Mortality Prediction Utilizing Blood Biomarkers to Predict the Severity of COVID-19 Using Machine Learning Technique

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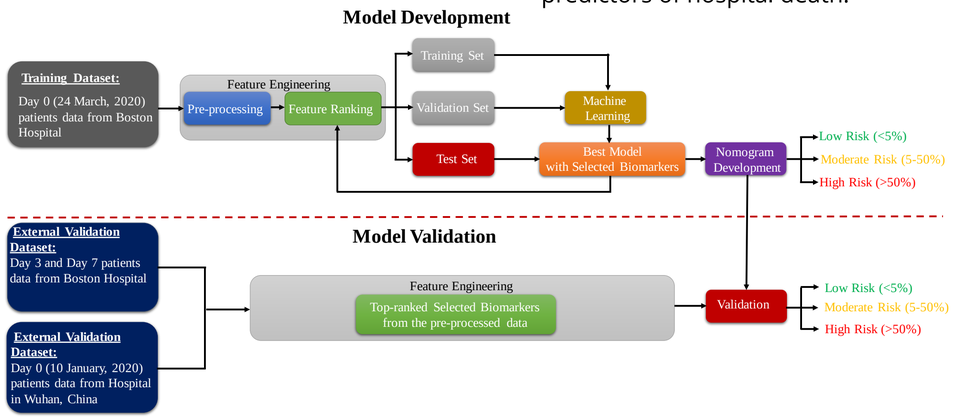
INTRODUCTION

Healthcare researchers have been working on mortality prediction for COVID-19 patients with differing levels of severity. A rapid and reliable clinical evaluation of disease intensity will assist in the allocation and prioritization of mortality mitigation resources. The novelty of the work proposed in this paper is an early prediction model of high mortality risk for both COVID-19 and non-COVID-19 patients, which provides state-of-the-art performance, in an external validation cohort from a different population.

METHODOLOGY

Retrospective research was performed on two separate hospital datasets from two different countries for model development and validation. In the first dataset, COVID-19 and non-COVID-19 patients were admitted to the emergency department in Boston (24 March 2020 to 30 April 2020), and in the second dataset, 375 COVID-19 patients were admitted to Tongji Hospital in China (10 January 2020 to 18 February 2020). The key parameters to predict the risk of mortality for COVID-19 and non-COVID-19 patients were identified and a nomogram-based scoring technique was developed using the top-ranked five parameters. Age, Lymphocyte count, D-dimer, CRP, and Creatinine (ALDCC), information acquired at hospital admission, were identified by the logistic regression model as the primary predictors of hospital death.

Figure 1. Illustration of the study methodology.



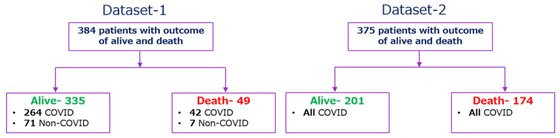


Figure 2. Outcome tree for the patients of Dataset-1 and Dataset-2.

CONCLUSION

In summary, the developed nomogram can be deployed for rapid and reliable mortality prediction of patients with both COVID-19 and non-COVID-19, based on multiple risk factors, such as Age, Lymphocyte count, D-dimer, CRP, and Creatinine. The model can predict the patient's prognosis with a high accuracy, well in advance of the actual clinical outcomes. As a result, the use of ALDCC can assist physicians in developing an effective and optimized patient management strategy without overloading healthcare resources, as well as minimizing death, through an increased and expected response. The authors have also created a webpage as App [71] to assist healthcare personnel in predicting early mortality using the developed model and easily accessible ALDCC scoring. We hope to improve the model's performance even more with the help of a larger dataset comprising data from other centers and countries

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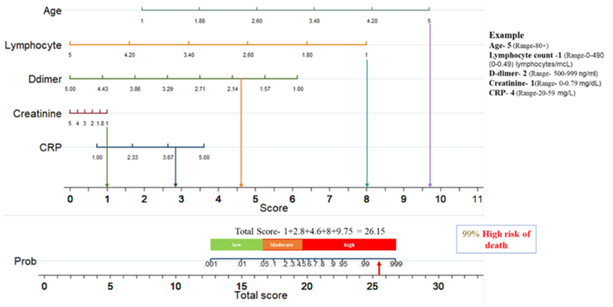

Figure 3. An example of nomogram-based ALDCC score to predict the probability of death of a patient from the test set (3 weeks before the actual outcome).

DISCUSSION

This study found that age, lymphocyte count, creatinine levels, and CRP levels were key predictors of death probability for COVID-19 patients. A nomogram-based prognostic model was developed using these predictors, which exhibited excellent calibration and discrimination in predicting the probability of death. The model also provided a simple and interpretable early warning method for stratifying high-risk patients. The research suggests that the model can be improved with a larger dataset and by including other parameters. The tool might be used to allocate resources appropriately and in research to evaluate its ability to predict the death of COVID-19 patients.

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