Table 3. Project TICKER Outcome Measures to be Analyzed with a Control Chart

Measure[1]	How Calculated	X-Axis	Y-Axis	Graph Title	Goal Line	Data Collection Instrument
CPB time	Target Population: C Chart type: I Chart Notes: 2,3	Label: Date of Surgery Scale: January 2004 - present	Labels: CPB Time (minutes) Scale: 0 -500	[Benchmark operation] – Cardiopulmonary Bypass Time	Context – to be set by institution	STS Congenital Heart Surgery Database Data Collection Form; Apollo Advance
XClamp time	Target Population: C Chart type: I Chart Notes: 2,3	Label: Date of Surgery Scale: January 2004 - present	Labels: XClamp Time (minutes) Scale: 0 -300	[Benchmark operation] – Cross Clamp Time	Context – to be set by institution	See above
Length of Case	Target Population: C Chart type: I Chart Notes: 2,3	Label: Date of Surgery Scale: January 2007 - present	Labels: Case Length (minutes) Scale: 0 -1000	[Benchmark operation] – Length of Case	Context – to be set by institution	See above
Total hospital LOS	Target Population: C Chart type: I Chart Notes: 2,3	Label: Discharge Date Scale: January 2004 - present	Labels: LOS (days) Scale: 0 -200	[Benchmark operation] – Total Hospital Length of Stay	Context – to be set by institution	See above
Post-operative LOS	Target Population: C Chart type: I Chart Notes: 2,3	Label: Discharge Date Scale: January 2004 - present	Labels: Post-op LOS (days) Scale: 0 -200	[Benchmark operation] – Post-operative Length of Stay	Context – to be set by institution Example: Goals: VSD ↓25% (4.875) TOF ↓40% (6.66)	See above
Open chest days	Target Population: C Chart type: I Chart Note: 4	Label: Date of Surgery Scale: January 2006 - present	Labels: Days Scale: 0 -120	Open Chest Days	Context – to be set by institution	See above
Re-operations due to bleeding	Target Population: C STS Complication Code: 240 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale: 0 - 200	Pediatric congenital heart surgeries between re-operations due to bleeding	Infinity	See above

Measure[1]	How Calculated	X-Axis	Y-Axis	Graph Title	Goal Line	Data Collection Instrument
Cardiac re-operations, exclusive of bleeding	Target Population: C STS Complication Code: 22 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2010 - present	Label: Cases Between Scale: 0 - 125	Pediatric congenital heart surgeries between unplanned cardiac re-operations exclusive of bleeding	Infinity	See above
Chylothorax	Target Population: C STS Complication Code: 210 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale: 0 - 160	Pediatric congenital heart surgeries between chylothoraces	Infinity	See above
Vocal cord dysfunction (possible recurrent laryngeal nerve injury)	Target Population: C STS Complication Code: 310 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale: 0 - 150	Pediatric congenital heart surgeries between possible recurrent laryngeal nerve injuries	Infinity	See above
Paralyzed diaphragm (possible phrenic nerve injury)	Target Population: C STS Complication Code: 300 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale: 0 - 160	Pediatric congenital heart surgeries between possible phrenic nerve injuries	Infinity	See above
Neurological deficit persisting at discharge	Target Population: C STS Complication Code: 320 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale: 0 - 160	Pediatric congenital heart surgeries between neurological deficits persistent at discharge	Infinity	See above
Cardiac arrest during or following procedure	Target Population: C STS Complication Code: 30 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale: 0 - 100	Pediatric congenital heart surgeries between post-operative cardiac arrests	Infinity	See above

Measure[1]	How Calculated	X-Axis	Y-Axis	Graph Title	Goal Line	Data Collection Instrument
Post-operative/ Post-procedural mechanical circulatory support (IABP, VAD, ECMO, CPS)	Target Population: C STS Complication Code: 40 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale:0 - 125	Pediatric congenital heart surgeries between cases requiring post-operative mechanical circulatory support	Infinity	See above
Renal failure requiring replacement therapies	Target Population: C STS Complication Codes: 230, 223, 224 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Complication Scale: January 2004 - present	Label: Cases Between Scale: 0 - 400	Pediatric congenital heart surgeries between cases requiring replacement therapies	Infinity	See above
Unplanned readmission to the hospital within 30 days of discharge	Target Population: C STS Complication Code: 360 Chart type: G Chart; annual & cumulative complication rate (crude). Notes: 5,6	Label: Date of Surgery Scale: January 2007 - present	Label: Cases Between Scale: 0 - 100	Pediatric congenital heart surgeries between readmissions within 30 days of discharge	Infinity	See above
Operative mortality (risk-adjusted)	Target Population: C Chart type: G charts, stratified by STS-EACTS risk category; cumulative mortality rate. Notes:5,7	Label: Date of Surgery Scale: January 2005 - present	Label: Cases between Scale: 0-140	STS-EACTS Category [1-5] Cases Between Operative Mortalities	N/A	See above
VAP	Target Population: C Chart type: T Chart Note: 8	Label: Date of Infection Scale: January 2006- present	Label: Calendar Days Between Scale: 0 - 500	Calendar Days Between Pediatric Cardiac Surgery VAP	Infinity	Hospital Epidemiology or your institution's source for reporting hospital-acquired infections
CLABSI	Target Population: C Chart type: T Chart Note: 8	Label: Date of Infection Scale: January 2006 - present	Label: Calendar Days Between Scale: 0 - 500	Calendar Days Between Pediatric Cardiac Surgery CLABSI	Infinity	Hospital Epidemiology or your institution's source for reporting hospital-acquired infections

Measure[1]	How Calculated	X-Axis	Y-Axis	Graph Title	Goal Line	Data Collection Instrument
CAUTI	Target Population: C Chart type: T Chart Note: 8	Label: Date of Infection Scale: January 2006 - present	Label: Calendar Days Between Scale: 0 - 500	Calendar Days Between Pediatric Cardiac Surgery Foley CAUTI	Infinity	Hospital Epidemiology or your institution's source for reporting hospital-acquired infections
Patient and family satisfaction	Target Population: C Questions: "How well staff worked together to care for you," "Likelihood of recommending this hospital to others," and "Overall rating of care given at hospital" Chart type: Xbar and S Charts	Label: Date of Discharge Scale: October 2008 - present	Label: Mean Scale: 0 - 5	Patient and Family Satisfaction [Question]	N/A	Press-Ganey (Discharge Unit)

Abbreviations: CPB, cardiopulmonary bypass; XClamp, cross clamp; LOS, length of stay; IABP, intra-aortic balloon pump; VAD, Ventricular assist device; ECMO, Extracorporeal membrane oxygenation; CPS, Cardiopulmonary support; VAP, ventilator-associated pneumonia; CLABSI, central line-associated bloodstream infection; CAUTI, catheter-associated urinary tract infection

Notes:

(1) All outcome measures operationalized through STS definitions unless otherwise indicated.
(2) Data are stratified by benchmark operation (VSD repair, TOF repair, AVSD repair, ASO, Fontan, Norwood (Stage 1) and are depicted in separate charts.
(3) Chart reviews of cases with data points outside the upper and lower control limits are conducted by subject matter experts. If it is determined that the special causes are related to patient condition and not systems issues affected by this project, the data points are ghosted, thereby removing those values from the calculation of the mean and control limits.
(4) Post-operative patients with delayed sternal closures are captured via STS. A quality analyst abstracted chest closure dates from patient records and calculated patient level open chest days.
(5) Opportunities include one per patient per surgical admission and are attributed to the date of the primary surgery. Multiple events for the same patient during the same admission, are flagged in the database as high risk patients, however are not included as multiple events in the analysis.
(6) Members of our advisory council asked to also have these measures reported as incidence rates.
(7) Data are stratified by a multi-institutional validated complexity tool (STS-EACTS) and depicted in separate charts.
(8) Opportunities include calendar days between infections.