

Systems for scoring severity of illness in intensive care

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Summary

Severity of illness scoring systems are increasingly being used by many intensive care units to predict mortality and to compare results and different therapies. A study was undertaken to evaluate three of these systems — therapeutic intervention scoring system (TISS), acute physiology and chronic health evaluation (APACHE II), and organ failure — in a 2-year prospective analysis in a multidisciplinary intensive care unit. A total of 728 patients with a wide variety of diseases were entered into the study. The relationship between score and mortality in all patients and in specific groups was investigated. The APACHE II system is likely to be the most useful in comparing different therapies and intensive care units, while the organ failure system was more accurate in predicting outcome. No system was precise enough in its predictive powers to make decisions to deny or terminate treatment.

S Afr Med J 1989; 76: 17-20.

A number of scoring systems have been used to characterise the severity of various diseases in the intensive care environment. These include the therapeutic intervention scoring system (TISS), acute physiology and chronic health evaluation (APACHE II), acute physiology score (APS) and organ failure scoring systems.¹⁻⁴ As yet none of these systems have achieved widespread validation as the ideal method of scoring severity of disease, although the APACHE II system is the most widely used. In addition to determining the severity of disease of patients in intensive care units (ICUs), evaluating therapeutic protocols and comparing results from different ICUs, these systems have been introduced to help predict the outcome of diseases to ensure the maintenance of the highest possible standard of care.

This prospective study evaluates APACHE II, TISS and an organ failure scoring system as an early measure of determining the eventual outcome in critically ill patients admitted to a respiratory intensive care unit.

Patients and methods

All patients admitted to the Respiratory Intensive Care Unit (RICU) at Groote Schuur Hospital during 1985 and 1986 were included in this study. The patients were admitted from all departments including medicine, surgery, trauma, obstetrics and gynaecology. The majority of patients required ventilatory support and/or intensive haemodynamic monitoring. Patients with primary cardiac disease were usually admitted to a specialised coronary care unit.

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All data were collected prospectively and included demographic information, primary diagnosis and outcome. Patients were scored on TISS, APACHE II and an organ failure score during the first 24 hours of admission.

TISS evaluates 76 therapeutic tasks in 3 categories: active management, monitoring and ward care. Each applicable task is evaluated on a score of 1 - 4 depending on the intensity of intervention of medical or nursing care. A critically ill patient will usually amass a score of more than 20 points. Some examples of TISS tasks and scores appear in Table I.

TABLE I. SELECTED EXAMPLES OF TISS SCORES

	Score
Management task	
Controlled ventilation	4
Chest tubes	3
Nasogastric tube feeding	2
1 peripheral intravenous catheter	1
Monitoring task	
Pulmonary artery catheter	4
Arterial line	3
Central venous pressure	2
ECG	1
Ward task	
Frequent intake/output	3
Hourly neuro-vital signs	2
Tracheostomy care	1

The APACHE II score is based on 11 physiological measurements, the Glasgow Coma Scale, age and previous health status (Table II). Each physiological measurement is scored from 0 to 4 depending on its deviation from normal. The score is determined from the most deranged value of that measurement in the first 24 hours in the ICU. More severely ill patients usually score more than 20 APACHE II points. Organ failure as defined for this study is shown in Table III.

TABLE II. MEASUREMENT IN APACHE II

Physiological variables
Temperature
Mean arterial pressure
Heart rate
Respiratory rate
Oxygenation
Arterial pH
Serum sodium
Serum potassium
Serum creatinine
Haematocrit
White blood count
Glasgow Coma Scale
Age
Chronic ill health

TABLE III. DEFINITION OF ORGAN FAILURE

Renal	Creatinine > 150 µmol/l
Cardiovascular	Systolic blood pressure < 80 mmHg (or requiring inotropes to maintain blood pressure) with adequate volume replacement
Respiratory	Requiring IPPV or Pao₂ < 15 kPa on Fio₂ 0,5
CNS	Unconscious (no response to verbal command in absence of sedation)
Hepatic	Bilirubin or liver enzymes > twice normal
Haematological	Platelets < 50 x 10⁹/l or white cell count < 2 x 10⁹/l

Pao₂ = partial arterial oxygen pressure; Fio₂ = fractional inspired oxygen concentration.

Results

Seven hundred and twenty-eight patients (375 males and 353 females) were admitted to the RICU during 1985 and 1986. The average age was 43 years (range 12 - 88 years). Of the patients 522 (71,7%) received intermittent positive-pressure ventilation (IPPV), 72 (9,9%) received continuous positive airway pressure (CPAP) by facemask, and 101 (13,9%) received oxygen by facemask. There were 130 deaths, giving a mortality rate of 17,9%.

The major diagnostic categories, mean TISS and APACHE II scores and mortality rates are shown in Table IV.

The relation between severity of illness scores for TISS, APACHE II and organ failure and the mortality for the total number of patients are shown in Figs 1 - 3.

Selected disease categories (pneumonia and adult respiratory distress syndrome (ARDS)) with the relation between APACHE II and organ failure score and mortality are shown in Figs 4 - 7.

Discussion

These three systems for scoring severity of illness were selected for evaluation because they have previously been shown to predict severity of illness accurately if mortality is used as the end-point.^{2,4,5} They have been found to be useful in comparing the quality of care provided by different ICUs and of value in assessing therapeutic protocols and evaluating efficacy of new

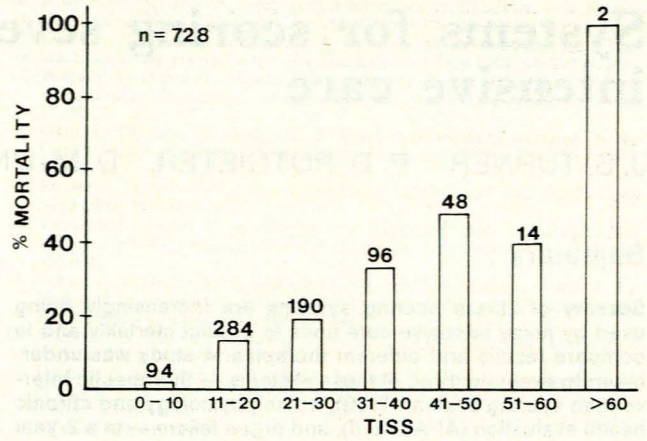


Fig. 1. Percentage mortality for various TISS scores for all patients.

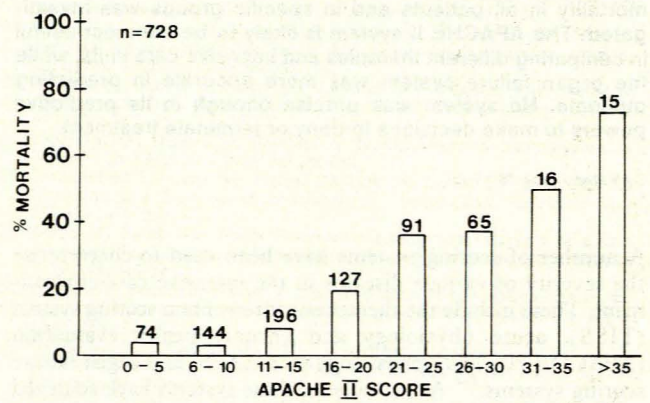


Fig. 2. Percentage mortality for various APACHE II scores for all patients.

treatments.⁶ In our study we have confirmed that TISS, APACHE II and the organ failure score all show a good relation with mortality in all patients admitted to the RICU when they were scored over the first 24 hours after admission. Mortality in relation to severity of illness in individual disease groups (e.g. pneumonia) indicates a similar outcome in our ICU for 1985 and 1986, which suggests that the quality of care for the 2 years has remained the same. The organ failure score showed the best relation between increase in score and mortality. APACHE II and the organ failure score proved to be easier and less time-consuming to perform. Both score the

TABLE IV. NUMBERS OF PATIENTS IN MAJOR DIAGNOSTIC CATEGORIES ADMITTED DURING 1985 AND 1986 WITH MEAN TISS AND APACHE II SCORES AND MORTALITY

Diagnosis	No. of patients		Mean TISS		Mean APACHE II		Mortality (%)	
	1985	1986	1985	1986	1985	1986	1985	1986
Pneumonia	43	54	24,3	26,1	20,4	18,2	42	35
Asthma	60	36	13,7	19,3	15	16	3,3	2,7
Flail chest	44	45	20,9	19,6	9,9	9,5	6,8	6,6
ARDS	41	32	23,5	30,4	15,5	17,5	24,4	31
Postoperative*	27	23	18,7	23,4	7,6	10,1	3,7	0
Overdose	25	16	18	21,8	15,8	15,3	16	0
Other disease	131	151	—	—	—	—	—	—
Total (1985 and 1986)	728		19,9		14,1		17,9	

* Elective postoperative admission to ICU.

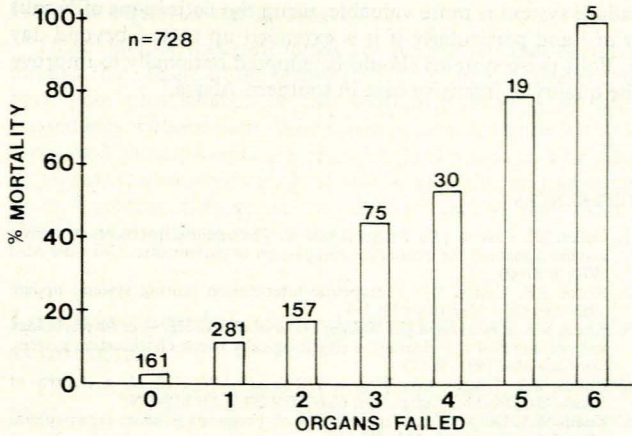


Fig. 3. Percentage mortality for number of organs failed for all patients.

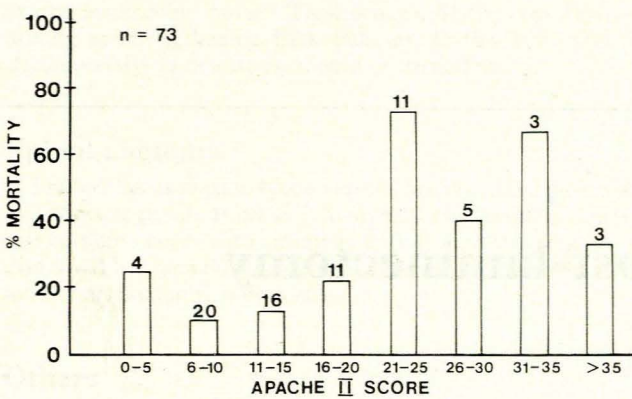


Fig. 4. Percentage mortality v. APACHE II scores for patients with ARDS.

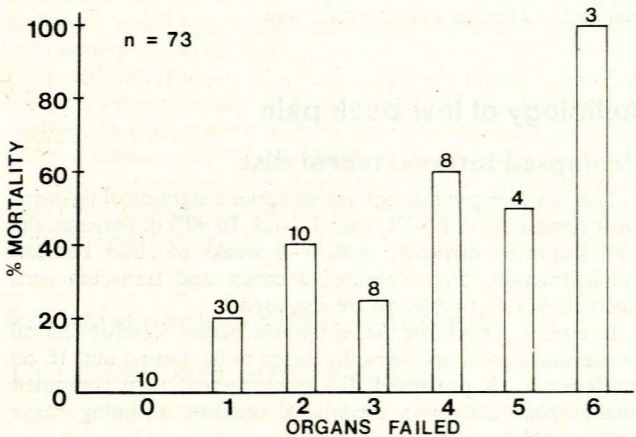


Fig. 5. Percentage mortality v. number of organs failed for patients with ARDS.

severity of illness by measuring physiological deviation from normal and thus would appear more valuable than TISS, which measures the degree of invasiveness of management and investigation and degree of monitoring of the patients. Although TISS may determine the severity of illness in an individual ICU, it may be of less value when comparing different ICUs where different levels of invasive management are used. Although the predictive value of these scoring systems was high there were notable exceptions, since some patients with

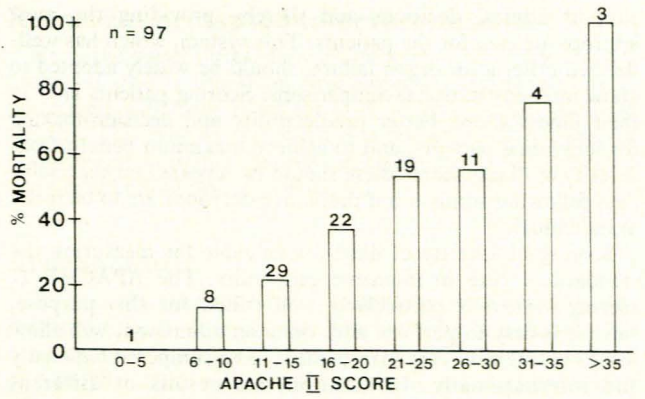


Fig. 6. Percentage mortality v. APACHE II scores for patients with pneumonia.

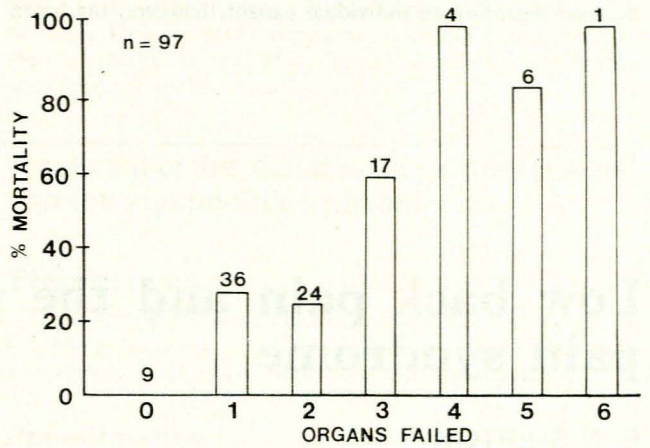


Fig. 7. Percentage mortality v. number of organs failed for patients with pneumonia.

low scores died. These deaths were usually due to sudden unexpected events (intracranial haemorrhage, unexplained cardiac arrest), late complications (progressive multiple organ failure secondary to sepsis) or delayed effects (paraquat poisoning).

In certain individual diseases, notably pneumonia, the relation between severity of illness scores and mortality is excellent. However, in the group of patients with ARDS the relation between organ failure and APACHE II is very poor. This is probably due to the heterogeneous causation of ARDS and subsequent complications which may develop. If ARDS is defined by specific causes the relation with these scoring systems may be improved. However, numbers were too small in our survey to separate aetiological groups. Even in individual diseases, however, the correlations between mortality and score were insufficiently accurate to determine individual patient outcome. Scoring patients on subsequent days after initiating therapy, which would evaluate response to treatment, may improve the prognostic value in individual patients.

The organ failure score showed the best overall correlation with mortality and is the simplest system to use. This score was included in our prospective study, and the definitions of organ failure were kept simple. Knaus *et al.*⁵ have used and validated a system which examines only 5 organ systems (cardiovascular, respiratory, renal, haematological and neurological). They have shown that 3-organ failure on day 1 predicts 80% mortality and a 3-organ failure score on day 5 predicts 100% mortality, as does 3-organ failure on subsequent days, thus allowing prognostic estimates accurate enough to

support clinical decisions and thereby providing the most appropriate care for the patients. This system, which has well-defined criteria for organ failure, should be widely adopted to allow inter-institutional comparisons. Scoring patients later in their illness allows better predictability and decision-making for individual patients, and to achieve maximum benefit from severity of illness scores these should be repeated on successive days following admission if predictive decisions are to be made in individuals.

Scoring of severity of illness is valuable for measuring the standard of care in intensive care units. The APACHE II scoring system is particularly well suited for this purpose, since it is easy to perform and, done on admission, will allow results of intensive care management to be compared nationally and internationally. In addition, the results of different therapies can be compared, because APACHE II accurately predicts severity in illness in a large group of patients. It will also be valuable in identifying problem areas and allowing changes in therapy to be carefully monitored. For making a decision regarding an individual patient, however, the organ

failure system is more valuable, using the definitions of Knaus *et al.*⁵ and particularly if it is extended up to and beyond day 5. Both these systems should be adopted nationally to improve the quality of intensive care in southern Africa.⁷

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