NATIONAL QUALITY FORUM

National Voluntary Consensus Standards for
Pediatric Cardiac Surgery Measures

Measure Number: PCS-008-09

Measure Title: Surgical Volume for Pediatric and Congenital Heart Surgery, Stratified by the Five STS-EACTS Mortality Levels

Description: Surgical volume for pediatric and congenital heart surgery stratified by the five STS-EACTS Mortality Levels, a multi-institutional validated complexity stratification tool

Numerator Statement: Number of pediatric and congenital cardiac surgery operations (types "CPB" and "No-CPB Cardiovascular") in each of the strata of complexity specified by the five STS-EACTS Mortality Levels, a multi-institutional validated complexity stratification tool.

Denominator Statement: N/A

Level of Analysis: Group of clinicians, Facility, Integrated delivery system, Health plan, Community/Population

Data Source: Electronic Health/Medical Record, Electronic Clinical Database (The Society of Thoracic Surgeons Congenital Heart Surgery Database), Electronic Clinical Registry (The Society of Thoracic Surgeons Congenital Health Surgery Database), Paper Medical Record

Measure Developer: The Society of Thoracic Surgeons

Type of Endorsement: Recommended for Time-Limited Endorsement (Steering Committee Vote, Yes-9, No-0, Abstain-0)

Attachments: "STS Attachment: STS Procedure Code Definitions" & "STS Data Collection Tool"

PCS-008-09 Surgical Volume for Pediatric and Congenital Heart Surgery, Stratified by the Five STS-EACTS Mortality Levels (STS) (Society of Thoracic Surgeons)	**Recommendation:** Time-Limited Endorsement Yes-9; No-0; Abstain-0 **Final Measure Evaluation Ratings: I:** Y-9; N-0 **S:** H-6; M-3; L-0 **U:** H-9; M-0; L-0 **F:** H-9; M-0; L-0 **Discussion:** **I:** Overall, the Steering Committee agreed this measure met the importance criteria. The STS-EACTS Mortality Score is a stratified schema based on true data. This score was implemented by several authors based on actual data from the STS database. This measure is used in conjunction with the STS mortality measure stratfied by risk level (PCS-018) **S:** This being risk-stratified basically requires the use of STS codes. **U:** The Steering Committee believes that this is a unique and understandable measure, which adds to its value. It can be useful for comparisons across centers. This is not harmonized to previously NQF-endorsed measure #0339, as this uses a more robust identification of procedures. **F:** The Committee agreed on a high feasibility rating.

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THE NATIONAL QUALITY FORUM

MEASURE SUBMISSION FORM VERSION 3.1
March 2009

The measure information you submit will be shared with NQF's Steering Committees and Technical Advisory Panels to evaluate measures against the NQF criteria of importance to measure and report, scientific acceptability of measure properties, usability, and feasibility. Four conditions (as indicated below) must be met before proposed measures may be considered and evaluated for suitability as voluntary consensus standards. Not all acceptable measures will be strong—or equally strong—among each set of criteria. The assessment of each criterion is a matter of degree; however, all measures must be judged to have met the first criterion, *importance to measure and report*, in order to be evaluated against the remaining criteria. References to the specific measure evaluation criteria are provided in parentheses following the item numbers. Please refer to the *Measure Evaluation Criteria* for more information at *www.qualityforum.org* under Core Documents. Additional guidance is being developed and when available will be posted on the NQF website.

Use the tab or arrow (↓→) keys to move the cursor to the next field (or back ←↑). There are three types of response fields:

- drop-down menus - select one response;
- check boxes – check as many as apply; and
- text fields – you can copy and paste text into these fields or enter text; these fields are not limited in size, but in most cases, we ask that you summarize the requested information.

Please note that URL hyperlinks do not work in the form; you will need to type them into your web browser.

Be sure to answer all questions. Fields that are left blank will be interpreted as no or none. Information must be provided in this form. Attachments are not allowed except to provide additional detail or source documents for information that is summarized in this form. If you have important information that is not addressed by the questions, they can be entered into item #46 near the end of the form.

For questions about this form, please contact the NQF Project Director listed in the corresponding call for measures.

	CONDITIONS FOR CONSIDERATION BY NQF
	Four conditions must be met before proposed measures may be considered and evaluated for suitability as voluntary consensus standards.
A (A)	*Public domain or Measure Steward Agreement signed: Agreement signed and submitted (If no, do not submit)* *Template for the Measure Steward Agreement is available at www.qualityforum.org under Core Documents.*
B (B)	*Measure steward/maintenance: Is there an identified responsible entity and process to maintain and update the measure on a schedule commensurate with clinical innovation, but at least every 3 years?* *Yes, information provided in contact section (If no, do not submit)*
C (C)	*Intended use: Does the intended use of the measure include BOTH public reporting AND quality improvement? Yes (If no, do not submit)*
D (D)	*Fully developed and tested: Is the measure fully developed AND tested?* *No, testing will be completed within 24 months (If not tested and no plans for testing within 24 months, do not submit)*

THE NATIONAL QUALITY FORUM

MEASURE SUBMISSION FORM VERSION 3.1
March 2009

	(for NQF staff use) NQF Review #: PCS-008-09 NQF Project: Pediatric Cardiac Surgery
	MEASURE SPECIFICATIONS & DESCRIPTIVE INFORMATION
1	*Information current as of (date- MM/DD/YY): 7/21/10*
2	*Title of Measure: Surgical Volume for Pediatric and Congenital Heart Surgery, Stratified by the Five STS-EACTS Mortality Levels*
3	**Brief description of measure [1]:** Surgical volume for pediatric and congenital heart surgery stratified by the five STS-EACTS Mortality Levels, a multi-institutional validated complexity stratification tool
4 (2a)	**Numerator Statement:** Number of pediatric and congenital cardiac surgery operations (types "CPB" and "No-CPB Cardiovascular") in each of the strata of complexity specified by the five STS-EACTS Mortality Levels, a multi-institutional validated complexity stratification tool. **Time Window:** One year (12 months) and 4 years (48 months) **Numerator Details** (Definitions, codes with description): There are currently three validated systems of Complexity Stratification in use to categorize operations for pediatric and congenital heart disease on the basis of complexity. Each of these is used in some registry databases, and data is currently stratified using each of the three systems in the most recent outcome reports of the Society of Thoracic Surgery Congenital Heart Surgery database. The three systems are: 1. the RACHS-1 (Risk Adjustment in Congenital Heart Surgery) System with 5 functional levels; 2. The Aristotle Basic Complexity Score with 4 levels; and 3. STS-EACTS Mortality Levels (5 levels). As demonstrated in the following publication **(STS Attachment 1 (of 2) - O'Brien et al, JTCVS, Nov 2009)**, the five STS-EACTS Mortality Levels constitute an objective and empirically based tool for complexity stratification. In addition, it represents an improvement over existing consensus-based tools. O'Brien SM, Clarke DR, Jacobs JP, Jacobs ML, Lacour-Gayet FG, Pizarro C, Welke KF, Maruszewski B, Tobota Z, Miller WJ, Hamilton L, Peterson ED, Mavroudis C, Edwards FH. **An empirically based tool for analyzing mortality associated with congenital heart surgery.** The Journal of Thoracic and Cardiovascular Surgery, 2009 Nov;138(5):1139-53.PMID: 19837218, November 2009. Numerator definition: The number of patients who undergo pediatric and congenital Cardiac Operation - Cardiac operations are defined as operations that are of operation types of "CPB" or "No CPB Cardiovascular". (CPB is cardiopulmonary bypass.) [1]. Numerator definition: The number of index cardiac operations in each level of complexity stratification using the five STS-EACTS Mortality Levels, a multi-institutional validated complexity stratification tool. The following are STS procedure codes for pediatric and congenital cardiac operations per the STS Congenital Heart Surgery Database Version 3.0 Data Specifications. Analysis should include any index operation performed with any of the following component procedures on a patient with pediatric and/or congenital cardiac disease: 10, 20, 30, 40, 2110, 50, 60, 70, 80, 85, 100, 110, 120, 130, 140, 150, 170, 180, 190, 2300, 2250, 2230, 210, 220, 230, 240, 2290, 250, 2220, 260, 270, 2120, 280, 2200, 290, 300, 310, 330, 340, 350, 360, 370, 380, 390, 400, 420, 430, 440, 450, 460, 2280, 465, 470, 480, 490, 500, 510, 520, 530, 540, 550, 570, 590, 2270, 600, 630, 640, 650, 610, 620, 1774, 1772, 580, 660, 2240, 2310, 2320, 670, 680, 690, 700, 715, 720, 730, 735, 740,

[1] Example of measure description: Percentage of adult patients with diabetes aged 18-75 years receiving one or more A1c test(s) per year.

	750, 760, 770, 780, 2100, 790, 800, 810, 820, 830, 2260, 840, 850, 860, 870, 880, 2160, 2170, 2180, 2140, 2150, 890, 900, 910, 920, 930, 940, 950, 960, 970, 980, 1000, 1010, 1025, 1030, 2340, 1035, 1050, 1060, 1070, 1080, 1090, 1110, 1120, 1123, 1125, 1130, 1140, 1145, 1150, 1160, 2190, 2210, 1180, 1200, 1210, 1220, 1230, 1240, 1250, 1260, 1275, 1280, 1285, 1290, 1291, 1300, 1310, 1320, 1330, 1340, 1360, 1365, 1370, 1380, 1390, 1410, 1450, 1460, 2350, 1470, 1480, 1490, 1500, 1590, 1600, 1610, 1630, 2095, 1640, 1650, 1660, 1670, 1680, 1690, 1700, 2330, 2130, 1720, 1730, 1740, 1760, 1780, 1790, 1802, 1804, 1830, 1860 ****Please find data definitions in STS Attachment 2 (of 2) - STS Procedure Code Definitions.** Pediatric heart surgery is heart surgery on patients <18 years of age to treat congenital or acquired cardiac disease. Congenital heart surgery is heart surgery on patients of any age to treat congenital cardiac disease. Our measures apply to both pediatric heart surgery and congenital heart surgery, thus applying to the following operations: 1. heart surgery on patients less than 18 years of age to treat congenital or acquired cardiac disease 2. heart surgery on patients of any age to treat congenital cardiac disease References: 1.Jacobs JP, Mavroudis C, Jacobs ML, Maruszewski B, Tchervenkov CI, Lacour-Gayet FG, Clarke DR, Yeh T, Walters HL 3rd, Kurosawa H, Stellin G, Ebels T, Elliott MJ. What is Operative Mortality? Defining Death in a Surgical Registry Database: A Report from the STS Congenital Database Task Force and the Joint EACTS-STS Congenital Database Committee. The Annals of Thoracic Surgery, 81(5):1937-41, May 2006.
5 (2a) **Time Window:**	**Denominator Statement:** NA **Denominator Details** (Definitions, codes with description):
6 (2a, 2d)	**Denominator Exclusions:** **Measure Exclusions:** Any operation that is not a pediatric or congenital Cardiac Operation. Cardiac operations are defined as operations that are of operation types of “CPB” or “No CPB Cardiovascular” (CPB is cardiopulmonary bypass.) [1]. Any operation that is a pediatric or congenital open heart surgery (operation types of “CPB” or "No CPB Cardiovascular") that cannot be classified into a level of complexity by the five STS-EACTS Mortality Levels. 1.Jacobs JP, Mavroudis C, Jacobs ML, Maruszewski B, Tchervenkov CI, Lacour-Gayet FG, Clarke DR, Yeh T, Walters HL 3rd, Kurosawa H, Stellin G, Ebels T, Elliott MJ. What is Operative Mortality? Defining Death in a Surgical Registry Database: A Report from the STS Congenital Database Task Force and the Joint EACTS-STS Congenital Database Committee. The Annals of Thoracic Surgery, 81(5):1937-41, May 2006. **Denominator Exclusion Details** (Definitions, codes with description):
7 (2a, 2h)	**Stratification** Do the measure specifications require the results to be stratified? Other ► If “other” describe: Stratified by the five STS-EACTS Mortality Levels, a multi-institutional validated complexity stratification tool. Please see information provided in numerator details section above **Identification of stratification variable(s):** **Stratification Details** (Definitions, codes with description):
8 (2a,	**Risk Adjustment** Does the measure require risk adjustment to account for differences in patient severity before the onset of care? No ► **If yes,** (select one) ► Is there a separate proprietary owner of the risk model? (select one)

2e) **Identify Risk Adjustment Variables:**

Detailed risk model: attached ☐ **OR** Web page URL:

9 (2a)

Type of Score: Count **Calculation Algorithm:** attached ☐ **OR** Web page URL:

Interpretation of Score (*Classifies interpretation of score according to whether better quality is associated with a higher score, a lower score, a score falling within a defined interval, or a passing score*)
Better quality = Higher score ► If "Other", please describe: Just monitoring this measure should improve quality.

10 (2a. 4a, 4b)

Identify the required data elements(e.g., primary diagnosis, lab values, vital signs)**:** operation
Data dictionary/code table attached ☐ **OR** Web page URL:
Data Quality (2a) *Check all that apply*
☒ Data are captured from an authoritative/accurate source (e.g., lab values from laboratory personnel)
☒ Data are coded using recognized data standards
☒ Method of capturing data electronically fits the workflow of the authoritative source
☒ Data are available in EHRs
☒ Data are auditable

11 (2a, 4b)

Data Source and Data Collection Methods *Identifies the data source(s) necessary to implement the measure specifications. Check all that apply*

☒ Electronic Health/Medical Record
☒ Electronic Clinical Database, Name: The Society of Thoracic Surgeons Congenital Heart Surgery Database
☒ Electronic Clinical Registry, Name: The Society of Thoracic Surgeons Congenital Heart Surgery Database
☒ Electronic Claims
☐ Electronic Pharmacy data
☐ Electronic Lab data
☐ Electronic source – other, Describe:

☒ Paper Medical Record
☐ Standardized clinical instrument, Name:
☐ Standardized patient survey, Name:
☐ Standardized clinician survey, Name:
☐ Other, Describe:

Instrument/survey attached ☐ **OR** Web page URL:
http://www.sts.org/documents/pdf/ndb/CongenitalData CollectionForm3_0_NonAnnotated_20090916.pdf

12 (2a)

Sampling *If measure is based on a sample, provide instructions and guidance on sample size.*
Minimum sample size:

Instructions:

13 (2a)

Type of Measure: Structure ► If "Other", please describe:

► If part of a composite or paired with another measure, please identify composite or paired measure

14 (2a)

Unit of Measurement/Analysis (*Who or what is being measured*) *Check all that apply.*

☐ Can be measured at all levels
☐ Individual clinician (e.g., physician, nurse)
☒ Group of clinicians (e.g., facility department/unit, group practice)
☒ Facility (e.g., hospital, nursing home)
☒ Integrated delivery system
☒ Health plan
☒ Community/Population
☐ Other (*Please describe*):

15 (2a)

Applicable Care Settings *Check all that apply*

☐ Can be used in all healthcare settings
☐ Ambulatory Care (office/clinic)
☐ Behavioral Healthcare
☐ Community Healthcare
☐ Dialysis Facility
☐ Emergency Department
☐ EMS emergency medical services
☐ Health Plan
☐ Hospice
☒ Hospital
☐ Long term acute care hospital
☐ Nursing home/ Skilled Nursing Facility (SNF)
☐ Prescription Drug Plan
☐ Rehabilitation Facility
☐ Substance Use Treatment Program/Center
☐ Other (*Please describe*):

	☐ Home Health
	IMPORTANCE TO MEASURE AND REPORT
	Note: This is a threshold criterion. If a measure is not judged to be sufficiently important to measure and report, it will not be evaluated against the remaining criteria.
16 (1a)	**Is measure related to a National Priority Partners priority area?** Safety reliability (for NQF staff use) **Does measure address a specific NPP goal?** (www.qualityforum.org/about/NPP/): Safety
17 (1a)	**Does the measure address a high impact aspect of healthcare** high resource use **Summary of Evidence:** Congenital heart disease is a common birth defect that affects approximately 1 in 125 live births [1]. Pediatric and Congenital Heart Surgery is a subspecialty of high resource utilization that has the potential to repair or palliate the majority of patients with pediatric and congenital cardiac disease. **Citations[2] for Evidence:** 1. Tchervenkov CI, Jacobs JP, Bernier P-L, Stellin G, Kurosawa H, Mavroudis C, Jonas RA, Cicek SM, Al-Halees Z, J. Elliott MJ, Jatene MB, Kinsley RH, Kreutzer C, Leon-Wyss J, Liu J, Maruszewski B, Nunn GR, Ramirez-Marroquin S, Sandoval N, Sano S, Sarris GE, Sharma R, Shoeb A, Spray TL, Ungerleider RM, Yangni-Angate H, Ziemer G. The improvement of care for paediatric and congenital cardiac disease across the World: a challenge for the World Society for Pediatric and Congenital Heart Surgery. In: 2008 Supplement to Cardiology in the Young: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 63–69, December 9, 2008.
18 (1b)	**Opportunity for Improvement** *Provide evidence that demonstrates considerable variation, or overall poor performance, across providers.* **Summary of Evidence:** The incidence of mortality stratified by complexity varies between centers, as demonstrated in the STS Congenital Heart Surgery Database. **Citations for Evidence:** Jacobs JP, Jacobs ML, Mavroudis C, Lacour-Gayet FG, Tchervenkov CI. Executive Summary: The Society of Thoracic Surgeons Congenital Heart Surgery Database - Tenth Harvest – (January 1, 2005 – December 31, 2008). The Society of Thoracic Surgeons (STS) and Duke Clinical Research Institute (DCRI), Duke University Medical Center, Durham, North Carolina, United States, Spring 2009 Harvest.
19 (1b)	**Disparities** *Provide evidence that demonstrates disparity in care/outcomes related to the measure focus among populations.* **Summary of Evidence:** No formal testing of disparities has been done. Disparities and trends could be tested for many of these metrics using the STS Database. The incidence of mortality stratified by complexity varies between centers, as demonstrated in the STS Congenital Heart Surgery Database **Citations for evidence:** Jacobs JP, Jacobs ML, Mavroudis C, Lacour-Gayet FG, Tchervenkov CI. Executive Summary: The Society of Thoracic Surgeons Congenital Heart Surgery Database - Tenth Harvest – (January 1, 2005 – December 31, 2008). The Society of Thoracic Surgeons (STS) and Duke Clinical Research Institute (DCRI), Duke University Medical Center, Durham, North Carolina, United States, Spring 2009 Harvest.
20 (1c)	**If measuring an Outcome** Describe relevance to the national health goal/priority, condition, population, and/or care being addressed: **If not measuring an outcome, provide evidence supporting this measure topic and grade the strength of the evidence** *Summarize the evidence (including citations to source) supporting the focus of the measure as follows:* • Intermediate outcome – evidence that the measured intermediate outcome (e.g., blood pressure, Hba1c) leads to improved health/avoidance of harm or cost/benefit. • Process – evidence that the measured clinical or administrative process leads to improved

[2] Citations can include, but are not limited to journal articles, reports, web pages (URLs).

health/avoidance of harm and
if the measure focus is on one step in a multi-step care process, it measures the step that has the greatest effect on improving the specified desired outcome(s).

- Structure – evidence that the measured structure supports the consistent delivery of effective processes or access that lead to improved health/avoidance of harm or cost/benefit.
- Patient experience – evidence that an association exists between the measure of patient experience of health care and the outcomes, values and preferences of individuals/ the public.
- Access – evidence that an association exists between access to a health service and the outcomes of, or experience with, care.
- Efficiency– demonstration of an association between the measured resource use and level of performance with respect to one or more of the other five IOM aims of quality.

Type of Evidence *Check all that apply*

☐ Evidence-based guideline
☐ Meta-analysis
☒ Systematic synthesis of research
☒ Quantitative research studies
☐ Qualitative research studies
☐ Other (*Please describe*):

Overall Grade for Strength of the Evidence[3] (*Use the USPSTF system, or if different, also describe how it relates to the USPSTF system)*:

Summary of Evidence (*provide guideline information below*): The relationship between the volume of pediatric and congenital cardiac surgery performed at a center and quality of care is unclear and controversial at best [1, 2, 3, 4, 5, 6, 7]. Nevertheless, in order to track a variety of outcomes represented in other proposed Quality Indicators, one must have a firm grasp on the volume of pediatric and congenital cardiac surgery performed at a center over both 1 year and 4 year time intervals. The very act of tracking this structure measure is necessary in order to track other outcome measures that use this structure measure as a denominator. Furthermore, the very act of tracking this structure measure can, in and of itself, lead to improvements in quality.

Furthermore, volume should be stratified by complexity [8, 9, 10, 11, 13]. The selection of the proper tool for complexity stratification tool can be controversial. Suitable multi-institutional validated complexity stratification tools include the 5 functional RACHS-1 classifications, the 4 Aristotle Basic Complexity Score Levels, and the five STS-EACTS Mortality Levels. When comparing RACHS-1 and Aristotle, the Aristotle methodology allows classification of more operations while the RACHS-1 system discriminates better at the higher end of complexity [15].

The discrimination of any complexity stratification tool as a predictor of mortality can be quantified by calculating the c statistic, which is equivalent to the area under the receiver operating characteristic curve, as determined by univariable logistic regression [14]. The c statistic represents the probability that a randomly selected patient who had the outcome of interest (i.e. discharge mortality) had a higher predicted risk of the outcome compared to a randomly selected patient who did not experience the outcome. The c statistic generally ranges from 0.5 to 1.0 with 0.5 representing no discrimination (i.e. a coin flip) and 1.0 representing perfect discrimination.The model for risk-adjustment in the STS Adult Cardiac Surgery Database for predicting 30-day mortality after surgery to place coronary arterial bypass grafts, contains 28 clinical variables and has a C-statistic of 0.78 [14].

The Table below documents the c-statistic for the previously mentioned complexity stratification tools [13].

[3]The strength of the body of evidence for the specific measure focus should be systematically assessed and rated, e.g., USPSTF grading system www.ahrq.gov/clinic/uspstmeth.htm: A - The USPSTF recommends the service. There is high certainty that the net benefit is substantial. B - The USPSTF recommends the service. There is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial. C - The USPSTF recommends against routinely providing the service. There may be considerations that support providing the service in an individual patient. There is at least moderate certainty that the net benefit is small. Offer or provide this service only if other considerations support the offering or providing the service in an individual patient. D - The USPSTF recommends against the service. There is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits. I - The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of the service. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.

Method of Modeling Procedures	Model without patient covariates	Model with patient covariates
STS-EACTS Congenital Heart Surgery Mortality Categories (2009)	**C = 0.778**	**C = 0.812**
RACHS-1 Categories	**C = 0.745**	**C = 0.802**
Aristotle Basic Complexity Score	**C = 0.687**	**C = 0.795**

****STS recommends that only the STS-EACTS Congenital Heart Surgery Mortality Categories (2009) are used for complexity stratification of volume. The rationale for this is two-fold:**

1. **The C-statistic for the STS-EACTS Congenital Heart Surgery Mortality Categories (2009) is higher than those of the RACHS-1 Categories and the Aristotle Basic Complexity Score.**
2. **The publications provided below document that 84% of pediatric and congenital cardiac operations can be assessed by the RACHS-1 Categories, 96% by the Aristotle Basic Complexity Score, and 99% by the STS-EACTS Congenital Heart Surgery Mortality Categories (2009) [11,13,14].**

Please note that the following publication is provided as STS Attachment 1 (of 2) - O'Brien et al, JTCVS, Nov 2009:

O'Brien SM, Clarke DR, Jacobs JP, Jacobs ML, Lacour-Gayet FG, Pizarro C, Welke KF, Maruszewski B, Tobota Z, Miller WJ, Hamilton L, Peterson ED, Mavroudis C, Edwards FH. **An empirically based tool for analyzing mortality associated with congenital heart surgery.** The Journal of Thoracic and Cardiovascular Surgery, 2009 Nov;138(5):1139-53.PMID: 19837218, November 2009.

Citations for Evidence:

1. Welke KF, O'Brien SM, Peterson ED, Ungerleider RM, Jacobs ML, Jacobs JP. The Complex Relationship between Pediatric Cardiac Surgical Case Volumes and Mortality Rates in a National Clinical Database. The Journal of Thoracic and Cardiovascular Surgery,. 2009 May;137(5):1133-40. Epub 2009 Mar 17, PMID: 19379979, May, 2009.

2. Bradley SM. Good Things in Small Packages: Meeting Challenge in the Low-volume Program. Jacobs JP, Wernovsky G, Cooper DS, Gaynor JW, Anderson RH (editors). 2009 Supplement to Cardiology in the Young: Annual Heart Week in Florida Supplement Number 7 - Innovation Associated With The Treatment Of Patients With Congenital and Pediatric Cardiac Disease, Cardiology in the Young, Volume 19, accepted for publication, in press.

3. Jenkins KJ, Newburger JW, Lock JE, et al. In-hospital mortality for surgical repair of congenital heart defects: preliminary observations of variation by hospital caseload. Pediatrics. 1995;95:323-30.

4. Hannan EL, Racz M, Kavey RE, Quagebeur JM, Williams R. Pediatric cardiac surgery: the effect of hospital and surgeon volume on in-hospital mortality. Pediatrics. 1998;101:963-9.

5. Sollano JA, Gelijns AC, Moskowitz AJ, et al. Volume-outcome relationships in cardiovascular operations: New York State, 1990-1995. J Thorac Cardiovasc Surg. 1999;117:419-28.

6. Chang RK, Klitzner TS. Can regionalization decrease the number of deaths for children who undergo cardiac surgery? A theoretical analysis. Pediatrics. 2002; 109:173-81.

7. Quintessenza JA, Jacobs JP, Morell VO. Issues in Regionalization of Pediatric Cardiovascular Care. Progress in Pediatric Cardiology 18 (2003) 49–53. Elsevier Science Ireland Ltd. 2003.

8. Jacobs JP, Lacour-Gayet FG, Jacobs ML, Clarke DR, Tchervenkov CI, Gaynor JW, Spray TL, Maruszewski B, Stellin G, Gould J, Dokholyan RS, Peterson ED, Elliott MJ, Mavroudis C. Initial application in the STS congenital database of complexity adjustment to evaluate surgical case mix and results. Ann Thorac Surg.

2005 May;79(5):1635-49.

9. Jacobs JP, Jacobs ML, Maruszewski B, Lacour-Gayet FG, Clarke DR, Tchervenkov CI, Gaynor JW, Spray TL, Stellin G, Elliott MJ, Ebels T, Mavroudis C. Current status of the European Association for Cardio-Thoracic Surgery and the Society of Thoracic Surgeons Congenital Heart Surgery Database. Ann Thorac Surg 80(6):2278-83, 2005.

10. Lacour-Gayet F., Jacobs J.P., Clarke D.R., Maruszewski B., Jacobs M.L., O'Brien S.M., Mavroudis C. Evaluation of the quality of care in congenital heart surgery: contribution of the Aristotle complexity score. Adv Pediatr. 2007;54:67-83.

11. O'Brien S.M., Jacobs J.P., Clarke D.R., Maruszewski B., Jacobs M.L., Walters H.L., Tchervenkov C.I., Welke K.F., Tobota Z., Stellin G., Mavroudis C., Hamilton J.R., Gaynor J.W., Pozzi M., Lacour-Gayet F.G. Accuracy of the Aristotle basic complexity score for classifying the mortality potential of congenital heart surgery operations. Ann Thorac Surg. 2007 Dec;84(6):2027-37.

12. Jacobs ML, Jacobs JP. Jenkins KJ, Gauvreau K, Clarke DR, Lacour-Gayet F. Stratification of complexity: The Risk Adjustment for Congenital Heart Surgery-1Method and The Aristotle Complexity Score – past, present, and future. Cardiol Young. 2008 Dec;18 Suppl 2:163-8.

13. O'Brien SM, Clarke DR, Jacobs JP, Jacobs ML, Lacour-Gayet FG, Pizarro C, Welke KF, Maruszewski B, Tobota Z, Miller WJ, Hamilton L, Peterson ED, Mavroudis C, Edwards FH. **An empirically based tool for analyzing mortality associated with congenital heart surgery.** The Journal of Thoracic and Cardiovascular Surgery, 2009 Nov;138(5):1139-53.PMID: 19837218, November 2009.

14. Jacobs JP, Jacobs ML, Lacour-Gayet FG, Jenkins KJ, Gauvreau K, Bacha EA, Maruszewski B, Clarke DR, Tchervenkov CI, Gaynor JW, Spray, TL, Stellin G, O'Brien SM, Elliott MJ, Mavroudis C. Stratification of Complexity Improves Utility and Accuracy of Outcomes Analysis in a Multi-institutional Congenital Heart Surgery Database – Application of the RACHS-1 and Aristotle Systems in the STS Congenital Heart Surgery Database. Pediatric Cardiology, accepted for publication, in press.

21 (1c)

Clinical Practice Guideline *Cite the guideline reference; quote the specific guideline recommendation related to the measure and the guideline author's assessment of the strength of the evidence; and summarize the rationale for using this guideline over others.*

Guideline Citation: At the current time no uniform practice guidelines are in place for pediatric and congenital cardiac surgery. Clinical care rationale mainly depends on the consensus of a panel of experts in the field. In lieu of guideline support for the measures, published consensus opinion and supporting clinical data from the STS Congenital Heart Surgery Database will be used.

Specific guideline recommendation:

Guideline author's rating of strength of evidence (*If different from USPSTF, also describe it and how it relates to USPSTF*)**:**

Rationale for using this guideline over others:

22 (1c)

Controversy/Contradictory Evidence *Summarize any areas of controversy, contradictory evidence, or contradictory guidelines and provide citations.*

Summary:

The selection of the proper tool for complexity stratification tool can be controversial. Suitable multi-institutional validated complexity stratification tools include the five functional RACHS-1 classifications, the four Aristotle Basic Complexity Score Levels, and the five STS-EACTS Mortality Levels [1, 2, 3, 4, 5]. When comparing RACHS-1 and Aristotle, the Aristotle methodology allows classification of more operations while the RACHS-1 system discriminates better at the higher end of complexity [5].

The discrimination of any complexity stratification tool as a predictor of mortality can be quantified by calculating the c statistic, as described in the previous section. The c-statistic represents the probability that a randomly selected patient who had the outcome of interest (i.e. discharge mortality) had a higher

predicted risk of the outcome compared to a randomly selected patient who did not experience the outcome. The c-statistic generally ranges from 0.5 to 1.0 with 0.5 representing no discrimination (i.e. a coin flip) and 1.0 representing perfect discrimination. The model for risk-adjustment in the STS Adult Cardiac Surgery Database for predicting 30-day mortality after surgery to place coronary arterial bypass grafts, contains 28 clinical variables and has a C-statistic of 0.78 [5].

Table 1 displays c-statistics for the previously mentioned complexity stratification tools [4]:

Table 1: Method of Modeling Procedures	Model without patient covariates	Model with patient covariates
STS-EACTS Congenital Heart Surgery Mortality Categories (2009)	**C = 0.778**	**C = 0.812**
RACHS-1 Categories	**C = 0.745**	**C = 0.802**
Aristotle Basic Complexity Score	**C = 0.687**	**C = 0.795**

****STS recommends that only the STS-EACTS Congenital Heart Surgery Mortality Categories (2009) are used for complexity stratification of volume. The rationale for this was provided in a previous section.**

Citations:

1. Jacobs ML, Jacobs JP, Jenkins KJ, Gauvreau K, Clarke DR, Lacour-Gayet FL. Stratification of complexity: The Risk Adjustment for Congenital Heart Surgery-1 Method and The Aristotle Complexity Score – past, present, and future. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 163–168, December 9, 2008.

2. Clarke DR, Lacour-Gayet F, Jacobs JP, Jacobs ML, Maruszewski B, Pizarro C, Edwards FH, Mavroudis C. The assessment of complexity in congenital cardiac surgery based on objective data. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 169–176, December 9, 2008.

3. O'Brien SM, Jacobs JP, Clarke DR, Maruszewski B, Jacobs ML, Walters HL 3rd, Tchervenkov CI, Welke KF, Tobota Z, Stellin G, Mavroudis C, Hamilton JR, Gaynor JW, Pozzi M, Lacour-Gayet FG. Accuracy of the Aristotle Basic Complexity Score for classifying the mortality and morbidity potential of congenital heart surgery operations. The Annals of Thoracic Surgery, 84(6):2027-37, PMID: 18036930, December 2007.

4. O'Brien SM, Clarke DR, Jacobs JP, Jacobs ML, Lacour-Gayet FG, Pizarro C, Welke KF, Maruszewski B, Tobota Z, Miller WJ, Hamilton L, Peterson ED, Mavroudis C, Edwards FH. **An empirically based tool for analyzing mortality associated with congenital heart surgery.** The Journal of Thoracic and Cardiovascular Surgery, 2009 Nov;138(5):1139-53.PMID: 19837218, November 2009

5. Jacobs JP, Jacobs ML, Lacour-Gayet FG, Jenkins KJ, Gauvreau K, Bacha EA, Maruszewski B, Clarke DR, Tchervenkov CI, Gaynor JW, Spray, TL, Stellin G, O'Brien SM, Elliott MJ, Mavroudis C. Stratification of Complexity Improves Utility and Accuracy of Outcomes Analysis in a Multi-institutional Congenital Heart Surgery Database – Application of the RACHS-1 and Aristotle Systems in the STS Congenital Heart Surgery Database. Pediatric Cardiology, accepted for publication, in press.

23 (1) **Briefly describe how this measure (as specified) will facilitate significant gains in healthcare quality related to the specific priority goals and quality problems identified above:** Over the past decade, mortality after pediatric cardiac surgery has been declining and currently stands at 4%. Nevertheless, operative mortality remains a significant indicator of programmatic quality. Because case mix varies between programs, operative mortality must be stratified by case mix [1, 2, 3, 4, 5]. In addition, in order to

track a variety of outcomes represented in other proposed Quality Indicators, one must have a firm grasp on the volume of pediatric and congenital cardiac surgery performed at a center over both 1 year and 4 year time intervals, stratified by complexity, as required by this measure (Surgical Volume for Pediatric and Congenital Heart Surgery, Stratified by the five STS-EACTS Mortality Levels)

Tracking this structure measure is necessary in order to track other outcome measures that use this structure measure as a denominator. Furthermore, very act of tracking this structure measure should in and of itself lead to improvements in quality.

References:

1. Jacobs ML, Jacobs JP, Jenkins KJ, Gauvreau K, Clarke DR, Lacour-Gayet FL. Stratification of complexity: The Risk Adjustment for Congenital Heart Surgery-1 Method and The Aristotle Complexity Score – past, present, and future. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 163–168, December 9, 2008.

2. Clarke DR, Lacour-Gayet F, Jacobs JP, Jacobs ML, Maruszewski B, Pizarro C, Edwards FH, Mavroudis C. The assessment of complexity in congenital cardiac surgery based on objective data. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 169–176, December 9, 2008.

3. O'Brien SM, Jacobs JP, Clarke DR, Maruszewski B, Jacobs ML, Walters HL 3rd, Tchervenkov CI, Welke KF, Tobota Z, Stellin G, Mavroudis C, Hamilton JR, Gaynor JW, Pozzi M, Lacour-Gayet FG. Accuracy of the Aristotle Basic Complexity Score for classifying the mortality and morbidity potential of congenital heart surgery operations. The Annals of Thoracic Surgery, 84(6):2027-37, PMID: 18036930, December 2007.

4. O'Brien SM, Clarke DR, Jacobs JP, Jacobs ML, Lacour-Gayet FG, Pizarro C, Welke KF, Maruszewski B, Tobota Z, Miller WJ, Hamilton L, Peterson ED, Mavroudis C, Edwards FH. An empirically based tool for analyzing mortality associated with congenital heart surgery. The Journal of Thoracic and Cardiovascular Surgery, 2009 Nov;138(5):1139-53.PMID: 19837218, November 2009.

5. Jacobs JP, Jacobs ML, Lacour-Gayet FG, Jenkins KJ, Gauvreau K, Bacha EA, Maruszewski B, Clarke DR, Tchervenkov CI, Gaynor JW, Spray, TL, Stellin G, O'Brien SM, Elliott MJ, Mavroudis C. Stratification of Complexity Improves Utility and Accuracy of Outcomes Analysis in a Multi-institutional Congenital Heart Surgery Database – Application of the RACHS-1 and Aristotle Systems in the STS Congenital Heart Surgery Database. Pediatric Cardiology, accepted for publication, in press.

SCIENTIFIC ACCEPTABILITY OF MEASURE PROPERTIES

Note: Testing and results should be summarized in this form. However, additional detail and reports may be submitted as supplemental information or provided as a web page URL. If a measure has not been tested, it is only potentially eligible for time-limited endorsement.

24 **Supplemental Testing Information:** attached ☐ **OR** Web page URL:

25 **Reliability Testing**

(2b) **Data/sample:**

"Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials. Without the agreement of independent observers able to replicate research procedures, or the ability to use research tools and procedures that yield consistent measurements, researchers would be unable to satisfactorily draw conclusions, formulate theories, or make claims about the generalizability of their research."
[http://writing.colostate.edu/guides/research/relval/]

	The reliability of the STS-EACTS Congenital Heart Surgery Mortality Categories (2009) is documented in detail in the following manuscript: O'Brien SM, Clarke DR, Jacobs JP, Jacobs ML, Lacour-Gayet FG, Pizarro C, Welke KF, Maruszewski B, Tobota Z, Miller WJ, Hamilton L, Peterson ED, Mavroudis C, Edwards FH. An empirically based tool for analyzing mortality associated with congenital heart surgery. The Journal of Thoracic and Cardiovascular Surgery, 2009 Nov;138(5):1139-53.PMID: 19837218, November 2009. **Accuracy and Completeness of the STS Congenital Heart Surgery Database data** The audit process assures the accuracy and completeness of the STS Congenital data through a combination of two strategies: 1. Intrinsic data verification – designed to rectify inconsistencies of data and missing elements of data) 2. Site visits with "Source Data Verification" – in other words, verification of the data at the primary source of the data This process of verification of data has demonstrated that the STS Congenital Heart Surgery Database is very complete and accurate, as documented in the STS Congenital Heart Surgery Database Report Overview, as well as in the following peer-reviewed publication: Clarke DR, Breen LS, Jacobs ML, Franklin RCG, Tobota Z, Maruszewski B, Jacobs JP. **Verification of data in congenital cardiac surgery**. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 177–187, December 9, 2008. **Analytic Method:** **Testing Results:**
26 (2c)	**Validity Testing** **Data/sample:** "Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. While reliability is concerned with the accuracy of the actual measuring instrument or procedure, validity is concerned with the study's success at measuring what the researchers set out to measure. Researchers should be concerned with both external and internal validity. External validity refers to the extent to which the results of a study are generalizable or transferable. Internal validity refers to (1) the rigor with which the study was conducted (e.g., the study's design, the care taken to conduct measurements, and decisions concerning what was and wasn't measured) and (2) the extent to which the designers of a study have taken into account alternative explanations for any causal relationships they explore (Huitt, 1998). In studies that do not explore causal relationships, only the first of these definitions should be considered when assessing internal validity. Scholars discuss several types of internal validity: • Face Validity • Criterion Related Validity • Construct Validity • Content Validity" [http://writing.colostate.edu/guides/research/relval/]

This measure has been developed by a multi-institutional, multi-subspecialty panels of experts made up of international leaders in the medical and surgical care of patients with pediatric and congenital heart disease. This process is described in detail in the following publications:

1. Jacobs JP. (Editor). 2008 Supplement to Cardiology in the Young: **Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease**, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Cardiology in the Young, Volume 18, Supplement S2, pages 1 –530, December 9, 2008.

2. Jacobs JP. **Introduction – Databases and the assessment of complications associated with the treatment of patients with congenital cardiac disease**. In: 2008 Supplement to Cardiology in the Young: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 1-37, December 9, 2008.

3. Jacobs JP, Jacobs ML, Mavroudis C, Backer CL, Lacour-Gayet FG, Tchervenkov CI, Franklin RCG, Béland MJ, Jenkins KJ, Walters III H, Bacha EA, Maruszewski B, Kurosawa H, Clarke DR, Gaynor JW, Spray TL, Stellin G, Ebels T, Krogmann ON, Aiello VD, Colan SD, Weinberg P, Giroud JM, Everett A, Wernovsky G, Martin J. Elliott MJ, Edwards FH. **Nomenclature and databases for the surgical treatment of congenital cardiac disease – an updated primer and an analysis of opportunities for improvement**. In: 2008 Supplement to Cardiology in the Young: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 38–62, December 9, 2008.

Mortality and morbidity related to pediatric and congenital heart surgery are defined in detail in the following publications:

1. Jacobs JP, Mavroudis C, Jacobs ML, Maruszewski B, Tchervenkov CI, Lacour-Gayet FG, Clarke DR, Yeh T, Walters HL 3rd, Kurosawa H, Stellin G, Ebels T, Elliott MJ. **What is Operative Mortality? Defining Death in a Surgical Registry Database: A Report from the STS Congenital Database Task Force and the Joint EACTS-STS Congenital Database Committee**. The Annals of Thoracic Surgery, 81(5):1937-41, May 2006.

2. Jacobs JP, Jacobs ML, Mavroudis C, Maruszewski B, Tchervenkov CI, Lacour-Gayet FG, Clarke DR, Yeh T, Walters HL 3rd, Kurosawa H, Stellin G, Ebels T, Elliott MJ, Vener DF, Barach P, Benavidez OJ, Bacha EA.. **What is Operative Morbidity? Defining Complications in a Surgical Registry Database: A Report from the STS Congenital Database Task Force and the Joint EACTS-STS Congenital Database Committee**. The Annals of Thoracic Surgery; 84:1416-1421, October 2007.

Due to the process used to develop these measures, we believe they have exceptional face validity**.** These metrics have external validity because they are clearly generalizable or transferable, as documented in the publications mentioned above. When used in the STS Congenital Heart Surgery Database, these metrics have internal validity due to (1) the rigor of the analyses conducted and (2) the extent to which the STS Congenital Heart Surgery Database Task Force has recognized and considered alternative explanations for any causal relationships reported, as documented in the STS Congenital Heart Surgery Database Feedback Report and Report Overview, which has been sent to the National Quality Forum in a separate e-mail. Finally, as these outcome metrics encompass a broad and comprehensive range of outcomes that are all directly related to pediatric cardiac surgery performance, we believe they have strong content and construct validity.

As stated above, extensive testing has also been performed within the STS Congenital Heart Surgery Database that confirms the validity and reliability of the three multi-institutional validated complexity stratification tools (the five functional RACHS-1 classifications, the four Aristotle Basic Complexity Score Levels, or the five STS-EACTS Congenital Heart Surgery Mortality Categories [2009]). This testing is summarized in the following manuscripts:

1. O'Brien SM, Jacobs JP, Clarke DR, Maruszewski B, Jacobs ML, Walters HL 3rd, Tchervenkov CI, Welke KF, Tobota Z, Stellin G, Mavroudis C, Hamilton JR, Gaynor JW, Pozzi M, Lacour-Gayet FG. **Accuracy of the**

Aristotle Basic Complexity Score for classifying the mortality and morbidity potential of congenital heart surgery operations. The Annals of Thoracic Surgery, 84(6):2027-37, PMID: 18036930, December 2007.

2. Jacobs JP, Jacobs ML, Lacour-Gayet FG, Jenkins KJ, Gauvreau K, Bacha E, Maruszewski B, Clarke DR, Tchervenkov CI, Gaynor JW, Spray TL, Stellin G, O'Brien SM, Elliott MJ, Mavroudis C. **Stratification of complexity improves the utility and accuracy of outcomes analysis in a Multi-Institutional Congenital Heart Surgery Database: Application of the Risk Adjustment in Congenital Heart Surgery (RACHS-1) and Aristotle Systems in the Society of Thoracic Surgeons (STS) Congenital Heart Surgery Database**. Pediatric Cardiology, 2009, DOI 10.1007/s00246-009-9496-0.

3. O'Brien SM, Clarke DR, Jacobs JP, Jacobs ML, Lacour-Gayet FG, Pizarro C, Welke KF, Maruszewski B, Tobota Z, Miller WJ, Hamilton L, Peterson ED, Mavroudis C, Edwards FH. **An empirically based tool for analyzing mortality associated with congenital heart surgery**. The Journal of Thoracic and Cardiovascular Surgery, 2009 Nov;138(5):1139-53.PMID: 19837218, November 2009.

The third manuscript in the list above describes the development of the "STS–EACTS Congenital Heart Surgery Mortality Categories (2009)" using data from 77,294 operations entered into the European Association for Cardiothoracic Surgery (EACTS) Congenital Heart Surgery Database (33,360 operations) and the STS Congenital Heart Surgery Database (43,934 patients) between 2002 and 2007. This manuscript clearly states that: "Model performance was subsequently assessed in an independent validation sample (n = 27,700) and compared with 2 existing methods: Risk Adjustment for Congenital Heart Surgery (RACHS-1) categories and Aristotle Basis Complexity scores." **This peer-reviewed and published validity testing using "an independent validation sample (n = 27,700 operations)" generated the c-statistics shown in Table 1 below and should satisfy the requirements for validity and reliability testing for our outcome metrics. The technical details of this validity and reliability testing is described in reference number 3 above. This publication is also provided as STS Attachment 1 (of 2) - O'Brien et al, JTCVS, Nov 2009.**

Table 1: Method of Modeling Procedures	Model without patient covariates	Model with patient covariates
STS-EACTS Congenital Heart Surgery Mortality Categories (2009)	**C = 0.778**	**C = 0.812**
RACHS-1 Categories	**C = 0.745**	**C = 0.802**
Aristotle Basic Complexity Score	**C = 0.687**	**C = 0.795**

Analytic Method:

Testing Results:

27 (2d)

Measure Exclusions *Provide evidence to justify exclusion(s) and analysis of impact on measure results during testing.*

Summary of Evidence supporting exclusion(s): We will exclude any operation that is not a pediatric or congenital Cardiac Operation. Cardiac operations are defined as operations that are of operation types of "CPB" or "No CPB Cardiovascular" (CPB is cardiopulmonary bypass.) [1]. In addition, We will exclude any operation that is a pediatric or congenital open heart surgery (operation types of "CPB" or "No CPB Cardiovascular") that cannot be classified into a level of complexity by the five STS-EACTS Mortality Levels.

This measure is designed to track surgical volume stratified by the five STS-EACTS Mortality Levels, which is a multi-institutional validated complexity stratification tool. Published methodology is available that describes the proper techniques for gathering this information based on the consensus of a panel of experts.

Furthermore, it is important to understand that the Society of Thoracic Surgeons advocates utilization of a systematic multi-institutional clinical database (registry) for the analysis of cardiac surgical outcomes and the assessment of quality. Evidence from three recent investigations suggests that the validity of coding of

	lesions seen in the congenitally malformed heart via the International Classification of Diseases as used in Administrative Databases is likely to be poor[2, 3, 4]. First, in a series of 373 infants with congenital cardiac defects at Children's Hospital of Wisconsin, investigators report that only 52% of the cardiac diagnoses in the medical records had a corresponding code from the International Classification of Diseases in the hospital discharge database [2]. Second, the Hennepin County Medical Center discharge database in Minnesota identified all infants born during 2001 with a code for congenital cardiac disease using the International Classification of Diseases. A review of these 66 medical records by physicians was able to confirm only 41% of the codes contained in the administrative database from the International Classification of Diseases [3]. Third, the Metropolitan Atlanta Congenital Defect Program of the Birth Defect Branch of the Centers for Disease Control and Prevention of the federal government of the United States of America carried out surveillance of infants and fetuses with cardiac defects delivered to mothers residing in Atlanta during the years 1988 through 2003 [4]. These records were reviewed and classified using both administrative coding and the clinical nomenclature used in the Society of Thoracic Surgeons Congenital Heart Surgery Database. This study concluded that analyses based on the codes available in the International Classification of Diseases are likely to "have substantial misclassification" of congenital cardiac disease. Several potential reasons can explain the poor diagnostic accuracy of Administrative Databases and codes from the International Classification of Diseases: 1) accidental miscoding 2) coding performed by medical records clerks who have never seen the actual patient 3) contradictory or poorly described information in the medical record 4) lack of diagnostic specificity for congenital cardiac disease in the codes of the of International Classification of Diseases 5) inadequately trained medical coders **Citations for Evidence:** 1. Jacobs JP, Mavroudis C, Jacobs ML, Maruszewski B, Tchervenkov CI, Lacour-Gayet FG, Clarke DR, Yeh T, Walters HL 3rd, Kurosawa H, Stellin G, Ebels T, Elliott MJ. What is Operative Mortality? Defining Death in a Surgical Registry Database: A Report from the STS Congenital Database Task Force and the Joint EACTS-STS Congenital Database Committee. The Annals of Thoracic Surgery, 81(5):1937-41, May 2006. 2. Cronk CE, Malloy ME, Pelech AN, et al. Completeness of state administrative databases for surveillance of congenital heart disease. Birth Defects Res A Clin Mol Teratol 2003; 67: 597-603. 3. Frohnert BK, Lussky RC, Alms MA, Mendelsohn NJ, Symonik DM, Falken MC. Validity of hospital discharge data for identifying infants with cardiac defects. J Perinatol 2005; 25: 737-742. 4. Strickland MJ, Riehle-Colarusso TJ, Jacobs JP, Reller MD, Mahle WT, Botto LD, Tolbert PE, Jacobs ML, Lacour-Gayet FG, Tchervenkov CI, Mavroudis C, Correa A. The importance of nomenclature for congenital cardiac disease: implications for research and evaluation. In: 2008 Supplement to Cardiology in the Young: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young, Volume 18, Issue S2 (Suppl. 2), pp 92–100, December 9, 2008. **Data/sample:** **Analytic Method:** **Testing Results:**
28 (2e) 	**Risk Adjustment Testing** *Summarize the testing used to determine the need (or no need) for risk adjustment and the statistical performance of the risk adjustment method.* **Data/sample:** None **Analytic Method:** **Testing Results:**

	►**If outcome or resource use measure not risk adjusted, provide rationale:**
29 (2g)	**Testing comparability of results when more than 1 data method is specified** (*e.g., administrative claims or chart abstraction*) **Data/sample:** Clinical data abstraction is the only method utilized **Analytic Method:** **Results:**
30 (2f)	**Provide Measure Results from Testing or Current Use** (select one) **Data/sample:** The STS Congenital Heart Surgery Database **Methods to identify statistically significant and practically/meaningfully differences in performance:** Outliers can be identified with 95% confidence intervals based on the sample size, with complexity stratification for one and four-year time intervals. **Results:** Currently being collected in the STS Congenital Heart Surgery Database. Data will be provided within 24 months after endorsement is received. We know that 82 out of 122 pediatric heart surgery centers in the USA participate in the STS Congenital Heart Surgery Database.
31 (2h)	**Identification of Disparities** ►If measure is stratified by factors related to disparities (i.e. race/ethnicity, primary language, gender, SES, health literacy), **provide stratified results:** NA ►If disparities have been reported/identified, but measure is not specified to detect disparities, provide rationale:
	USABILITY
32 (3)	*Current Use In use If in use, how widely used Nationally ► If "other," please describe: The STS Congenital Heart Surgery Database* ☐ *Used in a public reporting initiative, name of initiative:* *Sample report attached* ☐ *OR Web page URL:*
33 (3a)	**Testing of Interpretability** (*Testing that demonstrates the results are understood by the potential users for public reporting and quality improvement*) **Data/sample:** Post-operative mortality and morbidity data are currently being collected voluntarily by The Society of Thoracic Surgeons Congenital Cardiac Surgery Database. All of the outcome metrics are used by clinicians as performance feedback and are tracked in the STS Database. No focused consumer testing has been done to date on any of these metrics. No public reporting has been done on any of these metrics to date. Pediatric and congenital heart surgery is very different from adult heart surgery; separate metrics are necessary. **Methods:** **Results:**
34 (3b, 3c)	**Relation to other NQF-endorsed™ measures** ►Is this measure similar or related to measure(s) already endorsed by NQF (on the same topic or the same target population)? *Measures can be found at www.qualityforum.org under Core Documents.* *Check all that apply* ☐ Have not looked at other NQF measures ☒ Other measure(s) for same target population ☒ Other measure(s) on same topic ☐ No similar or related measures **Name and number of similar or related NQF-endorsed™ measure(s):** NQF # 0340

Title: Pediatric Heart Surgery Volume (PDI 7)
Status: Endorsed
Endorsed on: MAY 15, 2008
Steward(s): Agency for Healthcare Research and Quality
Description: Raw volume compared to annual thresholds (100 procedures)

NQF # 0339
Title: Pediatric Heart Surgery Mortality (PDI 6) (risk adjusted)
Status: Endorsed
Endorsed on: MAY 15, 2008
Steward(s): Agency for Healthcare Research and Quality
Description: Number of in-hospital deaths in patients undergoing surgery for congenital heart disease per 1000 patients.

Are the measure specifications harmonized with existing NQF-endorsed™ measures? Not harmonized
►If not fully harmonized, provide rationale: NQF # 0340 and NQF # 0339 are both suboptimal. The limitations of each of these measures will be reviewed below:

NQF # 0340
Title: Pediatric Heart Surgery Volume (PDI 7)
Status: Endorsed
Endorsed on: MAY 15, 2008
Steward(s): Agency for Healthcare Research and Quality
Description: Raw volume compared to annual thresholds (100 procedures)

The relationship between the volume of pediatric and congenital cardiac surgery performed at a center and quality of care is unclear and controversial at best [1, 2, 3, 4, 5, 6, 7]. Evidence simply does not exist to support an annual volume threshold of 100 procedures.

Nevertheless, in order to track a variety of outcomes represented in other proposed Quality Indicators, one must have a firm grasp on the volume of pediatric and congenital cardiac surgery performed at a center over both 1 year and 4 year time intervals. The very act of tracking this structure measure is necessary in order to track other outcome measures that use this structure measure as a denominator. Furthermore, very act of tracking this structure measure should in and of itself lead to improvements in quality.

The operations counted towards this metric must clearly be defined as pediatric or congenital Cardiac Operation. Cardiac operations are defined as operations that are of operation types of "CPB" or "No CPB Cardiovascular". (CPB is cardiopulmonary bypass.) [8]. Published methodology is available that describes the proper techniques for gathering this information based on the consensus of a panel of experts.

NQF # 0339
Title: Pediatric Heart Surgery Mortality (PDI 6) (risk adjusted)
Status: Endorsed
Endorsed on: MAY 15, 2008
Steward(s): Agency for Healthcare Research and Quality
Description: Number of in-hospital deaths in patients undergoing surgery for congenital heart disease per 1000 patients.

Furthermore, it is important to understand that the Society of Thoracic Surgeons advocates utilization of a systematic multi-institutional clinical database (registry) for the analysis of cardiac surgical outcomes and the assessment of quality. Evidence from three recent investigations suggests that the validity of coding of lesions seen in the congenitally malformed heart via the International Classification of Diseases as used in Administrative Databases is likely to be poor[9, 10, 11]. First, in a series of 373 infants with congenital cardiac defects at Children's Hospital of Wisconsin, investigators report that only 52% of the cardiac diagnoses in the medical records had a corresponding code from the International Classification of Diseases in the hospital discharge database [9]. Second, the Hennepin County Medical Center discharge database in

Minnesota identified all infants born during 2001 with a code for congenital cardiac disease using the International Classification of Diseases. A review of these 66 medical records by physicians was able to confirm only 41% of the codes contained in the administrative database from the International Classification of Diseases [10]. Third, the Metropolitan Atlanta Congenital Defect Program of the Birth Defect Branch of the Centers for Disease Control and Prevention of the federal government of the United States of America carried out surveillance of infants and fetuses with cardiac defects delivered to mothers residing in Atlanta during the years 1988 through 2003 [11]. These records were reviewed and classified using both administrative coding and the clinical nomenclature used in the Society of Thoracic Surgeons Congenital Heart Surgery Database. This study concluded that analyses based on the codes available in the International Classification of Diseases are likely to "have substantial misclassification" of congenital cardiac disease.

Several potential reasons can explain the poor diagnostic accuracy of Administrative Databases and codes from the International Classification of Diseases:
1) accidental miscoding
2) coding performed by medical records clerks who have never seen the actual patient
3) contradictory or poorly described information in the medical record
4) lack of diagnostic specificity for congenital cardiac disease in the codes of the of International Classification of Diseases
5) inadequately trained medical coders

References:

1. Welke KF, O'Brien SM, Peterson ED, Ungerleider RM, Jacobs ML, Jacobs JP. The Complex Relationship between Pediatric Cardiac Surgical Case Volumes and Mortality Rates in a National Clinical Database. The Journal of Thoracic and Cardiovascular Surgery,. 2009 May;137(5):1133-40. Epub 2009 Mar 17, PMID: 19379979, May, 2009.

2. Bradley SM. Good Things in Small Packages: Meeting Challenge in the Low-volume Program. Jacobs JP, Wernovsky G, Cooper DS, Gaynor JW, Anderson RH (editors). 2009 Supplement to Cardiology in the Young: Annual Heart Week in Florida Supplement Number 7 - Innovation Associated With The Treatment Of Patients With Congenital and Pediatric Cardiac Disease, Cardiology in the Young, Volume 19, accepted for publication, in press.

3. Jenkins KJ, Newburger JW, Lock JE, et al. In-hospital mortality for surgical repair of congenital heart defects: preliminary observations of variation by hospital caseload. Pediatrics. 1995;95:323-30.

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6.Chang RK, Klitzner TS. Can regionalization decrease the number of deaths for children who undergo cardiac surgery? A theoretical analysis. Pediatrics. 2002; 109:173-81.

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	FEASIBILITY
35 (4a)	*How are the required data elements generated? Check all that apply* ☒ *Data elements are generated concurrent with and as a byproduct of care processes during care delivery (e.g., blood pressure or other assessment recorded by personnel conducting the assessment)* ☐ *Data elements are generated from a patient survey (e.g., CAHPS)* ☒ *Data elements are generated through coding performed by someone other than the person who obtained the original information (e.g., DRG or ICD-9 coding on claims)* ☒ *Other, Please describe: The Society of Thoracic Surgeons Congenital Heart Surgery Database*
36 (4b)	*Electronic Sources All data elements* ►*If all data elements are not in electronic sources, specify the near-term path to electronic collection by most providers:* ►*Specify the data elements for the electronic health record: Surgery*
37 (4c)	*Do the specified exclusions require additional data sources beyond what is required for the other specifications? No* ►*If yes, provide justification:*
38 (4d)	*Identify susceptibility to inaccuracies, errors, or unintended consequences of the measure:* *Inaccuracies and Errors:* *This measure may be susceptible to human error (i.e., recording the measure inaccurately or not recording the measure at all)* *Unintended Consequences:* *One should be cautious in drawing conclusions from the observation of these measures, especially in circumstances where there is a declining morbidity and mortality. 1,2* *1. Welke KF, Karamlou T, Ungerleider RM, Diggs BS. Mortality is not a valid indicator of quality differences between pediatric cardiac surgery programs. Ann Thoracic Surgery. (in press)* *2. O'Brien SM, Gauvreau K. Statistical issues in the analysis and interpretation of outcomes for congenital cardiac surgery. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young. 2008;18(Suppl.2):145–151.* *Describe how could these potential problems be audited:* *Inaccuracies and Errors:* *Each participant is responsible for the quality and accuracy of the data they submit to the database. Each*

	participant agrees to the following quality control measures in the participation agreement: *i) "Participant hereby warrants that all data submitted for inclusion in the CHS Database will be accurate and complete, and acknowledges that such data may be subject to independent audit. Participant will use its best efforts to address any data or related deficiencies identified by the independent data warehouse service provider, and agrees to cooperate with and assist STS and its designees in connection with the performance of any independent audit.* *ii) Participant warrants that it will take all reasonable steps to avoid the submission of duplicative data for inclusion in the CHS Database, including but not limited to apprising the Director of the STS National Database and the independent data warehouse service provider about any other Participation Agreements in which an individual cardiothoracic surgeon named above or on Schedule A attached hereto (as amended from time to time) is also named."* *In addition, the Data warehouse and analysis center at Duke Clinical Research Institute, performs a series of internal quality controls on the submitted data and issues an annual data quality report* *Unintended Consequences:* *The Society of Thoracic Surgeons Database audit process is used. In addition, outliers can be identified with 95% confidence intervals based on the sample size with complexity stratification for one and four-year time intervals* *Did you audit for these potential problems during testing? Yes If yes, provide results:* *Clarke DR, Breen LS, Jacobs ML, Franklin RCG, Tobota Z, Maruszewski B, Jacobs JP. Verification of data in congenital cardiac surgery. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young. 2008;18(Suppl. 2):177–187.*
39 (4e))	*Testing feasibility Describe what have you learned/modified as a result of testing and/or operational use of the measure regarding data collection, availability of data/missing data, timing/frequency of data collection, patient confidentiality, time/cost of data collection, other feasibility/ implementation issues:* *Lessons Learned:* *•The STS CHS database collects gender, race/ethnicity, age and geographic location information, so disparities and trends can be studied for populations at risk.* *•Data elements required for the measure can be captured and the measure is actionable by the physician.* *•There are no data availability issues.* *•Cost to collect the data includes staff training and the use of specific software. However there are no additional costs over what a provider would pay to be a part of the STS CHS Database or other registry that collects this information.* *•This measure can be used in a variety of care settings and at different levels of analysis (i.e. physician, hospital, etc.)* *•Formal reliability testing was not done. Instead, the participant is bound by the participation agreement and his/her participation can be monitored by observing the data submitted on an annual basis.* *•There are no confidentiality concerns. The data is de-identified, and the sites must be HIPAA compliant and obtain IRB approval for use of the database.* *•The STS Congenital Quality Measures Sub-Committee meets at the STS Annual Meeting. The Subcommittee will review each STS congenital cardiac surgery measure on a yearly basis. Changes or updates to the measure will be at the recommendation of the committee.* *• The STS has a yearly meeting (The Advances in Quality and Outcomes Conference) devoted to the Database for the clinicians and data coordinators.* *•The audit process has demonstrated that data is very complete and accurate.1* *1. Clarke DR, Breen LS, Jacobs ML, Franklin RCG, Tobota Z, Maruszewski B, Jacobs JP. Verification of data in congenital cardiac surgery. In: 2008 Cardiology in the Young Supplement: Databases and The Assessment*

of Complications associated with The Treatment of Patients with Congenital Cardiac Disease, Prepared by: The Multi-Societal Database Committee for Pediatric and Congenital Heart Disease, Jeffrey P. Jacobs, MD (editor). Cardiology in the Young. 2008;18(Suppl. 2):177–187.

CONTACT INFORMATION

40 *Web Page URL for Measure Information* *Describe where users (implementers) should go for more details on specifications of measures, or assistance in implementing the measure.*
Web page URL: www.sts.org

41 **Measure Steward Point of Contact**
First Name: Jane **MI:** M **Last Name:** Han **Credentials (MD, MPH, etc.):** MSW
Organization: The Society of Thoracic Surgeons
Street Address: 633 N. Saint Clair St, Suite 2320 **City:** Chicago **State:** IL **ZIP:** 60611
Email: jhan@sts.org **Telephone:** 312-202-5856 ext:

42 **Measure Developer Point of Contact** **If different from Measure Steward**
First Name: **MI:** **Last Name:** **Credentials (MD, MPH, etc.):**
Organization:
Street Address: **City:** **State:** **ZIP:**
Email: **Telephone:** ext:

ADDITIONAL INFORMATION

43 **Workgroup/Expert Panel involved in measure development** Workgroup/panel used
►If workgroup used, describe the members' role in measure development: The STS Task Force to Develop NQF Indicators for Pediatric and Congenital Cardiac Surgery members collectively formulated the numerator statement and defined its parameters in addition to identifying data elements and sources of data.
►Provide a list of workgroup/panel members' names and organizations:

Name	Institution	Location
Erle H. Austin, III, MD	University of Louisville Kosair Children's Hospital	Louisville, KY
Emile A. Bacha, MD	Children's Hospital Boston Department of Cardiovascular Surgery	Boston, MA
Pedro J. del Nido, MD	Children's Hospital Boston Department of Cardiac Surgery	Boston, MA
Charles D. Fraser, Jr., MD	Texas Children's Hospital Division of Congenital Heart Surgery	Houston, TX
Frederick L. Grover, MD	University of Colorado Health Sciences Center Department of Surgery	Aurora, CO
Jennifer C. Hirsch, MD	University of Michigan Health System Section of Cardiac Surgery	Ann Arbor, MI
Jeffrey P. Jacobs, MD	The Congenital Heart Institute of Florida	Saint Petersburg, FL
Marshall L. Jacobs, MD	Cleveland Clinic Center for Pediatric and Congenital Heart Diseases	Cleveland, OH
David L. Morales, MD	Texas Children's Hospital Division of Congenital Heart Surgery	Houston, TX
Kamal K. Pourmoghadam, MD	Geisinger Medical Center Department of Pediatric Cardiac Surgery	Danville, PA
Jeffrey B. Rich, MD	Mid-Atlantic Cardiothoracic Surgeons, Ltd.	Norfolk, VA
James S. Tweddell, MD	Children's Hospital of Wisconsin Department of Cardiothoracic Surgery	Milwaukee, WI

44	*Measure Developer/Steward Updates and Ongoing Maintenance* *Year the measure was first released: NA* *Month and Year of most recent revision: NA* *What is the frequency for review/update of this measure? Once a year at STS Annual Meeting* *When is the next scheduled review/update for this measure? January 2011*
45	**Copyright statement/disclaimers:**
46	**Additional Information:**
47	**I have checked that the submission is complete and any blank fields indicate that no information is provided.** ☒
48	**Date of Submission** (*MM/DD/YY*)**:** 3/11/10

Procedure Code	Description	Definition
10	PFO, Primary closure	Suture closure of patent foramen ovale (PFO)
20	ASD repair, Primary closure	Suture closure of secundum (most frequently), coronary sinus, sinus venosus or common atrium ASD.
30	ASD repair, Patch	Patch closure (using any type of patch material) of secundum, coronary sinus, or sinus venosus ASD.
40	ASD repair, Device	Closure of any type ASD (including PFO) using a device
2110	ASD repair, Patch + PAPVC repair	
50	ASD, Common atrium (single atrium), Septation	Septation of common (single) atrium using any type patch material.
60	ASD creation/enlargement	Creation of an atrial septal defect or enlargement of an existing atrial septal defect using a variety of modalities including balloon septostomy, blade septostomy, or surgical septectomy. Creation may be accomplished with or without use of cardiopulmonary bypass.
70	ASD partial closure	Intentional partial closure of any type ASD (partial suture or fenestrated patch closure).
80	Atrial septal fenestration	Creation of a fenestration (window) in the septum between the atrial chambers. Usually performed using a hole punch, creating a specifically sized communication in patch material placed on the atrial septum.
85	Atrial fenestration closure	Closure of previously created atrial fenestration using any method including device, primary suture, or patch.
100	VSD repair, Primary closure	Suture closure of any type VSD.
110	VSD repair, Patch	Patch closure (using any type of patch material) of any type VSD.
120	VSD repair, Device	Closure of any type VSD using a device.
130	VSD, Multiple, Repair	Closure of more than one VSD using any method or combination of methods. Further information regarding each type of VSD closed and method of closure can be provided by additionally listing specifics for each VSD closed. In the case of multiple VSDs in which only one is closed the procedure should be coded as closure of a single VSD. The fundamental diagnosis, in this case, would be “VSD, Multiple” and a secondary diagnosis can be the morphological type of VSD that was closed at the time of surgery.
140	VSD creation/enlargement	Creation of a ventricular septal defect or enlargement of an existing ventricular septal defect.
150	Ventricular septal fenestration	Creation of a fenestration (window) in the septum between the ventricular chambers. Usually performed using a hole punch, creating a specifically sized communication in patch material placed on the ventricular septum.
170	AVC (AVSD) repair, Complete (CAVSD)	Repair of complete AV canal (AVSD) using one- or two patch or other technique, with or without mitral valve cleft repair.
180	AVC (AVSD) repair, Intermediate (Transitional)	Repair of intermediate AV canal (AVSD) using ASD and VSD patch, or ASD patch and VSD suture, or other technique, with or without mitral valve cleft repair.
190	AVC (AVSD) repair, Partial (Incomplete) (PAVSD)	Repair of partial AV canal defect (primum ASD), any technique, with or without repair of cleft mitral valve.
2300	Valvuloplasty, Common atrioventricular valve	

2250	Valvuloplasty converted to valve replacement in the same operation, Common atrioventricular valve	
2230	Valve replacement, Common atrioventricular valve	
210	AP window repair	Repair of AP window using one- or two-patch technique with cardiopulmonary bypass; or, without cardiopulmonary bypass, using transcatheter device or surgical closure.
220	Pulmonary artery origin from ascending aorta (hemitruncus) repair	Repair of pulmonary artery origin from the ascending aorta by direct reimplantation, autogenous flap, or conduit, with or without use of cardiopulmonary bypass.
230	Truncus arteriosus repair	Truncus arteriosus repair that most frequently includes patch VSD closure and placement of a conduit from RV to PA. In some cases, a conduit is not placed but an RV to PA connection is made by direct association. Very rarely, there is no VSD to be closed. Truncal valve repair or replacement should be coded separately (Valvuloplasty, Truncal valve; Valve replacement, Truncal valve), as would be the case as well with associated arch anomalies requiring repair (e.g., Interrupted aortic arch repair).
240	Valvuloplasty, Truncal valve	Truncal valve repair, any type.
2290	Valvuloplasty converted to valve replacement in the same operation, Truncal valve	
250	Valve replacement, Truncal valve	Replacement of the truncal valve with a prosthetic valve.
2220	Truncus + Interrupted aortic arch repair (IAA) repair	
260	PAPVC repair	PAPVC repair revolves around whether an intracardiac baffle is created to redirect pulmonary venous return to the left atrium or if the anomalous pulmonary vein is translocated and
270	PAPVC, Scimitar, Repair	In scimitar syndrome, PAPVC repair also revolves around whether an intracardiac baffle is created to redirect pulmonary venous return to the left atrium or if the anomalous pulmonary vein is translocated and connected to the left atrium directly. If there is an associated ASD and it is closed, that procedure should also be listed. Occasionally an
2120	PAPVC repair, Baffle redirection to left atrium with systemic vein translocation (Warden) (SVC sewn to right atrial appendage)	
280	TAPVC repair	Repair of TAPVC, any type. Issues surrounding TAPVC repair involve how the main pulmonary venous confluence anastomosis is fashioned, whether an associated ASD is closed or left open or enlarged (ASD closure and
2200	TAPVC repair + Shunt - systemic-to-pulmonary	

290	Cor triatriatum repair	Repair of cor triatriatum. Surgical decision making revolves around the approach to the membrane creating the cor triatriatum defect, how any associated ASD is closed, and how any associated anomalous pulmonary vein connection is addressed. Both ASD closure and anomalous pulmonary venous connection may be listed as separate procedures.
300	Pulmonary venous stenosis repair	Repair of pulmonary venous stenosis, whether congenital or acquired. Repair can be accomplished with a variety of approaches: sutureless, patch venoplasty, stent placement, etc.
310	Atrial baffle procedure (non-Mustard, non-Senning)	The atrial baffle procedure code is used primarily for repair of systemic venous anomalies, as in redirection of left superior vena cava drainage to the right atrium.
330	Anomalous systemic venous connection repair	With the exception of atrial baffle procedures (harvest code 310), anomalous systemic venous connection repair includes a range of surgical approaches, including, among others: ligation of anomalous vessels, reimplantation of anomalous vessels (with or without use of a conduit), or redirection of anomalous systemic venous flow through directly to the pulmonary circulation (bidirectional Glenn to redirect LSVC or RSVC to left or right pulmonary artery, respectively).
340	Systemic venous stenosis repair	Stenosis or obstruction of a systemic vein (most commonly SVC or IVC) may be relieved with patch or
350	TOF repair, No ventriculotomy	Tetralogy of Fallot repair (assumes VSD closure and relief of pulmonary stenosis at one or more levels), without use of an incision in the infundibulum of the right ventricle for exposure. In most cases this would be a transatrial and transpulmonary artery approach to repair the VSD and relieve the pulmonary stenosis. If the main pulmonary artery incision is extended proximally through the pulmonary annulus, this must be considered "transannular" and thus a ventricular incision, though the length of the incision onto the ventricle itself may be minimal.
360	TOF repair, Ventriculotomy, Nontransanular patch	Tetralogy of Fallot repair (assumes VSD closure and relief of pulmonary stenosis at one or more levels), with use of a ventriculotomy incision, but without placement of a trans-pulmonary annulus patch. If the main pulmonary artery incision is extended proximally through the pulmonary annulus, this must be considered "transannular" and thus a ventricular incision, though the length of the incision onto the ventricle itself may be minimal.
370	TOF repair, Ventriculotomy, Transanular patch	Tetralogy of Fallot repair (assumes VSD closure and relief of pulmonary stenosis at one or more levels), with use of a ventriculotomy incision and placement of a trans-pulmonary annulus patch. If the main pulmonary artery incision is extended proximally through the pulmonary annulus, this must be considered "transannular" and thus a ventricular incision, though the length of the incision onto the ventricle itself may be minimal.

380	TOF repair, RV-PA conduit	Tetralogy of Fallot repair (assumes VSD closure and relief of pulmonary stenosis at one or more levels), with placement of a right ventricle-to-pulmonary artery conduit. In this procedure the major components of pulmonary stenosis are relieved with placement of the RV-PA conduit.
390	TOF - AVC (AVSD) repair	Tetralogy of Fallot repair (assumes VSD closure and relief of pulmonary stenosis at one or more levels), with repair of associated AV canal defect. Repair of associated atrial septal defect or atrioventricular valve repair(s) should be listed as additional or secondary procedures under the primary TOF-AVC procedure.
400	TOF - Absent pulmonary valve repair	Repair of tetralogy of Fallot with absent pulmonary valve complex. In most cases this repair will involve pulmonary valve replacement (pulmonary or aortic homograft, porcine, other) and reduction pulmonary artery arterioplasty.
420	Pulmonary atresia - VSD (including TOF, PA) repair	For patients with pulmonary atresia with ventricular septal defect without MAPCAs, including those with tetralogy of Fallot with pulmonary atresia, repair may entail either a tetralogy-like repair with transannular patch placement, a VSD closure with placement of an RV-PA conduit, or an intraventricular tunnel VSD closure with transannular patch or RV-PA conduit placement. To assure an accurate count of repairs of pulmonary atresia-VSD without MAPCAs, even if a tetralogy-type repair or Rastelli-type repair is used, the pulmonary atresia-VSD code should be the code used, not Rastelli procedure or tetralogy of Fallot repair with transannular patch.
430	Pulmonary atresia - VSD - MAPCA (pseudotruncus) repair	In the presence of MAPCAs, this code implies implies pulmonary unifocalization (multi- or single-stage), repair of VSD (may be intraventricular tunnel or flat patch VSD closure), and placement of an RV-PA conduit.
440	Unifocalization MAPCA(s)	Anastomosis of aortopulmonary collateral arteries into the left, right, or main pulmonary artery or into a tube graft or other
450	Occlusion MAPCA(s)	Occlusion, or closing off, of MAPCAs. This may be done with a transcatheter occluding device, usually a
460	Valvuloplasty, Tricuspid	Reconstruction of the tricuspid valve may include but not be limited to a wide range of techniques including: leaflet patch extension, artificial chordae placement, papillary muscle transplocation with or without detachment. Annuloplasty techniques that may be done solely or in combination with leaflet, chordae or muscle repair to achieve a competent valve include: eccentric annuloplasty, Kay annular plication, purse-
2280	Valvuloplasty converted to valve replacement in the same operation, Tricuspid	

465	Ebstein's repair	To assure an accurate count of repairs of Ebstein's anomaly of the tricuspid valve, this procedure code was included. Repair of Ebstein's anomaly may include, among other techniques, repositioning of the tricuspid valve, plication of the atrialized right ventricle, or right reduction atrioplasty. Often associated ASD's may be closed and arrhythmias addressed with surgical ablation procedures. These procedures should be entered as separate procedure codes.
470	Valve replacement, Tricuspid (TVR)	Replacement of the tricuspid valve with a prosthetic valve.
480	Valve closure, Tricuspid (exclusion, univentricular approach)	In a functional single ventricle heart, the tricuspid valve may be closed using a patch, thereby excluding the RV. Tricuspid valve closure may be used for infants with Ebstein's anomaly and
490	Valve excision, Tricuspid (without replacement)	Excision of the tricuspid valve without placement of a valve prosthesis.
500	Valve surgery, Other, Tricuspid	Other tricuspid valve surgery not specified in procedure codes.
510	RVOT procedure	Included in this procedural code would be all RVOT procedures not elsewhere specified in the nomenclature system. These might be, among others: resection of subvalvar pulmonary stenosis (not DCRV type; may be localized fibrous diaphragm or high infundibular stenosis), right ventricular patch augmentation, or reduction pulmonary artery arterioplasty.
520	1 1/2 ventricular repair	Partial biventricular repair; includes intracardiac repair with bidirectional cavopulmonary anastomosis to volume unload a small ventricle or poorly functioning ventricle
530	PA, reconstruction (plasty), Main (trunk)	Reconstruction of the main pulmonary artery trunk commonly using patch material. If balloon angioplasty is performed or a stent is placed in the main pulmonary artery intraoperatively, this code may be used in addition to the balloon dilation or stent placement code. If MPA reconstruction is performed with PA debanding, both codes should be listed.
540	PA, reconstruction (plasty), Branch, Central (within the hilar bifurcation)	Reconstruction of the right or left branch (or both right and left) pulmonary arteries (within the hilar bifurcation) commonly using patch material. If balloon angioplasty is performed or a stent is placed in the right or left (or both) pulmonary artery intraoperatively, this code may be used in addition to the balloon dilation or stent placement code. If, rarely, branch PA
550	PA, reconstruction (plasty), Branch, Peripheral (at or beyond the hilar bifurcation)	Reconstruction of the peripheral right or left branch (or both right and left) pulmonary arteries (at or beyond the hilar bifurcation) commonly using patch material. If balloon angioplasty is performed or a stent is placed in the right or left (or both) peripheral pulmonary artery intraoperatively, this code may be used in addition to the balloon dilation or stent placement code.

570	DCRV repair	Surgical repair of DCRV combines relief of the low infundibular stenosis (via muscle resection) and closure of a VSD when present. A ventriculotomy may be required and is repaired by patch enlargement of the infundibulum. VSD closure and patch enlargement of the infundibulum, if done, should be listed as separate procedure codes.
590	Valvuloplasty, Pulmonic	Valvuloplasty of the pulmonic valve may include a range of techniques including but not limited to: valvotomy with or without bypass, commissurotomy, and valvuloplasty.
2270	Valvuloplasty converted to valve replacement in the same operation, Pulmonic	
600	Valve replacement, Pulmonic (PVR)	Replacement of the pulmonic valve with a prosthetic valve. Care must be taken to differentiate between homograft pulmonic valve replacement and placement of a homograft RV-PA conduit.
630	Valve excision, Pulmonary (without replacement)	Excision of the pulmonary valve without placement of a valve prosthesis.
640	Valve closure, Semilunar	Closure of a semilunar valve (pulmonic or aortic) by any technique.
650	Valve surgery, Other, Pulmonic	Other pulmonic valve surgery not specified in procedure codes.
610	Conduit placement, RV to PA	Placement of a conduit, any type, from RV to PA.
620	Conduit placement, LV to PA	Placement of a conduit, any type, from LV to PA.
1774	Conduit placement, Ventricle to aorta	Placement of a conduit from the right or left ventricle to the aorta.
1772	Conduit placement, Other	Placement of a conduit from any chamber or vessel to any vessel, valved or valveless, not listed elsewhere.
580	Conduit reoperation	Conduit reoperation is the code to be used in the event of conduit failure, in whatever position (LV to aorta, LV to PA, RA to RV, RV to aorta, RV to PA, etc.), and from whatever cause (somatic growth, stenosis, insufficiency, infection, etc).
660	Valvuloplasty, Aortic	Valvuloplasty of the aortic valve for stenosis and/or insufficiency including, but not limited to the following techniques: valvotomy (open or closed), commissurotomy, aortic valve suspension, leaflet (left, right or noncoronary) partial resection, reduction, or leaflet shaving, extended valvuloplasty (freeing of leaflets, commissurotomy, and extension of leaflets using autologous or bovine pericardium), or annuloplasty (partial - interrupted or noncircumferential sutures, or complete - circumferential sutures).
2240	Valvuloplasty converted to valve replacement in the same operation, Aortic	
2310	Valvuloplasty converted to valve replacement in the same operation, Aortic – with Ross procedure	

2320	Valvuloplasty converted to valve replacement in the same operation, Aortic – with Ross-Konno procedure	
670	Valve replacement, Aortic (AVR)	Replacement of the aortic valve with a prosthetic valve (mechanical, bioprosthetic, or homograft). Use this code only if type of valve prosthesis is unknown or does not fit into the specific valve replacement codes available. Autograft valve replacement should be coded as a Ross procedure.
680	Valve replacement, Aortic (AVR), Mechanical	Replacement of the aortic valve with a mechanical prosthetic valve.
690	Valve replacement, Aortic (AVR), Bioprosthetic	Replacement of the aortic valve with a bioprosthetic prosthetic valve.
700	Valve replacement, Aortic (AVR), Homograft	Replacement of the aortic valve with a homograft prosthetic valve.
715	Aortic root replacement, Bioprosthetic	Replacement of the aortic root (that portion of the aorta attached to the heart; it gives rise to the coronary arteries) with a bioprosthesis (e.g., porcine) in a conduit, often composite.
720	Aortic root replacement, Mechanical	Replacement of the aortic root (that portion of the aorta attached to the heart; it gives rise to the coronary arteries) with a mechnical prosthesis in a composite conduit.
730	Aortic root replacement, Homograft	Replacement of the aortic root (that portion of the aorta attached to the heart; it gives rise to the coronary arteries) with a homograft.
735	Aortic root replacement, Valve sparing	Replacement of the aortic root (that portion of the aorta attached to the heart; it gives rise to the coronary arteries) without replacing the aortic valve (using a tube graft).
740	Ross procedure	Replacement of the aortic valve with a pulmonary autograft and replacement of the pulmonary valve with a homograft conduit.
750	Konno procedure	Relief of left ventricular outflow tract obstruction associated with aortic annular hypoplasia, aortic valvar stenosis and/or aortic valvar insufficiency via Konno aortoventriculoplasty. Components of the surgery include a longitudinal incision in the aortic septum, a vertical incision in the outflow tract of the right ventricle to join the septal incision, aortic valve replacement, and patch reconstruction of the outflow tracts of both ventricles.
760	Ross-Konno procedure	Relief of left ventricular outflow tract obstruction associated with aortic annular hypoplasia, aortic valvar stenosis and/or aortic valvar insufficiency via Konno aortoventriculoplasty using a pulmonary autograft root for the aortic root replacement.
770	Other annular enlargement procedure	Techniques included under this procedure code include those designed to effect aortic annular enlargement that are not included in other procedure codes. These include the Manougian and Nicks aortic annular enlargement procedures.

780	Aortic stenosis, Subvalvar, Repair	Subvalvar aortic stenosis repair by a range of techniques including excision, excision and myotomy, excision and myomectomy, myotomy, myomectomy, initial placement of apical-aortic conduit (LV to aorta conduit replacement would be coded as conduit reoperation), Vouhé aortoventriculoplasty (aortic annular incision at commissure of left and right coronary cusps is carried down to the septum and RV infundibulum; septal muscle is resected, incisions are closed, and the aortic annulus is reconstituted), or other aortoventriculoplasty techniques.
2100	Aortic stenosis, Subvalvar, Repair, With myectomy for IHSS	
790	Aortic stenosis, Supravalvar, Repair	Repair of supravalvar aortic stenosis involving all techniques of patch aortoplasty and aortoplasty involving the use of all autologous tissue. In simple patch aortoplasty a diamond-shaped patch may be used, in the Doty technique an extended patch is placed (Y shaped patch, incision carried into two sinuses), and in the Brom repair the ascending aorta is transected, any fibrous ridge is resected, and the three sinuses are patched separately.
800	Valve surgery, Other, Aortic	Other aortic valve surgery not specified in other procedure codes.
810	Sinus of Valsalva, Aneurysm repair	Sinus of Valsalva aneurysm repair can be organized by site of aneurysm (left, right or noncoronary sinus), type of repair (suture, patch graft, or root repair by tube graft or valved conduit), and approach used (from chamber of origin (aorta) or from chamber of penetration (LV, RV, PA, left or right atrium, etc.). Aortic root replacement procedures in association with sinus of Valsalva aneurysm repairs are usually for associated uncorrectable aortic insufficiency or multiple sinus involvement and the aortic root replacement procedure should also be listed. Additional procedures also performed at the time of sinus of Valsalva aneurysm repair include but are not limited to VSD closure, repair or replacement of aortic valve, and coronary reconstruction; these procedures should also be coded separately from the sinus of Valsalva aneurysm repair.
820	LV to aorta tunnel repair	LV to aorta tunnel repair can be accomplished by suture, patch, or both, and may require reimplantation of the right coronary artery. Associated coronary artery procedures should be coded separately from the LV to aorta tunnel repair.
830	Valvuloplasty, Mitral	Repair of mitral valve including, but not limited to: valvotomy (closed or open heart), cleft repair, annuloplasty with or without ring, chordal reconstruction, commissuorotomy, leaflet repair, or papillary muscle repair.
2260	Valvuloplasty converted to valve replacement in the same operation, Mitral	

840	Mitral stenosis, Supravalvar mitral ring repair	Supravalvar mitral ring repair.
850	Valve replacement, Mitral (MVR)	Replacement of mitral valve with prosthetic valve, any kind, in suprannular or annular position.
860	Valve surgery, Other, Mitral	Other mitral valve surgery not specified in procedure codes.
870	Norwood procedure	The Norwood operation is synonymous with the term 'Norwood (Stage 1)' and is defined as an aortopulmonary connection and neoaortic arch construction resulting in univentricular physiology and pulmonary blood flow controlled with a calibrated systemic-to-pulmonary artery shunt, or a right ventricle to pulmonary artery conduit, or rarely, a cavopulmonary connection. When coding the procedure “Norwood procedure”, the primary procedure of the operation should be “Norwood procedure”. The second procedure (Procedure 2 after the Norwood procedure) must then document the source of pulmonary blood flow and be chosen from the following eight choices: 1. Shunt, Systemic to pulmonary, Modified Blalock-Taussig Shunt (MBTS) 2. Shunt, Systemic to pulmonary, Central (from aorta or to main pulmonary artery) 3. Shunt, Systemic to pulmonary, Other 4. Conduit placement, RV to PA 5. Bidirectional cavopulmonary anastomosis (BDCPA) (bidirectional Glenn) 6. Glenn (unidirectional cavopulmonary anastomosis) (unidirectional Glenn) 7. Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn) 8. HemiFontan
880	HLHS biventricular repair	Performed in patients who have small but adequately sized ventricles to support systemic circulation. These patients usually have small, but not stenotic, aortic and/or mitral valves. Primary biventricular repair has consisted of extensive aortic arch and ascending aorta enlargement with a patch, closure of interventricular and interatrial communications, and conservative approach for left ventricular outflow tract
2160	Hybrid Approach "Stage 1", Application of RPA & LPA bands	A “Hybrid Procedure” is defined as a procedure that combines surgical and transcatheter interventional approaches. The term “Hybrid approach” is used somewhat differently than the term “Hybrid Procedure”. A “Hybrid approach” is defined as any of a group of procedures that fit into the general silo of procedures developed from the combined use of surgical and transcatheter interventional techniques. Therefore, not all procedures classified as “Hybrid approach” are truly “ Hybrid Procedures”.

2170	Hybrid Approach "Stage 1", Stent placement in arterial duct (PDA)	A “Hybrid Procedure” is defined as a procedure that combines surgical and transcatheter interventional approaches. The term “Hybrid approach” is used somewhat differently than the term “Hybrid Procedure”. A “Hybrid approach” is defined as any of a group of procedures that fit into the general silo of procedures developed from the combined use of surgical and transcatheter interventional techniques. Therefore, not all procedures classified as “Hybrid approach” are truly “ Hybrid Procedures”.
2180	Hybrid Approach "Stage 1", Stent placement in arterial duct (PDA) + application of RPA & LPA bands	A “Hybrid Procedure” is defined as a procedure that combines surgical and transcatheter interventional approaches. The term “Hybrid approach” is used somewhat differently than the term “Hybrid Procedure”. A “Hybrid approach” is defined as any of a group of procedures that fit into the general silo of procedures developed from the combined use of surgical and transcatheter interventional techniques. Therefore, not all procedures classified as “Hybrid approach” are truly “ Hybrid Procedures”.
2140	Hybrid approach "Stage 2", Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding + Aortic arch repair (Norwood [Stage 1] + Superior Cavopulmonary anastomosis(es) + PA Debanding)	A “Hybrid Procedure” is defined as a procedure that combines surgical and transcatheter interventional approaches. The term “Hybrid approach” is used somewhat differently than the term “Hybrid Procedure”. A “Hybrid approach” is defined as any of a group of procedures that fit into the general silo of procedures developed from the combined use of surgical and transcatheter interventional techniques. Therefore, not all procedures classified as “Hybrid approach” are truly “ Hybrid Procedures”. It should be acknowledged that a Hybrid approach "Stage 2" (Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding, with or without Aortic arch repair) gets its name not because it has any actual hybrid elements, but because it is part of a planned staged approach that is typically commenced with a hybrid procedure.
2150	Hybrid approach "Stage 2", Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding + Without aortic arch repair	A “Hybrid Procedure” is defined as a procedure that combines surgical and transcatheter interventional approaches. The term “Hybrid approach” is used somewhat differently than the term “Hybrid Procedure”. A “Hybrid approach” is defined as any of a group of procedures that fit into the general silo of procedures developed from the combined use of surgical and transcatheter interventional techniques. Therefore, not all procedures classified as “Hybrid approach” are truly “ Hybrid Procedures”. It should be acknowledged that a Hybrid approach "Stage 2" (Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding, with or without Aortic arch repair) gets its name not because it has any actual hybrid elements, but because it is part of a planned staged approach that is typically commenced with a hybrid procedure

890	Transplant, Heart	Heart transplantation, any technique, allograft or xenograft.
900	Transplant, Heart and lung	Heart and lung (single or double) transplantation.
910	Partial left ventriculectomy (LV volume reduction surgery) (Batista)	Wedge resection of LV muscle, with suturing of cut edges together, to reduce LV volume.
920	Pericardial drainage procedure	Pericardial drainage can include a range of therapies including, but not limited to: pericardiocentesis, pericardiostomy tube placement, pericardial window creation, and open pericardial drainage (pericardiotomy).
930	Pericardiectomy	Surgical removal of the pericardium.
940	Pericardial procedure, Other	Other pericardial procedures that include, but are not limited to: pericardial reconstruction for congenital absence of the pericardium, pericardial biopsy, pericardial mass or cyst excision.
950	Fontan, Atrio-pulmonary connection	Fontan-type procedure with atrio-pulmonary connection.
960	Fontan, Atrio-ventricular connection	Fontan-type procedure with atrio-ventricular connection, either direct or with RA-RV conduit, valved or nonvalved.
970	Fontan, TCPC, Lateral tunnel, Fenestrated	Total cavopulmonary connection using an intraatrial lateral tunnel construction, with fenestration.
980	Fontan, TCPC, Lateral tunnel, Nonfenestrated	Total cavopulmonary connection using an intraatrial lateral tunnel construction, with no fenestration.
1000	Fontan, TCPC, External conduit, Fenestrated	Total cavopulmonary connection using an external conduit to connect the infradiaphragmatic systemic venous return to the pulmonary artery, with fenestration.
1010	Fontan, TCPC, External conduit, Nonfenestrated	Total cavopulmonary connection using an external conduit to connect the infradiaphragmatic systemic venous return to the pulmonary artery, with no fenestration.
1025	Fontan revision or conversion (Re-do Fontan)	Revision of a previous Fontan procedure to a total cavopulmonary connection.
1030	Fontan, Other	Other Fontan procedure not specified in procedure codes. May include takedown of a Fontan procedure.
2340	Fontan + Atrioventricular valvuloplasty	
1035	Ventricular septation	Creation of a prosthetic ventricular septum. Surgical procedure used to septate univentricular hearts with two atrioventricular valves. Additional procedures, such as resection of subpulmonic stenosis, should be listed separately.
1050	Congenitally corrected TGA repair, Atrial switch and ASO (double switch)	Repair of congenitally corrected TGA by concomitant atrial switch (Mustard or Senning) and arterial switch operation. VSD closure is usually performed as well; this should be coded separately.
1060	Congenitally corrected TGA repair, Atrial switch and Rastelli	Repair of congenitally corrected TGA by concomitant atrial switch (Mustard or Senning) and VSD closure to the aortic valve with placement of an RV-to-PA conduit.
1070	Congenitally corrected TGA repair, VSD closure	Repair of congenitally corrected TGA by VSD closure only.

1080	Congenitally corrected TGA repair, VSD closure and LV to PA conduit	Repair of congenitally corrected TGA by VSD closure and placement of an LV-to-PA conduit.
1090	Congenitally corrected TGA repair, Other	Any procedures for correction of CCTGA not otherwised specified in other listed procedure codes.
1110	Arterial switch operation (ASO)	Arterial switch operation is used for repair of transposition of the great arteries (TGA). The pulmonary artery and aorta are transected and translocated so that the pulmonary artery arises from the right ventricle and the aorta from the left ventricle. Coronary artery transfer is also accomplished.
1120	Arterial switch operation (ASO) and VSD repair	Arterial switch operation is used for repair of transposition of the great arteries (TGA). The pulmonary artery and aorta are transected and translocated so that the pulmonary artery arises from the right ventricle and the aorta from the left ventricle. Coronary artery transfer is also accomplished. The VSD is closed, usually with a patch.
1123	Arterial switch procedure + Aortic arch repair	Concomitant arterial switch operation and repair of the aortic arch in patients with transposition of the great arteries with intact ventricular septum and associated coarctation of the aorta or interrupted aortic arch.
1125	Arterial switch procedure and VSD repair + Aortic arch repair	Concomitant arterial switch operation with VSD closure and repair of aortic arch in patients with transposition of the great arteries with VSD and associated coarctation of the aorta or interrupted aortic arch.
1130	Senning	Atrial baffle procedure for rerouting of venous flow in TGA effecting a “physiological repair”. The caval flow is directed behind the baffle to the mitral valve, left ventricle and pulmonary artery while the pulmonary venous flow is directed in front of the baffle to the tricuspid valve, right ventricle, and aorta. The Senning procedure uses atrial wall to construct the baffle.
1140	Mustard	Atrial baffle procedure for rerouting of venous flow in TGA effecting a “physiological repair”. The caval flow is directed behind the baffle to the mitral valve, left ventricle and pulmonary artery while pulmonary venous flow is directed in front of the baffle to the tricuspid valve, right ventricle, and aorta. The Mustard procedure uses patch material to construct the baffle.
1145	Atrial baffle procedure, Mustard or Senning revision	Revision of a previous atrial baffle procedure (either Mustard or Senning), for any reason (e.g., obstruction, baffle leak).
1150	Rastelli	Most often used for patients with TGA-VSD and significant LVOTO, the Rastelli operation consists of an

1160	REV	The Lecompte (REV) intraventricular repair is designed for patients with abnormalities of ventriculoarterial connection in whom a standard intraventricular tunnel repair cannot be erformed. It is also suitable for patients in whom an arterial switch procedure with tunneling of the VSD to the pulmonary artery cannot be performed because of pulmonary (left ventricular outflow tract) stenosis. A right ventriculotomy incision is made. The infundibular (conal) septum, located between the two semilunar valves, is aggressively resected if its presence interferes with the construction of a tunnel from the VSD to the aorta. The VSD is then tunneled to the aorta. The decision to perform or not to perform the Lecompte maneuver should be made at the beginning of the operation. If the Lecompte maneuver is not performed the pulmonary artery is translocated to the right ventricular outflow tract on the side of the aorta that provides the shortest route. (When the decision to perform the Lecompte maneuver has been made, the great vessels are transected and this maneuver is performed at the
2190	Aortic root translocation over left ventricle (Including Nikaidoh procedure)	
2210	TGA, Other procedures (Kawashima, LV-PA conduit, other)	
1180	DORV, Intraventricular tunnel repair	Repair of DORV using a tunnel closure of the VSD to the aortic valve. This also includes the posterior straight tunnel repair of Kawashima
1200	DOLV repair	Because of the morphologic variability of DOLV, there are many approaches to repair, including: intraventricular tunnel repair directing the VSD to the pulmonary valve, the REV procedure, or the Rastelli procedure. In the case of DOLV use this code for tunnel closure to the pulmonary valve. If the REV or Rastelli procedures are performed then use those respective codes.
1210	Coarctation repair, End to end	Repair of coarctation of aorta by excision of the coarctation segment and end-to-end circumferential anastomosis of the aorta.
1220	Coarctation repair, End to end, Extended	Repair of coarctation of the aorta by excision of the coarctation segment and end-to-end anastomosis of the oblique ends of the aorta, creating an extended anastomosis.
1230	Coarctation repair, Subclavian flap	Repair of coarctation of the aorta by ligating, dividing, and opening the subclavian artery, incising the coarctation site, and folding down the subclavian artery onto the incision in the aorta, suturing the subclavian "flap" in place, creating a roof over the area of the previous coarctation.
1240	Coarctation repair, Patch aortoplasty	Repair of coarctation of the aorta by incising the coarctation site with placement of a patch sutured in place longitudinally along the aortotomy edge.

1250	Coarctation repair, Interposition graft	Repair of coarctation of the aorta by resection of the coarctation segment and placement of a prosthetic tubular interposition graft anastomosed circumferentially to the cut ends of the aorta.
1260	Coarctation repair, Other	Any repair of coarctation not specified in procedure codes. This may include, for example, a combination of two approaches for coarctation repair or extra-anatomic bypass graft, etc.
1275	Coarctation repair + VSD repair	Coarctation of aorta repair, any technique, and simultaneous VSD repair, any type VSD, any type repair.
1280	Aortic arch repair	Aortic arch repair, any technique.
1285	Aortic arch repair + VSD repair	Aortic arch repair, any technique, and simultaneous VSD repair, any type VSD, any type repair. This includes repair of IAA with VSD.
1290	Coronary artery fistula ligation	Coronary artery fistula repair using any technique. If additional technique information may be supplied by another procedure code, please list separately (e.g., bypass graft).
1291	Anomalous origin of coronary artery from pulmonary artery repair	Repair of anomalous origin of the coronary artery (any) from the pulmonary artery, by any technique (ligation, translocation with aortic implantation, Takeuchi operation, bypass graft). If additional technique information may be supplied by another procedure code, please list separately (for example, bypass graft).
1300	Coronary artery bypass	Coronary artery bypass graft procedure, any technique (with or without CPB, venous or arterial graft, one or more grafts, etc.), for any coronary artery pathology (coronary arterial fistula, aneurysm, coronary bridging, atresia of left main, acquired coronary artery disease, etc.).
1310	Coronary artery procedure, Other	Any coronary artery procedure not specifically listed.
1320	Interrupted aortic arch repair	Repair of interrupted aortic arch (any type) by any technique (direct anastomosis, prosthetic graft, etc). Does not include repair of IAA-VSD.
1330	PDA closure, Surgical	Closure of a PDA by any surgical technique (ligation, division, clip) using any approach (i.e., thoracotomy, thoracoscopic, etc).
1340	PDA closure, Device	Closure of a PDA by device using transcatheter techniques.
1360	Vascular ring repair	Repair of vascular ring (any type, except pulmonary artery sling) by any technique.
1365	Aortopexy	Surgical fixation of the aorta to another structure (usually the posterior aspect of the sternum) to relieve compression on another vessel or structure (e.g., trachea).
1370	Pulmonary artery sling repair	Pulmonary artery sling repair by any technique.
1380	Aortic aneurysm repair	Aortic aneurysm repair by any technique.
1390	Aortic dissection repair	Aortic dissection repair by any technique
1410	Transplant, lung(s)	Lung or lobe transplantation of any type.

1450	Pacemaker implantation, Permanent	Implantation of a permanent pacemaker of any type (e.g., single-chamber, dual-chamber, atrial antitachycardia), with any lead configuration or type (atrial, ventricular, atrial and ventricular, transvenous, epicardial, transmural), by any technique (sternotomy, thoracotomy etc).
1460	Pacemaker procedure	Any revision to a previously placed pacemaker system including revisions to leads, generators, pacemaker pockets. This may include explantation of pacemakers or leads as well.
2350	Explantation of pacing system	
1470	ICD (AICD) implantation	Implantation of an (automatic) implantable cardioverter defibrillator system.
1480	ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	Any revision to a previously placed AICD including revisions to leads, pads, generators, pockets. This may include explantation procedures as well.
1490	Arrhythmia surgery - atrial, Surgical Ablation	Surgical ablation (any type) of any atrial arrhythmia.
1500	Arrhythmia surgery - ventricular, Surgical Ablation	Surgical ablation (any type) of any ventricular arrhythmia.
1590	Shunt, Systemic to pulmonary, Modified Blalock-Taussig Shunt (MBTS)	Placement of a tube graft from a branch of the aortic arch to the pulmonary artery with or without bypass, from any approach (thoracotomy, sternotomy).
1600	Shunt, Systemic to pulmonary, Central (from aorta or to main pulmonary artery)	A direct anastomosis or placement of a tube graft from the aorta to the pulmonary artery with or without bypass, from any approach (thoracotomy, sternotomy).
1610	Shunt, Systemic to pulmonary, Other	Placement of any other systemic-to-pulmonary artery shunt, with or without bypass, from any approach (thoracotomy, sternotomy) that is not otherwise coded. Includes classic Blalock-Taussig systemic-to-pulmonary artery shunt.
1630	Shunt, Ligation and takedown	Takedown of any shunt.
2095	Shunt, Reoperation	
1640	PA banding (PAB)	Placement of a pulmonary artery band, any type.
1650	PA debanding	Debanding of pulmonary artery. Please list separately any pulmonary artery reconstruction required.
1660	Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	In the Damus-Kaye-Stansel procedure the proximal transected main pulmonary artery is connected by varying techniques to the aorta.
1670	Bidirectional cavopulmonary anastomosis (BDCPA) (bidirectional Glenn)	Superior vena cava to pulmonary artery anastomosis allowing flow to both pulmonary arteries with an end-to side superior vena-to-pulmonary artery anastomosis.
1680	Glenn (unidirectional cavopulmonary anastomosis) (unidirectional Glenn)	Superior vena cava to ipsilateral pulmonary artery anastomosis (i.e., LSVC to LPA, RSVC to RPA).

1690	Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn)	Bilateral superior vena cava-to-pulmonary artery anastomoses (requires bilateral SVCs).
1700	HemiFontan	A HemiFontan is an operation that includes a bidirectional superior vena cava (SVC)-to-pulmonary artery anastomosis and the connection of this “SVCpulmonary artery amalgamation” to the atrium, with a “ dam” between this “SVC-pulmonary artery amalgamation” and the atrium. This operation can be accomplished with a variety of operative strategies including the following two techniques and other techniques that combine elements of both of these approaches: (1) Augmenting both branch pulmonary arteries with a patch and suturing the augmented branch pulmonary arteries to an incision in the medial aspect of the superior vena cava. (With this approach, the pulmonary artery patch forms a roof over the SVC-topulmonary artery anastomosis and also forms a “dam” between the SVC-pulmonary artery amalgamation and the right atrium.) (2) Anastomosing both ends of the divided SVC to incisions in the top and bottom of the right pulmonary artery, and using a separate patch to close junction of the SVC and the right atrium.
2330	Superior cavopulmonary anastomosis(es) (Glenn or HemiFontan) + Atrioventricular valvuloplasty	
2130	Superior Cavopulmonary anastomosis(es) + PA reconstruction	
1720	Aneurysm, Ventricular, Right, Repair	Repair of right ventricular aneurysm, any technique.
1730	Aneurysm, Ventricular, Left, Repair	Repair of left ventricular aneurysm, any technique.
1740	Aneurysm, Pulmonary artery, Repair	Repair of pulmonary artery aneurysm, any technique.
1760	Cardiac tumor resection	Resection of cardiac tumor, any type.
1780	Pulmonary AV fistula repair/occlusion	Repair or occlusion of a pulmonary arteriovenous fistula.
1790	Ligation, Pulmonary artery	Ligation or division of the pulmonary artery. Most often performed as a secondary procedure.
1802	Pulmonary embolectomy, Acute pulmonary embolus	Acute pulmonary embolism (clot) removal, through catheter or surgery.
1804	Pulmonary embolectomy, Chronic pulmonary embolus	Chronic pulmonary embolism (clot) removal, through catheter or surgery.
1830	Ligation, Thoracic duct	Ligation of the thoracic duct; most commonly for persistent chylothorax.
1860	Mediastinal procedure	Any non-cardiovascular mediastinal procedure not otherwise listed.

The Society of Thoracic Surgeons

Congenital Heart Surgery Database

Data Collection Form Version 3.0

September 16, 2009

ADMINISTRATIVE

Participant ID:	STS Trial Link Number:

DEMOGRAPHICS

Patient ID (software generated)	Patient SSN: __ __ __ - __ __ - __ __ __ __		MRN:
Health Insurance Claim Number:			
Patient Last Name:	Patient First Name:		Patient MI:
Patient Region:	Postal Code:		Country:
Birth City:	Birth Region:		Birth Country:
Mother's Last Name:	Mother's First Name:	Mother's MI:	Mother's SSN: __ __ __ - __ __ - __ __ __ __
DOB: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __	Birth Weight (kg):		Gender: ☐ M ☐ F ☐ Ambiguous
Premature Birth: ☐ Yes ☐ No	Gestational age at birth (in weeks):		

Race (select all that apply):

Caucasian:	☐ Yes ☐ No	Black/African American:	☐ Yes ☐ No
Asian:	☐ Yes ☐ No	Am Indian/Alaskan Nat:	☐ Yes ☐ No
Native Hawaiian/Pacific Islander:	☐ Yes ☐ No	Other:	☐ Yes ☐ No

Hispanic or Latino Ethnicity ☐ Yes ☐ No

Date of Last Follow- Up: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __

Last follow-up NYHA Classification: ☐ NYHA 1 ☐ NYHA 2 ☐ NYHA 3 ☐ NYHA 4

Mortality Status at Last Follow - Up: ☐ Alive ☐ Dead

Mortality Date: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __

NONCARDIAC CONGENITAL ANATOMIC ABNORMALITIES (select all that apply)

- ☐ 5 = None
- ☐ 10 = Anal Atresia (imperforate anus)
- ☐ 20 = Congenital diaphragmatic hernia (CDH)
- ☐ 30 = Gastroschisis
- ☐ 40 = Hirschsprung's disease (Congenital aganglionic megacolon)
- ☐ 50 = Intestinal malrotation
- ☐ 60 = Omphalocele
- ☐ 70 = Tracheoesophageal fistula (TEF)

CHROMOSOMAL ABNORMALITIES (select all that apply)

- ☐ 5 = No chromosomal abnormality identified
- ☐ 10 = 11p15.5
- ☐ 20 = 11q
- ☐ 30 = 12p1.21
- ☐ 40 = 12p12.1
- ☐ 50 = 12q24
- ☐ 60 = 15q21.1
- ☐ 70 = 1q42.1
- ☐ 80 = 20p12
- ☐ 90 = 22q11 deletion
- ☐ 100 = 2p21
- ☐ 110 = 3p22
- ☐ 120 = 45X0
- ☐ 130 = 47,XXY
- ☐ 140 = 4p
- ☐ 150 = 4p16
- ☐ 160 = 5p
- ☐ 170 = 6p12
- ☐ 180 = 7q11
- ☐ 190 = 7q11.23
- ☐ 200 = 7q32
- ☐ 210 = 7q34
- ☐ 220 = 8q12
- ☐ 230 = Monosomy X
- ☐ 240 = TGFBR1 or 2
- ☐ 250 = Trisomy 08
- ☐ 260 = Trisomy 09
- ☐ 270 = Trisomy 13
- ☐ 280 = Trisomy 18
- ☐ 290 = Trisomy 21
- ☐ 310 = Other chromosomal abnormality

SYNDROMES (select all that apply)

- ☐ 5 = No syndromic abnormality identified
- ☐ 10 = Alagille syndrome (intrahepatic biliary duct agenesis)
- ☐ 20 = Apert syndrome
- ☐ 30 = Brugada syndrome (Sudden unexplained nocturnal death syndrome) (SUNDS)
- ☐ 40 = Cardiofaciocutaneous syndrome
- ☐ 50 = Carpenter syndrome
- ☐ 60 = Cat-eye syndrome
- ☐ 70 = CHARGE Association
- ☐ 80 = Cornelia de Lange syndrome
- ☐ 90 = Costello syndrome
- ☐ 100 = Cri-du-chat syndrome
- ☐ 110 = Deletion 10p syndrome
- ☐ 120 = Deletion 8p syndrome
- ☐ 130 = DiGeorge syndrome (velocardiofacial syndrome) (conotruncal anomaly face syndrome) (22q11 deletion)
- ☐ 140 = Down syndrome (Trisomy 21)
- ☐ 150 =Edwards syndrome (Trisomy 18)
- ☐ 160 = Ellis-van Creveld syndrome
- ☐ 165 = Fetal alcohol syndrome (FAS)
- ☐ 166 = Fetal drug exposure
- ☐ 170 =Goldenhar syndrome
- ☐ 180 = Heterotaxy syndrome
- ☐ 190 = Heterotaxy syndrome, Asplenia syndrome
- ☐ 200 = Heterotaxy syndrome, Polysplenia syndrome
- ☐ 210 = Holt-Oram syndrome
- ☐ 220 = Jacobsen syndrome
- ☐ 230 = Kabuki syndrome
- ☐ 240 = Kartagener syndrome (Siewert syndrome) (Primary ciliary dyskinesia)
- ☐ 250 = Klinefelter syndrome (XXY Syndrome)
- ☐ 260 = LEOPARD syndrome
- ☐ 270 = Loeys-Dietz syndrome
- ☐ 280 = Long QT syndrome (Ward Romano syndrome)
- ☐ 290 = Marfan syndrome
- ☐ 300 = Marfan-like syndrome
- ☐ 310 = Mucopolysaccharidosis type IH (Hurler syndrome)
- ☐ 320 = Mucopolysaccharidosis type IH/S (Hurler-Scheie syndrome)
- ☐ 330 = Mucopolysaccharidosis type II (Hunter syndrome)
- ☐ 340 = Mucopolysaccharidosis type IS (Scheie syndrome)
- ☐ 350 = Noonan syndrome
- ☐ 360 = Patau syndrome (Trisomy 13)
- ☐ 370 = Rethore syndrome (Trisomy 9)
- ☐ 380 = Rubella
- ☐ 390 = Rubinstein-Taybi syndrome
- ☐ 400 = Short QT syndrome
- ☐ 410 = Situs inversus
- ☐ 420 = Smith-Lemli-Opitz syndrome
- ☐ 430 = Turner syndrome (45XO)
- ☐ 440 = VACTERL syndrome (VACTER/VATER/VATERR syndrome)
- ☐ 450 = VACTERL-H syndrome (VATER association with hydrocephalus) (Briard-Evans syndrome)
- ☐ 460 = Warkany syndrome (Trisomy 8)
- ☐ 470 = Williams syndrome (Williams-Beuren syndrome)
- ☐ 480 = Wolff-Parkinson-White syndrome (WPW syndrome)
- ☐ 490 = Wolf-Hirschhorn syndrome
- ☐ 510 = Other syndromic abnormality

HOSPITALIZATION

Hospital Name:	Hospital Zip Code:	Hospital State:
Hospital National Provider Identifier:		

Payor – *(Select all that apply)*

Government Health Insurance: ☐ Yes ☐ No *(If Yes, select all that apply: ↓)*

Medicare: ☐ Yes ☐ No *(If Yes →)* Medicare Fee For Service: ☐ Yes ☐ No

Medicaid: ☐ Yes ☐ No Military Health Care: ☐ Yes ☐ No

State-Specific Plan: ☐ Yes ☐ No Indian Health Service: ☐ Yes ☐ No

Commercial Health Insurance: ☐ Yes ☐ No

Health Maintenance Organization: ☐ Yes ☐ No

Non-U.S. Insurance: ☐ Yes ☐ No

None / Self: ☐ Yes ☐ No

Admission date: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __	Surgery date: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __	
Height (Cm):	Weight (Kg):	Age at time of surgery (in days):

PREOPERATIVE FACTORS (select all that apply)

- ☐ 10 = No preoperative factors identified
- ☐ 200 = Cardio-pulmonary resuscitation
- ☐ 210 = Preoperative complete AV block
- ☐ 220 = Preoperative/Preprocedural mechanical circulatory support (IABP, VAD, ECMO, or CPS)
- ☐ 230 = Shock, Persistent at time of surgery
- ☐ 240 = Shock, Resolved at time of surgery
- ☐ 250 = Diabetes mellitus, Insulin dependent
- ☐ 260 = Diabetes mellitus, Non-insulin dependent
- ☐ 270 = Hypothyroidism
- ☐ 280 = Currently taking steroids as treatment for adrenal insufficiency
- ☐ 290 = Currently taking steroids for any reason other than treatment of adrenal insufficiency
- ☐ 295 = Colostomy present
- ☐ 300 = Enterostomy of small intestine present
- ☐ 305 = Esophagostomy present
- ☐ 307 = Gastrostomy present
- ☐ 310 = Hepatic dysfunction
- ☐ 320 = Necrotizing entero-colitis, Treated medically
- ☐ 330 = Necrotizing entero-colitis, Treated surgically
- ☐ 340 = Coagulation disorder, Hypercoagulable state
- ☐ 350 = Coagulation disorder, Hypocoagulable state not secondary to medication (intrinsic hypocoagulable state)
- ☐ 360 = Coagulation disorder, Hypocoagulable state secondary to medication
- ☐ 370 = Endocarditis
- ☐ 380 = Sepsis
- ☐ 390 = Sepsis with positive blood culture
- ☐ 400 = Preoperative neurological deficit
- ☐ 410 = Seizure during lifetime
- ☐ 420 = Seizure within 48 hours prior to surgery
- ☐ 430 = Stroke, CVA, or Intracranial hemorrhage > Grade 2 during lifetime
- ☐ 440 = Stroke, CVA, or Intracranial hemorrhage > Grade 2 within 48 hours prior to surgery
- ☐ 450 = Renal dysfunction
- ☐ 460 = Renal failure requiring dialysis
- ☐ 470 = Mechanical ventilation to treat cardiorespiratory failure
- ☐ 480 = Respiratory Syncytial Virus
- ☐ 490 = Single lung
- ☐ 500 = Tracheostomy present
- ☐ 777 = Other preoperative factors

DIAGNOSIS

Antenatal Diagnosis of Congenital Heart Disease: ☐ Yes ☐ No

		Select ALL diagnosis that apply (↓)	CIRCLE the ONE PRIMARY diagnosis for this operation	Select the ONE FUNDAMENTAL diagnosis for this patient (↓)
Septal Defects	ASD	☐	10 = PFO	☐
		☐	20 = ASD, Secundum	☐
		☐	30 = ASD, Sinus venosus	☐
		☐	40 = ASD, Coronary sinus	☐
		☐	50 = ASD, Common atrium (single atrium)	☐
	VSD	☐	71 = VSD, Type 1 (Subarterial) (Supracristal) (Conal septal defect) (Infundibular)	☐
		☐	73 = VSD, Type 2 (Perimembranous) (Paramembranous) (Conoventricular)	☐
		☐	75 = VSD, Type 3 (Inlet) (AV canal type)	☐
		☐	77 = VSD, Type 4 (Muscular)	☐
		☐	79 = VSD, Type: Gerbode type (LV-RA communication)	☐
		☐	80 = VSD, Multiple	☐
	AV Canal	☐	100 = AVC (AVSD), Complete (CAVSD)	☐
		☐	110 = AVC (AVSD), Intermediate (transitional)	☐
		☐	120 = AVC (AVSD), Partial (incomplete) (PAVSD) (ASD, primum)	☐
	AP Window	☐	140 = AP window (aortopulmonary window)	☐
		☐	150 = Pulmonary artery origin from ascending aorta (hemitruncus)	☐
	Truncus Arteriosus	☐	160 = Truncus arteriosus	☐

		☐	170 = Truncal valve insufficiency	☐
		☐	2010 = Truncus arteriosus + Interrupted aortic arch	☐
Pulmonary Venous Anomalies	Partial Anomalous Pulmonary Venous Connection	☐	180 = Partial anomalous pulmonary venous connection (PAPVC)	☐
		☐	190 = Partial anomalous pulmonary venous connection (PAPVC), scimitar	☐
	Total Anomalous Pulmonary Venous Connection	☐	200 = Total anomalous pulmonary venous connection (TAPVC), Type 1 (supracardiac)	☐
		☐	210 = Total anomalous pulmonary venous connection (TAPVC), Type 2 (cardiac)	☐
		☐	220 = Total anomalous pulmonary venous connection (TAPVC), Type 3 (infracardiac)	☐
		☐	230 = Total anomalous pulmonary venous connection (TAPVC), Type 4 (mixed)	☐
Cor Triatriatum		☐	250 = Cor triatriatum	☐
Pulmonary Venous Stenosis		☐	260 = Pulmonary venous stenosis	☐
Systemic Venous Anomalies	Anomalous Systemic Venous Connection	☐	270 = Systemic venous anomaly	☐
	Systemic venous obstruction	☐	280 = Systemic venous obstruction	☐
Right Heart Lesions	Tetralogy of Fallot	☐	290 = TOF	☐
		☐	2140 = TOF, Pulmonary stenosis	☐
		☐	300 = TOF, AVC (AVSD)	☐
		☐	310 = TOF, Absent pulmonary valve	☐
	Pulmonary Atresia	☐	320 = Pulmonary atresia	☐
		☐	330 = Pulmonary atresia, IVS	☐
		☐	340 = Pulmonary atresia, VSD (Including TOF, PA)	☐
		☐	350 = Pulmonary atresia, VSD-MAPCA (pseudotruncus)	☐
		☐	360 = MAPCA(s) (major aortopulmonary collateral[s]) (without PA-VSD)	☐
	Tricuspid Valve Disease and Ebstein's Anomaly	☐	370 = Ebstein's anomaly	☐
		☐	380 = Tricuspid regurgitation, non-Ebstein's related	☐
		☐	390 = Tricuspid stenosis	☐
		☐	400 = Tricuspid regurgitation and tricuspid stenosis	☐
		☐	410 = Tricuspid valve, Other	☐
	RVOT Obstruction and/or Pulmonary Stenosis	☐	420 = Pulmonary stenosis, Valvar	☐
		☐	430 = Pulmonary artery stenosis (hypoplasia), Main (trunk)	☐
		☐	440 = Pulmonary artery stenosis, Branch, Central (within the hilar bifurcation)	☐
		☐	450 = Pulmonary artery stenosis, Branch, Peripheral (at or beyond the hilar bifurcation)	☐
		☐	470 = Pulmonary artery, Discontinuous	☐
		☐	490 = Pulmonary stenosis, Subvalvar	☐
		☐	500 = DCRV	☐
	Pulmonary Valve Disease	☐	510 = Pulmonary valve, Other	☐
		☐	530 = Pulmonary insufficiency	☐
		☐	540 = Pulmonary insufficiency and pulmonary stenosis	☐
Shunt failure	Shunt failure	☐	2130 = Shunt Failure	NA
Conduit failure	Conduit failure	☐	520 = Conduit failure	☐
Left Heart Lesions	Aortic Valve Disease	☐	550 = Aortic stenosis, Subvalvar	☐
		☐	560 = Aortic stenosis, Valvar	☐
		☐	570 = Aortic stenosis, Supravalvar	☐
		☐	590 = Aortic valve atresia	☐
		☐	600 = Aortic insufficiency	☐
		☐	610 = Aortic insufficiency and aortic stenosis	☐
		☐	620 = Aortic valve, Other	☐
	Sinus of Valsalva Fistula/Aneurysm	☐	630 = Sinus of Valsalva aneurysm	☐
	LV to Aorta Tunnel	☐	640 = LV to aorta tunnel	☐

	Mitral Valve Disease	☐	650 = Mitral stenosis, Supravalvar mitral ring	☐
		☐	660 = Mitral stenosis, Valvar	☐
		☐	670 = Mitral stenosis, Subvalvar	☐
		☐	680 = Mitral stenosis, Subvalvar, Parachute	☐
		☐	695 = Mitral stenosis	☐
		☐	700 = Mitral regurgitation and mitral stenosis	☐
		☐	710 = Mitral regurgitation	☐
		☐	720 = Mitral valve, Other	☐
	Hypoplastic Left Heart Syndrome	☐	730 = Hypoplastic left heart syndrome (HLHS)	☐
	Shone's syndrome	☐	2080 = Shone's syndrome *{CAN NOT BE PRIMARY DIAGNOSIS}*	☐
Cardiomyopathy		☐	740 = Cardiomyopathy (including dilated, restrictive, and hypertrophic)	☐
		☐	750 = Cardiomyopathy, End-stage congenital heart disease	☐
Pericardial Disease		☐	760 = Pericardial effusion	☐
		☐	770 = Pericarditis	☐
		☐	780 = Pericardial disease, Other	☐
Single Ventricle		☐	790 = Single ventricle, DILV	☐
		☐	800 = Single ventricle, DIRV	☐
		☐	810 = Single ventricle, Mitral atresia	☐
		☐	820 = Single ventricle, Tricuspid atresia	☐
		☐	830 = Single ventricle, Unbalanced AV canal	☐
		☐	840 = Single ventricle, Heterotaxia syndrome	☐
		☐	850 = Single ventricle, Other	☐
		☐	851 = Single Ventricle + Total anomalous pulmonary venous connection (TAPVC)	☐
Transposition of the Great Arteries	Congenitally Corrected TGA	☐	870 = Congenitally corrected TGA	☐
		☐	872 = Congenitally corrected TGA, IVS	☐
		☐	874 = Congenitally corrected TGA, IVS-LVOTO	☐
		☐	876 = Congenitally corrected TGA, VSD	☐
		☐	878 = Congenitally corrected TGA, VSD-LVOTO	☐
	Transposition of the Great Arteries	☐	880 = TGA, IVS	☐
		☐	890 = TGA, IVS-LVOTO	☐
		☐	900 = TGA, VSD	☐
		☐	910 = TGA, VSD-LVOTO	☐
DORV		☐	930 = DORV, VSD type	☐
		☐	940 = DORV, TOF type	☐
		☐	950 = DORV, TGA type	☐
		☐	960 = DORV, Remote VSD (uncommitted VSD)	☐
		☐	2030 = DORV + AVSD (AV Canal)	☐
		☐	975 = DORV, IVS	☐
DOLV		☐	980 = DOLV	☐
Thoracic Arteries and Veins	Coarctation of Aorta and Aortic arch hypoplasia	☐	990 = Coarctation of aorta	☐
		☐	1000 = Aortic arch hypoplasia	☐
		☐	92 = VSD + Aortic arch hypoplasia	☐
		☐	94 = VSD + Coarctation of aorta	☐
	Coronary Artery Anomalies	☐	1010 = Coronary artery anomaly, Anomalous aortic origin of coronary artery from aorta (AAOCA)	☐
		☐	1020 = Coronary artery anomaly, Anomalous pulmonary origin (includes ALCAPA)	☐
		☐	1030 = Coronary artery anomaly, Fistula	☐
		☐	1040 = Coronary artery anomaly, Aneurysm	☐
		☐	1050 = Coronary artery anomaly, Other	☐
	Interrupted Arch	☐	1070 = Interrupted aortic arch	☐

		☐	2020 = Interrupted aortic arch + VSD	☐
		☐	2000 = Interrupted aortic arch + AP window (aortopulmonary window)	☐
	Patent Ductus Arteriosus	☐	1080 = Patent ductus arteriosus	☐
	Vascular rings and Slings	☐	1090 = Vascular ring	☐
		☐	1100 = Pulmonary artery sling	☐
	Aortic Aneurysm	☐	1110 = Aortic aneurysm (including pseudoaneurysm)	☐
	Aortic Dissection	☐	1120 = Aortic dissection	☐
Thoracic and Mediastinal Disease	Lung Disease	☐	1130 = Lung disease, Benign	☐
		☐	1140 = Lung disease, Malignant	☐
	Pectus Excavatum, Carinatum	☐	1150 = Pectus	☐
	Tracheal Stenosis	☐	1160 = Tracheal stenosis	☐
		☐	1170 = Airway disease	☐
	Pleural Disease	☐	1430 = Pleural disease, Benign	☐
		☐	1440 = Pleural disease, Malignant	☐
		☐	1450 = Pneumothorax	☐
		☐	1460 = Pleural effusion	☐
		☐	1470 = Chylothorax	☐
		☐	1480 = Empyema	☐
	Esophageal Disease	☐	1490 = Esophageal disease, Benign	☐
		☐	1500 = Esophageal disease, Malignant	☐
	Mediastinal Disease	☐	1505 = Mediastinal disease	☐
		☐	1510 = Mediastinal disease, Benign	☐
		☐	1520 = Mediastinal disease, Malignant	☐
	Diaphragmatic Disease	☐	1540 = Diaphragm paralysis	☐
		☐	1550 = Diaphragm disease, Other	☐
Electrophysiological		☐	1180 = Arrhythmia	☐
		☐	2040 = Arrhythmia, Atrial	☐
		☐	2050 = Arrhythmia, Junctional	☐
		☐	2060 = Arrhythmia, Ventricular	☐
		☐	1185 = Arrhythmia, Heart block	☐
		☐	1190 = Arrhythmia, Heart block, Acquired	☐
		☐	1200 = Arrhythmia, Heart block, Congenital	☐
		☐	1220 = Arrhythmia, Pacemaker, Indication for replacement	☐
Miscellaneous, Other		☐	1230 = Atrial Isomerism, Left *{CAN NOT BE PRIMARY DIAGNOSIS}*	NA
		☐	1240 = Atrial Isomerism, Right *{CAN NOT BE PRIMARY DIAGNOSIS}*	NA
		☐	2090 = Dextrocardia *{CAN NOT BE PRIMARY DIAGNOSIS}*	NA
		☐	2100 = Levocardia *{CAN NOT BE PRIMARY DIAGNOSIS}*	NA
		☐	2110 = Mesocardia *{CAN NOT BE PRIMARY DIAGNOSIS}*	NA
		☐	2120 = Situs inversus *{CAN NOT BE PRIMARY DIAGNOSIS}*	NA
		☐	1250 = Aneurysm, Ventricular, Right (including pseudoaneurysm)	☐
		☐	1260 = Aneurysm, Ventricular, Left (including pseudoaneurysm)	☐
		☐	1270 = Aneurysm, Pulmonary artery	☐
		☐	1280 = Aneurysm, Other	☐
		☐	1290 = Hypoplastic RV	☐
		☐	1300 = Hypoplastic LV	☐
		☐	2070 = Postoperative bleeding	☐
		☐	1310 = Mediastinitis	☐
		☐	1320 = Endocarditis	☐
		☐	1325 = Rheumatic heart disease *{CAN NOT BE PRIMARY DIAGNOSIS}*	NA
		☐	1330 = Prosthetic valve failure	☐

		☐ 1340 = Myocardial infarction	☐
		☐ 1350 = Cardiac tumor	☐
		☐ 1360 = Pulmonary AV fistula	☐
		☐ 1370 = Pulmonary embolism	☐
		☐ 1385 = Pulmonary vascular obstructive disease	☐
		☐ 1390 = Pulmonary vascular obstructive disease (Eisenmenger's)	☐
		☐ 1400 = Primary pulmonary hypertension	☐
		☐ 1410 = Persistent fetal circulation	☐
		☐ 1420 = Meconium aspiration	☐
		☐ 1560 = Cardiac, Other	☐
		☐ 1570 = Thoracic and/or mediastinal, Other	☐
		☐ 1580 = Peripheral vascular, Other	☐
		☐ 7000 = Normal heart	☐
		☐ 7777 = Miscellaneous, Other	☐
STATUS POST (No "Status post – diagnoses" can be a primary diagnosis or fundamental diagnosis)			
Septal Defects	ASD	☐ 4010 = Status post - PFO, Primary closure	
		☐ 4020 = Status post - ASD repair, Primary closure	
		☐ 4030 = Status post - ASD repair, Patch	
		☐ 4040 = Status post - ASD repair, Device	
		☐ 6110 = Status post - ASD repair, Patch + PAPVC repair	
		☐ 4050 = Status post - ASD, Common atrium (single atrium), Septation	
		☐ 4060 = Status post - ASD creation/enlargement	
		☐ 4070 = Status post - ASD partial closure	
		☐ 4080 = Status post - Atrial septal fenestration	
		☐ 4085 = Status post - Atrial fenestration closure	
	VSD	☐ 4100 = Status post - VSD repair, Primary closure	
		☐ 4110 = Status post - VSD repair, Patch	
		☐ 4120 = Status post - VSD repair, Device	
		☐ 4130 = Status post - VSD, Multiple, Repair	
		☐ 4140 = Status post - VSD creation/enlargement	
		☐ 4150 = Status post - Ventricular septal fenestration	
	AV Canal	☐ 4170 = Status post - AVC (AVSD) repair, Complete (CAVSD)	
		☐ 4180 = Status post - AVC (AVSD) repair, Intermediate (Transitional)	
		☐ 4190 = Status post - AVC (AVSD) repair, Partial (Incomplete) (PAVSD)	
		☐ 6300 = Status post - Valvuloplasty, Common atrioventricular valve	
		☐ 6250 = Status post - Valvuloplasty converted to valve replacement in the same operation, Common atrioventricular valve	
		☐ 6230 = Status post - Valve replacement, Common atrioventricular valve	
	AP Window	☐ 4210 = Status post - AP window repair	
		☐ 4220 = Status post - Pulmonary artery origin from ascending aorta (hemitruncus) repair	
	Truncus Arteriosus	☐ 4230 = Status post - Truncus arteriosus repair	
		☐ 4240 = Status post - Valvuloplasty, Truncal valve	
		☐ 6290 = Status post - Valvuloplasty converted to valve replacement in the same operation, Truncal valve	
		☐ 4250 = Status post - Valve replacement, Truncal valve	
		☐ 6220 = Status post - Truncus + Interrupted aortic arch repair (IAA) repair	
Pulmonary Venous Anomalies	Partial Anomalous Pulmonary Venous Connection	☐ 4260 = Status post - PAPVC repair	
		☐ 4270 = Status post - PAPVC, Scimitar, Repair	
		☐ 6120 = Status post - PAPVC repair, Baffle redirection to left atrium with systemic vein translocation (Warden) (SVC sewn to right atrial appendage)	

	Total Anomalous Pulmonary Venous Connection	☐ 4280 = Status post - TAPVC repair ☐ 6200 = Status post - TAPVC repair + Shunt - systemic-to-pulmonary
Cor Triatriatum		☐ 4290 = Status post - Cor triatriatum repair
Pulmonary Venous Stenosis		☐ 4300 = Status post - Pulmonary venous stenosis repair
Systemic Venous Anomalies	Anomalous Systemic Venous Connection	☐ 4310 = Status post - Atrial baffle procedure (non-Mustard, non-Senning) ☐ 4330 = Status post - Anomalous systemic venous connection repair
	Systemic venous obstruction	☐ 4340 = Status post - Systemic venous stenosis repair
Right Heart Lesions	Tetralogy of Fallot	☐ 4350 = Status post - TOF repair, No ventriculotomy ☐ 4360 = Status post - TOF repair, Ventriculotomy, Nontransanular patch ☐ 4370 = Status post - TOF repair, Ventriculotomy, Transanular patch ☐ 4380 = Status post - TOF repair, RV-PA conduit ☐ 4390 = Status post - TOF - AVC (AVSD) repair ☐ 4400 = Status post - TOF - Absent pulmonary valve repair
	Pulmonary Atresia	☐ 4420 = Status post - Pulmonary atresia - VSD (including TOF, PA) repair ☐ 4430 = Status post - Pulmonary atresia - VSD - MAPCA (pseudotruncus) repair ☐ 4440 = Status post - Unifocalization MAPCA(s) ☐ 4450 = Status post - Occlusion MAPCA(s)
	Tricuspid Valve Disease and Ebstein's Anomaly	☐ 4460 = Status post - Valvuloplasty, Tricuspid ☐ 6280 = Status post - Valvuloplasty converted to valve replacement in the same operation, Tricuspid ☐ 4465 = Status post - Ebstein's repair ☐ 4470 = Status post - Valve replacement, Tricuspid (TVR) ☐ 4480 = Status post - Valve closure, Tricuspid (exclusion, univentricular approach) ☐ 4490 = Status post - Valve excision, Tricuspid (without replacement) ☐ 4500 = Status post - Valve surgery, Other, Tricuspid
	RVOT Obstruction, IVS Pulmonary Stenosis	☐ 4510 = Status post - RVOT procedure ☐ 4520 = Status post - 1 1/2 ventricular repair ☐ 4530 = Status post - PA, reconstruction (plasty), Main (trunk) ☐ 4540 = Status post - PA, reconstruction (plasty), Branch, Central (within the hilar bifurcation) ☐ 4550 = Status post - PA, reconstruction (plasty), Branch, Peripheral (at or beyond the hilar bifurcation) ☐ 4570 = Status post - DCRV repair
	Pulmonary Valve Disease	☐ 4590 = Status post - Valvuloplasty, Pulmonic ☐ 6270 = Status post - Valvuloplasty converted to valve replacement in the same operation, Pulmonic ☐ 4600 = Status post - Valve replacement, Pulmonic (PVR) ☐ 4630 = Status post - Valve excision, Pulmonary (without replacement) ☐ 4640 = Status post - Valve closure, Semilunar ☐ 4650 = Status post - Valve surgery, Other, Pulmonic
Conduit operations	Conduit operations	☐ 4610 = Status post - Conduit placement, RV to PA ☐ 4620 = Status post - Conduit placement, LV to PA ☐ 5774 = Status post - Conduit placement, Ventricle to aorta ☐ 5772 = Status post - Conduit placement, Other
	Conduit Stenosis / Insufficiency	☐ 4580 = Status post - Conduit reoperation
Left Heart Lesions	Aortic Valve Disease	☐ 4660 = Status post - Valvuloplasty, Aortic ☐ 6240 = Status post - Valvuloplasty converted to valve replacement in the same operation, Aortic ☐ 6310 = Status post - Valvuloplasty converted to valve replacement in the same operation, Aortic – with Ross procedure ☐ 6320 = Status post - Valvuloplasty converted to valve replacement in the same operation, Aortic – with Ross-Konno procedure ☐ 4670 = Status post - Valve replacement, Aortic (AVR)

		☐ 4680 = Status post - Valve replacement, Aortic (AVR), Mechanical
		☐ 4690 = Status post - Valve replacement, Aortic (AVR), Bioprosthetic
		☐ 4700 = Status post - Valve replacement, Aortic (AVR), Homograft
		☐ 4715 = Status post - Aortic root replacement, Bioprosthetic
		☐ 4720 = Status post - Aortic root replacement, Mechanical
		☐ 4730 = Status post - Aortic root replacement, Homograft
		☐ 4735 = Status post - Aortic root replacement, Valve sparing
		☐ 4740 = Status post - Ross procedure
		☐ 4750 = Status post - Konno procedure
		☐ 4760 = Status post - Ross-Konno procedure
		☐ 4770 = Status post - Other annular enlargement procedure
		☐ 4780 = Status post - Aortic stenosis, Subvalvar, Repair
		☐ 6100 = Status post - Aortic stenosis, Subvalvar, Repair, With myectomy for IHSS
		☐ 4790 = Status post - Aortic stenosis, Supravalvar, Repair
		☐ 4800 = Status post - Valve surgery, Other, Aortic
	Sinus of Valsalva Aneurysm	☐ 4810 = Status post - Sinus of Valsalva, Aneurysm repair
	LV to Aorta Tunnel	☐ 4820 = Status post - LV to aorta tunnel repair
	Mitral Valve Disease	☐ 4830 = Status post - Valvuloplasty, Mitral
		☐ 6260 = Status post - Valvuloplasty converted to valve replacement in the same operation, Mitral
		☐ 4840 = Status post - Mitral stenosis, Supravalvar mitral ring repair
		☐ 4850 = Status post - Valve replacement, Mitral (MVR)
		☐ 4860 = Status post - Valve surgery, Other, Mitral
	Hypoplastic Left Heart	☐ 4870 = Status post - Norwood procedure
		☐ 4880 = Status post - HLHS biventricular repair
		☐ 6160 = Status post - Hybrid Approach "Stage 1", Application of RPA & LPA bands
		☐ 6170 = Status post - Hybrid Approach "Stage 1", Stent placement in arterial duct (PDA)
		☐ 6180 = Status post - Hybrid Approach "Stage 1", Stent placement in arterial duct (PDA) + application of RPA & LPA bands
		☐ 6140 = Status post - Hybrid approach "Stage 2", Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding + Aortic arch repair (Norwood [Stage 1] + Superior Cavopulmonary anastomosis(es) + PA Debanding)
		☐ 6150 = Status post - Hybrid approach "Stage 2", Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding + Without aortic arch repair
Cardiomyopathy		☐ 1590 = Status post - Transplant, Heart
		☐ 1610 = Status post - Transplant, Heart and lung
		☐ 4910 = Status post - Partial left ventriculectomy (LV volume reduction surgery) (Batista)
Pericardial Disease		☐ 4920 = Status post - Pericardial drainage procedure
		☐ 4930 = Status post - Pericardiectomy
		☐ 4940 = Status post - Pericardial procedure, Other
Single Ventricle		☐ 4950 = Status post - Fontan, Atrio-pulmonary connection
		☐ 4960 = Status post - Fontan, Atrio-ventricular connection
		☐ 4970 = Status post - Fontan, TCPC, Lateral tunnel, Fenestrated
		☐ 4980 = Status post - Fontan, TCPC, Lateral tunnel, Nonfenestrated
		☐ 5000 = Status post - Fontan, TCPC, External conduit, Fenestrated
		☐ 5010 = Status post - Fontan, TCPC, External conduit, Nonfenestrated
		☐ 5025 = Status post - Fontan revision or conversion (Re-do Fontan)
		☐ 5030 = Status post - Fontan, Other
		☐ 6340 = Status post - Fontan + Atrioventricular valvuloplasty
		☐ 5035 = Status post - Ventricular septation

Transposition of the Great Arteries	Congenitally Corrected TGA	☐ 5050 = Status post - Congenitally corrected TGA repair, Atrial switch and ASO (double switch) ☐ 5060 = Status post - Congenitally corrected TGA repair, Atrial switch and Rastelli ☐ 5070 = Status post - Congenitally corrected TGA repair, VSD closure ☐ 5080 = Status post - Congenitally corrected TGA repair, VSD closure and LV to PA conduit ☐ 5090 = Status post - Congenitally corrected TGA repair, Other
	Transposition of the Great Arteries	☐ 5110 = Status post - Arterial switch operation (ASO) ☐ 5120 = Status post - Arterial switch operation (ASO) and VSD repair ☐ 5123 = Status post - Arterial switch procedure + Aortic arch repair ☐ 5125 = Status post - Arterial switch procedure and VSD repair + Aortic arch repair ☐ 5130 = Status post - Senning ☐ 5140 = Status post - Mustard ☐ 5145 = Status post - Atrial baffle procedure, Mustard or Senning revision ☐ 5150 = Status post - Rastelli ☐ 5160 = Status post - REV ☐ 6190 = Status post - Aortic root translocation over left ventricle (Including Nikaidoh procedure) ☐ 6210 = Status post - TGA, Other procedures (Kawashima, LV-PA conduit, other)
DORV		☐ 5180 = Status post - DORV, Intraventricular tunnel repair
DOLV		☐ 5200 = Status post - DOLV repair
Thoracic Arteries and Veins	Coarctation of Aorta and Aortic arch hypoplasia	☐ 5210 = Status post - Coarctation repair, End to end ☐ 5220 = Status post - Coarctation repair, End to end, Extended ☐ 5230 = Status post - Coarctation repair, Subclavian flap ☐ 5240 = Status post - Coarctation repair, Patch aortoplasty ☐ 5250 = Status post - Coarctation repair, Interposition graft ☐ 5260 = Status post - Coarctation repair, Other ☐ 5275 = Status post - Coarctation repair + VSD repair ☐ 5280 = Status post - Aortic arch repair ☐ 5285 = Status post - Aortic arch repair + VSD repair
	Coronary Artery Anomalies	☐ 5290 = Status post - Coronary artery fistula ligation ☐ 5291 = Status post - Anomalous origin of coronary artery from pulmonary artery repair ☐ 5300 = Status post - Coronary artery bypass ☐ 5305 = Status post - Anomalous aortic origin of coronary artery from aorta (AAOCA) repair ☐ 5310 = Status post - Coronary artery procedure, Other
	Interrupted Arch	☐ 5320 = Status post - Interrupted aortic arch repair
	Patent Ductus Arteriosus	☐ 5330 = Status post - PDA closure, Surgical ☐ 5340 = PDA closure, Device
	Vascular Rings and Slings	☐ 5360 = Status post - Vascular ring repair ☐ 5365 = Status post - Aortopexy ☐ 5370 = Status post - Pulmonary artery sling repair
	Aortic Aneurysm	☐ 5380 = Status post - Aortic aneurysm repair
	Aortic Dissection	☐ 5390 = Status post - Aortic dissection repair
Thoracic and Mediastinal Disease	Lung Disease	☐ 5400 = Status post - Lung biopsy ☐ 1600 = Status post - Transplant, lung(s) ☐ 5420 = Status post - Lung procedure, Other
	Pectus Excavatum, Carinatum	☐ 5430 = Status post - Pectus repair
	Tracheal Stenosis	☐ 5440 = Status post - Tracheal procedure
Electrophysiological		☐ 5450 = Status post - Pacemaker implantation, Permanent ☐ 5460 = Status post - Pacemaker procedure ☐ 6350 = Status post - Explantation of pacing system

	☐ 5470 = Status post - ICD (AICD) implantation ☐ 5480 = Status post - ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure ☐ 5490 = Status post - Arrhythmia surgery - atrial, Surgical Ablation ☐ 5500 = Status post - Arrhythmia surgery - ventricular, Surgical Ablation
Interventional Cardiology Procedures	☐ 6500 = Status post - Cardiovascular catheterization procedure, Diagnostic ☐ 6520 = Status post - Cardiovascular catheterization procedure, Diagnostic, Angiographic data obtained ☐ 6550 = Status post - Cardiovascular catheterization procedure, Diagnostic, Electrophysiology alteration ☐ 6540 = Status post - Cardiovascular catheterization procedure, Diagnostic, Hemodynamic alteration ☐ 6510 = Status post - Cardiovascular catheterization procedure, Diagnostic, Hemodynamic data obtained ☐ 6530 = Status post - Cardiovascular catheterization procedure, Diagnostic, Transluminal test occlusion ☐ 6410 = Status post - Cardiovascular catheterization procedure, Therapeutic ☐ 6670 = Status post - Cardiovascular catheterization procedure, Therapeutic, Adjunctive therapy ☐ 6570 = Status post - Cardiovascular catheterization procedure, Therapeutic, Balloon dilation ☐ 6590 = Status post - Cardiovascular catheterization procedure, Therapeutic, Balloon valvotomy ☐ 6600 = Status post - Cardiovascular catheterization procedure, Therapeutic, Coil implantation ☐ 6610 = Status post - Cardiovascular catheterization procedure, Therapeutic, Device implantation ☐ 6640 = Status post - Cardiovascular catheterization procedure, Therapeutic, Perforation (establishing interchamber and/or intervessel communication) ☐ 6580 = Status post - Cardiovascular catheterization procedure, Therapeutic, Septostomy ☐ 6620 = Status post - Cardiovascular catheterization procedure, Therapeutic, Stent insertion ☐ 6630 = Status post - Cardiovascular catheterization procedure, Therapeutic, Stent re-dilation ☐ 6650 = Status post - Cardiovascular catheterization procedure, Therapeutic, Transcatheter Fontan completion ☐ 6660 = Status post - Cardiovascular catheterization procedure, Therapeutic, Transcatheter implantation of valve ☐ 6680 = Status post - Cardiovascular electrophysiological catheterization procedure ☐ 6690 = Status post - Cardiovascular electrophysiological catheterization procedure, Therapeutic ablation
Palliative Procedures	☐ 5590 = Status post - Shunt, Systemic to pulmonary, Modified Blalock-Taussig Shunt (MBTS) ☐ 5600 = Status post - Shunt, Systemic to pulmonary, Central (from aorta or to main pulmonary artery) ☐ 5610 = Status post - Shunt, Systemic to pulmonary, Other ☐ 5630 = Status post - Shunt, Ligation and takedown ☐ 6095 = Status post - Shunt, Reoperation ☐ 5640 = Status post - PA banding (PAB) ☐ 5650 = Status post - PA debanding ☐ 5660 = Status post - Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction) ☐ 5670 = Status post - Bidirectional cavopulmonary anastomosis (BDCPA) (bidirectional Glenn) ☐ 5680 = Status post - Glenn (unidirectional cavopulmonary anastomosis) (unidirectional Glenn) ☐ 5690 = Status post - Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn) ☐ 5700 = Status post - HemiFontan ☐ 6330 = Status post - Superior cavopulmonary anastomosis(es) (Glenn or HemiFontan) + Atrioventricular valvuloplasty ☐ 6130 = Status post - Superior Cavopulmonary anastomosis(es) + PA reconstruction ☐ 5710 = Status post - Palliation, Other
Mechanical Support	☐ 6360 = Status post - ECMO cannulation ☐ 6370 = Status post - ECMO decannulation ☐ 5910 = Status post - ECMO procedure ☐ 5900 = Status post - Intraaortic balloon pump (IABP) insertion

		☐ 5920 = Status post - Right/left heart assist device procedure ☐ 6390 = Status post - VAD explantation ☐ 6380 = Status post - VAD implantation
Anesthetic procedures		☐ 6420 = Status post - Echocardiography procedure, Sedated transesophageal echocardiogram ☐ 6430 = Status post - Echocardiography procedure, Sedated transthoracic echocardiogram ☐ 6435 = Status post - Non-cardiovascular, Non-thoracic procedure on cardiac patient with cardiac anesthesia ☐ 6440 = Status post - Radiology procedure on cardiac patient, Cardiac Computerized Axial Tomography (CT Scan) ☐ 6450 = Status post - Radiology procedure on cardiac patient, Cardiac Magnetic Resonance Imaging (MRI) ☐ 6460 = Status post - Radiology procedure on cardiac patient, Diagnostic radiology ☐ 6470 = Status post - Radiology procedure on cardiac patient, Non-Cardiac Computerized Tomography (CT) on cardiac patient ☐ 6480 = Status post - Radiology procedure on cardiac patient, Non-cardiac Magnetic Resonance Imaging (MRI) on cardiac patient ☐ 6490 = Status post - Interventional radiology procedure on cardiac patient
Miscellaneous Procedures		☐ 5720 = Status post - Aneurysm, Ventricular, Right, Repair ☐ 5730 = Status post - Aneurysm, Ventricular, Left, Repair ☐ 5740 = Status post - Aneurysm, Pulmonary artery, Repair ☐ 5760 = Status post - Cardiac tumor resection ☐ 5780 = Status post - Pulmonary AV fistula repair/occlusion ☐ 5790 = Status post - Ligation, Pulmonary artery ☐ 5802 = Status post - Pulmonary embolectomy, Acute pulmonary embolus ☐ 5804 = Status post - Pulmonary embolectomy, Chronic pulmonary embolus ☐ 5810 = Status post - Pleural drainage procedure ☐ 5820 = Status post - Pleural procedure, Other ☐ 5830 = Status post - Ligation, Thoracic duct ☐ 5840 = Status post - Decortication ☐ 5850 = Status post - Esophageal procedure ☐ 5860 = Status post - Mediastinal procedure ☐ 5870 = Status post - Bronchoscopy ☐ 5880 = Status post - Diaphragm plication ☐ 5890 = Status post - Diaphragm procedure, Other ☐ 5930 = Status post - VATS (video-assisted thoracoscopic surgery) ☐ 5940 = Status post - Minimally invasive procedure ☐ 5950 = Status post - Bypass for noncardiac lesion ☐ 5960 = Status post - Delayed sternal closure ☐ 5970 = Status post - Mediastinal exploration ☐ 5980 = Status post - Sternotomy wound drainage ☐ 5990 = Status post - Thoracotomy, Other ☐ 6000 = Status post - Cardiotomy, Other ☐ 6010 = Status post - Cardiac procedure, Other ☐ 6020 = Status post - Thoracic and/or mediastinal procedure, Other ☐ 6030 = Status post - Peripheral vascular procedure, Other ☐ 6040 = Status post - Miscellaneous procedure, Other ☐ 6050 = Status post - Organ procurement ☐ 11777 = Status post - Other procedure

PROCEDURES		
Select ALL procedures that apply. (↓)		Circle the ONE PRIMARY procedure for this operation.
Septal Defects	ASD	☐ 10 = PFO, Primary closure ☐ 20 = ASD repair, Primary closure ☐ 30 = ASD repair, Patch

		☐ 40 = ASD repair, Device
		☐ 2110 = ASD repair, Patch + PAPVC repair
		☐ 50 = ASD, Common atrium (single atrium), Septation
		☐ 60 = ASD creation/enlargement
		☐ 70 = ASD partial closure
		☐ 80 = Atrial septal fenestration
		☐ 85 = Atrial fenestration closure
	VSD	☐ 100 = VSD repair, Primary closure
		☐ 110 = VSD repair, Patch
		☐ 120 = VSD repair, Device
		☐ 130 = VSD, Multiple, Repair
		☐ 140 = VSD creation/enlargement
		☐ 150 = Ventricular septal fenestration
	AV Canal	☐ 170 = AVC (AVSD) repair, Complete (CAVSD)
		☐ 180 = AVC (AVSD) repair, Intermediate (Transitional)
		☐ 190 = AVC (AVSD) repair, Partial (Incomplete) (PAVSD)
		☐ 2300 = Valvuloplasty, Common atrioventricular valve
		☐ 2250 = Valvuloplasty converted to valve replacement in the same operation, Common atrioventricular valve
		☐ 2230 = Valve replacement, Common atrioventricular valve
	AP Window	☐ 210 = AP window repair
		☐ 220 = Pulmonary artery origin from ascending aorta (hemitruncus) repair
	Truncus Arteriosus	☐ 230 = Truncus arteriosus repair
		☐ 240 = Valvuloplasty, Truncal valve
		☐ 2290 = Valvuloplasty converted to valve replacement in the same operation, Truncal valve
		☐ 250 = Valve replacement, Truncal valve
		☐ 2220 = Truncus + Interrupted aortic arch repair (IAA) repair
Pulmonary Venous Anomalies	Partial Anomalous Pulmonary Venous Connection	☐ 260 = PAPVC repair
		☐ 270 = PAPVC, Scimitar, Repair
		☐ 2120 = PAPVC repair, Baffle redirection to left atrium with systemic vein translocation (Warden) (SVC sewn to right atrial appendage)
	Total Anomalous Pulmonary Venous Connection	☐ 280 = TAPVC repair
		☐ 2200 = TAPVC repair + Shunt - systemic-to-pulmonary
Cor Triatriatum		☐ 290 = Cor triatriatum repair
Pulmonary Venous Stenosis		☐ 300 = Pulmonary venous stenosis repair
Systemic Venous Anomalies	Anomalous Systemic Venous Connection	☐ 310 = Atrial baffle procedure (non-Mustard, non-Senning)
		☐ 330 = Anomalous systemic venous connection repair
	Systemic venous obstruction	☐ 340 = Systemic venous stenosis repair
Right Heart Lesions	Tetralogy of Fallot	☐ 350 = TOF repair, No ventriculotomy
		☐ 360 = TOF repair, Ventriculotomy, Nontransanular patch
		☐ 370 = TOF repair, Ventriculotomy, Transanular patch
		☐ 380 = TOF repair, RV-PA conduit
		☐ 390 = TOF - AVC (AVSD) repair
		☐ 400 = TOF - Absent pulmonary valve repair
	Pulmonary Atresia	☐ 420 = Pulmonary atresia - VSD (including TOF, PA) repair
		☐ 430 = Pulmonary atresia - VSD - MAPCA (pseudotruncus) repair
		☐ 440 = Unifocalization MAPCA(s)
		☐ 450 = Occlusion MAPCA(s)
	Tricuspid Valve Disease and Ebstein's Anomaly	☐ 460 = Valvuloplasty, Tricuspid
		☐ 2280 = Valvuloplasty converted to valve replacement in the same operation, Tricuspid

		☐ 465 = Ebstein's repair
		☐ 470 = Valve replacement, Tricuspid (TVR)
		☐ 480 = Valve closure, Tricuspid (exclusion, univentricular approach)
		☐ 490 = Valve excision, Tricuspid (without replacement)
		☐ 500 = Valve surgery, Other, Tricuspid
	RVOT Obstruction, IVS Pulmonary Stenosis	☐ 510 = RVOT procedure
		☐ 520 = 1 1/2 ventricular repair
		☐ 530 = PA, reconstruction (plasty), Main (trunk)
		☐ 540 = PA, reconstruction (plasty), Branch, Central (within the hilar bifurcation)
		☐ 550 = PA, reconstruction (plasty), Branch, Peripheral (at or beyond the hilar bifurcation)
		☐ 570 = DCRV repair
	Pulmonary Valve Disease	☐ 590 = Valvuloplasty, Pulmonic
		☐ 2270 = Valvuloplasty converted to valve replacement in the same operation, Pulmonic
		☐ 600 = Valve replacement, Pulmonic (PVR)
		☐ 630 = Valve excision, Pulmonary (without replacement)
		☐ 640 = Valve closure, Semilunar
		☐ 650 = Valve surgery, Other, Pulmonic
Conduit operations	Conduit operations	☐ 610 = Conduit placement, RV to PA
		☐ 620 = Conduit placement, LV to PA
		☐ 1774 = Conduit placement, Ventricle to aorta
		☐ 1772 = Conduit placement, Other
	Conduit Stenosis / Insufficiency	☐ 580 = Conduit reoperation
Left Heart Lesions	Aortic Valve Disease	☐ 660 = Valvuloplasty, Aortic
		☐ 2240 = Valvuloplasty converted to valve replacement in the same operation, Aortic
		☐ 2310 = Valvuloplasty converted to valve replacement in the same operation, Aortic – with Ross procedure
		☐ 2320 = Valvuloplasty converted to valve replacement in the same operation, Aortic – with Ross-Konno procedure
		☐ 670 = Valve replacement, Aortic (AVR)
		☐ 680 = Valve replacement, Aortic (AVR), Mechanical
		☐ 690 = Valve replacement, Aortic (AVR), Bioprosthetic
		☐ 700 = Valve replacement, Aortic (AVR), Homograft
		☐ 715 = Aortic root replacement, Bioprosthetic
		☐ 720 = Aortic root replacement, Mechanical
		☐ 730 = Aortic root replacement, Homograft
		☐ 735 = Aortic root replacement, Valve sparing
		☐ 740 = Ross procedure
		☐ 750 = Konno procedure
		☐ 760 = Ross-Konno procedure
		☐ 770 = Other annular enlargement procedure
		☐ 780 = Aortic stenosis, Subvalvar, Repair
		☐ 2100 = Aortic stenosis, Subvalvar, Repair, With myectomy for IHSS
		☐ 790 = Aortic stenosis, Supravalvar, Repair
		☐ 800 = Valve surgery, Other, Aortic
	Sinus of Valsalva Aneurysm	☐ 810 = Sinus of Valsalva, Aneurysm repair
	LV to Aorta Tunnel	☐ 820 = LV to aorta tunnel repair
	Mitral Valve Disease	☐ 830 = Valvuloplasty, Mitral
		☐ 2260 = Valvuloplasty converted to valve replacement in the same operation, Mitral
		☐ 840 = Mitral stenosis, Supravalvar mitral ring repair
		☐ 850 = Valve replacement, Mitral (MVR)

		☐ 860 = Valve surgery, Other, Mitral
	Hypoplastic Left Heart	☐ 870 = Norwood procedure ☐ 880 = HLHS biventricular repair ☐ 2160 = Hybrid Approach "Stage 1", Application of RPA & LPA bands ☐ 2170 = Hybrid Approach "Stage 1", Stent placement in arterial duct (PDA) ☐ 2180 = Hybrid Approach "Stage 1", Stent placement in arterial duct (PDA) + application of RPA & LPA bands ☐ 2140 = Hybrid approach "Stage 2", Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding + Aortic arch repair (Norwood [Stage 1] + Superior Cavopulmonary anastomosis(es) + PA Debanding) ☐ 2150 = Hybrid approach "Stage 2", Aortopulmonary amalgamation + Superior Cavopulmonary anastomosis(es) + PA Debanding + Without aortic arch repair
Cardiomyopathy		☐ 890 = Transplant, Heart ☐ 900 = Transplant, Heart and lung ☐ 910 = Partial left ventriculectomy (LV volume reduction surgery) (Batista)
Pericardial Disease		☐ 920 = Pericardial drainage procedure ☐ 930 = Pericardiectomy ☐ 940 = Pericardial procedure, Other
Single Ventricle		☐ 950 = Fontan, Atrio-pulmonary connection ☐ 960 = Fontan, Atrio-ventricular connection ☐ 970 = Fontan, TCPC, Lateral tunnel, Fenestrated ☐ 980 = Fontan, TCPC, Lateral tunnel, Nonfenestrated ☐ 1000 = Fontan, TCPC, External conduit, Fenestrated ☐ 1010 = Fontan, TCPC, External conduit, Nonfenestrated ☐ 1025 = Fontan revision or conversion (Re-do Fontan) ☐ 1030 = Fontan, Other ☐ 2340 = Fontan + Atrioventricular valvuloplasty ☐ 1035 = Ventricular septation
Transposition of the Great Arteries	Congenitally Corrected TGA	☐ 1050 = Congenitally corrected TGA repair, Atrial switch and ASO (double switch) ☐ 1060 = Congenitally corrected TGA repair, Atrial switch and Rastelli ☐ 1070 = Congenitally corrected TGA repair, VSD closure ☐ 1080 = Congenitally corrected TGA repair, VSD closure and LV to PA conduit ☐ 1090 = Congenitally corrected TGA repair, Other
	Transposition of the Great Arteries	☐ 1110 = Arterial switch operation (ASO) ☐ 1120 = Arterial switch operation (ASO) and VSD repair ☐ 1123 = Arterial switch procedure + Aortic arch repair ☐ 1125 = Arterial switch procedure and VSD repair + Aortic arch repair ☐ 1130 = Senning ☐ 1140 = Mustard ☐ 1145 = Atrial baffle procedure, Mustard or Senning revision ☐ 1150 = Rastelli ☐ 1160 = REV ☐ 2190 = Aortic root translocation over left ventricle (Including Nikaidoh procedure) ☐ 2210 = TGA, Other procedures (Kawashima, LV-PA conduit, other)
DORV		☐ 1180 = DORV, Intraventricular tunnel repair
DOLV		☐ 1200 = DOLV repair
Thoracic Arteries and Veins	Coarctation of Aorta and Aortic arch hypoplasia	☐ 1210 = Coarctation repair, End to end ☐ 1220 = Coarctation repair, End to end, Extended ☐ 1230 = Coarctation repair, Subclavian flap ☐ 1240 = Coarctation repair, Patch aortoplasty ☐ 1250 = Coarctation repair, Interposition graft ☐ 1260 = Coarctation repair, Other ☐ 1275 = Coarctation repair + VSD repair

		☐	1280 = Aortic arch repair
		☐	1285 = Aortic arch repair + VSD repair
	Coronary Artery Anomalies	☐	1290 = Coronary artery fistula ligation
		☐	1291 = Anomalous origin of coronary artery from pulmonary artery repair
		☐	1300 = Coronary artery bypass
		☐	1305 = Anomalous aortic origin of coronary artery from aorta (AAOCA) repair
		☐	1310 = Coronary artery procedure, Other
	Interrupted Arch	☐	1320 = Interrupted aortic arch repair
	Patent Ductus Arteriosus	☐	1330 = PDA closure, Surgical
		☐	1340 = PDA closure, Device
	Vascular Rings and Slings	☐	1360 = Vascular ring repair
		☐	1365 = Aortopexy
		☐	1370 = Pulmonary artery sling repair
	Aortic Aneurysm	☐	1380 = Aortic aneurysm repair
	Aortic Dissection	☐	1390 = Aortic dissection repair
Thoracic and Mediastinal Disease	Lung Disease	☐	1400 = Lung biopsy
		☐	1410 = Transplant, lung(s)
		☐	1420 = Lung procedure, Other
	Pectus Excavatum, Carinatum	☐	1430 = Pectus repair
	Tracheal Stenosis	☐	1440 = Tracheal procedure
Electrophysiological		☐	1450 = Pacemaker implantation, Permanent
		☐	1460 = Pacemaker procedure
		☐	2350 = Explantation of pacing system
		☐	1470 = ICD (AICD) implantation
		☐	1480 = ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure
		☐	1490 = Arrhythmia surgery - atrial, Surgical Ablation
		☐	1500 = Arrhythmia surgery - ventricular, Surgical Ablation
Interventional Cardiology Procedures		☐	2500 = Cardiovascular catheterization procedure, Diagnostic
		☐	2520 = Cardiovascular catheterization procedure, Diagnostic, Angiographic data obtained
		☐	2550 = Cardiovascular catheterization procedure, Diagnostic, Electrophysiology alteration
		☐	2540 = Cardiovascular catheterization procedure, Diagnostic, Hemodynamic alteration
		☐	2510 = Cardiovascular catheterization procedure, Diagnostic, Hemodynamic data obtained
		☐	2530 = Cardiovascular catheterization procedure, Diagnostic, Transluminal test occlusion
		☐	2410 = Cardiovascular catheterization procedure, Therapeutic
		☐	2670 = Cardiovascular catheterization procedure, Therapeutic, Adjunctive therapy
		☐	1540 = Cardiovascular catheterization procedure, Therapeutic, Balloon dilation
		☐	2590 = Cardiovascular catheterization procedure, Therapeutic, Balloon valvotomy
		☐	1580 = Cardiovascular catheterization procedure, Therapeutic, Coil implantation
		☐	1560 = Cardiovascular catheterization procedure, Therapeutic, Device implantation
		☐	2640 = Cardiovascular catheterization procedure, Therapeutic, Perforation (establishing interchamber and/or intervessel communication)
		☐	2580 = Cardiovascular catheterization procedure, Therapeutic, Septostomy
		☐	1550 = Cardiovascular catheterization procedure, Therapeutic, Stent insertion
		☐	2630 = Cardiovascular catheterization procedure, Therapeutic, Stent re-dilation
		☐	2650 = Cardiovascular catheterization procedure, Therapeutic, Transcatheter Fontan completion
		☐	2660 = Cardiovascular catheterization procedure, Therapeutic, Transcatheter implantation of valve
		☐	2680 = Cardiovascular electrophysiological catheterization procedure
		☐	2690 = Cardiovascular electrophysiological catheterization procedure, Therapeutic ablation

Palliative Procedures	☐ 1590 = Shunt, Systemic to pulmonary, Modified Blalock-Taussig Shunt (MBTS) ☐ 1600 = Shunt, Systemic to pulmonary, Central (from aorta or to main pulmonary artery) ☐ 1610 = Shunt, Systemic to pulmonary, Other ☐ 1630 = Shunt, Ligation and takedown ☐ 2095 = Shunt, Reoperation ☐ 1640 = PA banding (PAB) ☐ 1650 = PA debanding ☐ 1660 = Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction) ☐ 1670 = Bidirectional cavopulmonary anastomosis (BDCPA) (bidirectional Glenn) ☐ 1680 = Glenn (unidirectional cavopulmonary anastomosis) (unidirectional Glenn) ☐ 1690 = Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn) ☐ 1700 = HemiFontan ☐ 2330 = Superior cavopulmonary anastomosis(es) (Glenn or HemiFontan) + Atrioventricular valvuloplasty ☐ 2130 = Superior Cavopulmonary anastomosis(es) + PA reconstruction ☐ 1710 = Palliation, Other
Mechanical Support	☐ 2360 = ECMO cannulation ☐ 2370 = ECMO decannulation ☐ 1910 = ECMO procedure ☐ 1900 = Intraaortic balloon pump (IABP) insertion ☐ 1920 = Right/left heart assist device procedure ☐ 2390 = VAD explantation ☐ 2380 = VAD implantation
Anesthetic procedures	☐ 2420 = Echocardiography procedure, Sedated transesophageal echocardiogram ☐ 2430 = Echocardiography procedure, Sedated transthoracic echocardiogram ☐ 2435 = Non-cardiovascular, Non-thoracic procedure on cardiac patient with cardiac anesthesia ☐ 2440 = Radiology procedure on cardiac patient, Cardiac Computerized Axial Tomography (CT Scan) ☐ 2450 = Radiology procedure on cardiac patient, Cardiac Magnetic Resonance Imaging (MRI) ☐ 2460 = Radiology procedure on cardiac patient, Diagnostic radiology ☐ 2470 = Radiology procedure on cardiac patient, Non-Cardiac Computerized Tomography (CT) on cardiac patient ☐ 2480 = Radiology procedure on cardiac patient, Non-cardiac Magnetic Resonance Imaging (MRI) on cardiac patient ☐ 2490 = Radiology procedure on cardiac patient, Therapeutic radiology
Miscellaneous Procedures	☐ 1720 = Aneurysm, Ventricular, Right, Repair ☐ 1730 = Aneurysm, Ventricular, Left, Repair ☐ 1740 = Aneurysm, Pulmonary artery, Repair ☐ 1760 = Cardiac tumor resection ☐ 1780 = Pulmonary AV fistula repair/occlusion ☐ 1790 = Ligation, Pulmonary artery ☐ 1802 = Pulmonary embolectomy, Acute pulmonary embolus ☐ 1804 = Pulmonary embolectomy, Chronic pulmonary embolus ☐ 1810 = Pleural drainage procedure ☐ 1820 = Pleural procedure, Other ☐ 1830 = Ligation, Thoracic duct ☐ 1840 = Decortication ☐ 1850 = Esophageal procedure ☐ 1860 = Mediastinal procedure ☐ 1870 = Bronchoscopy

☐ 1880 = Diaphragm plication
☐ 1890 = Diaphragm procedure, Other
☐ 1930 = VATS (video-assisted thoracoscopic surgery)
☐ 1940 = Minimally invasive procedure
☐ 1950 = Bypass for noncardiac lesion
☐ 1960 = Delayed sternal closure
☐ 1970 = Mediastinal exploration
☐ 1980 = Sternotomy wound drainage
☐ 1990 = Thoracotomy, Other
☐ 2000 = Cardiotomy, Other
☐ 2010 = Cardiac procedure, Other
☐ 2020 = Thoracic and/or mediastinal procedure, Other
☐ 2030 = Peripheral vascular procedure, Other
☐ 2040 = Miscellaneous procedure, Other
☐ 2050 = Organ procurement
☐ 7777 = Other procedure

OPERATIVE

Procedure Location:
☐ Cardiac OR ☐ ICU ☐ SICU
☐ General OR ☐ CVICU ☐ Radiology Suite
☐ Hybrid Suite ☐ NICU ☐ Procedure Room
☐ Cath lab ☐ PICU ☐ Other

Operation Type: ☐ CPB ☐ No CPB Cardiovascular ☐ ECMO
☐ Thoracic ☐ Interventional Cardiology ☐ VAD w/ CPB
☐ VAD w/out CPB ☐ NonCardiac/NonThoracic Procedure w/ Anesthesia ☐ Other

If Op type is NonCardiac/NonThoracic Procedure w/Anesthesia, skip to Complications section

Surgeon: | Surgeon NPI: | Taxpayer Identification Number:

Assisting Surgeon: | Assisting Surgeon NPI:

Resident Surgeon: | Resident Surgeon Identifier:

Consultant Attending: | Consultant Attending Identifier:

Referring Cardiologist: | Referring Physician:

Reoperation Within This Admission: ☐ **Yes – Planned reoperation** ☐ **No** ☐ **Yes – Unplanned reoperation**

Number of Prior Cardiothoracic Operations: | Number of Prior CPB Cardiothoracic Operations:

OR Entry Time: *(00:00 – 23:59)* __ __: __ __ | Skin Incision Start Time: *(00:00 – 23:59)* __ __: __ __

(If operation type is No CPB Cardiovascular→) Cross Clamp Time – No CPB: *(minutes):*

(If operation type is CPB or VAD w/ CPB↓)

CPB Time *(minutes):* Cross Clamp Time - CPB:*(minutes):* Circulatory Arrest Time *(minutes):*

Patient Temperature Monitoring Site : (IF Yes, Lowest Core Temperature recorded at site):

Bladder:	☐ Yes ☐ No	*(If Yes →)*	_____ °C
Esophageal:	☐ Yes ☐ No	*(If Yes →)*	_____ °C
Nasopharyngeal:	☐ Yes ☐ No	*(If Yes →)*	_____ °C
Rectal:	☐ Yes ☐ No	*(If Yes →)*	_____ °C
Tympanic:	☐ Yes ☐ No	*(If Yes →)*	_____ °C
Other:	☐ Yes ☐ No	*(If Yes →)*	_____ °C

Cooling Time: *(minutes)* Rewarming Time: *(minutes)*

Cerebral Perfusion Utilized: ☐ Yes ☐ No *(If Yes ↓)*

Cerebral Perfusion Time: _____ *(minutes)*

Cerebral Perfusion Cannulation Site:

Innominate Artery	☐ Yes ☐ No	Right Subvclavian	☐ Yes ☐ No
Right Axillary Artery	☐ Yes ☐ No	Right Carotid Artery	☐ Yes ☐ No
Left Carotid Artery	☐ Yes ☐ No	Superior Vena Cava	☐ Yes ☐ No

Cerebral Perfusion Periods: _____
Cerebral Perfusion Flow Rate: _____ *(mL/kg) per minute*
Cerebral Perfusion Temperature: _____ °C

Arterial Blood Gas Management During Cooling: ☐ Alpha STAT ☐ pH STAT
☐ phSTAT cooling/Alpha STAT rewarming ☐ Other Combination

Hematocrit Prior to Circulatory Arrest or Cerebral Perfusion: _____

Cardioplegia Administered: ☐ Yes ☐ No *(If Yes ↓)*

Cardioplegia Number of Doses: _____
Cardioplegia Delivery Ratio: Blood Solution (BS) ____ Cardioplegia Solution (CS) _____
Initial Delivery Route of Cardioplegia:

Antegrade Aortic Root	☐ Yes ☐ No	Antegrade Right Coronary Ostia	☐ Yes ☐ No
Antegrade Left Coronary Ostia	☐ Yes ☐ No	Retrograde Coronary Sinus	☐ Yes ☐ No

Subsequent Delivery Route of Cardioplegia:

Antegrade Aortic Root	☐ Yes ☐ No	Antegrade Right Coronary Ostia	☐ Yes ☐ No
Antegrade Left Coronary Ostia	☐ Yes ☐ No	Retrograde Coronary Sinus	☐ Yes ☐ No

Longest Myocardial Ischemic Interval: _____ *(minutes)*

Cardioplegia Solution: ☐ Hyperpolarizing ☐ Depolarizing ☐ Modified Depolarizing ☐ None

Lowest Hematocrit on CPB: _____

Endotracheal Intubation Performed ☐ Yes ☐ No *(If Yes ↓)*

Intubation Date/Time: *(mm/dd/yyyy 00:00 – 23:59)* _ _ / _ _ / _ _ _ _ _ _:_ _

Initial Extubation Date/Time: *(mm/dd/yyyy 00:00 – 23:59)* _ _ / _ _ / _ _ _ _ _ _:_ _

Extubated in OR: ☐ Yes ☐ No

Re-Intubated After Initial Postoperative Extubation: ☐ Yes ☐ No *(If Yes ↓)*

Final Extubation Date/Time: *(mm/dd/yyyy 00:00 – 23:59)* _ _ / _ _ / _ _ _ _ _ _:_ _

Time of Skin Closure: *(00:00 – 23:59)* _ _:_ _ | OR Exit Time: *(00:00 – 23:59)* _ _:_ _ | Extended Through Midnight: ☐ Yes ☐ No

Pulmonary Vascular Resistance Measured: ☐ Yes ☐ No

(If Yes and WeightKg >=40 →) PVR: _____ *(Wood units)*

(If Yes and WeightKg <40 →) PVR Index: _____ *(Wood units x m2)*

Intraoperative Near Infrared Spectroscopy (NIRS) Cerebral Metrics Used: ☐ Yes ☐ No *(If Yes ↓)*

Cerebral Oximeter Provided First Indication: ☐ Yes ☐ No

Pre-Induction Baseline Regional Oxygen Saturation: Left: ____ *(%)* Right ____ *(%)* Center ____ *(%)*

Cumulative Saturation Below Threshold: Left: ____ *(minute-%)* Right ____ *(minute-%)* Center ____ *(minute-%)*

Skin Closure Regional Oxygen Saturation: Left: ____ *(%)* Right ____ *(%)* Center ____ *(%)*

Cerebral Regional Oxygen Saturation Percentiles:

Percentile Range:	<=30	31-40	41-50	51-60	61-70	71-80	81-90	>90
Minutes:								

Intraoperative Near Infrared Spectroscopy (NIRS) Somatic Metrics Used: ☐ Yes ☐ No *(If Yes ↓)*

Somatic Oximeter Provided First Indication: ☐ Yes ☐ No

Somatic Sensor Location: ☐ Renal ☐ Mesenteric

Pre-Induction Baseline Somatic Regional Oxygen Saturation: _____ *(%)*

Cumulative Somatic Saturation Below Threshold: _____ *(minute-%)*

Somatic Regional Oxygen Saturation Percentiles:

Percentile Range:	<=30	31-40	41-50	51-60	61-70	71-80	81-90	>90
Minutes:								

Postoperative Near Infrared Spectroscopy (NIRS) Cerebral Metrics Used: ☐ Yes ☐ No *(If Yes ↓)*

Cerebral Oximeter Provided First Indication: ☐ Yes ☐ No

Cumulative Cerebral Saturation Below Threshold:

Left: ____ *(minute-%)* Right: ____ *(minute-%)* Center: ____ *(minute-%)*

Cerebral Regional Oxygen Saturation Percentiles:

Percentile Range:	<=30	31-40	41-50	51-60	61-70	71-80	81-90	>90
Minutes:								

Postoperative Near Infrared Spectroscopy (NIRS) Somatic Metrics Used: ☐ Yes ☐ No *(If Yes ↓)*

Somatic Oximeter Provided First Indication: ☐ Yes ☐ No

Somatic Sensor Location: ☐ Renal ☐ Mesenteric

Cumulative Somatic Saturation Below Threshold: _____ *(minute-%)*

Somatic Regional Oxygen Saturation Percentiles:

Percentile Range:	<=30	31-40	41-50	51-60	61-70	71-80	81-90	>90
Minutes:								

Intraop Blood Products Used: ☐ Yes ☐ No

*(If No →)*Intraop Blood Products Refused: ☐ Yes ☐ No

(If Yes ↓)			Number of donor exposures:	Number of Units:	Number of Milliliters:
Red Blood Cells	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Fresh Frozen Plasma	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____

Cryoprecipitate	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Platelets	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Whole Blood	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Factor VIIa	☐ Yes ☐ No	*(If Yes →)*	Total Dosage: _____ (micrograms / kg)		

Intraop Medications:

Aprotinin:	☐ Yes ☐ No	*(If Yes →)*	Aprotinin – Dose: Full Dose Half Dose
Epsilon Amino-Caproic Acid:	☐ Yes ☐ No	*(If Yes →)*	Dose: _____
Desmopressin:	☐ Yes ☐ No	*(If Yes →)*	Dose: _____
Tranexamic Acid:	☐ Yes ☐ No	*(If Yes →)*	Dose: _____

POST OPERATIVE

Blood Products Used Postoperatively: ☐ Yes ☐ No

(If Yes ↓)			Number of donor exposures:	Number of Units:	Number of Milliliters:
Red Blood Cells	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Fresh Frozen Plasma	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Cryoprecipitate	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Platelets	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Whole Blood	☐ Yes ☐ No	*(If Yes →)*	_____	_____	_____
Factor VIIa	☐ Yes ☐ No	*(If Yes →)*	Total Dosage: _____ (micrograms / kg)		

COMPLICATIONS

☐ 15 = No complications

OR select ALL that apply: (↓)

☐ 16 = No complications during the intraoperative and postoperative time periods (No complications prior to discharge and no complications within < or = 30 days of surgery)

☐ 350 = Intraoperative death or intraprocedural death

☐ 360 = Unplanned readmission to the hospital within 30 days of surgery or intervention

☐ 370 = Multi-System Organ Failure (MSOF) = Multi-Organ Dysfunction Syndrome (MODS)

☐ 30 = Cardiac arrest, Timing = Cardiac arrest (MI) during or following procedure (Perioperative/Periprocedural = Intraoperative/Intraprocedural and/or Postoperative/Postprocedural)

☐ 80 = Cardiac dysfunction resulting in low cardiac output

☐ 384 = Cardiac failure (severe cardiac dysfunction)

☐ 280 = Endocarditis-postprocedural infective endocarditis

☐ 110 = Pericardial effusion, Requiring drainage

☐ 390 = Pulmonary hypertension

☐ 140 = Pulmonary hypertensive crisis (PA pressure > systemic pressure)

☐ 130 = Pulmonary vein obstruction

☐ 120 = Systemic vein obstruction

☐ 240 = Bleeding, Requiring reoperation

☐ 102 = Sternum left open, Planned

☐ 104 = Sternum left open, Unplanned

☐ 22 = Unplanned cardiac reoperation during the postoperative or postprocedural time period, exclusive of reoperation for bleeding

☐ 24 = Unplanned interventional cardiovascular catheterization procedure during the postoperative or postprocedural time period

☐ 26 = Unplanned non-cardiac reoperation during the postoperative or postprocedural time period

☐ 40 = Postoperative/Postprocedural mechanical circulatory support (IABP, VAD, ECMO, or CPS)

☐ 71 = Arrhythmia

☐ 72 = Arrhythmia requiring drug therapy

☐ 73 = Arrhythmia requiring electrical cardioversion or defibrillation

☐ 74 = Arrhythmia necessitating pacemaker, Permanent pacemaker

☐ 75 = Arrhythmia necessitating pacemaker, Temporary pacemaker

☐ 210 = Chylothorax

☐ 200 =Pleural effusion, Requiring drainage

☐ 180 = Pneumonia

☐ 190 = Pneumothorax, Requiring intervention

☐ 150 = Postoperative/Postprocedural respiratory insufficiency requiring mechanical ventilatory support > 7 days

☐ 160 = Postoperative/Postprocedural respiratory insufficiency requiring reintubation

☐ 170 = Respiratory failure, Requiring tracheostomy

☐ 230 = Renal failure - acute renal failure, Acute renal failure requiring dialysis at the time of hospital discharge

☐ 223 = Renal failure - acute renal failure, Acute renal failure requiring temporary dialysis with the need for dialysis not present at hospital discharge

☐ 224 = Renal failure - acute renal failure, Acute renal failure requiring temporary hemofiltration with the need for dialysis not present at hospital discharge

☐ 290= Sepsis

☐ 320 = Neurological deficit, Neurological deficit persisting at discharge

☐ 325 = Neurological deficit, Transient neurological deficit not present at discharge

☐ 300 = Paralyzed diaphragm (possible phrenic nerve injury)

☐ 400 = Peripheral nerve injury, Neurological deficit persisting at discharge

☐ 331 = Seizure

☐ 410 = Spinal cord injury, Neurological deficit persisting at discharge

☐ 420 = Stroke

☐ 310 = Vocal cord dysfunction (possible recurrent laryngeal nerve injury)

☐ 250 = Wound dehiscence (sterile)

☐ 255 = Wound dehiscence (sterile), Median sternotomy

☐ 261 = Wound infection

☐ 262 = Wound infection-Deep wound infection

☐ 270 = Wound infection-Mediastinitis

☐ 263 = Wound infection-Superficial wound infection

☐ 900 = Other complication

☐ 901 = Other operative/procedural complication

DISCHARGE/READMISSION

Reoperation after this operation within this admission: ☐ Yes ☐ No

Date of Hospital Discharge: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __

Mortality Status at Hospital Discharge: ☐ Alive ☐ Dead

(If Alive →) Discharge Location: ☐ Home ☐ Other Acute Care Center ☐ Other Chronic Care Center

Date of Database Discharge: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __

Mortality Status at Database Discharge: ☐ Alive ☐ Dead ☐ Unknown *(If Alive ↓)*

Readmission within 30 days: ☐ Yes ☐ No *(If Yes →)* Readmission Date: *(mm/dd/yyyy)* __ __ / __ __ / __ __ __ __

(If Yes →) Primary Readmission Reason *(select one↓):*

- ☐ 26 = Thrombotic Complication
- ☐ 27 = Embolic Complication
- ☐ 28 = Hemorrhagic Complication
- ☐ 29 = Stenotic Complication
- ☐ 2 = Arrhythmias/Heart Block
- ☐ 3 = Congestive Heart Failure
- ☐ 30 = Cardiac Transplant Rejection
- ☐ 31 = Myocardial Ischemia
- ☐ 14 = Renal Failure
- ☐ 6 = Pericardial Effusion and/or Tamponade
- ☐ 32 = Pleural Effusion
- ☐ 33 = Neurologic Complication
- ☐ 7 = Respiratory Complication/Airway Complication
- ☐ 34 = Septic/Infectious Complication
- ☐ 35 = Cardiovascular Device Complications
- ☐ 36 = Residual/Recurrent Cardiovascular Defects
- ☐ 37 = Failure to Thrive
- ☐ 25 = VAD Complications
- ☐ 39 = Gastrointestinal Complication
- ☐ 38 = Other Cardiovascular Complication
- ☐ 998 = Other - Readmission related to this index operation
- ☐ 999 = Other - Readmission not related to this index operation

Status at 30 days after surgery: ☐ Alive ☐ Dead ☐ Unknown

Mortality Assigned to this Operation: ☐ Yes ☐ No Operative Mortality: ☐ Yes ☐ No

ANESTHESIA

ANESTHESIA Administrative

Primary Anesthesiologist Attending: _____

Secondary Anesthesiologist Attending ☐ Yes ☐ No *(If Yes →)* Name: _____

Fellow or Resident Present ☐ Yes ☐ No

CRNA/SRNA Present ☐ Yes ☐ No *(If Yes →)* Name: _____

Non-CV Physician: _____

ANESTHESIA Preoperative

Preoperative Medications: ☐ None *(If not None, select all pre-operative medications that apply: ↓)*

- ☐ Amiodarone
- ☐ Aspirin
- ☐ Bosentan
- ☐ Captopril (Capoten)
- ☐ Clopidogrel
- ☐ Coumadin
- ☐ Digoxin
- ☐ Diltiazem
- ☐ Dobutamine
- ☐ Dopamine
- ☐ Enalapril
- ☐ Epinephrine (Adrenalin)
- ☐ Esmolol (Brevibloc)
- ☐ Fentanyl
- ☐ Furosemide (Lasix)
- ☐ Heparin
- ☐ Low Molecular Weight Heparin
- ☐ Labetolol
- ☐ Lisinopril
- ☐ Midazolam (Versed)
- ☐ Milrinone
- ☐ Morphine
- ☐ Nitroglycerin
- ☐ Nitroprusside
- ☐ Norepinephrine (Levophed)
- ☐ Propranolol
- ☐ Prostaglandin
- ☐ Sildenafil
- ☐ Sotalol
- ☐ Vasopressin
- ☐ ACE inhibitors not otherwise listed
- ☐ Beta Blockers not otherwise listed
- ☐ Anti-arrhythmics not otherwise listed
- ☐ Inotropes not otherwise listed (e.g., study drugs (levosimendan))
- ☐ Vasodilators not otherwise listed
- ☐ Vasoconstrictors not otherwise listed

Preoperative Sedation ☐ Yes ☐ No

(If Yes →) Preoperative Sedation Route: ☐ IM ☐ IV ☐ Nasal ☐ PO (Oral) ☐ Rectal

(If Yes, select all pre-operative sedation drugs that apply: ↓)

Atropine	☐ Yes ☐ No	Lorazepam	☐ Yes ☐ No
Demerol	☐ Yes ☐ No	Midazolam	☐ Yes ☐ No
Diazepam	☐ Yes ☐ No	Morphine	☐ Yes ☐ No
Glycopyrrolate	☐ Yes ☐ No	Pentobarbital	☐ Yes ☐ No
Ketamine	☐ Yes ☐ No		

Preoperative Oxygen Saturation: _____ %

Date and Time of Transport to Procedure Location Or Anesthesia Start Time: ___/___/___ ___:___

ANESTHESIA Monitoring

Arterial Line ☐ Yes ☐ No *(If Yes →)* Type: *(Select all that apply)*

Radial	☐ Yes ☐ No	Brachial	☐ Yes ☐ No
Axillary	☐ Yes ☐ No	Femoral	☐ Yes ☐ No
Ulnar	☐ Yes ☐ No	Dorsalis Pedis	☐ Yes ☐ No
Posterior Tibial	☐ Yes ☐ No	Central	☐ Yes ☐ No

Cutdown ☐ Yes ☐ No *(If Yes →)* Type: *(Select all that apply)*

Radial	☐ Yes ☐ No	Femoral	☐ Yes ☐ No
Ulnar	☐ Yes ☐ No	Other	☐ Yes ☐ No

Percutaneous Central Pressure ☐ Yes ☐ No

(If Yes →) Location: *(Select all that apply)*

Right Internal Jugular	☐ Yes ☐ No	Left Internal Jugular	☐ Yes ☐ No
Right Subclavian	☐ Yes ☐ No	Left Subclavian	☐ Yes ☐ No
Right Femoral Vein	☐ Yes ☐ No	Left Femoral Vein	☐ Yes ☐ No
Other	☐ Yes ☐ No		

CVP Placed by Anesthesia ☐ Yes ☐ No

Swan-Ganz Catheter ☐ Yes ☐ No

Oximetric Central Line (ScVO2) ☐ Yes ☐ No

Neurologic Monitoring ☐ Yes ☐ No

(If Yes →) Neurological Monitoring Type: ☐ Near Infrared Spectroscopy (NIRS) ☐ Transcranial Doppler (TCD) ☐ Bispectral Index (BIS) ☐ Other

Lowest Recorded Intraoperative Temperature: _____ *° C*

Intraoperative Temperature Site: ☐ Nasal ☐ Esophageal ☐ Bladder ☐ Rectal ☐ Axillary ☐ Skin

Transesophageal Echocardiography ☐ Yes ☐ No

ANESTHESIA Anesthetic Technique

Date and Time of Induction: ___/___/___ ___:___
mm/ dd/ yyyy hh : mm

Induction Type:

Inhalation ☐ Yes ☐ No *(If Yes →)* Primary Induction Agent ☐ Sevoflurane ☐ Halothane

Intraveneous ☐ Yes ☐ No *(If Yes →)* Primary Induction Agent ☐ Propofol ☐ Etomidate ☐ Ketamine ☐ Sodium Thiopental ☐ Fentanyl ☐ Sufentanil ☐ Midazolam

Intramuscular (IM) ☐ Yes ☐ No *(If Yes →)* Primary Induction Agent ☐ Ketamine ☐ Midazolam

Primary Maintenance Agent: ☐ Alfentanil ☐ Desflurane ☐ Dexmedetomidine ☐ Fentanyl ☐ Halothane ☐ Isoflurane ☐ Ketamine ☐ Midazolam ☐ Morphine ☐ Propofol ☐ Remifentanil ☐ Sevoflurane ☐ Sufentanil

Regional Anesthetic ☐ Yes ☐ No

(If Yes →) Regional Anesthetic Site: ☐ Thoracic Epidural Catheter ☐ Lumbar Epidural Catheter ☐ Caudal Epidural Catheter ☐ Lumbar Epidural – Single shot ☐ Caudal Epidural – Single shot ☐ Lumbar Intrathecal Single Shot

(If Yes →) Regional Anesthetic Drug: *(Select all that apply)*

Bupivicaine	☐ Yes ☐ No	Bupivicaine/Fentanyl	☐ Yes ☐ No
Clonidine	☐ Yes ☐ No	Fentanyl	☐ Yes ☐ No
Hydromorphone	☐ Yes ☐ No	Lidocaine	☐ Yes ☐ No
Morphine	☐ Yes ☐ No	Ropivicaine	☐ Yes ☐ No
Ropivicaine/Fentanyl	☐ Yes ☐ No	Tetracaine	☐ Yes ☐ No
Other	☐ Yes ☐ No		

ANESTHESIA Airway

Airway Type: ☐ No airway support ☐ Bag-mask ☐ Nasal cannulae ☐ Laryngeal Mask Airway (LMA) ☐ Endotracheal intubation ☐ Tracheostomy

(If LMA →) Airway Size *(mm):* ☐ 1.0 ☐ 1.5 ☐ 2.0 ☐ 2.5 ☐ 3.0 ☐ 4.0 ☐ 5.0

(If Endotracheal intubation →) Airway Size *(mm):* ☐ 2.5 ☐ 3.0 ☐ 3.5 ☐ 4.0 ☐ 4.5 ☐ 5.0 ☐ 5.5 ☐ 6.0 ☐ 6.5 ☐ 7.0 ☐ 7.5 ☐ 8.0

Cuffed ☐ Yes ☐ No

Airway Site: ☐ Oral ☐ Nasal ☐ Tracheostomy

ANESTHESIA Transfusion

Transfusion ☐ Yes ☐ No

(If Yes ↓) Number of donor exposures:

Packed Red Blood Cells (PRBC)	☐ Yes ☐ No	*(If Yes →)*	_____
Platelets	☐ Yes ☐ No	*(If Yes →)*	_____
Fresh Frozen Plasma (FFP)	☐ Yes ☐ No	*(If Yes →)*	_____
Cryoprecipitate	☐ Yes ☐ No	*(If Yes →)*	_____
Whole Blood	☐ Yes ☐ No	*(If Yes →)*	_____
Factor VIIa	☐ Yes ☐ No	*(If Yes →)*	Total dosage : _____ *(micrograms / kg)*

ANESTHESIA Intraoperative Pharmacology

Intraoperative Medications: ☐ None *(If not None, select all intra-operative medications that apply: ↓)*

- ☐ Adenosine bolus
- ☐ Alfentanil infusion
- ☐ Aminocaproic Acid (Amicar)
- ☐ Amiodarone bolus/infusion
- ☐ Aprotinin (Trasylol)
- ☐ Calcium (Gluconate or Chloride) infusion
- ☐ Dexmetetomidine (Precedex)
- ☐ Dobutamine infusion
- ☐ Dopamine infusion
- ☐ Epinephrine (Adrenalin) infusion
- ☐ Esmolol bolus/infusion
- ☐ Fentanyl bolus/infusion
- ☐ Furosemide bolus/infusion
- ☐ Insulin bolus/infusion
- ☐ Intraoperative Steroids (Hydrocortisone/Methylprednisolone/Dexamethasone)
- ☐ Isoproterenol infusion
- ☐ Levophed (Norepinephrine) infusion
- ☐ Magnesium Sulfate bolus
- ☐ Midazolam bolus/infusion
- ☐ Milrinone bolus/infusion
- ☐ Morphine bolus/infusion
- ☐ Nesiritide Infusion
- ☐ Nicardipine Infusion
- ☐ Nitric Oxide inhalation
- ☐ Nitroglycerin (Tridil) infusion
- ☐ Nitroprusside (Nipride)
- ☐ Phenoxybenzamine bolus
- ☐ Phentolamine (Regitine) Bolus/Infusion
- ☐ Phenylephrine infusion
- ☐ Propofol (Diprivan) infusion
- ☐ Prostaglandin infusion
- ☐ Remifentanil infusion
- ☐ Thyroid Hormone bolus/infusion
- ☐ Tranexamic Acid infusion
- ☐ Vasopressin infusion
- ☐ Other Inotrope
- ☐ Other Vasodilator
- ☐ Other Vasoconstrictor

ANESTHESIA Pharmacology On Arrival To ICU/PACU

Medications Given At Time Of Transfer: ☐ None *(If not None, select all medications that apply: ↓)*

- ☐ Aminocaproic Acid (Amicar) infusion
- ☐ Amiodarone infusion
- ☐ Aprotinin (Trasylol) infusion
- ☐ Calcium Chloride infusion
- ☐ Calcium Gluconate infusion
- ☐ Dexmetetomidine (Precedex) infusion
- ☐ Dobutamine infusion
- ☐ Dopamine infusion
- ☐ Epinephrine (Adrenalin) infusion
- ☐ Fentanyl infusion
- ☐ Insulin infusion
- ☐ Isoproterenol infusion
- ☐ Midazolam (Versed) infusion
- ☐ Milrinone infusion
- ☐ Morphine infusion
- ☐ Muscle Relaxant infusion
- ☐ Nesiritide Infusion
- ☐ Nicardipine infusion
- ☐ Nitric Oxide inhalation
- ☐ Nitroglycerin (Tridil) infusion
- ☐ Nitroprusside (Nipride) infusion
- ☐ Norepinephrine (Levophed) infusion
- ☐ Phentolamine (Regitine)Infusion
- ☐ Phenylephrine infusion
- ☐ Propofol (Diprivan) infusion
- ☐ Prostaglandin infusion
- ☐ Thyroid Hormone infusion
- ☐ Tranexamic Acid infusion
- ☐ Vasopressin infusion
- ☐ Other Inotrope
- ☐ Other Vasodilator
- ☐ Other Vasoconstrictor

ANESTHESIA ICU/PACU Care

Date and Time of ICU/PACU Arrival: ___/___/___ ___:___
mm/ dd/ yyyy hh : mm

Initial FiO2: _____

Mechanical circulatory support ☐ Yes ☐ No

ABG ☐ Yes ☐ No *(If Yes →)* pH: _____ Base Excess: _____
pCO2: _____ Lactate: _____
pO2: _____

Initial pulse oximeter _____ %

Temperature on ICU/PACU Arrival: _____ ° C

Temperature Measurement Site: ☐ Forehead scan ☐ Tympanic membrane ☐ Skin ☐ Rectal ☐ Bladder ☐ Oral ☐ Axillary

Need for Temporary Pacemaker on Arrival In ICU/PACU ☐ Yes ☐ No

(If Yes →) Site of Temporary Pace Maker: ☐ Epicardial ☐ Transvenous

(If Yes →) Type of Temporary Pacing: ☐ Atria ☐ Atrio-ventricular ☐ Ventricular ☐ Other

ANESTHESIA Anesthesia Adverse Events

Anesthesia adverse events: ☐ None *(If not None, select all adverse events that apply: ↓)*

- ☐ Dental Injury
- ☐ Respiratory Arrest
- ☐ Difficult Intubation/Reintubation
- ☐ Stridor / Sub-glottic Stenosis
- ☐ Extubation
- ☐ Endotracheal Tube Migration
- ☐ Airway Injury
- ☐ Arrythmia - Central Venous Line Placement
- ☐ Myocardial Injury - Central Venous Line Placement
- ☐ Vascular Compromise - Central Venous Line Placement
- ☐ Pneumothorax - Central Venous Line Placement
- ☐ Vascular Access
- ☐ Hematoma
- ☐ Arterial Puncture
- ☐ Intravenous/Intra-arterial Air Embolism
- ☐ Bleeding - Regional Anesthetic Site
- ☐ Intrathecal Puncture - Regional
- ☐ Local Anesthetic Toxicity - Regional
- ☐ Neurologic Injury - Regional
- ☐ Anaphylaxis/Anaphylactoid Reaction
- ☐ Non-allergic Drug Reaction
- ☐ Medication Administration
- ☐ Medication Dosage
- ☐ Intraoperative Recall
- ☐ Malignant Hyperthermia
- ☐ Protamine Reaction
- ☐ Cardiac Arrest - Unrelated To Surgery
- ☐ Esophageal Bleeding / Rupture
- ☐ Esophageal Chemical Burn
- ☐ Airway Compromise
- ☐ TEE Related-Extubation
- ☐ Patient Transfer Event
- ☐ Neurologic Injury

ADULT DATA

ADULT PREOPERATIVE FACTORS *(if 18 yrs or older)*

Current Or Recent Cigarette Smoker: ☐ Yes ☐ No

Family History of Coronary Artery Disease: ☐ Yes ☐ No

Last Hematocrit: _____

Last White Blood Cell Count: _____

Diabetes: ☐ Yes ☐ No *(If Yes →)* Diabetes Control: *(select one)* ☐ None ☐ Diet ☐ Oral ☐ Insulin ☐ Other

Last A1c Level: _____

Dyslipidemia: ☐ Yes ☐ No

Last Creatinine Level: _____

Renal Failure – Dialysis: ☐ Yes ☐ No

Hypertension: ☐ Yes ☐ No

Infectious Endocarditis: ☐ Yes ☐ No *(If Yes →)* Infectious Endocarditis Type: ☐ Treated ☐ Active

Chronic Lung Disease: ☐ No ☐ Mild ☐ Moderate ☐ Severe

Immunosuppressive Therapy: ☐ Yes ☐ No

Peripheral Arterial Disease: ☐ Yes ☐ No

Cerebrovascular Disease: ☐ Yes ☐ No

(If Yes →) Coma: ☐ Yes ☐ No

CVA: ☐ Yes ☐ No *(If Yes →)* CVA-When: ☐ Recent (<=2 weeks) ☐ Remote (>2 weeks)

CVD TIA: ☐ Yes ☐ No

CVD NonInvasive >75%: ☐ Yes ☐ No

CVD Prior Carotid Surgery: ☐ Yes ☐ No

CORONARY BYPASS *(if 18 yrs or older)*

Coronary Artery Bypass Grafting Done: ☐ Yes ☐ No *(If Yes ↓)*

Number of Distal Anastomoses with Arterial Conduits: _____

Number of Distal Anastomoses with Venous Conduits: _____

(If 1 or more →) Distal Anastomoses - Vein Harvest Technique: ☐ Endovascular ☐ Direct Vision ☐ Both

Saphenous Vein Harvest Time: _____ *(minutes)*

Anastomotic Device Used: ☐ Yes ☐ No *(If Yes →)* Anastomotic Device: ☐ Glue ☐ Magnets ☐ Clips ☐ Staples ☐ Other

Internal Mammary Arteries Used for Grafts: ☐ Left IMA ☐ Right IMA ☐ Both IMAs ☐ No IMA If Left, Right, or Both ↓

IMA Harvest Technique: ☐ Direct Vision ☐ Thoracoscopy

☐ Combination ☐ Robotic Assisted

Number of IMA Distal Anastomoses: _____

Radial Artery Used: ☐ No Radial ☐ Left Radial ☐ Right Radial ☐ Both Radials If Left, Right, or Both ↓

Number of Radial Artery Distal Anastomoses: _____

Radial Distal Anastomoses Harvest Technique: ☐ Endovascular ☐ Direct Vision ☐ Both

Radial Artery Harvest Time: _____ (minutes)

Number of Gastro-Epiploic Artery Distal Anastomoses: _____

Number of Other Arterial Distal Anastomoses: _____

Valve Surgery *(if 18 yrs or older)*

Surgical Procedure done on Aortic, Mitral, Tricuspid, or Pulmonic Valves: ☐ Yes ☐ No *(If Yes ↓)*

Aortic Procedure:	Mitral Procedure:	Tricuspid Procedure:	Pulmonic Procedure
No	No	No	No
Replacement	Annuloplasty Only	Annuloplasty Only	Replacement
Repair/Reconstruction	Replacement	Replacement	Reconstruction
Root Reconstruction w/ Valve Conduit	Reconstruction w/ Annuloplasty	Reconstruction w/ Annuloplasty	
Replacement + Aortic Graft Conduit	Reconstruction w/o Annuloplasty	Reconstruction w/o Annuloplasty	
Root Reconstruction w/ Valve Sparing	↓	Valvectomy	
Resuspension Aortic Valve w/ Replacement Ascending Aorta	*(If Replacement)* Mitral Repair Attempt: ☐ Yes ☐ No		
Resuspension Aortic Valve w/o Replacement Ascending Aorta			
Resection Sub-Aortic Stenosis			

Aortic Annular Enlargement: ☐ Yes ☐ No

↓ **Key** M = Mechanical B = Bioprosthesis H = Homograft A = Autograft (Ross) R = Ring/Annuloplasty BA = Band/Annuloplasty

Aortic Prosthesis -	Implant Type:	None M B H A R BA	Implant: _____	Size: _____
Mitral Prosthesis -	Implant Type:	None M B H A R BA	Implant: _____	Size: _____
Tricuspid Prosthesis -	Implant Type:	None M B H A R BA	Implant: _____	Size: _____
Pulmonic Prosthesis -	Implant Type:	None M B H A R BA	Implant: _____	Size: _____

Valve Key

Mechanical

112 = Carpentier-Edwards PERIMOUNT Theon RSR Pericardial Bioprosthesis

2 = ATS Mechanical Prosthesis

3 = Björk-Shiley Convex-Concave Mechanical Prosthesis

4 = Björk-Shiley Monostrut Mechanical Prosthesis

6 = CarboMedics Mechanical Prosthesis

57 = CarboMedics Carbo-Seal Ascending Aortic Valved Conduit Prosthesis

58 = CarboMedics Carbo-Seal Valsalva Ascending Aortic Valved Conduit Prosthesis

59 = CarboMedics Reduced Cuff Aortic Valve

60 = CarboMedics Standard Aortic Valve

61 = CarboMedics Top-Hat Supra-annular Aortic Valve

62 = CarboMedics OptiForm Mitral Valve

63 = CarboMedics Standard Mitral Valve

64 = CarboMedics Orbis Universal Valve

65 = CarboMedics Small Adult Aortic and Mitral Valves

53 = Lillehei-Kaster Mechanical Prosthesis

10 = MCRI On-X Mechanical Prosthesis

8 = Medtronic-Hall/Hall Easy-Fit Mechanical Prosthesis

66 = Medtronic ADVANTAGE Mechanical Prosthesis

9 = OmniCarbon Mechanical Prosthesis

54 = OmniScience Mechanical Prosthesis

11 = Sorin Bicarbon (Baxter Mira) Mechanical Prosthesis

12 = Sorin Monoleaflet Allcarbon Mechanical Prosthesis

13 = St. Jude Medical Mechanical Heart Valve

67 = St. Jude Medical Masters Series Mechanical Heart Valve

68 = St. Jude Medical Masters Series Aortic Valve Graft Prosthesis

69 = St. Jude Medical Mechanical Heart Valve Hemodynamic Plus (HP) Series

70 = St. Jude Medical Masters Series Hemodynamic Plus Valve with FlexCuff Sewing Ring

71 = St. Jude Medical Regent Valve

14 = Starr-Edwards Caged-Ball Prosthesis

15 = Ultracor Mechanical Prosthesis

Bioprosthesis

108 = ATS 3f Aortic Bioprosthesis

72 = Edwards Prima Stentless Porcine Bioprosthesis - Subcoronary

73 = Edwards Prima Stentless Porcine Bioprosthesis - Root

19 = Biocor Porcine Bioprosthesis

74 = Biocor Stentless Porcine Bioprosthesis - Subcoronary

75 = Biocor Stentless Porcine Bioprosthesis - Root

21 = CarboMedics PhotoFix Pericardial Bioprosthesis

76 = Carpentier-Edwards Duraflex Porcine Bioprosthesis

77 = Carpentier-Edwards Prima Plus Stentless Porcine Bioprosthesis - Subcoronary

78 = Carpentier-Edwards Prima Plus Stentless Porcine Bioprosthesis - Root

22 = Carpentier-Edwards PERIMOUNT Pericardial Bioprosthesis

103 = Carpentier-Edwards PERIMOUNT Pericardial Magna Bioprosthesis

23 = Carpentier-Edwards Standard Porcine Bioprosthesis

25 = Carpentier-Edwards Supra-Annular Aortic Porcine Bioprosthesis

79 = Cryolife O'Brien Stentless Porcine Bioprosthesis - Subcoronary

80 = Cryolife O'Brien Stentless Porcine Bioprosthesis - Root

113 = Carpentier-Edwards PERIMOUNT RSR Pericardial Bioprosthesis

114 = Carpentier-Edwards PERIMOUNT Theon Pericardial Bioprosthesis

115 = Carpentier-Edwards S.A.V. Porcine Bioprosthesis

116 = Edwards Prima Plus Stentless Bioprosthesis

117 = Carpentier-Edwards PERIMOUNT Plus Pericardial Bioprosthesis with Tricentrix Holder

118 = Carpentier-Edwards Duraflex Low Pressure Porcine Bioprosthesis

119 = Carpentier-Edwards Duraflex Low Pressure ESR Porcine Bioprosthesis

120 = Carpentier-Edwards PERIMOUNT Theon Pericardial Bioprosthesis with Tricentrix Holder.

121 = St. Jude Medical Biocor Supra Stented Porcine Bioprosthesis

122 = St. Jude Medical Epic Supra Stented Porcine Bioprosthesis.

Homograft

89 = CryoLife Aortic Homograft

90 = CryoLife Pulmonary Homograft

91 = CryoLife CryoValve SG(Decellularized)Aortic Homograft

92 = CryoLife CryoValve SG Pulmonary Homograft

41 = Homograft Aortic - Subcoronary

42 = Homograft Aortic - Root

43 = Homograft Mitral

44 = Homograft Pulmonic Root

93 = LifeNet CV Allografts

Autograft

45 = Pulmonary Autograft to aortic root (Ross Procedure)

Ring/Annuloplasty

109 = ATS Simulus Flex-O Ring

110 = ATS Simulus Flex-C Band

94 = CarboMedics AnnuloFlo Ring

95 = CarboMedics AnnuloFlex Ring

96 = CarboMedics CardioFix Bovine Pericardium with PhotoFix Technology

46 = Carpentier-Edwards Classic Annuloplasty Ring

104 = Carpentier-Edwards Geoform Ring

105 = Carpentier-Edwards IMR Etlogix Ring

47 = Carpentier-Edwards Physio Annuloplasty System Ring

48 = Cosgrove-Edwards Annuloplasty System Ring

97 = Edwards MC³ Tricuspid Annuloplasty System G Future Band

98 = Genesee Sculptor Annuloplasty Ring

49 = Medtronic Sculptor Ring

50 = Medtronic-Duran AnCore Ring

51 = Sorin-Puig-Messana Ring

52 = St. Jude Medical Séguin Annuloplasty Ring.

106 = St. Jude Medical Rigid Saddle Ring

99 = St. Jude Medical Tailor Annuloplasty Ring

123 = ATS Simulus Flexible Annuloplasty ring.

124 = ATS Simulus Semi-Rigid Annuloplasty ring

125 = Carpentier-Edwards Classic Annuloplasty Ring with Duraflo Treatment

55 = Hancock Standard Porcine Bioprosthesis

28 = Hancock II Porcine Bioprosthesis

29 = Hancock Modified Orifice Porcine Bioprosthesis

30 = Ionescu-Shiley Pericardial Bioprosthesis

31 = Labcor Stented Porcine Bioprosthesis

81 = Labcor Stentless Porcine Bioprosthesis - Subcoronary

82 = Labcor Stentless Porcine Bioprosthesis - Root

83 = Medtronic Freestyle Stentless Porcine Bioprosthesis - Subcoronary

84 = Medtronic Freestyle Stentless Porcine Bioprosthesis - Root

35 = Medtronic Intact Porcine Bioprosthesis

36 = Medtronic Mosaic Porcine Bioprosthesis

85 = Medtronic Contegra Bovine Jugular Bioprosthesis

37 = Mitroflow Pericardial Bioprosthesis

39 = St. Jude Medical Toronto SPV Stentless Porcine Bioprosthesis

40 = St. Jude Medical-Bioimplant Porcine Bioprosthesis

86 = St. Jude Medical Biocor Stented Tissue Valve

87 = St. Jude Medical Epic Stented Porcine Bioprosthesis

88 = St. Jude Medical Toronto Root Stentless Porcine Bioprosthesis

38 = Sorin Pericarbon Stentless Pericardial Bioprosthesis

111 = Carpentier-Edwards PERIMOUNT MAGNA Pericardial Bioprosthesis with Carpentier-Edwards Thermafix Tissue Process

126 = Carpentier-Edwards Physio Annuloplasty Ring with Duraflo Treatment

127 = Cosgrove-Edwards Annuloplasty System with Duraflo Treatment

128 = Myxo Etlogix Annuloplasty Ring

131 = Sorin Memo 3D Ring

132 = UNIRING, Universal Annuloplasty System

Band / Annuloplasty

100 = Medtronic Colvin Galloway Future Band

101 = Medtronic Duran Band

102 = Medtronic Duran - Ancore Band

107 = St. Jude Medical Tailor Annuloplasty Band

Other

777 = Other

VAD *(if 18 yrs or older)*

Ventricular Assist Device Implanted: ☐ Yes ☐ No *(If Yes ↓)*

Previous VAD: ☐ Yes ☐ No *(If Yes →)* Implanted at another facility: ☐ Yes ☐ No

References to "Initial VAD" refer to the initial VAD for this hospitalization, not a VAD placed during a previous hospitalization.

Current Circulatory Support: For Initial VAD Only

Indication for VAD: ☐ Bridge to Transplantation ☐ Bridge to Recovery ☐ Destination
☐ Postcardiotomy Ventricular Failure (Separation from CPB) ☐ Device Malfunction ☐ End of Life

Intubated Pre VAD: ☐ Yes ☐ No

Hemodynamics Pre VAD:

PCWP: _____mm/Hg CVP: _____mm/Hg CI: _____L/ (min x m2)

RV Function: ☐ Normal ☐ Mildly Impaired ☐ Moderately Impaired ☐ Severely Impaired

VAD Device Data:

Implant Type: **Fill in below:** Right VAD (RVAD) Left VAD (LVAD) BiVentricular BiVAD (BiVAD) Total Artificial Heart (TAH)

Product Type: **Fill in below:** 1. HeartQuest VAD 2. Lion Heart 3. Novacor LVAS 4. Heartsaver VAD 5. Jarvik 2000 6. DeBakey VAD 7. TandemHeart pVAD 8. AB-180 iVAD 9. CardioWest TAH 10. Thoratec IVAD 11. HeartMate VE 12. HeartMate IP LVAS 13. HeartMate SNAP-VE 14. HeartMate XVE 15. HeartMate II 16. HeartMate III 17. BVS5000i 18. AbioCor 19. Incor 20. Excor 22. Abiomed AB 5000 23. Abiomed Impella 24. VentrAssist 25. Circulite LVAD 26. HeartWare – HVAD 27. Terumo – DuraHeart LVAD 28. WorldHeart – Levacor LVAD 29. Levitronix – CentriMag 21. Other

Explant Reason: **Fill in below:** 1. Cardiac Transplant 2. Recovery 3. Device Transfer 4. Device Related Infection 5. Device Malfunction 6. End of Life

Initial Implant Data

Implant Type	Product Type	Implant Date	Explant	Explant Date	Explant Reason	Transplant Date
_____	_____	___ / __ / _____ mm dd yyyy	☐ Yes ☐ No	___ / ___ / _____ mm dd yyyy	_____	___ / ___ / _____ mm dd yyyy

Initial VAD Cannulation/Attach Site:

LVAD Inflow: ☐ Left Atrium ☐ Left Ventricle

RVAD Inflow: ☐ Right Atrium ☐ Right Ventricle

Additional Implant(s) Data

Second Device Implanted: ☐ Yes ☐ No *(If Yes ↓)*

Implant Type #2	Product Type #2	Implant Date #2	Explant #2	Explant Date #2	Explant Reason #2	Transplant Date #2
_____	_____	___ / ___ / ____ mm dd yyyy	☐ Yes ☐ No	___ / ___ / ___ mm dd yyyy	_____	___ / ___/____ mm dd yyyy

Implant #2 VAD Cannulation/Attach Site:

LVAD Inflow: ☐ Left Atrium ☐ Left Ventricle

RVAD Inflow: ☐ Right Atrium ☐ Right Ventricle

Third Device Implanted: ☐ Yes ☐ No *(If Yes ↓)*

Implant Type #3	Product Type #3	Implant Date #3	Explant #3	Explant Date #3	Explant Reason #3	Transplant Date #3
_____	_____	___ / ___ / ____ mm dd yyyy	☐ Yes ☐ No	___ / ___ / ___ mm dd yyyy	_____	___ / ___/____ mm dd yyyy

Implant #3 VAD Cannulation/Attach Site:

LVAD Inflow: ☐ Left Atrium ☐ Left Ventricle

RVAD Inflow: ☐ Right Atrium ☐ Right Ventricle

Primary VAD Complications Data:

Intracranial Bleed: ☐ Yes ☐ No

Embolic Stroke: ☐ Yes ☐ No

Driveline and/or Cannula Infection: ☐ Yes ☐ No

Pump Pocket Infection: ☐ Yes ☐ No

VAD Endocarditis: ☐ Yes ☐ No

Device Malfunction: ☐ Yes ☐ No

Bowel Obstruction: ☐ Yes ☐ No

Additional Complications (not specific to initial VAD as above) to be collected in Complications.

VAD Discharge Status: ☐ With VAD

☐ Without VAD

☐ Expired in hospital (where initial VAD was implanted)

