**Cost of coronary syndrome treated with percutaneous coronary intervention and 30-day unplanned readmission in the United States**

Short title: Cost of PCI in the United States

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**Abstract**

**Objectives:** This study aimed to examine the cost of coronary syndrome treated with percutaneous coronary intervention (PCI) and 30-day unplanned readmissions..

**Background:** There is limited understanding of the hospital cost of index PCI and 30-day unplanned readmissions.

**Methods:** Patients undergoing PCI between 2010 and 2014 in the U.S. Nationwide Readmission Database were included. The primary outcome was total cost defined by cost of index PCI and first unplanned readmission within 30-days.

**Results:** This analysis included 2,294,245 patients who underwent PCI, and the mean cost was $23,541±$20,730 (~$10.8 billion/year). There was a modest increase in cost over the study years of 17.5%. Of the 9.4% with an unplanned readmission within 30 days, the mean total cost was $35,333±24,230 versus $22,323±19,941 for those not readmitted. The variables most strongly associated with the highest quartile of cost were heart failure (adjusted odds ratio (aOR) 25.60 [95% CI 21.59-30.35]), need for circulatory support (aOR 11.62 [10.13-13.32]), periprocedural coronary artery bypass graft (CABG, aOR 585.08 [357.85-956.58]), and readmission within 30 days (aOR 24.49 [22.40-26.77]). An acute kidney injury (8.5%), major bleed (0.8%), vascular injury (0.8%), or need for periprodedural CABG (1.4%) had an average increased cost of $21,935, $30,898, $27,875 and $43,005, respectively, compared to PCI without adverse outcome.

**Conclusions:** The annual 30-day hospital cost of PCI is approximately $10.8 billion, and the costs associated with in-hospital adverse events, particularly the need for acute kidney injury and emergency CABG, were significant.

**Introduction**

Percutaneous coronary intervention (PCI) is among the most commonly performed medical procedures in the United States1 with over 650,000 PCI procedures undertaken in 20142. The safety of PCI has improved significantly over time with fewer complications3 and PCI has now become the most widely used revascularization modality around the world4.It has been suggested that the estimated total cost of PCI in the United States annually was $10 billion5.

In addition to the direct costs of PCI, there are financial burdens associated with PCI-related complications and early readmissions. For example, it has been reported the PCI complications represent 11.9% of 30-day readmissions6. Furthermore, readmissions within 30 days are associated with financial penalties7 with the Affordable Care Act including financial penalties for hospitals that have risk-adjusted readmission rates for specific conditions above specific benchmarks8. A previous study9 has evaluated cost and predictors of cost in PCI but this study had several limitations. First, all readmissions were included including planned readmissions potentially for staged PCI procedures. Secondly, this study did not consider the impact of periprocedural adverse events on costs and readmissions. No previous study has specifically focused on costs of PCI on a national level that considers temporal trends and has attempted to quantify the influence of in-hospital periprocedural adverse events and 30-day unplanned readmissions.

In this study, we aimed to examine: 1) the cost and trends in cost of PCI defined by the cost of the index PCI procedure and first readmission within 30 days; 2) the predictors of being in the highest quartile of cost considering patient demographics, comorbidities, hospital variables, and in-hospital periprocedural adverse events at index PCI; and 3) the estimated additional cost of in-hospital periprocedural adverse events over a 5-year period (2010-2014).

**Methods**

The Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality has produced the Nationwide Readmissions Database (NRD), which contains national hospitalization data for patients of all ages within the United States10. The data in the NRD is derived from discharge-level data for hospitalizations from 21 geographically dispersed states and is designed to represent 49.1% of all US hospitalizations11. For each patient episode there is a de-identified unique patient linkage number, which enables determination of readmissions by tracking patients across hospitals within a calendar year. We conducted a retrospective national cohort study using data from the NRD.

Men and women, aged 18 years or older, who underwent PCI with discharge dates between 2010 and 2014 and with 30-day follow up were included. Patients who underwent PCI were identified by the procedural codes 066 (PTCA OR CORONARY ATHER), 3606 (INSERT CORON ART STENT), and 3607 (INSERT DRUG ELUTING CRNRY AR). These codes were searched in the 15 procedural codes for each inpatient admission12.

The primary outcome in this study was cost of index PCI and first unplanned readmission within 30 days. This was defined as the cost (in US dollars) associated with the first admission for PCI and the first unplanned readmission within 30 days of discharge. The cost data as provided by HCUP provides an estimate of the total inpatient cost. Therefore, this would include all treatments received during the admission with PCI so treatments for acute myocardial infarction, cardiogenic shock and other adverse events where present. For national estimates, the cost variable was derived by multiplying the charge-to-cost ratio by the hospital charge for the inpatient admission. Patients were excluded if they were discharged during the month of December, had an elective readmission within 30-days and had a missing value for cost. The reason patients were excluded if they were discharged in the month of December was because these patients may not have 30-days of follow up.

Additional data were collected including patient demographics, comorbidities, hospital variables, and in-hospital outcomes as previously described using International Statistical Classification of Disease and Related Health Problems (ICD) 9 codes and Elixhauser comorbidity codes which were available in the NRD13. These variables included age, sex, year, elective admission, weekend admission, primary expected payer, median household income, hospital-bed number, location, teaching status, discharge location, length of stay, and cost were available in the NRD dataset. Diagnosis of acute myocardial infarction was defined as a first diagnostic code of 410\*1 or 4111. Using the ICD-9 diagnostic codes we defined several patient variables including smoking status (V1582 3051), dyslipidemia (2720–2724), complete heart block (4260), stroke or transient ischemic attack (431 433\*1 434\*1 435\* 4336\* 99701), cardiogenic shock (78551), cardiac arrest (4275), acute kidney injury (4590\* 56881 5789\* V582\* 431\* 4329\*) and bleeding (4590\* 56881 5782\* 431\* 4329\*). Vascular injuries were determined by ICD-9 diagnostic codes (900–904 9982 9992 9977 86804) and ICD-9 procedural codes (3931 3941 3949 3952 3956 3957 3959 3979). ICD-9 procedural codes were used to define receipt of circulatory support (3761 3768 3965), multivessel disease (0041 0042 0043 0046 0047 0048), bifurcation disease (0044), vasopressor use (0017), fractional flow reserve (0059), intravascular ultrasound (0024), drug eluting stent (3607), blood transfusion (9900), cardiogenic shock and cardiac arrest. Elixhauser comorbidity code was used to define alcohol misuse. Periprocedural adverse events were defined as in-hospital acute kidney injury (AKI), major bleeding, vascular injury and periprocedural coronary artery bypass graft surgery (CABG). AKI was defined by the ICD-9 code 584\* which corresponds to acute kidney failure. The codes 4590\* (hemorrhage, unspecified), 56881 (hemoperitoneum) 5789\* (gastrointestinal hemorrhage) V582\* (blood transfusion) 431\* (intracerebral hemorrhage) 4329\* (unspecified intracranial hemorrhage) were used to define major bleeding. The composite of all the periprocedural adverse events were used to define any adverse event. Periprocedural inpatient CABG was defined by the ICD-9 procedural codes: 36.1\* (Bypass anastomosis for heart revascularization) 36.20 (Heart revascularization by arterial implant) 36.31 (open chest transmyocardial revascularization) 36.32 (other transmyocardial revascularization) 36.9\* (other operation on vessels of the heart).

Statistical analyses were performed on Stata 15.0 (College Station, TX). Cost was defined into quartiles. The descriptive statistics of the quartiles of cost are presented according to patient demographics, comorbidities, hospital variables, and in-hospital outcomes. Trends in cost, periprocedural adverse events and readmissions were examined graphically. Histogram plots were used to examine the cost of PCI in the entire cohort and according to 30-day unplanned readmission. The impact of in-hospital periprocedural adverse events on cost estimates were presented in a table. Computations were performed to determine the average additional cost for patients with an adverse event and then this value was subtracted from the average cost difference from a PCI without an adverse event. The additional cost was multiplied by the number of cases with adverse event to estimate the additional cost for the period between 2010 and 2014 and divided it by 5 years to yield the additional cost associated with the adverse event per year. A multiple logistic regression was used to identify predictors associated with patients in the highest quartile of cost compared to the lowest quartile of cost. All variables were adjusted for in the model except elective as this variable was collinear with diagnosis of acute myocardial infarction. The associations are expressed as adjusted odds ratio (aOR) [95% confidence interval]. Sensitivity analyses were performed to explore cost histograms according to age group, sex, heart failure, multivessel disease, cardiogenic shock, circulatory support, emergency CABG, in-hospital bleeding, discharge status and urban or rural hospital. An additional analysis was performed stratified by diagnosis of acute myocardial infarction.In view of the lack of a normal distribution for cost we performed additional analysis of predictors of cost after logarithmic transform and a linear regression to identify predictors of cost. Further sensitivity analysis was performed considering the impact of inflation where the inflation rate was determined from the medical care in U.S. city average, all urban raw consumer price index published by the United States Department of Labor, Bureau of Labor Statistics 14.

**Results**

A total of 2,576,141 patients underwent PCI in the NRD database between 2010 and 2014 (Supplementary Figure 1). After exclusion of patients discharged in the month of December, those with missing values for cost and elective readmissions, a total of 2,294,245 patients were included in the analysis. The histogram of the cost for coronary syndromes treated with PCI and 30-day unplanned readmissions is shown in Figure 1 for the entire cohort and stratified by whether the patient was readmitted within 30 days. The mean total cost of index PCI and 30-day unplanned readmissions in the cohort was $23,541±$20,730. In this group 9.4% of patients had an unplanned readmission within 30 days and the mean total cost for those readmitted versus those not readmitted were $35,333±24,230 and $22,323±19,941, respectively (p<0.001). The estimated average annual total cost associated with coronary syndromes treated with PCI and 30-day unplanned readmissions in the United States based on the national estimates from this cohort was ~10.8 billion/year.

The trends in total cost of coronary syndromes treated with PCI and 30-day unplanned readmissions are examined in Figure 2. This total cost increased from $21,683 in 2010 to $25,480 in 2014 (17.5% increase over 5 years). Examining the effect of periprocedural adverse events, the average total cost for patients with a these events ($43,925) was much higher than patient who had a readmission ($35,333) and those with neither readmission or periprocedural adverse event ($19,937). There was a modest decline in readmissions from 9.5% and 9.7% in 2010 and 2011, respectively to 9.1% in 2014 while periprocedural adverse event rates increased from 8.8% to 13.7% across the years (Supplementary Figure 2).

The characteristics of the cohort according to quartile of cost of coronary syndrome treated with PCI and 30-day unplanned readmissions are shown in Table 1 and the characteristics of the whole cohort are shown in Supplementary Table 1. The mean total cost associated with coronary syndromes treated with PCI and 30-day unplanned readmissions for quartiles 1, 2, 3 and 4 were $10,783, $16,132, $21,913 and $45,335 respectively. Patients in the highest quartile were older (66.7 years for quartile 4 vs 64.2 years, 63.9 years and 64.7 years in quartile 1, 2 and 3, respectively) with more females (34.6% for quartile 4 vs 32.1% 31.9% and 32.8% for quartile 1, 2 and 3, respectively). Medicare patients represented the majority of patients in all quartiles, but the proportion of patients was greatest in quartile 4 (58.7%). Comorbidities including diabetes (41.6%), atrial fibrillation (18.6%), previous stroke/TIA (8.7%), peripheral vascular disease (15.5%), chronic lung disease (22.0%), renal failure (22.4%), and anemia (20.7%) were the most prevalent in the highest quartile group. In-hospital periprocedural adverse events including acute kidney injury (8.5%), major bleeding (0.8%), vascular injury (0.8%) and periprocedural CABG (1.4%) were overall low. However, rates were higher in quartile 4 compared to quartile 1, 2, and 3.

The strongest predictors of being in the highest quartile for the cost associated with coronary syndromes treated with PCI and 30-day unplanned readmissions were periprocedural CABG (adjusted odds ratio (aOR) 585.08 [357.08-956.58]), heart failure (aOR 25.60 [95% CI 21.59-30.35]) and readmission within 30 days (aOR 24.49 [22.40-26.77]). Existing coronary artery disease (aOR 0.75 [0.66-0.80]) and urban hospitals (aOR 0.23 [0.11-0.45]) were associated with fewer patients in the highest quartile of cost (Table 2).

The predictors of highest and lowest quartile of cost associated with coronary syndromes treated with PCI and 30-day unplanned readmissions stratified by indication for PCI (acute myocardial infarction or elective) are shown in Supplementary Table 2. Similar predictors of higher cost were observed in the acute myocardial infarction and elective cohorts.

The histogram of cost associated with coronary syndromes treated with PCI and 30-day unplanned readmissions according to subgroups of patients showed no major differences for age group and sex but there was a shift to greater cost for heart failure, multivessel disease, cardiogenic shock, circulatory support, emergency CABG, and in-hospital bleeding (Supplementary Figure 3). Urban hospital was associated with less cost.

Table 3 examines the costs associated with coronary syndromes treated with PCI, 30-day unplanned readmissions and in-hospital adverse events during admission with PCI. The cost of a PCI admission with an acute kidney injury, bleeding, vascular injury and periprocedural CABG was $41,080, $50,177, $47,344 and $62,835, respectively. On average sustaining an acute kidney injury, major bleed, or vascular injury increased costs by of $21,935, $30,898, $27,875, respectively. The need for periprocedural CABG surgery was associated with an increase cost by $43,005. Considering the prevalence of adverse events and the associated increased cost, the major expenses associated with in-hospital adverse events per year was $854 million for acute kidney injury.

The logarithmic transformed cost analysis is shown in Table 4 and 5 representing the analysis without and with inflation adjustment respectively. Important predictors of cost were periprocedural CABG (coefficient 2.30 [2.27-2.33]), heart failure (coefficient 1.67 [1.64-1.69]), and readmission within 30-days (coefficient 1.54 [1.53-1.55]). The inflation rate over the time period increased by 12% between 2010 and 2014. After consideration of inflation for the logarithmic transformed cost model, the important predictors appear to be receipt of fractional flow reserve (coefficient 2.64 [1.94-3.55]), heart failure (coefficient 1.97 [1.78-2.18]) and emergency CABG (coefficient 2.33 [2.03-2.68]).

The visual abstract of this work is shown in Figure 3.

**Discussion**

Our analysis of hospital costs for index PCI and associated procedures, and their associated 30-day unplanned readmissions, captured by the Nationwide Readmission dataset demonstrates several key findings. Firstly, an average total cost of $23,541 is observed for PCI procedures, and this average increases to $35,333 if a patient had an unplanned readmission and $34,025 if there was a peri-procedural adverse event. Secondly, the cost of index admission and unplanned readmission at 30-days has increased by 17.5% comparing costs between 2010 to 2014. Thirdly, procedures associated with increased total cost appear to be those undertaken for more acute patients, such as those with acute myocardial infarction, circulatory support, cardiogenic shock, cardiac arrest, major bleeding, vascular injury and periprocedural CABG. Finally, the impact of peri-procedural adverse events on cost estimates are significant as periprocedural CABG, major bleeding and acute kidney injury increase the average cost of a PCI by $43,005, $30,898 and $21,935, respectively, which translates to an additional cost per year of approximately $280 million, $110 million and $854 million respectively.

This study highlights the significant impact of peri-procedural adverse events on 30-day hospital costs. The average cost for 30-day elective readmissions after PCI was $15,802±17,254 in the current study. We have shown that compared to uncomplicated PCI, the additional cost of in-hospital adverse events can increase cost by approximately $23,000 to $44,000 depending on the type of adverse event. Annually these peri-procedural adverse events are estimated to be associated with several hundred million additional dollars. As PCI has evolved in safety and efficacy, there is a greater expectation on clinicians and health services to reduce costs whilst maintaining high quality patient care. Our analysis seem to suggest that rates of in-hospital adverse events have remained stable over time at approximately 3.0%. While some of these adverse events are unavoidable, these findings support the continued need to optimize management to further reduce the frequency of peri-procedural adverse events and their associated 30-day readmissions, as well investigate optimal strategies to manage these adverse events when they do occur with respect to both patient outcomes and cost. While the cost of the average periprocedural adverse event is associated with a greater cost than sustained during an unplanned readmission, the rates of periprocedural adverse events are approximately 3-fold less than readmissions, so the annual cost associated with readmissions is greater than in-hospital periprocedural adverse events.

The wide range in costs of PCI may be explained by a variety of factors, which are influenced by hospital stay, complication rate and readmissions. Broadly, the two groups of patients that undergo PCI are those admitted with acute coronary syndrome and those who are elective, particularly as the length of stay and risk profiles of these patients may differ which results in differences in cost. In addition, the current study shows that the propensity for increased cost is much greater in patients who have an in-hospital periprocedural adverse events. While elective patients are more likely to be hemodynamically and physiologically stable compared to those presenting with acute myocardial infarction, rapid advances in PCI technology has increased the number of PCIs among patients with complex or high-risk coronary lesions15, and this may be associated with more adverse events in elective patients16. Furthermore, the aging population has inevitably led to an increasing burden of comorbidities. Observational data suggest that at least 75% of patients who undergo PCI have at least 1 comorbid condition17, and comorbidity burden has been shown to be associated with increased in-hospital mortality, in-hospital complications, length of stay, healthcare costs18, and early readmissions13.

Considering the average urban consumer’s medical care cost in the United States, over the period of 2010 to 2014 there was an increase in inflation of 12%. In the current study the costs of PCI over the same period was higher at 17.5%. We suspect that the greater cost for PCI over time may reflect newer and more expensive technologies utilized in PCI in more recent years which are not present in all areas of medical care.

This study provides some insight about predictors of greater costs in PCI and is able to estimate the direct cost of common periprocedural adverse events following PCI. High-risk patients, such as those with acute myocardial infarction compared to elective cases, and those that have in-hospital periprocedural adverse eventssuch as cardiogenic shock, cardiac arrest, major bleeding, and emergency CABG have greater associated cost likely due to the additional management needed and longer length of stay. Heart failure was the comorbidity with the strongest independent association with greater 30-day cost. Data suggest that heart failure is the most common cause of hospitalization in the elderly, and a major factor contributing to economic burden is the high rate of unplanned readmissions associated with heart failure19. We found that coronary artery disease was associated with reduced odds of being in the highest quartile of total cost. One potential reason for this may be that patients with known coronary artery disease are also those who are more likely to have elective procedures which have less risk and costs associated with adverse events.

We observed that among patients that underwent PCI the use of FFR was associated with increased cost. While it is not clear why FFR would be correlated with greater overall cost, the current dataset does not consider patients who underwent coronary angiogram with FFR but did not undergo PCI procedure. It is likely that for patients that were not included in this analysis, FFR is cost-saving compared to a “PCI-for-all-angiographically-significant-lesions” strategy. Furthermore, it is likely that FFR is undertaken in patients with more complex and extensive coronary artery disease, that we cannot fully adjust for, which would contribute to the increased cost associated with FFR use that we have observed.

While we show that patients that have peri-procedural adverse events are correlated to more 30-day readmissions, it is important to acknowledge that most readmissions are not related to the PCI procedure. A previous national study in the United States suggests that the majority of readmissions are due to a non-cardiac reason12 and another study of a large integrated healthcare system found that only 11.9% of readmissions were complications related to the PCI6. Furthermore, it has been suggested that few readmissions after PCI resulted in discovery of a technical problem with the original PCI or the need for new unplanned readmissions20.

While some drivers of cost may be unavoidable such as patients with cardiac arrest or cardiogenic shock, a number of strategies may be considered to reduce cost. First, early unplanned readmissions increase cost for PCI, and implementation of strategies such as the use of readmission risk score, discharge checklist, close follow-up of high risk patients, and patient education videos have been shown to reduce readmissions21. Secondly, periprocedural CABG appears to be a major contributor to increased cost as the cost on average increases by $42,825 compared to an PCI without a periprocedural adverse event. An American study of emergency CABG reported that between 2008 and 2013, 29.2% of emergency CABG procedures were because of an attempted PCI causing a coronary artery dissection resulting in hemodynamic instability, which had increased from 5.3% in the period between 2003 and 200722. This may reflect the present era of PCI in more complex anatomy, such as heavily calcified lesions, chronic total occlusion, and/or extremely tortuous, and coronary perforations may occur as a result of guide wire advancement, balloon/stent advancement, balloon/stent inflation, over sizing or ruptured balloon/stent, entry into a subintimal passage in the setting of a severe dissection23, and the use of debulking atherectomy techniques16. Thirdly, bleeding avoidance strategies should be routinely adopted in PCI as major bleeds contribute significantly to cost. Radial access significantly reduces femoral access-site related retroperitoneal bleeding24, other major vascular complications, and, in acute coronary syndrome, mortality25. Radial access is also associated with a reduction in cost26,27. Bleeding risk estimation is also useful as it helps operators tailor access site and choice and duration of antithrombotic therapy28. There is also evidence that radial access decreases acute kidney injury, which may reduce cost of care post PCI29,30.

This study has several limitations. Firstly, the annualized construction of the NRD precludes linkage of patients between years and patients discharged in the month of December in each calendar year has to be excluded to ensure the cohort has at least 30-day of follow up. Secondly, the dataset used from the NRD was designed to represent the entire United States and we are unable to explore regional variations in total costs. Thirdly, this is a retrospective analysis of hospital data and we are unable to consider cost outside of hospital and indirect costs such as transport or loss of employment. Fourthly, the nature of the administrative database is such that patients are coded with diagnosis and procedure, which may suggest a complication from the PCI, but cannot be definitely ascertained as a PCI-related complication as we only know that both events occurred during the same admission. Nevertheless, the majority of these events are likely to be a complication of the PCI procedure rather than spontaneous events. We observed that this dataset has a very small proportion of patients with elective-day case PCI which suggests that outpatient elective PCI procedures may not be included. This may bias that sample and together with the observation that many elective cases were admitted post PCI may suggest that the findings for elective PCI may not be generalizable to all elective PCI cases. This is in contrast to datasets such as the NCDR that captures all PCI procedures including lower risk outpatient day case procedures, which may explain why our periprocedural adverse event rates are higher (8.5%) than those reported in work using the NCDR dataset (7.1%)31. Furthermore, whilst the NCDR dataset has specific fields for bleeding complications, the NCDR dataset uses ICD-9 codes that may account for differences in reported incidences. Our study is also limited because the data is derived from administrative databases where there may be coding errors and biases related to ascertainment of exposure variables, covariates and outcomes. Another limitation is that economic data can change faster than clinical data so that costs estimated in the current study may not be entirely reflective of current costs because the study was conducted up to 2014. While we are able to determine the primary causes of readmissions we are uncertain whether they are directly related to PCI or they are more related to existing non-PCI related cardiac or non-cardiac disease. However, the admission for PCI and any planned outpatient care would be opportunities to address the existing non-PCI related health problems to prevent readmission. Finally, while we were able to adjust for a variety of factors collected in the NRD such as patient demographics, comorbidities, hospital factors, and in-hospital periprocedural adverse events there may be residual confounding from unmeasured factors as the study is observational in nature.

In conclusion, the 30-day cost of coronary syndromes treated with PCI and 30-day unplanned readmissions in the United States is substantial (~$10.9 billion), and these costs significantly increases in patients who have in-hospital periprocedural adverse outcome or are readmitted within 30-days. As PCI strategies evolve, there is a greater expectation on clinicians and health services to reduce costs whilst maintaining high quality patient care. This study highlights potential variables associated with PCI that should be further studied in terms of how best to optimize the prevention and/or management of with the aim of reducing associated expenditures and improving patient outcomes.

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**Figure 1:** Cost for PCI (cost of admission and first readmission within 30-days)



**Figure 2:** Trends in cost and in the subgroups according to presence of readmission or complications

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**Figure 3: Visual abstract**

Figures 3 Legend: References: “A very large heart on CXR and a pacemaker”, by James Heilman, licensed under CC By-SA 3.0. “Right internal jugular vein drainage and right carotid artery infusion”, by K. Van Meurs, K.P. Lally, G. Peek, J.B. Zwischenberger, licensed under CC BY 2.5. Blausen.com staff (2014) “Medical gallery of Blausen Medical 2014”. WikiJournal of Medicine 1 (2). “aortic dissection – aortendissektion Scheme”, by J. Heuser, licensed under CC BY-SA 3.0.

**Table 1: Characteristics by quartiles of total cost**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Quartile 1 of total cost**  **(n=573,626)** | **Quartile 2 of total cost (n=573,499)** | **Quartile 3 of total cost (n=573,565)** | **Quartile 4 of total cost (n=573,555)** |
| Total cost  Average (SD)  Median (IQR) | $10,783 ± 2,495  $11,330 [$9,555-$12,683) | $16,132 ± 1,343  $16,096 [$14,969-$17,273] | $21,913 ± 2,201  $21,661 [$19,989-$23,704] | $45,335 ± 31,791  $35,980 [$30,010-$48,490] |
| Age (year) | 64.2 ± 12.1 | 63.9 ± 12.4 | 64.7 ± 12.5 | 66.7 ± 12.5 |
| Female | 32.1% | 31.9% | 32.8% | 34.6% |
| Elective | 26.3% | 15.2% | 12.2% | 11.3% |
| Acute myocardial infarction | 38.6% | 53.6% | 57.5% | 57.0% |
| Weekend admission | 14.7% | 21.2% | 23.0% | 23.3% |
| Primary expected payer  Medicare  Medicaid  Private  Uninsured  No charge  Other | 52.0%  7.9%  29.9%  6.0%  0.8%  3.4% | 50.1%  6.7%  31.9%  6.6% 0.9%  3.9% | 52.1%  7.3%  30.2%  5.7%  0.8  3.9% | 58.7%  8.3%  24.5% 4.3%  0.6%  3.6% |
| Quartile of income based on post code  0-25th  26-50th  51-75th  76th-100th | 34.6%  26.7%  21.9%  16.8% | 30.5%  26.4%  23.7%  19.5% | 27.2%  25.1%  25.1%  22.6% | 25.0%  24.0%  25.1%  25.8% |
| Smoking | 40.3% | 43.2% | 42.4% | 37.9% |
| Alcohol misuse | 2.0% | 2.5% | 2.7% | 3.4% |
| Dyslipidemia | 72.8% | 72.6% | 71.6% | 65.1% |
| Hypertension | 75.5% | 74.1% | 74.3% | 73.7% |
| Diabetes | 34.5% | 34.4% | 36.8% | 41.6% |
| Obesity | 13.4% | 15.7% | 16.5% | 16.9% |
| Heart failure | 0.1% | 0.3% | 1.0% | 5.3% |
| Coronary artery disease | 95.5% | 94.5% | 93.9% | 91.7% |
| Previous myocardial infarction | 14.1% | 13.8% | 13.8% | 14.0% |
| Previous PCI | 22.5% | 21.1% | 19.9% | 18.4% |
| Previous CABG | 8.1% | 7.7% | 7.7% | 7.5% |
| Valvular heart disease | 0.06% | 0.13% | 0.34% | 1.52% |
| Atrial fibrillation | 8.0% | 9.3% | 11.7% | 18.6% |
| Previous TIA/stroke | 5.7% | 6.2% | 7.1% | 8.7% |
| Peripheral vascular disease | 8.9% | 9.3% | 10.8% | 15.5% |
| Pulmonary circulatory disorder | 0.03% | 0.06% | 0.19% | 1.01% |
| Peptic ulcer disease | 0.02% | 0.02% | 0.02% | 0.03% |
| Chronic lung disease | 13.4% | 15.0% | 17.3% | 22.0% |
| Renal failure | 8.6% | 10.3% | 13.4% | 22.4% |
| Liver failure | 0.8% | 1.1% | 1.2% | 1.9% |
| Hypothyroidism | 7.9% | 8.9% | 9.5% | 10.5% |
| Anemia | 5.2% | 7.3% | 10.6% | 20.7% |
| Cancer | 1.3% | 1.5% | 1.8% | 2.7% |
| Depression | 5.4% | 6.4% | 7.0% | 7.7% |
| Dementia | 1.2% | 1.6% | 2.1% | 3.2% |
| Hospital bedsize  Small  Medium  Large | 6.2%  17.9%  76.0% | 5.2%  21.3%  73.5% | 5.6%  22.1%  72.4% | 5.9%  20.7%  73.5% |
| Urban hospital | 99.9% | 99.8% | 99.7% | 99.8% |
| Teaching hospital | 55.7% | 52.7% | 52.6% | 54.9% |
| Multivessel disease | 8.0% | 12.7% | 19.5% | 23.6% |
| Bifurcation lesion | 2.1% | 2.4% | 3.0% | 3.7% |
| Circulatory support | 0.5% | 1.0% | 2.6% | 12.8% |
| FFR | 1.3% | 1.6% | 2.1% | 2.3% |
| IVUS | 5.0% | 6.0% | 7.8% | 9.2% |
| Drug eluting stent | 70.3% | 74.8% | 76.5% | 70.1% |
| Cardiogenic shock | 0.6% | 1.1% | 2.5% | 11.2% |
| Cardiac arrest | 0.5% | 1.0% | 1.8% | 6.7% |
| Acute kidney failure | 2.1% | 4.3% | 7.4% | 20.1% |
| Major bleeding | 0.2% | 0.3% | 0.5% | 2.2% |
| Vascular injury | 0.3% | 0.4% | 0.7% | 2.1% |
| Periprocedural CABG | 0.02% | 0.01% | 0.15% | 5.49% |
| Length of stay (days) | 1.8 ± 1.2 | 2.5 ±1.6 | 3.3 ± 2.3 | 7.8 ± 9.4 |
| Index PCI cost (USD) | $10,733 ± 2,520 | $15,963 ± 1,582 | $21,320 ± 2,849 | $41,697 ± 30,929 |
| Readmit cost (USD) | $50 ± 448 | $169 ± 918 | $592 ± 2,062 | $3,638 ± 11,822 |
| Discharge location or in-hospital death  Home  Transfer to other hospital  Care home  Discharge against medical advice  In-hospital death  Other or missing | 95.4%  1.0%  2.4%  0.5%  0.7%  <0.01% | 92.8%  1.8%  4.0%  0.4%  0.9%  <0.01% | 87.9%  3.5%  6.6%  0.4%  1.6%  0.01% | 67.1%  12.5%  14.6%  0.4%  5.4%  0.05% |

**Table 2: Predictors of patients in the highest vs the lowest quartile of cost**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Predictor of highest quartile of cost** | **Adjusted Odds Ratio** | **[95% Confidence Interval]** | | **p-value** |
| Age (per year) | 1.01 | 1.01 | 1.01 | <0.001 |
| Female | 0.95 | 0.93 | 0.98 | <0.001 |
| Acute myocardial infarction | 2.33 | 2.17 | 2.49 | <0.001 |
| Weekend admission | 1.54 | 1.49 | 1.60 | <0.001 |
| Primary expected payer vs Medicare | | | |  |
| Medicaid | 1.26 | 1.15 | 1.38 | <0.001 |
| Private | 0.98 | 0.94 | 1.02 | 0.37 |
| Uninsured | 0.95 | 0.88 | 1.01 | 0.12 |
| No charge | 1.11 | 0.86 | 1.42 | 0.52 |
| Other | 1.25 | 1.12 | 1.39 | <0.001 |
| Quartile of income based on post code vs 0th-25th quartile | | | | |
| 26-50th | 1.35 | 1.25 | 1.47 | <0.001 |
| 51-75th | 1.70 | 1.53 | 1.88 | <0.001 |
| 76th-100th | 2.61 | 2.28 | 2.99 | <0.001 |
| Smoking | 0.97 | 0.93 | 1.01 | 0.11 |
| Alcohol misuse | 1.68 | 1.57 | 1.81 | <0.001 |
| Dyslipidemia | 0.82 | 0.79 | 0.85 | <0.001 |
| Hypertension | 0.88 | 0.84 | 0.91 | <0.001 |
| Diabetes | 1.20 | 1.17 | 1.23 | <0.001 |
| Obesity | 1.28 | 1.23 | 1.34 | <0.001 |
| Heart failure | 25.60 | 21.59 | 30.35 | <0.001 |
| Coronary artery disease | 0.75 | 0.66 | 0.85 | <0.001 |
| Previous myocardial infarction | 1.15 | 1.10 | 1.19 | <0.001 |
| Previous PCI | 0.85 | 0.82 | 0.89 | <0.001 |
| Previous CABG | 1.00 | 0.95 | 1.06 | 0.92 |
| Valvular heart disease | 9.00 | 6.84 | 11.84 | <0.001 |
| Atrial fibrillation | 1.86 | 1.79 | 1.94 | <0.001 |
| Previous TIA/stroke | 1.25 | 1.19 | 1.31 | <0.001 |
| Peripheral vascular disease | 1.45 | 1.39 | 1.52 | <0.001 |
| Pulmonary circulatory disorder | 11.99 | 8.08 | 17.79 | <0.001 |
| Peptic ulcer disease | 1.56 | 0.82 | 2.96 | 0.17 |
| Chronic lung disease | 1.46 | 1.42 | 1.51 | <0.001 |
| Renal failure | 1.39 | 1.33 | 1.45 | <0.001 |
| Liver failure | 1.75 | 1.61 | 1.91 | <0.001 |
| Hypothyroidism | 1.07 | 1.03 | 1.12 | <0.001 |
| Anemia | 2.73 | 2.60 | 2.87 | <0.001 |
| Cancer | 1.63 | 1.51 | 1.76 | <0.001 |
| Depression | 1.23 | 1.17 | 1.29 | <0.001 |
| Dementia | 1.72 | 1.59 | 1.85 | <0.001 |
| Hospital bedsize vs small | | | | |
| Medium | 0.92 | 0.58 | 1.44 | 0.71 |
| Large | 0.67 | 0.43 | 1.03 | 0.07 |
| Urban hospital | 0.23 | 0.11 | 0.45 | <0.001 |
| Teaching hospital | 1.00 | 0.85 | 1.17 | 0.99 |
| Multivessel disease | 4.66 | 4.33 | 5.01 | <0.001 |
| Bifurcation lesion | 1.32 | 1.14 | 1.52 | <0.001 |
| Circulatory support | 11.62 | 10.13 | 13.33 | <0.001 |
| FFR | 2.06 | 1.81 | 2.34 | <0.001 |
| IVUS | 2.37 | 2.08 | 2.70 | <0.001 |
| Drug eluting stent | 1.84 | 1.74 | 1.95 | <0.001 |
| Cardiogenic shock | 3.88 | 3.50 | 4.30 | <0.001 |
| Cardiac arrest | 6.84 | 6.22 | 7.53 | <0.001 |
| Acute kidney failure | 5.59 | 5.18 | 6.02 | <0.001 |
| Major bleeding | 7.01 | 5.98 | 8.21 | <0.001 |
| Vascular injury | 7.07 | 5.98 | 8.21 | <0.001 |
| Periprocedural CABG | 585.08 | 357.08 | 956.58 | <0.001 |
| Readmission within 30-days | 24.49 | 22.40 | 26.77 | <0.001 |

**Table 3: Impact of in-hospital periprocedural adverse events on annual cost estimates**

|  |  |  |  |
| --- | --- | --- | --- |
| Group | Number | Median cost (interquartile range) | Average cost ± standard deviation |
| No readmission or periprocedural adverse events | 1866425 | $17160 (13152-23049) | $19937 ± 13088 |
| Readmission | 214660 | $29017 (21363-41446) | $35333 ± 24230 |
| Any periprocedural adverse events | 245645 | $32575 (21415-51697) | $43925 ± 42210 |
| Specific periprocedural adverse events |  |  |  |
| Acute kidney injury | 194593 | $43032 (20609-49607) | $43032 ± 43751 |
| Bleeding | 17801 | $36757 (24026-61700) | $51995 ± 53286 |
| Vascular injury | 19357 | $32029 (20685-54209) | $48972 ± 60941 |
| Periprocedural CABG | 32541 | $51887 (39734-71953) | $64102 ± 44829 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Number | Average cost per adverse event or readmission | Cost difference from no adverse event | Cost impact (millions USD) | Cost impact per year (millions USD) |
| No readmission or periprocedural adverse events | 2048600 | $21097 | - | - | - |
| Readmission | 215363 | $35333 | $14236 | $3066 | $613 |
| Any periprocedural adverse events | 245645 | $43925 | $22828 | $5608 | $1122 |
| Acute kidney injury | 194593 | $43032 | $21935 | $4268 | $854 |
| Bleeding | 17801 | $51995 | $30898 | $550 | $110 |
| Vascular injury | 19357 | $48972 | $27875 | $540 | $108 |
| Periprocedural CABG | 32541 | $64102 | $43005 | $1399 | $280 |

**Table 4: Linear regression model of the logarithmic transformed cost to identify predictors of increased cost**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Predictor of log(cost) | Coefficient | 95% confidence interval | | p-value |
| Age (per year) | 1.00 | 1.00 | 1.00 | <0.001 |
| Female | 0.99 | 0.99 | 0.99 | <0.001 |
| Acute myocardial infarction | 1.13 | 1.11 | 1.15 | <0.001 |
| Weekend admission | 1.07 | 1.06 | 1.07 | <0.001 |
| Primary expected payer vs Medicare | | | |  |
| Medicaid | 1.02 | 1.00 | 1.04 | 0.017 |
| Private | 1.00 | 0.99 | 1.00 | 0.39 |
| Uninsured | 0.99 | 0.99 | 1.00 | 0.21 |
| No charge | 1.02 | 0.98 | 1.05 | 0.33 |
| Other | 1.03 | 1.01 | 1.05 | <0.001 |
| Quartile of income based on post code vs 0th-25th quartile | | | | |
| 26-50th | 1.04 | 1.03 | 1.06 | <0.001 |
| 51-75th | 1.08 | 1.06 | 1.10 | <0.001 |
| 76th-100th | 1.15 | 1.12 | 1.18 | <0.001 |
| Smoking | 0.99 | 0.99 | 1.00 | 0.011 |
| Alcohol misuse | 1.08 | 1.07 | 1.09 | <0.001 |
| Dyslipidemia | 0.96 | 0.96 | 0.97 | <0.001 |
| Hypertension | 0.98 | 0.97 | 0.98 | <0.001 |
| Diabetes | 1.02 | 1.02 | 1.03 | <0.001 |
| Obesity | 1.04 | 1.03 | 1.04 | <0.001 |
| Heart failure | 1.67 | 1.64 | 1.69 | <0.001 |
| Coronary artery disease | 0.95 | 0.89 | 1.01 | 0.099 |
| Previous myocardial infarction | 1.02 | 1.01 | 1.02 | <0.001 |
| Previous PCI | 0.98 | 0.97 | 0.99 | <0.001 |
| Previous CABG | 1.00 | 0.99 | 1.01 | 0.41 |
| Valvular heart disease | 1.17 | 1.14 | 1.20 | <0.001 |
| Atrial fibrillation | 1.10 | 1.10 | 1.11 | <0.001 |
| Previous TIA/stroke | 1.03 | 1.02 | 1.03 | <0.001 |
| Peripheral vascular disease | 1.06 | 1.05 | 1.07 | <0.001 |
| Pulmonary circulatory disorder | 1.23 | 1.19 | 1.27 | <0.001 |
| Peptic ulcer disease | 1.06 | 0.97 | 1.15 | 0.20 |
| Chronic lung disease | 1.06 | 1.05 | 1.06 | <0.001 |
| Renal failure | 1.05 | 1.05 | 1.06 | <0.001 |
| Liver failure | 1.09 | 1.08 | 1.10 | <0.001 |
| Hypothyroidism | 1.01 | 1.01 | 1.01 | <0.001 |
| Anemia | 1.16 | 1.15 | 1.17 | <0.001 |
| Cancer | 1.08 | 1.07 | 1.09 | <0.001 |
| Depression | 1.03 | 1.03 | 1.04 | <0.001 |
| Dementia | 1.06 | 1.05 | 1.07 | <0.001 |
| Hospital bedsize vs small | |  |  |  |
| Medium | 1.04 | 0.93 | 1.17 | 0.52 |
| Large | 1.00 | 0.89 | 1.12 | 0.99 |
| Urban hospital | 0.85 | 0.81 | 0.89 | <0.001 |
| Teaching hospital | 1.00 | 0.98 | 1.03 | 0.96 |
| Multivessel disease | 1.23 | 1.22 | 1.24 | <0.001 |
| Bifurcation lesion | 1.04 | 1.02 | 1.06 | <0.001 |
| Circulatory support | 1.41 | 1.39 | 1.43 | <0.001 |
| FFR | 1.10 | 1.08 | 1.13 | <0.001 |
| IVUS | 1.13 | 1.11 | 1.15 | <0.001 |
| Drug eluting stent | 1.08 | 1.07 | 1.09 | <0.001 |
| Cardiogenic shock | 1.25 | 1.24 | 1.26 | <0.001 |
| Cardiac arrest | 1.32 | 1.31 | 1.34 | <0.001 |
| Acute kidney failure | 1.32 | 1.30 | 1.33 | <0.001 |
| Major bleeding | 1.35 | 1.33 | 1.37 | <0.001 |
| Vascular injury | 1.40 | 1.37 | 1.42 | <0.001 |
| Periprocedural CABG | 2.30 | 2.27 | 2.33 | <0.001 |
| Readmission within 30-days | 1.54 | 1.53 | 1.55 | <0.001 |

R2=0.3335

**Table 5: Linear regression model of the logarithmic transformed inflation adjusted cost to identify predictors of increased inflation adjusted cost**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Predictor of inflation adjusted cost | Coefficient | 95% confidence interval | | p-value |
| Age (per year) | 1.00 | 1.00 | 1.01 | 0.001 |
| Female | 0.93 | 0.90 | 0.96 | <0.001 |
| Acute myocardial infarction | 1.99 | 1.78 | 2.23 | <0.001 |
| Weekend admission | 1.19 | 1.15 | 1.24 | <0.001 |
| Primary expected payer vs Medicare | | | |  |
| Medicaid | 1.15 | 0.99 | 1.33 | 0.072 |
| Private | 0.91 | 0.85 | 0.97 | 0.004 |
| Uninsured | 1.07 | 0.96 | 1.19 | 0.2 |
| No charge | 1.50 | 1.05 | 2.17 | 0.028 |
| Other | 1.12 | 0.94 | 1.35 | 0.21 |
| Quartile of income based on post code vs 0th-25th quartile | | | | |
| 26-50th | 1.08 | 0.94 | 1.26 | 0.28 |
| 51-75th | 1.15 | 0.93 | 1.41 | 0.19 |
| 76th-100th | 1.12 | 0.83 | 1.51 | 0.45 |
| Smoking | 1.16 | 1.07 | 1.27 | 0.001 |
| Alcohol misuse | 1.16 | 1.06 | 1.28 | 0.002 |
| Dyslipidemia | 0.99 | 0.93 | 1.05 | 0.68 |
| Hypertension | 1.05 | 1.00 | 1.11 | 0.038 |
| Diabetes | 1.09 | 1.05 | 1.13 | <0.001 |
| Obesity | 1.29 | 1.20 | 1.39 | <0.001 |
| Heart failure | 1.97 | 1.78 | 2.18 | <0.001 |
| Coronary artery disease | 0.78 | 0.70 | 0.87 | <0.001 |
| Previous myocardial infarction | 1.08 | 1.01 | 1.15 | 0.019 |
| Previous PCI | 1.06 | 0.98 | 1.13 | 0.128 |
| Previous CABG | 0.97 | 0.90 | 1.06 | 0.55 |
| Valvular heart disease | 1.32 | 1.14 | 1.53 | <0.001 |
| Atrial fibrillation | 1.29 | 1.24 | 1.35 | <0.001 |
| Previous TIA/stroke | 1.13 | 1.07 | 1.20 | <0.001 |
| Peripheral vascular disease | 1.04 | 0.98 | 1.10 | 0.19 |
| Pulmonary circulatory disorder | 1.64 | 1.38 | 1.93 | <0.001 |
| Peptic ulcer disease | 0.69 | 0.32 | 1.45 | 0.33 |
| Chronic lung disease | 1.07 | 1.02 | 1.12 | 0.009 |
| Renal failure | 1.15 | 1.09 | 1.22 | <0.001 |
| Liver failure | 1.41 | 1.28 | 1.56 | <0.001 |
| Hypothyroidism | 1.15 | 1.09 | 1.21 | <0.001 |
| Anemia | 1.19 | 1.12 | 1.27 | <0.001 |
| Cancer | 1.28 | 1.17 | 1.40 | <0.001 |
| Depression | 1.11 | 1.02 | 1.19 | 0.01 |
| Dementia | 1.16 | 1.07 | 1.25 | <0.001 |
| Hospital bedsize vs small | |  |  |  |
| Medium | 1.12 | 0.53 | 2.38 | 0.76 |
| Large | 0.80 | 0.38 | 1.65 | 0.54 |
| Urban hospital | 0.72 | 0.06 | 8.35 | 0.79 |
| Teaching hospital | 1.19 | 0.84 | 1.70 | 0.33 |
| Multivessel disease | 1.09 | 1.01 | 1.18 | 0.028 |
| Bifurcation lesion | 0.99 | 0.77 | 1.28 | 0.94 |
| Circulatory support | 1.37 | 1.23 | 1.53 | <0.001 |
| FFR | 2.63 | 1.94 | 3.55 | <0.001 |
| IVUS | 1.09 | 0.81 | 1.45 | 0.59 |
| Drug eluting stent | 1.46 | 1.33 | 1.60 | <0.001 |
| Cardiogenic shock | 1.35 | 1.25 | 1.46 | <0.001 |
| Cardiac arrest | 1.75 | 1.62 | 1.88 | <0.001 |
| Acute kidney failure | 1.75 | 1.61 | 1.90 | <0.001 |
| Major bleeding | 1.30 | 1.15 | 1.47 | <0.001 |
| Vascular injury | 1.03 | 0.89 | 1.19 | 0.73 |
| Periprocedural CABG | 2.33 | 2.03 | 2.68 | <0.001 |
| Readmission within 30-days | 1.42 | 1.36 | 1.50 | <0.001 |

R2=0.0375

**Supplementary Figure 1:** Flow diagram of patient inclusion



**Supplementary Figure 2:** Trends in periprocedural adverse events and readmissions

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**Supplementary Figure 3:** Cost in patient subgroups

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**Supplementary Table 1: Characteristics of the whole cohort**

|  |  |
| --- | --- |
| Variable | Total cohort |
| Age (year) | 64.9 ± 12.4 |
| Female | 32.8% |
| Elective | 16.2% |
| Acute myocardial infarction | 51.7% |
| Weekend admission | 20.5% |
| Primary expected payer  Medicare  Medicaid  Private  Uninsured  No charge  Other | 53.2%  7.6%  29.2%  5.6%  0.8%  3.7% |
| Quartile of income based on post code  0-25th  26-50th  51-75th  76th-100th | 29.3%  25.6% 23.9%  21.2% |
| Smoking | 40.9% |
| Alcohol misuse | 2.6% |
| Dyslipidemia | 70.5% |
| Hypertension | 74.4% |
| Diabetes | 36.8% |
| Obesity | 15.6% |
| Heart failure | 1.7% |
| Coronary artery disease | 93.9% |
| Previous myocardial infarction | 13.9% |
| Previous PCI | 20.5% |
| Previous CABG | 7.7% |
| Valvular heart disease | 0.5% |
| Atrial fibrillation | 11.9% |
| Previous TIA/stroke | 6.9% |
| Peripheral vascular disease | 11.1% |
| Pulmonary circulatory disorder | 0.3% |
| Peptic ulcer disease | 0.02% |
| Chronic lung disease | 16.9% |
| Renal failure | 13.7% |
| Liver failure | 1.2% |
| Hypothyroidism | 9.2% |
| Anemia | 13.5% |
| Cancer | 10.9% |
| Depression | 1.8% |
| Dementia | 2.0% |
| Hospital bedsize  Small  Medium  Large | 5.7%  20.5% 73.8% |
| Urban hospital | 99.8% |
| Teaching hospital | 54.0% |
| Multivessel disease | 16.0% |
| Bifurcation lesion | 2.8% |
| Circulatory support | 4.2% |
| FFR | 1.9% |
| IVUS | 7.0% |
| Cardiogenic shock | 3.8% |
| Cardiac arrest | 3.8% |
| Acute kidney failure | 8.5% |
| Major bleeding | 0.7% |
| Vascular injury | 0.8% |
| Periprocedural CABG | 1.4% |
| Length of stay (days) | 3.9±5.5 |
| Index PCI cost (USD) | $22,428±19524 |
| Readmit cost (USD) | $1,112±6,199 |
| Discharge location or in-hospital death  Home  Transfer to other hospital  Care home  Discharge against medical advice  In-hospital death  Other or missing | 85.8%  4.7%  6.9%  0.4%  2.1%  0.02% |

**Supplementary Table 2: Predictors of patients in the highest vs the lowest quartile of cost in patient with and without acute myocardial infarction**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Predictor of highest quartile of cost** | **Acute myocardial infarction** | | | | **Elective PCI** | | | |
| **Adjusted Odds Ratio** | **[95% Confidence Interval]** | | **p-value** | **Adjusted Odds Ratio** | **[95% Confidence Interval]** | | **p-value** |
| Age (per year) | 1.01 | 1.00 | 1.01 | <0.001 | 1.01 | 1.01 | 1.01 | <0.001 |
| Female | 0.94 | 0.91 | 0.97 | <0.001 | 0.96 | 0.93 | 0.99 | 0.011 |
| Weekend admission | 1.20 | 1.16 | 1.23 | <0.001 | 2.29 | 2.14 | 2.45 | <0.001 |
| Primary expected payer vs Medicare | | | | | | | | |
| Medicaid | 1.33 | 1.21 | 1.46 | <0.001 | 1.23 | 1.10 | 1.37 | <0.001 |
| Private | 0.91 | 0.87 | 0.95 | <0.001 | 1.04 | 0.97 | 1.11 | 0.24 |
| Uninsured | 0.83 | 0.77 | 0.90 | <0.001 | 1.32 | 1.19 | 1.45 | <0.001 |
| No charge | 0.90 | 0.69 | 1.18 | 0.44 | 1.72 | 1.29 | 2.31 | <0.001 |
| Other | 1.16 | 1.03 | 1.31 | 0.014 | 1.32 | 1.16 | 1.49 | <0.001 |
| Quartile of income based on post code vs 0th-25th quartile | | | | | | | | |
| 26-50th | 1.42 | 1.30 | 1.55 | <0.001 | 1.30 | 1.19 | 1.41 | <0.001 |
| 51-75th | 1.80 | 1.60 | 2.02 | <0.001 | 1.63 | 1.47 | 1.81 | <0.001 |
| 76th-100th | 3.05 | 2.62 | 3.55 | <0.001 | 2.35 | 2.04 | 2.71 | <0.001 |
| Smoking | 0.88 | 0.84 | 0.92 | <0.001 | 1.07 | 1.01 | 1.13 | 0.013 |
| Alcohol misuse | 1.49 | 1.36 | 1.62 | <0.001 | 2.02 | 1.83 | 2.24 | <0.001 |
| Dyslipidemia | 0.90 | 0.86 | 0.94 | <0.001 | 0.76 | 0.72 | 0.80 | <0.001 |
| Hypertension | 0.90 | 0.86 | 0.94 | <0.001 | 0.87 | 0.82 | 0.91 | <0.001 |
| Diabetes | 1.25 | 1.22 | 1.29 | <0.001 | 1.16 | 1.12 | 1.20 | <0.001 |
| Obesity | 1.21 | 1.15 | 1.27 | <0.001 | 1.34 | 1.27 | 1.42 | <0.001 |
| Heart failure | 24.80 | 16.19 | 37.99 | <0.001 | 20.30 | 17.04 | 24.17 | <0.001 |
| Coronary artery disease | 1.00 | 0.92 | 1.08 | 0.91 | 0.25 | 0.12 | 0.49 | <0.001 |
| Previous myocardial infarction | 1.09 | 1.03 | 1.15 | 0.002 | 1.16 | 1.11 | 1.22 | <0.001 |
| Previous PCI | 0.84 | 0.80 | 0.89 | <0.001 | 0.86 | 0.82 | 0.91 | <0.001 |
| Previous CABG | 1.02 | 0.95 | 1.10 | 0.60 | 1.00 | 0.94 | 1.06 | 0.94 |
| Valvular heart disease | 6.17 | 2.48 | 15.33 | <0.001 | 8.31 | 6.25 | 11.05 | <0.001 |
| Atrial fibrillation | 1.78 | 1.70 | 1.87 | <0.001 | 1.87 | 1.78 | 1.97 | <0.001 |
| Previous TIA/stroke | 1.13 | 1.06 | 1.20 | <0.001 | 1.33 | 1.26 | 1.40 | <0.001 |
| Peripheral vascular disease | 1.48 | 1.39 | 1.57 | <0.001 | 1.44 | 1.37 | 1.52 | <0.001 |
| Pulmonary circulatory disorder | 29.23 | 6.45 | 132.49 | <0.001 | 9.20 | 6.09 | 13.89 | <0.001 |
| Peptic ulcer disease | 3.23 | 1.17 | 8.91 | 0.023 | 0.95 | 0.47 | 1.94 | 0.89 |
| Chronic lung disease | 1.42 | 1.36 | 1.49 | <0.001 | 1.46 | 1.41 | 1.52 | <0.001 |
| Renal failure | 1.40 | 1.33 | 1.48 | <0.001 | 1.37 | 1.30 | 1.45 | <0.001 |
| Liver failure | 1.55 | 1.37 | 1.74 | <0.001 | 1.87 | 1.66 | 2.10 | <0.001 |
| Hypothyroidism | 0.97 | 0.92 | 1.02 | 0.26 | 1.16 | 1.10 | 1.22 | <0.001 |
| Anemia | 2.53 | 2.38 | 2.70 | <0.001 | 2.80 | 2.63 | 2.98 | <0.001 |
| Cancer | 1.54 | 1.38 | 1.71 | <0.001 | 1.66 | 1.49 | 1.84 | <0.001 |
| Depression | 1.12 | 1.05 | 1.19 | <0.001 | 1.31 | 1.23 | 1.39 | <0.001 |
| Dementia | 1.41 | 1.28 | 1.53 | <0.001 | 2.12 | 1.89 | 2.38 | <0.001 |
| Hospital bedsize vs small |  |  |  |  |  |  |  |  |
| Medium | 0.77 | 0.48 | 1.21 | 0.25 | 1.13 | 0.67 | 1.88 | 0.65 |
| Large | 0.60 | 0.39 | 0.93 | 0.022 | 0.78 | 0.47 | 1.28 | 0.32 |
| Urban hospital | 0.24 | 0.10 | 0.56 | 0.001 | 0.22 | 0.13 | 0.37 | <0.001 |
| Teaching hospital | 1.10 | 0.92 | 1.31 | 0.28 | 0.92 | 0.77 | 1.09 | 0.32 |
| Multivessel disease | 4.65 | 4.26 | 5.07 | <0.001 | 4.81 | 4.43 | 5.22 | <0.001 |
| Bifurcation lesion | 1.55 | 1.35 | 1.77 | <0.001 | 1.18 | 0.96 | 1.44 | 0.11 |
| Circulatory support | 8.85 | 7.74 | 10.13 | <0.001 | 22.56 | 17.76 | 28.66 | <0.001 |
| FFR | 2.51 | 2.08 | 3.02 | <0.001 | 1.97 | 1.70 | 2.27 | <0.001 |
| IVUS | 4.05 | 3.45 | 4.77 | <0.001 | 1.92 | 1.66 | 2.22 | <0.001 |
| Drug eluting stent | 2.24 | 2.09 | 2.39 | <0.001 | 1.53 | 1.43 | 1.63 | <0.001 |
| Cardiogenic shock | 3.84 | 3.47 | 4.26 | <0.001 | 8.37 | 6.37 | 10.99 | <0.001 |
| Cardiac arrest | 5.03 | 4.53 | 5.58 | <0.001 | 15.50 | 12.73 | 18.88 | <0.001 |
| Acute kidney failure | 4.30 | 3.95 | 4.68 | <0.001 | 6.80 | 6.18 | 7.48 | <0.001 |
| Major bleeding | 6.80 | 5.56 | 8.31 | <0.001 | 7.06 | 5.55 | 8.98 | <0.001 |
| Vascular injury | 5.90 | 4.65 | 7.48 | <0.001 | 7.49 | 6.32 | 8.88 | <0.001 |
| Periprocedural CABG | 648.90 | 348.09 | 1209.67 | <0.001 | 552.71 | 354.99 | 911.94 | <0.001 |
| Readmission within 30-days | 28.23 | 25.11 | 31.72 | <0.001 | 23.13 | 20.97 | 25.52 | <0.001 |