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# PREDICTION SCORES AND COMPLEXITY OF PHYSICAL THERAPY APPROACH IN THE INTENSIVE CARE UNIT OF THE CLINICAL EMERGENCY HOSPITAL BUCHAREST

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**Abstract.** Evaluation scores of critically ill patients began to develop in the '70s, in an attempt to create a real model to allow the quantification of disease severity, outcomes, prognosis and mortality rate of hospitalized patients in ICU. Over time many such scores were developed, some of them have lost practical value, being no longer in use, others are important tools in assessing critically ill patients.
There are basically four areas of application of these scores: research and clinical trials - for this purpose, scores serve as common, standardized tools of patient comparison, as a common language for researchers and clinicians, who may thus decide how the results of clinical research can influence their daily practice; administrative field - refers to the capital allocation depending on the disease severity, to cost-effectiveness analysis; performance assessment field: comparative performance assessment of ICU from year to year is important, as well as, individual performance assessment; assessment of individual prognosis and treatment protocols or decisions. There are four known validated prediction scores: APACHE (Acute Physiology and Chronic Health Evaluation), SAPS (Simplified Acute Physiology Score), MPM (Mortality Prediction Model) and SOFA (Sequential Organ Failure Assessment) score. A prediction score (severity score) represents a numerical value, composed of a variety of clinical parameters, quantifying the severity of the disease. This can be introduced into a mathematical equation, the result reflecting the probability of clinical course, usually the mortality rate. There is an obvious correlation between the severity of the prediction score, length of ICU stay and the complexity of physical therapy. This study aims to demonstrate the importance of starting prompt physical therapy in critically ill patients with high severity scores, significantly influencing individual recovery and prognosis.
**Keywords:** prediction scores, intensive care, physical therapy

## Introduction

Evaluation systems of critically ill patients began to develop in the 70s, in an attempt to create a real model to allow the quantification of disease severity, development opportunities, prognosis and mortality rate of hospitalized patients in ICU. Over time, many such systems were developed, some of them have lost practical value, being no longer in use, others are important tools in assessing critical patient.

There are basically four areas of application of these systems:

- research and clinical trials: for this purpose scores serve as common, standardized tools for patient comparison, as a common language for researchers and clinicians, who may thus decide how the results of clinical research can influence their daily practice.Thus, only evaluation systems that are approved and published in specialized literature should be used.
- administrative field refers to the capital allocation depending on the severity of disease, to the possibility of evaluation of these administrative decisions, to the cost-effectiveness analysis.
- performance assessment field: comparative performance assessment of ICU is important each and every year, as well as, individual performance assessment.
- individual prognosis assessment field and treatment protocols or decisions.

There are known four validated prediction scores: APACHE (Acute Physiology and Chronic Health Evaluation), SAPS (Simplified Acute Physiology

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Score), MPM (Mortality Prediction Model) and SOFA (Sequential Organ Failure Assessment) score.

A prediction score (severity score) represents a numerical value, formed from a variety of clinical parameters, quantifying the severity of the disease. It can be included in a mathematical equation whose result reflects the probability of clinical evolution, usually the mortality rate.

The relation between the severity score and the evolution is empirically determined from many databases. Prediction scores from ICU cannot be used for patients outside the ICU.

There are two major principles to consider in the evaluation of a prediction score. First, an instrument should measure an important result. Most of the ICU scores quantify intra-hospital mortality, while others measure long term mortality and functional status. Second, an instrument should be easy to use because data gathering from critically ill patients might be time-consuming and expensive.

The accuracy of risk scores in predicting mortality and calibration are the characteristics used in the evaluation of a prediction system:

The accuracy of the score in predicting mortality describes the precision of a certain prediction. For instance, if an evaluation system predicts 70% mortality, the accuracy of the score in predicting mortality is perfect if the noticed mortality is 70%.

Calibration describes the way in which the instrument functions on a large scale of predicted mortalities. Using the above example, a prediction instrument would be extremely well calibrated if it had the same accuracy for 90%, 50% and 20% mortality.

## ICU scores

Widespread in the USA[1], the APACHE score is frequently used in the Intensive Care Unit of the Clinical Emergency Hospital Bucharest. Practically, it is the first risk score with an adapted pattern for the critically ill patient, whatever his/her specific diagnosis. It was published in 1981 by Knaus et al, allowing patient classification by intra-hospital mortality risk. Its most recent version is APACHE IV.

The APACHE score requires the introduction of clinical variables which then generate a severity score. The resulting severity score is integrated into a regression equation which leads to a mortality prediction. The required variables are different depending on the version, but the generally used parameters are: age, diagnosis, previous treatment and a certain number of acute and chronic physiologic variables. The APACHE

**APACHE II (physiological variables) (A)**

| Physiological variables | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|
| **Rectal T°C** | ≥41 | 39-40.9 | | 38.5-38.9 | 36-38.4 | 34-35.9 | 32-33.9 | 30-31.9 | ≤29.9 |
| **Mean Arterial Pressure (mmHg)** | ≥160 | 130-159 | 110-129 | | 70-109 | | 50-69 | | ≤49 |
| **Pulse (beats/min)** | ≥180 | 140-179 | 110-139 | | 70-109 | | 55-69 | 40-54 | ≤39 |
| **Respiratory Rate (breaths/min)** | ≥50 | 35-49 | | 25-34 | 12-24 | 10-11 | 6-9 | | ≤5 |
| **PaO2* (mmHg)** | ≥500 | 350-499 | 200-349 | | <200 | | | | |
| **AaDO2** (mmHg)** | | | | | >70 | 61-70 | | 55-60 | <55 |
| **Arterial pH** | ≥7.7 | 7.6-7.69 | | 7.5-7.59 | 7.33-7.49 | | 7.25-7.32 | 7.15-7.24 | <7.15 |
| **Serum Na+ (mmol/l)** | ≥180 | 160-179 | 155-159 | 150-154 | 130-149 | | 120-129 | 111-119 | ≤110 |
| **Serum K+ (mmol/l)** | ≥7 | 6-6.9 | | 5.5-5.9 | 3.5-5.4 | 3-3.4 | 2.5-2.9 | | <2.5 |
| **Serum Creatinine (micromol/l)** | ≥3.5 | 2-3.4 | 1.5-1.9 | | 0.6-1.4 | | <0.6 | | |
| **Haematocrit (%)** | ≥60 | | 50-59.9 | 46-49.9 | 30-45.9 | | 20-29.9 | | <20 |
| **White Blood Count (x109/l)** | ≥40 | | 20-39.9 | 15-19.9 | 3-14.9 | | 1-2.9 | | <1 |
| **GCS** | Score = 15 – actual GCS | | | | | | | | |
| **Serum HCO3 (mmol/l)** | ≥52 | 41-51.9 | | 32-40.9 | 22-31.9 | | 18-21.9 | 15-17.9 | <15 |

**Table I.** A = Total physiological variables score points; * If FiO2≥50% record AaDO2; ** If FiO2<50% record PaO2; B = Age points

score uses the most distant values compared to normal that are registered in the first 24 hours after admission to the ICU.

Exactly like in most prediction models, APACHE requires periodic retesting, review and update because its accuracy diminishes as treatments and other factors influence mortality.

Most frequently mentioned are APACHE II and III, though APACHE IV was also validated.

In the case of APACHE I there are 34 physiological parameters taken into account, each one of them being evaluated from 0 to 4 points, according to the degree of deviation from normal, one way or the other. The addition result represents the acute physiologic score, based on which there are four categories of patients, from A to D, according to the death risk.

A very important progress brought by the introduction of this score was the improvement of possibilities to demonstrate the efficiency of newer therapies, based on non-randomized studies, allowing patient stratification in groups of different disease severity levels and comparing these two groups.

Practically, this score isn't used anymore, being replaced with a new version developed by the same authors and published in 1985 as APACHE II

APACHE II score has three components: acute physiologic score (A), age score (B), chronic condition evaluation score (C) [2].

The acute physiology score has 12 physiological parameters, each one of them having 4 levels of deviation from normal, either increasing or decreasing being evaluated from 0 to 4; the sum represents the acute physiology score.

The variables used to calculate the APACHE II severity score are mentioned in the table 1. Though the APACHE II severity score is based on the worst values of variables during the first 24 hours following the ICU admission, it seems like an acceptable alternative[3]. APACHE II is not perfect. The progress cannot be correctly anticipated for certain specific subgroups (for example liver failure, sepsis), because a discrepancy in mortality prediction for patients in ICU that are transfered in the outpatient department has been noted[4,5].

If the patient is known to have multiple organ dysfunction or immune suppression, record as follows :

Non-surgical patients or surgical postoperative emergency status – 5 points.

Elective postoperative patients -2 points.

APACHE II = A + B + C [6]

APACHE II score results from adding the points from each section: acute physiology score, age points and chronic health points, global score being from 0 to 67 points [2].

The score is calculated in the first 24 hours from admission in the ICU and evaluated in evolution through periodical calculation.

The APACHE II Score database was of 5030 patients admitted to 13 units of Intensive Care over a three year duration. A correlation between the mortality rate, ICU length of stay and the APACHE score was demonstrated[2].

| **Points** | 0 | 2 | 3 | 5 | 6 |
|---|---|---|---|---|---|
| **Age** | ≤44 years | 45-54 | 55-64 | 65-74 | ≥75 |

**Table II.** C = Chronic Condition points

**Physical therapy for the critically ill patient in the ICU**

ICU patient recovery treatment covers respectively:

- Patient's regular position changes from one side to another to prevent pressure/bed-sores and subsequent ulcers.
- Respiratory physical therapy to prevent respiratory complications.
- Physical therapy for maintaining muscular flexibility and joint mobility.
- Physical therapy for stimulating the nervous tissue unaltered by disease and to facilitate its overtaking of the functions of altered brain structures.
- Patient's cognitive stimulation (close friends' visits, music, image panels that would help integrate him/her into the environment, make him/her aware of the day, the hour and the place he lives in, personal data, family photos).

**Objectives of physical therapy:**

- Prevention and treatment of respiratory complications
- Spasticity prophylaxis or treatment
- Prophylaxis or treatment of joint aches, ankylosis
- Maintenance of optimal arterial, venous and lymphatic circulation
- Preventing bed-sores
- Stimulation of the nervous tissue in cortical areas unaltered by disease and facilitating its overtaking of the functions of altered brain structures.

**Techniques for reaching these objectives:**

- Neuro-proprioceptive facilitation techniques: Kabath technique, Bobath
- Sensorial stimulation techniques
- Passive, slow, superior and inferior limb mobilization in bed
- Patient mobilization in sitting or standing position

**Respiratory physiotherapy consists of:**

- Postural drainage - patient positioning is based on pulmonary injury, thus providing an optimal ventilation of the area and bronchial secretions drainage (if needed)
- Thoracic manual techniques of percussion and vibration during postural drainage
- Increase in tidal volume using manual thoracic compressions
- Abdominal breathing stimulation techniques
- Cough stimulation maneuvers

- Subcutaneous soft tissue light thoracic massage (it reduces local edema, restores normal rib breathing mobility).

**Results of physical therapy correlated with icu scores**

In our ICU units a protocol of early initiation of physical therapy has been instituted, with adjustments being made for disease characteristics and severity.

The moment of physical therapy initiation is important: patients with similar APACHE scores at ICU admission in our hospital had better outcomes, and shorter ICU stay if physical therapy was initiated early.

Patients who did not benefit from physical therapy at the same time as disease specific intensive care had a higher mortality.

## Conclusions

There is an obvious correlation between prediction score severity, ICU and hospital length of stay and the complexity of physical therapy.

Early physical therapy is essential for patients with high severity scores, thus significantly influencing recovery and individual prognostic.

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