Commentary: Outliers—Salvage operations and the Society of Thoracic Surgeons risk model

Clark R. Murray, MD, MSc,^a and Leora B. Balsam, MD^b

From the ^aDepartment of Surgery and ^bDivision of Cardiac Surgery, UMass Memorial Medical Center, Worcester, Mass.

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Address for reprints: Leora B. Balsam, MD, Division of Cardiac Surgery UMass Memorial Medical Center, University Campus 55 Lake Ave N, Worcester, MA 01655 (E-mail: leora.balsam@umassmemorial.org).

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The cardiac surgeon is often faced with difficult decisions that may alter the course of a patient's life. This is no more evident than in salvage operations, defined in the Society of Thoracic Surgeons (STS) National Database as cases in which patients are actively receiving cardiopulmonary resuscitation or require extracorporeal membrane oxygenation for stabilization immediately before surgery. Whether to offer surgery under these conditions is a decision that must be made, considering both clinical factors and the wishes of the patient. Establishing consensus among the clinical team is necessary, and for cases that are deemed futile, surgery should not be offered.

In this issue of the *Journal*, Chancellor and colleagues¹ hypothesize that risk aversion arising from public reporting of outcomes in cardiac surgery affects decision making in salvage cases. By applying the STS model for predicted risk of operative mortality, they compare observed to expected operative mortality in elective, urgent, emergency, and salvage cases from a regional database of 19 cardiac surgery centers in Virginia and North Carolina (Virginia Cardiac Services Quality Initiative) during a period from 2002 to 2017. Primary coronary artery bypass grafting, isolated valve operations, and combined coronary artery bypass grafting and valve cases were analyzed. Among the 76,498 cases, only 117 were salvage cases (0.15%). Chancellor and colleagues¹ find better concordance between the observed and predicted mortalities in lower and moderate risk cases, with worse agreement in the salvage cases. The predicted risk of mortality was higher than the observed risk in the salvage cases, with a mean observed to expected ratio of 1.41 (95% confidence interval, 1.06-1.84).

When assessing the fit of the STS model to the salvage cases, one must consider several factors. First, disagreement with the model in this small subset does not imply that the model works badly. The model is designed to fit the larger STS cohort, and as Chancellor and colleagues¹ demonstrate, it does this quite well. Second, with regard to salvage

Clark R. Murray, MD, MSc (left), and Leora B. Balsam, MD (right).

Central Message

The STS model for predicting operative mortality is designed to fit a large population. Salvage cases constitute a small subset, and, not surprisingly, the model may not fit it well.

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cases, there are missing data elements that may affect the model's fit with this subset. These include all the cases declined by surgeons because of perceived futility. It may in fact be that were these included in the calculation, the predicted and observed risk of mortality would align more closely.

Chancellor and colleagues¹ suggest that risk aversion arising from public reporting may play a role in surgical decision making in salvage cases. This particular hypothesis is difficult to prove, and public reporting notably is voluntary in the states that participate in the Virginia Cardiac Services Quality Initiative (Virginia and North Carolina). Risk aversion arising from public reporting has not been easy to demonstrate in cardiac surgery, and a recent report from Shahian and colleagues² found little evidence that it influences decision making in cardiac surgery. Most studies that have explored this topic have looked for shifts in patient acuity and risk, typically from geographic regions that have cardiac surgery public reporting to those that do not, spanning a period before and after public reporting. In general, these studies have not been able to find evidence that risk aversion occurs as a result of public reporting of cardiac surgery outcomes. This is unlike the field of interventional cardiology, in which risk aversion has been more easily identified in the context of percutaneous coronary intervention for acute myocardial infarction with cardiogenic shock.^{2,3}

One of the more important findings of this study was that inclusion of salvage cases did not noticeably affect the centers' overall mortalities. Because these were rare cases, the overall mortalities were driven by the more frequent elective, urgent, and emergency cases. This point is emphasized in Table E1 from that article.¹

Chancellor and colleagues¹ draw attention to a vulnerable patient population that may have the most to gain from intervention. The conclusions to draw from the study are that (1) the STS model should not be expected to fit this small subset, (2) this study neither proves nor disproves the hypothesis that risk aversion arising from public reporting exists in cardiac surgery, and (3) outcomes of rare salvage

cases do not appreciably influence a center's overall observed to expected mortality ratio when applying the STS model.

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