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Standardised mortality ratio based on the sum of age and percentage total body surface area burned is an adequate quality indicator in burn care: An exploratory review

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ABSTRACT

Standardised Mortality Ratio (SMR) based on generic mortality predicting models is an established quality indicator in critical care. Burn-specific mortality models are preferred for the comparison among patients with burns as their predictive value is better. The aim was to assess whether the sum of age (years) and percentage total body surface area burned (which constitutes the Baux score) is acceptable in comparison to other more complex models, and to find out if data collected from a separate burn centre are sufficient for SMR based quality assessment.

The predictive value of nine burn-specific models was tested by comparing values from the area under the receiver-operating characteristic curve (AUC) and a non-inferiority analysis using 1% as the limit (delta). SMR was analysed by comparing data from seven reference sources, including the North American National Burn Repository (NBR), with the observed mortality (years 1993–2012, $n = 1613$, 80 deaths). The AUC values ranged between 0.934 and 0.976. The AUC 0.970 (95% CI 0.96–0.98) for the Baux score was non-inferior to the other models. SMR was 0.52 (95% CI 0.28–0.88) for the most recent five-year period compared with NBR based data.

The analysis suggests that SMR based on the Baux score is eligible as an indicator of quality for setting standards of mortality in burn care. More advanced modelling only marginally improves the predictive value. The SMR can detect mortality differences in data from a single centre.

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1. Introduction

Mortality is still one of the most important outcome measures in burn care [1–10] although other measures are now in use [11,12] because improvements in the quality of care mean that less people die [13–15]. To compare mortality with previously-reported results is, however, difficult, as differences in case mix cannot be adjusted for by just analysing frequency and mean values [16]. A number of models that predict mortality and adjust for case mix after burns have therefore been presented over the years [3,7,14,17–83], but there is still no consensus as to which one is the gold standard [84].

The difference between the expected and observed mortality can be an indicator of quality if the model that is predicting mortality has a high predictive value, and if there is a large reference group available including values over all admissions, which are regularly updated [85]. The volume and the periodicity of the North American National Burn Repository (NBR) [86] makes it applicable as a reference group [5,16,44].

The standardised mortality ratio (SMR) based on generic models that predict mortality is a valid method of assessing mortality in general intensive care [87]. The predictive value of these models has not, however, been fully tested on patients with burns, and the few studies that have assessed the Acute Physiology and Chronic Health Evaluation (APACHE) have not shown specifically that it predicts mortality significantly better than the combination of age and extent of injury [56,60,68,69]. The predictive power of generic scales among general intensive care patients is also usually lower [88,89] than the predictive power of burn-specific scales [17,19]. Variations in outcome assessment registered may be due to differences in the variables that are included in the models, and how many patients that are excluded from the mortality predictions [90].

The Baux score [2,91] is based on two powerful determinants of burn mortality: age and percentage total body surface area burned (TBSA%) [2,14,17–19,33,36,70,71,92,93], which are easily recorded with minimal diagnostic ambiguity. Although the initial expected percentage for mortality is outdated [2], the sum of the Baux score (age and percentage total body surface area burned) can be used for assessing mortality by the SMR.

Prognostic scoring systems in burns have recently been extensively reviewed [84]. However, and importantly for this study, no comparative evaluation was made of the corresponding outcomes of these different scoring systems on a specific group of patients. It therefore served as an excellent base and a source of inspiration for the present work.

Our aim was to evaluate the predictive value of the sum of age and TBSA% (the Baux score as it is used in the present study), compared with a selection of other more advanced models for the prediction of mortality after burns, and to find out whether data from a five-year period [3] from a single burn centre is enough to obtain significant differences in SMR. We also wanted to discuss in depth the value of the variables included in the different models. The study was approved by the Regional Ethics Review Board in Linköping.

2. Methods

2.1. Selection and care of patients

All patients admitted with burns during a 20-year period (1993–2012) were included. The patients were treated at the Burn centre during the burn care period, including patients who were admitted for comfort care, and those who survived were discharged home or to a rehabilitation facility. Patients who died after the care period at the burn centre were not classified as deaths. TBSA% and percentage full thickness burn (FTB%) were recorded on admission by a detailed Lund & Browder chart, as well as age, gender, and whether they received mechanical ventilation; these data were collected prospectively but analysed retrospectively. Patients were treated according to our usual protocol, which has previously been described [94].

2.2. Search

We searched PubMed (from October 2013 until October 2014) for papers that presented analyses of mortality among patients with burns of all ages. The terms burn, mortality, death, model, and prediction were used in various combinations. Fig. 1 shows the selection and exclusion of papers. Papers that described combined variables and weighted models with data of expected mortality were included.

Table 1 shows an outline of how the two levels of mortality models were used.

Comparison of the predictive value: Models were excluded that contained variables not easily available on a general dataset of burns and variables susceptible to ambiguity of definition or diagnosis. The following variables, with rather unambiguous definitions, were found to be generally available as they have been frequently used in a multitude of previous reports from different burn centres: age, TBSA%, percent deep burns, gender, mechanical ventilation or inhalation injury, and mortality (Supplementary Table S1, in Supplementary file 1). A final selection was made by two of the authors to exclude models that were virtually the same as others and the final decision was taken by consensus (Table S2, Supplementary file 1).

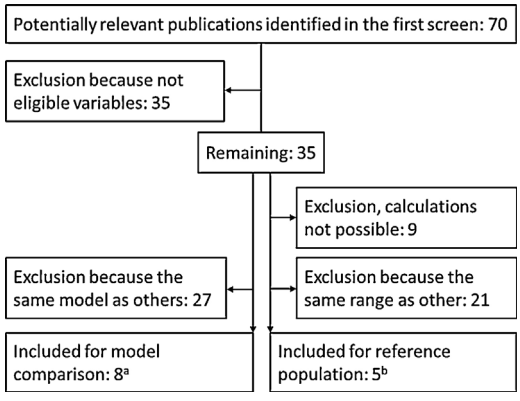

Fig. 1 – Flowchart showing the selection and exclusion of papers according to the dual aim. [a] Eight papers, 9 models. [b] Five papers. The 6th reference group is the annual NBR report.