Literature Review

Critical care resources are often provided to the “too well” and as well as to the “too sick”. The former include the patients admitted to an ICU following major elective surgery for overnight observation and discharged within 24 hours. The latter comprise of critically ill patients who die despite all therapeutic efforts. As tremendous pressure exists for restricted ICU beds and limited resources, admission is justified only for patients expected to survive or with a good chance of recovery and also for those who have an uncertain prognosis; those patients who are likely to die regardless of treatment should be given lower priority.

It is important to optimise not just medical and financial resources but also human resources in the delivery of health care especially in the developing countries. It is for these reasons that illness scoring systems were introduced to formulate priorities for ICU admissions in patients with acute illness or trauma. Since the critically ill have roughly the same degree of physiological derangements, the indices in scoring systems are designed to enable a complex clinical situation to be expressed numerically by weighing certain variables, which are summed to give an overall score.[3]

In addition, scoring systems also help determine appropriate withdrawal of active therapy, identify the wasteful use of parenteral nutrition, define the useless treatment of haematological malignancy, avoid expensive treatment of trauma patients with a high probability of dying, and avoid unnecessary admission to the ICU of low risk patients.

Scoring systems are based on deviation from normal of physiological variables. The variables to be recorded, and the degree of weighting applied to each are usually defined by clinical consensus or multivariate analysis.

Several scoring systems have been evolved for triage, predicting prognosis and outcome, and also to help in withdrawing therapy.

Scoring Systems

1) ***Therapeutic Intervention Scoring System (TISS)***

TISS was introduced in1974 as a method of quantifying nursing, medical and technological support activity, and for costing. It consists of 76 procedures assigned a point score of 1 to 4. It is used as a non-specific system for assessing ICU activity and expenditure, and may indicate nursing and medical dependency. TISS can therefore be used to indicate suitability for transfer from the ICU to a high dependency unit or general ward.

2) ***Trauma Scoring***

The Injury Severity Score (ISS), an anatomic scale composed of the sum of squares of the Abbreviated Injury Scale (AIS) from the three most severely injured body regions, is used for retrospective comparisons of outcomes in trauma centres. Prospective physiologic scoring systems, the Trauma Score (TS) and the Paediatric Trauma Score (PTS), are used to predict outcome and direct patients to appropriate facilities. The Glasgow Coma Scale (GCS) is a useful prognostic tool for patients with acute head injuries. The American Society of Anaesthesiologist Physical Status (ASAPS) score predicts mortality occurring due to blunt trauma but is not very useful for discriminating small differences in severely injured patients.

3) ***Sepsis Scoring***

Sepsis scoring uses admission values of physiological and laboratory data, haemodynamic data after fluid resuscitation, and weightings for underlying disease, infective focus and the organisms isolated. The score significantly improves the ability to predict hospital mortality compared to Acute Physiology and Chronic Health Evaluation (APACHE) II.

4) ***Lung Injury Scoring***

The acute lung injury severity score is a semi-quantitative score. The score is derived from the chest radiograph findings, PaO_2/FiO_2 ratio, and the amount of PEEP and static respiratory compliance if ventilated. Each component scores from 1 to a maximum of 4 points, which are summed and divided by the number of components used. A score of >2.5 indicates severe lung injury.

5) SAPS (Simplified Acute Physiology Score)

In this scoring system the original APACHE has been simplified to 14 variables, similar to APACHE II. It includes urine output and the need for mechanical ventilation and excludes measure of oxygenation, chronic health evaluation (CHE) and diagnosis.

6) SAPS II

This system utilises 17 variables including the type of surgery and the presence of immunosuppressive illness.

7) APACHE (Acute Physiology and Chronic Health Evaluation) - APACHE

A conceptual model for the APACHE prognostic system was formulated in 1979, identifying the factors that influenced outcome from an acute illness.[4] APACHE incorporated the following:

a) type of disease: classified using the primary diagnostic reason for ICU admission, which if not available then was considered using the principle organ system dysfunction;

b) physiologic reserve: age and chronic disease;

c) severity of illness measured by acute physiological abnormalities, with no therapeutic interventions.

The APACHE score consisted of acute physiology score (APS) and CHE. APS included 34 variables with weightings (0 – 4) and the worst value within 32 hr after admission was used. CHE involved classification into A: excellent health to D: severely failing health. The disadvantage was the large number of variables used and the 32 hr allowed for data collection.

APACHE II

APACHE II was introduced in 1985, with APS variables reduced to 12 and recorded within the first 24 hr of ICU admission.[5] CHE was done for severe organ dysfunction and nonoperative and emergency surgeries were given additional weight. Age was also incorporated in the score. Currently APACHE II is used for: control for case mix, quality assurance in ICUs, predicting death in non-ICU patients, and resource allocation.

APACHE III

APACHE III was developed to improve the statistical predictive power of the APACHE score, and to identify and quantify the factors in ICU care that contribute to the variations in ICU outcome.[6] APACHE score variables were reduced to a manageable scoring system.

Becker et al have reported that ICU scoring systems allow prediction of patient outcomes and comparison of ICU performance.[7] Sherck and colleagues have reported contrary findings. According to these authors, ICU scoring systems do not allow prediction of patient outcomes or comparison of ICU performance.[8] The systems cannot be accurate enough to direct management decisions in specific patients. Also, they have questioned the reliability of these systems for comparing different ICUs and different populations, especially in surgical and trauma patients.

Schuster and co-workers analysed the correlation between score parameters of SAPS-II with the time spent in the ICU, and also in hospital, for 604 general medical ICU and 510 CCU patients. [9] The risk of death calculated from SAPS-II significantly correlated with the duration of intensive care. They also found shorter hospital stay was significantly related to patients who died. Their study concluded that the scoring system is a suitable tool to predict the duration of intensive care treatment and length of hospitalisation, in addition to outcome, and thus serves as gauge of efficiency.

The daily APACHE II scoring study by Rogers et al failed to predict individual patient mortality in ICU.[10]

A study of the ability of the APACHE II scoring system to predict patient outcome in two Canadian ICUs showed good correlation between predicted outcome and observed outcome, thus validating the ability of the APACHE II system in predicting group outcome.[11]

Falk and co-authors have reported the poor predictive power of scoring systems for individual prognosis after cardiac surgery.[12] However, they suggested that utilising scoring systems to identify accurately low-risk patients who have a favourable postoperative course, a subset of patients eligible for early ward referral, could be defined. This saves ICU resources, which has become an important issue in cardiac surgery.

Similarly, Turner and colleagues evaluated the predictive value of the APACHE II scoring system in cardiothoracic surgical patients.[13] There was a good correlation between the APACHE II score and mortality rate. Low APACHE II scores accurately predicted survival but only very high scores accurately predicted death.

A retrospective study of the APACHE II scoring system’s ability to predict the need for prolonged support after coronary revascularisation showed APACHE II scores for the severely ill post-CABG patients appear to represent their true physiologic status. This suggests that this scoring system may reflect the severity of illness and thus, may be useful in indicating a requirement for prolonged care. In addition, the APACHE II scoring may have a role in quality assurance and stratification of the cardiac surgical population’s utilisation of ICU resources.[14]

Tang et al used the APACHE II scoring system in critically ill obstetrical patients and found that the obstetric patients requiring intensive care had a better outcome than predicted.[15]

APACHE II scores in patients with acute pancreatitis and its comparison with clinical assessment, Ranson and Glasgow multiple factor scoring systems showed that APACHE II scoring system is a useful addition to the management and study of these patients, providing an objective indication of the severity and possible outcome of an attack soon after admission to hospital. This permits the early, non-invasive selection of patients for intensive therapy.[16]

Similarly, Kaufmann and colleagues reviewed retrospectively the ability of APACHE III scores to recognise acute pancreatitis patients at high risk of developing severe or fatal complications.[17] Ranson scores too were calculated for comparison. In addition to advanced age, female sex, biliary obstruction and elevated Ranson score, a high APACHE III score was found to be a risk factor for an increased rate of life-threatening complications in acute pancreatitis.

A study done on patients diagnosed with acute pancreatitis by Williams and co-workers concluded that high scores predicted patients who had multiple complications or death.[18] Elevated APACHE III scores also predicted prolonged hospitalisation.

Glance and co-workers evaluated the cost-effectiveness of prognostic scoring systems in predicting death in ICU using mortality risk estimates based on daily APACHE III scores.[19] The study failed to demonstrate the effectiveness of APACHE III in predicting mortality risk in ICU patients. It could not justify the cost-effectiveness of using APACHE III as the basis to withdraw therapy.

In brain injured patients admitted to a neurosurgical ICU, TISS and APACHE III score systems were performed and the result indicated a high level of association between the two widely used ICU scoring systems.[20]

A prospective study of SAPS, APACHE II score, and number of Organ System Failures performed by Brivet and co-workers in patients with severe acute renal failure, demonstrated the ability of scoring systems to predict poor outcome of the patient.[21]

Le Gall et al assessed organ dysfunction in ICU utilising the Logistic Organ Dysfunction (LOD) score on the first day of ICU stay, and the outcome measured was the patient's vital status at hospital discharge.[22] Their study validated the LOD system as an objective tool for assessing severity levels for organ dysfunction in the ICU.

A study of Multiple Organ Dysfunction Score prospectively compared with APACHE II and Organ Failure scores as a predictor of patient outcome in septic shock proved Multiple Organ Dysfunction scores could accurately predict the outcome groups, whereas daily APACHE II and Organ Failure scores could not.[23]

APACHE II scoring system in acute myocardial infarction showed close correlation between observed and predicted mortality rates in classes of patients with various APACHE II scores, while observed mortality in patients with scores of 20 – 24 was higher than the predicted mortality.[24] The study concluded that the in-hospital mortality in patients with acute myocardial infarction could be accurately predicted with APACHE III scores.

Even in HIV seropositive patients admitted to a medical ICU, APACHE II scores accurately predicted mortality in all patients with total leucocyte count (TLC) $\geq$ 201 cells / mm^3, while it underestimated mortality risk in HIV-positive patients with TLC $\leq$ 200 cells / mm^3. [25]

Swann and co-workers performed an audit of ICU admissions from the operating theatre, evaluating prospectively the APACHE II scores on day of admission, the incidence of ICU-specific interventions, length of stay in ICU, and outcomes.[26] The audit of postoperative ICU admissions provided valuable insights into standards of anaesthetic practice and utilisation of ICU resources. The study showed patients not requiring ICU-specific interventions to be well managed in an intermediate care.

An interesting study done by Von Bierbrauer and colleagues prospectively determined APACHE III and APACHE II scores, in German ICUs, to validate the use of the APACHE III scoring system.[27] Their study concluded that the recently introduced APACHE III is superior to the established but older APACHE II, thus validating its use in German ICUs.

A Spanish study by Rivera-Fern’andez and co-workers prospectively performed APACHE III scoring to customise mortality predictions and to evaluate its discrimination and calibration in Spanish ICUs.[28] The customised APACHE III demonstrated the requisite validation, calibration, and discrimination for its use in Spanish critical care patients.

Carneiro and colleagues evaluated prospectively the predictive performance of APACHE III scoring systems in risk stratification and prognosis in critical surgical patients.[29] Their study proved APACHE III scoring system to be an excellent prognostic score system.