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Commentary regarding prognostic profiling of children with serious postoperative complications: A novel probability model for failure to rescue

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ABSTRACT

This is a commentary on the manuscript by Mpody C, Arends J, Aldrink J, et al., titled "Prognostic Profiling of Children with Serious Post-Operative Complications: A Novel Probability Model for Failure to Rescue".

In this issue of the Journal of Pediatric Surgery, Nafiu and colleagues propose a prognostic index predicting failure to rescue (FTR) defined as death within 30 days of an operation that was followed by a complication. FTR, first proposed by Silber et al. [1], has been the focus of increasing attention as a surgical quality metric [2]. Previously, in children, most of the FTR literature has been focused on cardiac surgical procedures [3]. That is changing. In addition to the present article, this journal recently e-published a paper by Kim et al. [4] that also looked at FTR using the NSQIP-Pediatric participant use file. A brief comparison of these two works may help surgeons caring for children at risk for postoperative complications.

Both papers estimate an FTR rate of 2.4% and document a higher rate for children suffering more than 1 complication. Nafiu et al. used data from 2012 to 2017, while Kim et al. used patients treated between 2012 and 2016 as their cohort. The methodology used by the teams differs slightly. Both looked at all cases followed by one or more complications. Both used descriptive statistics to describe demographic, comorbidity, and procedure related variables. Both used univariable logistic regression with the outcome of interest, FTR, to define a group of variables that were related to FTR. Both found a positive relationship between the number of preoperative risk factors and FTR, and the number of complications and FTR, with higher mortality in those patients with more risk factors and more complications.

Nafiu's group proposed a risk index derived by multiplying the regression coefficient for each risk demographic and preoperative risk factor by 10, rounding to the nearest integer, and summing all of these numbers for each patient. They used an internal validation strategy that iteratively divided the cohort up randomly into derivation and validation groups to estimate the fit of this index with the actual outcomes of the cases in the cohort. They then divided the patients suffering at least 1 postoperative complication into 3 groups based on this score with FTR rates varying from low (0.1), to intermediate (3.3), to high (22.6). Kim's group used a propensity score, or the probability of having 2 or more complications derived from a multivariable logistic regression model with serious complications regressed on all covariates. They then calculated a score for each patient using the inverse of this probability. This was used to weight a regression model of FTR with the predictor being the number of serious complications (1 or 2+). This group then looked at the type of complication and its impact on FTR for both the groups having 1 complication and those having 2 or more (Tables 4 and 5). They showed that in both groups there was a significant association between the type of complication and FTR.

Following the logic and statistical methods used in these papers requires a lot of effort from our readers. The authors rigorously apply advanced techniques. All surgeons need to be aware of some real-world issues from this type of work, and its promise of improved situational awareness for surgical teams. Data sets and models contain bias that may impact accuracy of predictive results. The NSQIP-Pediatric risk calculator (https://riskcalculator.facs.org/peds/, accessed on 9/21/2020) is an example of a tool that is sensitive to the accuracy of data input and

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limited by bias. For instance, that calculator will define risks for gender specific operations (hypospadias repair, oophorectomy) in the opposite gender, and provides a mortality risk of 2.9% for an emergent cholecystectomy done on a patient with ascending cholangitis, septic shock, on a ventilator, with a hematologic disorder, and an ASA of 3. This estimate is biased low because of the very low mortality observed for laparoscopic cholecystectomy, and the fact that modern care for the patient described would not be a laparoscopic cholecystectomy. The dangers of using advanced analytics, including artificial intelligence on large data sets that contain bias, were recently reviewed [5]. Much work remains to be done to remove this type of bias from data sets used to inform prognostic tools that must be accurate for underrepresented minority children, those with unfavorable social determinants of health, all ages, including neonates, and so forth. Future analysis also should pay attention to the clinical context of risk factors, and to variable interactions.

We should not use such worries to minimize the importance of the contributions made by these authors. Their ideas may shape the future. For the present, they (and others) have clearly described a minimal data set needed to estimate risk of FTR. These variables include age, gender, race, specific preoperative risk factors such as ventilator and or pressor dependence, cardiac history, and others. The more of these that are present, the higher the risk for problems. All surgeons and anesthesiologists caring for children who need surgical procedures should know these factors about their patients. A synoptic preoperative status sheet is a tool that would help ensure this baseline awareness of the actual operative risk of every child undergoing surgery. Surgeons and caregivers should also recognize that occurrence of a postoperative complication is a serious event that dramatically increases the risk of death for their patient, and that multiple complications rapidly increase this risk. Surgeons should also recognize that operations considered low risk result in a large number of potentially preventable deaths [6].

Finally, surgical leaders, hospital administration, and quality improvement workers should be familiar with the concept of FTR and recognize that, in the future, there will be increasing interest in using this as a formal quality metric to compare institutions and providers.

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