STA723 - Case Study 3: Mortality from Pediatric Cardiovascular Surgery

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1 Background

As the result of a recent New York Times expose, UNC Hospital recently suspended most of its complex pediatric cardiovascular surgical procedures. Most hospitals participate in voluntary public reporting through the Society for Thoracic Surgeons (STS) Congenital Heart Surgery Database. At the time of the last report, roughly 85% of programs participated in this voluntary reporting. Data are made available over 4-year analytic time windows in each annual report. Note that due to periodic data updates, the data we have may differ slightly from the data available online, either on the STS website or on individual hospital websites. While UNC did not participate in this program at the time of the expose, they eventually posted 2015-2018 mortality data online. The data on neonates+infants+children is comparable to the data we will consider from the STS database. The data include the number of pediatric (neonates+infants+children) surgical procedures during the 2015-2018 reporting period and the number of deaths resulting from those procedures.

Note that an important aspect of evaluating hospital performance in pediatric surgery is that certain hospitals have substantial expertise and a reputation in certain areas, such as pediatric cardiology, and this leads to them potentially getting a more challenging group of procedures and higher mortality. This type of issue is commonly referred to as the *case mix* in the literature - for instance, highly ranked programs and academic centers may attract the more severely diseased and may thus potentially have a more challenging case mix than rural hospitals. Unfortunately, individual level

data are not available due to privacy reasons and instead group-level data are available providing information on how risky the patients are in addition to the results of surgeries. The data contain a hospital-specific expected mortality rate for procedures in each of 5 categories, in which category 1 represents the simplest procedures (which should have the lowest mortality), and category 5 represents the most challenging procedures associated with the highest mortality. You can read more about specific procedures included in each category. Because there is significant potential for variation in difficulty of procedures even within a category, the expected mortality rate is provided separately for each category and hospital based on the individual patients seen by that hospital during the time period of interest.

Finally, an additional challenge is data sparsity, potentially calling for a very careful shrinkage or hierarchical modeling approach. For instance, certain hospitals have 0 mortality but only few procedures too.

2   Research Focus

Interest focuses investigating mortality rates, both overall and stratified by procedure complexity, for the hospitals represented in the data, leading to a ranking of hospitals in terms of their performance in conducting pediatric cardiovascular surgeries. In particular, the overarching goal is to provide parents with a decision rule for deciding which hospital to go to for a procedure given the specific condition of their: if your child needs surgery for a level X condition, what hospital would you recommend in NC?

3   Potentially Useful Resources

You may find the ideas in George et al paper to be quite useful in formulating a reasonable modeling approach.

- https://arxiv.org/pdf/1510.00842v2.pdf (Rockova & George paper, focusing on the important issue of properly defining shrinkage targets)

- https://www.luriechildrens.org/en/specialties-conditions/heart-center/volumes-outcomes/the-meaning-behind-stat-scores-categories/ Descriptions of how they currently define the categories of facilities.

- https://www.uncchildrens.org/uncmc/unc-childrens/care-treatment/heart/outcomes/ (UNC data – these were updated to 2018-2021 for what I assume are PR reasons given the greatly improved performance, but you can scroll down to get the older data. You could probably also scrape the newer data online.)

- A previous researcher did some web scraping. No guarantees that it was done correctly. You can use the files Web_Scraping.R and amy.rdata to reproduce or modify it.