ICU scoring systems

Note: No ICU scoring system is accurate enough to predict individual patient mortality. Instead, they assign patients to a population with a given mortality risk.

Illness severity and mortality scores

APACHE II

- Validated 1985 (Critical Care Medicine)
- Subjective scoring system (variables and weighting determined by expert opinion)
- Developed from a sample of 5,030 US ICU patients, excluding CABG and burns patients, 12 routine physiological values + age + premorbid illnesses recorded in first 24 hours of ICU admission
- Admission source weighted - emergency, non-operative -&gt; 50 diagnostic categories (therefore less useful if patient does not fit into a category)
- Score 0 - 71
- Increasing score denotes increased deviation from the norm and correlates with risk of hospital mortality
- Score 24 = mortality risk approximately 50%. Score 35 = mortality risk approximately 80%
- Has demonstrated good calibration and discrimination (ROC 0.85) across broad critical care pop.
- Used predominantly to allocate resources, compare unit outcomes and for research
- Accuracy falls when used for cohorts different from development cohort (calibration)
- With advancing critical care processes, APACHE-II tends to overestimate mortality risk (loss of calibration with resulting loss of discrimination), thus need for redevelopment from new database

APACHE III

- Objective scoring system (variables derived from statistical analysis)
- Larger reference population =&gt; better calibration
- Excludes <16yo, burns and chest pain
- CABG patients form a separate category
- Attempt to improve mortality prediction for individual patients
- 17 physiological variables + age + only those co-morbidities that were thought to affect immunity (esp AIDS and haematological malignancy) recorded in first 24 hours of ICU admission
- Examined effect of ICU patient selection and timing
- 78 diagnostic categories
- Improved calibration and discrimination (ROC 0.9) for both US and European critical care populations

APACHE score used to convert raw mortality to standardised mortality rate (SMR) = observed mortality / expected mortality -&gt; allows comparison within (monthly, annual) and between units.

Alternative to APACHE = SAPS I - III. SAPS-III

- Developed from global ICU dataset - Europe, Australia, South and Central America
- 20 variables divided into pre-admission, admission and physiology
- Excluded burns, coronary care and CABG
- Calculation of score can be customised for the region using it, to maintain calibration and discrimination (ROC 0.85)
- Subsequent analysis showed that pre-admission circumstances contributed to 50% of the mortality risk, admission circumstances 22.5% and physiology 27.5%

Mortality Prediction Models I and II

- Bypass severity of illness score and calculate mortality risk directly
- MPM-I calculates risk at admission (MPM-I0) and after 24 hours of ICU management (MPM-I24)
- MPM-II calculates MPM-II0,24,48 and 72

Comparison of APACHE, SAPS and MPM systems has shown later versions of each system performs better than earlier versions, but no one system performs significantly better than the others
Organ failure scores

SOFA
(Sequential Organ Failure Assessment)
• Developed by the European Society of Intensive Care, 1996 (Intensive Care Medicine)
• Originally developed for use in sepsis, but subsequently validated for non-sepsis organ failure
Mixture of anatomical, physiological and therapy-weighted scoring
Score 0 - 4 for degree of derangement in 6 organ systems
Respiratory: PaO2/FiO2 ratio + need for mechanical ventilation
CVS: MAP + need for inotrope support
CNS: GCS
Renal: Creatinine level
Liver: Bilirubin level
Coagulation: Platelet level
Score 0 - 24
Units measure initial, highest and/or mean SOFA score
i-SOFA or SOFA-max > 11, or mean SOFA > 5 are associated with a mortality of >80%
An increase of SOFA score in the first 48hrs is associated with a mortality of 50%

Alternatives include the MODS and LODS systems

Injury and trauma scores

Abbreviated Injury Scale
• Anatomical score
• Estimates risk of mortality
6 body regions: Head & neck, Face, Thorax, Abdomen, Pelvis & extremities, External (skin)
6 injury scores: 1 (minor), 2 (moderate), 3 (severe, non life-threatening), 4 (severe, life-threatening), 5 (life-threatening, survival uncertain), 6 (unsurvivable)
Developed for MVAs, but later validated for blunt and penetrating injury.

Injury severity score
• Anatomical scoring system
• Modifies for blunt and penetrating injury
Square of the top 3 AIS scores, which results in a linear relationship with mortality and severity
Maximum = 75 (ie 3x25, not 3x36 = 108, as an AIS score of 6 in any area is fatal)
Score > 16 => major trauma and mortality risk > 10%

Revised Trauma Score (RTS)
• Physiological scoring system
• Uses pre-hospital RR, sBP and GCS
Each parameter scores 1 - 4
Total range = 4 - 16
Used to predict mortality

Trauma Revised Injury Severity Score (TRISS)
• Combines ISS + RTS + Age + presence of penetrating injury to predict likelihood of survival

ASCOT
• Similar to TRISS but uses more injury details, more age subdivisions and physiology variables derived from the resus room rather than pre-hospital
• Marginally better survival prediction

Others
Organ specific scoring systems
- Ranson, Imrie, Balthazar for acute pancreatitis
- Parsonnet score for cardiac disease
EURO score for cardiothoracic surgery
Child-Pugh, MELD and King's College Hospital scores for liver failure
GCS for head injury

Summary

How are ICU scoring systems used in the day-to-day management of patients?

The choice of which scoring system to use is determined by:
- what is being measured - severity of illness, organ failure, trauma, specific organs
- how comparable the population being measured is to the scoring system cohort (calibration)

No ICU scoring system is accurate enough to predict individual patient mortality. Instead, they assign patients to a population with a given mortality risk.

As a result, ICU scoring systems often do not specifically influence therapy, but simply give an indication of the probable outcome and, as such, are mainly restricted to audit and research. Exceptions include the organ-specific scoring systems; eg. World Federation of Neurosurgeons grading of SAH in determining operative versus non operative management and the MELD score in determining selection and timing of liver transplants.