

# The Society of Thoracic Surgeons National Database 2017 Annual Report



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The Society of Thoracic Surgeons (STS) National Database has three major component databases: the STS Adult Cardiac Surgery Database (ACSD), the STS Congenital Heart Surgery Database (CHSD), and the STS General Thoracic Surgery Database (GTSD). Beginning in January 2016, *The Annals of Thoracic Surgery* began publishing a monthly series of scholarly articles on outcomes analysis, quality improvement, and patient safety.

This article summarizes the status of the STS National Database as of October 2017 and summarizes the articles about the STS National Database that appeared in *The Annals of Thoracic Surgery* 2017 series "Outcomes Analysis, Quality Improvement, and Patient Safety."

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The Society of Thoracic Surgeons (STS) National Database has three major component databases: the STS Adult Cardiac Surgery Database (ACSD), the STS Congenital Heart Surgery Database (CHSD), and the STS General Thoracic Surgery Database (GTSD). Beginning in January 2016, *The Annals of Thoracic Surgery* began publishing a monthly series of scholarly articles on outcomes analysis, quality improvement, and patient safety [1–23]. Many of these articles were based on data contained in the STS National Database. In 2017, seven of the articles that appeared in *The Annals of Thoracic Surgery* 2017 series "Outcomes Analysis, Quality Improvement, and Patient Safety" were derived from the STS National Database [14, 16, 18, 20, 21, 23]: three articles on outcomes and quality (one each from ACSD, CHSD, and GTSD) [14, 16, 18], three articles on research (one each from ACSD, CHSD, and GTSD) [20, 21, 23], and a final summary article, "The Society of Thoracic Surgeons National Database 2017 Annual Report." These seven articles alternated with three additional articles on topics related to patient safety [17, 19, 22] and one article discussing the timely topic of "How Is Physician Work Valued?" [15]. This final summary article in the 2017 series summarizes the status of the STS National Database as of October 2017 and

summarizes the articles from this series that were derived from the STS National Database.

## The STS National Database: Outcomes and Quality

Data from the STS National Database are reported back to participants in Feedback Reports, which facilitate benchmarking individual institutional outcomes to national aggregate data. Table 1 provides information regarding the size and penetration of the three major component databases of the STS National Database [24, 25]. Selected national aggregate outcomes of the more commonly performed surgical procedures in STS ACSD, STS CHSD, and STS GTSD are provided in Tables 2, 3, and 4, respectively [2, 4, 6, 14, 16, 18, 26, 27].

Data from the STS National Database are also used to facilitate the development of quality measures that are designed to assess the quality of health care provided by cardiothoracic surgical teams. Quality measures that are endorsed by the National Quality Forum (NQF) are recognized as "best in class," evidence based, and valid [1, 13]. The STS is currently the steward for more NQF-endorsed measures than any other specialty-based medical professional organization [1, 13]. As of September 30, 2017, the NQF has endorsed 33 STS quality measures [1]. Table 5 stratifies these quality measures by the Donabedian triad of structure, process, and outcome, and Table 6 provides a detailed listing of these 33 performance measures. NQF endorsed three new STS

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Table 1. The Society of Thoracic Surgeons National Database Participation<sup>a</sup>

Variable	STS Adult Cardiac Surgery Database <sup>a</sup>	STS Congenital Heart Surgery Database <sup>a</sup>	STS Congenital Cardiac Anesthesia Module <sup>a,b</sup>	STS General Thoracic Database <sup>a</sup>
In the USA				
Participants, <sup>c</sup> No.	1,088	113	58	285
Hospitals, <sup>d</sup> No.	1,113	133	68	346
Surgeons, No.	2,934	372	534 (anesthesiologists)	952
Operations, <sup>e</sup> No.	6,078,240	422,931	117,790	505,440
States, No.	50	40	31	44
Estimated penetration at the hospital level, % <sup>f,g,h</sup>	>90–95 of hospitals that perform adult heart surgery in the USA <sup>f</sup>	>95 of hospitals that perform pediatric heart surgery in the USA <sup>g</sup>	49.6 <sup>g</sup>	? <sup>h</sup>
Programs in USA and Canada that consented to voluntarily publicly report (as of September 29, 2016), %	59.9	66.6	Public reporting is not available	18.1
Total countries (including USA), No. <sup>i</sup>	7	4	2	3
Participants outside USA, No.				
Hospitals, No. <sup>d</sup>	31	6	1	2
Surgeons, No.	31	6	1	2
Operations, No. <sup>e</sup>	174	22	1	9
Total participants, No.	50,066	12,442	15	727
Total hospitals, No. <sup>d</sup>	1,119	119	59	287
Total surgeons, No.	1,144	139	69	348
Total surgeons, No.	3,108	394	535	961
Total operations, No. <sup>e</sup>	6,128,306	435,373	117,805	506,167

<sup>a</sup> The data in Table 1 were updated on October 1, 2017. <sup>b</sup> The STS Congenital Cardiac Anesthesia Module was developed jointly by STS and the Congenital Cardiac Anesthesia Society. <sup>c</sup> 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. <sup>d</sup> 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, the number of STS Database Participant and the number of hospitals is slightly different. <sup>e</sup> Total number of operations in STS ACSD refers to the total number of operations captured in the STS ACSD since its formation in 1989. The total number of operations in the STS CHSD and STS GTSD refers to the total number of operations in STS CHSD and STS GTSD since these databases began storing data at DCRI in 1998. DCRI is the data warehouse and analytic center for ACSD, CHSD, and GTSD. <sup>f</sup> Center-level penetration (number of CMS sites with at least 1 matched STS participant divided by the total number of CMS CABG sites) increased from 45% in 2000 to 90% in 2012. In 2012, 973 of 1,081 CMS CABG sites (90%) were linked to an STS site. Patient-level penetration (number of CMS CABG hospitalizations done at STS sites divided by the total number of CMS CABG hospitalizations) increased from 51% in 2000 to 94% in 2012. In 2012, 71,634 of 76,072 CMS CABG hospitalizations (94%) occurred at an STS site. Completeness of case inclusion at STS sites (number of CMS CABG cases at STS sites linked to STS records divided by the total number of CMS CABG cases at STS sites) increased from 88% in 2000 to 98% in 2012. In 2012, 69,213 of 70,932 CMS CABG hospitalizations at STS sites (97%) were linked to an STS record [24]. <sup>g</sup> The 2015 STS Congenital Heart Surgery Practice and Manpower Survey estimates that pediatric cardiac operations are performed in 125 hospitals in the USA and in 8 hospitals in Canada [25]. <sup>h</sup> The penetration of the STS GTSD cannot be calculated because the number of general thoracic surgical programs in the USA (the denominator of penetration) is not known. Figure 3 in Jacobs and colleagues [1] provides graphs documenting the number of participants (the numerator of penetration; Fig 3A) and surgeons (Fig 3B) in the STS GTSD. <sup>i</sup> Countries participating in the STS ACSD are USA (50 states), Brazil, Canada, Israel, Italy, Turkey, and United Arab Emirates. Countries participating in the STS CHSD are USA (39 states), Canada (3 Canadian Provinces), Columbia, and Turkey. Countries participating in the STS GTSD are USA (43 states), Singapore, and United Arab Emirates.

ACSD = Adult Cardiac Surgery Database; CABG = coronary artery bypass grafting; CHSD = Congenital Heart Surgery Database; CMS = Centers for Medicare and Medicaid Services; DCRI = Duke Clinical Research Institute; GTSD = General Thoracic Surgery Database; STS = The Society of Thoracic Surgeons; USA = United States of America.

Table 2. Selected Outcomes of the More Commonly Performed Adult Cardiac Surgical Procedures in Calendar Year 2015<sup>a</sup>

Outcomes	CABG	AVR	AVR + CABG	MVR	MVR + CABG	MV Repair	MV Repair + CABG
Operations, No.	151,474	29,462	17,570	7,027	2,681	8,764	3,862
Mortality, %							
In-hospital	1.8	1.6	3.3	4.0	8.7	0.9	4.1
Operative <sup>b</sup>	2.2	2.1	3.9	4.7	9.8	1.1	4.1
Major morbidity, %							
Reoperation <sup>c</sup>	2.2	4.4	6.3	7.9	11.6	3.6	7.0
DSWI/mediastinitis	0.3	0.1	0.3	0.2	0.4	0.1	0.3
Permanent stroke	1.3	1.3	2.2	1.9	3.3	1.3	2.6
Prolonged ventilation >24 hours	8.2	7.5	12.8	17.0	29.0	5.3	19.8
Renal failure	2.1	2.0	3.7	4.4	8.2	1.1	5.2
New-onset AF	24.0	31.7	39.6	34.2	44.2	29.8	42.6
Readmission <30 days of discharge	10.0	10.0	12.6	15.7	16.1	8.8	13.3
Postoperative hospital LOS, d							
Mean	6.9	7.2	8.5	10.0	11.6	6.5	9.8
Median	6.0	6.0	7.0	7.0	9.0	5.0	8.0

<sup>a</sup> Selected outcomes of the more commonly performed adult cardiac surgical procedures in calendar year 2016 will be published in the January 2018 article in *The Annals of Thoracic Surgery* entitled: "The Society of Thoracic Surgeons Adult Cardiac Surgery Database: 2018 Update on Outcomes and Quality". <sup>b</sup> Operative Mortality is defined in all Society of Thoracic Surgeons databases as (1) all deaths, regardless of cause, occurring during the hospitalization in which the operation was performed, even if after 30 days (including patients transferred to other acute care facilities); and (2) all deaths, regardless of cause, occurring after discharge from the hospital but before the end of postoperative day 30 [26, 27]. <sup>c</sup> National Quality Forum definition of reoperation.

AF = atrial fibrillation; AVR = aortic valve replacement; CABG = coronary artery bypass grafting; DSWI = deep sternal wound infection; LOS = length of stay; MV = mitral valve; MVR = mitral valve replacement.

composite measures in 2017: an individual surgeon composite measure for adult cardiac surgery [28], a composite measure for mitral valve repair/replacement (MVR) [29], and a composite measure for MVR combined with coronary artery bypass grafting (CABG) [30].

Finally, as a result of its commitment to accountability and transparency, STS publicly reports cardiothoracic surgical outcomes on the Consumer Reports website and the STS website [<http://publicreporting.sts.org/>] (Table 7). The NQF has endorsed all STS publicly reported measures. At the time of this publication, the

following measures are publicly reported by the STS: STS CABG Composite Measure, STS Aortic Valve Replacement (AVR) Composite Measure, STS AVR + CABG Composite Measure, STS Risk-Adjusted Operative Mortality for Pediatric and Congenital Heart Surgery, and STS Lobectomy for Lung Cancer Composite Measure. Public reporting of the STS MVR Composite Measure and the STS MVR + CABG Composite Measure is planned for 2018, and public reporting of the STS Esophagectomy for Esophageal Cancer Composite Measure is planned for 2019. All of

Table 3. Selected Outcomes of the More Commonly Performed Pediatric and Congenital Cardiac Surgical Procedures in the 4-Year Analytic Window of Calendar Years January 2012 to December 2015<sup>a</sup>

Variable	Off -Bypass Coarctation	VSD	TOF	AVC	ASO	ASO+VSD	Glenn/ Hemi-Fontan	Fontan	Truncus	Norwood
Operations, No.	3,964	7,250	4,648	3,169	1,888	785	4,839	4,279	631	2,810
Operative Mortality, <sup>b</sup> %	1.3	0.6	1.1	3.0	2.7	5.3	2.5	1.2	9.4	15.7
Postoperative LOS, d										
Aggregate average per patient	12.2	8.4	11.5	16.7	16.4	18.6	14.4	13.3	32.0	43.6
Median participant-specific average	11.2	7.8	10.7	16.1	15.9	17.0	13.14	13.6	29.5	41.8

<sup>a</sup> Selected outcomes of the more commonly performed congenital and pediatric cardiac surgical procedures in calendar years 2013 to 2016 will be published in an upcoming article in *The Annals of Thoracic Surgery*. <sup>b</sup> Operative Mortality is defined in all Society of Thoracic Surgeons databases as (1) all deaths, regardless of cause, occurring during the hospitalization in which the operation was performed, even if after 30 days (including patients transferred to other acute care facilities); and (2) all deaths, regardless of cause, occurring after discharge from the hospital but before the end of the postoperative day 30 [26, 27].

ASO = arterial switch operation; AVC = atrioventricular canal repair; LOS = length of stay; TOF = tetralogy of Fallot; VSD = ventricular septal defect.

**Table 4. Selected Outcomes of the More Commonly Performed General Thoracic Surgical Procedures in the 3-Year Analytic Window of January 1, 2014, to December 31, 2016<sup>a</sup>**

Variable	Wedge Resection	Segmentectomy	Lobectomy	Pneumonectomy	Esophagectomy
Operations, No.	18,812	3,825	33,326	1,505	6,792
Operative Mortality, <sup>b</sup> %	0.8	0.9	1.3	6.4	3.4
Median postoperative LOS, d	2.0	3.0	4.0	5.0	10.0

<sup>a</sup> Data from 24th Data Analysis of the Society of Thoracic Surgeons General Thoracic Surgery Database (ie, 2017 Spring Harvest Feedback Report, Tables 10 to 14; time window: January 1, 2014, to December 31, 2016). <sup>b</sup> Operative Mortality is defined in all Society of Thoracic Surgeons databases as (1) all deaths, regardless of cause, occurring during the hospitalization in which the operation was performed, even if after 30 days (including patients transferred to other acute care facilities); and (2) all deaths, regardless of cause, occurring after discharge from the hospital, but before the end of the 30th postoperative day [26, 27].

LOS = length of stay.

these publicly reported measures are reported at the hospital level and at the program level.

Surgeon-level reporting of cardiac surgery outcomes derived from claims data is currently being performed by several states and by other rating organizations, including ProPublica and Consumer’s Checkbook, and additional initiatives are planned by other entities. To provide a more comprehensive and accurate measure of the performance of individual adult cardiac surgeons, the STS has developed an Individual Surgeon-level Composite Measure for Adult Cardiac Surgery [28], a highly reliable measure of a surgeon’s 3-year case experience for five major procedures. This measure will be communicated confidentially to individual surgeons in 2018, with the likelihood of voluntary surgeon-level public reporting commencing in 2019 or 2020.

### The STS National Database: Research

Summaries of research based on each of the three STS National Databases were published in 2016 [8, 10, 12] and 2017 [20, 21, 23]. The STS has three mechanisms by which investigators at institutions participating in the STS National Database may propose and make operational a research project using data from the STS National Database. Research projects may be proposed to the following three STS Task Forces: (1) STS Access and Publications (A&P) Task Force, STS Participant User File (PUF) Task Force, and STS Task Force on Longitudinal Follow-up

and Linked Registries (LFLR). Applications for research projects can be submitted to the STS for A&P, PUF, or LFLR for the all three STS databases: ACSD, CHSD, and GTSD.

Research proposed to A&P is typically funded by the STS, and statistical analysis is performed at Duke Clinical Research Institute, the data warehouse and analytic center of all STS databases. All participants in the STS National Database are eligible to propose A&P research projects and participate in A&P research. Through A&P, the STS funds novel, well-conceived, and hypothesis-driven studies that are proposed and performed by database participants. Extra consideration is given to projects that involve multiple investigators and institutions and can be completed within 9 to 12 months. A&P research is divided into two categories: A&P Minor Data Requests and A&P Major Data Requests.

A&P Minor Data Requests are intended for purposes of internal quality improvement and research. Data generated from A&P Minor Data Requests are not intended for use in presentations or publications, cannot include multivariable modeling or complex statistical analysis, and cannot be combined with or compared against externally sourced data. However, data generated from an A&P Minor Data Request may be used as background information for an A&P Major Data Requests. In general, minor data requests must require less than 4 hours of statistical analytic time and are reviewed and approved by the chair of the A&P subcommittee to which the request pertains. Each subcommittee chair and the A&P Task Force Chair may consider minor data requests that require additional hours case by case.

A&P Major Data Requests are typically approved for up to 80 analytic hours and are designed for projects that will be presented at regional, national, or international meetings and published in the peer reviewed literature. Multivariable modeling or complex statistical analysis is permissible with an A&P Major Data Request. Most A&P Major Data Requests are limited to short-term analyses that involve the time of the hospitalization and 30 days after surgery (whichever is longer). A subset of A&P Major Data Requests can include longitudinal analysis of outcomes using the linkage of the STS National Database to Centers for Medicare and Medicaid Services (CMS) data [24, 31–33]; these longitudinal analyses are usually approved for 100 hours of analytic time. To submit a request to perform

**Table 5. National Quality Forum–Endorsed Society of Thoracic Surgeons Measures as of September 30, 2017, Stratified by the Donabedian Triad of Structure, Process, and Outcome<sup>a</sup>**

Variable	Structure	Process	Outcome	Composite	Total
Adult Cardiac	1	7	13	6	27
Congenital	2	0	2	0	4
Thoracic	1	0	1	0	2
Total	4	7	16	6	33

<sup>a</sup> National Quality Forum (NQF) disclaimer: Measures may be used for noncommercial implementation and/or reporting of performance data. Contact the Measure Steward if you wish to use the measure for another purpose. NQF is not responsible for the application or outcomes of measures. Data source: [www.qualityforum.org/QPS](http://www.qualityforum.org/QPS) (Exported from QPS on 09/30/2017 at 11:32 A.M.)

Table 6. National Quality Forum–Endorsed Society of Thoracic Surgeons Measures as of September 30, 2017<sup>a</sup>

Measure	Measure Title	NQF#	Updated Date	Status	Type of Measure	Database	Donabedian
1	Participation in a Systematic Database for Cardiac Surgery	0113	Nov 10, 2014	Endorsed–Reserve	Quality	ACSD	Structure
2	Anti-Lipid Treatment Discharge	0118	Feb 6, 2017	Endorsed	Quality	ACSD	Process
3	Anti-Platelet Medication at Discharge	0116	Feb 10, 2017	Endorsed–Reserve	Quality	ACSD	Process
4	Beta Blockade at Discharge	0117	Jan 25, 2017	Endorsed	Quality	ACSD	Process
5	Duration of Antibiotic Prophylaxis for Cardiac Surgery Patients	0128	Nov 12, 2014	Endorsed–Reserve	Quality	ACSD	Process
6	Preoperative Beta Blockade	0127	Jan 25, 2017	Endorsed	Quality	ACSD	Process
7	Selection of Antibiotic Prophylaxis for Cardiac Surgery Patients	0126	Feb 10, 2015	Endorsed–Reserve	Quality	ACSD	Process
8	Use of Internal Mammary Artery (IMA) in Coronary Artery Bypass Graft (CABG)	0134	Jan 25, 2017	Endorsed	Quality	ACSD	Process
9	Risk-Adjusted Coronary Artery Bypass Graft (CABG) Readmission Rate	2514	Dec 8, 2016	Endorsed	Quality	ACSD	Outcome
10	Risk-Adjusted Deep Sternal Wound Infection	0130	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
11	Risk-Adjusted Operative Mortality for Aortic Valve Replacement (AVR)	0120	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
12	Risk-Adjusted Operative Mortality for Aortic Valve Replacement (AVR) + CABG Surgery	0123	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
13	Risk-Adjusted Operative Mortality for CABG	0119	July 14, 2015	Endorsed	Quality	ACSD	Outcome
14	Risk-Adjusted Operative Mortality for Mitral Valve (MV) Repair	1501	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
15	Risk-Adjusted Operative Mortality for Mitral Valve (MV) Repair + CABG Surgery	1502	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
16	Risk-Adjusted Operative Mortality for Mitral Valve (MV) Replacement	0121	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
17	Risk-Adjusted Operative Mortality for Mitral Valve (MV) Replacement + CABG Surgery	0122	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
18	Risk-Adjusted Postoperative Prolonged Intubation (Ventilation)	0129	Nov 12, 2014	Endorsed	Quality	ACSD	Outcome
19	Risk-Adjusted Postoperative Renal Failure	0114	Nov 10, 2014	Endorsed	Quality	ACSD	Outcome
20	Risk-Adjusted Stroke/Cerebrovascular Accident	0131	Nov 10, 2014	Endorsed	Quality	ACSD	Outcome
21	Risk-Adjusted Surgical Re-exploration	0115	Feb 6, 2017	Endorsed	Quality	ACSD	Outcome
22	STS Aortic Valve Replacement (AVR) + Coronary Artery Bypass Graft (CABG) Composite Score	2563	Nov 7, 2014	Endorsed	Composite	ACSD	Composite
23	STS Aortic Valve Replacement (AVR) Composite Score	2561	Nov 7, 2014	Endorsed	Composite	ACSD	Composite
24	STS CABG Composite Score	0696	Sept 3, 2015	Endorsed	Composite	ACSD	Composite
25	STS Individual Surgeon Composite Measure for Adult Cardiac Surgery	3030	Jan 25, 2017	Endorsed	Composite	ACSD	Composite
26	STS Mitral Valve Repair/Replacement (MVRR) + Coronary Artery Bypass Graft (CABG) Composite Score	3032	Jan 25, 2017	Endorsed	Composite	ACSD	Composite
27	STS Mitral Valve Repair/Replacement (MVRR) Composite Score	3031	Jan 25, 2017	Endorsed	Composite	ACSD	Composite
28	Participation in a National Database for Pediatric and Congenital Heart Surgery	0734	Nov 12, 2014	Endorsed	Quality	CHSD	Structure

(Continued)

Table 6. Continued

Measure	Measure Title	NQF#	Updated Date	Status	Type of Measure	Database	Donabedian
29	Surgical Volume for Pediatric and Congenital Heart Surgery: Total Programmatic Volume and Programmatic Volume Stratified by the 5 STAT Mortality Categories	0732	Feb 6, 2017	Endorsed	Quality	CHSD	Structure
30	Operative Mortality Stratified by the 5 STAT Mortality Categories	0733	Feb 6, 2017	Endorsed	Quality	CHSD	Outcome
31	Risk-Adjusted Operative Mortality for Pediatric and Congenital Heart Surgery	2683	Feb 6, 2017	Endorsed	Quality	CHSD	Outcome
32	Participation in a Systematic National Database for General Thoracic Surgery	0456	Nov 12, 2014	Endorsed	Quality	GTSD	Structure
33	Risk-Adjusted Morbidity and Mortality for Lung Resection for Lung Cancer	1790	Oct 17, 2016	Endorsed	Quality	GTSD	Outcome

<sup>a</sup> NQF disclaimer: Measures may be used for non-commercial implementation and/or reporting of performance data. Contact the Measure Steward if you wish to use the measure for another purpose. NQF is not responsible for the application or outcomes of measures. Data source: [www.qualityforum.org/QPS](http://www.qualityforum.org/QPS) (Exported from QPS on 09/30/2017 at 11:32 A.M.)

ACSD = Adult Cardiac Surgery Database; CHSD = Congenital Heart Surgery Database; GTSD = General Thoracic Surgery Database; NQF = National Quality Forum; STAT = The Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery; STS = The Society of Thoracic Surgeons.

Table 7. Participation in Voluntary Public Reporting With The Society of Thoracic Surgeons National Database

Database	Enrolled, %	Unique STS Consents/ US and Canada Participants <sup>a</sup>
Adult Cardiac	59.9	658/1,098
Congenital	66.6	78/117
Thoracic	18.1	52/287

<sup>a</sup> As of Friday, September 29, 2017.

STS = The Society of Thoracic Surgeons; US = United States.

an A&P Minor Data Request or an A&P Major Data Request, one must submit a Data Request Form available at [<http://www.sts.org/quality-research-patient-safety/research/publications-and-research/access-data-sts-national-database>].

Research proposed to PUF is typically funded by the institution of the investigative team. The PUF Research Program allows analysis of national-scale deidentified data from the STS National Database at the institution of the investigator(s). The PUF Program is an option for investigators to pose research questions, quickly obtain quality data, analyze these data themselves (given documentation of appropriate biostatistical resources), receive feedback, and develop their efforts into abstracts and manuscripts. PUF research creates a platform where clinical outcomes and comparative effectiveness research using STS data can be performed at investigators' own institutions. PUF research does not allow linkage of the STS National Database to CMS data or other sources of data, and PUF research is limited to analysis of the surgical hospitalization and episode of care and 30-day follow-up. To submit a request to perform a PUF Data Request, one must submit a Data Request Form available at [<http://www.sts.org/puf>].

Research proposed to LFLR is typically funded by extramural grants. LFLR projects are larger research initiatives that involve linking data sets and longitudinal analyses. Research involving linked data sets cannot be performed with PUF. As discussed above, subset of A&P Major Data Requests can include longitudinal analysis of outcomes using the STS-CMS link [24, 31-33]. All other analyses using linked data must be reviewed and approved by LFLR. To submit a request to perform an analysis by using the LFLR, one must submit a Data Request Form available at [<http://www.sts.org/quality-research-patient-safety/research/publications-and-research/access-data-sts-national-database>], under the heading "Grant Proposals."

## Summary

The STS National Database is one of the leading clinical registries in the world. All three component databases of the STS National Database support outcomes analysis, quality improvement, and research. Multiple ongoing initiatives in 2018 will further advance database science under the leadership of the STS Quality Measurement Task Force, the STS Task Force on Quality Initiatives, the

STS Public Reporting Task Force, the STS Informatics Task Force, and the STS Patient Reported Outcomes Task Force.

This “Outcomes Analysis, Quality Improvement, and Patient Safety” series of articles has allowed the STS and the Workforces on National Databases, Patient Safety, and Coding and Reimbursement to convey timely summaries of important topics related to outcomes, quality, and safety.

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