Trauma team training at a "high-risk, low-incidence" hospital

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ABSTRACT

INTRODUCTION: Trauma is the leading cause of death in younger people in the Western world. It is of great importance that smaller trauma centres with "high-risk, low-incidence" trauma resuscitations maintain high standards in trauma resuscitation, as severely injured patients are occasionally treated. We aimed to evaluate the effect of implementing trauma team training (TTT). Additionally, we investigated the incidence of severe traumas using the Injury Severity Score (ISS).

METHODS: Data on process times were collected in a three-month period before and after implementation of TTT at the Regional Hospital Randers, Denmark. Process times from arrival of the patient in the trauma room until chest X-ray, trauma CT, CT description and transfer were registered. ISS was calculated as trauma severity.

RESULTS: A total of 43 trauma patients were registered. ISS values were not significantly different between the two cohorts. 5/43 (12%) had an ISS > 15 as an expression of severe traumas. A tendency to reduced process times was found, but results were not statistically significant.

CONCLUSIONS: Despite limitations in this study, our results point towards a reduced process time after the implementation of TTT. At an organisational level, TTT can draw attention to challenges, inappropriate local procedures and allocation of material and staff in order to improve trauma resuscitations. Only 12% of patients had an ISS > 15, emphasising the need to simulate trauma resuscitations using TTT.

FUNDING: none.

TRIAL REGISTRATION: The study was registered with the Danish Data Protection Agency.

Trauma is the leading cause of death in the age 1-44 years in the Western world [1]. In Denmark, severely injured patients are treated in 22 trauma centres; four level-1 university hospitals and 18 level-2 regional hospitals [2]. Trauma patients are treated by a trauma team gathering ad hoc to perform acute assessment and resuscitation of the severely injured patient. The composition of the trauma teams varies between hospitals, with staffing ranging 9-17 healthcare professionals [2].

Regional hospitals are so-called "high-risk, low-incidence" hospitals regarding trauma care. The number and severity of trauma cases are low compared with trauma centres at university hospitals. In Denmark, pre-hospital visitation refers most severe injuries to level-1 trauma centres.

However, severe trauma cases are occasionally treated at regional hospitals. Hence, it is of utmost importance that both technical and non-technical skills in trauma resuscitation are trained in order to provide and maintain a high standard of care [3].

Up to 70% of errors in the medical world are due to human factors [4]. Errors are often due to inadequate non-technical skills, e.g. ineffective communication and inability to translate medical knowledge into clinical practice [5]. Simulation can improve both non-technical and technical skills and thus prevent errors and improve patient safety by increasing the trauma teams' efficiency [6]. Simulation provides a possibility to optimize teamwork by training specific skills in realistic scenarios without endangering patients [7-9].

Technical skills include intubation, handling drainage tubes, etc. However, the strength of team training predominately lies within the non-technical skills including communication, teamwork, leadership, etc. [6].

Structured debriefings led by simulation facilitators ensures reflective learning through feedback from peers [4, 9]. Furthermore, simulation allows the involved staff to repeat scenarios to maintain and improve the achieved skills over time [10]. Furthermore, the complexity of scenarios and the context can be adjusted according to the specific learning objectives. Several studies conclude that the benefit of simulation is greatest if the context and learning environment are similar to the daily working environment. Simulation can either take place in the real working environment (in-situ simulation) or in training facilities (off-site) [11, 12].

Previous studies have shown that implementation of trauma team training (TTT) was associated with improved trauma processing times and a reduction in patient mortality and morbidity [7, 13].

The aim of this study was to evaluate the effect of TTT implementation on processing times during trauma resuscitation. We registered processing times in trauma resuscitation at Regional Hospital Randers, Denmark. Processing times from arrival to chest radiograph, CT and total time in the trauma centre until

ORIGINAL ARTICLE

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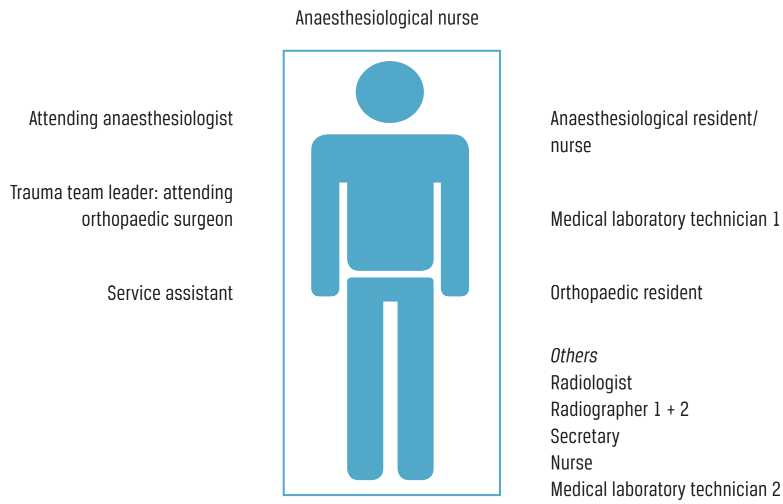
Dan Med J 2020;67(3):A03190189

FIGURE 1 / Trauma team participants at Regional Hospital Randers. The trauma team consisted of 15 members, and the trauma team leader was an orthopaedic surgeon.



transfer to a ward or an operating theatre were registered.

Furthermore, we aimed to estimate the incidence of severe trauma cases at the Regional Hospital Randers.

METHODS

A prospective interventional study comparing processing times in trauma resuscitation before and after the implementation of TTT at Regional Hospital Randers.

The validated Injury Severity Score (ISS) was used to estimate the severity of the traumatic injuries. The ISS scale ranges 0-75, and an ISS > 15 defines severe trauma with multiple injuries in several body regions [14].

Inclusion criteria of trauma team training participants

Participants were all healthcare professionals who normally participate in trauma resuscitation, acting in their own profession to maximise the clinical relevance.

Participants were signed up via an electronic course platform. The list of participants was monitored by instructors to ensure that participants from all groups of healthcare professionals were represented at each TTT. Reminders were sent to the head of the participating departments to ensure enrolment in TTT.

Team members and line-up in trauma resuscitation resembled the real trauma team at each TTT and is presented in **Figure 1**.

TTT consisted of a 90-minute session following a curriculum containing theoretical, advanced trauma life support (ATLS) principles, two standardised scenarios and two debriefings (**Figure 2**). The curriculum was standardised and could therefore be readily adapted by the simulation facilitators. The primary focus of TTT was to train non-technical skills with specific learning goals at each session and scenario. Both figurants and manikins were used depending on the learning objectives [11, 12]

TTT facilitators were orthopaedic surgeons with approved ATLS courses and regional simulation facilitator courses and with previous experience with simulation. Training was done off-site at the Learning Center at Regional Hospital Randers. The setting was a realistic trauma training room.

Prior to TTT implementation, there was no formalised TTT including team training and scenarios at Regional Hospital Randers. However, approximately twice a year, a four-hour theoretical presentation and introduction to trauma resuscitation was held. After the lecture, the participants would observe the on-call staff conducting an unannounced in-situ trauma simulation. This trauma course was also held throughout the study period.

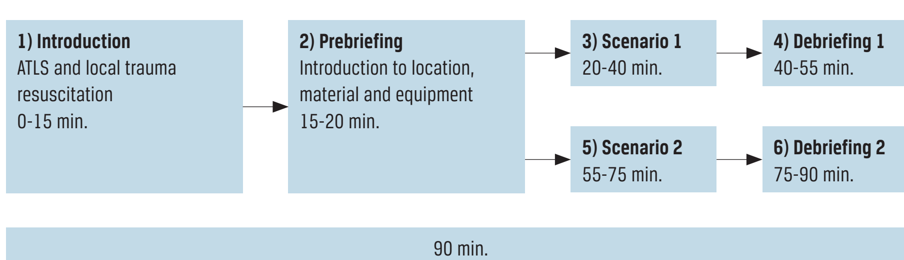
Data collection

Data were collected three months before and three months after TTT implementation.

Data consisted of time intervals (processing times) from arrival in the trauma room to the following events: chest radiograph, trauma CT, description of the CT (verbally handed over to the trauma leader) and transfer to a ward or an operating theatre.

The secretary and the orthopaedic resident on call recorded processing times on pre-printed forms during resuscitation. Every morning, trauma cases were pre-

FIGURE 2 / Trauma team training time line.



ATLS = advanced trauma life support.

sented at morning conferences and the primary investigator controlled if the paper-based forms had been filled in. However, no trauma database existed at the time of the study. The primary author transferred all data from the pre-printed forms to an electronic database after completion of the data collection.

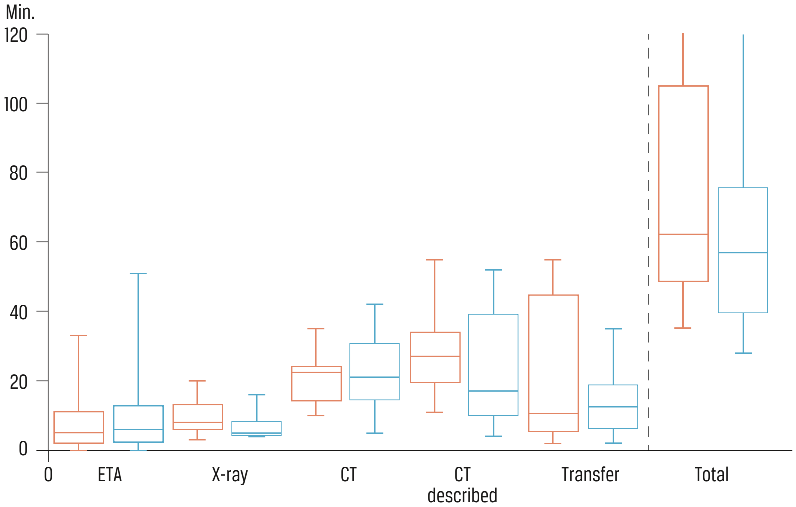
The ISS was estimated with an ISS calculator based on journal reviews and CT descriptions. Observations regarding organisational obstacles in trauma resuscitation were also registered during trauma resuscitation.

Statistical analysis

Processing times before and after the implementation of TTT were compared using the non-parametric Mann-Whitney test. Unless otherwise stated, median (range) is reported. A $p \leq 0.05$ was considered statistically significant.

Trial registration: The study was registered with the Danish Data Protection Agency.

FIGURE 3 / Box plot depicting the median trauma processing times, interquartile range (box) and range (whiskers) before (red) and after (blue) trauma team training.



ETA = estimated time of arrival.

RESULTS

TTT implementation was organised in six 90-minute sessions in the period January 2017 – November 2017. Hence, the pre-TTT period ran 1 October – 31 December 2016 and the post-TTT period ran 1 December 2017 – 28 February 2018. Records on number of participants at the TTT throughout the implementation period were not kept. However, total of 84-94 healthcare professionals participated during the TTT implementation period. At least 14 participants were present at each of the six sessions; however, the number of precourse online registrations was higher.

In total, 43 trauma patients, of whom two were children, were registered (n pre-TTT = 23, n post-TTT = 20). Five patients had an ISS > 15, indicating severe trauma. ISS was not significantly different pre and post TTT implementation (median ISS: 6.5 (0-29) versus 1 (0-21); $p = 0.07$), which made the two cohorts comparable. Missing data due to missing paper-based forms were noted for a few trauma resuscitations. It was not possible to retrieve the missing data after the study period.

Processing times pre-TTT compared with post-TTT were not statistically significantly reduced (**Figure 3**). However, the median total processing time was reduced from 62 minutes to 57 minutes until transfer to a ward or an operating theatre ($p > 0.05$), and 75% of all trauma cases were handled within 75 minutes compared with 105 minutes before TTT ($p > 0.05$).

Furthermore, observations regarding suboptimal placement of materials and lack of refill of equipment were noted during two trauma resuscitations. These observations formed the basis for subsequent structural improvements in the trauma room. Furthermore, TTT participants also disclosed suggestions for improvements and less effective workflow in trauma resuscitation for future improvements.

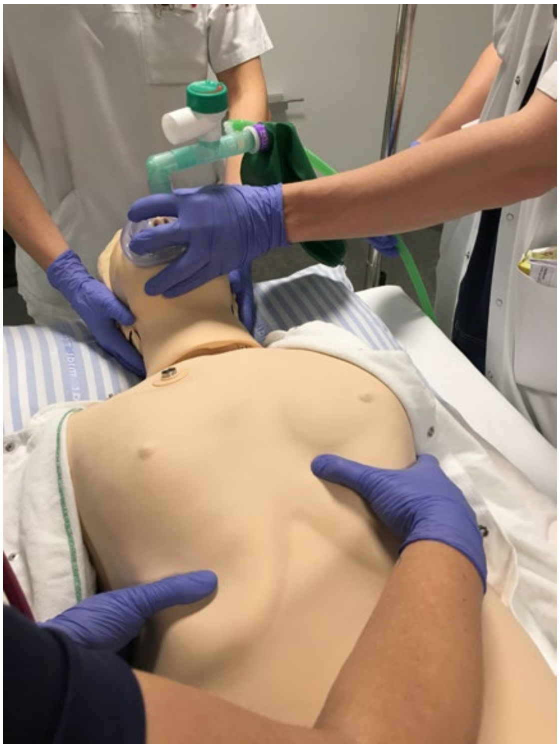
DISCUSSION

Implementation of TTT did not statistically significantly reduce processing times. However, we noted that the majority of the median processing times were improved after TTT implementation. This trend is in line with the statistically significant improvement observed in trauma processing times after implementation of TTT at other institutions [13, 15].

Our study had several limitations, possibly influencing the results. One possible explanation for the lack of statistical significance is that the study may have been underpowered because of the relatively small sample size ($n_{pre\text{-}TTT} = 23$, $n_{post\text{-}TTT} = 20$, $n_{total} = 43$).

Both data collection periods were predetermined to last three months each and the date for TTT implementation was set before initiating the study. Due to organisational and management agreements, this time frame could not be changed. The second data collection period could have been extended, but we decided to maintain equally long data collection periods and thus approximately the same number of traumas in both periods.

Another explanation for the lack of statistical significance may be that our 90-minute TTT sessions held every second month had no measurable significant impact on processing times. If this holds true, it might be due to the duration or frequency of the simulation course. These should preferably be longer and held more often [10].



Simulation using either manikins or figurants is an effective method to improve the resuscitation of trauma patients. Trauma team training can be implemented using different equipment and settings depending on local resources.

Further limitations include that we did not register whether the individual trauma team members of the post-TTT trauma resuscitations had participated in the TTT during the implementation period. This is likely to have influenced the results as we assess the performance of teams. Several members might not have participated in TTT at the time of the data collection. Furthermore, conducting the data collection period further away from TTT implementation could potentially have reduced the noise of the implementation phase.

TTT drew attention to challenges, inappropriate local procedures and allocation of material and staff at an organisational level. During this study, institutional awareness was enhanced to identify and address these issues by improving local guidelines and allocation of material.

Besides the benefit of training, a low-incidence, high-risk clinical situation simulation of trauma resuscitation may reduce processing times and thus enable hospital staff to resume their work earlier after it was interrupted by the trauma resuscitation [13, 15]. However, the effect of TTT on processing times and the potential cost effectiveness of implementing TTT warrant further investigation.

After having completed the present study, we were in a position to make TTT improvements. Scenarios were updated and the facilitators were further educated in debriefing and simulation training.

At the Regional Hospital Randers, this project triggered the implementation of a local trauma database as from January 2019. The number of trauma patients, processing times, severity (ISS) and participants in trauma resuscitations are registered prospectively. This allows us to follow the effect of TTT continuously in future research.

In this study, we found that five of 43 trauma patients (12%) had an ISS > 15. This result was surprisingly high as guidelines predict severely injured trauma patients to be referred to level-one trauma centres. The ISS results underpin the importance of simulation training by improving and maintaining competencies that are fundamental in caring for severely injured patients. This important finding could encourage similar departments and institutions to implement TTT and operate a trauma database. Only nine of 22 Danish trauma hospitals state that they have a trauma database [2].

TTT as a learning method facilitates replacement of scenarios and adaptation of learning goals as needed, for example as part of improvements after near-miss and adverse events or during the development or implementation of guidelines. At an organisational level, TTT may produce increased attention to optimising the placement of equipment and use of resources.

At the Regional Hospital Randers, we developed a simple curriculum for TTT organising which could readily be implemented and give all participants the same basic education. The curriculum is independent of simulation resources but requires support from the implicated departments. TTT should be performed by simulation facilitators trained in medical simulation and holding experience in debriefing and ATLS concepts.

CONCLUSIONS

Implementation of TTT is important to meet the perquisites of regional hospitals with a "high risk and low incidence" of severe trauma. The incidence of 12% of severely injured patients with an ISS > 15 underlines the importance of training and maintaining skills in trauma resuscitation. The ideal form, frequency and content of TTT warrant further studies. In the present study, a simple 90-minute simulation course lead to improvements at the organisational level and produced a tendency towards lower processing times in trauma resuscitation.

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ACCEPTED: 10 December 2019
CONFLICTS OF INTEREST: none. Disclosure forms provided by the authors are available with the full text of this article at Ugeskriftet.dk/dmj

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