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Original Article

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Severity and prognosis in intensive care: prospective application of the Apache II Index

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ABSTRACT

Context: The performance of each ICU needs to be assessed within the overall context of medical care, as well as by the institution which the ICU forms part of. Evaluation mechanisms in the field of intensive care have been developed that are recognized worldwide within the scientific literature.

Objective: To study outcomes from groups of critical patients and to compare their actual and estimated mortality rates.

Design: Prospective study of patients' outcomes.

Setting: A tertiary care unit for a period of 13 months (anesthesiology intensive care unit at the Escola Paulista de Medicina).

Participants: 520 patients selected according to sex, age and nature of hospitalization.

Diagnostic Test: The modified APACHE II prognostic index was applied in order to assess clinical severity and anticipation of mortality in three groups who had non-surgical treatment, emergency surgery and elective surgery.

Main measurements: The APACHE II index.

Results: The application of this index allowed patients to be stratified and expected death risks for both subgroups and the entire sample population to be calculated. The observed mortality rate was greater than the expected rate (28.5% versus 23.6%, respectively), with a statistically significant difference. The standardized mortality rate was 1.20. Patients who obtained scores above 25 presented a significant outcome towards death. The most severe and worst evolving cases were, in decreasing order: non-surgical, emergency surgical and scheduled surgical patients; the actual general mortality rate was higher than the expected one.

Conclusions: The use of the APACHE II index made it possible to stratify critical patient groups according to the severity of their condition.

Key-words: Severity. Mortality. Intensive Care. APACHE II.

INTRODUCTION

Intensive care, a recognized form of treatment since the early 1950s,[1] has gone through considerable change. The introduction of new treatments, technological developments, the increase in life expectancy and the growth of chronic diseases which at some time require intensive care support are some of the factors which have determined the rapid changes in this new speciality.[2] Parallel to this, the maintenance of intensive care units (ICU) has become a very costly medical activity,[3,4] especially in developing countries.

The performance of each ICU needs to be assessed within the overall context of medical care, as well as by the institution which the ICU forms part of.[5] Evaluation mechanisms in the field of intensive care have been developed that are recognized worldwide within the scientific literature. These methods are also called prognostic indices.[6-9] They may be used independently or associated with other classification systems. They provide exact, critical and satisfactory results and allow for the establishment or change of guidelines in the structures under observation. Estimates of the level of severity and forecasting of the outcome for seriously ill patients have relevant applications,

as they allow for an evaluation of efficacy and an analysis of cost and benefit for equipment and/or treatments,[10] and they help in making decisions on when to start, maintain or interrupt intensive care.[11]

METHODS

From October 15, 1991, until November 30, 1992, 762 patients were admitted into the ICU of the Hospital São Paulo from the surgical center, emergency service and wards of the same hospital.

Two hundred and forty-two patients were excluded from the preliminary study because of insufficient data, age under 12, discharge from the ICU in less than 24 hours, death within 8 hours after admission to the unit and hospitalization for donation of organs (Table 1). The remaining 520 patients were all included in this study, of which 305 patients were male and 215 were female. Two hundred and eighty-two were over 50 years of age, the average age being 51 and the full range 15 to 88. There were 111 non-surgical patients and 309 surgical ones (308 were subjected to elective operations and 101 were emergencies). Table 2 shows patient distribution according to nature of hospitalization and age.

Table 1 - Exclusion from preliminary selection of 762 patients

Reasons	n
Insufficient data (< 23 variables)	40
Age < 12 years	04
ICU stay < 24 hours	141
Death prior to 8 hours in ICU	37
Donors of organs	20
Total	**242**

The modified APACHE II prognostic index[7] was applied in order to assess clinical severity and anticipation of mortality in three groups who had non-surgical treatment, emergency surgery and elective surgery. The index was applied to situations that had not been foreseen in Knaus's original paper.[7] In sedated patients still under immediate postoperative observation, Glascow's coma score was calculated only after complete awakening. In intubated patients, Glascow's score was calculated considering the comprehension capacity equivalent to that of speech. For respiratory frequency in intermittent mandatory ventilation the score zero (corresponding to a frequency between 12 and 24 cycles per minute) was given when the patient seemed to be comfortable and presented satisfactory arterial gasometry. Postoperative patients from myocardial revascularization operations were included. The time spent at the ICU and the mortality rate were registered. Patients' data were registered on specific data sheets, and these were then processed in a microcomputer using a program dedicated to this purpose, based on the equation proposed by Knaus. This procedure was carried out by a single supervised worker and at the end of or after the first 24 hours of ICU stay.

Statistical Methods. Statistical analysis was done using the partition chi-square test for 2xN tables,[12] in order to compare types of hospitalization and scoring levels with mortality rates, and using the chi-square test[13] to study the frequency of discharge or death in relation to what was anticipated by the Knaus equation. The same test was used to compare expected and actual

Table 2 - Patients according to nature of hospitalization and age (years)

Age	Non-surgical	Emergency surgery	Elective surgery	Total
12 ⊢⊣ 20	7 (20.0)	9 (25.7)	19 (54.3)	35 (6.7)
20 —⊣ 30	16 (22.8)	11 (15.7)	43 (61.5)	70 (13.4)
30 —⊣ 40	14 (19.1)	20 (27.3)	39 (53.6)	73 (14.0)
40 —⊣ 50	12 (20.0)	11 (18.3)	37 (61.7)	60 (11.5)
50 —⊣ 60	23 (24.7)	18 (19.3)	52 (56.0)	93 (17.8)
60 —⊣ 70	19 (19.0)	10 (10.0)	71 (71.0)	100 (19.3)
> 70	20 (22.4)	22 (24.7)	47 (52.9)	89 (17.2)
Total	**111 (21.3)**	**101 (19.4)**	**308 (59.3)**	**520 (100.0)**

Percentages given in parenthesis

death frequencies, according to the specific equation. In all tests statistical significance was set at $p \leq 0.05$, and the significant values were marked by an asterisk.

RESULTS

The application of the above method to the patients in our series produced the following results:

1. Severity

In relation to APACHE II, the greatest frequency was in the range of 10 to 20 points (56.5%; 294 patients), with an overall average of 16. Only 47 patients (9.0%) reached a score above 25 and only one patient got a score of zero. The highest score registered was 42 (Table 3).

The nature of hospitalization had a considerable influence when measuring the index. Thus, out of the 294 patients whose scores were within the most-frequent range (10 to 20), 48 (16.3%) were non-surgical patients, 61 (20.7%) had undergone emergency surgery and 185 (62.9%) had had elective surgery. In the extreme range, APACHE II scores above 25 were attained by 47 patients, the largest proportion being represented by non-surgical (24 patients; 51.1%), followed by emergency surgery (14 patients; 29.7%) and elective surgery (9 patients; 19.1%) (Table 4).

2. ICU stay

The patients in this study spent from 1 to 142 days in the ICU with a total of 2975 patient-days. The average was 5.7 days, although most of the patients (336; 64.6%) spent no longer than 4 days in the ICU (Table 5).

3. Severity and ICU stay

The majority of the patients studied spent no longer than 4 days in the ICU (336 patients). The most frequent scoring range (10 to 20) was found in 188 patients in this group of 4-day ICU stay. Patients with APACHE II scores over 20 also showed a short ICU stay. In other words, both low and high scores were found in association with a short ICU stay. Out of 47 patients with scores over 25, only 7 (14.8%), spent over 10 days in the ICU (Table 6).

4. Mortality

Hospital discharge showed a fairly even distribution across the age groups involved. The highest discharge rate occurred in the group from 40 to 50 years of age, but there was an overall tendency in all groups to reach a discharge rate between 70 and 75% irrespective of age. However, on analyzing mortality per age group, it

Table 3 - Patients according to APACHE II scores

Scores	Number of patients	%
0 ⊢⊣ 5	25	4.8
5 —⊣ 10	94	18.0
10 —⊣ 15	164	31.7
15 —⊣ 20	130	25.0
20 —⊣ 25	60	11.5
25 —⊣ 30	25	4.8
> 30	22	4.2
Total	**520**	**100.0**

Table 4 - APACHE II scores according to nature of hospitalization

Age	Non-surgical	Emergency surgery	Elective surgery	**Total**
0 ⊢⊣ 5	4 (16.0)	7 (28.0)	14 (56.0)	**25**
5 —⊣ 10	13 (13.8)	12 (12.7)	69 (73.5)	**94**
10 —⊣ 15	26 (15.8)	37 (22.5)	101 (61.7)	**164**
15 —⊣ 20	22 (16.9)	24 (18.4)	84 (64.7)	**130**
20 —⊣ 25	22 (36.6)	7 (11.6)	31 (51.8)	**60**
25 —⊣ 30	15 (60.0)	6 (24.0)	4 (16.0)	**25**
> 30	9 (40.9)	8 (36.3)	5 (22.8)	**22**
Total	**111 (21.3)**	**101 (19.4)**	**308 (59.3)**	**520**

Percentages given in parenthesis

is clear that the highest mortality rate was found among patients over 50: 59.4% (88 out of 148 patients), as shown in Table 7. There were more deaths with increasing age, except in the group aged between 40 and 50 where the mortality rate decreased. The overall tendency of these data points was towards at least one death for every 3 discharges from the ICU, except in the group aged between 40 and 50 years.

Regarding differences according to sex, 26.2% (80) of the men and 31.6% (68) of the women died at the ICU (Table 8). The non-surgical patients showed a high mortality rate (55.9%) while those who underwent emergency surgery reached 43.6% and those who had elective operation presented 13.7%. There was a statistically significant difference between the mortality rates for surgical (emergency and elective) and non-surgical patients, and between those who underwent elective and emergency operations (Table 9).

In terms of outcome, 66 of the patients in the study spent over 10 days at the ICU, and of these, 37 (56.1%) died. Of the 336 patients (64.6%) who spent at most 4 days in the ICU, 67 (19.9%) died. The highest incidence of death occurred on the second, the fourth and after the tenth day in the ICU. The low death proportion registered between the ninth and tenth day of ICU might be explained by the small number of patients who stayed there so long (Table 10).

Table 5 - ICU stay

Hospital days	Number of patients	%
1	103	19.9
2	113	21.7
3	60	11.6
4	60	11.6
5	38	7.3
6	27	5.2
7	21	4.0
8	16	3.0
9	8	1.5
10	8	1.5
>10	66	12.7
Total	**520**	**100.0**

5. Severity and mortality among ICU patients

There was a close connection between the final APACHE II score and outcome (discharge or death) for ICU patients. At low score levels the number of patients surviving was high; in fact, the survival rate reached 100% for scores of 0 to 5 and then decreased progressively as scores increased. On the other hand, a comparison between the calculated scores and the number of deaths showed that mortality went up as the index obtained increased. In the range of greatest frequency (scores from 10 to 20), the mortality rate was 23.1%, while patients with scores above 25 showed a mortality rate of 89.3%. As for extreme scores, patients with scores under 5 (25 patients; 4.8% of the total) all survived, whereas only one survived in the group of patients with scores over 30 (22 patients; 4.2% of the total) (Table 11).

6. Expected and actual mortality

The APACHE II index applied to these 520

Table 6 - APACHE II scores according to ICU stay (in days)

Scores	One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten	Eleven	Total
0|—|5	6 (24.0)	7 (28.0)	2 (8.0)	2 (8.0)	2 (8.0)	0 (0.0)	1 (4.0)	1 (4.0)	0 (0.0)	0 (0.0)	4 (16.0)	25 (4.8)
5—|10	24 (25.5)	24 (25.5)	16 (17.0)	9 (9.5)	5 (5.3)	1 (1.0)	3 (3.1)	3 (3.1)	1 (1.0)	1 (1.0)	7 (7.4)	94 (18.1)
10—|15	20 (12.1)	45 (27.4)	21 (12.8)	25 (15.2)	12 (7.3)	10 (6.0)	3 (1.8)	3 (1.8)	2 (1.2)	3 (1.8)	20 (12.2)	164 (31.5)
15—|20	33 (25.3)	21 (16.1)	11 (8.4)	12 (9.2)	9 (6.9)	8 (6.1)	9 (6.9)	4 (3.0)	1 (0.7)	3 (2.3)	19 (14.6)	130 (25)
20—|25	11 (18.3)	9 (15.0)	7 (11.6)	6 (10.0)	4 (6.6)	5 (8.3)	3 (5.0)	2 (3.3)	3 (5.0)	1 (1.6)	9 (15.0)	60 (11.5)
25—|30	3 (12.0)	4 (16.0)	2 (8.0)	5 (20.0)	3 (12.0)	1 (4.0)	1 (4.0)	1 (4.0)	0 (0.0)	0 (0.0)	5 (20.0)	25 (4.8)
>30	6 (27.2)	3 (13.6)	1 (4.5)	1 (4.5)	3 (13.6)	2 (9.0)	1 (4.5)	2 (9.0)	1 (4.5)	0 (0.0)	2 (9.1)	22 (4.2)
Total	**103 (19.8)**	**113 (21.7)**	**60 (11.5)**	**60 (11.5)**	**38 (7.3)**	**27 (5.1)**	**21 (4.0)**	**16 (3.0)**	**8 (1.5)**	**8 (1.5)**	**66 (12.6)**	**520 (100)**

Percentages given in parenthesis

patients resulted in an expected mortality of 23.6% (123 patients) and expected discharge of 76.4% (397 expected survivors). However, 148 patients (28.5%) actually died at the ICU and 372 patients (71.5%) were discharged. Therefore a statistically significant difference was observed between the actual mortality and that anticipated by the Knaus equation (Table 12).

The outcomes for patients were anticipated at all scoring levels. Tables 13, 14 and 15 show the expected and the actual outcomes at each scoring level. In absolute numbers, only scores of 0 to 5 presented a survival rate above that expected, while at all other levels, especially those above a score of 25, the opposite occurred.

The expected proportional distribution of deaths across the scoring levels was in accordance with the actual distribution. Therefore, it appeared to be possible to predict the distribution of deaths in the patients studied using the APACHE II index (Table 16). Outcomes were also predicted according to age groups, as shown in Table 17. The expected number of deaths was lower than the actual number with some exceptions (age groups 20 to 30 and 40 to 50 years). The expected proportional distribution of deaths per age group was in accordance with the actual distribution observed (Table 18).

DISCUSSION

The prognostic or severity indices attempt to quantify the organ dysfunction of severely ill patients, converting the severity of the patient's condition into a numerical value based on known groups of clinical and laboratory alterations.

The prognostic indices are actually based on the so-called "Euclidian Distance", that is, the distance between a given clinical or laboratory measure and a value considered as "normal".[14] The farther the measured value is from the normal one (below or above it) the higher the score obtained. The final total score, an important tool for assessing the clinical condition, is inserted into a specific equation with distinct diagnostic categories given different weights. The solution of this equation represents the percentage risk of death for an individual patient or a group of patients studied.[7,8,14]

Many attempts have been made to quantify severity. The stratification of the severity in coronary disease[15] and the scale for cumulative diseases are examples of such attempts. Prognostic indices related to trauma were developed in the 1970s,[14,16] and Shoemaker[17] and Sacco[18] produced the prototypes for future prognostic indices. The Therapeutic Intervention Scoring System (TISS)[9,19] was described by Cullen in 1974; it is an index of therapeutic measures but it is also applicable to establish patients' prognostics. Many other publications in prognostic indices were produced after 1975. In 1981 Knaus *et al* introduced the APACHE System (Acute Physiology and Chronic Health Evaluation)[6] which received worldwide acclaim. The system evolved into APACHE II,[7] which resulted from a study involving 5815 patients from 13 American hospitals; it is based on the degree of physiological disarrangement of 12 variables, on the age and on the previous health condition. The system subsequently evolved into APACHE III.[8,20] Several other indices have been proposed by

Table 7 - Outcomes for patients hospitalized at the ICU according to age groups

Age	Discharges	Deaths	**Total**
12|—| 20	25 (71.4)	0 (28.6)	**35 (6.7)**
20—|30	53 (75.7)	17 (24.3)	**70 (13.4)**
30—|40	51 (69.8)	22 (30.2)	**73 (14.0)**
40—|50	49 (81.6)	11 (18.4)	**60 (11.5)**
50—|60	64 (68.8)	29 (31.2)	**93 (17.9)**
60—|70	73 (73.0)	27 (27.0)	**100 (19.3)**
>70	57 (64.0)	32 (36.0)	**89 (17.2)**
Total	**372 (71.5)**	**148 (28.5)**	**520 (100.0)**

Percentages given in parenthesis

Table 8 - Patient discharges/deaths at the ICU according to sex

Sex	Discharges	Deaths	Total
Male	225 (73.8)	80 (26.2)	**305**
Female	147 (68.4)	68 (31.6)	**215**
Total	**372 (71.5)**	**148 (28.5)**	**520**

Percentages given in parenthesis

Table 9 - Patients according to nature of hospitalization at the ICU and their outcomes

Patients	Discharges	Deaths	Total
non-surgical	49 (44.1)	62 (55.9)	**111**
emerg surgery	57 (56.4)	44 (43.6)	**101**
elect surgery	266 (86.3)	42 (13.7)	**308**
Total	**372 (71.5)**	**148 (28.5)**	**520**

Chi-square test: calculated $\chi^2 = 85.47$*; critical $\chi^2 = 5.99$

Partition chi-square: non-surgical deaths exceeding surgical deaths (emergency and elective) (calculated $\chi^2 = 81.55$*) and deaths in emergency surgery exceeding those in elective surgery (calculated $\chi^2 = 3.92$*); Percentages given in parenthesis

workers from different countries,[21] but the APACHE system, especially APACHE II, has managed to gain widespread acceptance in the medical community and has become an important supporting tool for scientific studies.

APACHE II allows for a cost/benefit evaluation of intensive care,[22] establishes minimum requirements for admission to the ICU,[23] stratifies patients or groups of patients according to the severity of their diseases,[6] follows the outcome and response to therapy, compares patient groups in clinical trials, calculates the death risk for patients or groups of patients,[6] evaluates the performance of ICU work,[24] and compares the results obtained at a particular ICU to those of other ICUs providing similar services.[25] Moreover, this index enables researchers to compare expected and actual mortality rates,[6,26,27] to evaluate new technologies and/or intensive therapies, to make medical decisions and/or modify their approach,[28] and may partially help in determining whether to omit

Table 10 - Patients according to outcome and ICU stay (in days)

Days	Discharges	Deaths	Total
1	91 (88.3)	12 (11.7)	**103 (19.9)**
2	91 (80.5)	22 (19.5)	**113 (21.8)**
3	49 (81.6)	11 (18.7)	**60 (11.5)**
4	38 (63.3)	22 (36.7)	**60 (11.5)**
5	27 (71.0)	11 (29.0)	**38 (7.3)**
6	18 (66.6)	9 (33.4)	**27 (5.2)**
7	12 (57.1)	9 (42.9)	**21 (4.0)**
8	7 (43.7)	9 (56.3)	**16 (3.0)**
9	5 (62.5)	3 (37.5)	**8 (1.5)**
10	5 (62.5)	3 (37.5)	**8 (1.5)**
> 10	29 (43.9)	37 (56.1)	**66 (12.8)**
Total	**372 (71.5)**	**148 (28.5)**	**520 (100.0)**

Percentages given in parenthesis

Table 11 - APACHE II scores according to outcomes for ICU patients

Scores	Discharges	%	Deaths	%	Total	%
0⊢5	25	100.0	0	0.0	25	4.8
5⊢10	85	90.4	9	9.6	94	18.0
10⊢15	135	82.3	29	17.7	164	31.7
15⊢20	91	70.0	39	30.0	130	25.0
20⊢25	31	51.6	29	48.4	60	11.5
25⊢30	4	16.0	21	84.0	25	4.8
>30	1	4.5	21	95.5	22	4.2
Total	**372**	**71.5**	**148**	**28.5**	**520**	**100.0**

Percentages given in parenthesis

or interrupt the intensive care.[10] A daily application of APACHE II has been used to attempt to define individual patient prognoses.[29]

In spite of the benefits and advantages set out above, the APACHE II index also presents some drawbacks which have been much criticized. The index is calculated on the day or at the end of the day when the patient is admitted to the ICU and therefore only produces a picture of that moment, not a dynamic view. On the other hand, the calculation of this index requires at least two measurements of each physiological parameter and the second of these will be influenced by the intensive treatment.[30] Another obstacle is the subjectivity inherent in certain items on the worker's data sheets. The more researchers who apply this index, the less precise are the data. Doctors' and nurses' files need to be made uniform, a task which is sometimes difficult in clinical practice. Mean blood pressure measurements are unchanged whether or not the patient is under the effects of vasoactive drugs. Also, it is not always simple to fit all cases into the diagnostic categories specified in the index. Therefore, a given clinical condition is classified according to the weight of a general category (neurological, cardiovascular, respiratory, gastrointestinal, metabolic/renal). To classify patients within the strict categories of previously existing chronic illness or immunosuppression, as required by the index, is not always possible. The most substantial criticism one might make against prognostic indices as a whole is that their very principle implies a subjective or artificial transformation of clinical and laboratory observations into numerical values (scores).

Table 12 - Expected and actual mortality of ICU patients

Outcome	Actual	Expected
Deaths	148 (28.5)	123 (23.6)
Discharges	372 (71.5)	397 (76.4)
Total	**520 (100.0)**	**520 (100.0)**

Adherence chi-square test: calculated χ^2=6.65*; critical χ^2 = 3.84; Percentages given in parenthesis

Table 13 - APACHE II scores and actual outcome

Scores	Discharges	Deaths	**Total**
0⊢⊣5	25 (100.0)	0 (0.0)	**25**
5⊢⊣10	85 (90.4)	9 (9.6)	**94**
10⊢⊣15	135 (82.3)	29 (17.7)	**164**
15⊢⊣20	91 (70.0)	39 (30.0)	**130**
20⊢⊣25	31 (51.6)	29 (48.4)	**60**
25⊢⊣30	4 (19.0)	21 (81.0)	**25**
> 30	1 (4.7)	21 (95.3)	**22**
Total	**372 (71.5)**	**148 (28.5)**	**520**

Chi-square test: calculated χ^2 = 133.93*; critical χ^2: 12.59; Partition chi-square: Scoring levels 25 ⊣ 30 and > 30: more deaths than at any other level (calculated χ^2 = 94.12*); Scoring level 20 ⊣ 30: more deaths than any lower scoring level (calculated χ^2 = 22.68*); Scoring level 15 ⊣ 20: more deaths than any lower scoring level (calculated χ^2 = 12.01*); Percentages given in parenthesis

Table 14 - APACHE II scores and expected outcome

Scores	Discharges	Deaths	**Total**
0⊢⊣5	24 (96.0)	1 (4.0)	**25**
5⊢⊣10	86 (91.5)	8 (8.5)	**94**
10⊢⊣15	142 (86.6)	22 (13.4)	**164**
15⊢⊣20	98 (75.4)	32 (24.6)	**130**
20⊢⊣25	35 (58.4)	25 (41.6)	**60**
25⊢⊣30	9 (36.0)	16 (64.0)	**25**
>30	3 (13.7)	19 (86.3)	**22**
Total	**397 (76.4)**	**123 (23.6)**	**520**

Percentages given in parenthesis

Table 15 - APACHE II scores and actual and expected outcome

	Actual outcome				Expected outcome				
Scores	Discharges	%	Deaths	%	Discharges	%	Deaths	%	**Total**
0⊢⊣5	25	6.8	0	0.0	24	6.0	1	0.8	**25**
5⊢⊣10	85	22.9	9	6.0	86	21.7	8	6.5	**94**
10⊢⊣15	135	36.3	29	19.7	142	35.8	22	17.8	**164**
15⊢⊣20	91	24.4	39	26.4	98	24.7	32	26.1	**130**
20⊢⊣25	31	8.3	29	19.7	35	8.9	25	20.4	**60**
25⊢⊣30	4	1.0	21	14.1	9	2.2	16	13.0	**25**
>30	1	0.3	21	14.1	3	0.7	19	15.4	**22**
Total	**372**	**100**	**148**	**100**	**397**	**100**	**123**	**100**	**520**

In the present study a few slight modifications were introduced into the method proposed by Knaus. The calculation of Glascow's coma score is not feasible when the patient is anesthetized, sedated or intubated. Instead of giving a low score, which would indicate the non-existence of neurological lesions, the final assessment was delayed until the effect of the anesthesia or sedation had ceased. Patients with tracheal tubes, who therefore were unable to speak, could not be classified as having any neurological impairment. This way, an equivalence to the patients' apparent comprehension and apparent ability to speak was adopted when summing up Glascow's coma score. Having dealt with the difficulties described above, the application of APACHE II and also the calculations involved were quite simple procedures that may be reproduced in most ICUs.[31]

In this study, the APACHE II index was calculated for each of the 520 patients admitted into the ICU over a period of time. The vast majority (409 patients; 78.6%) were in their postoperative period after major operations (emergency or elective), as our ICU is eminently a surgical one. Many also presented non-surgical associated diseases. There were patients who were previously surgical and developed non-surgical complications several days after the operation. The population of surgical patients was composed mainly of patients undergoing cardiovascular, pulmonary and gastrointestinal interventions as well as victims of polytraumatism. There were also quite a few patients undergoing transplantation (mostly kidney, but also heart and lung). Among the non-surgical patients (111 patients; 21.3%) most of them presented cardiopathy, respiratory disease (especially ARDS), sepsis and septic shock and cases of successful resuscitation after cardiorespiratory arrest. This study was limited to the assessment only of patients' outcomes inside the ICU, excluding possible deaths occurring at other hospital units after discharge from ICU.

Table 16 - Actual and expected deaths at the ICU

Scores	Actual	Expected
0⊢⊣5	0 (0.0)	1 (0.8)
5⊢⊣10	9 (6.0)	8 (6.5)
10⊢⊣15	29 (19.7)	22 (17.8)
15⊢⊣20	39 (26.4)	32 (26.1)
20⊢⊣25	29 (19.7)	25 (20.4)
25⊢⊣30	21 (14.1)	16 (13.0)
>30	21 (14.1)	19 (15.4)
Total	**148 (100)**	**123 (100)**

Adherence chi-square test: calculated $\chi^2 = 7.29$; critical $\chi^2 = 12.59$; percentages given in parenthesis

Table 18 - Actual and expected deaths according to age

Age	Actual	Expected
12⊢⊣20	10 (6.8)	8 (6.5)
20⊢⊣30	17 (11.4)	18 (14.7)
30⊢⊣40	22 (14.9)	15 (12.2)
40⊢⊣50	11 (7.9)	12 (9.8)
50⊢⊣60	29 (19.6)	24 (19.5)
60⊢⊣70	27 (18.2)	21 (17.0)
>70	32 (21.7)	25 (20.3)
Total	**148 (100)**	**123 (100)**

Adherence chi-square test: calculated $\chi^2 = 8.62$; critical $\chi^2 = 12.59$; percentages given in parenthesis

Table 17 - Actual and expected outcome according to age groups

	Actual outcome				Expected outcome				
Age	Discharges	%	Deaths	%	Discharges	%	Deaths	%	**Total**
12⊢⊣20	25	6.7	10	6.8	27	6.9	8	6.5	**35**
20⊢⊣30	53	14.2	17	11.4	52	13.1	18	14.7	**70**
30⊢⊣40	51	13.7	22	14.9	58	14.6	15	12.2	**73**
40⊢⊣50	49	13.1	11	7.4	48	12.1	12	9.8	**60**
50⊢⊣60	64	17.3	29	19.6	69	17.3	24	19.5	**93**
60⊢⊣70	73	19.6	27	18.2	79	19.9	21	17.0	**100**
>70	57	15.4	32	21.7	64	16.1	25	20.3	**89**
Total	**372**	**100.0**	**148**	**100.0**	**397**	**100.0**	**123**	**100.0**	**520**

Percentages given in parenthesis

Concerning patients' outcomes, some differences were observed between actual mortality and the mortality expected from Knaus's equation.[7] In absolute numbers, 148 deaths occurred whereas 123 were expected, which was a statistically significant difference (Table 12). However, the ratio of actual mortality to expected mortality[26] was 1.20, which is below the Brazilian standard (1.66) found in a study involving 1781 patients from 10 hospitals.[32] The standardized mortality rate, which represents the actual/expected mortality ratio, is more and more frequently calculated in ICUs today. The calculation of this rate allows for a fine-tuning of the prognostic index for different populations of patients and clinical situations.[27]

Some factors may be involved in the difference between the expected and the actual mortality rate when applying the Knaus equation in the USA. Such factors might be population differences, staff, material and organizational resources and different periods studied.

The inclusion of patients who underwent myocardial revascularization in the present study has a parallel in Shaughnessy and Mickler's study.[33] These authors calculated the APACHE II index for such patients, as opposed to Knaus's original work[7] in which these patients were excluded. The average score for such patients was 23.5 and the authors concluded that the "perioperative" therapeutic interventions caused a strong impact on the physiological variables used in calculating the index. In the process of validation of the APACHE III index, Knaus's group began to include patients submitted to myocardial revascularization in prospective studies in order to predict ICU stay and outcome.[34]

The systematic application of the APACHE II index at the ICU has allowed comparison of patient groups and has given support to the evaluation of routine protocols and therapeutic interventions such as artificial ventilation, invasive hemodynamic monitoring, renal substitution and so on, thus contributing to a more rational use of hospital beds in the ICU.

The severity and mortality decreased from non-surgical cases to emergency surgery and from this group to that of patients who underwent elective surgery. No correlation was found between severity or mortality and time spent at ICU. There was also no correlation between mortality and age or sex. There was, however, a correlation between severity and mortality. The actual mortality on the whole was higher than the expected mortality. It was not possible to show any difference between actual and expected mortality rates in relation to the various age groups studied.

CONCLUSION

The application of the APACHE II index was useful in identifying and stratifying critical patient groups according to the severity of their clinical condition.

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RESUMO

Contexto: É necessário que cada UTI possa avaliar seu próprio desempenho no contexto global da assistência médica e possa ser igualmente avaliada pela instituição em que está inserida. Existem mecanismos avaliadores do tratamento intensivo, amplamente reconhecidos pela literatura médica mundial. **Objetivos**: Estudar a evolução de grupos de doentes críticos e comparar as respectivas taxas de mortalidade real e esperada. **Tipo de estudo**: Estudo prospectivo da evolução de pacientes. **Local:** Unidade de cuidados terciários de um hospital-escola durante 13 meses. (UTI da Anestesiologia da Escola Paulista de Medicina). **Participantes**: 520 pacientes, agrupados segundo sexo, idade e caráter da internação. **Teste diagnóstico:** Para avaliação da gravidade e previsão de mortalidade, foi aplicado nos três grupos - doentes não-cirúrgicos, cirúrgicos em urgências e cirúrgicos eletivos - o índice prognóstico APACHE II modificado. **Variáveis estudadas**: Índice APACHE II. **Resultados**: O índice permitiu a estratificação e o cálculo do risco de óbito de grupos de doentes. A taxa de mortalidade observada foi superior à esperada (28,5% e 23,6%, respectivamente), com diferença estatisticamente significante, sendo que a razão mortalidade observada/mortalidade esperada foi 1,20. Dos pacientes com escore acima de 25, 89% evoluíram para óbito. Os grupos de pior evolução foram, pela ordem: pacientes não cirúrgicos, cirúrgicos em urgências e cirúrgicos eletivos; a mortalidade geral observada foi superior à esperada. **Conclusões**: A aplicação do índice serviu para estratificar grupos de pacientes críticos de acordo com a sua gravidade.
Palavras-chave: Gravidade. Mortalidade. Medicina Intensiva. APACHE II.