

## Disease history to predict mortality risk in ICU patients



Patients in the intensive care unit are highly heterogeneous, and include elderly patients who generally have a long history of disease. Prediction of prognosis can often be difficult because of the severity of patient illness and disease history. Severity scores that are based on acute physiology measures are often used in the ICU to predict mortality. However, these scores are non-specific, and individual mortality predictions can often turn out to be inaccurate.

Long-term disease is generally not exploited in clinical settings and is usually not considered when making important clinical decisions. This is ironic, keeping in mind the fact that a large number of ICU patients have long disease histories. The biggest advantage of using long-term disease history is that its predictive value remains stable over time compared with physiology measures. Disease history is also independent of ICU care and can be made available at the time of patient admission to the ICU.

Researchers from the University of Copenhagen and Rigshospitalet investigated whether the inclusion of long-term disease history before ICU admission could improve mortality predictions. For the purpose of this analysis, the researchers used long-term disease history data for more than 230,000 Danish ICU patients. This data was used to develop an ICU mortality prediction model. Both long-term history of disease and acute physiology measures were aggregated to predict mortality risk for patients.

This is the first study of its kind in which machine learning is used to predict mortality for ICU patients on the basis of long-term disease history. The machine learning model was used to predict 30-day and 90-day mortality. In-hospital mortality was calculated based on how many patients die while still at the hospital. The 30-day mortality was measured 30 days after admission to the ICU, irrespective of whether the patients were outpatients or inpatients. In order to establish how the length of disease history affected mortality, the neural networks were trained for datasets with history of 1 month, 3 months, 6 months, 1 year, 2.5 years, 5 years, 7.5 years, 10 years and 23 years before admission to the ICU.

Several mortality prediction scores were compared, including the Simplified Acute Physiology Score (SAPS) II, the Acute Physiologic Assessment and Chronic Health Evaluation (APACHE) II, and the Multimorbidity Index. These scores are based on specific markers of patient physiology that are recorded during the first few hours after ICU admission.

Findings from the analysis showed that mortality predictions with a model based solely on disease history outperformed the Multimorbidity Index, and produced results that were similar to SAPS II and APACHE II. These results were further validated in an external independent dataset of 1528 patients.

It is thus safe to conclude that disease history can be used to differentiate mortality risk between patients in the ICU who have similar vital signs. These mortality scores are more precise than SAPS II and APACHE II scores.

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