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### Validation of Stroke Prognostic Scores: What Do Clinicians Need to Know?

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Prognosis is a medical term, derived from the Greek – fore-knowing, foreseeing – to denote the likelihood of the occurrence of a particular outcome. In the last few years, several colleagues have developed stroke risk prognostic scores to predict different outcomes, including early and long-term mortality, disability, discharge disposition, response to tPA and risk of intracerebral hemorrhage after thrombolysis, among others [1–7]. When applied to large populations, risk scores can provide useful prognostic estimates.

Clinicians, patients and their families wonder about the probability of having a good outcome, response to an intervention, or risk of death and/or disability after an acute ischemic stroke.

The iScore (Ischemic Stroke Risk Score) is a validated score including several well-known factors affecting stroke outcomes (e.g. age, sex, stroke severity, glucose on admission, concomitant comorbid conditions, preadmission dependency, etc.) [8]. It can be used not only to estimate the risk of short- and long-term death and disability early after hospitalization for an acute ischemic stroke ([www.sorcan.ca/iscore](http://www.sorcan.ca/iscore)), but also the likelihood of achieving a favorable outcome after tPA and risk of intracranial hemorrhage [9, 10].

Béjot et al. [11] evaluated the performance of the iScore in over 1,000 stroke patients, applying a population-based design in France. They found good performance of the iScore when applied to their patients: the C-statistic was 0.85 (95% CI: 0.82–0.89) for 30-day and 0.84 (0.81–0.87) for 1-year mortality. Similar findings were observed for disability (C-statistic: 0.81, 95% CI: 0.79–0.84). They also found similar good discrimination for mortality (C-statistic: 0.85, 95% CI: 0.76–0.93) and for functional outcome at discharge (C-statistic: 0.81, 95% CI: 0.72–0.90) for patients receiving tPA.

#### What Are the Limitations of the Study?

The sample size is relatively small. Despite this, however, the authors showed good performance when comparing the observed versus the predicted outcomes by the iScore when applied to a dif-

ferent (other than the validated) population. It is also possible that other variables not included in the iScore may have influenced the observed outcomes.

#### What Are the Practical Implications for Clinicians?

First, since stroke is a syndrome with multiple mechanisms and broad implicated factors, the prediction of clinical outcomes after stroke constitutes a challenge.

Second, there are several risk scores (e.g. TPI, DRAGON, AS-TRAL, SEDAN, SPAN-100) to predict clinical outcomes after stroke [2–4, 6, 12]. Clinicians need practical and validated tools in several ethnic groups when discussing prognosis with stroke patients and their families.

Third, a recent randomized study (JURaSSiC) revealed that the iScore improved clinicians' independent estimations of outcomes after stroke. For example, the overall clinician's accuracy for death or disability at discharge was 16.9% compared to 90% of the iScore-based estimates, which were within the 95% CI of observed outcomes [13].

Fourth, the application of clinical tools (available on the web or for smart phones) may help in communicating with and in counseling patients and their families [14]. In my personal view and as shown in the JURaSSiC trial, most stroke risk prediction outcome scores would facilitate, on average, better estimations compared to predictions based solely on the experience of clinicians [13].

Fifth, several authors attempted to compare different risk scores. They favored the use of some risk scores by comparing two statistical performance measures: discrimination and calibration. However, these measures have limited (if any) use for practical clinicians [15]. What we need to know is how many patients were 'correctly diagnosed' by each risk score in the general population and/or prespecified groups. Moreover, clinicians would like to know the probability of a good outcome or the risk of intracerebral hemorrhage predicted by each risk score after receiving tPA (compared to patients not receiving tPA). It is important to bear in mind that calibration and discrimination are statistical measures of the performance of the models that provide limited information to answer the aforementioned questions.

Sixth, when applying risk scores it is important to evaluate their validity in the studied population (e.g. external validity or generalizability). For example, the iScore was initially created and validated in an ethnically diverse population from Canada [8]. More recently, studies from Greece, Korea, China and other countries revealed good performance in other ethnic groups [16–19]. The present study provides some additional evidence of its application to a well-defined European population [11]. Together, the aforementioned points illustrate some of the benefits, caveats and limitations for outcome predictions using risk scores. Paraphrasing Albert Einstein (March 14, 1879 to April 18, 1955): 'Occurrences in this domain are beyond the reach of exact prediction because of the variety of factors in operation, not because of any lack of order in nature.'

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### Disclosure Statement

Dr. Saposnik declares no conflict of interest.

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