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Review

Mortality prediction models in the general trauma population: A systematic review

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ABSTRACT

Background: Trauma is the leading cause of death in individuals younger than 40 years. There are many different models for predicting patient outcome following trauma. To our knowledge, no comprehensive review has been performed on prognostic models for the general trauma population. Therefore, this review aimed to describe (1) existing mortality prediction models for the general trauma population, (2) the methodological quality and (3) which variables are most relevant for the model prediction of mortality in the general trauma population.

Methods: An online search was conducted in June 2015 using Embase, Medline, Web of Science, Cinahl, Cochrane, Google Scholar and PubMed. Relevant English peer-reviewed articles that developed, validated or updated mortality prediction models in a general trauma population were included.

Results: A total of 90 articles were included. The cohort sizes ranged from 100 to 1,115,389 patients, with overall mortality rates that ranged from 0.6% to 35%. The Trauma and Injury Severity Score (TRISS) was the most commonly used model. A total of 258 models were described in the articles, of which only 103 models (40%) were externally validated. Cases with missing values were often excluded and discrimination of the different prediction models ranged widely (AUROC between 0.59 and 0.98). The predictors were often included as dichotomized or categorical variables, while continuous variables showed better performance.

Conclusion: Researchers are still searching for a better mortality prediction model in the general trauma population. Models should 1) be developed and/or validated using an adequate sample size with sufficient events per predictor variable, 2) use multiple imputation models to address missing values, 3) use the continuous variant of the predictor if available and 4) incorporate all different types of readily available predictors (i.e., physiological variables, anatomical variables, injury cause/mechanism, and demographic variables). Furthermore, while mortality rates are decreasing, it is important to develop models that predict physical, cognitive status, or quality of life to measure quality of care.

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Background

Trauma is the leading cause of death in individuals younger than 40 years, resulting in more than 5 million deaths annually [1]. Survival status, which includes in-hospital mortality and 30-day mortality, is a commonly used outcome measure for evaluating the quality of trauma care. Outcome measurement can be performed using a comparison between observed and expected mortality rates. Expected mortality is measured by prediction modelling. However, it is meaningless to compare crude mortality rates without an adjustment for the differences in patient populations since outcome is largely dependent on patient characteristics, such as injury severity [2]. The heterogeneity of the trauma population makes it difficult to apply one accurate model for both minor and major injuries while also being applicable to all age groups.

Many different models were developed in previous decades to predict mortality or survival in trauma patients [3–6]. A frequently used and cited model is the Trauma and Injury Severity Score (TRISS) [3]. This prediction model is based on age, anatomical (Injury Severity Score [ISS]) and physiological (coded Revised Trauma Score [RTS]) variables and uses different coefficients for blunt and penetrating injuries. The ISS incorporates the sum of all squared Abbreviated Injury Scale (AIS) values of the three most severely injured areas. The coded RTS is the weighted sum of the Glasgow Coma Scale (GCS), the systolic blood pressure (SBP) and the respiratory rate (RR). The weights for the variables in the TRISS are derived from data based on trauma populations. Newly developed models incorporate other or revised predictors (e.g., comorbidities and different categories for age [4,6] or blood pressure [5]).

Systematic reviews have previously been conducted for prognostic models of trauma [7–11]. However, the reviews focused solely on specific predictive measures and traumatic injuries or excluded widely used models. To our knowledge, no comprehensive review has been performed on all prognostic models or incorporated all relevant predictive measures for both the general and heterogeneous trauma populations.

The aim of this review is to describe (1) the existing mortality prediction models for the general trauma population, (2) the methodological quality and (3) which variables are most relevant for the model prediction of mortality in the general trauma population.

Methods

Search strategies

The databases Embase, Medline, Web of Science, Cinahl, Cochrane, Google Scholar and PubMed were searched for eligible articles in June 2015. With the assistance of a librarian, search strategies were developed using a combination of text words and subheadings that were matched to specific index terms of the database (Supplemental File 1). To identify other potentially relevant articles, references of the included articles were evaluated. Duplicates were removed by the reference management database RefWorks Write-N-Cite 4.2.

Inclusion and exclusion criteria

Articles that developed and/or validated a prediction model in the general clinical trauma population with mortality as an outcome measure were included. In this review, a prediction model was defined as a combination of at least two variables that predicted mortality. The general trauma population referred to all patients admitted to a hospital because of an injury due to an external cause. Last, included articles were required to have been published in scientific peer-reviewed English language journals up to June 2015. The exclusion of patients with low injury severity in the literature was not considered exclusionary criteria in this review because patient groups remained heterogeneous, with a large variety of injuries.

Articles that focused only on mortality within 24 h after injury, those with specific age cohorts, or those with specific anatomical injuries were excluded.

Data screening and extraction

The first review investigator (LM) screened all titles and abstracts and excluded all articles that obviously met exclusionary criteria. After this selection, two reviewers (LM and MJ) independently screened the full text of the remaining manuscripts.

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