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Commentary: Can machine learning reduce readmissions after esophagectomy? A consummation devoutly to be wished

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CENTRAL MESSAGE

Machine learning for reducing readmissions after esophagectomy: not ready for prime time.

Unplanned hospital readmissions are a significant burden on health care resources, with a price tag estimated to exceed 17 billion dollars annually.¹ Although not yet designated a quality metric by the Centers for Medicare & Medicaid Services, readmissions after esophagectomy are a major concern for esophageal surgeons and, more importantly, are demoralizing events for patients and their families. Despite advances in preoperative risk stratification, intraoperative and perioperative care, and increased adoption of enhanced recovery protocols, readmissions after esophagectomy remain stubbornly high. Readmissions rates within 30 days' postdischarge have hovered around 20% over the past decade and are as high as 30% at the 90-day mark.^{2,3} Is it possible that some complex surgical procedures are associated with fixed unalterable rates of readmission? In the case of esophagectomy, that may well be the case, given the multiple comorbidities frequently encountered in this patient population. However, we believe there is still room for improvement, since nearly 70% of all readmissions occur within 2 weeks of hospital discharge. The majority of these readmissions are commonly labeled as due to "gastrointestinal" or "cardiopulmonary" complications, that may well be directly attributable to the surgical procedure itself. If such events could be reliably anticipated, diagnosed and, most importantly, managed or

prevented before discharge, we might finally make a dent in the readmission rate.

That is precisely the objective of the current report by Bolourani and colleagues in this issue of the *Journal*.⁴ The authors reviewed the National Readmission Database for all esophagectomies performed in 2016 and used machine-learning (ML) techniques to develop prediction models for early readmission after esophagectomy. They generated 2 models, the first with a high sensitivity of 90.4% for clinical decision making and the second with an accuracy of 92.8% and specificity of 99.3% for quality review. Undoubtedly, ML has substantial potential applications in health care delivery, exemplified by the use of radiomics to predict malignancy in pulmonary nodules or deep learning in screening for diabetic retinopathy or decreasing the error rate in detection of nodal metastases in breast cancer.⁵⁻⁷ Some commonly used ML algorithms enable computers to make predictions using labeled data in a "training" set and then test the model on a new, unseen "validation" set.

Clearly, the granularity of the data and proper variable definition are crucial to the validity of the model. The inadequacy of some variable definitions in administrative databases, such as the one used by the authors, is well-recognized and raises the question whether the research question posited by the authors can be satisfactorily answered by the data inputted into the algorithm. Furthermore, the lack of an appropriate validation set further reduces the validity of the models. Our current experience with ML models is that variable selection is very unstable, particularly when continuous variables are categorized to make results more meaningful. The real challenge is persuading surgeons, not an easily persuadable lot, that variables selected by ML models are sufficiently robust compared with clinical variables that have endured the

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Disclosures: Dr Altorki has clinical trial support from Astra Zeneca LLC and research support from NCI Moonshot (UG3CA244697). Dr Sedrakyan reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication May 12, 2020; revisions received May 12, 2020; accepted for publication May 12, 2020; available ahead of print June 1, 2020.

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J Thorac Cardiovasc Surg 2021;161:1944-5

0022-5223/\$36.00

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<https://doi.org/10.1016/j.jtcvs.2020.05.054>

test of time, such as prolonged length of stay, end-organ insufficiency, frailty index, and multiple important comorbidities. A head-to-head comparison of a validated ML models against best physician judgment or against traditional models or even hybrid models would be necessary to accelerate adoption of artificial intelligence in surgical practice after esophagectomy. After all, it is an article of faith among surgeons that good outcomes after esophagectomy are often the result of good judgment by surgeons seasoned by many years of hard-won and sometimes painful experience. Model that!

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Commentary: How to catch a boomerang: Learning from hospital readmissions after thoracic surgery

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CENTRAL MESSAGE

Machine learning can aid in the development of readmission models to evaluate quality and to guide clinical practice.

Esophagectomy continues to be a mainstay of treatment for early and locally advanced esophageal cancer. Despite recent advances in technique, such as minimally invasive esophagectomy and robotic-assisted esophagectomy, esophagectomy remains a relatively high-risk procedure even in expert hands, with reported morbidity of 49% and mortality of 1%.¹ Esophagectomy has changed not only in approach,

but also in difficulty with the wide application of neoadjuvant chemoradiotherapy. Ultimately the margin for error is thin, with data identifying postoperative complications and readmission as predictive of poor short-term and long-term survival.² Moreover, in the current health care climate, provision of high-quality surgery must be married to cost-efficient care.

In this issue of the *Journal*, Bolourani and colleagues³ demonstrate the utility of machine learning to the application of predicting early (within 30 days) readmission after esophagectomy. To do so, they analyze the National Readmission Databases from 2016, and report a total early readmission rate of 18.8%. As expected, early readmission was

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Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication May 26, 2020; revisions received May 26, 2020; accepted for publication May 27, 2020; available ahead of print June 26, 2020.

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J Thorac Cardiovasc Surg 2021;161:1945-6

0022-5223/\$36.00

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<https://doi.org/10.1016/j.jtcvs.2020.05.111>