The analysis of intensive care unit length of stay in a competing risk setting†

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We read with great interest the article by De Cocker and colleagues [1]. It deals with one of the hot topics in cardiac surgery, as the prediction of postoperative intensive care unit length of stay (ICU-LOS) can be a useful tool for quality control and for the planning of perioperative resources, reducing costs, and improving the standard of care.

In our opinion, the novel issue of the article is the evaluation of ICU-LOS as a time-to-event variable. Previous studies have focused on ICU risk modeling but their common limitation was the dichotomizing of the continuous data nature of ICU-LOS [2]. To our knowledge, it is the first time that regression models for time-to-event data are employed for the prediction of ICU-LOS. Nonetheless, the article raises some methodological questions.

The authors evaluated the predictors of time-to-ICU discharge and considered deaths in ICU as censored. This choice leads to an overestimation of the probability of the event in the naive Kaplan–Meier estimator, as the assumption of independence of the censoring distribution is violated [3]. ICU-LOS represents a classic example of time-to-event variable in a competing risk setting, where an individual can experience more than one type of event, named discharge and death, and the occurrence of one type of event hinders the occurrence of the other [4]. When competing risks are present, Kaplan–Meier estimates cannot be interpreted as probabilities and their complements can be interpreted as the probability of an event of representing an ideal world when the other types of events do not exist. A different approach based on the cumulative incidence function (CIF) is suggested. Consequently, the effects of covariates should be modeled not on the crude hazard rates but directly on the CIF, with methods that are alternative to the Cox analysis [5].

Moreover, by its nature, the Cox model estimates the effect of the covariate on the time-to-event but does not make any assumption on the baseline hazard. In our opinion, the goal of this model should be to simultaneously characterize both the basic underlying distribution of time-to-event and the distribution changes as a function of the covariates, namely error and systematic components, respectively. The baseline distribution reflects the ICU-discharge protocol employed in the ICU and can have high variations. No ICU discharge criteria were reported but a high percentage of the study population (43%) had an ICU-LOS >2 days. This large quote does not seem to be representative of the modern cardiac ICU and does not reflect the fast-track protocol that is nowadays employed in several cardiac ICUs. Hence, a more detailed analysis of the baseline ICU-LOS should be considered.

In conclusion, if the methods utilized in this study were addressed in a rather refined fashion by focusing on competing risks and fully parametric algorithms, the results of this study could have had a far wider utility. Nevertheless, by the token that this study has pioneered the correct methodology for the analysis of ICU-LOS after cardiac surgery, it certainly is a valuable addition to the literature.

†The corresponding author of the original article [1] was invited to reply but did not respond.

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