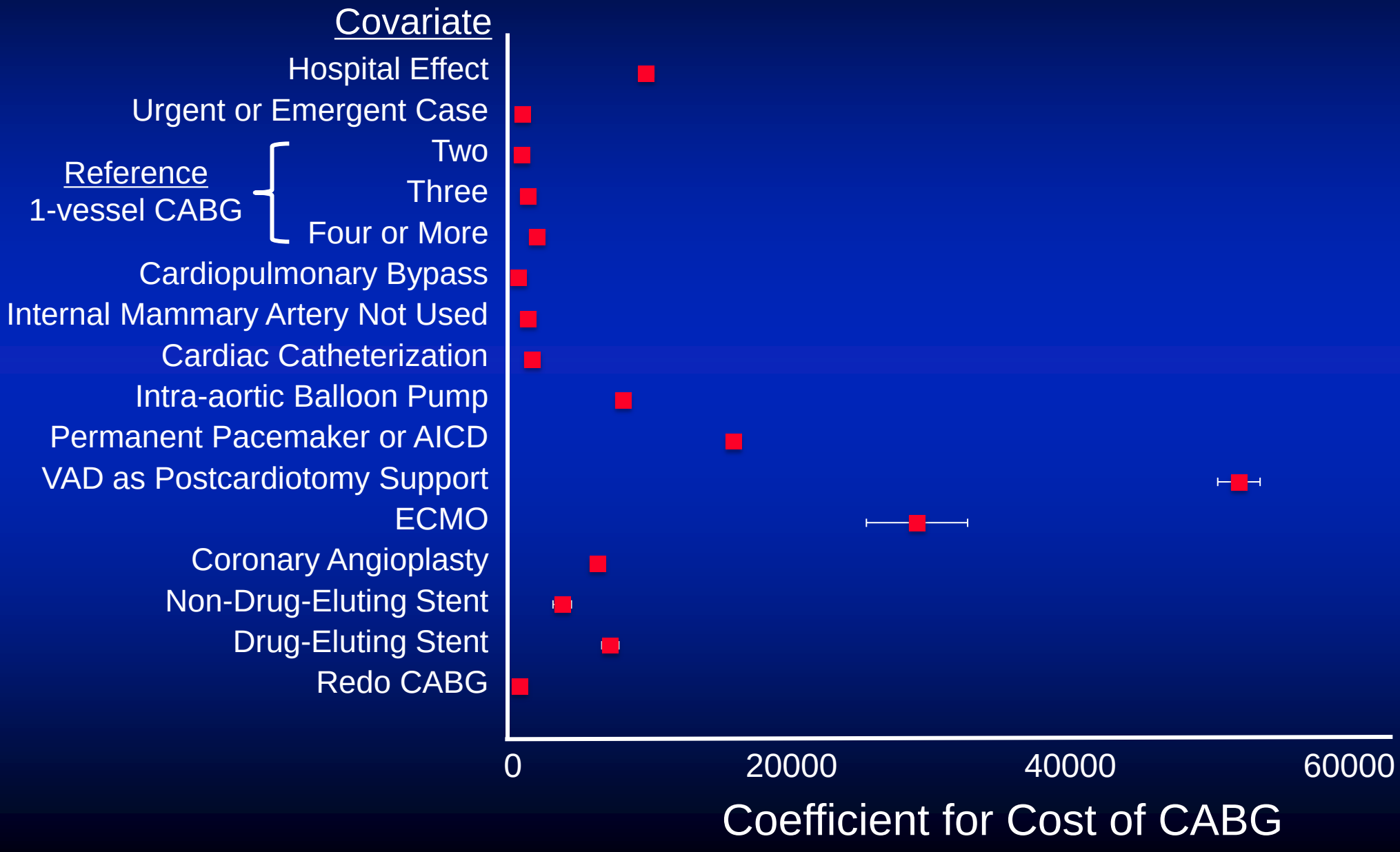
Costs of CABG at the Hospital Level



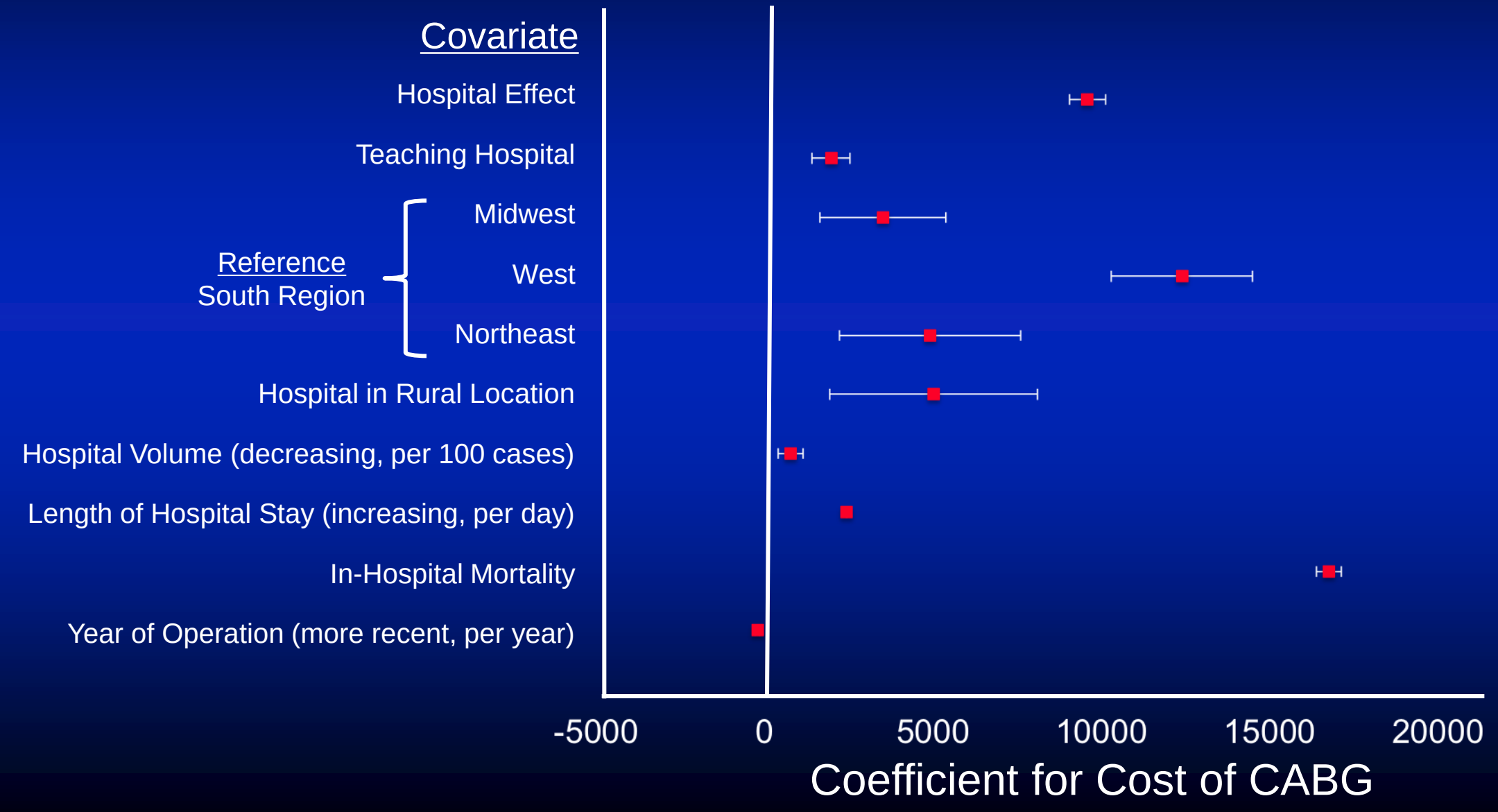
Mixed Effect Linear Regression Model for Cost of CABG: Patient-Level Variables



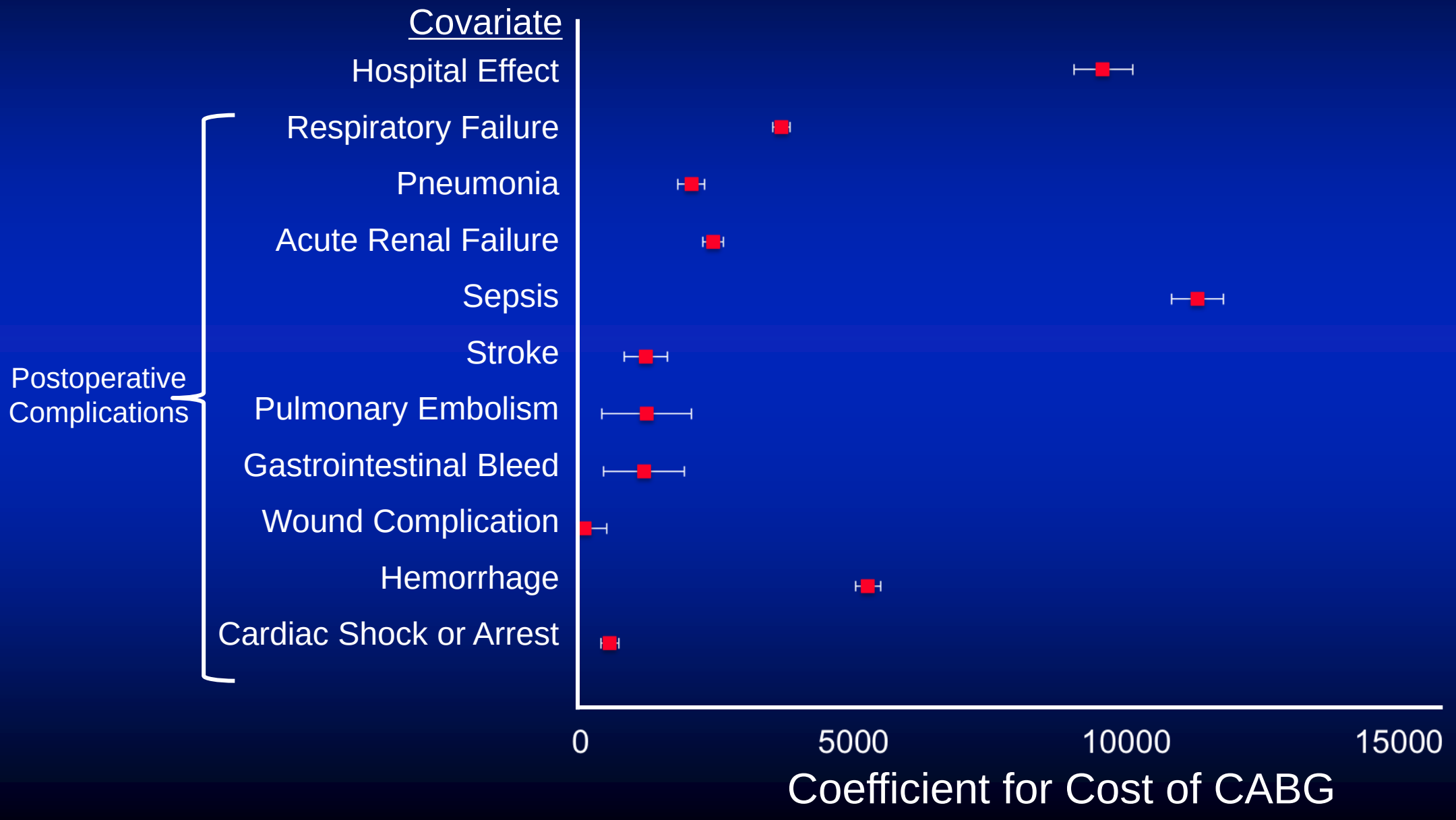
Mixed Effect Linear Regression Model for Cost of CABG: Operative Variables



Mixed Effect Linear Regression Model for Cost of CABG: Hospital-Level and "Other" Variables



Mixed Effect Linear Regression Model for Cost of CABG: Postoperative Complications



Summary

For CABG, there are only 5 variables that are greater drivers of cost than the Hospital Effect:

-VAD (coefficient 52,094)

-ECMO (coefficient 28,999)

-Mortality (coefficient 16,758)

-Permanent Pacemaker/ICD (15,831)

-Sepsis (coefficient 11,303)

-*Hospital Effect (coefficient 9,560)*

As point of comparison, urgent/emergent coefficient is 693

Conclusions

Controlling for what we determined to be the 34 significant variables that drove cost, the individual hospital remained an extremely important variable

Understanding the reasons for this hospital center variability may provide us with opportunities to substantially decrease costs of CABG in the United States

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