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Commentary: If a patient's life is at stake, let's not stop at the surface of the curves

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The *Journal* does not only publish original research articles, which are obviously of an excellent level, but it also provides articles concerning the statistical method and the practical implications.

The article by Movahedi and colleagues¹ is just 1 of them. The authors detail how a receiver operating characteristic (ROC) curve works and what erroneous messages it can deliver under certain conditions—which (unfortunately or may be not) occur very often in medicine. In fact, the problem focused on by this article is a very common phenomenon called the imbalance of the data. What every score does (and for the same reason is defined as a classifier) is to assign labels (eg, dead or alive) to patients. Consequently, every score assigns patients to 4 categories: the true dead, the false (labeled) dead, the true surviving, and the false (labeled) surviving. If the numbers of patients in these categories is unequal, there we have the unbalancing of data and the ROC curve could lead to an overly optimistic interpretation of the score's performance. The authors offer as an example 2 mortality scores used to predict the outcome after left ventricular assist device implantation (namely the HeartMate Risk Score² and the Random Forest³), but indeed their observations can be applied to any other scores. Movahedi and colleagues¹ discuss the problem and suggest—as a solution—the use of a supplemental evaluation tool: The precision-recall curve.⁴

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Left, Francesco Pollari, MD, PhD, and right, Michele Di Mauro, MD, PhD, MSc

CENTRAL MESSAGE

Imbalanced data could lead to an overoptimistic performance of ROC curve analysis. The use of precision-recall curves and calibration tests are recommended.

The ROC curve is among the most-used tools in medical statistics, and for this reason, it risks being abused. Like other things in life, ROC analysis was invented for other purposes (it was developed during World War II to decide whether a radar signal was an enemy airplane or not, and eventually whether or not to shoot it down⁵) and is now commonly applied by the medical-scientific community to identify what probability a patient has to survive an intervention. Given the ethical implications (of the intervention sure, but also of shooting down an airplane) it is necessary to understand with great care the limits of this technique and to consider more parameters before taking action (eg, the precision-recall curve, but without forgetting calibration tests such as the Brier score).⁶

The Roman poet Carlo Alberto Camillo Mariano Salustri (1871-1950), also known as Trilussa, effectively summarized in his satirical verses the limits of statistics, especially in the case of imbalanced data: “According to statistic, everyone has a chicken. And if you do not have any, that means some other owns 2.” Obviously if you are the person without a chicken and you are hungry, it is not of statistical significance.

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