

It Is Difficult to Make Predictions, Especially About the Future

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Physicists, politicians, poets, and punters understand the pitfalls of predicting the future. Similarly, predicting outcomes after stroke rehabilitation can be difficult when based on clinical impression, and several approaches to combining key variables in predictive models have been developed.¹⁻³ In this issue, Scrutinio et al⁴ introduce a predictive model of functional outcome after stroke based on retrospective data from several hundred patients who were treated at the Maugeri rehabilitation centers between 2002 and 2015. Their primary binary logistic model predicts the probability of a patient having mild disability at discharge from inpatient rehabilitation, defined as a score of ≥ 61 on the motor component of the functional independence scale (M-FIM; maximum score 91). A second model predicts the probability of a patient requiring no more than supervision in activities of daily living at discharge. Both models use expected predictors such as age, sex, and FIM scores on admission to rehabilitation and perform well with areas under the curve around 0.80. The authors have taken a further step by creating an online tool that allows them to calculate the probability that each of their patients will achieve each of these outcomes. In their study sample, the probability of achieving an M-FIM score of at least 61 points is $<20\%$ for 60% of patients, $>80\%$ for 20% of patients, and around chance for the remaining 20% of patients. The probability of requiring no more than supervision is $<20\%$ for 80% of patients.

The strengths of the study include the large sample of patients most of whom had moderate-to-severe disability on admission to rehabilitation, rigorous statistical analyses, and the use of independent data sets to derive and validate their models. The authors acknowledge some limitations, including the retrospective nature of the study and differences between the rehabilitation service at their centers compared with other settings. The latter is particularly important. The median time poststroke of admission to rehabilitation was around 20 days, and the median length of stay was between 7 and 8 weeks. This means that the models are unlikely to generalize to other settings that typically have shorter rehabilitation time frames.

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The dichotomous nature of the predicted outcomes and the prediction of these outcomes at discharge from rehabilitation are potentially problematic. The latter may mean that predictions become self-fulfilling prophecies, as patients will be discharged when they achieve the expected outcome. The dichotomous nature of the outcomes is problematic if the predictions are used to select patients for rehabilitation, as the authors suggest. Doing so might mean that patients who could make meaningful improvements in function are denied rehabilitation because they have a low probability of achieving an M-FIM score of at least 61. The authors are silent on how high the probability of achieving this outcome needs to be before they consider rehabilitation worthwhile, and the question of what the patient considers a worthwhile improvement is not addressed. Rehabilitation can be very worthwhile (and even more important) for people who never regain the minimal levels of disability modeled in this study. However, the authors do provide a supplementary model for predicting whether a patient's M-FIM score will increase by at least 25 points during inpatient rehabilitation. Approximately twice as many patients achieved this meaningful increase in M-FIM score than achieved the primary or secondary outcomes. Unfortunately, this supplementary model is not included in their prediction tool. In summary, the dichotomous outcome measures of the study represent a limitation that is not unique to the Maugeri centers. The field is striving to achieve consensus for sensorimotor measures⁵ and patient-centered outcomes,⁶ and this issue remains an ongoing topic of debate.

The potential influence of therapy dose on outcomes in the Maugeri sample is uncertain, as therapy dose was not included in the models. All patients reportedly completed standard rehabilitation of 16 hours per week, though it is highly unlikely that this was the actual therapy dose for all patients. More severely disabled patients completed a less intense, but unspecified, therapy program. Including a measure of actual rather than scheduled therapy dose might have allowed the authors to predict which patients would benefit most from a higher dose or intensity of therapy. This information could be useful for rehabilitation planning.

The authors conclude that their prediction tool could be useful in clinical practice for patient education, guiding management decisions, selection of patients for rehabilitation, and efficient use of resources. These ideas need to be tested in their setting with a carefully developed strategy for implementation of the tool, which engages all stakeholders, considers the characteristics of the tool, and the willingness of all members of the clinical team to use the information provided.⁷ The tool could also be useful for testing the effectiveness of interventions within their service that might increase the probability of achieving good outcomes. Further research is then needed to study the effects of implementation—to what extent

does this information affect clinical decision making, what are the potential benefits and the unintended consequences (which may be negative), what are the perceptions of patients and their families, and how might this information be used by policymakers?

Stroke outcomes are typically worse for patients who are older, have more severe stroke, and are more unwell. The study by Scrutinio et al⁴ confirms previous work showing that functional outcomes after stroke rehabilitation are affected by patients' age, sex, and initial disability. It is also an interesting first step toward using these factors to predict the probability of being minimally disabled on discharge from this rehabilitation setting. Other healthcare settings could use this approach to developing their own prediction models, and then explore the effects of implementing these predictions in clinical practice.

Disclosures

None.

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