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# Basal functional status predicts functional recovery in critically ill patients with multiple-organ failure☆,☆☆

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ABSTRACT

*Purpose:* We aimed to investigate the effect of baseline demographic, clinical, and functional characteristics of intensive care unit (ICU) patients with multiple-organ failure (MOF) on their functional recovery at 6 and 12 months posthospitalization.

*Materials and methods:* A total of 545 consecutively admitted adult patients with MOF during on admission were included in the study. Patients' functional status was prospectively assessed and compared with the baseline status and at 6 and 12 months postdischarge, using the Modified Rankin Scale and the Glasgow Outcome Scale Extended. Severity of disease on admission was assessed using the Acute Physiology and Chronic Health Evaluation II and the Simplified Acute Physiology Score II.

*Results:* A total of 266 patients were followed up. Functional status among MOF survivors improved between the 6th and 12th month postdischarge from the ICU. Higher functional status before admission, lower severity scores on admission, and younger age positively affected the improvement in functional status after ICU discharge.

*Conclusions:* The level of functional status befre ICU admission should be considered not only in research studies looking a long-term outcomes from ICU but also in the clinical care planning of critically ill patients during and after their ICU admission.



## 1. Introduction

In the intensive care unit (ICU), multiple-organ failure (MOF) can be defined as the dysfunction of 2 or more organ systems defined by the Sequential Organ Failure Assessment (SOFA) criteria. Multiple-organ failure is among the leading causes of prolonged hospitalization and death in ICU [1,2]. When they survive, MOF patients' functional status is considerably diminished, and they have numerous residual physical and neuropsychological symptoms [3]. Their recovery and rehabilitation are usually a long-drawn-out process, and it can take more than 2 years until they regain previous levels of health and functional status [4]. It has been found that 2 to 7 years posttrauma, patients with MOF are 4 times more likely to require assistance in their activities of daily living than patients who did not have MOF [4]. All these consequences usually have a high impact not only on patients' quality of life but also the lives of their families, who often have to adopt significant lifestyle changes to be able to attend the postdischarge needs of patients. A better understanding of patients' prefunctional status before ICU admission and how this can affect the long-term outcome is essential. This will allow achievement of optimal criteria for admission in ICU as well as the development of high-quality long-term follow-up programs for ICU survivors. In turn, this would be of great benefit not only for patients but also for their relatives and/or carers and ICU professionals [5,6].

The present study aimed to explore the associations between baseline demographic, clinical, and functional characteristics of ICU nonpolytrauma and nonneurocritical adult patients who had MOF

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during the first 24 hours of admission and their functional recovery 6 and 12 months posthospitalization.

## 2. Methods

A prospective cohort study was carried out in a 26-bed case mix, closed adult ICU of a public hospital in Toledo (Spain).

### 2.1. Sample

The study included all 545 eligible patients admitted consecutively to the ICU between January 2011 and September 2012. Inclusion criteria included all of the following: 16 years and older and diagnosed with MOF during the first 24 hours after admission. Each organ system was evaluated on admission using the most abnormal data and given a score from 0 (normal function) to 4 (most abnormal) according to the original definitions. *Severe organ failure* was defined as a SOFA score greater than or equal to 3 in any organ system. *Multiple-organ failure* was defined as the occurrence of severe organ failure in 2 or more organ systems during the ICU. Exclusion criteria included admissions for neurocritical disease or admissions for polytrauma, defined as the syndrome of multiple injuries with a pathophysiology of polytrauma with an injury severity score of 16 or higher [7]. These patients were excluded due to 2 main reasons. First, both the development and progress of the MOF are considerably different from those in the rest of the medical and surgical groups of critically ill patients. Second, the brain injury suffered by the excluded patients is often associated with mobility dysfunction, which would have required a different approach in the assessment of functional status [8-10]. The time lapse between ICU discharge and readmission was recorded, where applicable, and the information from the first ICU admission included in this study was the data considered as baseline data.

### 2.2. Data collection

On admission, the patient's baseline functional status was assessed by the admitting specialist using the Modified Rankin Scale (MRS). Recent evidence points to a decline in functional status well before ICU admission [11]. For this reason, baseline functional status was determined by the patient him/herself or by the next of kin when the patient was unable to answer, based upon function before the start of the pathologic process resulting in admission [12]. The severity scores at admission, assessed with the Acute Physiology and Chronic Health Evaluation II (APACHE II) and the Simplified Acute Physiology Score II (SAPS-II), were also collected.

A series of 2 follow-up structured telephone interviews with each participant were conducted by one of the investigators (SRV), 6 and over 12 months post–hospital discharge. When talking to the patient impracticable, the interview was carried out with a relative in the presence of the patient [4]. For the assessment of the patient's functional status posthospitalization, the MRS and the Extended Glasgow Outcome Scale (GOS-E) were used. The interviewer rescored 30% of the interviews, and there was negligible intraobserver variation.

### 2.3. Instruments

Acute Physiology and Chronic Health Evaluation II and SAPS-II scores are severity scoring systems comprising a score and a probability of mortality prediction model calculated with logistic regression. In both cases, the higher the score, the more severe the disease and the higher the risk of death are. Acute Physiology and Chronic Health Evaluation II score ranges from 0 to 71 points and is based upon values of 12 routinely collected physiologic measurements during the first 24 hours of admission, age, and previous health status of the patient. Simplified Acute Physiology Score II score ranges from 0 to 163 points and is based on the worst values of 12 physiological variables during the first 24 hours of admission (0-116 points), age (0-17 points), and type of admission and 3 disease-related variables (0-30 points) [13].

The MRS is a 7-level scale measuring the level of independence and disability. Scores range from 0 to 6, where 0 means “no symptoms at all”; 1, “no significant disability despite symptoms”; 2, “slight disability”; 3, “moderate disability”; 4, “moderately severe disability”; 5, “severe disability”; and 6, “death.” The GOS-E is an 8-level scale designed to measure level of functional recovery. Scores range from 1 to 8, with the following meanings: 1, “death”; 2, “vegetative state”; 3, “lower severe disability”; 4, “upper severe disability”; 5, “lower moderate disability”; 6, “upper moderate disability”; 7, “lower good recovery”; and 8, “upper good recovery” [14].

### 2.4. Variables

The variables of interest, describing functional status, were the MRS and GOS-E score values after admission. In the inferential analyses, the scales' scores were divided into 2 a priori defined groupings, representing what the authors considered “good functional status” (MRS 0-2 and GOS-E 6-8) or “poor functional status” (MRS 3-5 and GOS-E 2-5). Scores meaning death (MRS 6 and GOS-E 1) were excluded from these analyses.

The baseline functional status (MRS) before admission and the level of severity on admission (APACHE II and SAPS-II) were considered independent variables affecting the level of functional recovery posthospitalization. Relevant a priori confounders were considered in the analyses, including age, sex, readmission, primary reason for admission, and length of stay in ICU and hospital, among others.

### 2.5. Statistical analysis

Descriptive statistics were used to describe each of the variables of the study, including demographic and clinical data, patients' baseline severity level, and baseline functional status as well as their functional status posthospital discharge. Categorically grouped data were expressed as percentages. Continuous variables were summarized with their mean and SD or minimum-maximum ranges and medians and interquartile ranges, depending on their distribution. The $\chi^2$ test and Fisher exact test (where appropriate) were used to compare categorical data. Continuous variables were compared using the Student *t* test or nonparametric Mann-Whitney *U* test (where appropriate).

Logistic regression was used when investigating the factors possibly related to poor functional status at 6 and 12 months. Variables showing significant associations in the bivariate analyses were then used in the multivariate logistic regression analyses.

All data were processed and analyzed using Microsoft Excel 2000 (Microsoft, Redmond, WA) and SPSS 15.0 for Windows (SPSS, Chicago, IL).

### 2.6. Ethical considerations

The study was approved by the regional ethical committee. Oral informed consent was sought from patients or patients' next of kin (when patients were unable to consent) on admission and before conducting the follow-up interviews.

## 3. Results

### 3.1. Sample

The participant flow chart from the eligible patients to the final sample at 6- and 12-month follow-ups is shown in Fig. 1. Of 545 eligible patients, 228 (42%) and 215 (39%) survived 6 and 12 months after hospital discharge, respectively. The baseline characteristics are described in Table 1.

Sixty-one patients (18.7% of hospital survivors) were lost to follow-up due to patients not being able to be contacted.