Association between level of hospital care and opportunities for improvement in adult trauma patients

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# Abstract

## Background

## Methods

## Results

## Conclusion

# Introduction

Trauma is a global issue affecting millions of people every year worldwide. Globally somewhere between 4-6 million people die every year due to trauma, and around 40 million get permanently injured and 100 million people get temporarily injured each year (1). In Sweden, during 2023, 5221 people died due to trauma (2).

In this paper, level of care will be categorized according to five categories in order of most care to least care, emergency department, general ward, operating theatre, high dependency unit and critical care unit. These are based on the Utstein template, a template used in trauma registries for reporting several trauma care variables (3). Depending on the severity of the injury each patient supposedly ends up in a higher care level. A higher care level equals more doctors, nurses and staff, as well as access to more complex machinery. However, it also equals a higher cost, and a larger drain of resources.

Opportunities for improvement (OFI) can be defined as “preventable factors affecting morbidity and mortality”. The factors included in are the following: “clinical judgement errors, delays in treatment or diagnosis, missed diagnoses, technical errors, preventable deaths and other errors” (4). OFI or OFI-like variables are commonly logged in trauma registries. OFI-like variables can be things such as adverse events, a “a harmful and negative outcome which happens when a patient has been provided with medical care”.

There exists several trauma registries worldwide, which are used in order to evaluate trauma care and in order to improve trauma care (5). These registries commonly contain patient information, such as sex, age, type of injury, as well as morbidity and mortality outcomes. The Karolinska Hospital trauma center have a trauma registry where opportunities for improvement and level of care is included, among other variables (6).

Clinical judgement errors are somewhat common in the emergency ward, according to a systematic review published in 2022 (7). In the study 5.7% of patients had at least one diagnostic error, resulting in harm becoming 2% of patients and death in about 0.2%. In the US, about 130 million patients every year goes to the emergency department, which results in 7 million patients misdiagnosed, harm becoming 2.5 million and 350 000 patients dying. In a systematic review containing 16424 surgical patients, 14.4% of patients experienced adverse events and 50% of these were deemed avoidable (8). In a study from 2005, 50 errors involving 32 patients were made by doctors in an ICU setting(9). These errors resulted in a higher mortality rate (38% vs 9%). The errors were categorised as human failures in 73% of cases, and as avoidable in 92%. In More studies related to doctor error have been conducted in the emergency ward setting, the operating theatre and the intensive care unit compared to the general ward and the high-dependency unit. This might point to the fact that there may be possible to affect a larger number of opportunities for improvement in these less studied cohorts.

There have been several studies previously regarding OFI and OFI-like factors in a trauma setting, but few studies with the direct focus on how OFI relates to care level. Previous studies show that there exists a connection between OFI and level of care (6), but this connection has not been examined directly. There exist studies on specific OFI or OFI-like factors in specific levels of care, but there have not been any systematic approaches made were the same measure for OFI gets compared across different care levels.

The aim of this study is to determine the number of opportunities for improvement in each level of in-hospital care, and how patient factors are associated with these opportunities at each level.

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# Methods

We will use the patient data register at Karolinska institute trauma center from 2013-2023, thus making a single center retrospective cohort study.

## Study design

This is a registry-based cohort study.

## Setting

This study will be conducted using data collected at Karolinska University Hospital trauma center, a level I trauma center (11). Opportunities for improvement are since 2017 in Karolinska Hospital measured by a specialised nurse, who reviews all trauma patient cases and flags cases where OFI might be found(6). The cases flagged then get reviewed at a deeper level by another specialised nurse, and the cases where OFI might be found gets reviewed by a multidisciplinary conference, where cases are either admitted or discarded. All patients dying due to trauma are also discussed in a conference where OFI is also discussed. Before 2017 OFI was decided by a small group of clinicians. We will use the trauma care quality database and trauma registry from Karolinska University hospital in this paper. The data available in the trauma registry includes 14000 trauma patients and is logged from the years 2012-2023. The data from the trauma care quality database is a subset of the same data containing 8000 patients where opportunities for improvement have also been logged. The data contains information according to the Utstein template, which includes factors such as Glasgow come scale, systolic blood pressure and respiratory rate (3)

## Participants

The patients included are all above the age of 15, with an ISS greater than 9 or patients with a trauma team activation upon hospital arrival. Excluded patients were younger than 15 or dead on arrival.

## Variables and data sources/measurements

Our outcome is measured specifically in regard to level of in hospital care, which means that several variables need to be taken into account. The following patient factors will be included: patient age, injury mechanism, ASA score preinjury, Glascow come scale at arrival to hospital, systolic blood pressure at arrival, respiratory rate at arrival, base excess at arrival, injury severity score (ISS), highest level of in hospital care and OFI. Level of hospital care is numbered from 1-5, with 1 representing the emergency ward, 2 representing the general ward, 3 representing the operative theatre, 4 representing the high dependency unit and 5 representing the intensive care unit. R will be used for the statistical analysis. Unadjusted and adjusted logistic regression will be used to determine the associations between level of care and opportunities for improvement. Multivariable logistic regression, and bivariable logistic regression will be used. Synthetic data will be used when developing the code required to extract data. When this code is deemed functional, it will be implemented on the real data. This is done to decrease risk of bias. A 5% significance level and 95% confidence levels will be used in this paper.

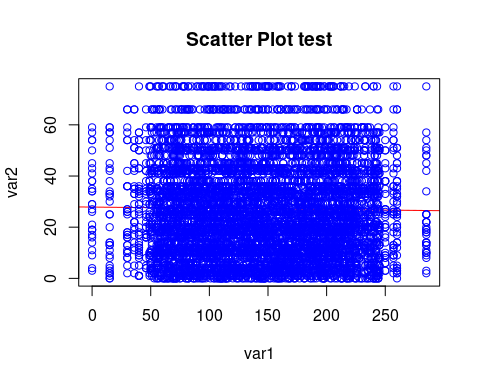
## Bias

## Study size

## Quantitative variables

## Statistical methods

# Results

[1] 6 # Label levels study.samplept\_Gender, levels = c(“Male”, “Female”))

## Outcome data

Cohort study — Report numbers of outcome events or summary measures over time

Case-control study — Report numbers in each exposure category, or summary measures of exposure

Cross-sectional study — Report numbers of outcome events or summary measures

## Main results

1. Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
2. Report category boundaries when continuous variables were categorized
3. If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

## Other analyses

Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses –>

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# Discussion  
  
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Key results  
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Summarise key results with reference to study objectives  
  
Limitations  
-----------  
  
Discuss limitations of the study, taking into account sources of  
potential bias or imprecision. Discuss both direction and magnitude  
of any potential bias  
  
Interpretation  
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Give a cautious overall interpretation of results considering  
objectives, limitations, multiplicity of analyses, results from  
similar studies, and other relevant evidence  
  
Generalisability  
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Discuss the generalisability (external validity) of the study results  
  
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# Conclusion

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