



## ORIGINAL

# Predictive scoring systems in multiorgan failure: A cohort study<sup>☆</sup>



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### KEYWORDS

Predictive scoring systems;  
Hospital mortality;  
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Multi-organ failure;  
APACHE;  
SAPS;  
MPM

### Abstract

**Objective:** An evaluation is made of the hospital mortality predicting capacity of the main predictive scoring systems.

**Design:** A 2-year retrospective cohort study was carried out.

**Setting:** A third level ICU with surgical and medical patients.

**Patients:** All patients with multiorgan failure during the first day in the ICU.

**Main variables:** APACHE II and IV, SAPS II and III, MPM II and hospital mortality.

**Results:** A total of 568 patients were included. Mortality rate: 39.8% (226 patients). Discrimination (area under the ROC curve; 95% CI): APACHE IV (0.805; 0.751–0.858), SAPS II (0.755; 0.697–0.814), MPM II (0.748; 0.688–0.809), SAPS III (0.737; 0.675–0.799) and APACHE II (0.699; 0.633–0.765). MPM II showed the best calibration, followed by SAPS III. APACHE II, SAPS II and APACHE IV showed very poor calibration. Standard mortality ratio (95% CI): APACHE IV 1.9 (1.78–2.02); APACHE II 1.1 (1.07–1.13); SAPS III 1.1 (1.06–1.14); SAPS II 1.03 (1.01–1.05); MPM 0.9 (0.86–0.94).

**Conclusions:** APACHE IV showed the best discrimination, with poor calibration. MPM II showed good discrimination and the best calibration. SAPS II, in turn, showed the second best discrimination, with poor calibration. The APACHE II calibration and discrimination values currently disadvised its use. SAPS III showed good calibration with modest discrimination. Future studies at regional or national level and in certain critically ill populations are needed.

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**PALABRAS CLAVE**

Escalas pronósticas;  
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APACHE;  
SAPS;  
MPM

**Escalas pronósticas en la disfunción multiorgánica: estudio de cohortes****Resumen**

*Objetivo:* Valorar el grado en que las escalas pronósticas son capaces de predecir la mortalidad hospitalaria.

*Diseño:* Estudio de cohortes retrospectivo de 2 años.

*Ámbito:* UCI médico-quirúrgica de un hospital de tercer nivel.

*Pacientes:* Todos los pacientes con síndrome de disfunción multiorgánica en el primer día de ingreso.

*Variables de interés:* APACHE II y IV, SAPS II y III, MPM II y muerte hospitalaria.

*Resultados:* Se incluyeron 568 pacientes. Mortalidad hospitalaria: 39,8% (226 pacientes). Discriminación (área bajo la curva; IC 95%): APACHE IV (0,805; 0,751-0,858), SAPS II (0,755; 0,697-0,814), MPM II (0,748; 0,688-0,809), SAPS III (0,737; 0,675-0,799) y APACHE II (0,699; 0,633-0,765). El MPM II es el que mejor calibra, seguido por el SAPS III. APACHE II, SAPS II y APACHE IV presentan una muy mala calibración. Razón estandarizada de mortalidad (IC 95%): APACHE IV 1,9 (1,78-2,02); APACHE II 1,1 (1,07-1,13); SAPS III 1,1 (1,06-1,14); SAPS II 1,03 (1,01-1,05); MPM 0,9 (0,86-0,94).

*Conclusiones:* APACHE IV tiene la mejor capacidad discriminativa y mala calibración. MPM II tiene una buena discriminación y la mejor calibración. En cuanto al SAPS II, mantiene la segunda mejor discriminación y una mala calibración. El APACHE II muestra unos valores de calibración y discriminación que desaconsejarían su utilización en la actualidad, y el SAPS III mantiene una adecuada calibración y una discriminación moderada. La valoración de estos resultados podría marcar el inicio de nuevos estudios a nivel regional/nacional en determinadas poblaciones de pacientes críticos.

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**Introduction**

Improvement in the quality of critical care requires quantitative assessment of the structure used, the care process, and patient evolution.<sup>1</sup> In this regard, patient evolution is clearly determined by the initial severity of the disease condition. Measuring severity is a constant concern in the critically ill patient, and offers a range of benefits.<sup>2</sup> In effect, the measurement of severity helps establish a prognosis, fundamentally in terms of patient mortality. Furthermore, it allows us to know the profile of our patients, and has an impact upon the management of the material and human resources used. Prognostic assessment, by allowing the adjustment of actual mortality to predicted mortality, affords a care quality indicator that facilitates comparison with other institutions (benchmarking).<sup>1</sup> Lastly, the measurement of severity plays an important role in facilitating the investigation of outcomes, by ensuring the comparison of patients that exhibit similar severity factors. In this respect, severity scales have been designed with a view to standardizing the measurement of severity.

Three large groups of severity scales with different versions are predominantly used<sup>3</sup>: the Acute Physiology and Chronic Health Evaluation (APACHE), the Simplified Acute Physiology Score (SAPS), and the Mortality Prediction Models (MPM). Based on a logit function, these scales transform their scores into in-hospital mortality probability values, grouping the patients in terms of the probability of death. Such predictive scoring systems have been developed from the analysis of large cohorts of patients with different

medical–surgical diseases.<sup>4</sup> Their main limitations are a lack of individual predictive capacity, their use in patient populations not included in the studies from which the scales were originally developed, or their application to groups of patients with concrete diseases.<sup>5</sup>

Although many factors are related to mortality (age, comorbidity, diagnosis upon admission to the Intensive Care Unit [ICU], etc.), the severity of the physiological anomalies are its fundamental conditioning parameter.<sup>6</sup> In the critical patient, these anomalies find their maximum expression in multiple organ dysfunction syndrome (MODS). Patients with MODS present a high mortality rate that is correlated to the number of affected organs.<sup>7</sup> Although these individuals form part of the population of patients from which the severity scales were developed (accounting for about one-third of the total patients in a third-level ICU), we have found no previous studies exclusively based on subjects of this kind.<sup>4</sup>

The present study was carried out to determine the degree to which the currently most widely used predictive scoring systems are able to predict real mortality in the ICU among patients who develop MODS in the first 24 h of admission.

**Patients and methods**

A retrospective cohort study was made in the ICU of Hospital Virgen de la Salud (Toledo, Spain), consecutively analyzing the case histories of medical–surgical patients with MODS over a period of two years. The patients were required to

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