



# The Society of Thoracic Surgeons Congenital Heart Surgery Database: 2018 Update on Outcomes and Quality

Jeffrey P. Jacobs, MD, John E. Mayer, Jr, MD, Sara K. Pasquali, MD, MHS, Kevin D. Hill, MD, David M. Overman, MD, James D. St. Louis, MD, S. Ram Kumar, MD, PhD, Carl L. Backer, MD, Charles D. Fraser, MD, James S. Tweddell, MD, and Marshall L. Jacobs, MD

Division of Cardiac Surgery, Department of Surgery, Johns Hopkins University School of Medicine, Baltimore, Maryland (JPJ, MLJ); Division of Cardiovascular Surgery, Department of Surgery, Johns Hopkins All Children's Heart Institute, Johns Hopkins All Children's Hospital and Florida Hospital for Children, Saint Petersburg, Tampa, and Orlando, Florida (JPJ, MLJ); Department of Cardiac Surgery, Boston Children's Hospital, Harvard Medical School, Boston, Massachusetts (JEM); Department of Pediatrics and Communicable Diseases, C.S. Mott Children's Hospital, University of Michigan, Ann Arbor, Michigan (SKP); Duke University School of Medicine and Duke Clinical Research Institute, Duke University Medical Center, Durham, North Carolina (KDH); Division of Cardiovascular Surgery, The Children's Heart Clinic, Children's Hospitals and Clinics of Minnesota, Minneapolis, Minnesota (DMO); Department of Surgery, University of Missouri-Kansas City School of Medicine, Kansas City, Missouri (JDSL); Department of Surgery, Keck School of Medicine of the University of Southern California, Los Angeles, California (SRK); Division of Cardiovascular-Thoracic Surgery, Department of Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, Northwestern University Feinberg School of Medicine, Chicago, Illinois (CLB); Department of Surgery, Texas Children's Hospital, Baylor College of Medicine, Houston, Texas (CDF); and Department of Cardiothoracic Surgery, Heart Institute, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio (JST)

The Society of Thoracic Surgeons Congenital Heart Surgery Database is a comprehensive registry of clinical outcomes that captures almost all pediatric cardiac surgical operations in the United States. It is the platform for all activities of The Society of Thoracic Surgeons related to the analysis of outcomes and the improvement of quality in this subspecialty. This article summarizes current aggregate national outcomes in congenital and pediatric cardiac surgery and reviews related activities in the areas of quality measurement, performance improvement, and transparency. The reported data about aggregate national outcomes are exemplified by an analysis of 10 benchmark operation groups performed from January 2013 through December 2016. This analysis documents the overall aggregate Operative

Mortality (interquartile range among all participating programs) for the following procedural groups: off-bypass coarctation repair, 1.3% (0.0% to 1.4%); ventricular septal defect repair, 0.6% (0.0% to 0.9%); tetralogy of Fallot repair, 1.1% (0.0% to 2.0%); complete atrioventricular canal repair, 2.7% (0.0% to 4.4%); arterial switch operation, 2.2% (0.0% to 2.9%); arterial switch operation and ventricular septal defect repair, 5.1% (0.0% to 8.3%); Glenn/HemiFontan, 2.1% (0.0% to 3.1%); Fontan operation, 1.1% (0.0% to 0.0%); truncus arteriosus repair, 10.1% (0.0% to 15.4%); and Norwood procedure, 15.8% (9.0% to 25.0%).

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The Society of Thoracic Surgeons Congenital Heart Surgery Database (STS CHSD) was founded in 1994 to provide assessment of programmatic and aggregate outcomes to participants and to support quality improvement and patient safety in pediatric and congenital cardiothoracic surgery [1–3]. STS CHSD is now the largest congenital and pediatric cardiac surgical clinical data registry in the world, containing data for approximately 435,373 operations as of October 1, 2017. These data are the foundation for assessment of performance (by benchmarking and evaluation of individual programmatic outcomes within the context of national aggregate data), development and subsequent

application of sophisticated risk adjustment models [4–7], quality improvement initiatives, research, voluntary public reporting [8–13], development of reimbursement strategies, and governmental and regulatory collaborations. This article is the third annual report summarizing current national aggregate congenital and pediatric cardiac surgical outcomes [14–16].

## Overview of STS CHSD

Collection of detailed clinical data and feedback of risk-adjusted nationally benchmarked results to participating

Address correspondence to Dr Jeffrey P. Jacobs, Division of Cardiovascular Surgery, John Hopkins All Children's Heart Institute, John Hopkins All Children's Hospital, 601 Fifth St S, St. Petersburg, FL 33701; email: jeffjacobs@jhmi.edu.

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cardiac surgical programs are the primary functions of STS CHSD [17]. A participant in STS CHSD is typically a hospital cardiac surgery program, a practice group of cardiothoracic surgeons, or uncommonly, an individual surgeon. Data are submitted to the STS data warehouse and analytical center at the Duke Clinical Research Institute (DCRI). The Duke Clinical Research Institute develops Feedback Reports two times each year based on the most recently completed 48-month period of data collection, and these Feedback Reports are distributed every 6 months to each STS CHSD participant. These Feedback Reports facilitate internal quality assessment and serve as a platform for quality improvement. These Feedback Reports present data about risk-stratified and risk-adjusted outcomes of the individual participant within the context of multiinstitutional aggregate benchmarks obtained by pooling data from all participants located in the United States or Canada.

The spectrum of individual congenital cardiac malformations is broad, and the variety of types of cardiac disease affecting individuals early in life is large. Consequently, to collect relevant data, STS CHSD must account for nearly 200 individual diagnoses and a roughly comparable number of distinct types of therapeutic interventions, which are not infrequently performed in various combinations as elements of a multiple component operation. To maintain clinical relevance with evolving surgical practice, data elements undergo periodic revision to clarify existing variables, harmonize definitions with related national and international databases, add new variables of interest, and remove irrelevant or rarely used data elements. These revisions are performed on a 3-year cycle.

As of 2017, STS CHSD included 119 participants comprising 394 surgeons from 40 states in the United States and from Canada (3 provinces), Colombia, and Turkey [18]. When reporting multiinstitutional aggregate data, STS CHSD includes only data from participants located in the United States and Canada. Thus, the aggregate data in this report are from operations performed at 116 participants, 113 located in the United States and 3 located in Canada.

Of the 435,373 cumulative worldwide operations included in STS CHSD as of October 1, 2016, 422,931 were submitted by participants located in the United States [18]. The 113 participants located in the United States represent 133 hospitals [18]. An STS database participant is a “practice group of cardiothoracic surgeons” or, uncommonly, an individual cardiothoracic surgeon. In most instances, an STS database participant is a hospital cardiac or thoracic surgery program. In most situations, one STS database participant is linked to 1 hospital; however, in some instances, 1 STS database participant is linked to more than 1 hospital or 1 hospital is linked to more than 1 STS database participant. Therefore, minor differences exist between the number of STS database participants and the number of hospitals submitting data to the STS databases.

The Report of the 2015 STS Congenital Heart Surgery Practice Survey, undertaken by the STS Workforce on Congenital Heart Surgery, estimated that pediatric

cardiac operations are performed in 125 hospitals in the United States and in 8 hospitals in Canada [19]. Therefore, more than 95% of hospitals that perform pediatric cardiac operations in the United States participate in STS CHSD; and, the patient-level penetration is estimated to be an even higher percentage, because virtually all high-volume pediatric cardiac surgical programs in the United States participate in STS CHSD. These data suggest that nearly all pediatric cardiac operations performed in the United States are captured in STS CHSD.

### The STS CHSD: Aggregate Outcomes

The aggregate outcomes summarized in this section are based on data collected in STS CHSD for all operations performed from January 1, 2013, through December 31, 2016, inclusive, and presented in the 2017 Spring Harvest Feedback Report [17]. The outcomes in this report are based on the data elements specified in the current versions of the data collection instrument (versions 3.0, 3.22, and 3.3, which went live on January 1, 2010, January 1, 2014, and January 1, 2016, respectively), and are presented using only data from centers located in the United States or Canada.

Table 1 reports aggregate outcomes of risk-stratified operations in STS CHSD during the last 4 years (January 2013 through December 2016), with the end points of Operative Mortality and postoperative length of stay (PLOS) [20–22]. Although the aggregate data in Table 1 are not risk adjusted, these unadjusted outcomes data are risk-stratified by The STS–European Association for Cardiothoracic Surgery (STAT) Mortality Categories [21, 22]. The Appendix provides the latest version of the STAT Mortality Categories that was used to create Table 1. In Table 1, it is interesting to note that the PLOS for STAT Mortality Category 2 is longer than the PLOS for STAT Mortality Category 3, whereas the mortality for STAT Mortality Category 3 is higher than for STAT Mortality 2. The explanation for this observation is uncertain, although the STS CHSD 2016 and 2017 Update on Outcomes and Quality [15, 16] also reported this same observation. In the future, we may choose to stratify mortality outcomes by the STAT Mortality Categories [21, 22] and PLOS outcomes by the STAT Morbidity Categories [23].

Table 2 reports unadjusted aggregate outcomes for current benchmark operation groups in STS CHSD, also during the last 4 years (January 2013 through December 2016) and also with the end points of Operative Mortality and PLOS [20]. Data about the following 10 benchmark operation groups are included in Table 2:

1. Ventricular septal defect (VSD) repair
2. Tetralogy of Fallot (TOF) repair
3. Complete atrioventricular canal repair (complete atrioventricular septal defect repair [CAVSD repair])
4. Arterial switch
5. Arterial switch + VSD repair
6. Glenn/HemiFontan
7. Fontan operation

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