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## APACHE III VS. APACHE II SCORE IN OUTCOME PREDICTION OF POLITRAUMATIZED PATIENTS

**Abstract:** Traumatic injuries are one of the most important problems in developed world. They are the third cause of death after cardiovascular and neoplastic diseases and the first leading cause of death in the most productive population. Evaluation of the degree of the injuries is one of the most important initial steps in clinical care of these patients. The stratification of trauma patients has relied on scores specific to trauma populations. APACHE II, a modification of the APACHE, assigns numerical values (0 to 4 with high scores indicating more severe illness) to 12 clinical and biochemical parameters. APACHE III consists of a set of equations for predicting hospital mortality, ICU mortality, hospital length of stay, ICU length of stay, risk of active treatment, duration of mechanical ventilation and Therapeutic Intervention Scoring System (TISS).

**Goal:** the aim of this study was to investigate the ability of APACHE II and APACHE III in predicting mortality rate of multiple trauma patients.

**Material and methods:** This prospective cross-sectional study included 84 multiple trauma patients admitted to the ICU of Emergency center, Clinical center of Serbia. Patient's demographic data, vital signs (systolic blood pressure (SBP), heart rate, respiratory rate (RR)), mechanism of injury, level of consciousness (based on Glasgow coma scale (GCS)), and other required variables for calculation of APACHE II and APACHE III scores were recorded.

**Results:** The most common cause of trauma was traffic accidents. Kind of injuries highly correlate with APACHE III, but not with APACHE II score. SIRS score on admission highly correlate with APACHE III, but not with APACHE II score. Outcome is highly correlated with APACHE II on admission, but not with APACHE III. ISS i TS highly correlate both with APACHE II and APACHE III score. Mean daily risk values are significant different between survived and dead patients. By this model,

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it was presented that failure in predicting outcome is less than 10%, based on prediction according SIRS on admission and APACHE III score.

**Key words:** APACHE II, APACHE III, politrauma, outcome prediction

## Introduction:

Traumatic injuries are one of the most important problems in developed world. They are the third cause of death after cardiovascular and neoplastic diseases and the first leading cause of death in the most productive population<sup>1</sup>. Trauma is defined as an acute organ and system of organs damage accompanied by functional disarrangements caused by some external forces (mechanical or chemical). Evaluation of the degree of the injuries is one of the most important initial steps in clinical care of these patients. The stratification of trauma patients has relied on scores specific to trauma populations<sup>2,3</sup>.

There are various systems available for scoring trauma severity, but no ideal trauma scoring system is currently available.

Acute physiology and chronic health evaluation (apache I, II and III) are used widely for the assessment of illness severity and outcome prediction in ICUs.

The need to collect information on patients in the intensive care units (ICU) and use that information to improve outcomes, led to the development of Acute Physiology, Age, and Chronic Health Evaluation system, known by its acronym APACHE.

APACHE II, a modification of the APACHE, assigns numerical values (0 to 4 with high scores indicating more severe illness) to 12 clinical and biochemical parameters: temperature, mean arterial blood pressure, heart rate, respiratory rate, oxygenation, arterial ph, serum sodium, potassium and creatinine, WBC and GCS<sup>4</sup>. These combined score from these 12 parameters makes up the Acute Physiology Score (APS) of APACHE II. Points are also assigned for age group and preexisting illness. Combined scores below 10 suggest relatively mild illness while score above 15 indicate moderate to severe illness. According to the APACHE II definition, scores were calculated based on the worst physiologic parameters within the first 24 hours following hospital admission<sup>5</sup>.

APACHE III was introduced in 1991. The score consists of a set of equations for predicting hospital mortality, ICU mortality, hospital length of stay, ICU length of stay, risk of active treatment, duration of mechanical ventilation<sup>1,4</sup>, and Therapeutic Intervention Scoring System (TISS). APACHE III still does not widely accepted by practitioners

APACHE III scores were calculated for each patient from data collected during the first 24 hours of ICU admission. The APACHE III score consists of several parts including the primary reason for ICU admission, age, sex, race, preexisting co-mor-

bidities, and location prior to ICU admission. The range of APACHE III score is from 0 to 299 points<sup>6</sup>.

**Goal:** the aim of this study was to investigate the ability of APACHE II and APACHE III in predicting mortality rate of multiple trauma patients.

## Methods

### *Study design and setting*

This prospective cross-sectional study included 84 multiple trauma patients admitted to the ICU of Emergency center, Clinical center of Belgrade, from January 2016 to June 2017. Patients younger than 15 years old and those who died within less than 8 hours of arrival were excluded. Each patient's demographic data, vital signs (systolic blood pressure (SBP), heart rate, respiratory rate (RR)), mechanism of injury, level of consciousness (based on Glasgow coma scale (GCS)), and other required variables for calculation of APACHE II and APACHE III scores were recorded. TRISS combines physiologic (Revised Trauma Score: RTS)<sup>6,7</sup> and anatomic (Injury Severity Score: ISS) components of injury with age. Data collected on admission to the emergency department, were used for calculation of RTS and ISS.

### *Definitions:*

**RTS (Revised Trauma Score):** RTS is the sum of the coded value multiplied of GCS, SBP Systolic blood pressure), and RR (respiratory rate). It is calculated by the following formula:

$$\text{RTS} = 0.9368 \text{ GCS} + 0.7326 \text{ SBP} + 0.2908 \text{ RR}$$

RTS values range from 0 to 7.84.

**ISS:** ISS is an index of severity and location of anatomy injury. It correlates reasonably well with mortality probability, and is calculated by adding the square of each of the coded values of the three most severely injured body regions and has a range from 0 to 75. RTS, ISS, and patient age, were placed in a logistic transformation to predict a survival probability ( $P_s$ ) ranging from 0 to 1 and death probability (POD) is  $1 - P_s$ .

**APACHE:** APACHE III scores were calculated for each patient from data collected during the first 24 hours of ICU admission. The APACHE III score consists of several parts including the primary reason for ICU admission, age, sex, race, preexisting comorbidities<sup>9</sup>, and location prior to ICU admission. The range of APACHE III score is from 0 to 299 points.

### *Statistical analysis*

Data were analyzed by SPSS 21 software. Continuous variables were expressed as mean  $\pm$  standard deviation and categorical ones were expressed in frequencies and percentages.

Chi square and Fisher exact test were used to compare categorical measures and student's *t*-test was used to compare means.  $P > 0.05$  was considered as statistically non-significant.

### *Results*

Study group consisted of 84 multiple trauma patients; 68 of them were male (80.95%) and 16 (19.05%) were female. Mean age was  $42.39 \pm 14.60$  years (range: 17-69 years). The most common cause of trauma was traffic accidents involving: pedestrian-car accidents (25.50%), car-car accidents (41.76%), motorcycle-car accidents (12.32%), Car rollover (2.40%), pedestrian- motorcycle accidents (3.21%) and motor rollover (2.06%). The others were falling down (6.44%) and other various reasons (2.67%). Outcome: 30 (35.72%) died. For both APACHE II and APACHE III predicted death rates significantly correlated with observed death rates ( $p < 0.0001$ ). The mean age of dead patients was  $42.24 \pm 12.07$  years compared to  $39.03 \pm 15.76$  years for those who survived ( $p = 0.4$ ).

**Table 1. APACHE II and APACHE III score on admission according to other effects and scores**

Efect	Value	F	Hyp df	Er df	p	Strength of analysis
<b>Constant</b>	,579	50,115	2,000	73,000	,000	1,000
<b>Ethiology of injury</b>	,125	5,227	2,000	73,000	,008	,817
<b>SIRS on admission</b>	,271	2,902	8,000	148,000	,005	,943
<b>outcome</b>	,105	4,271	2,000	73,000	,018	,729
<b>ISS</b>	,219	10,251	2,000	73,000	,000	,984
<b>TS</b>	,394	23,760	2,000	73,000	,000	1,000
Alpha level = ,05						

Kind of injuries highly correlate with APACHE III, but not with APACHE II score.

SIRS score on admission highly correlate with APACHE III, but not with APACHE II score.

Outcome is highly correlated with APACHE II on admission, but not with APACHE III.

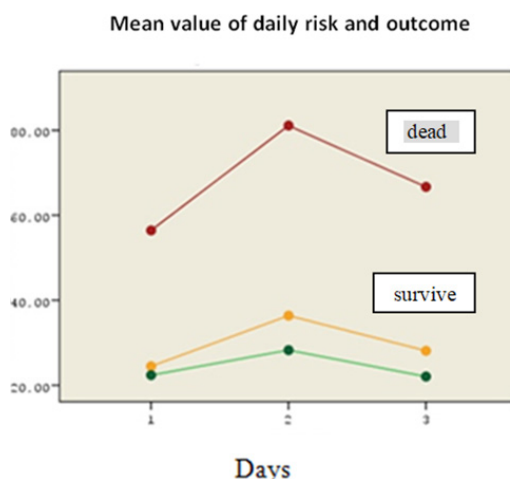
ISS i TS highly correlate both with APACHE II and APACHE III score.

**Tabela 34. Confidence interval for APACHE III scor according outcome (survived)**

Observed data	Model			
	Outcome		% Confidence	
	Dead	Survived	Dead	
Outcome	Dead	27	3	90,0
	Survived	5	49	90,7
<b>Overall %</b>				90,5
Benchmark 0,50				

By this model, it was presented that failure in predicting outcome is less than 10%, based on prediction according SIRS on admission and APACHE III score.

**Figure I. Daily risk (calculated by APACHE III equation) and outcome**



Mean daily risk values are significant different between survived and dead patients

## ***Discussion***

When we investigated the use of APACHE III scores on the first and subsequent days to estimate mortality risk over time for individual patients, we learned that the use of initial, third and latest-day scores achieved maximum power regarding outcome<sup>4,5</sup>.

To evaluate outcome for a multidagnostic group of ICU patients, the APACHE III score must be used in combination with an APACHE III disease classification and patient location weighting.

Intensive care units could compare their mortality experience with this reference data base by using a patient-by-patient measurement of risk in order to compare the predicted mortality rate with the actual mortality rate. The difference between predicted and actual death rates is one measure of quality of care<sup>9</sup>. This technique has proved useful in a variety of studies comparing the mortality experience of ICUs and investigating the incremental impact of specific treatment and of structural, process, or organizational changes on patient outcome. Comparisons among units in different hospitals may have to account for these variations in patient selection and discharge practices<sup>10</sup>.

Prognostic efforts will never be able to predict outcome with 100 percent specificity. All trauma surgeons and anaesthesiologists, however, uses past experience to guide future decisions.

The APACHE III score can be used alone only within homogeneous disease categories and then for severity stratification, not risk prediction<sup>11</sup>.

According to our study, APACHE III outcome predictions (90% of confidence) compare favorably with those of physician judgment and can be use to predict outcome of patients with severe multiple injuries.

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