Larger Centers May Produce Better Outcomes: Is Regionalization in Congenital Heart Surgery a Superior Model?

Sarah Burki,[a,b] and Charles D. Fraser Jr[a,b]

Efforts to correlate outcomes of children undergoing heart surgery with center volume and characteristics are not novel. In the current era, outcomes are defined as, and in many cases limited to, mortality rates. Over the past two decades, several investigators have explored various aspects of the volume–mortality relationship. The association between center volume and mortality, although not uniform, is highly implicated by the current literature. Notwithstanding, varied population densities in the United States makes regionalization of specialized services, such as pediatric cardiac surgery, undeniably challenging. There may be an unfortunate reality that larger centers have some advantage in achieving, at the very least, timely measures. However, as pediatric cardiac surgery progresses as a specialty, the definition of 'outcomes' must be expanded beyond simplified, dichotomous parameters. While mortality has been our historical primary focus, as it should be, it is reasonable to propose that our focus should be increasingly refined towards patient- and family-centric measures, including morbidity, cost/value ratio, and overall hospital experience.
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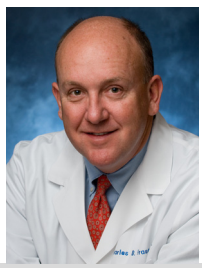
Introduction

The effort to correlate outcomes of children undergoing heart surgery with center volume and characteristics is not a novel concept. In the early 1990s, Jenkins and colleagues[1] reported their observations on the relationship between outcomes of pediatric cardiac surgery and hospital caseload. Subsequent reports consist largely of single-center studies, often based on administrative data.[2,3] In the current era, "outcomes" are defined as, and in many cases limited to, mortality rates. However, as pediatric cardiac surgery progresses as a specialty, the definition of outcomes must be expanded beyond simplified, dichotomous parameters. While excellent care may be provided in smaller volume programs, there does appear to be a correlation between program size and resource commitment. This may translate into outcomes variability.



C.D. Fraser, Jr, MD, Chief, Congenital Heart Surgery & Surgeon-in-Chief, Texas Children's Hospital.

Central Message

A link between volume and mortality may exist. Outcomes other than mortality need consideration. Regionalization may be challenging to implement.

The subject we have been asked to discuss may be divided into two distinct issues; the first relates to whether larger centers secure better outcomes for pediatric cardiac surgery patients; the latter, concerning regionalization, may be challenging to practically implement and merits independent consideration.

[a]Department of Congenital Heart Surgery, Texas Children's Hospital, Houston, TX.
[b]Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, TX.
Address correspondence to Charles D. Fraser, Jr, MD, Congenital Heart Surgery, Texas Children's Hospital, 6621 Fannin Street MC19345H, Houston, TX 77030. E-mail: charlesf@bcm.edu

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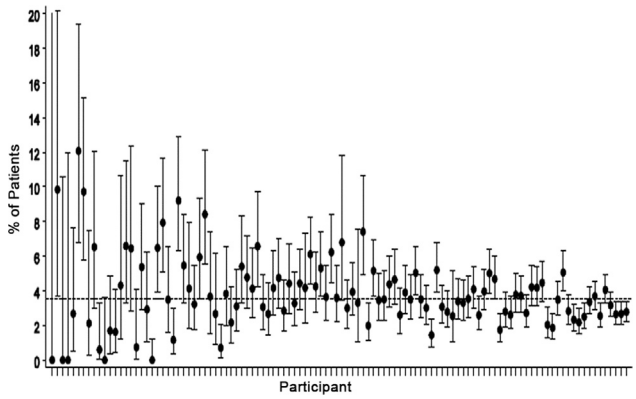

Figure 1 STS graph representing congenital heart surgery center operative mortality.

Center Size and Relevance to Decision Making

The Society of Thoracic Surgeons (STS) designates congenital heart surgery program size based on the number of index cases performed annually. The cutoff thresholds for the number of operations necessary to fall in each category (that is, small, medium, or large), are essentially arbitrary. 'Large' programs are defined as programs performing over 250 index cases per year, whereas 'small' programs perform less than 100.[4] In other words, a small program can expect to perform about two procedures per week. By using hospital-reported data aggregated over 4-year cycles, the STS generates a graphical representation (Fig. 1) of mortality whereby individual programs, though anonymized, compare with their counterparts nationwide.

While individual pediatric cardiac surgery programs are deeply invested in this outcome, how does a referring physician, family member, or patient utilize these 'data' in deciphering program performance? As one can clearly see from the graph (Fig. 1), significance of outcomes (mortality) differences are difficult to assess. Does this mean all programs achieve comparable results?

Benefits Available to Texas Children's Hospital as a Large Center

For the past two decades, we have been fortunate to be a part of a very large hospital center (Texas Medical Center) in a large city (Houston, TX). As part of this conglomerate, Texas Children's Hospital (TCH) has experienced steady growth over the preceding 20 years: from $2.6M in annual revenue in 1995 to $2.6B in 2014, with over $3B dollars projected this year. Additionally, in response to increasing demands, we have had exponential increases in both admissions and facilities in square feet. Commensurate with this growing demand, increased availability in resources has allowed us great latitude in establishing advanced programs such as pediatric lung transplantation, ventricular assist device program, and very recently, a fetal surgery program.

Needless to say, programmatic experience grows in tandem with the institution. Last year we were very pleased to report an annual operative mortality of $<1\%$ at TCH. Compared with the STS national benchmark of 3.51% for 2014, our mortality rate may not be statistically different. That notwithstanding, the difference between 1% and 2% mortality is a slippery slope wherein excellence can quickly descend into mediocrity. We maintain, with conviction, that it takes commitment from all team members to safeguard against creeping decline. To illustrate, individual surgeons, as part of a unified and seamless team, have rescued colleagues' postoperative patients time and again. Large programs like ours are afforded a sizeable group of fully dedicated Heart Center professionals who each contribute their expertise, as well as unique perspective, to all aspects of patient care. This team is available at all times – weekdays, weekends, and holidays. We contend that this should be an element of center performance assessment.

Current State of the Evidence

As noted earlier, several investigators have explored the link between center volume and mortality.[4–9] In 2002, Chang and Klitzner of UCLA[10] studied the effect of theoretically 'closing' low-volume pediatric cardiac surgery centers with the poorest outcomes and redirecting those patients to surrounding higher-volume centers in the state of California. Their model was based on abstracted statewide hospital discharge data between 1995 and 1997, and consisted of 6,592 patients in 20 hospitals. The authors reported that 83 deaths could theoretically be avoided if all patients were referred from low- and medium-volume centers to high-volume, high-performing institutions, with mortality dropping from 5.34% to 4.08%. While their results support the notion that regionalization is indeed associated with a reduction in pediatric cardiac surgery mortality, the authors also concede that such a highly regionalized system may not be the most feasible or cost-efficient model to achieve intended outcomes. Similarly, in their study published in 2009, Welke and colleagues[4] sought to determine an association between pediatric cardiac surgery volume and mortality using a sophisticated case mix (Aristotle Basic Complexity Score) adjustment. Querying the STS CHS database between 2002 and 2006, they found that when surgical volume was regarded as a categorical variable, the inverse relationship between volume and mortality gained greater significance ($P = .02$) as case complexity increased (ABC score > 3.0). Moreover, to investigate factors influencing the volume–outcome relationship, Pasquali and Jacobs[8] conducted a large multicenter analysis of hospitals reporting to the STS CHS database between 2006 and 2009. The cohort consisted of 35,776 children undergoing cardiac surgery in 68 centers. It was found that lower center volume was significantly associated with higher mortality in those with postoperative complications, and that the association was most