ORIGINAL RESEARCH

Trends in Reoperative Coronary Artery Bypass Graft Surgery for Older Adults in the United States, 1998 to 2017

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BACKGROUND: The likelihood of undergoing reoperative coronary artery bypass graft surgery (CABG) is important for older patients who are considering first-time CABG. Trends in the reoperative CABG for these patients are unknown.

METHODS AND RESULTS: We used the Medicare fee-for-service inpatient claims data of adults undergoing isolated first-time CABG between 1998 and 2017. The primary outcome was time to first reoperative CABG within 5 years of discharge from the index surgery, treating death as a competing risk. We fitted a Cox regression to model the likelihood of reoperative CABG as a function of patient baseline characteristics. There were 1,666,875 unique patients undergoing first-time isolated CABG and surviving to hospital discharge. The median (interquartile range) age of patients did not change significantly over time (from 74 [69–78] in 1998 to 73 [69–78] in 2017); the proportion of women decreased from 34.8% to 26.1%. The 5-year rate of reoperative CABG declined from 0.77% (95% CI, 0.72%–0.82%) in 1998 to 0.23% (95% CI, 0.19%–0.28%) in 2013. The annual proportional decline in the 5-year rate of reoperative CABG overall was 6.6% (95% CI, 6.0%–7.1%) nationwide, which did not differ across subgroups, except the non-white non-black race group that had an annual decline of 8.5% (95% CI, 6.2%–10.7%).

CONCLUSIONS: Over a recent 20-year period, the Medicare fee-for-service patients experienced a significant decline in the rate of reoperative CABG. In this cohort of older adults, the rate of declining differed across demographic subgroups.

Key Words: older adults ■ reoperative CABG ■ trend

Survival after coronary revascularization procedures has steadily improved over time despite increasing patient complexity, but the long-term rate of reoperative coronary artery bypass graft surgery (CABG) and how it has changed over time remain unknown. Characterizing the rate of reoperative CABG after initial revascularization is important from a patient perspective, because CABG is associated with a long recovery time and the majority of patients prefer percutaneous coronary intervention (PCI) over CABG, even in a hypothetical scenario where PCI is associated with higher risks of death and repeat revascularization. Therefore, information regarding the chance of undergoing reoperative CABG should be part of shared-decision making. However, evolution of this important outcome has only been characterized in a voluntary registry or within trial data. The role of reoperative CABG is limited to select situations, including when the disease is not amenable to PCI or in patients with an occluded internal mammary artery graft to the left anterior descending artery. Reoperative CABG is also recommended when there is an indication that patients with significant coronary disease require another open-heart operation. Patient populations with indications for reoperative CABG have likely changed substantially.

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because techniques for PCI have improved and transcatheter approaches to valve replacement have emerged.10 Furthermore, the operative mortality and morbidity of reoperative CABG are relatively high.11–14 It is therefore important to identify how the rate of reoperative CABG evolved over time and what contemporary rates are.

In this study, we aimed to characterize the long-term rate of reoperative CABG in older adults, to assess the trends in the rate of reoperative CABG over 20 years, and whether the rate differed across patient subgroups.

**CLINICAL PERSPECTIVE**

**What Is New?**
- We characterized the contemporary rate of reoperative coronary artery bypass graft surgery within 5 years after the first-time coronary artery bypass graft surgery and its trend over a 20-year period.

**What Are The Clinical Implications?**
- Older adult patients undergoing first-time coronary artery bypass graft surgery can expect that the likelihood of having to undergo reoperative coronary artery bypass graft surgery is extremely low, with a 5-year rate of 0.2%.

**Data Source and Patients**

We used Medicare inpatient fee-for-service (FFS) claims data from the Centers for Medicare & Medicaid Services (CMS) to identify Medicare patients aged ≥65 years who underwent isolated CABG during an acute care hospitalization in the United States from January 1, 1998 through December 31, 2017, based on the International Classification of Diseases, Ninth and Tenth Revisions, Clinical Modification (ICD-9 CM and ICD-10 CM) procedure codes (Table S1). There were 2 131 269 individuals who underwent CABG, of whom 1 666 875 underwent isolated, nonconcomitant, first-time CABG and were discharged alive. We excluded patients with evidence of prior CABG, including those with prior Medicare FFS hospitalization for CABG before the index CABG hospitalization or having the diagnosis code indicating the past history of CABG at the time of first CABG between 1998 and 2017. This cohort of first-time isolated CABG was the baseline sample. We excluded patients who died during the index hospitalization because the aim of our study was to characterize the rate of reoperative CABG. Excluded concomitant cases were those including any valve operations, aortic operations, implantation of durable ventricular assist device, and noncardiac operations (Tables S2 and S3). We obtained information on patients’ death and transition to Medicare Advantage plans from the Medicare enrollment file obtained from CMS.

**Patient Baseline Characteristics**

Demographic information included age, sex, and race (white, black, or other). We identified cardiovascular risk factors (hypertension, diabetes mellitus, atherosclerotic disease, unstable angina, previous myocardial infarction, previous heart failure, peripheral vascular disease, stroke, and other cerebrovascular diseases), geriatric conditions (dementia, functional disability, and malnutrition), and other conditions (renal failure, chronic obstructive pulmonary disease, pneumonia, respiratory failure, liver disease, cancer, major psychiatric disorders, depression, and trauma). The comorbidities were defined according to the Hierarchical Condition Categories to assemble clinically coherent codes into candidate variables. This system was developed by physician and statistical consultants under a contract to CMS and has been used in prior studies.15–17 We determined comorbidities from a combination of secondary diagnosis codes for the index hospitalization and principal and secondary diagnosis codes for all hospitalizations over 12 months preceding the index CABG hospitalization. Because the maximum number of diagnosis codes in Medicare data increased from 10 to 25 in 2011,18 we restricted the 2011 to 2017 data to the first
10 diagnosis codes to calculate comorbidities, which has been demonstrated to yield the most consistent number of diagnoses when the data that cross 2011. This is also a commonly adopted approach.

**Outcome**
The outcome was reoperative isolated or concomitant CABG within 5 years of discharge for the initial CABG.

The time zero to count preoperative CABG was at the discharge. We included both isolated and concomitant reoperative CABG, because we aimed to characterize the rate of reoperative CABG irrespective of whether the indication was driven by the primary valvular disease or graft failure, in order to inform patients and clinicians. For patients with more than 1 reoperative CABG, the first reoperative CABG was selected. Patients who switched to a managed care plan before discharge were excluded.

**Table 1. Patient Characteristics**

| Variables                        | 1998 to 2002 | 2003 to 2007 | 2008 to 2012 | 2013 to 2017 |
|----------------------------------|--------------|--------------|--------------|--------------|
| N                                | 637 875      | 477 163      | 299 432      | 252 405      |
| Age, median (IQR), y             | 74 (69–78)   | 74 (69–79)   | 73 (69–79)   | 73 (69–78)   |
| Female                           | 219 042 (34.3) | 154 200 (32.3) | 90 341 (30.2) | 67 988 (26.9) |
| Race                             |              |              |              |              |
| White                            | 585 602 (91.8) | 430 519 (90.2) | 268 755 (69.8) | 222 711 (88.2) |
| Black                            | 26 618 (4.2)  | 24 283 (5.1)  | 15 835 (5.3)  | 13 529 (5.4)  |
| Other                            | 25 655 (4.0)  | 22 361 (4.7)  | 14 842 (5.0)  | 16 165 (6.4)  |
| Comorbidity                      |              |              |              |              |
| Heart failure                    | 47 118 (7.4)  | 31 882 (6.7)  | 19 059 (6.4)  | 17 056 (6.8)  |
| Myocardial infarction            | 42 035 (6.6)  | 26 021 (5.5)  | 17 859 (6.0)  | 16 600 (6.6)  |
| Unstable angina                  | 50 930 (8.0)  | 23 345 (4.9)  | 10 919 (3.6)  | 8241 (3.3)    |
| Chronic atherosclerosis          | 352 302 (55.2) | 255 965 (53.6) | 160 796 (53.7) | 122 413 (48.5) |
| Respiratory failure              | 7905 (1.2)    | 6929 (1.5)    | 7284 (2.4)    | 7966 (3.2)    |
| Hypertension                     | 394 950 (61.9) | 312 421 (65.5) | 184 047 (61.5) | 144 601 (57.3) |
| Stroke                           | 5817 (0.9)    | 4633 (1.0)    | 3034 (1.0)    | 2694 (1.1)    |
| Cerebrovascular disease          | 27 747 (4.3)  | 20 228 (4.2)  | 12 708 (4.2)  | 9231 (3.7)    |
| Renal failure                    | 26 543 (4.2)  | 44 145 (9.3)  | 47 582 (15.9) | 49 758 (19.7) |
| Chronic obstructive pulmonary disease | 116 992 (18.3) | 100 203 (21.0) | 48 419 (16.2) | 38 016 (15.1) |
| Pneumonia                        | 27 280 (4.3)  | 25 705 (5.4)  | 20 773 (6.9)  | 17 212 (6.8)  |
| Protein-calorie malnutrition     | 5165 (0.8)    | 6280 (1.3)    | 8730 (2.9)    | 8447 (3.3)    |
| Dementia                         | 6253 (1.0)    | 6339 (1.3)    | 5084 (1.7)    | 4826 (1.9)    |
| Functional disability            | 4725 (0.7)    | 3400 (0.7)    | 2532 (0.8)    | 2484 (1.0)    |
| Peripheral vascular disease      | 38 021 (6.0)  | 30 555 (6.4)  | 19 106 (6.4)  | 13 583 (5.4)  |
| Metastatic cancer                | 22 295 (3.5)  | 18 212 (3.8)  | 11 564 (3.9)  | 9228 (3.7)    |
| Trauma in past year              | 13 674 (2.1)  | 14 146 (3.0)  | 7716 (2.8)    | 4967 (2.0)    |
| Major psychiatric disorder       | 5150 (0.8)    | 4173 (0.9)    | 3704 (1.2)    | 2802 (1.1)    |
| Liver disease                    | 8013 (1.3)    | 7236 (1.5)    | 5134 (1.7)    | 5507 (2.2)    |
| Depression                       | 14 504 (2.3)  | 14 640 (3.1)  | 10 710 (3.6)  | 9954 (3.9)    |
| Diabetes mellitus                | 195 199 (30.6) | 158 437 (33.2) | 105 064 (35.1) | 99 710 (39.5) |
| Outcomes                         |              |              |              |              |
| 30-d mortality                   | 4877 (0.8)    | 3332 (0.7)    | 2176 (0.7)    | 1801 (0.7)    |
| 1-y mortality                    | 29 834 (4.7)  | 23 196 (4.9)  | 14 040 (4.7)  | 10 556 (4.2)  |
| Discharge to home                | 356 172 (55.8) | 201 450 (42.4) | 103 286 (34.5) | 76 888 (30.5) |
| Discharge to home with home health services | 157 176 (24.6) | 159 418 (33.4) | 111 201 (37.1) | 92 329 (36.6) |
| Discharge to skilled nursing home | 72 170 (11.3) | 66 086 (13.9) | 50 366 (16.8) | 47 981 (19.0) |
| Discharge to hospice             | 147 (0.02)    | 554 (0.12)    | 460 (0.15)    | 434 (0.17)    |
| Transferred to another acute-care hospital | 43 899 (6.9)  | 3879 (0.8)    | 272 (0.1)     | 104 (0.04)    |
| Other discharge destination      | 8309 (1.3)    | 45 776 (9.6)  | 33 847 (11.3) | 34 689 (13.7) |
| Length of stay, median (IQR), d  | 8 (6–11)      | 8 (6–11)      | 8 (6–11)      | 8 (6–11)      |

IQR indicates interquartile range.
undergoing reoperative CABG were censored. We defined 1-year crude mortality using Medicare enrollment file as all-cause death occurring within 1 year of the index operation. Deaths during the 5-year follow-up period without a reoperative CABG hospitalization were treated as a competing risk.

**Statistical Analysis**

We compared patients’ baseline characteristics over the study period and fit a single-variable Cox regression to describe the observed association between 5-year reoperative CABG and each of the individual characteristics. To assess the change in the rate of 5-year reoperative CABG over the study period, we fit the Cox regression to model the likelihood of reoperative CABG as a function of patient baseline characteristics, including an ordinal time variable that ranged from 0 to 19, corresponding to years 1998 (time=0) through 2017 (time=19), to represent the annual change in reoperative CABG rates. Patients without a full 5-year follow-up period were censored in the analysis. We also fitted the model separately for age, sex, and race subgroups. Deaths before reoperative CABG were addressed using the Fine and Gray method for competing risks. The Lee, Wei, and Amato method of robust sandwich variance matrix estimation was used to adjust for within-hospital clustering of patients. Analyses were conducted with the use of SAS software, version 9.4 (SAS Institute). To facilitate data presentation, patient characteristics were reported in 5-year intervals: 1998 to 2002, 2003 to 2007, 2008 to 2012, and 2013 to 2017. All statistical testing was 2-sided, and \( P < 0.05 \) was considered statistically significant. The study followed the guidelines for cohort studies described in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: Guidelines for Reporting Observational Studies.

**RESULTS**

**Study Sample and Patient Characteristics**

There were 1,666,875 unique Medicare FFS patients aged 65 years or older who underwent first-time isolated CABG and were discharged alive during the 20-year period. Between 1998 and 2017, the number of first-time isolated CABG in the FFS Medicare population declined from 528 to 166 per 100,000 beneficiaries/y; the median (interquartile range) age of patients did not change significantly over time (from 74 [69–78] to 73 [69–78]); the proportion of women decreased from 34.8% to 26.1%; the proportion of black patients increased from 4.2% to 5.4%.

Most comorbidities increased during the study period, including renal failure, pneumonia, protein-calorie malnutrition, dementia, functional disability, liver disease, and diabetes mellitus, while chronic atherosclerotic disease, cerebrovascular disease, and chronic obstructive pulmonary disease decreased (Table 1). Median (interquartile range) length of stay remained similar from 8 (6–11) to 8 (6–11) days. Patients discharged directly to home without home care decreased from 60.0% to 29.4% while discharge to a skilled nursing facility increased from 11.2% to 18.6%. Mortality within 30 days of the index operation, excluding in-hospital deaths, remained stable from 0.8% to 0.8% while crude 1-year mortality decreased from 4.6% to 4.3%.

**Rate of Reoperative CABG**

The single-variable Cox regression found that older age and male sex were associated with a lower likelihood of reoperative CABG. The presence of most of the comorbidities, including heart failure, renal failure, stroke, and functional disability, were associated with lower likelihood of reoperative CABG (Table 2).

**Table 2. Observed Patient Baseline Characteristics Associated With Reoperative CABG**

| Variables                                | Risk Ratio (95% CI) |
|------------------------------------------|--------------------|
| Age, per 1-y increase                    | 0.95 (0.95–0.96)   |
| Male sex (ref. female)                    | 0.70 (0.66–0.73)   |
| Comorbidity                              |                    |
| Heart failure                            | 0.88 (0.80–0.97)   |
| Myocardial infarction                     | 0.89 (0.81–0.99)   |
| Unstable angina                          | 1.49 (1.37–1.61)   |
| Chronic atherosclerosis                   | 1.01 (0.96–1.05)   |
| Respiratory failure                       | 0.83 (0.88–1.00)   |
| Hypertension                             | 1.15 (1.10–1.21)   |
| Stroke                                   | 0.66 (0.49–0.88)   |
| Cerebrovascular disease                   | 1.08 (0.97–1.20)   |
| Renal failure                            | 0.70 (0.64–0.77)   |
| Chronic obstructive pulmonary disease     | 0.98 (0.93–1.04)   |
| Pneumonia                                | 0.84 (0.75–0.94)   |
| Protein-calorie malnutrition              | 0.49 (0.38–0.65)   |
| Dementia                                 | 0.43 (0.32–0.59)   |
| Functional disability                     | 0.71 (0.52–0.97)   |
| Peripheral vascular disease              | 1.12 (1.03–1.23)   |
| Trauma in past year                      | 0.88 (0.76–1.03)   |
| Major psychiatric disorder               | 0.70 (0.53–0.93)   |
| Blood loss anemia                        | 0.86 (0.82–0.90)   |
| Depression                               | 0.97 (0.84–1.11)   |
| Diabetes mellitus                        | 0.91 (0.87–0.96)   |
| Asthma                                   | 1.16 (1.00–1.34)   |

The table shows the observed association between patient baseline characteristics and the likelihood of reoperative CABG during 5-year follow-up. Risk ratio > 1 is associated with increased likelihood of reoperative CABG. CABG indicates coronary artery bypass graft.
within 5 years decreased significantly and steadily over the 20-year period (Figure 1). When restricting to patients with a full 5-year follow-up period, the observed 5-year rate of reoperative CABG declined from 0.77% (95% CI, 0.72%–0.82%) in 1998 to 0.23% (95% CI, 0.19%–0.28%) in 2013 (Table 3). This decline between 1998 and 2013 occurred across all evaluated demographic subgroups, but was most prominent in women, non-white and non-black race, and age 75 to 84 years old, with percent changes of 67.3% (61.1%–75.0%), 86.9% (77.5%–96.3%), and 70.5% (63.2%–77.4%), respectively (Table 3). The rate of reoperative CABG was consistently the lowest across years until 2011 in patients older than age 85 years, and non-white and non-black race declined rapidly to become the demographic subgroup with the lowest rate after 2011. The findings did not change substantially when accounting for patient characteristics and geographic differences. The annual proportional decline in the 5-year rate of reoperative CABG was 6.6% (95% CI, 6.0%–7.1%) nationwide, which was consistent across subgroups, except the non-white non-black race group that had an annual decline of 8.5% (95% CI, 6.2%–10.7%) (Figure 2).

**DISCUSSION**

Between 1998 and 2017, the rate of reoperative CABG among Medicare FFS beneficiaries was low and declined significantly. In this cohort of older adults, the decline over time occurred across all demographic subgroups evaluated, with women, non-white and non-black race, and patients ages 75 to 84 years old showing the largest decline.

This study extends the prior literature in several ways. First, many studies reporting on the rate of reoperative CABG are more than a decade old, often limited to the pre-PCI era, and limited to centers that may not be representative of the national cohort. Therefore, the long-term rate of reoperative CABG in the contemporary era and how the rate had changed over time up to recent years remained unknown. With the complete follow-up information provided by claims data, our study allowed for comprehensive characterization of 5-year follow-up data over 2 decades. Second, the time-dependent likelihood of reoperative CABG since the time of initial CABG has not been characterized well in the contemporary era. While the Society of Thoracic Surgeons Adult Cardiac Surgery Database provided...
the national-level utilization of reoperative CABG, the study only reported on the cross-sectional data without patient-level longitudinal follow-up. A study linking the Society of Thoracic Surgeons Adult Cardiac Surgery Database and Medicare FFS data reported declining rate of repeat revascularization over time after CABG, but the study included data only up to 2007, at which time the 5-year rate of any revascularization after CABG was about 9%. Our study provided an insight into the contemporary likelihood of reoperative CABG by demonstrating that the likelihood increased essentially linearly since the time of initial CABG. Of note, the 5-year rate of reoperative CABG in our study matched with the report of the Society of Thoracic Surgeons data linked to Medicare data during the overlapping time period of 1991 to 2007 at 0.6%. Third, sex- and race-based difference in the utilization and outcome of CABG has been demonstrated, but such differences in the rate of reoperative CABG had not been examined extensively. Our study demonstrated that the rate of reoperative CABG and time-to-reoperative CABG differed across sociodemographic subgroups.

There are several potential explanations for what we observed. First, the decline in the use of reoperative CABG over time likely is because of the combination of improvement in the secondary prevention after initial CABG, increasing utilization of PCI, transcatheter valve procedures that reduced the need for concomitant reoperative CABG in the setting of primary valve indication, and possible increase in the graft longevity with technical improvement and multi-arterial graft use. Although long-term outcome of initial revascularization is favorable in CABG compared with PCI, data on outcomes of reoperative CABG compared with repeat PCI are conflicting. Our finding that older age and presence of comorbidity were associated with lower likelihood of reoperative CABG may be because older and more comorbid patients were likely treated via PCI rather than CABG. A prior multicenter observational study of older adults with acute myocardial infarction suggest that there may be a treatment assignment of patients with more functional reserve toward a more invasive treatment modality.

Studies have reported that the rate of repeat revascularization, via CABG or PCI at 5 years, is 8% to 26%. Our observation that <0.3% of the patients underwent reoperative CABG indicates that reoperative CABG is used for only a small proportion of patients in need of repeat revascularization. This is important because having to undergo CABG is a significant event from a patient perspective, especially at the time of repeat revascularization when the patients are older. Because older adults are increasingly susceptible to functional decline after a cardiovascular event, the 5-year rate of reoperative CABG was 0.7% in 1998 and 1.3% by demographic subgroup. Biennial data are shown, except for 2012 and 2013 data, which are consecutive. For example, the 5-year rate of reoperative CABG was 0.7% (95% CI 0.4–1.0) in 1998 for the overall cohort. CABG indicates coronary artery bypass graft.

| Table 3. Annual Trends in the 5-Year Rate of Reoperative CABG by Demographic Subgroup |
|-----------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Subgroups 1998 2000 2002 2004 2006 2008 2010 2012 2013 | Age 65–74 y | 0.90 (0.83–0.98) | 0.86 (0.79–0.93) | 0.80 (0.73–0.87) | 0.71 (0.63–0.78) | 0.57 (0.50–0.65) | 0.52 (0.44−0.60) | 0.43 (0.36–0.51) | 0.36 (0.29–0.44) |
| | Age 75–84 y | 0.89 (0.83−0.96) | 0.80 (0.73–0.87) | 0.50 (0.43–0.57) | 0.40 (0.33–0.48) | 0.34 (0.27–0.42) | 0.29 (0.23–0.37) | 0.21 (0.16–0.27) | 0.18 (0.13–0.25) |
| | Age 85+ y | 0.76 (0.68–0.84) | 0.72 (0.65–0.79) | 0.68 (0.62–0.74) | 0.57 (0.50–0.63) | 0.50 (0.42–0.58) | 0.44 (0.36–0.52) | 0.38 (0.31–0.45) | 0.32 (0.26–0.39) |
| | White race | 0.86 (0.79–0.93) | 0.80 (0.73–0.87) | 0.50 (0.43–0.57) | 0.40 (0.33–0.48) | 0.34 (0.27–0.42) | 0.29 (0.23–0.37) | 0.21 (0.16–0.27) | 0.18 (0.13–0.25) |
| | Black race | 0.72 (0.65–0.79) | 0.68 (0.62–0.74) | 0.57 (0.50–0.63) | 0.50 (0.42–0.58) | 0.44 (0.36–0.52) | 0.38 (0.31–0.45) | 0.32 (0.26–0.39) | 0.21 (0.16–0.27) |
| | Other race | 0.72 (0.65–0.79) | 0.68 (0.62–0.74) | 0.57 (0.50–0.63) | 0.50 (0.42–0.58) | 0.44 (0.36–0.52) | 0.38 (0.31–0.45) | 0.32 (0.26–0.39) | 0.21 (0.16–0.27) |
| | Female | 0.90 (0.83–0.96) | 0.80 (0.73–0.87) | 0.50 (0.43–0.57) | 0.40 (0.33–0.48) | 0.34 (0.27–0.42) | 0.29 (0.23–0.37) | 0.21 (0.16–0.27) | 0.18 (0.13–0.25) |
| | Male | 0.84 (0.77–0.90) | 0.78 (0.71–0.84) | 0.68 (0.61–0.74) | 0.57 (0.50–0.63) | 0.50 (0.42–0.58) | 0.44 (0.36–0.52) | 0.38 (0.31–0.45) | 0.32 (0.26–0.39) |
| | Overall | 0.84 (0.77–0.90) | 0.78 (0.71–0.84) | 0.68 (0.61–0.74) | 0.57 (0.50–0.63) | 0.50 (0.42–0.58) | 0.44 (0.36–0.52) | 0.38 (0.31–0.45) | 0.32 (0.26–0.39) |
the possibility of having to undergo reoperative CABG should be part of shared-decision making. Significant mortality and morbidity associated with reoperative CABG\(^2\) may explain the current predominance of PCI for repeat revascularization. Guidelines have class II recommendations for PCI as the first choice over CABG for repeat revascularization\(^9\) in most scenarios, but a rigorous comparative effectiveness study to guide the optimal approach for repeat revascularization is still needed.

From the patient’s perspective, undergoing PCI rather than CABG for recurrent need for revascularization may be favorable. For example, a patient survey showed that the majority of patients prefer PCI over CABG to treat multivessel coronary artery disease even when the presented hypothetical risk of 1-year death and repeat procedures were higher in PCI than CABG.\(^5\) This is an especially important consideration because in the same survey, physicians tended to prefer CABG over PCI based on the hypothetical risk differential. This potential discrepancy between physician and patient’s values highlight the significance of the perceived burden of having to undergo an open heart operation. Our finding of a steadily declining 5-year rate of undergoing reoperative CABG to \(<0.3\%\) provides important information to patients who are considering first-time CABG.

**Limitations**

Limitations of this study include the following. Because our data set consisted of only patients who were hospitalized, we could not evaluate the rate of repeat PCI, the majority of which are performed in outpatient settings.\(^3\)\(^8\) We evaluated patients who were Medicare FFS beneficiaries, and the observed rate of reoperative CABG in this cohort of older adults is likely lower than the rate in a younger population. Additionally, it is possible that the findings may not extend to Medicare Advantage beneficiaries, which have increased in number over time. We censored patients who switched to a Medicare Advantage plan after undergoing the initial CABG under a Medicare FFS plan to avoid excluding this cohort altogether. Additionally, we risk adjusted our model to account for potential changes in the composition of the co-morbidity profile, which is known to differ between Medicare FFS and Advantage plan beneficiaries. Claims data did not allow for assessment of granular clinical data pertinent to CABG, such as cross-clamp time and the number of arterial grafts used. Therefore, this limited our ability to further understand which improvements in the care process had impacts on the declining rate of reoperative CABG. However, our study aim was not to elucidate factors associated with the declining rate but rather to identify the contemporary rate of reoperative CABG.
and how it changed over time. The long study period may be susceptible to coding practice change. While the coding practice change may have affected the captured comorbidity diagnoses, it is unlikely that a significant procedural event such as CABG was susceptible to such changes.

CONCLUSIONS
Over the last 20 years, the Medicare FFS beneficiaries experienced a significant decline in the rate of reoperative CABG. In the contemporary era, the 5-year rate of reoperative CABG in older adults was <0.3%, indicating that only a small fraction of patients in need of repeat revascularization are treated by reoperative CABG. Patients undergoing first-time CABG could expect an extremely low chance of having to undergo reoperative CABG at 5 years.

ARTICLE INFORMATION
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Supplemental Materials
Tables S1–S3

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**Table S1. ICD-10 code for CABG.**

| ICD-10-PCS Code | ICD-10-PCS Code Label |
|-----------------|-----------------------|
| 0210083         | Bypass Coronary Artery, One Artery from Coronary Artery with Zooplastic Tissue, Open Approach |
| 0210088         | Bypass Coronary Artery, One Artery from Right Internal Mammary with Zooplastic Tissue, Open Approach |
| 0210089         | Bypass Coronary Artery, One Artery from Left Internal Mammary with Zooplastic Tissue, Open Approach |
| 0210093         | Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Venous Tissue, Open Approach |
| 0210098         | Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Venous Tissue, Open Approach |
| 0210099         | Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Venous Tissue, Open Approach |
| 0210483         | Bypass Coronary Artery, One Artery from Coronary Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0210488         | Bypass Coronary Artery, One Artery from Right Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0210489         | Bypass Coronary Artery, One Artery from Left Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0210493         | Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0210498         | Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0210499         | Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0211083         | Bypass Coronary Artery, Two Arteries from Coronary Artery with Zooplastic Tissue, Open Approach |
| 0211088         | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Zooplastic Tissue, Open Approach |
| 0211089         | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Zooplastic Tissue, Open Approach |
| 0211093         | Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Venous Tissue, Open Approach |
| 0211098         | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Venous Tissue, Open Approach |
| 0211099         | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Venous Tissue, Open Approach |
| 0211483         | Bypass Coronary Artery, Two Arteries from Coronary Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0211488         | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0211489         | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0211493         | Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0211498         | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0211499         | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0212083         | Bypass Coronary Artery, Three Arteries from Coronary Artery with Zooplastic Tissue, Open Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 0212088| Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Zooplastic Tissue, Open Approach |
| 0212089| Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Zooplastic Tissue, Open Approach |
| 0212093| Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Venous Tissue, Open Approach |
| 0212098| Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Venous Tissue, Open Approach |
| 212099 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Venous Tissue, Open Approach |
| 0212483| Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0212488| Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0212489| Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0212493| Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0212498| Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0212499| Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0213083| Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Zooplastic Tissue, Open Approach |
| 0213088| Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Zooplastic Tissue, Open Approach |
| 0213089| Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Zooplastic Tissue, Open Approach |
| 0213093| Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Venous Tissue, Open Approach |
| 0213098| Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Venous Tissue, Open Approach |
| 0213099| Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Venous Tissue, Open Approach |
| 0213483| Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0213488| Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0213489| Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 0213493| Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0213498| Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 0213499| Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 021008C| Bypass Coronary Artery, One Artery from Thoracic Artery with Zooplastic Tissue, Open Approach |
| 021008F| Bypass Coronary Artery, One Artery from Abdominal Artery with Zooplastic Tissue, Open Approach |
| 021008W| Bypass Coronary Artery, One Artery from Aorta with Zooplastic Tissue, Open Approach |
| 021009C| Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Venous Tissue, Open Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 021009F | Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Venous Tissue, Open Approach |
| 021009W | Bypass Coronary Artery, One Artery from Aorta with Autologous Venous Tissue, Open Approach |
| 02100A3 | Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Arterial Tissue, Open Approach |
| 02100A3 | Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Arterial Tissue, Open Approach |
| 02100A8 | Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02100A9 | Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02100AC | Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Arterial Tissue, Open Approach |
| 02100AF | Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Arterial Tissue, Open Approach |
| 02100AW | Bypass Coronary Artery, One Artery from Aorta with Autologous Arterial Tissue, Open Approach |
| 02100J3 | Bypass Coronary Artery, One Artery from Coronary Artery with Synthetic Substitute, Open Approach |
| 02100J8 | Bypass Coronary Artery, One Artery from Right Internal Mammary with Synthetic Substitute, Open Approach |
| 02100J9 | Bypass Coronary Artery, One Artery from Left Internal Mammary with Synthetic Substitute, Open Approach |
| 02100JC | Bypass Coronary Artery, One Artery from Thoracic Artery with Synthetic Substitute, Open Approach |
| 02100JF | Bypass Coronary Artery, One Artery from Abdominal Artery with Synthetic Substitute, Open Approach |
| 02100IW | Bypass Coronary Artery, One Artery from Aorta with Synthetic Substitute, Open Approach |
| 02100K3 | Bypass Coronary Artery, One Artery from Coronary Artery with Nonautologous Tissue Substitute, Open Approach |
| 02100K8 | Bypass Coronary Artery, One Artery from Right Internal Mammary with Nonautologous Tissue Substitute, Open Approach |
| 02100K9 | Bypass Coronary Artery, One Artery from Left Internal Mammary with Nonautologous Tissue Substitute, Open Approach |
| 02100KC | Bypass Coronary Artery, One Artery from Thoracic Artery with Nonautologous Tissue Substitute, Open Approach |
| 02100KF | Bypass Coronary Artery, One Artery from Abdominal Artery with Nonautologous Tissue Substitute, Open Approach |
| 02100KW | Bypass Coronary Artery, One Artery from Aorta with Nonautologous Tissue Substitute, Open Approach |
| 02100Z3 | Bypass Coronary Artery, One Artery from Coronary Artery, Open Approach |
| 02100Z8 | Bypass Coronary Artery, One Artery from Right Internal Mammary, Open Approach |
| 02100Z9 | Bypass Coronary Artery, One Artery from Left Internal Mammary, Open Approach |
| 02100ZC | Bypass Coronary Artery, One Artery from Thoracic Artery, Open Approach |
| 02100ZF | Bypass Coronary Artery, One Artery from Abdominal Artery, Open Approach |
| 021048C | Bypass Coronary Artery, One Artery from Thoracic Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021048F | Bypass Coronary Artery, One Artery from Abdominal Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021048W | Bypass Coronary Artery, One Artery from Aorta with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021049C | Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 021049F | Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 021049W | Bypass Coronary Artery, One Artery from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 02104A3 | Bypass Coronary Artery, One Artery from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02104A8 | Bypass Coronary Artery, One Artery from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02104A9 | Bypass Coronary Artery, One Artery from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02104AC | Bypass Coronary Artery, One Artery from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02104AF | Bypass Coronary Artery, One Artery from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02104AW | Bypass Coronary Artery, One Artery from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02104J3 | Bypass Coronary Artery, One Artery from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02104J8 | Bypass Coronary Artery, One Artery from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02104J9 | Bypass Coronary Artery, One Artery from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02104JC | Bypass Coronary Artery, One Artery from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02104JF | Bypass Coronary Artery, One Artery from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02104JW | Bypass Coronary Artery, One Artery from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02104K3 | Bypass Coronary Artery, One Artery from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02104KB | Bypass Coronary Artery, One Artery from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02104K9 | Bypass Coronary Artery, One Artery from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02104KC | Bypass Coronary Artery, One Artery from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02104KF | Bypass Coronary Artery, One Artery from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02104KW | Bypass Coronary Artery, One Artery from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02104Z3 | Bypass Coronary Artery, One Artery from Coronary Artery, Percutaneous Endoscopic Approach |
| 02104Z8 | Bypass Coronary Artery, One Artery from Right Internal Mammary, Percutaneous Endoscopic Approach |
| 02104Z9 | Bypass Coronary Artery, One Artery from Left Internal Mammary, Percutaneous Endoscopic Approach |
| 02104ZC | Bypass Coronary Artery, One Artery from Thoracic Artery, Percutaneous Endoscopic Approach |
| 02104ZF | Bypass Coronary Artery, One Artery from Abdominal Artery, Percutaneous Endoscopic Approach |
| 021108C | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Zooplastic Tissue, Open Approach |
| 021108F | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Zooplastic Tissue, Open Approach |
| 021108W | Bypass Coronary Artery, Two Arteries from Aorta with Zooplastic Tissue, Open Approach |
| 021109C | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Venous Tissue, Open Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 021109F | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Venous Tissue, Open Approach |
| 021109W | Bypass Coronary Artery, Two Arteries from Aorta with Autologous Venous Tissue, Open Approach |
| 02110A3 | Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Arterial Tissue, Open Approach |
| 02110A8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02110A9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02110AC | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Arterial Tissue, Open Approach |
| 02110AF | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Arterial Tissue, Open Approach |
| 02110AW | Bypass Coronary Artery, Two Arteries from Aorta with Autologous Arterial Tissue, Open Approach |
| 02110J3 | Bypass Coronary Artery, Two Arteries from Coronary Artery with Synthetic Substitute, Open Approach |
| 02110J8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Synthetic Substitute, Open Approach |
| 02110J9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Synthetic Substitute, Open Approach |
| 02110JC | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Synthetic Substitute, Open Approach |
| 02110JF | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Synthetic Substitute, Open Approach |
| 02110W | Bypass Coronary Artery, Two Arteries from Aorta with Synthetic Substitute, Open Approach |
| 02110K3 | Bypass Coronary Artery, Two Arteries from Coronary Artery with Nonautologous Tissue Substitute, Open Approach |
| 02110K8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Open Approach |
| 02110K9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Open Approach |
| 02110KC | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Open Approach |
| 02110KF | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Open Approach |
| 02110KW | Bypass Coronary Artery, Two Arteries from Aorta with Nonautologous Tissue Substitute, Open Approach |
| 02110Z3 | Bypass Coronary Artery, Two Arteries from Coronary Artery, Open Approach |
| 02110Z8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary, Open Approach |
| 02110Z9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary, Open Approach |
| 02110ZC | Bypass Coronary Artery, Two Arteries from Thoracic Artery, Open Approach |
| 02110ZF | Bypass Coronary Artery, Two Arteries from Abdominal Artery, Open Approach |
| 021148C | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021148F | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021148W | Bypass Coronary Artery, Two Arteries from Aorta with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021149C | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 021149F | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 021149W | Bypass Coronary Artery, Two Arteries from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 02114A3 | Bypass Coronary Artery, Two Arteries from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02114A8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02114A9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02114AC | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02114AF | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02114AW | Bypass Coronary Artery, Two Arteries from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02114J3 | Bypass Coronary Artery, Two Arteries from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02114J8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02114J9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02114JC | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02114JF | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02114JW | Bypass Coronary Artery, Two Arteries from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02114K3 | Bypass Coronary Artery, Two Arteries from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02114K8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02114K9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02114KC | Bypass Coronary Artery, Two Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02114KF | Bypass Coronary Artery, Two Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02114KW | Bypass Coronary Artery, Two Arteries from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02114Z3 | Bypass Coronary Artery, Two Arteries from Coronary Artery, Percutaneous Endoscopic Approach |
| 02114Z8 | Bypass Coronary Artery, Two Arteries from Right Internal Mammary, Percutaneous Endoscopic Approach |
| 02114Z9 | Bypass Coronary Artery, Two Arteries from Left Internal Mammary, Percutaneous Endoscopic Approach |
| 02114ZC | Bypass Coronary Artery, Two Arteries from Thoracic Artery, Percutaneous Endoscopic Approach |
| 02114ZF | Bypass Coronary Artery, Two Arteries from Abdominal Artery, Percutaneous Endoscopic Approach |
| 021208C | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Zooplastic Tissue, Open Approach |
| 021208F | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Zooplastic Tissue, Open Approach |
| 021208W | Bypass Coronary Artery, Three Arteries from Aorta with Zooplastic Tissue, Open Approach |
| 021209C | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Venous Tissue, Open Approach |
| Code    | Description                                                                                       |
|---------|--------------------------------------------------------------------------------------------------|
| 021209F | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Venous Tissue, Open Approach |
| 021209W | Bypass Coronary Artery, Three Arteries from Aorta with Autologous Venous Tissue, Open Approach     |
| 02120A3 | Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Arterial Tissue, Open Approach |
| 02120A8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02120A9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02120AC | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Arterial Tissue, Open Approach |
| 02120AF | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Arterial Tissue, Open Approach |
| 02120AW | Bypass Coronary Artery, Three Arteries from Aorta with Autologous Arterial Tissue, Open Approach     |
| 02120J3 | Bypass Coronary Artery, Three Arteries from Coronary Artery with Synthetic Substitute, Open Approach |
| 02120J8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Synthetic Substitute, Open Approach |
| 02120J9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Synthetic Substitute, Open Approach |
| 02120JC | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Synthetic Substitute, Open Approach |
| 02120JF | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Synthetic Substitute, Open Approach |
| 02120JW | Bypass Coronary Artery, Three Arteries from Aorta with Synthetic Substitute, Open Approach         |
| 02120K3 | Bypass Coronary Artery, Three Arteries from Coronary Artery with Nonautologous Tissue Substitute, Open Approach |
| 02120K8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Open Approach |
| 02120K9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Open Approach |
| 02120KC | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Open Approach |
| 02120KF | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Open Approach |
| 02120KW | Bypass Coronary Artery, Three Arteries from Aorta with Nonautologous Tissue Substitute, Open Approach |
| 02120Z3 | Bypass Coronary Artery, Three Arteries from Coronary Artery, Open Approach                        |
| 02120Z8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary, Open Approach                  |
| 02120Z9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary, Open Approach                   |
| 02120ZC | Bypass Coronary Artery, Three Arteries from Thoracic Artery, Open Approach                         |
| 02120ZF | Bypass Coronary Artery, Three Arteries from Abdominal Artery, Open Approach                        |
| 021248C | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021248F | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021248W | Bypass Coronary Artery, Three Arteries from Aorta with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021249C | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| Code   | Description                                                                                           |
|--------|--------------------------------------------------------------------------------------------------------|
| 021249F | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 021249W | Bypass Coronary Artery, Three Arteries from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 02124A3 | Bypass Coronary Artery, Three Arteries from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02124A8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02124A9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02124AC | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02124AF | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02124AW | Bypass Coronary Artery, Three Arteries from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02124J3 | Bypass Coronary Artery, Three Arteries from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02124J8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02124J9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02124JC | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02124JF | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02124JW | Bypass Coronary Artery, Three Arteries from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02124K3 | Bypass Coronary Artery, Three Arteries from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02124K8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02124K9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02124KC | Bypass Coronary Artery, Three Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02124KF | Bypass Coronary Artery, Three Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02124KW | Bypass Coronary Artery, Three Arteries from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02124Z3 | Bypass Coronary Artery, Three Arteries from Coronary Artery, Percutaneous Endoscopic Approach |
| 02124Z8 | Bypass Coronary Artery, Three Arteries from Right Internal Mammary, Percutaneous Endoscopic Approach |
| 02124Z9 | Bypass Coronary Artery, Three Arteries from Left Internal Mammary, Percutaneous Endoscopic Approach |
| 02124ZC | Bypass Coronary Artery, Three Arteries from Thoracic Artery, Percutaneous Endoscopic Approach |
| 02124ZF | Bypass Coronary Artery, Three Arteries from Abdominal Artery, Percutaneous Endoscopic Approach |
| 021308C | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Zooplasic Tissue, Open Approach |
| 021308F | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Zooplasic Tissue, Open Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 021308W | Bypass Coronary Artery, Four or More Arteries from Aorta with Zooplastic Tissue, Open Approach |
| 021309C | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Venous Tissue, Open Approach |
| 021309F | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Venous Tissue, Open Approach |
| 021309W | Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Venous Tissue, Open Approach |
| 02130A3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Arterial Tissue, Open Approach |
| 02130A8 | Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02130A9 | Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Arterial Tissue, Open Approach |
| 02130AC | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Arterial Tissue, Open Approach |
| 02130AF | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Arterial Tissue, Open Approach |
| 02130AW | Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Arterial Tissue, Open Approach |
| 02130J3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Synthetic Substitute, Open Approach |
| 02130K3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Nonautologous Tissue Substitute, Open Approach |
| 02130J8 | Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Synthetic Substitute, Open Approach |
| 02130J9 | Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Synthetic Substitute, Open Approach |
| 02130JC | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Synthetic Substitute, Open Approach |
| 02130JF | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Synthetic Substitute, Open Approach |
| 02130JW | Bypass Coronary Artery, Four or More Arteries from Aorta with Synthetic Substitute, Open Approach |
| 02130Z3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery, Open Approach |
| 02130Z8 | Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary, Open Approach |
| 02130Z9 | Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary, Open Approach |
| 02130ZC | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery, Open Approach |
| 02130ZF | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery, Open Approach |
| 021348C | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 021348F | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021348W | Bypass Coronary Artery, Four or More Arteries from Aorta with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 021349C | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 021349F | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 021349W | Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Venous Tissue, Percutaneous Endoscopic Approach |
| 02134A3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02134A8 | Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02134A9 | Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02134AC | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02134AF | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02134AW | Bypass Coronary Artery, Four or More Arteries from Aorta with Autologous Arterial Tissue, Percutaneous Endoscopic Approach |
| 02134J3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02134J8 | Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02134J9 | Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02134JC | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02134JF | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02134JW | Bypass Coronary Artery, Four or More Arteries from Aorta with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02134K3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02134KB | Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02134K9 | Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02134KC | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02134KF | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02134KW | Bypass Coronary Artery, Four or More Arteries from Aorta with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02134Z3 | Bypass Coronary Artery, Four or More Arteries from Coronary Artery, Percutaneous Endoscopic Approach |
| 02134Z8 | Bypass Coronary Artery, Four or More Arteries from Right Internal Mammary, Percutaneous Endoscopic Approach |
| 02134Z9 | Bypass Coronary Artery, Four or More Arteries from Left Internal Mammary, Percutaneous Endoscopic Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 02134ZC | Bypass Coronary Artery, Four or More Arteries from Thoracic Artery, Percutaneous Endoscopic Approach |
| 02134ZF | Bypass Coronary Artery, Four or More Arteries from Abdominal Artery, Percutaneous Endoscopic Approach |

ICD-9-CM codes for CABG are 36.10 through 36.19.
Table S2. ICD-9-CM codes used to exclude concomitant cardiac and non-cardiac operations.

| ICD-9-CM Procedure Code | ICD-9-CM Procedure Description                                           |
|-------------------------|--------------------------------------------------------------------------|
| 00.61                   | Percutaneous angioplasty or atherectomy of precerebral (extracranial) vessel(s) |
| 00.62                   | Percutaneous angioplasty or atherectomy of intracranial vessel(s)        |
| 00.63                   | Percutaneous insertion of carotid artery stent(s)                        |
| 00.64                   | Percutaneous insertion of other precerebral (extracranial) artery stent(s) |
| 00.65                   | Percutaneous insertion of intracranial vascular stent(s)                 |
| 32.41                   | Thoracoscopic lobectomy of lung                                          |
| 32.49                   | Other lobectomy of lung                                                  |
| 33.50                   | Lung transplantation, not otherwise specified                            |
| 33.51                   | Unilateral lung transplantation                                          |
| 33.52                   | Bilateral lung transplantation                                           |
| 33.60                   | Combined heart-lung transplantation                                      |
| 35.00                   | Closed heart valvotomy, unspecified valve                                |
| 35.01                   | Closed heart valvotomy, aortic valve                                     |
| 35.02                   | Closed heart valvotomy, mitral valve                                     |
| 35.03                   | Closed heart valvotomy, pulmonary valve                                  |
| 35.04                   | Closed heart valvotomy, tricuspid valve                                  |
| 35.1                    | Open heart valvuloplasty without replacement, unspecified valve           |
| 35.11                   | Open heart valvuloplasty of aortic valve without replacement             |
| 35.12                   | Open heart valvuloplasty of mitral valve without replacement             |
| 35.13                   | Open heart valvuloplasty of pulmonary valve without replacement          |
| 35.14                   | Open heart valvuloplasty of tricuspid valve without replacement          |
| 35.2                    | Replacement of unspecified heart valve                                   |
| 35.21                   | Replacement of aortic valve with tissue graft                            |
| 35.22                   | Other replacement of aortic valve                                       |
| 35.23                   | Replacement of mitral valve with tissue graft                            |
| 35.24                   | Other replacement of mitral valve                                       |
| 35.25                   | Replacement of pulmonary valve with tissue graft                         |
| 35.26                   | Other replacement of pulmonary valve                                     |
| 35.27                   | Replacement of tricuspid valve with tissue graft                         |
| 35.28                   | Other replacement of tricuspid valve                                     |
| 35.31                   | Operations on papillary muscle                                           |
| 35.32                   | Operations on chordae tendineae                                         |
| 35.33                   | Annuloplasty                                                             |
| 35.34                   | Infundibulectomy                                                         |
| 35.35                   | Operations on trabeculae carnea cordis                                   |
| 35.39                   | Operations on other structures adjacent to valves of heart               |
| 35.41                   | Enlargement of existing atrial septal defect                             |
| 35.42                   | Creation of septal defect in heart                                       |
| Code  | Description                                                                 |
|-------|-----------------------------------------------------------------------------|
| 35.5  | Repair of unspecified septal defect of heart with prosthesis                |
| 35.51 | Repair of atrial septal defect with prosthesis, open technique              |
| 35.52 | Repair of atrial septal defect with prosthesis, closed technique            |
| 35.53 | Repair of ventricular septal defect with prosthesis, open technique         |
| 35.54 | Repair of endocardial cushion defect with prosthesis                        |
| 35.55 | Repair of ventricular septal defect with prosthesis, closed technique       |
| 35.6  | Repair of unspecified septal defect of heart with tissue graft              |
| 35.61 | Repair of atrial septal defect with tissue graft                            |
| 35.62 | Repair of ventricular septal defect with tissue graft                       |
| 35.63 | Repair of endocardial cushion defect with tissue graft                      |
| 35.7  | Other and unspecified repair of unspecified septal defect of heart          |
| 35.71 | Other and unspecified repair of atrial septal defect                        |
| 35.72 | Other and unspecified repair of ventricular septal defect                   |
| 35.73 | Other and unspecified repair of endocardial cushion defect                  |
| 35.81 | Total repair of tetralogy of fallot                                         |
| 35.82 | Total repair of total anomalous pulmonary venous connection                 |
| 35.83 | Total repair of truncus arteriosus                                         |
| 35.84 | Total correction of transposition of great vessels, not elsewhere classified|
| 35.91 | Interventricular transposition of venous return                             |
| 35.92 | Creation of conduit between right ventricle and pulmonary artery           |
| 35.93 | Creation of conduit between left ventricle and aorta                       |
| 35.94 | Creation of conduit between atrium and pulmonary artery                    |
| 35.95 | Revision of corrective procedure on heart                                   |
| 35.96 | Percutaneous balloon valvuloplasty                                         |
| 35.98 | Other operations on septa of heart                                          |
| 35.99 | Other operations on valves of heart                                         |
| 37.31 | Pericardiectomy                                                             |
| 37.32 | Excision of aneurysm of heart                                               |
| 37.33 | Excision or destruction of other lesion or tissue of heart, open approach   |
| 37.35 | Partial ventriculectomy                                                     |
| 37.51 | Heart transplantation                                                       |
| 37.52 | Implantation of total internal biventricular heart replacement system       |
| 37.53 | Replacement or repair of thoracic unit of (total) replacement heart system   |
| 37.54 | Replacement or repair of other implantable component of (total) replacement heart system |
| 37.55 | Removal of internal biventricular heart replacement system                  |
| 37.63 | Repair of heart assist system                                               |
| 37.67 | Implantation of cardiomystimulation system                                  |
| 38.11 | Head and neck endarterectomy                                                |
| 38.12 | Endarterectomy, other vessels of head and neck                             |
| 38.14 | Endarterectomy of Aorta                                                     |
| 38.15 | Thoracic endarterectomy                                                     |
| Code  | Description                                                                 |
|-------|-----------------------------------------------------------------------------|
| 38.16 | Endarterectomy: Excision of tunica intima of artery to relieve arterial walls thickened by plaque or chronic inflammation. Location includes abdominal arteries excluding abdominal aorta: Celiac, Gastric, Hepatic, Iliac, Mesenteric, Renal, Splenic, Umbilical |
| 38.17 | Endarterectomy - abdominal veins: Iliac, Portal, Renal, Splenic, Vena cava. |
| 38.34 | Resection of vessel with replacement: Angiectomy, excision of aneurysm (arteriovenous), blood vessel (lesion) with anastomosis (4=orta, abdominal) |
| 38.42 | Resection of vessel with replacement: Angiectomy, excision of aneurysm with replacement (2=other vessels of head and neck; carotid, jugular) |
| 38.44 | Resection of vessel with replacement, aorta, abdominal                        |
| 38.45 | Resection of vessel with replacement, thoracic vessels                        |
| 39.21 | Caval-pulmonary artery anastomosis                                           |
| 39.22 | Aorta-subclavian-carotid bypass                                              |
| 39.23 | Other intrathoracic vascular shunt or bypass                                 |
| 39.24 | Aorta-renal bypass                                                          |
| 39.25 | Aorta-iliac-femoral bypass                                                   |
| 39.26 | Other intra-abdominal vascular shunt or bypass                               |
| 39.28 | Extracranial-intracranial (EC-IC) vascular bypass                           |
| 39.29 | Other (peripheral) vascular shunt or bypass                                 |
| 39.71 | Endovascular implantation of graft in abdominal aorta                        |
| 39.72 | Endovascular embolization or occlusion of head and neck vessels              |
| 39.73 | Endovascular implantation of graft in thoracic aorta                         |
| 39.74 | Endovascular removal of obstruction from head and neck vessel(s)             |
| 39.75 | Endovascular embolization or occlusion of vessel(s) of head or neck using bare coils |
| 39.76 | Endovascular embolization or occlusion of vessel(s) of head or neck using bioactive coils |
| 39.79 | Other endovascular procedures on other vessels                               |
| 85.22 | Resection of quadrant of breast                                              |
| 85.23 | Subtotal mastectomy, which excludes quadrant resection (85.22)              |
| 85.41 | Unilateral simple mastectomy                                                 |
| 85.42 | Bilateral simple mastectomy                                                  |
| 85.43 | Unilateral extended simple mastectomy                                         |
| 85.44 | Bilateral extended simple mastectomy                                          |
| 85.45 | Unilateral radical mastectomy                                                |
| 85.46 | Bilateral radical mastectomy                                                 |
| 85.47 | Unilateral extended radical mastectomy                                       |
| 85.48 | Bilateral extended radical mastectomy                                         |
Table S3. ICD-10 code to exclude concomitant cardiac and non-cardiac operations.

| ICD-10 Code | ICD-10 Code Description                                                                 |
|-------------|---------------------------------------------------------------------------------------|
| 024F07J     | Creation of Aortic Valve from Truncal Valve using Autologous Tissue Substitute, Open Approach |
| 024F08J     | Creation of Aortic Valve from Truncal Valve using Zooplastic Tissue, Open Approach     |
| 024F0JJ     | Creation of Aortic Valve from Truncal Valve using Synthetic Substitute, Open Approach  |
| 024F0KJ     | Creation of Aortic Valve from Truncal Valve using Nonautologous Tissue Substitute, Open Approach |
| 024G072     | Creation of Mitral Valve from Common Atrioventricular Valve using Autologous Tissue Substitute, Open Approach |
| 024G082     | Creation of Mitral Valve from Common Atrioventricular Valve using Zooplastic Tissue, Open Approach |
| 024G0J2     | Creation of Mitral Valve from Common Atrioventricular Valve using Synthetic Substitute, Open Approach |
| 024G0K2     | Creation of Mitral Valve from Common Atrioventricular Valve using Nonautologous Tissue Substitute, Open Approach |
| 024J072     | Creation of Tricuspid Valve from Common Atrioventricular Valve using Autologous Tissue Substitute, Open Approach |
| 024J082     | Creation of Tricuspid Valve from Common Atrioventricular Valve using Zooplastic Tissue, Open Approach |
| 024J0J2     | Creation of Tricuspid Valve from Common Atrioventricular Valve using Synthetic Substitute, Open Approach |
| 024J0K2     | Creation of Tricuspid Valve from Common Atrioventricular Valve using Nonautologous Tissue Substitute, Open Approach |
| 025F0ZZ     | Destruction of Aortic Valve, Open Approach                                            |
| 025F3ZZ     | Destruction of Aortic Valve, Percutaneous Approach                                     |
| 025F4ZZ     | Destruction of Aortic Valve, Percutaneous Endoscopic Approach                          |
| 025G0ZZ     | Destruction of Mitral Valve, Open Approach                                            |
| 025G3ZZ     | Destruction of Mitral Valve, Percutaneous Approach                                     |
| 025G4ZZ     | Destruction of Mitral Valve, Percutaneous Endoscopic Approach                          |
| 025H0ZZ     | Destruction of Pulmonary Valve, Open Approach                                          |
| 025H3ZZ     | Destruction of Pulmonary Valve, Percutaneous Approach                                  |
| 025H4ZZ     | Destruction of Pulmonary Valve, Percutaneous Endoscopic Approach                       |
| 025J0ZZ     | Destruction of Tricuspid Valve, Open Approach                                          |
| 025J3ZZ     | Destruction of Tricuspid Valve, Percutaneous Approach                                  |
| 025J4ZZ     | Destruction of Tricuspid Valve, Percutaneous Endoscopic Approach                       |
| 027F04Z     | Dilation of Aortic Valve with Drug-eluting Intraluminal Device, Open Approach          |
| 027F0DZ     | Dilation of Aortic Valve with Intraluminal Device, Open Approach                       |
| 027F0ZZ     | Dilation of Aortic Valve, Open Approach                                               |
| 027F34Z     | Dilation of Aortic Valve with Drug-eluting Intraluminal Device, Percutaneous Approach  |
| 027F3DZ     | Dilation of Aortic Valve with Intraluminal Device, Percutaneous Approach               |
| 027F3ZZ     | Dilation of Aortic Valve, Percutaneous Approach                                       |
| 027F44Z     | Dilation of Aortic Valve with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach |
| 027F4DZ     | Dilation of Aortic Valve with Intraluminal Device, Percutaneous Endoscopic Approach    |
| 027F4ZZ     | Dilation of Aortic Valve, Percutaneous Endoscopic Approach                             |
| 027G04Z     | Dilation of Mitral Valve with Drug-eluting Intraluminal Device, Open Approach          |
| 027G0DZ     | Dilation of Mitral Valve with Intraluminal Device, Open Approach                       |
| 027G0ZZ     | Dilation of Mitral Valve, Open Approach                                               |
| Code    | Description                                                                 |
|---------|-----------------------------------------------------------------------------|
| 027G34Z | Dilation of Mitral Valve with Drug-eluting Intraluminal Device, Percutaneous Approach |
| 027G3DZ | Dilation of Mitral Valve with Intraluminal Device, Percutaneous Approach     |
| 027G3ZZ | Dilation of Mitral Valve, Percutaneous Approach                              |
| 027G44Z | Dilation of Mitral Valve with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach |
| 027G4DZ | Dilation of Mitral Valve with Intraluminal Device, Percutaneous Endoscopic Approach |
| 027G4ZZ | Dilation of Mitral Valve, Percutaneous Endoscopic Approach                   |
| 027H04Z | Dilation of Pulmonary Valve with Drug-eluting Intraluminal Device, Open Approach |
| 027H0DZ | Dilation of Pulmonary Valve with Intraluminal Device, Open Approach          |
| 027H0ZZ | Dilation of Pulmonary Valve, Open Approach                                   |
| 027H34Z | Dilation of Pulmonary Valve with Drug-eluting Intraluminal Device, Percutaneous Approach |
| 027H3DZ | Dilation of Pulmonary Valve with Intraluminal Device, Percutaneous Approach |
| 027H3ZZ | Dilation of Pulmonary Valve, Percutaneous Approach                          |
| 027H44Z | Dilation of Pulmonary Valve with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach |
| 027H4DZ | Dilation of Pulmonary Valve with Intraluminal Device, Percutaneous Endoscopic Approach |
| 027H4ZZ | Dilation of Pulmonary Valve, Percutaneous Endoscopic Approach                |
| 027J04Z | Dilation of Tricuspid Valve with Drug-eluting Intraluminal Device, Open Approach |
| 027J0DZ | Dilation of Tricuspid Valve with Intraluminal Device, Open Approach          |
| 027J0ZZ | Dilation of Tricuspid Valve, Open Approach                                   |
| 027J34Z | Dilation of Tricuspid Valve with Drug-eluting Intraluminal Device, Percutaneous Approach |
| 027J3DZ | Dilation of Tricuspid Valve with Intraluminal Device, Percutaneous Approach |
| 027J3ZZ | Dilation of Tricuspid Valve, Percutaneous Approach                          |
| 027J44Z | Dilation of Tricuspid Valve with Drug-eluting Intraluminal Device, Percutaneous Endoscopic Approach |
| 027J4DZ | Dilation of Tricuspid Valve with Intraluminal Device, Percutaneous Endoscopic Approach |
| 027J4ZZ | Dilation of Tricuspid Valve, Percutaneous Endoscopic Approach                |
| 028F0ZX | Excision of Aortic Valve, Open Approach, Diagnostic                          |
| 028F0ZZ | Excision of Aortic Valve, Open Approach                                      |
| 028F3ZX | Excision of Aortic Valve, Percutaneous Approach, Diagnostic                 |
| 028F3ZZ | Excision of Aortic Valve, Percutaneous Approach                             |
| 028F4ZX | Excision of Aortic Valve, Percutaneous Endoscopic Approach, Diagnostic       |
| 028F4ZZ | Excision of Aortic Valve, Percutaneous Endoscopic Approach                   |
| 02BG0ZX | Excision of Mitral Valve, Open Approach, Diagnostic                          |
| 02BG0ZZ | Excision of Mitral Valve, Open Approach                                      |
| 02BG3ZX | Excision of Mitral Valve, Percutaneous Approach, Diagnostic                 |
| 02BG3ZZ | Excision of Mitral Valve, Percutaneous Approach                             |
| 02BG4ZX | Excision of Mitral Valve, Percutaneous Endoscopic Approach, Diagnostic       |
| 02BG4ZZ | Excision of Mitral Valve, Percutaneous Endoscopic Approach                   |
| 02BH0ZX | Excision of Pulmonary Valve, Open Approach, Diagnostic                       |
| 02BH0ZZ | Excision of Pulmonary Valve, Open Approach                                   |
| 02BH3ZX | Excision of Pulmonary Valve, Percutaneous Approach, Diagnostic              |
| 02BH3ZZ | Excision of Pulmonary Valve, Percutaneous Approach                          |
| 02BH4ZX | Excision of Pulmonary Valve, Percutaneous Endoscopic Approach, Diagnostic    |
| Code   | Description                                                                                     |
|--------|-------------------------------------------------------------------------------------------------|
| 02BH4ZZ| Excision of Pulmonary Valve, Percutaneous Endoscopic Approach                                   |
| 02BJ0ZX| Excision of Tricuspid Valve, Open Approach, Diagnostic                                          |
| 02BJ0ZZ| Excision of Tricuspid Valve, Open Approach                                                      |
| 02BJ3ZX| Excision of Tricuspid Valve, Percutaneous Approach, Diagnostic                                 |
| 02BJ3ZZ| Excision of Tricuspid Valve, Percutaneous Approach                                               |
| 02BJ4ZX| Excision of Tricuspid Valve, Percutaneous Endoscopic Approach, Diagnostic                      |
| 02BJ4ZZ| Excision of Tricuspid Valve, Percutaneous Endoscopic Approach                                    |
| 02CF0ZZ| Extirpation of Matter from Aortic Valve, Open Approach                                           |
| 02CF3ZZ| Extirpation of Matter from Aortic Valve, Percutaneous Approach                                   |
| 02CF4ZZ| Extirpation of Matter from Aortic Valve, Percutaneous Endoscopic Approach                       |
| 02CG0ZZ| Extirpation of Matter from Mitral Valve, Open Approach                                           |
| 02CG3ZZ| Extirpation of Matter from Mitral Valve, Percutaneous Approach                                   |
| 02CG4ZZ| Extirpation of Matter from Mitral Valve, Percutaneous Endoscopic Approach                       |
| 02CH0ZZ| Extirpation of Matter from Pulmonary Valve, Open Approach                                        |
| 02CH3ZZ| Extirpation of Matter from Pulmonary Valve, Percutaneous Approach                                |
| 02CH4ZZ| Extirpation of Matter from Pulmonary Valve, Percutaneous Endoscopic Approach                    |
| 02CJ0ZZ| Extirpation of Matter from Tricuspid Valve, Open Approach                                        |
| 02CJ3ZZ| Extirpation of Matter from Tricuspid Valve, Percutaneous Approach                                |
| 02CJ4ZZ| Extirpation of Matter from Tricuspid Valve, Percutaneous Endoscopic Approach                    |
| 02LH0CZ| Occlusion of Pulmonary Valve with Extraluminal Device, Open Approach                             |
| 02LH0DZ| Occlusion of Pulmonary Valve with Intraluminal Device, Open Approach                             |
| 02LH0ZZ| Occlusion of Pulmonary Valve, Open Approach                                                     |
| 02LH3CZ| Occlusion of Pulmonary Valve with Extraluminal Device, Percutaneous Approach                    |
| 02LH3DZ| Occlusion of Pulmonary Valve with Intraluminal Device, Percutaneous Approach                    |
| 02LH3ZZ| Occlusion of Pulmonary Valve, Percutaneous Approach                                              |
| 02LH4CZ| Occlusion of Pulmonary Valve with Extraluminal Device, Percutaneous Endoscopic Approach         |
| 02LH4DZ| Occlusion of Pulmonary Valve with Intraluminal Device, Percutaneous Endoscopic Approach         |
| 02LH4ZZ| Occlusion of Pulmonary Valve, Percutaneous Endoscopic Approach                                   |
| 02NF0ZZ| Release Aortic Valve, Open Approach                                                             |
| 02NF3ZZ| Release Aortic Valve, Percutaneous Approach                                                     |
| 02NF4ZZ| Release Aortic Valve, Percutaneous Endoscopic Approach                                           |
| 02NG0ZZ| Release Mitral Valve, Open Approach                                                             |
| 02NG3ZZ| Release Mitral Valve, Percutaneous Approach                                                     |
| 02NG4ZZ| Release Mitral Valve, Percutaneous Endoscopic Approach                                           |
| 02NH0ZZ| Release Pulmonary Valve, Open Approach                                                          |
| 02NH3ZZ| Release Pulmonary Valve, Percutaneous Approach                                                   |
| 02NH4ZZ| Release Pulmonary Valve, Percutaneous Endoscopic Approach                                        |
| 02NJ0ZZ| Release Tricuspid Valve, Open Approach                                                          |
| 02NJ3ZZ| Release Tricuspid Valve, Percutaneous Approach                                                   |
| 02NJ4ZZ| Release Tricuspid Valve, Percutaneous Endoscopic Approach                                        |
| 02QF0ZJ| Repair Aortic Valve created from Truncal Valve, Open Approach                                    |
| Code     | Description                                                                 |
|----------|-----------------------------------------------------------------------------|
| 02QF0ZZ | Repair Aortic Valve, Open Approach                                          |
| 02QF3ZZ | Repair Aortic Valve created from Truncal Valve, Percutaneous Approach       |
| 02QF3ZZ | Repair Aortic Valve, Percutaneous Approach                                  |
| 02QF4ZZ | Repair Aortic Valve, Percutaneous Endoscopic Approach                       |
| 02QG0ZZ | Repair Mitral Valve, Open Approach                                          |
| 02QG3ZZ | Repair Mitral Valve created from Left Atrioventricular Valve, Percutaneous Approach |
| 02QG3ZZ | Repair Mitral Valve, Percutaneous Approach                                   |
| 02QG4ZZ | Repair Mitral Valve created from Left Atrioventricular Valve, Percutaneous Endoscopic Approach |
| 02QG4ZZ | Repair Mitral Valve, Percutaneous Endoscopic Approach                       |
| 02QG0ZZ | Repair Pulmonary Valve, Open Approach                                        |
| 02QH0ZZ | Repair Tricuspid Valve, Open Approach                                        |
| 02QJ0ZZ | Repair Tricuspid Valve created from Right Atrioventricular Valve, Open Approach |
| 02QJ0ZZ | Repair Tricuspid Valve, Open Approach                                        |
| 02QJ3ZZ | Repair Tricuspid Valve created from Right Atrioventricular Valve, Percutaneous Approach |
| 02QJ3ZZ | Repair Tricuspid Valve, Percutaneous Approach                               |
| 02QJ4ZZ | Repair Tricuspid Valve created from Right Atrioventricular Valve, Percutaneous Endoscopic Approach |
| 02QJ4ZZ | Repair Tricuspid Valve, Percutaneous Endoscopic Approach                    |
| 02RF07Z | Replacement of Aortic Valve with Autologous Tissue Substitute, Open Approach |
| 02RF08Z | Replacement of Aortic Valve with Zooplastic Tissue, Open Approach           |
| 02RF0JZ | Replacement of Aortic Valve with Synthetic Substitute, Open Approach        |
| 02RF0KZ | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Open Approach |
| 02RF37H | Replacement of Aortic Valve with Autologous Tissue Substitute, Transapical, Percutaneous Approach |
| 02RF37Z | Replacement of Aortic Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02RF38H | Replacement of Aortic Valve with Zooplastic Tissue, Transapical, Percutaneous Approach |
| 02RF38Z | Replacement of Aortic Valve with Zooplastic Tissue, Percutaneous Approach   |
| 02RF3JH | Replacement of Aortic Valve with Synthetic Substitute, Transapical, Percutaneous Approach |
| 02RF3JZ | Replacement of Aortic Valve with Synthetic Substitute, Percutaneous Approach |
| 02RF3KH | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Transapical, Percutaneous Approach |
| 02RF3KZ | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02RF47Z | Replacement of Aortic Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02RF48Z | Replacement of Aortic Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02RF4IZ | Replacement of Aortic Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02RF4KZ | Replacement of Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02RG07Z | Replacement of Mitral Valve with Autologous Tissue Substitute, Open Approach |
| 02RG08Z | Replacement of Mitral Valve with Zooplastic Tissue, Open Approach           |
| 02RG0JZ | Replacement of Mitral Valve with Synthetic Substitute, Open Approach        |
| 02RG0KZ | Replacement of Mitral Valve with Nonautologous Tissue Substitute, Open Approach |
| 02RG37H | Replacement of Mitral Valve with Autologous Tissue Substitute, Transapical, Percutaneous Approach |
| Code   | Description                                              |
|--------|----------------------------------------------------------|
| 02RG37Z | Replacement of Mitral Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02RG38H | Replacement of Mitral Valve with Zooplastic Tissue, Transapical, Percutaneous Approach |
| 02RG38Z | Replacement of Mitral Valve with Zooplastic Tissue, Percutaneous Approach |
| 02RG3JH | Replacement of Mitral Valve with Synthetic Substitute, Transapical, Percutaneous Approach |
| 02RG3JZ | Replacement of Mitral Valve with Synthetic Substitute, Percutaneous Approach |
| 02RG3KH | Replacement of Mitral Valve with Nonautologous Tissue Substitute, Transapical, Percutaneous Approach |
| 02RG3KZ | Replacement of Mitral Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02RG47Z | Replacement of Mitral Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02RG48Z | Replacement of Mitral Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02RG4JZ | Replacement of Mitral Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02RH07Z | Replacement of Pulmonary Valve with Autologous Tissue Substitute, Open Approach |
| 02RH08Z | Replacement of Pulmonary Valve with Zooplastic Tissue, Open Approach |
| 02RH0JZ | Replacement of Pulmonary Valve with Synthetic Substitute, Open Approach |
| 02RH0KZ | Replacement of Pulmonary Valve with Nonautologous Tissue Substitute, Open Approach |
| 02RH37H | Replacement of Pulmonary Valve with Autologous Tissue Substitute, Transapical, Percutaneous Approach |
| 02RH37Z | Replacement of Pulmonary Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02RH38H | Replacement of Pulmonary Valve with Zooplastic Tissue, Transapical, Percutaneous Approach |
| 02RH38Z | Replacement of Pulmonary Valve with Zooplastic Tissue, Percutaneous Approach |
| 02RH3JH | Replacement of Pulmonary Valve with Synthetic Substitute, Transapical, Percutaneous Approach |
| 02RH3JZ | Replacement of Pulmonary Valve with Synthetic Substitute, Percutaneous Approach |
| 02RH3KH | Replacement of Pulmonary Valve with Nonautologous Tissue Substitute, Transapical, Percutaneous Approach |
| 02RH3KZ | Replacement of Pulmonary Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02RH47Z | Replacement of Pulmonary Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02RH48Z | Replacement of Pulmonary Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02RH4JZ | Replacement of Pulmonary Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02RJ07Z | Replacement of Tricuspid Valve with Autologous Tissue Substitute, Open Approach |
| 02RJ08Z | Replacement of Tricuspid Valve with Zooplastic Tissue, Open Approach |
| 02RJ0JZ | Replacement of Tricuspid Valve with Synthetic Substitute, Open Approach |
| 02RJ0KZ | Replacement of Tricuspid Valve with Nonautologous Tissue Substitute, Open Approach |
| 02RJ37H | Replacement of Tricuspid Valve with Autologous Tissue Substitute, Transapical, Percutaneous Approach |
| 02RJ37Z | Replacement of Tricuspid Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02RJ38H | Replacement of Tricuspid Valve with Zooplastic Tissue, Transapical, Percutaneous Approach |
| 02RJ38Z | Replacement of Tricuspid Valve with Zooplastic Tissue, Percutaneous Approach |
| 02RJ3JH | Replacement of Tricuspid Valve with Synthetic Substitute, Transapical, Percutaneous Approach |
| 02RJ3JZ | Replacement of Tricuspid Valve with Synthetic Substitute, Percutaneous Approach |
| 02RJ3KH | Replacement of Tricuspid Valve with Nonautologous Tissue Substitute, Transapical, Percutaneous Approach |
| 02RJ3KZ | Replacement of Tricuspid Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02RJ47Z | Replacement of Tricuspid Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02RJ48Z | Replacement of Tricuspid Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| Code       | Description                                                                                           |
|------------|-------------------------------------------------------------------------------------------------------|
| 02RJ4JZ   | Replacement of Tricuspid Valve with Synthetic Substitute, Percutaneous Endoscopic Approach            |
| 02RJ4KZ   | Replacement of Tricuspid Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02TH0ZZ   | Resection of Pulmonary Valve, Open Approach                                                           |
| 02TH3ZZ   | Resection of Pulmonary Valve, Percutaneous Approach                                                   |
| 02TH4ZZ   | Resection of Pulmonary Valve, Percutaneous Endoscopic Approach                                        |
| 02UF07J   | Supplement Aortic Valve created from Truncal Valve with Autologous Tissue Substitute, Open Approach  |
| 02UF07Z   | Supplement Aortic Valve with Autologous Tissue Substitute, Open Approach                              |
| 02UF08J   | Supplement Aortic Valve created from Truncal Valve with Zooplastic Tissue, Open Approach              |
| 02UF08Z   | Supplement Aortic Valve with Zooplastic Tissue, Open Approach                                         |
| 02UF09J   | Supplement Aortic Valve created from Truncal Valve with Synthetic Substitute, Open Approach           |
| 02UF09Z   | Supplement Aortic Valve with Synthetic Substitute, Open Approach                                       |
| 02UF0KJ   | Supplement Aortic Valve created from Truncal Valve with Nonautologous Tissue Substitute, Open Approach|
| 02UF0KZ   | Supplement Aortic Valve with Nonautologous Tissue Substitute, Open Approach                           |
| 02UF37J   | Supplement Aortic Valve created from Truncal Valve with Autologous Tissue Substitute, Percutaneous    |
|           | Approach                                                                                              |
| 02UF37Z   | Supplement Aortic Valve with Autologous Tissue Substitute, Percutaneous Approach                       |
| 02UF38J   | Supplement Aortic Valve created from Truncal Valve with Zooplastic Tissue, Percutaneous Approach      |
| 02UF38Z   | Supplement Aortic Valve with Zooplastic Tissue, Percutaneous Approach                                  |
| 02UF3JJ   | Supplement Aortic Valve created from Truncal Valve with Synthetic Substitute, Percutaneous Approach    |
| 02UF3JZ   | Supplement Aortic Valve with Synthetic Substitute, Percutaneous Approach                               |
| 02UF3KJ   | Supplement Aortic Valve created from Truncal Valve with Nonautologous Tissue Substitute, Percutaneous |
|           | Approach                                                                                              |
| 02UF3KZ   | Supplement Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Approach                    |
| 02UF47J   | Supplement Aortic Valve created from Truncal Valve with Autologous Tissue Substitute, Percutaneous    |
|           | Endoscopic Approach                                                                                    |
| 02UF47Z   | Supplement Aortic Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach            |
| 02UF48J   | Supplement Aortic Valve created from Truncal Valve with Zooplastic Tissue, Percutaneous Endoscopic    |
|           | Approach                                                                                              |
| 02UF48Z   | Supplement Aortic Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach                       |
| 02UF4JJ   | Supplement Aortic Valve created from Truncal Valve with Synthetic Substitute, Percutaneous Endoscopic  |
|           | Approach                                                                                              |
| 02UF4KJ   | Supplement Aortic Valve with Synthetic Substitute, Percutaneous Endoscopic Approach                    |
| 02UF4KZ   | Supplement Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach         |
| 02UG07E   | Supplement Mitral Valve created from Left Atrioventricular Valve with Autologous Tissue Substitute,   |
|           | Open Approach                                                                                        |
| 02UG07Z   | Supplement Mitral Valve with Autologous Tissue Substitute, Open Approach                              |
| 02UG08E   | Supplement Mitral Valve created from Left Atrioventricular Valve with Zooplastic Tissue, Open Approach|
| 02UG08Z   | Supplement Mitral Valve with Zooplastic Tissue, Open Approach                                         |
| 02UG0JE   | Supplement Mitral Valve created from Left Atrioventricular Valve with Synthetic Substitute, Open      |
|           | Approach                                                                                              |
| 02UG0JZ   | Supplement Mitral Valve with Synthetic Substitute, Open Approach                                       |
| 02UG0KE   | Supplement Mitral Valve created from Left Atrioventricular Valve with Nonautologous Tissue Substitute,|
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 02UG0KZ| Supplement Mitral Valve with Nonautologous Tissue Substitute, Open Approach |
| 02UG37E| Supplement Mitral Valve created from Left Atrioventricular Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02UG37Z| Supplement Mitral Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02UG38E| Supplement Mitral Valve created from Left Atrioventricular Valve with Zooplastic Tissue, Percutaneous Approach |
| 02UG38Z| Supplement Mitral Valve with Zooplastic Tissue, Percutaneous Approach |
| 02UG3JE| Supplement Mitral Valve created from Left Atrioventricular Valve with Synthetic Substitute, Percutaneous Approach |
| 02UG3JZ| Supplement Mitral Valve with Synthetic Substitute, Percutaneous Approach |
| 02UG3KE| Supplement Mitral Valve created from Left Atrioventricular Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02UG3KZ| Supplement Mitral Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02UG47E| Supplement Mitral Valve created from Left Atrioventricular Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UG47Z| Supplement Mitral Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UG48E| Supplement Mitral Valve created from Left Atrioventricular Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02UG48Z| Supplement Mitral Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02UG4JE| Supplement Mitral Valve created from Left Atrioventricular Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02UG4JZ| Supplement Mitral Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02UG4KE| Supplement Mitral Valve created from Left Atrioventricular Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UG4KZ| Supplement Mitral Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UH07Z| Supplement Pulmonary Valve with Autologous Tissue Substitute, Open Approach |
| 02UH08Z| Supplement Pulmonary Valve with Zooplastic Tissue, Open Approach |
| 02UH0JZ| Supplement Pulmonary Valve with Synthetic Substitute, Open Approach |
| 02UH0KZ| Supplement Pulmonary Valve with Nonautologous Tissue Substitute, Open Approach |
| 02UH37Z| Supplement Pulmonary Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02UH38Z| Supplement Pulmonary Valve with Zooplastic Tissue, Percutaneous Approach |
| 02UH3JZ| Supplement Pulmonary Valve with Synthetic Substitute, Percutaneous Approach |
| 02UH3KZ| Supplement Pulmonary Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02UH47Z| Supplement Pulmonary Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UH48Z| Supplement Pulmonary Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02UH4JZ| Supplement Pulmonary Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02UH4KZ| Supplement Pulmonary Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UJ07G| Supplement Tricuspid Valve created from Right Atrioventricular Valve with Autologous Tissue Substitute, Open Approach |
| 02UJ07Z| Supplement Tricuspid Valve with Autologous Tissue Substitute, Open Approach |
| 02UJ08G| Supplement Tricuspid Valve created from Right Atrioventricular Valve with Zooplastic Tissue, Open Approach |
| 02UJ08Z| Supplement Tricuspid Valve with Zooplastic Tissue, Open Approach |
| 02UJ0JG| Supplement Tricuspid Valve created from Right Atrioventricular Valve with Synthetic Substitute, Open Approach |
| 02UJ0JZ| Supplement Tricuspid Valve with Synthetic Substitute, Open Approach |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| 02UJ0KG | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Nonautologous Tissue Substitute, Open Approach |
| 02UJ0KZ | Supplement Tricuspid Valve with Nonautologous Tissue Substitute, Open Approach |
| 02UJ37G | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02UJ37Z | Supplement Tricuspid Valve with Autologous Tissue Substitute, Percutaneous Approach |
| 02UJ38G | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Zooplastic Tissue, Percutaneous Approach |
| 02UJ38Z | Supplement Tricuspid Valve with Zooplastic Tissue, Percutaneous Approach |
| 02UJ3JG | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Synthetic Substitute, Percutaneous Approach |
| 02UJ3JZ | Supplement Tricuspid Valve with Synthetic Substitute, Percutaneous Approach |
| 02UJ3KG | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02UJ3KZ | Supplement Tricuspid Valve with Nonautologous Tissue Substitute, Percutaneous Approach |
| 02UJ47G | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UJ47Z | Supplement Tricuspid Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UJ48G | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02UJ48Z | Supplement Tricuspid Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach |
| 02UJ4JG | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02UJ4JZ | Supplement Tricuspid Valve with Synthetic Substitute, Percutaneous Endoscopic Approach |
| 02UJ4KG | Supplement Tricuspid Valve created from Right Atrioventricular Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02UJ4KZ | Supplement Tricuspid Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach |
| 02VG07Z | Restriction of Mitral Valve, Open Approach                                      |
| 02VG08Z | Restriction of Mitral Valve, Percutaneous Approach                                |
| 02VG0JZ | Restriction of Mitral Valve, Percutaneous Endoscopic Approach                   |
| 02WF07Z | Revision of Autologous Tissue Substitute in Aortic Valve, Open Approach            |
| 02WF08Z | Revision of Zooplastic Tissue in Aortic Valve, Open Approach                       |
| 02WF0JZ | Revision of Synthetic Substitute in Aortic Valve, Open Approach                   |
| 02WF0KZ | Revision of Nonautologous Tissue Substitute in Aortic Valve, Open Approach         |
| 02WF37Z | Revision of Autologous Tissue Substitute in Aortic Valve, Percutaneous Approach    |
| 02WF38Z | Revision of Zooplastic Tissue in Aortic Valve, Percutaneous Approach              |
| 02WF3JZ | Revision of Synthetic Substitute in Aortic Valve, Percutaneous Approach            |
| 02WF3KZ | Revision of Nonautologous Tissue Substitute in Aortic Valve, Percutaneous Approach |
| 02WF47Z | Revision of Autologous Tissue Substitute in Aortic Valve, Percutaneous Endoscopic Approach |
| 02WF48Z | Revision of Zooplastic Tissue in Aortic Valve, Percutaneous Endoscopic Approach   |
| 02WF4JZ | Revision of Synthetic Substitute in Aortic Valve, Percutaneous Endoscopic Approach |
| 02WF4KZ | Revision of Nonautologous Tissue Substitute in Aortic Valve, Percutaneous Endoscopic Approach |
| 02WG07Z | Revision of Autologous Tissue Substitute in Mitral Valve, Open Approach           |
| 02WG08Z | Revision of Zooplastic Tissue in Mitral Valve, Open Approach                      |
| 02WG0JZ | Revision of Synthetic Substitute in Mitral Valve, Open Approach                   |
| Code   | Description                                           |
|--------|-------------------------------------------------------|
| 02WG0KZ | Revision of Nonautologous Tissue Substitute in Mitral Valve, Open Approach |
| 02WG37Z | Revision of Autologous Tissue Substitute in Mitral Valve, Percutaneous Approach |
| 02WG38Z | Revision of Zooplastic Tissue in Mitral Valve, Percutaneous Approach |
| 02WG3JZ | Revision of Synthetic Substitute in Mitral Valve, Percutaneous Approach |
| 02WG3KZ | Revision of Nonautologous Tissue Substitute in Mitral Valve, Percutaneous Approach |
| 02WG47Z | Revision of Autologous Tissue Substitute in Mitral Valve, Percutaneous Endoscopic Approach |
| 02WG48Z | Revision of Zooplastic Tissue in Mitral Valve, Percutaneous Endoscopic Approach |
| 02WG4JZ | Revision of Synthetic Substitute in Mitral Valve, Percutaneous Endoscopic Approach |
| 02WG4KZ | Revision of Nonautologous Tissue Substitute in Mitral Valve, Percutaneous Endoscopic Approach |
| 02WH07Z | Revision of Autologous Tissue Substitute in Pulmonary Valve, Open Approach |
| 02WH08Z | Revision of Zooplastic Tissue in Pulmonary Valve, Open Approach |
| 02WH0JZ | Revision of Synthetic Substitute in Pulmonary Valve, Open Approach |
| 02WH0KZ | Revision of Nonautologous Tissue Substitute in Pulmonary Valve, Open Approach |
| 02WH37Z | Revision of Autologous Tissue Substitute in Pulmonary Valve, Percutaneous Approach |
| 02WH38Z | Revision of Zooplastic Tissue in Pulmonary Valve, Percutaneous Approach |
| 02WH3JZ | Revision of Synthetic Substitute in Pulmonary Valve, Percutaneous Approach |
| 02WH3KZ | Revision of Nonautologous Tissue Substitute in Pulmonary Valve, Percutaneous Approach |
| 02WH47Z | Revision of Autologous Tissue Substitute in Pulmonary Valve, Percutaneous Endoscopic Approach |
| 02WH48Z | Revision of Zooplastic Tissue in Pulmonary Valve, Percutaneous Endoscopic Approach |
| 02WH4JZ | Revision of Synthetic Substitute in Pulmonary Valve, Percutaneous Endoscopic Approach |
| 02WH4KZ | Revision of Nonautologous Tissue Substitute in Pulmonary Valve, Percutaneous Endoscopic Approach |
| 02WJ07Z | Revision of Autologous Tissue Substitute in Tricuspid Valve, Open Approach |
| 02WJ08Z | Revision of Zooplastic Tissue in Tricuspid Valve, Open Approach |
| 02WJ0JZ | Revision of Synthetic Substitute in Tricuspid Valve, Open Approach |
| 02WJ0KZ | Revision of Nonautologous Tissue Substitute in Tricuspid Valve, Open Approach |
| 02WJ37Z | Revision of Autologous Tissue Substitute in Tricuspid Valve, Percutaneous Approach |
| 02WJ38Z | Revision of Zooplastic Tissue in Tricuspid Valve, Percutaneous Approach |
| 02WJ3JZ | Revision of Synthetic Substitute in Tricuspid Valve, Percutaneous Approach |
| 02WJ3KZ | Revision of Nonautologous Tissue Substitute in Tricuspid Valve, Percutaneous Approach |
| 02WJ47Z | Revision of Autologous Tissue Substitute in Tricuspid Valve, Percutaneous Endoscopic Approach |
| 02WJ48Z | Revision of Zooplastic Tissue in Tricuspid Valve, Percutaneous Endoscopic Approach |
| 02WJ4JZ | Revision of Synthetic Substitute in Tricuspid Valve, Percutaneous Endoscopic Approach |
| 02WJ4KZ | Revision of Nonautologous Tissue Substitute in Tricuspid Valve, Percutaneous Endoscopic Approach |
| I25.700 | Atherosclerosis of coronary artery bypass graft(s), unspecified, with unstable angina pectoris |
| I25.701 | Atherosclerosis of coronary artery bypass graft(s), unspecified, with angina pectoris with documented spasm |
| I25.708 | Atherosclerosis of coronary artery bypass graft(s), unspecified, with other forms of angina pectoris |
| I25.709 | Atherosclerosis of coronary artery bypass graft(s), unspecified, with unspecified angina pectoris |
| I25.710 | Atherosclerosis of autologous vein coronary artery bypass graft(s) with unstable angina pectoris |
| I25.711 | Atherosclerosis of autologous vein coronary artery bypass graft(s) with angina pectoris with documented spasm |
| I25.718 | Atherosclerosis of autologous vein coronary artery bypass graft(s) with other forms of angina pectoris |
| I25.719 | Atherosclerosis of autologous vein coronary artery bypass graft(s) with unspecified angina pectoris |
| Code   | Description                                                                 |
|--------|------------------------------------------------------------------------------|
| I25.720 | Atherosclerosis of autologous artery coronary artery bypass graft(s) with unstable angina pectoris |
| I25.721 | Atherosclerosis of autologous artery coronary artery bypass graft(s) with angina pectoris with documented spasm |
| I25.728 | Atherosclerosis of autologous artery coronary artery bypass graft(s) with other forms of angina pectoris |
| I25.729 | Atherosclerosis of autologous artery coronary artery bypass graft(s) with unspecified angina pectoris |
| I25.730 | Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with unstable angina pectoris |
| I25.731 | Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with angina pectoris with documented spasm |
| I25.738 | Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with other forms of angina pectoris |
| I25.739 | Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with unspecified angina pectoris |
| I25.750 | Atherosclerosis of native coronary artery of transplanted heart with unstable angina |
| I25.751 | Atherosclerosis of native coronary artery of transplanted heart with angina pectoris with documented spasm |
| I25.758 | Atherosclerosis of native coronary artery of transplanted heart with other forms of angina pectoris |
| I25.759 | Atherosclerosis of native coronary artery of transplanted heart with unspecified angina pectoris |
| I25.760 | Atherosclerosis of bypass graft of coronary artery of transplanted heart with unstable angina |
| I25.761 | Atherosclerosis of bypass graft of coronary artery of transplanted heart with angina pectoris with documented spasm |
| I25.768 | Atherosclerosis of bypass graft of coronary artery of transplanted heart with other forms of angina pectoris |
| I25.769 | Atherosclerosis of bypass graft of coronary artery of transplanted heart with unspecified angina pectoris |
| I25.790 | Atherosclerosis of other coronary artery bypass graft(s) with unstable angina pectoris |
| I25.791 | Atherosclerosis of other coronary artery bypass graft(s) with angina pectoris with documented spasm |
| I25.798 | Atherosclerosis of other coronary artery bypass graft(s) with other forms of angina pectoris |
| I25.799 | Atherosclerosis of other coronary artery bypass graft(s) with unspecified angina pectoris |
| I25.810 | Atherosclerosis of coronary artery bypass graft(s) without angina pectoris |
| I25.811 | Atherosclerosis of native coronary artery of transplanted heart without angina pectoris |
| I25.812 | Atherosclerosis of bypass graft of coronary artery of transplanted heart without angina pectoris |
| T82.01XD | Breakdown (mechanical) of heart valve prosthesis, subsequent encounter |
| T82.01XS | Breakdown (mechanical) of heart valve prosthesis, sequela |
| T82.02XD | Displacement of heart valve prosthesis, subsequent encounter |
| T82.02XS | Displacement of heart valve prosthesis, sequela |
| T82.03XD | Leakage of heart valve prosthesis, subsequent encounter |
| T82.03XS | Leakage of heart valve prosthesis, sequela |
| T82.09XD | Other mechanical complication of heart valve prosthesis, subsequent encounter |
| T82.09XS | Other mechanical complication of heart valve prosthesis, sequela |
| T82.211D | Breakdown (mechanical) of coronary artery bypass graft, subsequent encounter |
| T82.211S | Breakdown (mechanical) of coronary artery bypass graft, sequela |
| T82.212D | Displacement of coronary artery bypass graft, subsequent encounter |
| T82.212S | Displacement of coronary artery bypass graft, sequela |
| T82.213D | Leakage of coronary artery bypass graft, subsequent encounter |
| T82.213S | Leakage of coronary artery bypass graft, sequela |
| T82.218D | Other mechanical complication of coronary artery bypass graft, subsequent encounter |
| T82.218S | Other mechanical complication of coronary artery bypass graft, sequela |
| Code   | Description                                                                 |
|--------|-----------------------------------------------------------------------------|
| T82.221D | Breakdown (mechanical) of biological heart valve graft, subsequent encounter |
| T82.221S | Breakdown (mechanical) of biological heart valve graft, sequela             |
| T82.222D | Displacement of biological heart valve graft, subsequent encounter          |
| T82.222S | Displacement of biological heart valve graft, sequela                       |
| T82.223D | Leakage of biological heart valve graft, subsequent encounter                |
| T82.223S | Leakage of biological heart valve graft, sequela                            |
| T82.228D | Other mechanical complication of biological heart valve graft, subsequent encounter |
| T82.228S | Other mechanical complication of biological heart valve graft, sequela       |
| T82.6XXD | Infection and inflammatory reaction due to cardiac valve prosthesis, subsequent encounter |
| T82.6XXS | Infection and inflammatory reaction due to cardiac valve prosthesis, sequela |
| X2R.F032 | Replacement of Aortic Valve using Zooplastic Tissue, Rapid Deployment Technique, Open Approach, New Technology Group 2 |
| X2R.F332 | Replacement of Aortic Valve using Zooplastic Tissue, Rapid Deployment Technique, Percutaneous Approach, New Technology Group 2 |
| X2R.F432 | Replacement of Aortic Valve using Zooplastic Tissue, Rapid Deployment Technique, Percutaneous Endoscopic Approach, New Technology Group 2 |
| Z95.1  | Presence of aortocoronary bypass graft                                       |
| Z95.2  | Presence of prosthetic heart valve                                          |
| Z95.3  | Presence of xenogenic heart valve                                           |
| Z95.4  | Presence of other heart-valve replacement                                    |
| I25.10 | Atherosclerotic heart disease of native coronary artery without angina pectoris |
| I25.110 | Atherosclerotic heart disease of native coronary artery with unstable angina pectoris |
| I25.111 | Atherosclerotic heart disease of native coronary artery with angina pectoris with documented spasm |
| I25.118 | Atherosclerotic heart disease of native coronary artery with other forms of angina pectoris |
| I25.119 | Atherosclerotic heart disease of native coronary artery with unspecified angina pectoris |
| I25.3  | Aneurysm of heart                                                            |
| I25.41 | Coronary artery aneurysm                                                     |
| I25.42 | Coronary artery dissection                                                   |
| I25.5  | Ischemic cardiomyopathy                                                     |
| I25.6  | Silent myocardial ischemia                                                   |
| I25.82 | Chronic total occlusion of coronary artery                                   |
| I25.83 | Coronary atherosclerosis due to lipid rich plaque                            |
| I25.89 | Other forms of chronic ischemic heart disease                               |
| I25.9  | Chronic ischemic heart disease, unspecified                                 |
| Q24.5  | Malformation of coronary vessels                                            |
| R57.0  | Cardiogenic shock                                                           |
| I25.2  | Old myocardial infarction                                                    |
| 02HA0QZ | Insertion of Implantable Heart Assist System into Heart, Open Approach      |
| 02HA0RJ | Insertion of Short-term External Heart Assist System into Heart, Intraoperative, Open Approach |
| 02HA0RS | Insertion of Biventricular Short-term External Heart Assist System into Heart, Open Approach |
| Code      | Description                                                                                     |
|-----------|-------------------------------------------------------------------------------------------------|
| 02HA0RZ   | Insertion of Short-term External Heart Assist System into Heart, Open Approach                   |
| 02HA3QZ   | Insertion of Implantable Heart Assist System into Heart, Percutaneous Approach                   |
| 02HA3RJ   | Insertion of Short-term External Heart Assist System into Heart, Intraoperative, Percutaneous Approach |
| 02HA3RS   | Insertion of Biventricular Short-term External Heart Assist System into Heart, Percutaneous Approach |
| 02HA3RZ   | Insertion of Short-term External Heart Assist System into Heart, Percutaneous Approach           |
| 02HA4QZ   | Insertion of Implantable Heart Assist System into Heart, Percutaneous Endoscopic Approach         |
| 02HA4RJ   | Insertion of Short-term External Heart Assist System into Heart, Intraoperative, Percutaneous Endoscopic Approach |
| 02HA4RS   | Insertion of Biventricular Short-term External Heart Assist System into Heart, Percutaneous Endoscopic Approach |
| 02HA4RZ   | Insertion of Short-term External Heart Assist System into Heart, Percutaneous Endoscopic Approach |
| 02WA0QZ   | Revision of Implantable Heart Assist System in Heart, Open Approach                              |
| 02WA0RS   | Revision of Biventricular Short-term External Heart Assist System in Heart, Open Approach         |
| 02WA0RZ   | Revision of Short-term External Heart Assist System in Heart, Open Approach                       |
| 02WA3QZ   | Revision of Implantable Heart Assist System in Heart, Percutaneous Approach                       |
| 02WA3RS   | Revision of Biventricular Short-term External Heart Assist System in Heart, Percutaneous Approach |
| 02WA3RZ   | Revision of Short-term External Heart Assist System in Heart, Percutaneous Approach               |
| 02WA4QZ   | Revision of Implantable Heart Assist System in Heart, Percutaneous Endoscopic Approach            |
| 02WA4RS   | Revision of Biventricular Short-term External Heart Assist System in Heart, Percutaneous Endoscopic Approach |
| 02WA4RZ   | Revision of Short-term External Heart Assist System in Heart, Percutaneous Endoscopic Approach   |
| Code   | Description                                                      |
|--------|------------------------------------------------------------------|
| 5A02210| Assistance with Cardiac Output using Balloon Pump, Continuous    |
| 5A02116| Assistance with Cardiac Output using Other Pump, Intermittent    |
| 5A0211D| Assistance with Cardiac Output using Impeller Pump, Intermittent |
| 5A02110| Assistance with Cardiac Output using Balloon Pump, Intermittent  |
| 5A02216| Assistance with Cardiac Output using Other Pump, Continuous      |
| 5A0221D| Assistance with Cardiac Output using Impeller Pump, Continuous   |