Reviewer's report

Title: Use of generalised additive models to categorise continuous variables in clinical prediction

Version: 2 Date: 4 February 2013

Reviewer: Montserrat Rue

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RE: Use of generalised additive models to categorise continuous variables in clinical prediction

The objective of the work is well defined: to propose a criterion for categorising continuous variables to be used in clinical prediction rules (CPR) by seeking both the optimal number of categories and the optimal cut points.

In general, the methods are appropriate and well described. The data are sound. The manuscript is well written. The discussion and conclusions are well balanced and adequately supported by the data.

Major compulsory revisions
None

Minor essential revisions

1) In my opinion, the main limitation of the study is the dependence of the non-influence category on sample size. A study with a big sample size will end-up with a narrower non-influence category than a similar study with a smaller sample size. The authors comment this issue in the Discussion section but I think they should add it to the limitations section and discuss more its consequences. For example, if the authors had split the data into development and validation datasets, the non-influence category would have been wider. A sensitivity analysis of the impact of sample size would help to assess the impact of sample size in the variables' categories.

2) At the end of section Categorisation methodology, it is said that the validation criterion of comparing with the original continuous covariate will be used, even for non-linear relationships. For variables like blood pressure with a J or a U pattern, it does not seem to me the best way of proceeding. What do the authors think about using a parametric non-linear function, instead? It would be interesting that the authors add some considerations on this topic.

3) Although not essential for the purpose of the article, it would be interesting to know how many patients had a positive result in the outcome variable (poor evolution).
Discretionary Revisions

1) I recommend adding more information about the splines. Readers not familiar with this topic could benefit from an additional Appendix that explained concepts like basis, B-splines or knot optimization, not sufficiently detailed in the Theoretical methods section.

2) Have the authors considered working with a development and a validation dataset? An internal validation would have provided some evidence for or against data-dependency.

3) Poor evolution mixes death or other very serious events with non-invasive mechanical ventilation, which seems a less serious event to me. It would be interesting to repeat the analysis without including non-invasive mechanical ventilation in the composite endpoint and compare the cut-points obtained.

Minor issues not for publication

1) The sentence "Smoothing splines keep the dimension of the basis...." needs a comma somewhere.

2) Page 6, second to last line: ".....that it there is either a jump or a change in the slope".

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** Yes, and I have assessed the statistics in my report.

**Declaration of competing interests:**

I declare that I have no competing interests