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The ongoing quest for improving machine learning-based risk stratification

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This commentary refers to 'Machine learning-based mortality prediction: how to be connected to daily clinical practice?', by W.H. Kim and J.-T. Kim, on page 2913.

We greatly appreciate the interest of Kim and Kim in our recently published work.[1,2] As pointed out by them, the current version of the SEMMELWEIS-CRT score has some limitations besides its undeniable strengths. Although these limitations do not diminish its value, there is still room for improvement. Fortunately, machine learning (ML)-based risk stratification tools can be dynamically updated, which makes them even more appealing as clinical decision support systems in the era of rapidly growing databases and ever-expanding medical knowledge.

Missing values are unavoidable in retrospective medical registries and various methods exist to handle them appropriately. We were fully aware of the limitations of the mean imputation method; therefore, our model's performance was evaluated in combination with more sophisticated imputation techniques as well. However, our results did not change substantially, so we decided to choose the most simplistic method (i.e. mean imputation).

Another crucial step of ML analyses is selecting the optimal set of input features. In our present study, we focused on a population with significant comorbidity burden. Neglecting these risk factors and utilizing exclusively cardiac resynchronization therapy-specific variables would have led to decreased prediction accuracy. We would also like to emphasize that many of our input features are modifiable through the adjustment of pharmacological and non-pharmacological therapy. Nonetheless, we agree with Kim and Kim that there are additional domains of variables that could further improve the predictive capability of our model.

In the modelling phase, a series of experiments with various ML algorithms should be performed to determine which algorithm has the highest predictive power in the given scenario.[3] In our study, random forest demonstrated the best performance among the evaluated classifiers. However, we have to keep in mind that multiple factors (e.g. the derivation dataset and the nature of the research question) can significantly influence the performance of each ML technique; thus, others may report different algorithms providing the best performance.[4,5]

To avoid overfitting and enhance generalizability, we have taken several precautions during our analysis. Nevertheless, our study represents results from a single centre. Accordingly, researchers are encouraged to evaluate our model in external cohorts, and we would cordially collaborate on the multi-centric validation of our risk stratification tool.

In its present form, the SEMMELWEIS-CRT score could facilitate the prompt recognition of high-risk patients and the deployment of additional medical resources. Moreover, as part of shared decision-making, it could be used to alert patients and their families of the severity of the disease and encourage discussions regarding advanced care. Nonetheless, future investigations should target the identification of treatment plans that specifically fit the different levels of risk assessed using out tool.

By creating the initial version of the SEMMELWEIS-CRT score, we have taken the first step of a thousand-mile journey towards a clinical decision support tool that will be used on a daily basis. We would like to thank Kim and Kim for contributing to this process with their meaningful suggestions; we will consider them while updating our system in the future.

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