Are severely injured trauma victims in Norway offered advanced pre-hospital care? National, retrospective, observational cohort

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Conflicts of interest
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Background: Studies of severely injured patients suggest that advanced pre-hospital care and/or rapid transportation provides a survival benefit. This benefit depends on the disposition of resources to patients with the greatest need. Norway has 19 Emergency Helicopters (HEMS) staffed by anaesthesiologists on duty 24/7/365. National regulations describe indications for their use, and the use of the national emergency medical dispatch guideline is recommended. We assessed whether severely injured patients had been treated or transported by advanced resources on a national scale.
Methods: A national survey was conducted collecting data for 2013 from local trauma registries at all hospitals caring for severely injured patients. Patients were analysed according to hospital level; trauma centres or acute care hospitals with trauma functions. Patients with an Injury Severity Score (ISS) > 15 were considered severely injured.
Results: Three trauma centres (75%) and 17 acute care hospitals (53%) had data for trauma patients from 2013, a total of 3535 trauma registry entries (primary admissions only), including 604 victims with an ISS > 15. Of these 604 victims, advanced resources were treating and/or transporting 51%. Sixty percent of the severely injured admitted directly to trauma centres received advanced services, while only 37% of the severely injured admitted primarily to acute care hospitals received these services.
Conclusion: A highly developed and widely distributed HEMS system reached only half of severely injured trauma victims in Norway in 2013.

Editorial Comment
In order for people injured outside of the hospital to receive rapid and effective pre-hospital care, there needs to be timely and correct dispatch of services based on an alarm and recognition of need. This report presents a national review of how effectively the alarm and dispatch system has met injured patients' needs in the pre-hospital setting.

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Advanced pre-hospital trauma care includes personnel with specialized skills and equipment and rapid transportation, and is used extensively.[1] Systems differ between countries, as does the use of physicians vs. paramedics. Both offer extended skills and treatment modalities as compared to ordinary ground ambulances.[2] The advanced pre-hospital care may be delivered through Helicopter Emergency Medical Services systems or rapid response/emergency cars (collectively designated as HEMS). Several studies of severely injured patients suggest that advanced pre-hospital treatment or helicopter transportation provides a survival benefit, while other do not.[3] This possible benefit depends on the disposition of resources to patients with the greatest need.

The disposition of these services is based on an assumption that Emergency Medical Coordination Centres (EMCC) can dispatch the HEMS to patients in need and avoid any unnecessary use for patients with less severe injuries or no other additional cause for the use of HEMS. So far, no studies have assessed the use of advanced pre-hospital services in trauma victims in Norway. International studies have failed to define exact criteria for when to dispatch HEMS.[2,4]

The aim of this study was to assess the use of HEMS in Norway for severely injured patients on a national level.

Methods and material

The study was a retrospective, observational, cohort study.

Study setting

The mainland of Norway covers an area of 385,178 km^2 and had 5,051,000 inhabitants in 2013.[5] The Norwegian trauma system consists of four independent regions, with one trauma centre and 4–14 acute care hospitals in each region admitting injured patients. The four regional trauma centres have all the medical and surgical capabilities, similar to the level I and II trauma centres described by the American College of Surgeons Committee on Trauma (ACS-COT).[6] Acute care hospitals have 24-h general surgical services and, if needed, are able to stabilize trauma patients before transfer to the trauma centre. The acute care hospitals are similar to the level III centres described by ACS-COT.[6] Advanced pre-hospital care is offered by six anaesthesiologist-manned rescue helicopters and 13 anaesthesiologist-manned ambulance helicopters. Each of the 19 helicopter bases are also equipped with an emergency car for missions within the vicinity of the base, or during poor weather conditions. The distribution of hospitals and HEMS is shown in Fig. 1.

The HEMS system is solely activated through the 18 EMCC's (as per 2013). National regulations describe indications for the use of HEMS in Norway, but there are no national dispatch criteria. The Norwegian Index for Medical Emergency Assistance (Index) is the dispatch guideline used by the EMCC, but the criteria for notifying HEMS are rather nonspecific: 'If appropriate, consider sending the nearest otherwise occupied ambulance; notifying nearest doctor not on call; notifying HEMS; recommend private patient transport.' The anaesthesiologist who is part of the HEMS crew is responsible for triaging the patient and accepting or declining the mission based on information from the EMCC.[7]

Norway had no national trauma registry until 2015; however, most hospitals maintained local registries based on a nationally defined dataset,[8] a compulsory activity to comply with a national white paper on the national trauma system.[9] Hence, the information needed to answer the research question had to be collected from each hospital.

The Ethical Review Board of Northern Norway waived the need for board review approval (2014/1038 REK Nord, 04.07.2014).

Inclusion criteria

All primary admissions of injured patients occurring at any hospital in Norway that admitted trauma patients during the period from 1 January 2013 to 31 December 2013 with an injury severity score (ISS) > 15 were included, if the admitting hospital had complete data from 2013. Secondary transfers were excluded. Hospitals were stratified into two levels: trauma centres and acute care hospitals.

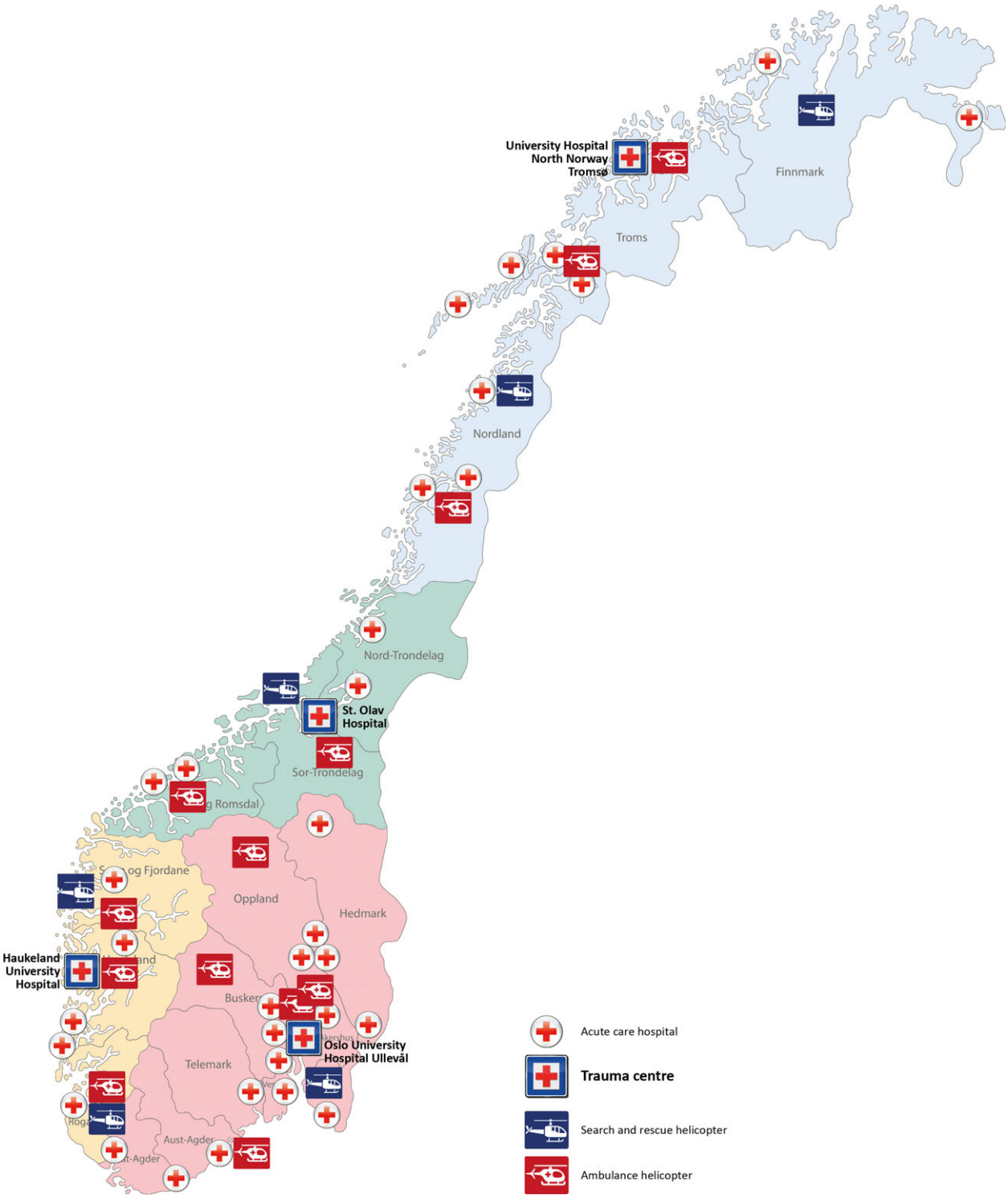

Fig. 1. The distribution of hospitals caring for patients with trauma and the ambulance and rescue helicopter bases in Norway in 2013. Illustration: Finnmark Health Trust, Hammerfest, Norway. [Colour figure can be viewed at wileyonlinelibrary.com]

Data collection

The study data were collected from August to December in 2014. All trauma centres ($n = 4$) and acute care hospitals with a defined trauma function ($n = 32$) were asked to inform whether they had registered data for trauma patients during 2013. Subsequently, patients were identified from the trauma registries at these hospitals.

Data regarding injury severity and pre-hospital care, including the presence of anaesthesiologists during pre-hospital care, were collected and registered by the local trauma registrars at each hospital. Registrars were all certified by the Association for the Advancement of Automotive Medicine. Anonymized data were provided to the authors.

Classification of injuries

The severity of the injuries was classified according to the Abbreviated Injury Scale (AIS).[10] The extent of the injuries was classified according to the Injury Severity Scale (ISS) [11] by the local registrars. Patients were included independent of whether the trauma team received them, or if they were subsequently found to have an injury with severity of New Injury Severity Score (NISS) > 12 after admission. These are the two main indications for registration in local trauma registries.

Results

Three trauma centres (75%) and 17 acute care hospitals (53%) registered data for trauma patients during 2013, providing a total of 3535 trauma registry entries (primary admissions only), which included 604 victims with an ISS > 15.

In total, 51% of all severely injured in this study were transported and/or treated before reaching hospital by an anaesthesiologist in 2013. The results are listed in Table 1.

Table 1 The pre-hospital care and transportation received by severely injured patients (ISS > 15) in Norway 2013, $n = 604$.

	No of patients	Patients treated and/or transported by HEMS	Patients treated and/or transported by EMS
All patients	604	305 (51%)	299 (49%)
Patients admitted to trauma centre	355	213 (60%)	142 (40%)
Patients admitted to acute care hospital	249	92 (37%)	157 (63%)

Helicopter emergency medical services and rapid response cars, all manned by anaesthesiologists (HEMS) compared to ground ambulances manned by two emergency medical technicians (EMS).

Discussion

We found a frequency of 51% advanced pre-hospital transportation and/or treatment of severely injured in Norway during 2013. In a mature system, build on a belief that a survival benefit of the service is expected, we had expected better precision in dispatch or better availability. The findings are in line with a recent study from Denmark.[12] Another recent study comparing the trauma centre in Oslo, Norway to the trauma centre in Stockholm, Sweden found an 8.2 times higher presence of pre-hospital anaesthesiologists in Oslo (30.5%) as compared to Stockholm (3.7%).[13] The 30-day mortality rate showed no statistically significant difference between the two centres, although the risk-adjusted survival rate was somewhat higher in Oslo than in Stockholm for primary admissions. Of 2221 severely injured patients admitted to the trauma centre at Oslo University Hospital between 2001 and 2007, 1059 patients (47.8%) were admitted and triaged by anaesthetist-manned units at the scene.[14]

Traditionally, three main benefits of HEMS for the severely injured are described: geographical access, shortened transfer time, and pre-hospital critical care interventions by skilled personnel.[3,15,16] Additionally, other benefits such as reduced need for secondary transfer and reduced mortality rates can be seen.[12] However, due to the cost, limited availability of HEMS, and non-negligible risk for both the crew and the patient, there is a growing focus on limiting over-triage.[15,17–20] Patients with minor injuries account for a majority of HEMS transports, and hence the costs.[21,22]

Treatment and/or transportation of severely injured patients with the HEMS system before hospital admission depend on a number of conditions. The emergency system must be notified, the decision to dispatch the HEMS must be made, the HEMS has to be available, and the transport distance/time to the destination should be long enough to not warrant direct admission by the first arriving ambulance. Few patients in Norway are brought to the hospital in private cars (only 1.2% in 2015, The Norwegian National Trauma Registry, personal communication). Hence, this does not seem to be a major cause for reduced use of pre-hospital anaesthesiologists to severely injured patients. For several years, the average rate of cancelled or rejected missions recorded in the national air ambulance system has been approximately 14%, of which 9% were due to weather conditions. Synchronous requests caused 4% rejections and duty time regulations precluded less than 1%. Thus, this consideration alone cannot explain the reduced use of pre-hospital anaesthesiologists to treat severely injured patients. Even at Oslo University Hospital, which cares for the most densely inhabited population, approximately half of the patients were located at a sufficient time and distance from the trauma hospital to receive advanced pre-hospital treatment.[13] We would expect this rate to be even higher at more distant hospitals and trauma centres. This leaves the dispatch process in the EMCC's with the majority of the responsibility for use of the HEMS for severely injured patients, either through a lack of HEMS dispatch or through medical rejection of the mission by the HEMS anaesthesiologist. A 2015 study from Western Norway found that more than a third of the HEMS dispatches from the EMCC were declined or aborted by the HEMS crew due to disappearance of the medical indication during interrogation, bad weather conditions, and competing missions.[7]

Efforts to define the exact criteria for HEMS dispatch have failed,[23] and there are a variety of dispatch models, both within and in between countries.[15] Primary dispatch models activate HEMS resources prior to EMS arrival on the scene and are based on dedicated dispatch criteria at the dispatch centre. These models are designed to save time, but there is no evidence of shorter time for the HEMS to reach the incident scene or the effect on mortality, severity of injury in patients actually transported, or proportion of patents admitted to intensive care units compared to secondary HEMS dispatch following requests from EMS personnel at the scene.[4,23] A study from the Air Ambulance of London found that the paramedics of that service had the same precision of identifying serious injury by interrogating the EMCC caller as ambulance personnel at the site of injury, and that both were significantly better than using mechanism of injury.[24] However, both methods resulted in over-triage. An Australian study found that dispatch by a physician-staffed HEMS crew was more likely to identify cases of severe paediatric trauma. It was also associated with more and faster transports directly to a trauma centre compared to dispatch by a paramedic at the dispatch centre.[25] A Scandinavian study on anaesthesiologist-staffed pre-hospital services found a population incidence of critical illness or injury of 11 per 10,000 person-years in Norway, based on deranged vital signs, advanced medical procedures performed, and advanced medication given.[2] The proportion of trauma patients in the study was 39%, and 27% were considered to have severely deranged vital signs.[2]

We found that more victims admitted primarily to trauma centres had pre-hospital treatment and/or transportation by HEMS than those arriving at acute care hospitals. This may be due to the correct selection of destination by the attending anaesthesiologist or because most helicopters are based at or in the vicinity of trauma centres. Another explanation may be the increasing number of severely injured elderly admitted to acute care hospitals after assumptions of minor injury mechanisms, which might have been missed during dispatch or at the scene.[26,27] When 37% of patients primarily admitted to an acute care hospital actually had advanced pre-hospital care and/or transportation this might be viewed as suboptimal triage concerning choice of destination by the attending anaesthesiologist. However, due to long transportation distances even in helicopter, the explanation may be more complex than poor identification of severely injured patients.

When discussing the expected rate of anaesthesiologist/HEMS presence in the pre-hospital setting, one may argue that 'load-and-go' is the preferred transportation method for severely injured patients, and that no injured patient should wait for an anaesthesiologist at the scene. Still, in the vicinity of the major hospitals, anaesthesiologist-staffed emergency vehicles are available and able to provide on-scene treatment quickly. Thus, we would have expected a higher rate of advanced pre-hospital treatment even in cities.

Limitations

Data for this study were provided from all hospitals with existing local registries for 2013. A recent study estimated that the annual number of trauma alarms in all Norwegian hospitals in 2012 was approximately 6600, of which 33% were at trauma centres and 66% at acute care hospitals.[28,29] This figure includes secondary transfers within the first 24 h after injury. We found 3535 primary admissions from 75% of the trauma centres and 53% of the acute care hospitals with responsibility for trauma cases. We have no reason to believe that the lack of data from the remaining trauma centre and 16 acute care hospitals skewed our findings in a systematic fashion.

Inclusion of patients and information about injury severity and the admission process was collected retrospectively. Ideally, the study should have included consecutive severely injured patients through the EMCC system and recorded the decisions made and advice given regarding pre-hospital handling. This was not possible with the design applied.

Conclusion

This study found that advanced pre-hospital treatment and/or transportation led by anaesthesiologists was offered to 51% of severely injured trauma victims in Norway. The frequency varied between victims admitted directly to trauma centres and victims admitted to acute care hospitals with a defined trauma function. If a survival benefit of the service is expected better precision in dispatch or better availability should be aimed at.

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