Author's response to reviews

Title: A straightforward approach to designing a scoring system for predicting length-of-stay of cardiac surgery patients

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Author's response to reviews: see over
A straightforward approach to designing a scoring system for predicting length-of-stay of cardiac surgery patients

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REPLEYS TO REVIEWERS

Editorial Requests

We would be grateful if you could address the comments in a revised manuscript and provide a cover letter giving a point-by-point response to the concerns. In particular, we would ask you please emphasize the utility of a customizable LOS model.

Reply To satisfy the editorial request, we have explained in more detail the utility of customizable models when the goal is optimization of internal management procedures. Consequently, in the revised version of the manuscript, we have modified the abstract (background), the Background (see highlighted changes - pages 3-4) and Discussion (see highlighted changes - page 12).

We would also ask you to carefully copyedit your manuscript to improve to improve the quality of written English.

Reply The English has been revised by a native English-speaking scientific translator with B.Sc. in physics and nearly 30 years of experience editing and translating scientific papers.
**Reviewer**

**Major compulsory revisions:**

The title should be changed to "A Straightforward approach to designing a scoring system for predicting length-of-stay in cardiac surgical patients."

While LOS is indeed an "outcome", similar literature generally considers mortality as the primary outcome.

The abstract and introduction talk about outcome prediction without mentioning that a customizable model is most useful for internal purposes (although this has been added to the background section of the abstract).

**Reply**

The title has been changed to “A straightforward approach to designing a scoring system for predicting length-of-stay of cardiac surgery patients”.

We have discussed the possibility of different definitions of valid end points for critically ill patients (mortality, morbidity or prolonged stay in intensive care). In particular, with reference to this point, we have changed the Background (see highlighted changes - second paragraph of page 3) and Discussion (see highlighted changes - first paragraph of page 12).

We have explained in more detail the utility of customizable models when the goal is optimization of internal management procedures. In the revised version of the manuscript, we have modified the abstract (background), the Background (see highlighted changes - pages 3-4) and Discussion (see highlighted changes - page 12).

I still think that low postoperative cardiac output and suitable postoperative cardiac output are two sides of the same coin, and it's redundant to say one is a risk factor and the other is protective. If different cut-points for the same continuous variable are being used, then these should be defined in the text. (Typically, <2.2 L/min/m2 is considered a low cardiac index)

**Reply**

A single cut–off point was defined for "postoperative cardiac output", so that this variable is dichotomous, like the other two variables "chronic dialysis" and "acute myocardial infarction".

However, unlike "chronic dialysis" and "acute myocardial infarction" (whose weight in the scoring system is high and positive if the variable is scored "yes", but close to zero when the variable is scored "no"), the variable "low postoperative cardiac output" has a significant positive weight on the scoring system when its value is "yes" as well as a remarkable negative weight when its value is "no" (see table 7).

From a quantitative point of view, the absence of "low postoperative cardiac output" is therefore a protective factor, while the absence of "chronic dialysis" and/or "acute myocardial infarction" is not a protective factor.

In any case, to satisfy the repeated request of the reviewer, we have deleted all reference to appropriate postoperative cardiac output being a protective factor (see highlighted changes – page 2, Abstract-Results and page 11, second paragraph).

The second paragraph of "background" more properly belongs in the discussion. I think a distinction should be made between scoring systems for mortality and scoring systems for LOS. One needs stable benchmarks to conclude if high-quality care is being delivered across
institutions. For LOS, one can make the argument that a customized model can be useful for internal purposes. The authors have added a line about operating room scheduling (appropriately) but there is a need for more clarity on which types of models should be customized. Standardization has its benefits when doing cross-institutional comparisons.

**Reply**

The second paragraph of "background" has been moved into the Discussion. We also emphasize the diversity of models used for comparison between institutions and those used for internal purposes (see new first paragraph, page 12). In particular, we argue that a scoring system for LOS is a useful model for internal use and that its customization is important in this type of application. To meet the reviewer's request, we have modified the abstract (background), the Background (see highlighted changes - pages 3-4) and Discussion (see highlighted changes - page 12).

**Minor points:**

120 hours (5 days) would be an extreme outlier for cardiac surgical postop ICU LOS. One might argue that a linear model might be more useful than a logistic regression to a single endpoint if the goal is predicting bed utilization.

**Reply**

In the discussion, we have motivated our choice (see highlighted changes – page 16 – last paragraph).

Page 12, discussion. The sentence on "Scoring systems are therefore generally used...developed" could use a reference. (Kramer editorial in CCM on "Models are not like fine wine", for example, or the MPM-III or APACHE-IV models both mention this). BTW, MPM-III and APACHE-IV are both sophisticated models that incorporate interaction terms. (same page, later)

**Reply**

We agree and have added the suggested reference (Ref. 26).

Figure 1 - I wonder if the same information might better be displayed with an ROC curve (Sensitivity vs. 1-Specificity) which is the more traditional method of displaying discrimination of a model.

**Reply**

In a ROC curve the true-positive rate (Sensitivity) is plotted as a function of the false-positive rate (1-Specificity) for different cut-off points. Each point on the ROC curve therefore represents a sensitivity/specificity pair corresponding to a particular decision threshold. Although (as reported in the manuscript) each change in prior probabilities is equivalent to modifying the decision threshold (i.e. the cost of a wrong decision), the ROC curve does not show the values of a priori probability. Thus it is necessary to use a different graphic representation (as in Figure 1) if one wants to show the behaviour of sensitivity and specificity as a function of prior probabilities.