Association between trauma severity models and opportunities for improvement: A retrospective cohort study

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Abbreviations

- KUH - Karolinska University Hospital
- OFI - Opportunities for improvement
- TCQD - Trauma Care Quality Database
- TRISS - Trauma and Injury Severity Score
- TSS - Trauma Severity Scores

Introduction

Traumatic injury is one of the leading causes of death worldwide, constituting nearly 8% of global deaths annually (1). The global health burden of physical injury has led to trauma being described as a worldwide pandemic. One of the characteristics of this particular pandemic is its demographic spread; trauma is a leading cause of death for people aged 10-49 years (2) and 90% of trauma-related deaths occur in low- to middle-income countries (1). Nonfatal outcomes also comprise a significant portion of the global health burden of disability (2), which can drastically reduce quality of life and lifespan in survivors of severe trauma. Outcomes in severe trauma are dependent on the quality of care received, and it has been shown in the US that trauma quality improvement programs improve outcomes (3).

Trauma severity scores (TSS) are used in trauma quality improvement programs and research for their usefulness in benchmarking and in comparing trauma severity between patients (4). The existence of these models is necessitated by the heterogeneous nature of trauma, due to the variety in its underlying causes, which affect both the type and severity of the injury. This heterogeneity poses challenges in comparing and evaluating trauma outcomes and has spurred the development of multiple TSS. TSS were initially intended for use in prehospital triage, and therefore were simplistic by design for ease of use (5), but over the years newer and more advanced models have been developed for quality assurance and research purposes. These models differ in their methodology but all have the aim of translating injury severity into quantitative values.

The Trauma and Injury Severity Score (TRISS) is one of the most commonly used models. TRISS is a combination index that incorporates patient age, injury severity by anatomical site, and physiological parameters (6). TRISS estimates the possibility of survival for the given parameters, and can be used by hospitals as a benchmark to compare outcomes against a standardised survival estimate.

Another cornerstone of trauma quality improvement programs worldwide are multidisciplinary morbidity and mortality (M&M) conferences. Management of severe trauma is highly time-sensitive and is also dependent on the actions of a multidisciplinary chain of healthcare providers. Errors in management are a common cause of preventable deaths (7). M&M conferences review selected patient cases and attempt to establish whether there were opportunities for improvement (OFI) in the management of each specific case and to implement corrective actions. OFI function in this manner as a proxy for suboptimal care. The WHO guidelines for trauma quality improvement programmes include specific recommendations on holding regularly scheduled M&M conferences, but also note that M&M conferences are not used to their fullest potential globally (4).

One limitation of M&M conferences is that their value in long-term quality improvement is dependent on

selection of appropriate cases for review. The process by which patient cases are selected for M&M review differs between clinics and one systematic review found that case selection is often non-standardised (8). There is an inherent weakness in relying on healthcare providers to self-report on cases they were involved in. One study in South Africa found that using electronic medical records to automatically generate reports led to a dramatic increase in reporting of morbidity and mortality over a system of self-reporting to M&M conferences (9). In institutions that have implemented more standardised approaches to case selection, factors that indicate case review include deaths, adverse events, and complications (4).

TSS are already used in some clinics to identify cases for peer review (4). However, the extent to which TSS are associated with or can predict opportunities for improvement (OFI) as found in M&M conferences is poorly understood. If it is found that an existing TSS model is associated with OFI, it could allow for another avenue of automatically identifying potentially mismanaged cases in a standardised fashion. This study aims to evaluate how trauma severity models are associated with and to what extent they can predict opportunities for improvement.

Methods

Study design

This is a single-centre retrospective cohort study, using data from two registries at Karolinska University Hospital (KUH): the trauma registry database and the trauma care quality registry. The trauma care quality database (TCQD) is a subset of the trauma registry and contains data on trauma patients who were selected for review at M&M conferences. These two databases will be linked and then analysis will be performed to estimate the association between the common TSS models TRISS, NORMIT, and RISCII, and opportunities for improvement using logistic regression. The predictive performance of these models will be evaluated using measures of discrimination and calibration.

Setting

KUH is located in Stockholm, Sweden. KUH's trauma centre is equivalent to a level 1 trauma centre according to American College of Surgeons standards (10). KUH is the primary trauma centre for the region of Stockholm. In addition, KUH has agreements with several other regions to provide trauma care for patients with severe trauma. KUH is thereby the major trauma centre for a population of almost 3 million people (10).

The trauma registry at KUH contains data on 21,000 patients collected between 2012 and 2021. This registry is also submitted to SweTrau, Sweden's national trauma registry database, and therefore meets SweTrau guidelines. The registered data includes prehospital vital signs and management, vital signs and management on arrival at hospital, information about the type of injury, and the primary method of treatment. Follow-up variables include, but are not limited to, survival at 30 days, days in ventilator, GCS at discharge, highest level of care, and transfers to other units.

The trauma care quality register is an internal hospital register and registers the outcome of each case reviewed M&M conferences.

Participants

Participants include all patients registered in both the trauma registry and the trauma care quality registry at KUH. The trauma registry includes all patients for whom the trauma team was activated after receiving a potentially traumatic injury, regardless of NISS score, and all patients with a NISS score >15, regardless of whether the trauma team was activated. Also included are patients who were transferred to the hospital within 7 days of injury and have a NISS score >15. Patients where the only traumatic injury is a chronic subdural hematoma and patients for whom the trauma team was activated without an underlying traumatic injury are excluded from the register.

The trauma care quality registry contains patients from the trauma registry that were selected for M&M review. At KUH, all fatalities are automatically selected for M&M review. In addition to this, the electronic medical records of all trauma patients are evaluated by research nursing staff to identify cases that potentially received sub-optimal care. Cases that two research nurses have evaluated and found to have potential for sub-optimal care are also selected for M&M review.

Variables

The studied outcome is the binary variable OFI, as identified by the multidisciplinary review board after M&M review. OFI is coded as either "Yes - at least one opportunity for improvement" or "No - no opportunities for improvement." The primary exposures of interest are trauma severity scores according to the TRISS, NORMIT, and RISCII models.

Bias

The method and data analysis model will be written using simulated data to reduce the risk of research bias. Real-world data will only be used once the data analysis model is completed and found to work correctly on simulated data.

Study size

Since all eligible participants must exist in both the trauma registry and the TCQD, and the TCQD is a subset of the trauma registry, the number of participants is limited to the number of cases registered in the TCQD. The TCQD includes around 2200 patients who were selected for review between 2014 and 2021.

Quantitative variables

The exposure variables are predicted survival as given by the studied trauma models. These variables are continuous. The outcome variable, OFI, is a binary variable.

Statistical methods

R, a programming language for statistical computing, will be used for compilation and analysis of data. Conversion and handling of variables will be carried out according to the SweTrau manual. Results will be presented with a confidence interval of 95%. P-values <0.05 will be considered significant.

Ethical considerations

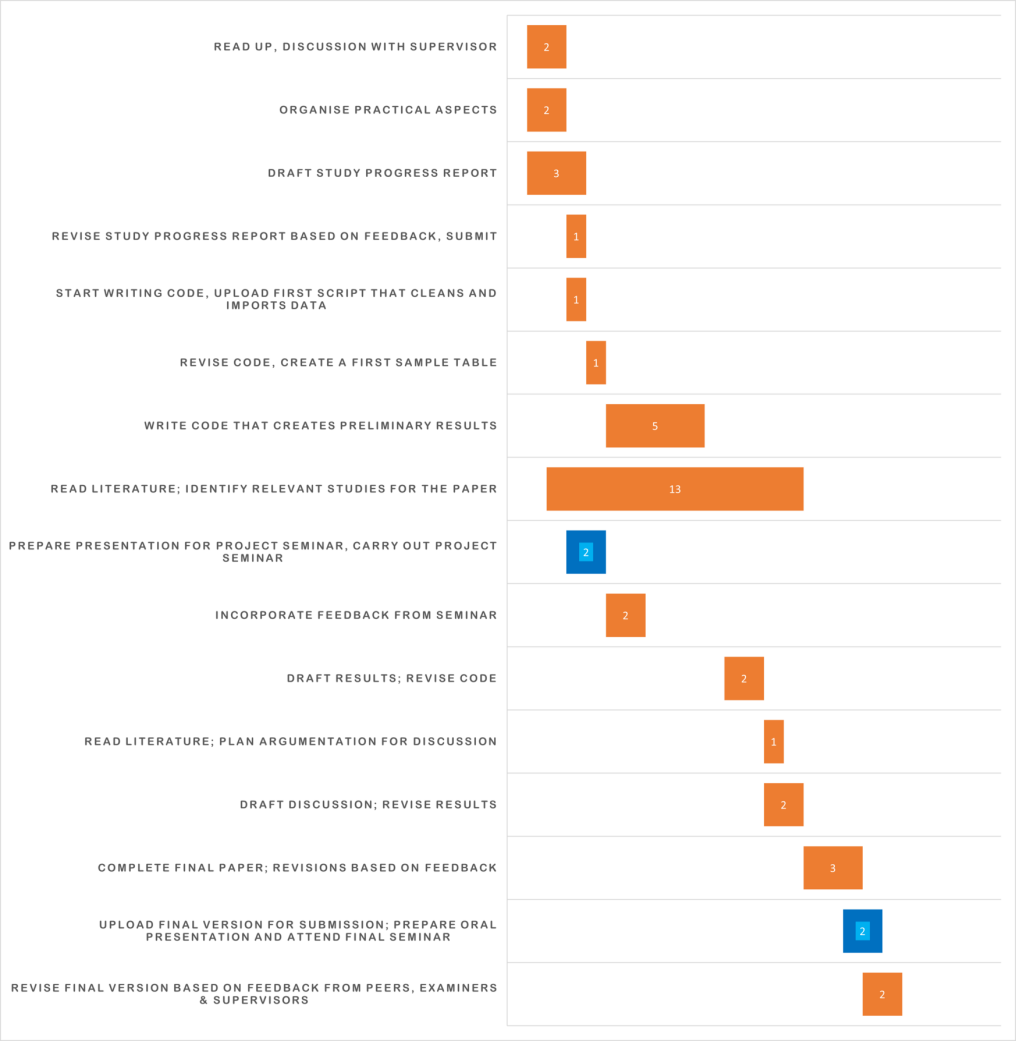
All patient information used in this study is anonymised and stored in a secure database. Patient medical records will not be accessed. Patients were not asked to give consent for inclusion in the KUH trauma registry. The ability and ethical approval to collect patient data for this registry without pre-emptively asking for patient consent is well-established, as collecting this data is deemed to be in the public interest according to article 6.1 e of GDPR regulations. Collecting data is in the public interest due to the fact that this patient register is used to improve management of trauma, which is a leading cause of death. Patients have the right to be removed from the register if they wish, and also have the right to a copy of data that is stored about them on request.

This project is a retrospective cohort study and the project has thereby had no effect on patient treatment. There is no risk that patients are harmed by inclusion in the study. This study has the potential to improve patient care by analysing a potential factor that could predict suboptimal trauma care. It is true that the patient population for this study includes vulnerable populations, such as the deceased and the severely injured, but this is justified by the fact that this population stands to gain the most from improved trauma care.

Stockholm Research Ethics Review Board approval number 2021-02541 and 2021-03531.

Development and time plan

This is a registry-based project and all data required were collected and available prior to the project beginning. The data consists of information about trauma patients at KUH and the outcomes of morbidity & mortality conferences on selected patient cases. The next step after submitting this progress report is to begin writing the code that will import and clean data. Once this is completed, the code for data analysis will be written. The analysis will consist of using logistic regression to see if trauma severity models can predict opportunities for improvement. Initially the code will be written using scrambled data in order to minimise researcher bias. Once the code for analysis is complete, it will be run on the real-life data to obtain the results for the study. I have written a detailed time plan, including dates for deadlines, that is available for my supervisors. We will be in contact on a regular basis to discuss progress. All of my code and text will be uploaded on a regular basis, which will allow for my supervisors to see my progress.



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