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## Critical Care

**SESSION TITLE:** ICU Management

**SESSION TYPE:** Original Investigation Slide

**PRESENTED ON:** Tuesday, October 31, 2017 at 08:45 AM - 10:00 AM

### Rothman Index Predicts ICU Mortality at 24 Hours

Michael Perkins* Melissa Knauert Shyoko Honiden Jonathan Siner Junchao Ma Donald Lee Edieal Pinker and Margaret Pisani Yale University School of Managment, New Haven, CT

**PURPOSE:** Severity scores were developed to predict mortality among critically ill patients. Many of these models predict mortality from static time points at 24 hours after intensive care unit (ICU) admission. Although they are historically validated to predict mortality in research settings, when applied at the bedside in real-time their usefulness diminishes. The Rothman Index (RI) was originally developed to indicate changes in a patient's one-year mortality risk using the electronic medical record (EMR). It utilizes 26 clinical variables,including vital signs, laboratory data, and nursing assessments, to generate a continuously updated score, which graphically represents both absolute values and change over time. It has been validated to predict 24-hour mortality and early escalation of care on floor patients, but there is a paucity of studies examining RI in the ICU patient population. The RI's continuous variable assessment makes it a potentially powerful tool in the dynamic ICU environment. We sought to determine the RI's ability to predict ICU mortality compared to APACHE II, a commonly used mortality prediction tool.

**METHODS:** A novel database was generated from the EMR, which included all ICU admissions from 2013-2015. Patient data was pulled from two tertiary care campuses of Yale-New Haven Hospital. From the original dataset (11,965 patients), only patients admitted to the medical ICU were included in the final model (4,806 patients and 5,863 encounters). Patients were equally distributed across age groups, with slightly more men then women (52.2% and 47.8% respectively). The mean length of stay was 3.7 days with a range of 0-155, and the ICU mortality/in-hospital mortality was 11.5% and 18.6% respectively. Patients were divided into derivation and validation cohorts (4104 encounters and 1759 encounters respectively). Univariate analyses were performed at 24-hours after ICU admission on length of stay, and the mean, maximum, minimum, and maximum change of the RI compared to ICU mortality. A multivariate analysis incorporating each of the univariate RI components was then performed and tested vs. the Apache II.

**RESULTS:** Both length of stay and the univariate analysis of mean, maximum, minimum and maximum change in Rothman Index (OR .941 p $<2^{-}e^{16}$, OR .944 p$<^{-}e^{16}$, OR .944 p$<^{-e16}$, and OR .992 p$<^{-}e^{16}$ respectively) were all significantly associated with ICU Mortality. The multivariate model of the univariate RI components performed as well as APACHE II (AUC 0.757 and AUC 0.788 respectively) in predicting ICU mortality at 24 hours.

**CONCLUSIONS:** We found that the RI had good predictive value for in-ICU mortality. This is a novel finding which has not yet been described in the literature. Furthermore, our multivariate model calculated at 24-hours performed as well as the current well-validated and accepted tool, APACHE II.

**CLINICAL IMPLICATIONS:** While our current modeling is limited by static measurement at 24 hours, the RI has the potential to calculate new scores every few minutes. Our future steps will be to develop a machine learning based estimation procedure that will leverage the dynamic nature of the RI to continuously predict ICU mortality at the bedside.

**DISCLOSURE:** The following authors have nothing to disclose: Michael Perkins, melissa knauert, Shyoko Honiden, Jonathan Siner, Junchao Ma, Donald Lee, Edieal Pinker, Margaret Pisani

I am an employee of Yale University School of Medicine; however, Yale New Haven Hospital, a separate entity, but the hospital I am associated with is an invester in Parahealth the parent company of the Rothamn Index. Neither Yale New Haven Hospital nor the Parahealth were involved in this research project. The Rothman Index has not yet been used in ICU patients to assess mortality. We sought to define that in our study.

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