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PALLIATIVE CARE CASE OF THE MONTH

Predicting Prognosis in the Intensive Care Unit

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Case: Mr. M is a 68 year old gentleman with a history of coronary artery disease who lives independently. After being found unresponsive at home, Mr. M was transported to the hospital and admitted to the intensive care unit (ICU). Due to hypotension requiring vasopressors and the presence of melena, the ICU team was concerned that a lower GI bleed may have precipitated his illness. An arterial blood gas showed a pH of 6.9. Other relevant laboratory studies showed creatinine of 3.0, hemoglobin of 6, white blood cell count of 12,000, platelet count of 100,000 and total bilirubin of 3.0. The patient's medical decision makers acknowledged the severity of the patient's illness and noted that he was a person who would not want to pursue aggressive life sustaining measures if he was unlikely to survive.

Discussion: Can we predict how likely Mr. M is to survive this hospitalization? Although there are no prognostic models that can predict individual mortality risk in a critically ill patient (1), there are several models which predict prognosis for groups of patients stratified by severity of illness. This is similar to predictive models in other areas of medicine such as end-stage-liver disease and heart failure. ICU prognostic models are used in outcomes research to compare patient groups, assess and compare ICU performance and help guide resource allocation. Additionally, these models may provide patients' families with likely patient outcomes which can guide goals of care discussions.

What are the most commonly applied models? Common models for predicting mortality in medical-surgical ICU patients include the Acute Physiologic and Chronic Health Evaluation (APACHE) score, the Mortality Probability Model (MPM) and the Simplified Acute Physiology Score (SAPS). These models use computer software to calculate a score based on multiple variables including type of admission, the patient's underlying diseases, physiologic data and laboratory data (in the case of APACHE). The APACHE score is based on the worst values available during ICU Day 1 whereas MPM-III and SAPS3 scores are calculated based on data obtained within one hour of ICU admission. The models require re-validation over time as ICU interventions and outcomes change. The APACHE score is currently in its fourth version.

MPM and SAPS are in their third versions. Although APACHE IV and MPM III require proprietary software to calculate a score, the SAPS3 score can be computed using a downloadable calculator (2).

What characteristics are important in assessing the accuracy of a prognostic model? The discrimination and calibration ability of ICU prognostic models determine their predictive accuracy (3). Discrimination is the ability of a model to predict a mortality rate similar to the observed rate. This is measured by the model's area under the receiver operating characteristic curve (AUC). Calibration reflects the model's ability to predict an outcome at multiple levels (mortality rates). Calibration is measured by the model's goodness of fit and reported as the Hosmer-Lemeshow goodness of fit (HL-GOF) statistic where a non-significant p-value is desirable.

How accurate are the most commonly applied models? The most recent versions of all three commonly applied models show both high discrimination and calibration. APACHE IV has an AUC of 0.88 and HL-GOF statistic of 16.9, p=0.08 (4). MPM-III had an AUC of 0.82 and HL-GOF=11.62, p=0.31 (5). The SAPS3 model has an AUC of 0.85 and HL-GOF 14.29, p=0.16 (6).

What are the limitations of ICU prognostic models? Although sensitive and specific in predicting outcomes of groups of patients, the major limitation of ICU prognostic models is that they are neither sensitive nor specific in predicting an individual patient's outcome. Also, as these models focus solely on patient mortality as the outcome measure, a patient's functional status after ICU intervention is not predicted. Functional status prediction is often a key determinant in conversations with patients' family members regarding the patient's future quality of life and goals of care.

Can I incorporate these models into goals of care discussions with patients and/or their families? Due to the logistical limitations of proprietary software, the APACHE IV and MPM-III scores are unlikely to be helpful in daily patient care. However, since a calculator is available for SAPS3, this score may be more convenient in practice.

This prognostic information may be shared with patients and their families if the medical provider feels that the decision maker can 1) understand the limitations of the prediction and 2) understand the broader clinical picture including the patient's likely future functional status.

Back to the case: Mr. M's SAPS3 score of 73 predicted a hospital mortality rate of 62%. After underscoring the fact that models cannot accurately predict individual mortality since they were developed to predict the outcome of groups of patients, the palliative care team discussed the low likelihood that the patient would survive his hospitalization with the patient's decision makers. Mr. M's decision makers decided to withdraw life-sustaining intervention, and he died within several days.

References

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