Trauma treatment delay

A retrospective cohort study on the factors affecting the delays in trauma care

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# Introduction

**Definition**

Within the realm of modern medicine, trauma care stands as an important part in healthcare and is crucial to lowering mortality and morbidity in injured patients. The definition of medical trauma is “a set of psychological and physiological responses to pain, injury, serious illness, medical procedures and frightening treatment experiences” (Traumatic Stress Studies 2020). As the definition suggests, it encompasses a broad spectrum of different conditions, both physical and psychological. The one we will be focusing on in this paper is physical trauma, which is defined as a serious injury to the body. It is often divided into two subgroups, blunt force trauma and penetrative trauma. Blunt force trauma happens when an object or force strikes the body, often causing bruising, broken bones or deep cuts. Examples of this could be car crashes, falls or direct blows to the body. Penetrative trauma is when an object pierces the skin or body and creates an open wound. Examples of this are gunshot wounds and stab wounds (General Medical Sciences 2020). Differences exist between the two groups, as blunt trauma patients tend to score higher on ISS scale on arrival and as such require more resources and be hospitalized for a longer period because of their more sever injuries(“Blunt Versus Penetrating Trauma: Is There a Resource Intensity Discrepancy?” 2019).

**Trauma statistics**

Trauma is and has long been a major cause of death around the world today, taking the lives of around 4,4 million people each year, almost 8% of all deaths (Organization 2021). In the United States, trauma is the 4th leading cause of death among the general population and the leading cause for people between the ages of 1 and 44 (AAST 2020). It is also an important cause of hospitalization and morbidity among all age groups, including seniors, and is responsible for an estimated 10% of all years lived with a disability globally. This has a significant burden on social and economic level, costing countries billions of US dollars each year in healthcare and lost productivity(Connolly et al. 2018). Studies estimate the cost of trauma care being between 18,500$ and 41,500$ in HIC, depending on the country (Willenberg et al. 2012). However, as one might expect, this burden is not evenly distributed between or within countries. Many social factors such as age, sex and social status play a major role in the risk of dying from trauma, with young men with low socio-economic status being at most risk (Organization 2021). It is not only patient level factors that affect how people might be affected by trauma. About 90% of all trauma related deaths occur in low- and middle-income countries, with death rates by trauma also being higher than in high income countries. Even within these LMIC, people of poorer socio-economic status have higher death rates in trauma-related injuries. Problems identified within these countries that contribute to these statisitics were infrastructure, education and training, attributed to lack of funding, brain drain to HIC and lack of availability of basic amenities (Shanthakumar et al. 2021). In HIC where funding and governance over the healthcare system is better designed, functioning trauma systems and dedicated trauma centers exist that have been shown to lower mortality but also improve functional outcome in trauma patients (Nirula and Brasel 2006).

**Trauma systems**

Trauma systems are infrastructures that exist to provide and optimize care for injured patients starting with injury recognition and triage, transport to appropriate trauma center, inpatient care and outpatient follow-up. Beyond the clinical side, it works with outreach, education and advocacy, data collection through registries, research, funding, and disaster preparedness and response. A comprehensive and functioning trauma system requires strong leadership and engagement at the trauma center, regional and national level (Connolly et al. 2018). This system is crucial to provide care for trauma patients, both in reducing morbidity and mortality in this patient group. Earlier studies from Sweden have shown that treating severely injured patients at one of these establishments is associated with a 41% lower adjusted 30-day mortality rate compared to being treated at a non trauma care center due to them being more capable of treating these patients, with patients with higher ISS scores having an even higher protective effect with >90% for the most critically injured patients (Candefjord, Asker, and Caragounis 2020). Other studies have shown similar results, showing that treating injured patients at trauma centers is associated with a 15-30% decrease in mortality [Moran et al. (2018)](Celso et al. 2006)[MacKenzie et al. (2006)](Haas et al. 2012). During the last three decades, the introduction of trauma systems has lowered the incidence of preventable death from approximately 25% to less than 5%. This is attributed to the improvements in care for acute brain injuries and bleeding control. The incidence of late death because of sepsis and multiple organ failure, possibly a result of better and earlier resuscitation (Asensio and Trunkey 2008). Functioning trauma systems saves lives in the hospital, but their work outside of the hospital is just as important. Data collection from injured patients, such as mechanism of injury or mortality, are essential for creating databases that can be used for research. In turn, that research can be used for planning injury prevention programs that target the most common injuries in the right ways, e.g. teen drivers, children, specific occupations etc. These injury prevention programs can be planned on trauma center, organizational or government level(ACS, n.d.).

Trauma teams are multidisciplinary and operate in these centers. They play a pivotal role in the initial care of the trauma patient, as they are primary care givers in the critical stage of trauma. In Sweden, they consist of individuals from the specialities of surgery, intensive care, orthopedics, nursing and support staff and are lead by a team leader. Their aim is to rapidly assess and stabilise the patient, prioritise their injuries and arrange for site of definitive care. Emergency nurses are often the personnel activating the trauma code using anatomical and physiological criteria, mechanism of injury and information obtained from emergency service personnel. Once in the trauma room, the team works through ABCDE, a systematic and structured method to assess and manage critically ill patients. It is designed to handle the most urgent problems first, such as airways and breathing, and then go through the rest of the body in a structured way so to not miss anything. (Hedberg et al. 2020).

**Delay in treatment**

Once treated, the patients information and timeline of what happened enters a trauma care database, depending on what hospital. At Nya Karolinska Universitetssjukhuset, all patients who have been treated and had ISS>9 or had the trauma alarm activated are included and screened for OFIs. A cornerstone of trauma quality improvement programs is multidisciplinary mortality and morbidity review to identify OFIs and implement corrective actions. This refers to a meeting where doctors from different specialities sit down and go through cases where possible OFIs were identified by nurses who go through the trauma care quality database. Examples of opportunities for improvement may include lack of resources and management errors. One common OFI that this paper will look further into is delayed treatment. Among the preventable or possibly preventable deaths in trauma patients, a subgroup of patients determined by the Combined Trauma Death Review Committee, delay in treatment has been identified as a major error contributing to death, found in up to 52.9% of patients in said group (Teixeira et al. 2007). Although it is such a common OFI, the patient level factors associated with delayed treatment are poorly understood. There may be several factors that correlate with receiving delayed treatment, but they have yet to be identified. Mapping these factors may help in identifying patients that might be at risk for receiving delayed treatment before it happens.

The aim of this paper is to determine what different patient level factors affect the risk of receiving delayed treatment at a trauma center.

# Methods

**Study design**

This is a registry based cohort study.

**Setting**

The data used is from the trauma registry and trauma care quality database at the Karolinska University Hospital in Solna. The trauma registry includes about 12000 patients treated between 2012 and 2022. The trauma care quality database is a subset of the trauma registry and includes about 6000 patients selected for review between 2014 and 2022.

**Participants**

The database only includes patients 15 and above, ISS >9 and/or trauma team activation. Inclusion in the study further requires that the patients have been assessed for OFIs. Exclusion happens if a patient is missing information in one of the examined patient factors.

**Variables**

The outcome is delayed treatment, which is defined as more than 30 minutes passing from arrival before receiving treatment, as identified by the multidisciplinary review board and recorded in the trauma care quality database. This project will link the two databases and assess how different patient level factors, such as age, sex, mechanism of injury, and injury severity, are associated with delayed treatment using logistic regression. A 5% significance level and 95% confidence levels will be used.

**Data sources/measurement**

The data comes from the trauma registry and trauma care quality database.

**Bias**

Bias is not relevant in this study as the data is collected from a database and processed by a coding program.

**Study size**

The study size is all of the eligible patients that was treated at the hospital between 2012 and 2022. Starting 2013 only a subgroup of patients were screened for OFIs, but starting 2017 all patients that are included in the database are screened for OFIs.

**Quantitative variables**

**Statistical methods**

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