ACUTE PHYSIOLOGY AND CHRONIC HEALTH EVALUATION (APACHE II) SCORING IN THE MEDICAL INTENSIVE CARE UNIT, NATIONAL UNIVERSITY HOSPITAL, SINGAPORE

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ABSTRACT

The intensive care unit provides multisystem support and therapy to critically ill patients, and represents an expensive part of hospital medicine. This survey validates the use of APACHE II as a severity scoring system that allows reliable prediction of outcome of intensive care patients in Singapore. The mortality rate of 37.4% in our medical intensive care unit compares favourably with the other established intensive care units in the United States of America. Our results also indicate that the aged fared as well as their younger counterparts. Patients with sepsis fared poorer than expected from their APACHE II scores, and stroke patients needing intensive care admission had an extremely poor prognosis (mortality rate of 85.7%). High APACHE II scores are associated with invasive haemodynamic monitoring.

Keywords: APACHE II, medical intensive care unit, Singapore.

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INTRODUCTION

Many types of severity or prognostic scoring systems exist for the intensive care unit[1-3]. APACHE II was introduced by Knaus et al[4] in 1985, and is a widely used system for scoring severity of illness in intensive care units. It is important to develop such scoring systems for a number of reasons. An objective scoring system allows audits of different units or the same unit with historical controls, and comparisons of different treatment modalities in those with similar severity of illness. In the current environment of escalating medical costs, such scores may allow us to restrict intensive care to those most at need, and provide a gauge of illness for deciding how aggressive management should be. This paper presents the results of applying APACHE II scoring system to our intensive care unit.

MATERIAL AND METHOD

The medical intensive care unit has five allocated beds but is able to overflow as needed, into the rest of the ward which has another five surgical intensive care beds,six coronary care beds, and three isolation rooms. All the beds have the facility for mechanical ventilation.

APACHE II scores[4] were determined prospectively over a six-month period from 1 June 1991 to 30 November 1991 by a single investigator (LKH) to ensure consistency. The predicted mortality is calculated according to the method in Knaus et al[4]. Patients who were admitted for plasma exchange were excluded from the analysis.

STATISTICS

Results are expressed as mean ± standard deviation.Unpaired t-Test was used to compare for differences between groups along with Chi-square testing.

RESULTS

One hundred and thirty-one patients were admitted in this period.The mean age was 53.4 (±17.3) years (range 14 to 84), with 51% males. Average length of stay was 4.1 days, and 62% patients were ventilated. The average APACHE II score was 21.5 (±12.1, range 2-55), and the distribution is shown in Fig 1.

Fig 1 – Distribution of APACHE II scores in the medical intensive care unit.

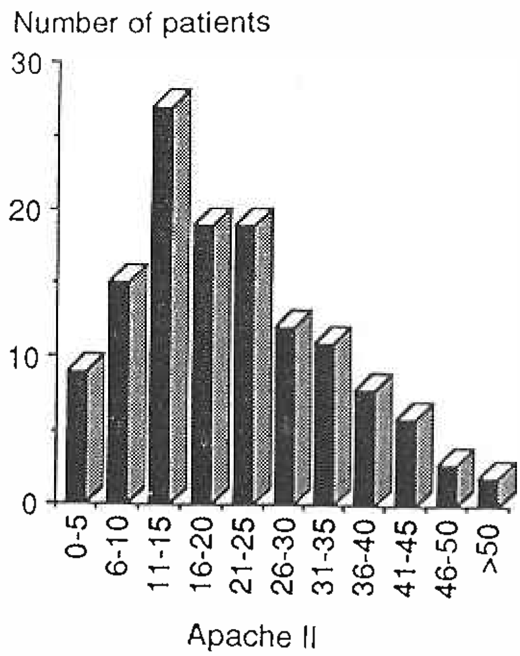

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Fig 2 – Diagnostic Groups Admitted to Medical Intensive Care Unit

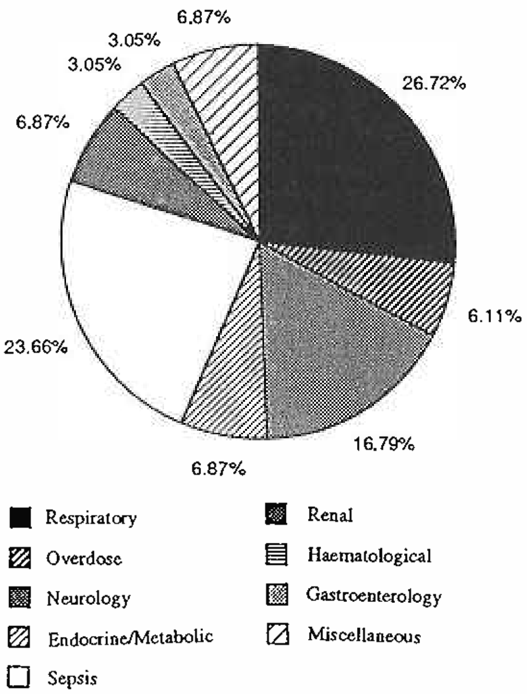
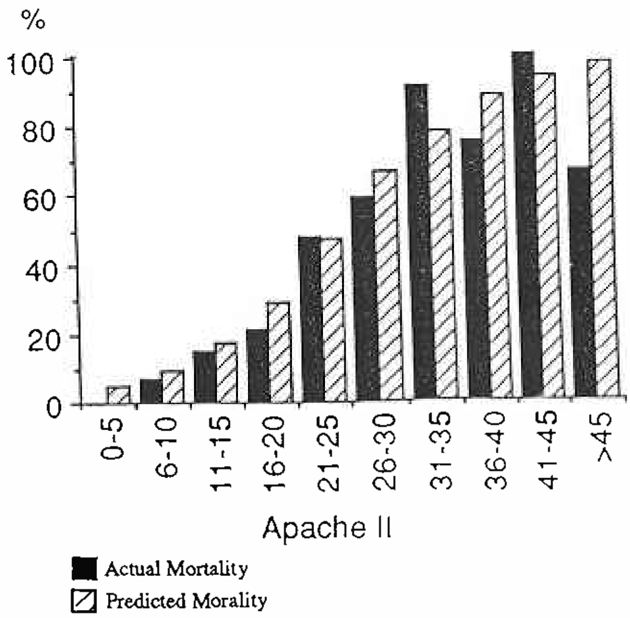


Fig 3 – Actual versus Predicted Mortality There is good correlation between the actual and predicted mortality (r=0.95; p=0.001).



The most common diagnostic group for admission was respiratory (26.7%), followed by sepsis (23.7%), and neurological cases (16.8%) (Fig 2). Actual and predicted mortalities in the different APACHE II range are demonstrated in Fig 3. Actual mortality is highly correlated with predicted mortality (r=0.95; p=0.001). APACHE II scores of survivors (16.6 ± 10.5) were significantly lower than non-survivors (29.7 ± 9.8, p=0.0001), while overall mortality was 37.4%, compared with a predicted mortality of 41.9%. If a predicted mortality of greater than 0.5 was taken to indicate subsequent death, a sensitivity of 75% and a specificity of 72%, with a positive predictive value of 84% and a negative predictive value of 69% were obtained.

Non-survivors had a mean age of 54.7 (±15.7) years, which was not significantly different from the survivors (52.6 years ± 18.3). Comparing patients under and above 60 years old, there is no significant difference in their outcome, average length of stay, and mean APACHE II scores (Fig 4). There was still no difference if the sample population was divided into those below 65 years old and those 65 years and above, or alternatively if 75 years old was taken as the dividing line (Table I).

Fig 4 – Effect of Age – There is no difference in outcome, length of stay, or mean APACHE II between those below 60 years and those 60 years and above.

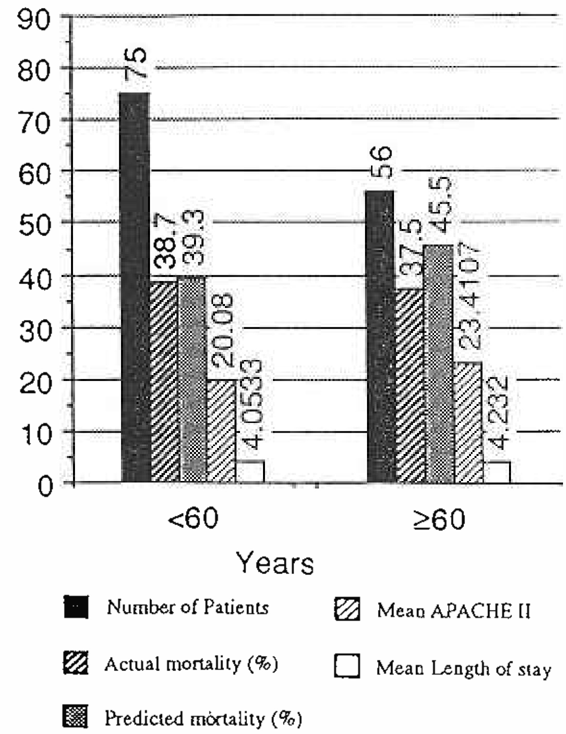
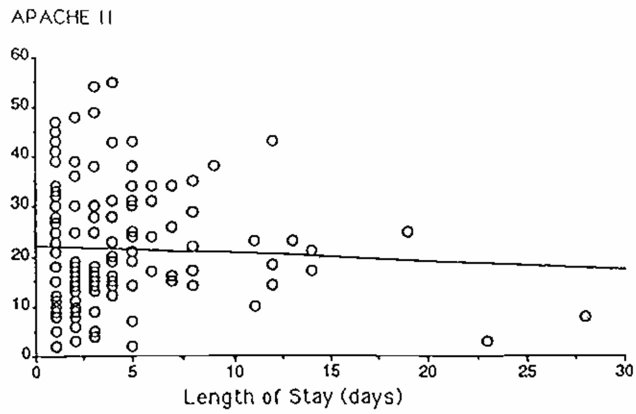


Table I – Effect of Age. There is no significant difference in outcome, mean length of stay, or mean APACHE II scores if the group is divided using 60, 65, or 75 years.

Age	No. of Patients	Mortality %	Length of Stay (days)	APACHE II (mean)
< 60 years	75	38.7%	4.1	20.1
≥ 60 years	56	37.5%	4.2	23.4
< 65 years	92	39.1%	3.9	20.3
≥ 65 years	39	35.9%	4.6	24.3
< 75 years	119	37.8%	4.2	21.6
≥ 75 years	12	41.7%	3.7	21.0

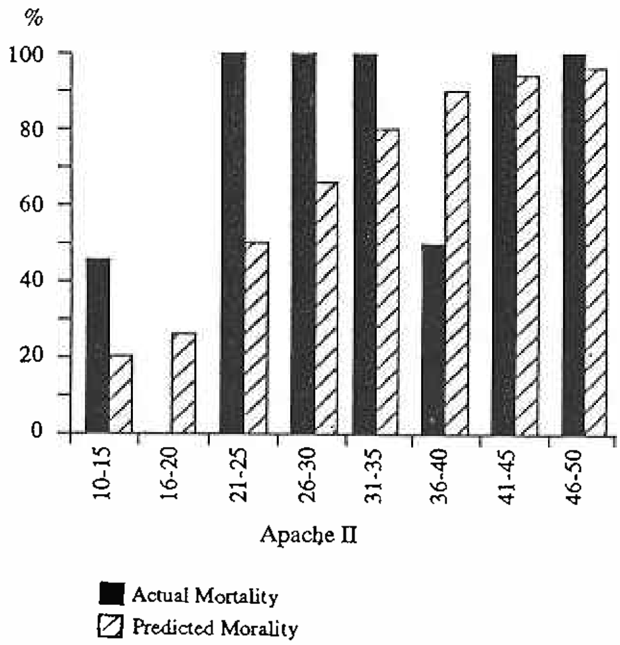
The duration of intensive care may relate to outcome, as those who survived stayed for 3.7 ± 4.2 days, while non-survivors stayed for 4.9 ± 4.1 days, though this difference is not significant. However, APACHE II score did not predict length of stay (Fig 5).

Fig 5 – APACHE II cannot predict the length of stay in intensive care.



Subset analysis showed that patients with sepsis (n=31) had a higher than predicted mortality (Fig 6). In addition, the APACHE II score was significantly higher in those who died (non-survivors; 30.5 ± 10.8; survivors: 17.4 ± 7.9; p<0.003).

Fig 6 – Septic Patients – Actual versus Predicted Mortality Septic patients have a higher than predicted mortality based on their APACHE II score.



Stroke patients (n=14) needing intensive care admission had a mortality of 85.7%, while other neurological cases had no associated mortality (Fig 7).

Higher APACHE II scores predicted invasive monitoring as mean APACHE II scores were significantly higher in those who received pulmonary artery catheters, or an intra-arterial cannula (Table II).

DISCUSSION

This study is the first validation study of APACHE II in the Singapore context with its multiracial component. There was a preliminary report from Kuala Lumpur[5] involving 100 cases

Fig 7 – CVA – Cerebrovascular accident
Stroke patients admitted to intensive care had a high mortality (85.7%) while there was no associated mortality with the other cases.

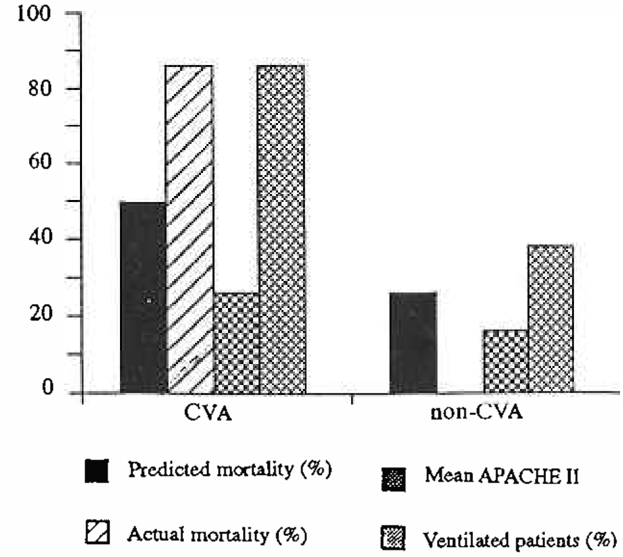


Table II – Higher APACHE II scores predict invasive monitoring

		Mean APACHE II	
1) Intra-arterial cannulae:	Yes	23.8	p<0.003
	No	17.4	
2) Pulmonary artery catheter:	Yes	27.3	p<0.0001
	No	18.8	

but there was no attempt to compare their actual outcome with predicted mortality. Predicted mortality is calculated from the APACHE II score, the diagnostic category, and the need for emergency surgery. This was validated across the United States of America in different intensive care units[4]. Our study has demonstrated that higher APACHE II scores are related to mortality, and our mortality figures in the different APACHE II ranges compare favourably with the predicted mortality, which serves as a standard for intensive care outcome.

Intensive care units are very expensive to run, and have limited beds. It is, therefore, imperative that the units do not admit unnecessary patients, and the length of stay is kept to a minimum. This means that patients who are too ill to benefit from any useful intervention that the unit can offer, or patients that are too well to warrant intensive care monitoring should be excluded from admission. Our average APACHE II score of 21.5 with the distribution as shown in Fig 1 suggests that this is not a major problem in our unit. It is also important to note that the APACHE II score cannot predict the length of stay, even though there is a tendency for the non-survivors to stay longer in the unit.

Invasive monitoring appeared to correlate with higher APACHE II scores. The increased need for closer monitoring is what one would expect in the more severely ill patients. It is, however, important to note that invasive monitoring is not a therapeutic modality, and a nationwide study in Finland has demonstrated no significant reduction in mortality when invasive haemodynamic monitoring was employed[6].

Patients with sepsis fared more poorly than predicted, with an overall mortality rate of 70% in this group of 31 patients. This compares with a mortality rate of 58% in 180 patients from Knaus et al[4]. This may reflect one of the diagnostic subcategories that need greater risk weighting in our local population. However, it is still a useful prognostic score as the non-survivors had a higher APACHE II score. This was also found in South Africa in their septic patients[7].

Neurology cases presenting with stroke had a high mortality. The involvement of the brainstem predicts a poor prognosis. The patients were admitted because of apnoea requiring mechanical ventilation, and therefore, their demise was expected with the absence of brainstem function.

The patients who died were not significantly older than the survivors. This suggests that age did not seem to be an important factor in determining outcome although age is part of the APACHE II scoring system. Patients who were 60 years old and above did not seem to stay longer than those less than 60 years old. The outcome of the older group was as good as the younger group. The same conclusion held true even when a higher age was taken as a dividing line. This may reflect a vigilant policy regarding appropriate admissions with particular emphasis placed on biological rather than chronological age. This issue was discussed in an editorial in Lancet[8] which concluded that age should not be the sole arbiter for excluding the elderly from intensive care, while a good quality of life before the acute illness should strongly argue for admission.

With this study we have established a description of our practice using the APACHE II score. This will serve as a useful baseline to evaluate the benefits of future treatment modalities using this data as historical controls. In addition, by having such a scoring system, different intensive care units within Singapore can be compared. For instance, we have previously been able to compare the medical intensive care unit with the surgical intensive unit in National University Hospital[9]. The average APACHE II scores were significantly higher in the medical side (mean APACHE II 20.4 {medical}, 13.4 {surgical}, p=0.001). This implied that the medical unit was generally admitting more severely ill patients.

APACHE II is currently being redeveloped to APACHE III. This will incorporate other variables, look at the change in APACHE score with time, add on other chronic health factors, increase the types of disease classification, and enlarge the database to improve prediction for the individual[10].

In conclusion, this study is the first published report on the validation of the APACHE II in the Singapore context. This is a useful scoring system and can be applied to our local context to quantify the severity of illness. For individual prognostication and more accurate predictions in the different diagnostic groups, especially in those with sepsis, we should develop a sufficiently large local database to allow us to create our own severity scoring system that reflects the local situation.

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