Clinical prediction rule

Clinical Prediction Rules are decision-making tools that quantify and then combine the contributions of specific clinical variables to predict the probability of a diagnosis, prognosis, or response to treatment.

It is a type of medical research study in which researchers try to identify the best combination of medical sign, symptoms, and other findings in predicting the probability of a specific disease or outcome.

Physicians have difficulty in estimated risks of diseases; frequently erring towards overestimation, perhaps due to cognitive biases such as base rate fallacy in which the risk of an adverse outcome is exaggerated.

In a prediction rule study, investigators identify a consecutive group of patients who are suspected of a having a specific disease or outcome. The investigators then compare the value of clinical findings available to the physician versus the results of more intensive testing or the results of delayed clinical follow up. It may involve, among other things, estimation of the clinical utility of diagnostic tests.

A survey of methods concluded “the majority of prediction studies in high impact journals do not follow current methodological recommendations, limiting their reliability and applicability”, confirming earlier findings from the diabetic literature[4]

Few prediction rules have had the consequences of their usage by physicians quantified.

When studied, the impact of providing the information alone (for example, providing the calculated probability of disease) has been negative.

However, when the prediction rule is implemented as part of a critical pathway, so that a hospital or clinic has procedures and policies established for how to manage patients identified as high or low risk of disease, the prediction rule has more impact on clinical outcomes.

The more intensively the prediction rule is implemented the more benefit will occur.

A study was to validate a clinical prediction rule developed to determine surgical outcome in patients with cervical spondylotic myelopathy (CSM). The study will also identify key clinical predictors of outcome at a global level.

This is a prospective multicenter cohort study.

Two-hundred seventy-eight and 479 surgical CSM patients enrolled in the AOSpine CSM-North American (CSM-NA) and CSM-International (CSM-I) studies, respectively.

The outcome measure was a Modified Japanese Orthopedic Association (mJOA) Scale.

A clinical prediction model was built using data from 272 patients enrolled in the CSM-NA study. Bootstrapping was used for internal validation. The original model was externally validated using data on 471 patients participating in the CSM-I study. The predictive performance of the model was evaluated, including its discrimination, measured by area under the receiver-operating curve (AUC), and calibration, assessed by calibration slope, observed:expected ratios, and Hosmer-Lemeshow goodness-of-fit test.

The modified original model consisted of six covariates: age (odds ratio [OR], 0.96), duration of symptoms (0.76), baseline severity score (1.21), psychiatric comorbidities (0.44), impairment of gait (2.48), and smoking status (0.50). The AUC for the original model was 0.77 (95% confidence interval [CI]: 0.71, 0.82) and across the bootstrap replicates was 0.77 (95% CI: 0.76, 0.77), reflecting good discrimination and internal validity. The model tested on the CSM-I dataset yielded an AUC of 0.74 (95% CI: 0.69, 0.79), a calibration slope of 0.75, and an insignificant Hosmer-Lemeshow test. The ORs generated for baseline mJOA (OR, 1.26), impairment of gait (2.67), age (0.97), and smoking (0.55) were very similar to the original values of 1.28, 2.39, and 0.97, respectively. Duration of symptoms (OR, 0.94) had a significantly different odds ratio than in the original model, but the direction of its relationship with outcome was the same. Psychiatric comorbidities was not a significant predictor at an international level, likely because of underreporting: only six patients outside of North American centers were diagnosed with depression or bipolar.

The parameter estimates generated from the original analysis were internally valid. The original model was also externally valid. The most significant global predictors of surgical outcome were baseline myelopathy severity, age, smoking status and impaired gait [1)].

Abusive head trauma (AHT) screening guided by a previously validated 4-variable clinical prediction rule (CPR) in datasets used by the Pediatric Brain Injury Research Network. Applied accurately and consistently, the validated, 4-variable clinical prediction rule (CPR) could theoretically improve the accuracy of abusive head trauma (AHT) screening in pediatric intensive care unit (PICU) settings [2)].

1)
Tetreault LA, Côté P, Kopjar B, Arnold P, Fehlings MG; AOSpine North America and International Clinical Trial Research Network. A clinical prediction model to assess surgical outcome in patients with cervical spondylotic myelopathy: internal and external validations using the prospective multicenter AOSpine North American and international datasets of 743 patients. Spine J. 2015 Mar 1;15(3):388-97. doi: 10.1016/j.spinee.2014.12.145. Epub 2014 Dec 27. PubMed PMID: 25549860.
2)
Hymel KP, Herman BE, Narang SK, Graf JM, Frazier TN, Stoiko M, Christie LM, Harper NS, Carroll CL, Boos SC, Dias M, Pullin DA, Wang M; Pediatric Brain Injury Research Network (PediBIRN) Investigators; Pediatric Brain Injury Research Network PediBIRN Investigators. Potential Impact of a Validated Screening Tool for Pediatric Abusive Head Trauma. J Pediatr. 2015 Oct 15. pii: S0022-3476(15)01022-7. doi: 10.1016/j.jpeds.2015.09.018. [Epub ahead of print] PubMed PMID: 26477871.