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Prediction of COVID-19 Related Mortality

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Commentary

The coronavirus disease 2019 (COVID-19) pandemic has recently emerged as a major and pressing threat to global healthcare systems. Since the first reports of its outbreak in China in December 2019, the global case count has risen to over 21 million known infections and over 750,000 deaths as of August 16, 2020. Despite public health efforts to improve testing, develop potential vaccines, and improve prevention strategies, the disease is putting a significant strain on healthcare systems and existing resources in many countries, particularly in those where the disease's spread has not been mitigated.

Efficient early detection of patients at risk of developing critical illness is thus critical for optimising resource allocation and monitoring overall disease progression. Clinical predictive models derived from electronic health records (EHRs) can help alleviate some of this burden and inform better decisions in general. For example, a model that can predict which patients are at higher risk of death may help ensure that resources are prioritised appropriately for these individuals. Furthermore, as more observational data is collected, these models could be used to discover new risk factors as well as reveal interactions between existing risk factors, providing better insights and opportunities for appropriate intervention.

Several approaches have been proposed to identify potential risk factors for COVID-19 mortality. Some of these approaches identify demographics and inflammatory markers associated with increased mortality, but they do not take into account risk factors that may change over time. Furthermore, many existing analyses are restricted to a single source of data, often from a single hospital, for both learning a model and predicting a patient's risk, which may limit their generalizability. Other more traditional measures of patient prognosis, such as sequential organ failure assessment (SOFA) scores, are based on examining a fixed set of risk factors that have not been specifically adapted to COVID-19; such measures fail to account for relevant changes in patient status outside of these risk factors and, as a result, frequently fail to achieve high levels of sensitivity and specificity in identifying high-risk patients. Due to these challenges, there is currently no COVID-19 risk score that I accounts for patient heterogeneity by using multiple, representative sources of data, (ii) includes important short-term and long-term risk factors that have a significant impact on mortality risk, (iii) reacts in real time to potentially rapid changes in patient status, and (iv) is risk adapted.

Because CovEWS is derived automatically from patient EHRs, it updates in real time without the need for manual intervention to reflect changes in patient status, and it accounts for a much larger number of risk factors associated with COVID-19 mortality than existing risk scores. CovEWS was developed using de-identified EHRs from 66,430 COVID-19 patients and is based on a time-varying neural Cox model that accounts for risk factors changing over time as well as potential non-linear interactions between risk factors and COVID-19-related mortality risk.

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