Performance of individual audit filters in predicting opportunities for improvement in adult trauma patients

A registry based cohort study

Josef Al-Khalili

Introduction

Trauma, a physical injury of external origin together with the body's associated response constitutes 9% of global deaths each year. (Organization et al. 2014) It is the leading cause of death for individuals between the ages 10 to 49(Vos et al. 2020),(Roth et al. 2018). Trauma Is categorized broadly into two groups by underlying mechanism: Penetrating and blunt trauma. Bullet wounds and knife cuts are common examples of penetrating trauma. Blunt trauma is attributed to injuries like road injuries and falls which are not sharp in nature. Generally speaking, blunt trauma is caused by high-force impact over a larger surface area compared to penetrating trauma where that force is applied to a smaller surface area causing greater pressure thus acting in a piercing manner often resulting in deeper lacerations to tissues and organs. Blunt trauma with enough force can however be penetrating in character(Hexdall and Miglietta 2011). In Sweden, road traffic incidence and falls are at the top of the list of mechanisms of injury accounting for around 80% of injuries(SweTrau 2022).

Impact

Injuries are not only a burden to the afflicted individual but also to a greater extent to society as a whole. One aspect of such societal effects are economic costs. There have been attempts to estimate the global cost of injury but due to its complexity it is not an easy task. It is however estimated that road injuries alone account for 2% of gross domestic product (GDP) in high-income countries(Organization et al. 2014).

Trauma care systems

In order to effectively treat trauma patients in regards to its specific nature and complexity a special subdivision of healthcare, trauma care, is used. Trauma care is a multidisciplinary, complex, and time-critical provision of healthcare delivered by specialized trauma centers. It uses a myriad of different specialties including but not limited to surgeons, anesthesiologists, emergency doctors and nurses. Because of its complexity and sensitivity to delay it is prone to errors that could have detrimental consequences (Ghorbani and Strömmer 2018).

Quality improvement

In order to minimize furthermore foresee such errors, Quality improvement (QI) programs have been established by the World Health Organisation (WHO) and the International Association for Trauma Surgery and Intensive Care (IATSIC). These programs have become a core part of the trauma process and its development all around the world (Organization et al. 2009).

QI programs consist of a set of recommended techniques that seek to enable discussion and analysis of the trauma process in order to take corrective measures for future success.

They have shown great results in reducing mortality with the implementation of quality improvement programs. (O'reilly et al. 2013)

Morbidity and mortality conferences - A cornerstone in functioning QI programmes

Morbidity and mortality conferences (M&M), also known as "death and complications conferences", are a central part of QI techniques. It is however a method which has been around in the healthcare community since 1904, the year that Dr. Ernest Amory Codman brought forward the importance of physician accountability in healthcare settings. Since then M&M has made itself deeply rooted in universal healthcare and developed into an established framework of crucial components of anonymity, a focus on specific adverse events, realising flawed approaches, critical analysis and lastly the effort to change and practice that change. (Gregor and Taylor 2016)

The M&M conferences are regularly scheduled meetings in which specific patient cases are brought up and discussed between healthcare professionals from all the different disciplines involved in trauma care and its processes. It is recommended that they are held for around 40 minutes but this varies between different hospitals.(Organization et al. 2009) During the conferences, a preventable death panel determines whether the death of a patient or a complication could have been preventable. When effectively implemented M&M, serves as a crucial fault-examining tool. They can transform such faults from being solely negative marks against individual care providers into incentives for reporting. These conferences promote a broader, system-based approach that emphasizes the analysis of tasks, teamwork, and quality improvement.(Lazzara et al. 2022)

Audit filters and Opportunities for improvement

Another technique that IQ programs offer is the use of audit filters (also known as quality indicators). Audit filters are specific established criteria involved in trauma processes and care. It is used to detect deviation from standardized care in order to further analyze the cause behind complications in Trauma patients. Examples of audit filters are death, the placement of 2 large bore intravenous lines within 15 minutes from arrival to a healthcare facility, etc. (Organization et al. 2009). Audit filters have shown to be effective in reducing mortality after its implementation in some hospitals (Chadbunchachai et al. 2001). In 2009 there was an extensive review made that sought to determine if audit filters could be used in improving processes of trauma care however none of the studies met established inclusion criteria.(Evans et al. 2009) The use of audit filters have also been associated with high frequencies of false positives, ranging from 24% to 80%.(Sanddal et al. 2011), (Roy et al. 2017), (Ghorbani and Strömmer 2018). Some audit filters seem to not correlate with OFIs at all (Lewis et al. 2017)

Opportunities for improvement (OFI) is the endpoint and aim of M&M conferences. Following the review of individual patient cases there is a consensus decision made regarding the existence of an OFI. It has been shown that such review process is associated with high-qualty trauma care. (Santana, Stelfox, et al. 2014) OFIs have shown failures in initial care (Vioque et al. 2014), specifically in airway management, fluid resucitation, hemorrhage control and chest injury management (Sanddal et al. 2011), (Roy et al. 2017), (O'reilly et al. 2013).

Aim

Trauma is a great burden globally and contribute to large economical costs for society, which is why OFIs are of such importance in trauma care development. While audit filters are good indicators of standard care, it is crucial to determine whether audit filters are of high value as a tool for predicting OFIs.

Methods

This is a registry-based cohort study that uses data from the trauma registry and trauma care quality database at the Karolinska University Hospital in Solna in order to evaluate the performance of individual audit filters in predicting OFIs.

Study setting and population

Karolinska University Hospital is classified as a Trauma level I hospital. Every year around 1500 patients receive treatment at the hospital. If a patient case results in team activation it is added to the Karolinska

trauma registry. If no team activation occurred but the patient had ISS>9 retrospectively it is also included in the registry. The Karolinska trauma registry is a subset of the national registry, the Swedish Trauma registry (SweTrau). The registry includes data on vital signs, times, injuries, and interventions as well as patient demographics according to the European consensus statement, the Utstein template

Karolinska trauma registry also contains a care quality database which contains specific audit filters and OFIs that are determined in M&M conferences through consensus decision. M&M conferences are attended by all professionals involved in trauma care. surgeons, neurosurgeons, orthopedics, anesthesiologists, nurses, and radiologists.

This process of determining OFIs unfolds in multiple stages, characterized by escalating levels of scrutiny. Notably, instances of mortality are directly referred to the multidisciplinary conference, where, in addition to assessing OFIs, a determination is made regarding whether the death was preventable or potentially preventable, a classification also falling under the purview of OFIs.

From 2013 to 2017 there was an effort put forward in identifying adverse outcomes which where unrelated to mortality, the review process underwent subsequent refinement and formalization during the study period. During this period each trauma patient case underwent individual assessments by a specialized trauma nurse in order to identify potential OFIs. It was, however not until 2017 in which this procedure was formalized and it became standardized to incorporate a prelimanary individual evaluation by a specialized trauma nurse upon data registration in the trauma registry and the trauma quality database. The trauma quality data underwent screening via audit filters, and all cases falling outside the criteria delineated by these filters, along with those trauma patients flagged by the nurse during the initial review for possible care failures, were subjected to a secondary review by two specialized nurses. Subsequent identification of a potential OFI during this second review prompted a comprehensive evaluation of the respective trauma patient's case.

eligibility criteria

In this study, we included all who underwent screening for OFIs derived from both the trauma registry and the trauma care quality database during the period spanning from 2013 to 2022. Exclusion criteria were applied to individuals under the age of 15, as their clinical management process has notable distinctions compared to those applicable to the adult population.

Variables

Outcome

The outcome variable in this study is an OFI, as established by the M&M conference through unanimous decision and furthermore valued as a binary variable with "Yes - At least one OFI identified" and "No - No OFI identified". This project will link the two databases and assess the performance of each audit filter in terms of discrimination and accuracy. A 5% significance level and 95% confidence level will be used.

Exposures

The exposure variable is the audit filters.

Predictors

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Participants

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Data sources/measurement

To calculate the sensitivity and specificity of each individual audit filter in predicting an OFI a mathematical equation is used:

True Positive (TP): Patient cases labeled with the specific audit filter and also show an OFI.

False Negative (FN): Patient cases labeled with the specific audit filter but show no OFI.

False Positive (FP): Patient cases not labeled with the specific audit filter but show an OFI.

True Negative (TN): Patient cases not labeled with the specific audit filter and also show no OFI.

The sensitivity is calculated accordingly: TP / (TP + FN)

The specificity is calculated accordingly: TN / (TN + FP)

Bias

The study results are generated by statistical analytics methods with the help of the statistical programming language, R. (R Core Team 2022). The data is already gathered thus there will be no bias in this study.

Study size

The study cohort encompasses all eligible patients treated at the hospital from 2012 to 2022.

Quantitative variables

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Statistical methods

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