NATIONAL QUALITY FORUM

National Voluntary Consensus Standards for
Pediatric Cardiac Surgery Measures

Measure Number: PCS-011-09

Measure Title: Selection of Antibiotic Administration for Pediatric and Congenital Cardiac Surgery Patient

Description: Percent of patients undergoing pediatric and congenital cardiac surgery who received body weight appropriate prophylactic antibiotics recommended for the operation

Numerator Statement: Number of pediatric and congenital cardiac surgery patients who received body weight appropriate prophylactic antibiotics recommended for the operation

Denominator Statement: Number of patients undergoing pediatric and congenital cardiac surgery operations

Level of Analysis: Individual clinician, Group of clinicians, Facility

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 Heart Surgery Database)

Measure Developer: The Society of Thoracic Surgeons

Type of Endorsement: Time Limited Endorsement (Steering Committee Vote, Yes-5 No-2, Abstain-1)

Attachments: "STS Attachment: STS Procedure Code Definitions"

PCS-011-09 Selection of Antibiotic Administration for Pediatric and Congenital Cardiac Surgery Patients (Society of Thoracic Surgeons)	**Recommendation:** Time-Limited Endorsement Yes-5; No-2; Abstain-1 **Final Measure Evaluation Ratings: I:** Y-8; N-1 **S:** H-4; M-3; L-1 **U:** H-3 M-5; L-0 **F:** H-2; M-4; L-1 **Discussion:** **I:** The Steering Committee believes that this is a relevant measure with high impact; surgical site infection in cardiac patients is a major complication. The Steering Committee is not sure that there are data as to the "best" antibiotics to administer to patients. This measure would be hard to monitor because of the large number of antibiotics that might be used around the country. **S:** There is an array of acceptable antibiotics that could be used and they change often. Experience with measures in other fields indicates that options for quickly changing the approved drug list in the specifications need to be in place. Body weight is not the only factor that determines appropriate dosages of antibiotics in high-risk patients. Clinicians take into account renal/liver dysfunction and anticipated drug clearance. The measure does not clearly identify who is responsible for selecting the dose. **U:** The measure is usable and distinct from other NQF cardiac surgery measures. Recommend adoption by itself or combined with PCS-010-09.

	F: The Steering Committee felt this should be easy to obtain from electronic medical records. Once the type of antibiotic has been established for the measure, the implementation should be easy since it is a matter of record in the chart.

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-011-09 NQF Project: Pediatric Cardiac Surgery
	MEASURE SPECIFICATIONS & DESCRIPTIVE INFORMATION
1	*Information current as of (date- MM/DD/YY): 9/30/10*
2	*Title of Measure: Selection of Appropriate Prophylactic Antibiotics and Weight-Appropriate Dosage for Pediatric and Congenital Cardiac Surgery Patients*
3	**Brief description of measure [1]:** Percent of patients undergoing pediatric and congenital cardiac surgery who were documented as having received body weight appropriate prophylactic antibiotics recommended for the operation
4 (2a)	**Numerator Statement:** Number of pediatric and congenital cardiac surgery patients who were documented as having received body weight appropriate prophylactic antibiotics recommended for the operation **Time Window:** One year (12 months) and 4 years (48 months) **Numerator Details** (Definitions, codes with description): The antimicrobial drugs listed are considered prophylactic antibiotics for the purposes of this measure. - Cefazolin - Cefuroxime - Cefotetan - Cefoxitin - Ampicillin - Ampicillin/sulbactam - Piperacillin/sulbactam - Clindamycin - Vancomycin
5 (2a)	**Denominator Statement:** Number of patients undergoing pediatric and congenital cardiac surgery operations **Time Window:** One year (12 months) and 4 years (48 months) **Denominator Details** (Definitions, codes with description): Cardiac operations are defined as operations that are of operation types "CPB" or "No CPB Cardiovascular" (CPB is cardiopulmonary bypass.) [1]. 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, 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,

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

	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.
6 (2a, 2d)	**Denominator Exclusions:** Patients who: - had principal or admission diagnosis of preoperative infectious disease - were receiving antibiotics at time of admission - have medical records that do not include antibiotic start date/time or incision date/time - were receiving antibiotics more than 24 hours prior to surgery - have physician documentation of infection prior to surgical procedure **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]. 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? No ► If "other" describe: **Identification of stratification variable(s):** NA **Stratification Details** (Definitions, codes with description): NA
8 (2a, 2e)	**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) **Identify Risk Adjustment Variables:** **Detailed risk model:** attached ☐ **OR** Web page URL:
9 (2a)	**Type of Score:** Rate/proportion **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)**:** primary diagnosis, 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:
- ☐ Electronic Clinical Registry, Name:
- ☒ 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: Upon receiving NQF endorsement, this measure will be added to the STS Congenital Heart Surgery Database for data collection and analysis

Instrument/survey attached ☐ **OR** Web page URL:

12 (2a)

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

Minimum sample size:

Instructions: NA

13 (2a)

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

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

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
- ☐ Home Health
- ☐ 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*):

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

Does the measure address a high impact aspect of healthcare high resource use

(1a)

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. Patient undergoing cardiac surgery are at increased risk for surgical site infections due to the use of cardiopulmonary bypass which can impair humoral immunologic defenses, systemic hypothermia, longer operation times, and the mandatory use of chest tubes and central lines that can be the source of bacterial contamination [2]. Pediatric patients are at even higher risk due to multiple factors including deep hypothermic circulatory arrest, planned delayed sternal closure for complex operations, need for extracorporeal life support, prolonged chest tube drainage for single ventricle palliations, and need for prolonged central venous access [2].

The majority of pediatric and congenital cardiac surgeries are performed in patients within the pediatric age range requiring antibiotic dosing by weight rather than standard adult dosing. Cardiopulmonary bypass adds an additional level of complexity given the increased volume of distribution for antibiotics especially in the neonatal/infant population.Body weight appropriate dosing is essential to insure adequate tissue concentrations to prevent infection [3]. Minor and major perioperative infections including superficial and deep wound infections, urinary tract infections, bloodstream infections, and mediastinitis can add significant morbidity, mortality, prolonged hospital length of stay, prolonged intensive care unit length of stay, and substantial increase in cost to the hospitalization of this high resource utilization patient group. The incidence of surgical site infections ranges from 1.6-6.6% [4]. The incidence of mediastinitis, a major postoperative infection, varies widely but is usually reported in the range of 0.2% [5] to 1.4% [6]. The hospital mortality associated with mediastinitis can be as high as 16% [7].

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.

2. Alphonso N, Anagnostopoulos PV, Scarpace S, Weintraub P, Azakie A, Raff G, Karl TR. Perioperative antibiotic prophylaxis in paediatric cardiac surgery. Cardiol Young 2007;17:12-25.

3. Linam WM, Margolis PA, Staat MA, Britto MT, Hornung R, Cassedy A, Connelly BL. Risk factors associated with surgical site infection after pediatric posterior spinal fusion procedure. Infect Control Hosp Epidemiol 2009;30(2):109-16.

4. Maher KO, VanDerElzen K, Bove EL, Mosca RS, Chenoweth CE, Kulik TJ. A retrospective review of three antibiotic prophylaxis regimens for pediatric cardiac surgical patients. Ann Thorac Surg 202;74:1195-1200.

5. Tortoriello TA, Friedman JD, Mckenzie ED, et al. Mediastinitis after pediatric cardiac surgery: A 15-year experience at a single institution. Ann Thorac Surg 2003; 76: 1655–1660.

6. Long CB, Shah SS, Lautenbach E, et al. Postoperative mediastinitis in children: Epidemiology, microbiology and risk factors for gram-negative pathogens. Pediatr Infect Dis J 2005; 24: 315–319.

7. Demmy TL, Park SB, Liebler GA, et al. Recent experience with major sternal wound complications. Ann thorac Surg 1990;49:458-62.

18 **Opportunity for Improvement** *Provide evidence that demonstrates considerable variation, or overall poor performance, across providers.*

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

(1b)	**Summary of Evidence:** The body weight appropriate antibiotic dosing has been demonstrated to reduce the incidence of surgical wound infections in select populations [1]. Minor and major perioperative infections including superficial and deep wound infections, urinary tract infections, bloodstream infections, and mediastinitis can add significant morbidity, mortality, prolonged hospital length of stay, prolonged intensive care unit length of stay, and substantial increase in cost to the hospitalization of this high resource utilization patient group. The incidence of surgical site infections ranges from 1.6-6.6% [2]. The incidence of mediastinitis, a major postoperative infection, varies widely but is usually reported in the range of 0.2% [3] to 1.4% [4]. The hospital mortality associated with mediastinitis can be as high as 16% [5]. There are no large studies in pediatric cardiac surgical patients that evaluate body weight appropriate dosing of prophylactic antibiotics. A recent survey of multiple congenital heart centers demonstrates a high degree of variability in perioperative antibiotic regimens [6]. **Citations for Evidence:** 1. Linam WM, Margolis PA, Staat MA, Britto MT, Hornung R, Cassedy A, Connelly BL. Risk factors associated with surgical site infection after pediatric posterior spinal fusion procedure. Infect Control Hosp Epidemiol 2009;30(2):109-16. 2. Maher KO, VanDerElzen K, Bove EL, Mosca RS, Chenoweth CE, Kulik TJ. A retrospective review of three antibiotic prophylaxis regimens for pediatric cardiac surgical patients. Ann Thorac Surg 202;74:1195-1200. 3. Tortoriello TA, Friedman JD, Mckenzie ED, et al. Mediastinitis after pediatric cardiac surgery: A 15-year experience at a single institution. Ann Thorac Surg 2003; 76: 1655–1660. 4. Long CB, Shah SS, Lautenbach E, et al. Postoperative mediastinitis in children: Epidemiology, microbiology and risk factors for gram-negative pathogens. Pediatr Infect Dis J 2005; 24: 315–319. 5. Demmy TL, Park SB, Liebler GA, et al. Recent experience with major sternal wound complications. Ann thorac Surg 1990;49:458-62. 6. Alphonso N, Anagnostopoulos PV, Scarpace S, Weintraub P, Azakie A, Raff G, Karl TR. Perioperative antibiotic prophylaxis in paediatric cardiac surgery. Cardiol Young 2007;17:12-25.
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 body weight appropriate antibiotic dosing has been demonstrated to reduce the incidence of surgical wound infections in select populations [1]. Minor and major perioperative infections including superficial and deep wound infections, urinary tract infections, bloodstream infections, and mediastinitis can add significant morbidity, mortality, prolonged hospital length of stay, prolonged intensive care unit length of stay, and substantial increase in cost to the hospitalization of this high resource utilization patient group. The incidence of surgical site infections ranges from 1.6-6.6% [2]. The incidence of mediastinitis, a major postoperative infection, varies widely but is usually reported in the range of 0.2% [3] to 1.4% [4]. The hospital mortality associated with mediastinitis can be as high as 16% [5]. There are no large studies in pediatric cardiac surgical patients that evaluate body weight appropriate dosing of prophylactic antibiotics. A recent survey of multiple congenital heart centers demonstrates a high degree of variability in perioperative antibiotic regimens [6]. **Citations for evidence:** 1. Linam WM, Margolis PA, Staat MA, Britto MT, Hornung R, Cassedy A, Connelly BL. Risk factors associated with surgical site infection after pediatric posterior spinal fusion procedure. Infect Control Hosp Epidemiol 2009;30(2):109-16. 2. Maher KO, VanDerElzen K, Bove EL, Mosca RS, Chenoweth CE, Kulik TJ. A retrospective review of three antibiotic prophylaxis regimens for pediatric cardiac surgical patients. Ann Thorac Surg 202;74:1195-1200.

3. Tortoriello TA, Friedman JD, Mckenzie ED, et al. Mediastinitis after pediatric cardiac surgery: A 15-year experience at a single institution. Ann Thorac Surg 2003; 76: 1655–1660.

4. Long CB, Shah SS, Lautenbach E, et al. Postoperative mediastinitis in children: Epidemiology, microbiology and risk factors for gram-negative pathogens. Pediatr Infect Dis J 2005; 24: 315–319.

5. Demmy TL, Park SB, Liebler GA, et al. Recent experience with major sternal wound complications. Ann thorac Surg 1990;49:458-62.

6. Alphonso N, Anagnostopoulos PV, Scarpace S, Weintraub P, Azakie A, Raff G, Karl TR. Perioperative antibiotic prophylaxis in paediatric cardiac surgery. Cardiol Young 2007;17:12-25.

20 (1c)

If measuring an Outcome Describe relevance to the national health goal/priority, condition, population, and/or care being addressed: NA

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 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)*: Grade B

Summary of Evidence (*provide guideline information below*)**:** Body weight appropriate dosing of antibiotics in the pediatric population is standard of care in all patient care settings. There is no specific literature to support a benefit, or reduction in infection rates, with body weight appropriate dosing of prophylactic antibiotics for pediatric and congenital cardiac surgery patients. In select populations, however, there is data to support a reduction in surgical site infections associated with body weight appropriate dosing [1].

Citations for Evidence: 1. Linam WM, Margolis PA, Staat MA, Britto MT, Hornung R, Cassedy A, Connelly BL. Risk factors associated with surgical site infection after pediatric posterior spinal fusion procedure. Infect

[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.

	Control Hosp Epidemiol 2009;30(2):109-16.
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:** There is no contradictory evidence in the literature regarding body weight appropriate dosing of prophylactic antibiotics for pediatric and congenital cardiac surgery patients. Body weight appropriate dosing of antibiotics in the pediatric population is standard of care in all patient care settings. **Citations:**
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, overall mortality after pediatric cardiac surgery has been declining and currently stands at 4%. Mortality for one of the benchmark operations, the Norwood procedure, has declined dramatically [1]. This declining mortality and the small number of pediatric cardiac surgical cases have made the assessment of mortality, as a single measure to evaluate the quality of care, less meaningful. The assessment of morbidity has become more important [2]. In order to properly assess morbidity, it is necessary to assess the incidence of substantial morbidities related to pediatric and congenital cardiac surgery performed at a center over both 1 year and 4 year time intervals. A crucial element in evaluating these morbidities, including post-operative infections, is the assessment of essential process measures that may impact these outcomes measures. Body weight appropriate dosing of prophylactic antibiotics is crucial to obtain adequate tissue levels in order to prevent surgical site infections. By tracking this process measure, it should improve awareness and compliance with this important preventive action to reduce morbidity and mortality in a high risk/high resource utilization patient population. References 1. W.T. Mahle, T.L. Spray, G. Wernovsky, J.W. Gaynor and B.J. Clark , Survival after reconstructive surgery for hypoplastic left heart syndrome: a 15-year experience from a single institution. Circulation 102 Suppl III (2000), pp. III-136–III-141. 2. Jacobs JP, Jacobs ML, et. al. What is Operative Morbidity? Defining Complications in a Surgical Registry Database. Annals of Thoracic Surgery 2007;87:1416-1421.
	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:** In 2007, The Society of Thoracic Surgeons (STS) Task Force to develop National Quality Forum (NQF) Indicators for Pediatric and Congenital Cardiac Surgery held a series of focused phone conferences involving multiple STS Congenital and Pediatric Heart Surgery leaders. This generated a proposal for National Quality Forum Indicators for Pediatric and Congenital Cardiac Surgery. The attached proposal has been approved unanimously by the STS Task Force to develop National Quality Forum Indicators for Pediatric and Congenital Cardiac Surgery. The proposal has been reviewed and approved by the following 6 STS Committees: 1. The STS Task Force to develop NQF Indicators for Pediatric and Congenital Cardiac Surgery 2. The STS Congenital Database Task Force 3. The STS Congenital Heart Surgery Work Force 4. The STS National Database Work Force 5. The STS Council on Quality, Research & Patient Safety 6. The STS Executive Committee Formal reliability/validity testing on these metrics has not ever been done. In fact, formal reliability/validity testing has never been done on any quality metrics for pediatric and congenital heart surgery. **Analytic Method:** **Testing Results:**
26 (2c)	**Validity Testing** **Data/sample:** The measure validity was confirmed by The Society of Thoracic Surgeons (STS) Task Force to develop National Quality Forum (NQF) Indicators for Pediatric and Congenital Cardiac Surgery after a comprehensive literature review. The measure validity was confirmed further by: - The STS Congenital Database Task Force - The STS Congenital Heart Surgery Work Force - The STS National Database Work Force - The STS Council on Quality, Research & Patient Safety - The STS Executive Committee Formal reliability/validity testing on these metrics has not ever been done. In fact, formal reliability/validity testing has never been done on any quality metrics for pediatric and congenital heart surgery. **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]. This Quality Indicator is designed to track body weight appropriate dosing of antibiotic prophylaxis for pediatric or congenital open heart surgery. 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	**Testing comparability of results when more than 1 data method is specified** (*e.g., administrative claims or chart abstraction*)

(2g)	**Data/sample:** Clinical data abstraction is the ony method used **Analytic Method:** **Results:**
30 (2f)	**Provide Measure Results from Testing or Current Use** (select one) **Data/sample:** Will be obtained from 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:** We do not collect this data in the current version of the STS Congenital Heart Surgery Database, but upon receiving NQF endorsement, the measure will be added to data collection and analysis. 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 development/testing If in use, how widely used (select one) ► If "other," please describe:* ☐ *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. The literature regarding antibiotic prophylaxis in adult heart surgery does not relate to pediatric heart surgery. **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) on same topic ☒ Other measure(s) for same target population ☐ No similar or related measures **Name and number of similar or related NQF-endorsed™ measure(s):** Similar or Related Measure - NQF # 0126 – Selection of Antibiotic Prophylaxis for Cardiac Surgery Patients - Description: Percent of patients undergoing cardiac surgery who received prophylactic antibiotics

recommended for the operation.

Rationale
Pediatric and congenital heart surgery is very different from adult heart surgery. Separate metrics are necessary. None of the literature regarding antibiotic prophylaxis in adult heart surgery relates to pediatric heart surgery.

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.

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, 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.

9. 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.

10. 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.

11. 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. **Describe the distinctive, improved, or additive value this measure provides to existing NQF-endorsed measures:** This metric is one of 20 structure, process, and outcome measures in pediatric and congenital cardiac surgery for evaluating quality of care. Although, in the past, there has been lack of uniform definitions as well as accurate reporting, the newly adopted consensus definitions should continue to improve our understanding of this important measure as it relates to pediatric and congenital cardiac surgery. The importance of this measure is well documented above, and it will be complementary to the other measures that are being evaluated by NQF.
	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: Once the measure receives NQF endorsement, data elements will be generated by the STS 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:* Diagnosis, 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 outcome measures, especially in circumstances where there is a declining mortality and small volume of cases [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. **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 2010*
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*)**:** 08/31/09

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.