The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 1 —coronary artery bypass grafting surgery

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Background: The first version of The Society of Thoracic Surgeons National Adult Cardiac Surgery Database (STS NCD) was developed nearly 2 decades ago. Since its inception, the number of participants has grown dramatically, patient acuity has increased, and overall outcomes have consistently improved. To adjust for these and other changes, all STS risk models have undergone periodic revisions. This report provides a detailed description of the 2008 STS risk model for coronary artery bypass grafting surgery (CABG).

Methods: The study population consisted of 774,881 isolated CABG procedures performed on adult patients aged 20 to 100 years between January 1, 2002, and December 31, 2006, at 819 STS NCD participating centers. This cohort was randomly divided into a 60% training (development) sample and a 40% test (validation) sample. The development sample was used to identify predictor variables and estimate model coefficients. The validation sample was used to assess model calibration and discrimination. Model outcomes included operative mortality, renal failure, stroke, reoperation for any cause, prolonged ventilation, deep sternal wound infection, composite major morbidity or mortality, prolonged length of stay (> 14 days), and short length of stay (< 6 days and alive). Candidate predictor variables were selected based on their availability in versions 2.35, 2.41, and 2.52.1 of the STS NCD and their presence in (or ability to be mapped to) version 2.61. Potential predictor variables were screened for overall prevalence in the study population, missing data frequency, coding concerns, bivariate relationships with outcomes, and their presence in previous STS or other CABG risk models. Supervised backwards selection was then performed with input from an expert panel of cardiac surgeons and biostatisticians. After successfully validating the fit of the models, the development and validation samples were subsequently combined, and the final regression coefficients were estimated using the overall combined (development plus validation) sample.

Results: The c-index for the mortality model was 0.812, and the c-indices for other endpoints ranged from 0.653 for

reoperation to 0.793 for renal failure in the validation sample. Plots of observed versus predicted event rates revealed acceptable calibration in the overall population and in numerous subgroups. When patients were grouped into categories of predicted risk, the absolute difference between the observed and expected event rates was less than 1.5% for each endpoint. The final model intercept and coefficients are provided.

Conclusion: New STS risk models have been developed for CABG mortality and eight other endpoints. Detailed descriptions of model development and testing are provided, together with the final algorithm. Overall model performance is excellent.

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