

# Implementation of a trauma system in Norway: a national survey

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**Background:** Trauma systems have improved outcomes for injured patients, but might be challenging to implement. We assessed the implementation of a trauma system in Norway after recommendations for a national trauma system were published in 2007, with a focus on elements in acute care hospitals.

**Methods:** All hospitals in Norway, except for the four regional trauma centres, admitting injured patients at the time of the study were included in a telephone survey. The questionnaire was administered during May 2013 by the regional trauma coordinators who interviewed the local trauma coordinator and/or the local doctor responsible for trauma care in all the acute care hospitals. The main categories were availability of the trauma team and team training, written procedures, preparedness and training of personnel. The compliance to a set of 17 predefined trauma system criteria was evaluated at each institution.

**Results:** Of the 35 acute care hospitals in Norway admitting trauma patients at the time of the survey, all were included. The median number of fulfilled criteria was 14. Major deficiencies were found in fulfilling competence criteria, maintaining a local trauma registry, and trauma audits. The number of fulfilled criteria correlated strongly with the size of the hospital and the frequency of trauma team activation.

**Conclusions:** Shortcomings in requirements for lower-level trauma care hospitals correlate to hospital size and frequency with which the trauma team is activated. In order to fulfill the minimum requirements, smaller hospitals should receive more attention.

## Editorial comment: what this article tells us

Six years after it was decided to implement a national trauma system, acute care hospitals in Norway generally fulfil the list of criteria in that system. Some aspects, however, were less well covered, such as use of trauma registries, trauma audits and training of personnel.

Formalised trauma systems have been shown to increase the quality of care given to severely injured patients.<sup>1-4</sup> According to one survey from 2005, the development of trauma systems seemed to be more advanced in the central states of Europe and less developed in others, including the Scandinavian countries.<sup>5,6</sup> Several factors that might affect the implementation of a trauma system have been identified. Factors that facilitate the process include research documenting the need for changes in existing care, continuous surveillance and quality improvement, and broad-based leadership.<sup>7-9</sup> Factors inhibiting the process include lack of financial resources and political will, and resistance against the centralisation of healthcare services.<sup>7,10,11</sup>

Two major drivers influenced trauma care improvement in Norway prior and parallel to the implementation of a national trauma system. Continued interest and leadership from the trauma centre in Oslo have resulted in a number of publications focusing on trauma care and the need for improvement.<sup>9,12-14</sup> A local initiative introducing multi-professional trauma team training using simulations developed from the northernmost hospital in Norway in 1997.<sup>15-17</sup>

In 2007, a multi-professional, national working group presented a proposal for a national trauma system in Norway to the regional health trusts.<sup>18</sup> Between 2008 and 2012, the boards of the four health regions in Norway decided to adopt and implement the trauma system in their region. However, regional interpretations of the recommended requirements for the trauma system varied significantly. This is currently a main focus for ongoing coordination efforts in addition to developing specific requirements to be used in the certification process for the regional trauma centres.

Two months after the decision to implement a trauma system in the South-Eastern Norway Regional Health Authority (December 2010), Kristiansen et al. performed a survey documenting a shortcoming in the training of personnel and protocols for inter-hospital transfer.<sup>19</sup> The aim of the present study is to describe the results of a similar survey performed on a national level, and to present the status in 2013 regarding elements of the trauma system relevant to acute care hospitals in Norway. Because the trauma system proposal fails to describe requirements for the regional trauma centres, this study only addresses

acute care hospitals that admitted trauma patients at the time of the survey.

## Methods

The mainland of Norway covers an area of 385,178 km<sup>2</sup> and had 5,051,000 inhabitants in 2013 (<https://www.ssb.no/befolkning/statistikker/folkber>). The Norwegian trauma system model comprises four regional health authorities with independent trauma systems, including two levels of receiving hospitals. The four regional trauma centres have all the medical and surgical specialities, including interventional vascular services and advanced intensive care units, similar to the level I and II trauma centres described by the American College of Surgeons Committee on Trauma (ACS-COT).<sup>8</sup> The acute care hospitals have 24-h general surgical services, and have the capabilities to stabilise trauma patients before transfer to the trauma centre if needed. The acute care hospitals are similar to the level III centres described by ACS-COT.<sup>8</sup> At the time of the study, no trauma certification system existed for any of the described hospital levels in Norway.

## Data collection

Data were collected by telephone during May 2013 by the regional trauma coordinators. They interviewed the local trauma coordinator and/or the local doctor responsible for trauma care at all the acute care hospitals. The questionnaire used in this survey is presented in Table 1. Specific dates were used to register the competency available at particular times. In addition, the number of times the trauma team was activated [trauma team activation (TTA)] in the four trauma centres was recorded.

## Variables

Kristiansen et al. performed a survey in January 2011, mapping the status of one of the regional trauma systems in Norway, and identified 17 criteria for acute care hospitals in their assessment of the recommended trauma system (Table 1).<sup>18,19</sup> The same criteria are used in this study, and are divided into groups. Criteria 1-5 assess the trauma team and trauma team training, criteria 6-8 assess high-cost preparedness, criteria 9-10

**Table 1** Questionnaire used in the survey.

Item no.	Criteria	Definitions
1	Defined TT	A defined multidisciplinary group of personnel receives trauma patients
2	TT activation criteria	Predefined and written criteria activates the TT
3	TT activation < 15 min	The time to assemble the TT is within 15 min
4	TT available 24 h	The TT is accessible around the clock
5	TT training	There are regular training sessions for the TT with a minimum frequency of two times per year. TT training is based on the principles described by the BEST foundation <sup>16</sup>
6	ED < 15 min	The emergency room is ready within 15 min
7	OR < 15 min	The operating theatre is ready within 15 min
8	CXR < 15 min	A chest x-ray is taken and made accessible within 15 min
9	Trauma Protocol	There is a written trauma protocol describing the management of major trauma
10	Trauma Checklist	A checklist is used for guiding and documenting the management of the trauma patient in the ED
11	Transfer Criteria	There are written criteria for transfer of patients to a higher level of care
12	Trauma Registry	The hospital record data of trauma patients is kept in a dedicated registry
13	Trauma Audits	The hospital conducts regular morbidity and mortality meetings. The meetings are multidisciplinary audits where management of the hospital's trauma patients are discussed. The minimum frequency is two times per year.
14	Trauma Team leader ATLS course	The leader of the TT is required to have attended the ATLS course
15	Trauma Team leader Haemostatic surgery course	The trauma team leader is required to have attended the DSTC course or equivalent haemostatic emergency surgery course
16	Anaesthesiologist ATLS course	The trauma team senior anaesthesiologist is required to have attended the ATLS course
17	Trauma nursing course	Minimum of one of the trauma team nurses is required to have attended the TNCC course or equivalent

TT, trauma team; BEST, better and systematic team-training; ED, emergency department; OR, operating room; CXR, chest x-ray; ATLS, advanced trauma life support; DSTC, definitive surgical trauma care; TNCC, trauma nursing core course.

assess the hospital's written trauma procedures and criteria 14–17 assess the training of personnel. Acute care hospitals were categorised as small, medium or large hospitals according to the annual number of TTAs; < 100 TTAs was considered small, 100–200 TTAs was considered medium and > 200 TTAs was considered a large acute care hospital. The hospitals were similarly categorised based on the size of the hospital's catchment population: < 100,000 was considered small, 100,000–200,000 was considered medium and > 200,000 was considered large.

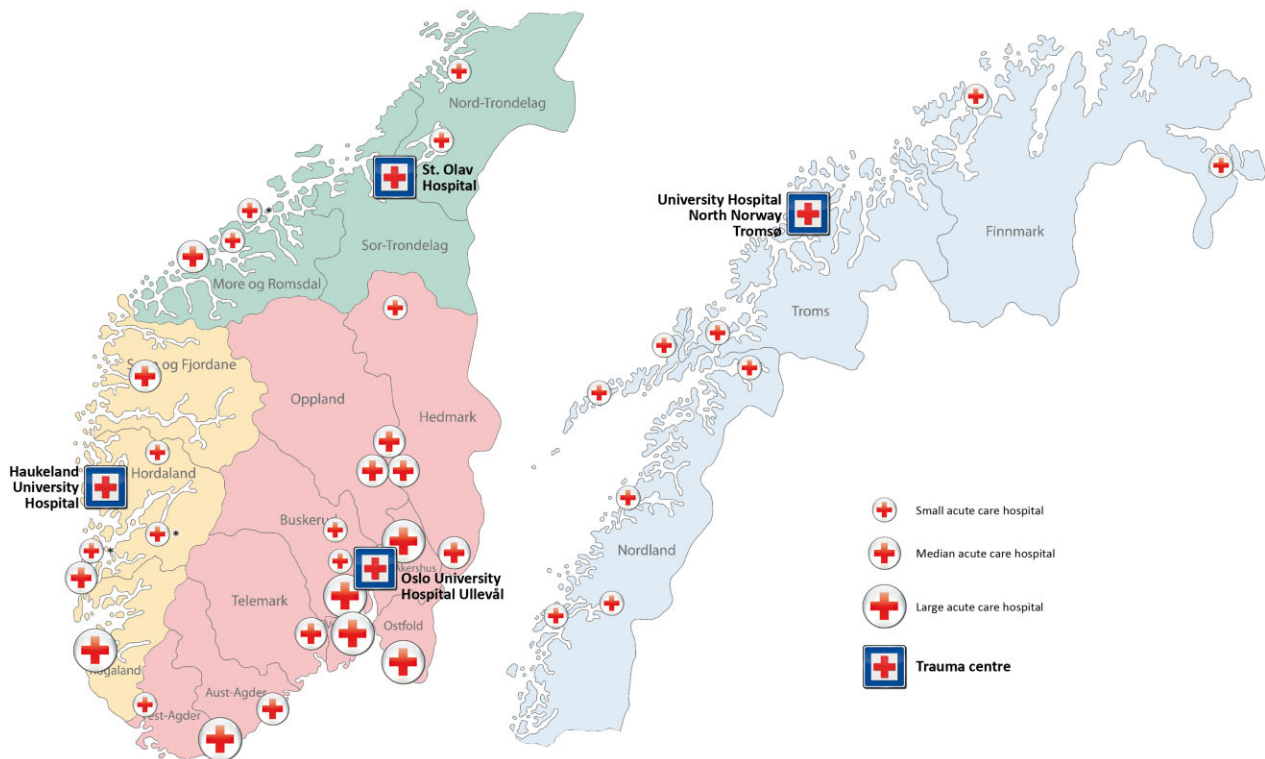
### Statistical analysis

Results are presented as the sum, frequency, percentage and median with interquartile range (IQR). Pearson correlations were computed to examine the relationships between the number of TTAs at the acute care hospitals and the fulfilment of the criteria listed in Table 1. The correlation between the hospitals' catchment area and the

number of criteria fulfilled was also analysed. According to Cohen's criteria, correlations  $\geq 0.50$  are considered large,  $< 0.50$ – $0.30$  medium and  $< 0.30$  small.<sup>20</sup> SPSS v. 21.0 (IBM Company, Chicago, IL, USA) was used for all analyses. Significance was assumed for  $P < 0.05$ .

### Results

The 39 hospitals in Norway admitting trauma patients at the time of the survey comprised 4 trauma centres and 35 acute care hospitals (Fig. 1). Approximately 7000 patients with potentially severe injuries are admitted annually in Norway. The regional trauma centres account for approximately 2500 of these, whereas about 4500 patients are primarily transported to the acute care hospitals. Of the 35 acute care hospitals, 20 (57%) received fewer than 100 patients during the 12 months preceding the study. The number of TTAs for each of the hospitals is given in Table 2. Overall, the number of fulfilled criteria



**Fig. 1.** Location of Norwegian acute care hospitals. Trauma teams are activated < 100 times per year at the small hospitals, 100–200 times at medium-sized hospitals and > 200 per year at the large hospitals. \*No longer receives trauma patients.

increased with increasing numbers of TTAs at each hospital, with a correlation coefficient of 0.510 ( $P < 0.01$ ). The correlation between the hospitals' catchment population and number of fulfilled criteria was similar, with a coefficient of 0.463 ( $P < 0.01$ ).

All included hospitals had 24-h emergency admission available for both surgical and trauma patients. All senior surgeons were on call from home during the evening and night, with a response time of 30 min. In 11 (31%) of 35 hospitals, the senior anaesthesiologist was on call in-house for 24 h. For the remaining 24 (69%) hospitals, the senior anaesthesiologist was on call from home with a response time of 15 or 30 min.

Of the 17 trauma system criteria, the median fulfilment rate for the hospitals was 14 (IQR 11, 15), ranging from 11 (IQR 9.5, 11), in the Northern Norway Regional Health Authority to 15 (IQR 14, 16) in the South-Eastern Norway Regional Health Authority. Details are provided in Table 3.

### Trauma teams

The criteria regarding the trauma team were to a great extent fulfilled. The hospitals that did not fulfil all the criteria were primarily the small hospitals where a major part of the trauma team members was on call from home, with a response time of 30 min.

### Material resources

The criteria concerning material resources were generally well covered except in the Northern Norway Regional Health Authority, which comprises many small hospitals. Again, radiology service in the emergency room and the personnel necessary to prepare the operating room were on call from home in the evening and night in eight of nine acute care hospitals, potentially delaying these procedures.

### Protocol and checklist

A high fulfilment rate of 96% was reported concerning protocols and checklists.

**Table 2** An overview of 35 acute care hospitals in Norway according to region, catchment population and number of trauma team activations (TTA) per year. Percentage is proportion of all 35 hospitals.

Region	Regional population	Number of TTA at the regional trauma centre	Number of regional acute care hospitals	Number of small acute care hospitals with number of TTA < 100	Number of medium acute care hospitals with number of TTA ≤ 200	Number of large acute care hospitals with number of TTA > 200	Nr of acute care hospitals with population ≤ 100,000	Number of acute care hospitals with < population < 200,000	Number of acute care hospitals with population > 200,000
South-Eastern Norway Regional Health Authority	2,785,000	1600	15 (43%)	4 (11%)	6 (17%)	5 (14%)	6 (17%)	4 (11%)	5 (14%)
Western Norway Regional Health Authority	1,042,000	473	6 (17%)	3 (9%)	2 (6%)	1 (3%)	3 (9%)	2 (6%)	1 (3%)
Central Norway Regional Health Authority	688,000	258	5 (14%)	4 (11%)	1 (3%)	–	3 (9%)	2 (6%)	–
Northern Norway Regional Health Authority	471,000	140	9 (26%)	9 (26%)	–	–	9 (26%)	–	–

TTA, trauma team activation.

### Transfer criteria

For the different regions, 80% or more of the hospitals had developed transfer criteria.

### Trauma registry

A trauma registry was present in approximately two thirds of the hospitals with no correlation for the presence of a registry with hospital size.

### Trauma audits

Trauma audits were absent in the Northern Norway Regional Health Authority, but was present in 73% of the acute care hospitals in the South-Eastern Norway Regional Health Authority. Again, small hospitals seemed to be responsible for the low completion rate.

### Training of personnel

Competence and training criteria were fulfilled for half the hospitals, ranging from one third of the hospitals in the Western Norway Regional Health Authority to two thirds of the hospitals in the South-Eastern Norway Regional Health Authority.

### Discussion

Six years after a national trauma system was proposed the acute care hospitals in Norway had, to a great extent, fulfilled the criteria regarding the trauma team with defined members, activation criteria, availability and response time. Criteria regarding material resources seemed to be fulfilled in accordance with the size of the hospital. Smaller hospitals tended to have key personnel on call from home, thereby potentially delaying the immediate availability of the emergency room, operating room and radiological imaging. Transfer criteria and protocols/checklists seemed to be well covered. The major shortcoming was the low number of local trauma registries, trauma audits and the more costly training of personnel. Kristiansen et al. reported in 2012 a median of 12 of 17 criteria fulfilled in the 19 acute care hospitals in the South-Eastern Regional Health Authority, but with no correlation to the size of the hospitals.<sup>19</sup> Our study suggests an improvement

**Table 3** Fulfilment of trauma care criteria in all 35 acute care hospitals in Norway.

	Proportion of fulfilled criteria in acute care hospitals (%)				
	All, <i>n</i> = 35	South-Eastern Norway Regional Health Authority, <i>n</i> = 15	Western Norway Regional Health Authority, <i>n</i> = 6	Central Norway Regional Health Authority, <i>n</i> = 5	Northern Norway Regional Health Authority, <i>n</i> = 9
Trauma team (criteria 1–5)	94	99	87	100	80
Material Resources (criteria 6–8)	84	100	94	100	41
Protocol and checklist (criteria 9–10)	96	100	92	100	89
Transfer criteria (criterion 11)	86	93	100	80	100
Trauma registry (criterion 12)	63	67	33	60	78
Trauma meetings (criterion 13)	43	73	17	60	0
Training of personnel (criteria 14–17)	53	65	33	45	50

with time, with a median fulfilment of 15 of 17 criteria in the current 17 acute care hospitals.

Only one third of trauma patients are admitted directly to the regional trauma centres. Thus, two thirds of all trauma patients are admitted to other acute care hospitals, which mandate that efforts be made to optimise trauma care in these hospitals. The lack of fulfilled criteria in hospitals with few TTAs is concerning, especially the lack of training, which is even more necessary to compensate for a small number of TTAs.

For smaller hospitals, it is a challenge to fulfil all trauma system criteria and give appropriate care to trauma patients at all times. As a minimum, there has to be support from the leadership, and the necessary resources to achieve and maintain this competency. In addition, several smaller hospitals rely partly on visiting part-time personnel in order to maintain a 24-h surgical service, and it seems to be difficult to recruit competent personnel. Since the time of the study, three hospitals with fewer than 100 TTAs per year no longer admit trauma patients due to regional decisions to discontinue a 24-h surgical service (Fig. 1). Trauma patients are now redirected to the other hospitals in their region, despite long transport distances and inclement weather conditions that restrict the use of airborne ambulances (Fig. 1).<sup>21</sup> There is a potential for increased experience and care levels with such adjustments, and this trend might continue.

The regional trauma centre in Oslo has maintained a trauma registry since 2000, enabling trauma researchers to present several important studies showing the results of the trauma

centre.<sup>9,22</sup> However, to assess the trauma system, including prehospital services, acute care hospitals, transfers and rehabilitation, a registry covering the whole region is necessary. A national trauma registry has been proposed as part of the Norwegian trauma system.<sup>18</sup> The registry is under development and according to schedule should be collecting data by the end of 2014. This would enable continuous surveillance and a basis for quality improvement.

### Limitations

The data in this study are based on telephone interviews with the regional trauma coordinators and regional doctors responsible for trauma care. This method might be limited by communication difficulties such as unforeseen ambiguity in the questions. However, the interviewer was free to elaborate on any potential misunderstanding, and the full-time employed regional trauma coordinators have a thorough knowledge of hospitals in their area.

The items 3, 6, 7 and 8 might include a report bias, as the given time intervals are required intervals and not actually measured intervals.

The criteria represent measurable parts of infrastructure, members of personnel, criteria for activation and courses. However, none of these criteria are measures of quality of care or patient outcome.

The resources available in acute care hospitals vary, mostly due to changes in personnel. Therefore, there is a risk of bias in the answers, which might result in a higher level of reported trauma

competence than available at all times. We tried to reduce this bias by asking about the competency available on specific dates in the proximity of the interview.

This study focuses only on the in-hospital non-trauma centre component of the trauma system. Several other components of the trauma system, like the trauma centres, pre-hospital care, definitive care facilities, disaster preparedness, finances, research and information systems, are not evaluated, but will be the focus of future assessments.<sup>8,23</sup>

## Conclusion

Of the 17 predefined criteria, the median fulfilment rate of acute care hospitals in the Norwegian trauma system was 14. There is a significant need for personnel training to fulfil the competency criteria. Furthermore, there is a need for quality improvement including trauma audits as well as local trauma registries. There is a significant correlation between the number of fulfilled criteria and the hospitals' catchment population and the corresponding number of TTAs.

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