Artificial intelligence was the stuff of intriguing novels and movies. One of the most exhilarating aspects of the human experience is the ability to learn. Rather than viewing the statisticians as some sort of foreign species, my advice is to embrace the uncertainty—work closely with statisticians whom you know and trust. If you cannot explain your clinical/scientific questions to them in terms that they can understand, it is likely that you do not understand the questions yourself. If they cannot explain the methods they would recommend to best answer those questions in terms that you

can understand, there is the likelihood that they may not understand those methods either. The rich interplay of investigator and statistician is a formula for high-level impactful research, as well as for mutual self-education.

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Check for updates

Commentary: Statistical methodology in cardiothoracic surgery: The devil is in the details

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Gritti and colleagues¹ are to be congratulated on an interesting and timely study evaluating the use of statistical methodology in the 3 preeminent cardiothoracic surgery journals. The authors evaluated all original manuscripts published in the *Journal of Thoracic and Cardiovascular Surgery*, *Annals of Thoracic Surgery*, and the *European Journal of Cardio-Thoracic Surgery* over the first 3 months of 2017. They report that 293 articles used a total of 1068 statistical methods, with an average of 3.6 methods per paper. Importantly, they highlight that only 4% used basic descriptive methods, whereas an introductory level of statistical knowledge was sufficient for only 16% of studies. These data support the growing body of literature

J. Hunter Mehaffey, MD, MSc, and Robert B. Hawkins, MD, MSc

CENTRAL MESSAGE

The use of advanced statistical methodology in the cardiothoracic literature continues to grow, and formal education is needed to enable clinicians to critically review and appropriately interpret results.

demonstrating an increasing complexity of the statistical methodology used in health outcomes research.²

The authors nicely highlight many of the statistical methods used; however, I was surprised to see the topic of propensity score categorized as “intermediate training required.” This method was used in 12% of the articles evaluated, and its use has certainly increased in recent years. Many clinicians consider propensity score matching studies to be similar to randomized trials and enjoy the ease of interpretability. Great care must be taken when interpreting these studies, however. Although a perfectly performed match is

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easy to interpret, matches are never ideal, and there are always trade-offs among matching techniques, covariates included, and priorities to balance. The typical result is slightly biased and the conclusion overstated. The *Journal of Thoracic and Cardiovascular Surgery* published an excellent primer on the topic of propensity score–matched studies in cardiothoracic surgery in 2015 that remains widely cited.³

In addition, the 2017 time period used in the present study was before the rise of machine learning and artificial intelligence methods in cardiothoracic surgery. These advanced approaches require detailed knowledge of the limitations of a study's design to appropriately interpret the results, as highlighted in a recent editorial by Ishwaran and Blackstone.⁴ These advanced data science techniques were developed to overcome limitations of current regression models and may prove especially useful when predicting outcomes in heterogeneous populations such as the congenital cardiac surgery database.

Finally, the authors appropriately conclude that clinicians need additional training in statistical methodology and should increasingly rely on biostatisticians for designing these complex studies. However, it is impossible to rely on statisticians to interpret every study in the journals for

us. It remains critical for the National Institutes of Health and other funding bodies to continue support for biostatistics training, which afforded my coauthor and I the opportunity to earn graduate degrees through T32 grant funding.⁵ It is encouraging to see an increasing number of trainees and junior faculty spending dedicated time earning advanced degrees to learn statistical methodology. Only through continued statistical learning will surgeons be able to understand increasingly complicated studies. The data are what the data are, but the devil is in the details.

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