

Quality Improvement Explained

Successful Reduction of Postoperative Chest Tube Duration and Length of Stay After Congenital Heart Surgery: A Multicenter Collaborative Improvement Project

Katherine E. Bates, MD, MSHP, Chloe Connelly, MA, Lara Khadr, MPH, Margaret Graupe, MS, Anthony M. Hlavacek, MD, Evonne Morell, MD, Sara K. Pasquali, MD, MHS, Jennifer L. Russell, MD, Susan K. Schachtner, MD, Courtney Strohacker, MD, Ronn E. Tanel, MD, Adam L. Ware, MD, Sharyl Wooton, MS, Nicolas L. Madsen, MD, MPH, Alaina K. Kipps, MD, MS, on behalf of the Pediatric Acute Care Cardiology Collaborative (PAC³)

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*This Quality Improvement Explained was prepared by
Katie Bates (primary author), Kaitlin L'Italien MD, MS (clinician), Stacey L. Tyson-Tracy (parent)*

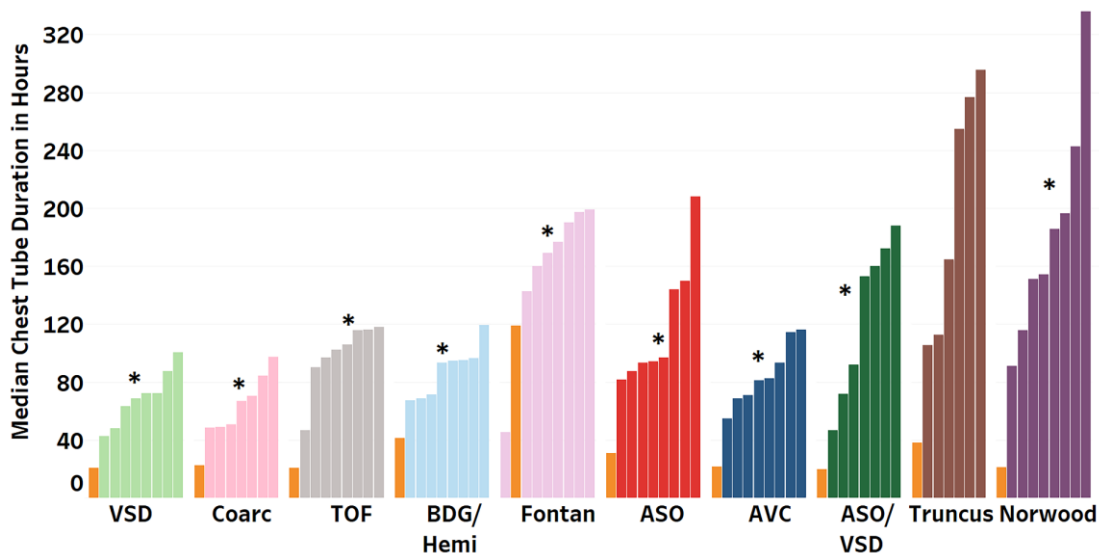
About this Study

What problem were you trying to solve?

- We wanted to decrease the length of time that a chest tube remains in a patient after surgery for congenital heart disease. The idea for the project arose when we noticed that there were differences among heart centers in how long they allowed chest tubes to remain in children after surgery for congenital heart disease. During this study, we found one center that removed chest tubes sooner after surgery without needing to replace them more often (shown in orange below).
- In this study, we wanted to see whether other heart centers might benefit from learning more about this “model center” in order to change how they manage postoperative chest tubes and hopefully remove them sooner.

Chart

This graph shows the average amount of time chest tubes remain in patients after surgery (y-axis) across 10 surgery types (x-axis). Each bar represents one of the participating hospital heart centers for each surgery. The hospital that was found to have chest tubes in patients for less time than the other hospitals (the “model” center) is shown in orange. When there is an * above the group of bars for one surgery, it shows that the difference between the orange hospital and the rest of the hospitals was significant; in other words, the difference was not likely due to chance.



How was this study performed?

- Nine heart centers who participate in both PAC³ and PC4 (Pediatric Cardiac Critical Care Consortium) used a method called “collaborative learning” to try and decrease the amount of time the chest tubes are used following surgery. This consisted of: 1) learning about how the model center manages chest tubes, 2) reviewing their own data on chest tube management and duration 3) quality improvement coaching, and 4) sharing their successes and challenges with the group.
- For our data analysis, we reviewed the history of patients from all the participating centers who underwent one of 9 “benchmark” surgeries. Benchmark surgeries refer to common congenital heart surgeries that are often used in congenital heart surgery research. (The nine surgeries are all shown in the chart above; the Fontan surgery was not included in this review.) We compared data from the baseline period to the post-intervention period to determine if the average duration of chest tubes and postoperative length of stay decreased.

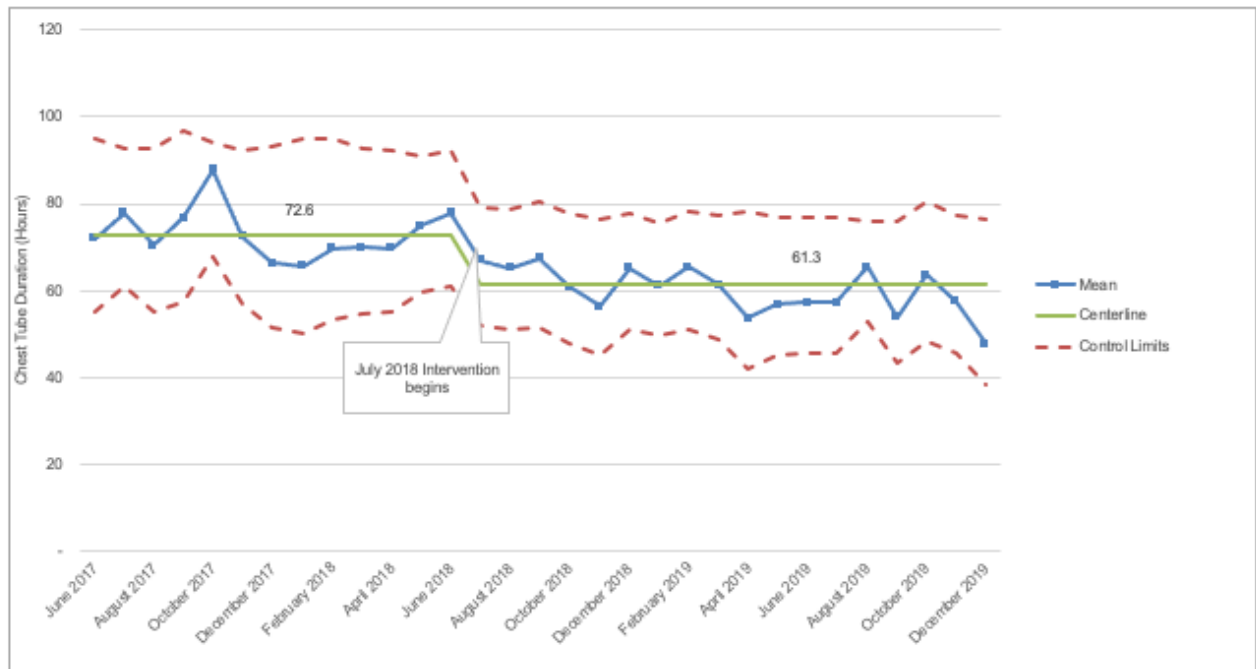
What quality improvement tools were used?

- [Key Driver Diagrams](#) were used to organize the project. We encouraged individual centers to use a [Stakeholder Analysis](#) tool as well as any other QI tools they use at their centers.
- [Statistical Process Control charts](#) were used to measure our progress. For our primary outcome, this chart plots the average time that chest tubes were in place each month. There is then a “center line” drawn which is the average of these monthly averages. We then looked

for a pattern in the data that suggests that the monthly averages have changed and redrew the center line accordingly.

What improvements were observed?

- Following the intervention start date, we saw a 15.6% reduction in the length of time that postoperative chest tubes stay in, from 72.6 to 61.3 hours.



- We also found a 9.8% reduction in average length of stay after surgery, from 9.2 to 8.3 days.
- Importantly, we did not see an increase in how often chest tubes needed to be replaced or how often patients were readmitted due to fluid building up in the chest.

What are the lessons learned from this work?

- Collaborative learning is an effective methodology to reduce variation across heart centers and ultimately improve patient outcomes.
- Chest tubes can be safely removed earlier after operations.
- We think the differences we previously found in chest tube duration across centers were due to variation in each heart center's chest tube management practices rather than differences in patient populations or other perioperative practices

What is the impact of this study?

- Many heart centers have seen significant reductions in how long chest tubes stay in and how long children stay in the hospital after their operations.
- These improvements have been maintained over time at the original 9 centers who participated in this study.

Could my center do a project like this?

- YES! In fact, we have shared the methods we used with a second group of PAC3 heart centers who have also been successful. We have shared our experience with this improvement project in a “change package” which is available [here](#).