The outcome of a prediction algorithm should be a true patient state rather than an available surrogate

We read “Popliteal scoring assessment for vascular extremity injuries in trauma study” with great interest, along with the subsequent letter and reply. We aimed to “risk-stratify patients with traumatic popliteal vascular injuries for amputation,” one of the most difficult decisions in surgery.

The purpose of prediction models is to inform individuals and guide decision making. When selecting the outcome of a prediction algorithm, one must seek a true patient state rather than a surrogate, even if the latter is easier to define or measure. This is because surrogate outcomes (1) are not as useful to the decision maker, (2) can constrain the decision agency, and (3) could contain errors, which are then propagated in the algorithm.

Predicting the “decision to amputate” is a surrogate for the true underlying state, “a requirement to amputate.” Amputation can be required because of an immediate threat to the patient’s life (due to hemorrhage), the unfeasibility of limb reconstruction (due to insufficiently available viable tissue), or later poor function or chronic pain. Amputation reflects a clinical decision arrived at through clinician perception and an appreciation of the risks of these patient states. One of the reasons the decision can be difficult is that inherently perceiving or predicting these states is challenging. As such, the prediction of amputation is not as valuable to the decision maker as would be the prediction of the true patient states of life-threatening blood loss, limb viability, or functional outcomes after attempted limb salvage.

Furthermore, the use of an algorithm to predict the “decision to amputate” necessarily infers that the end-user’s decision-making capacity will be constrained. This is because it references the intervention decisions that their predecessors have made, as aggregated in the training dataset, rather than providing information that informs the individualized decision for which the end-user requires support.

The training dataset can contain errors that are propagated by the algorithm developed from the data, unless appropriately cleaned or censored. This problem also exists with data-driven machine learning algorithms but can be addressed by incorporating expert knowledge in model development. Prediction algorithms should be designed to predict outcomes that will help clinicians and patients make treatment decisions rather than limit their decision-making agency.

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References


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