See Article page 1131.

Commentary: Machine learning starts with human learning

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The paper by Domaratzki and Kidane¹ is a gentle introduction to the realm of machine-learning (ML) methods. It is informative and sufficiently detailed to provide a general sense of the potential advantages of using ML in cardiothoracic surgery research. The question is how soon will these methods become sufficiently well understood and trusted to be adopted widely by cardiovascular researchers?

Leading thinkers in the areas of ML and artificial intelligence (AI) draw attention to the need for methods that produce explainable and interpretable results.²⁻⁴ The so-called “glass-box” methods stand in contrast to black-box methods that sometimes yield what may be perceived as “deus ex machina” results. In cardiothoracic and vascular surgery research, an explainable ML/AI method is one whose results surgeons feel comfortable accepting. For example, it is not uncommon for deep-learning methods to produce meaningful outcome predictions based on questionable inputs (features). Is it wise to trust and act upon AI/ML-based recommendations or predictions that, even if we approve of or agree with, cannot explain to ourselves and to others? Highly consequential cautionary tales in areas such as criminal justice or insurance, to only name a few, have shown that AI/ML automation can lead to serious bias and discrimination for certain groups defined based on their ethnicity, income, or sex.^{5,6} It is a matter that, so far, has received very limited attention in cardiothoracic or vascular surgery research but will likely surface in ways that we have to be prepared to deal with appropriately and justly.

Even though AI/ML-driven results should be developed and integrated gradually into routine analytical practice, their potential to positively impact the medical decision process is undeniable. For example, in addition to standard

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CENTRAL MESSAGE

Machine learning and artificial intelligence method will completely change our understanding of cardiothoracic and vascular outcome research. Data-centric training is a core ingredient for success.

metrics, a battery of ultra-high dimensional features is already collected preoperatively for cardiac surgery patients, such as imaging, echocardiography, or wearables data. These features (or covariates) will be incorporated routinely into the process of risk modeling and segmentation or that of outcome prediction. AI/ML algorithms are beyond the human capacity to synthesize and process this type of information, so they have the potential to unlock data relationships that are otherwise outside of the human perception depth. Given the computational sophistication that such algorithms entail, cloud-based platforms are the logical infrastructural choice.

I agree with the conclusions of Domaratzki and Kidane¹ that education in terms of basic premises and pitfalls of ML methods is necessary. However, even for the most successful autodidacts, this will not suffice. To take advantage of the unprecedented AI/ML developments and to fuel further scientific advancement in the field, it is necessary to invest massively in attracting and training data scientists in cardiothoracic and vascular surgery. Developing data-centric webinar series and allocating time for such training at major conferences, such as the American Association for Thoracic Surgery annual meeting, would be logical starting points.

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