Prehospital trauma care among 68 European neurotrauma centers: Results of the CENTER-TBI Provider Profiling Questionnaires

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Grant of financial support
Data used in preparation of this manuscript were obtained in the context of CENTER-TBI, a large collaborative project with the support of the European Commission 7th Framework program (602150).

Author contribution
FL and AIRM developed the idea for current paper. MC and RvB analyzed the data and wrote the first draft of the manuscript. RvB designed figure 1. All authors were involved in the development of the questionnaire, critically commented on the manuscript and approved the final version.

Abstract

The first hour following traumatic brain injury (TBI) is considered crucial to prevent death and disability. It is however not established yet how the prehospital care should be organized to optimize recovery during the first hour. The objective of the current study was to examine variation in prehospital trauma care across Europe aiming to inform comparative effectiveness analyses on care for neurotrauma patients.
A survey on prehospital trauma care was sent to 68 neurotrauma centers from 20 European countries participating in the CENTER-TBI study. The survey was developed using literature review and expert opinion and was pilot-tested in 16 centers.
All participants completed the questionnaire. Advanced life support was used in half of the centers (n=35, 52%), whereas the other centers used mainly basic life support (n = 26, 38%). A mobile medical team (MMT) could be dispatched 24/7 in most centers (n=66, 97%). Helicopters were used in approximately half of the centers to transport the MMT to the scene (n=39, 57%) and the patient to the hospital (n=31, 46%). Half of the centers used a stay-and-play approach at the scene (n=37, 55%) while the others used a scoop-and-run approach or another policy.
We found wide variation in prehospital trauma care across Europe. This may reflect differences in socio-economic situations, geographic differences and may also reflect a general lack of strong evidence for some aspects of prehospital care. The current variation provides the opportunity to study the effectiveness of prehospital interventions and systems of care in comparative effectiveness research.

Keywords
Traumatic brain injury; prehospital trauma care; survey; Europe; Comparative effectiveness research

Introduction

Trauma is a major cause of death and disability worldwide. Each year, approximately five million people die from injuries and many more are permanently or temporarily disabled.[1] Traumatic brain injury (TBI) is a contributing factor in one-third of all injury-related deaths.[2] As a consequence, improving care for patients with TBI may reduce the burden of trauma.

Care for trauma patients starts at the scene and the first hour following trauma, often referred to as the "golden hour", is considered crucial to prevent death and disability.[3] It is however not established yet how the prehospital care should be organized to optimize recovery during the first hour. Some advocate that advanced care (e.g. endotracheal intubation, intravenous fluid infusion, administrating medication) should start at the scene (usually referred to as a stay-and-play approach),[4] whereas others contend that trauma patients benefit most from prompt transport to the hospital for definitive care (usually referred to as scoop-and-run approach).[5] In addition, the effectiveness of dispatching systems, advanced life support required training for para(medics), and the use of helicopter services is uncertain.[6]

The aim of the current study was to examine variation in prehospital trauma care across Europe by sending a survey to 68 neurotrauma centers participating in the Collaborative European Neurotrauma Effectiveness Research in Traumatic Brain Injury (CENTER TBI) study. The results of this study will be used to inform comparative effectiveness analyses by identifying prehospital management styles that show substantial between-center variation. Once the CENTER-TBI patient-level data becomes available, comparative effectiveness of these prehospital management styles will be studied.

Methods

Study sample

Participants from centers participating in the CENTER TBI study (https://www.center-tbi.eu) were approached to complete a set of questionnaires about their treatment policies during the prehospital and emergency department care, hospital- and ICU admission and rehabilitation care. These centers comprised of 68 neurotrauma centers from 20 European countries, including Austria (n = 2), Belgium (n = 4), Bosnia Herzegovina (n = 2), Denmark (n = 2), Finland (n = 2), France (n = 7), Germany (n = 4), Hungary (n = 2), Israel (n = 2), Italy (n = 9), Lithuania (n = 2), Latvia (n = 3), the Netherlands (n = 7), Norway (n = 2), Romania (n = 1), Serbia (n = 1), Spain (n = 4), Sweden (n = 2), the United Kingdom (UK; n = 9) and Switzerland (n = 1).[7] They were mainly level I trauma centers with an academic affiliation from an urban region [7]. All centers provided ethical approval for the CENTER-TBI study.

Questionnaire development and administration

Questionnaires were developed through a comprehensive process including a literature study and expert opinion meetings, which has been described previously.[7] The questionnaires were pilot-tested in 16 of the participating centers. Reliability of the questionnaires, which was assessed by the addition of 5% duplicate questions, was adequate (median concordance rate: 0.85).

One of the questionnaires included 21 multiple-choice questions on prehospital trauma care, including dispatch systems, emergency services, target times, and prehospital policies (Supplement 1).

Participants were informed about the questionnaires by presentations, workshops and emails. The set of questionnaires was distributed via a web-based program (Quesgen Inc.) and participants were asked to coordinate the completion by involving subject experts from their center.

Analyses

Descriptive statistics were used to obtain frequencies and percentages. We assessed whether there were differences between geographic locations in prehospital trauma care. Hereto, countries were grouped into seven geographic regions based on the United Nations geo-scheme: Northern Europe (Norway, Sweden,

Finland and Denmark), Western Europe (Austria, Belgium, France, Germany, Switzerland and the Netherlands), the UK, Southern Europe (Italy and Spain), Eastern Europe (Hungary, Romania, Serbia and Bosnia Herzegovina), Baltic States (Latvia and Lithuania) and Israel. In addition, to examine the effect of socioeconomic situation on prehospital trauma care, we divided countries into "relatively high-income countries" and "relatively lower-income countries" based on a 2007 report by the European Union.[8] The countries Bosnia-Herzegovina, Bulgaria, Hungary, Latvia, Lithuania, Romania and Serbia were subsequently classified as relatively lower-income countries. We used Chi-Square test, and if appropriate Fisher's exact test to assess whether there were any significant differences in prehospital trauma care.All analyses were performed using Statistical Package for Social Science (SPSS) version 23.

Results

Dispatching systems

Participants from all eligible centers completed the questions on prehospital trauma care (n = 68, 100%). Of the 20 countries, 14 (70%) had a single central telephone number for all emergency services. The majority of the countries (n = 12, 60%) had implemented a selective dispatching system, meaning that dispatching depends on the nature and urgency of the reported incident. In 60% of the countries (n = 12), dispatch personnel received specialized training for medical dispatching (Supplement 2).

Initial prehospital response

Half of participants (n = 35, 52%) indicated that their centers use advanced life support (ALS) in calls where there is no indication for a mobile medical team (MMT) or medical emergency response team (MERIT). Basic Life Support (BLS) was used in 26 (38%) centers and the remainder indicated that a crew without training in clinical interventions or other types of life support were sent to the trauma scene (Table 1). Across Europe, participants from Northern Europe, the UK, the Baltic States and participants from Israel mainly used ALS, whereas participants from Southern- and Eastern Europe mainly used BLS (Supplement 3). In Western Europe, there was a more equal distribution between ALS and BLS, with Austria, Germany, the Netherlands and Switzerland using mainly ALS and Belgium and France using mainly BLS.

During the initial prehospital response (ALS or BLS), the majority of participants indicated that BLS to support vital signs would be used (n = 65, 96%), medication could be administered (n = 41, 60%), intravenous fluids could be infused (n = 42, 62%), cardioversion could occur (n = 48, 71%) and medical interventions could be prepared (n = 44, 65%). A minority of participants additionally indicated that intubation without drugs was possible (n = 29, 43%), or chest drain insertion (n = 9, 13%) or to perform other interventions, including spinal immobilization, splints backboards and pain control.

Regarding the training for ambulance personnel, one-third (n = 24, 35%) indicated that they required a paramedic training for emergency medicine. Other participants indicated nursing with additional training in critical care, BLS training, basic training for emergency medical technician or another training. For ambulance drivers, half of the participants indicated that they required specialized driving skills training in combination with BLS training (n = 35, 52%; Table 1).

Advanced response

In the large majority of centers, an MMT/MERIT can be dispatched 24/7 (n = 60, 88%). Indications for sending an MMT/MERIT include the presumption of central nervous damage (n = 52, 77%), severe bleeding (n = 58, 85%), an unresponsive patient (n = 58, 85%), respiratory distress (n = 53, 78%), entrapment (n = 51, 75%), multiple causalities (n = 66, 97%) and the presumption of cardiac arrest (n = 50, 74%; Table 2). In addition, some participants indicated to send an MMT / MERIT at each road traffic collision (n = 10, 15%), in sports trauma (n = 7, 10%) or in elderly patients with a fall accident (n = 11, 16%).

Helicopters are used as the general policy in approximately half of the centers (Table 2). Indications for sending a helicopter to the scene included the presumption of central nervous damage (n = 30, 44%), severe bleeding (n = 36, 53%), low GCS (n = 33, 49%), respiratory distress (n = 38, 41%) or multiple causalities (n = 37, 54%;

Table 2). The person who makes the decision to send an MMT or helicopter to the scene is the dispatcher in half of the centers (n = 34). Other participants indicated that the ambulance or doctor at the scene, first responders or the trauma cell made this decision (Supplement 4).
With regard to the specialists involved in the MMT or helicopter service, the majority of participants indicated that anesthesiologists (n = 53, 78%) and emergency physicians (n = 50, 59%) were generally included, whereas general surgeons, trauma surgeons, neurosurgeons and cardiologists are only represented in a minority of centers (Supplement 5).

Policy at the scene

Approximately half of the participants indicated to generally use a scoop-and-run policy, whereas the other half has a stay-and-play approach (Table 2). Across Europe, a scoop-and-run approach is mainly used in the UK, the Baltic States and Israel. In Western Europe, Southern Europe and Eastern Europe a stay-and-play approach is the main policy (Figure 1). In Northern Europe, half of the centers have a scoop-and-run approach, with Denmark having mainly a stay-and-play approach and Finland using mainly scoop-and-run. In Norway and Sweden, there was within-country variation in the approach at the scene.
For the evaluation of neurological status at the scene, in all but one center (n = 67, 99%) the Glasgow Coma Scale (GCS) was used. The AVPU is used in 29 (43%) centers and other assessment scales are only seldom used. Most participants (n = 50, 73%) indicated that a selected patient population is sent to the trauma center and others are sent to the closest hospital. To select patients that should be transported to a trauma center, in half of the centers (n = 36, 53%) a structured approach is implemented, whereas in other centers this is determined by the doctor at the scene or the ambulance personnel (Table 2).

Target times

The target time between the call for help and arrival at the scene is < 10 minutes in 28 (41%) of the centers and < 15 min in 25 (37%) centers. Others indicated smaller or larger target times or no target time at all. For working at the scene and transport from the scene to the hospital, half of the participants indicated that they have no target time. Others indicated target times <10 min, <15 min or < 20 minutes (Supplement 6).

The influence of socio-economic situation

There were no statistically significant differences between relatively high-income countries and relatively lower-income countries in the basic type of response (ALS vs. BLS) or in the general policy at the scene (scoop-and-run vs. stay-and-play), although there was a trend towards a higher percentage of ALS and stay-and-play in the higher-income countries. Participants from relatively higher-income countries indicated substantially more often that an MMT/MERIT could be dispatched 24/7 (100% vs. 82%, p = .02) and that helicopters were used to transport the MMT to the scene (67% vs 10%, p < .01) or the patient to the hospital (54% vs 0%, p < .01).

Discussion

We found wide variation in the prehospital management of trauma patients across Europe, e.g. approximately half of the centers reported dispatching a BLS crew to the trauma scene, whereas the other half involve an ALS crew. In addition, there was variation in requirements for training, the use of helicopter services, the policy at the scene and target times.

The substantial variation in prehospital care across Europe may partly reflect differences in socio-economic situations between countries. For instance, we found that the MMT and helicopters are dispatched significantly more often in relatively higher-income countries compared to relatively lower-income countries. This is in line with a recent systematic review that reported that trauma systems are often well-organized in high-income countries, but absent or less organized in lower-income countries.[9] This may drastically influence outcome of trauma patients.(REF: Dijkink).

Variation might further be related to differences in geographic situations, includinge.g. difference in mean travel distance from scene to the hospital, islands and climate. In addition,, it may also reflect the general lack of strong evidence for some aspects of prehospital care. Systematic reviews on prehospital trauma management have resulted in conflicting results and for many interventions, including endotracheal intubation, intravenous access, administration of medication and fluid therapy, benefits are unclear.[5, 10-12] In addition, the comparative effectiveness of BLS vs. ALS and scoop-and-run vs. stay-and-play have never been studied in a prospective, randomized controlled trial. The uncertainty on the effectiveness of prehospital trauma care is reflected in the large between-center variation for these strategies.

The strengths of this study include the comprehensive development process of the survey and the 100% response rate. An important limitation, which is inherent to a survey-design, is that we presented results that were reported by the participants rather than results that were directly observed. Consequently, we cannot exclude the possibility that participants presented a more favourable picture or presented personal experiences rather than the general prehospital policy in their hospital/region. Another limitation concerns the representativeness of the sample. The participating centers were mostly level I trauma centers with an Academic affiliation and many were specialized in neurotrauma. Therefore, the representativeness to all European centers or to general trauma centers is unclear.

A promising approach in examining the evidence for these differing approaches to prehospital trauma care is comparative effectiveness research (CER). CER is a relatively novel approach and exploits current practice variation to estimate the effectiveness of individual interventions or systems of care. The CENTER-TBI study is planning to use CER methodology to study the effectiveness of prehospital trauma care in patients with severe TBI. Topics of interest include ALS vs. BLS as primary response, the use of helicopter services vs. ground transport and a scoop-or-run vs. a stay-and-play policy at the scene.

Conflicts of interest

The authors declare that they have no competing interests.

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Table 1. Initial prehospital response among 68 neurotrauma centers

Variable	N (%)
Basic type of response that is send to the trauma scene when there is no indication for MMT/MERIT [ǂ]	
• Basic Life Support crew	26 (38%)
• Advanced Life Support crew	35 (52%)
• Crew without training in clinical interventions	2 (3%)
• Other [A]	5 (7%)
Actions performed by ambulance personnel during basic type of response*	
• Transportation of the patient	68 (100%)
• BLS, support vital signs without specialized medical equipment	65 (96%)
• Administering medication	41 (60%)
• Intubation without drugs	29 (43%)
• Placing chest drainage	9 (13%)
• Infusion of fluids	42 (62%)
• Cardioversion	48 (71%)
• Preparation of medical interventions	44 (65%)
• Other [B]	6 (9%)
Required training for ambulance personnel	
• Nursing with additional training in critical care	10 (15%)
• Basic Life Support / first aid training	14 (21%)
• Training emergency medical technician (basic)	9 (13%)
• Training emergency medical technician (paramedic)	24 (35%)
• Other [C]	11 (16%)
Required training for ambulance drivers	
• No training / the required training for ambulance personnel	7 (10%)
• Specialized driving skills training	2 (3%)
• Specialized driving skills training and training for ambulance personnel	19 (28%)
• Specialized driving skills training and basic life support training	35 (52%)
• Other [D]	5 (7%)

*More than one answer could be selected

[ǂ] Basic Life Support = the use of non-invasive techniques, such as non-invasive cardiopulmonary resuscitation, external hemorrhage control and supplemental oxygen administration; Advanced life support = basic life support with the additional use of more advanced techniques such as intubation, administration of medication, chest tubes and intravenous access

[A] Ambulance with specially trained nurse, anesthetic nurse, prehospital trauma life support

[B] spinal immobilization, limb splint, pain control

[C] ALS, anesthetic nurse, depends on the type of ambulances, emergency department nurse

[D] EMT/basic, paramedic, unknown

Abbreviations: BLS = basic life support; MERIT = medical emergency response incident team; MMT = mobile medical team

Table 2. Advanced response among 68 neurotrauma centers

Variable	N (%)
MMT / MERIT can be dispatched 24/7 †	66 (97%)
Helicopter is used to transport MMT to the scene †	39 (57%)
Helicopter is used to transport patient to the hospital †	31 (46%)
Criteria for sending an MMT*	
• At each road traffic accident	10 (15%)
• The presumption of central nervous damage	52 (77%)
• Severe bleeding	58 (85%)
• Low GCS / unresponsive patient	58 (85%)
• Respiratory distress	53 (78%)
• Entrapment	51 (75%)
• Major incident / multiple causalities	66 (97%)
• The presumption of cardiac arrest	50 (74%)
• Sports trauma	7 (10%)
• Elderly person with fall accident	11 (16%)
• Other [A]	14 (21%)
Criteria for sending a helicopter*	
• At each road traffic accident	1 (2%)
• The presumption of central nervous damage	30 (44%)
• Severe bleeding	36 (53%)
• Low GCS / unresponsive patient	33 (49%)
• Respiratory distress	28 (41%)
• Entrapment	22 (32%)
• Major incident / multiple causalities	37 (54%)
• The presumption of cardiac arrest	23 (34%)
• Sports trauma	2 (3%)
• Elderly person with fall accident	3 (4%)
• Other [B]	16 (24%)
General policy at the scene ǂ	
• Scoop-and-run	28 (41%)
• Stay-and-play	37 (55%)
• Other [C]	3 (4%)
Method used to evaluate the neurological status of the patient at the scene*	
• GCS	67 (99%)
• AVPU	29 (43%)
• ACDU	3 (4%)
• Simplified motor score	4 (6%)
• FOUR score	1 (2%)
• RLS85	1 (2%)
Transfer of the patient to the hospital	
• Mostly to the hospital closest to the scene	6 (9%)
• Mostly to a trauma center / major hospital	12 (18%)
• Selected patient population is sent to the trauma center, others are sent to the closest hospital	50 (73%)
Selection of patients for transport to trauma center	
• Structured approach (e.g. GCS, trauma score)	36 (53%)
• Choice of doctor at the scene	18 (26%)
• Choice of ambulance personnel	4 (6%)
• Other [D]	10 (15%)

*More than one answer could be selected

† Centers that selected 'Always' and 'Often'

ǂ Scoop and run = the point of focus is the speed of response and transport, the aim is to transport the patient as fast as possible to the hospital; Stay and play = the point of focus is to initiate primary treatment and stabilize the patient before transport

[A] ASCOT criteria, burns/amputations, chest pain, high energy accident, high-speed accident, major trauma triage tool, mechanism of injury, vital signs, subjective reasons

[B] burns/amputations, depends on location of accident and distance, on islands

[C] unknown, depends on situation and risk assessment, both

[D] dispatch center, central allocation, local trauma center protocol, mechanism of injury

Abbreviations: ACDU = Alert Confused Drowsy Unresponsive; AVPU = Alert Voice Pain Unresponsive; BLS = basic life support; FOUR = Full Outline of Unresponsiveness; GCS = Glasgow Coma Scale; MERIT = medical emergency response incident team; MMT = mobile medical team; RLS = Reaction Level Scale;

Table 3. Differences between relatively high-income countries and relatively lower-income countries in the prehospital care for patients with traumatic brain injury

Variable	Relatively high-income countries (n = 57)	Relatively lower-income countries (n = 11)	p-value
Basic type of response			
• BLS	21 (37%)	5 (46%)	.73*
• ALS	30 (53%)	5 (46%)	
• Crew without training in clinical interventions	1 (2%)	1 (8%)	
• Other	5 (8%)	0 (0%)	
Advanced type of response			
MMT / MERIT can be dispatched 24/7	57 (100%)	9 (82%)	.02
Helicopter is used to transport MMT to the scene	38 (67%)	1 (10%)	< .01
Helicopter is used to transport patient to the hospital	31 (54%)	0 (0%)	< .01
General policy at the scene			
• Scoop-and-run	21 (37%)	5 (46%)	.75**
• Stay-and-play	31 (55%)	6 (54%)	
• Other	5 (8%)	0 (0%)	

*Fisher's exact test for the comparison BLS vs ALS (exclude centers that responded 'crew without training in clinical interventions' or 'other')

**Fisher's exact test for the comparison scoop-and-run vs stay-and-play (exclude centers that responded 'other')

Abbreviations. ALS = Advanced Life Support; BLS = Basic Life Support; MERIT = medical emergency response incident team; MMT = mobile medical team

Figure 1:General trauma policy at the scene across 20 European countries

Note. **The pie charts represent the percentage of centers within every geographic location (Northern Europe, Western Europe, UK, Southern Europe, Baltic States, Eastern Europe and Israel) that indicated to mainly use a stay-and-play approach (in green), a scoop-and-run approach (in blue) or another approach (in yellow) at the trauma scene. In addition, for each country the main policy was displayed in colors (green = stay-and-play, blue = scoop-and-run, yellow = other). If the distribution between two or three policies was equally distributed within one country (e.g. 50% of the centers indicated to use a stay-and-play approach and 50% indicated a scoop-and-run approach) we used the color of the policy that was most often used in the geographic region.**

Supplemental Material

Supplement 1: Provider profiling questionnaire

Supplement 2. Dispatching systems in 20 European countries

Variable	N (%)
Central telephone number for all emergency services	14 (70%)
Dispatching system‡	
• Automatic	1 (5%)
• Dynamic	7 (35%)
• Selective	12 (60%)
Training for dispatch personnel	
• No special training	1 (5%)
• Specialized training for medical dispatching	12 (60%)
• Medical training	1 (5%)
• Nursing and specialized training for medical dispatching	6 (30%)

‡ Automatic = the ambulance which is stationary on post closest to the scene is mobilized; dynamic = the ambulance which is vacant closest to the scene is mobilized; selective = dispatching depends on the nature and urgency of the reported incident

Supplement 3. Between-region variation in prehospital care in Europe

Variable	Northern Europe (N =9)	Western Europe (N = 25)	UK (N =9)	Southern Europe (N =12)	Baltic States (N = 5)	Eastern Europe (N = 6)
Basic type of response						
BLS	1 (11%)	9 (36%)	1 (11%)	10 (83%)	2 (40%)	3 (50%)
ALS	6 (67%)	13 (52%)	7 (78%)	2 (17%)	3 (60%)	2 (33%)
Crew without training in clinical interventions	0 (0%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)
Other	2 (22%)	2 (8%)	1 (11%)	0 (0%)	0 (0%)	0 (0%)
Advanced type of response						
MMT / MERIT can be dispatched 24/7	9 (100%)	25 (100%)	9 (100%)	12 (100%)	4 (80%)	5 (83%)
Helicopter is used to transport MMT to the scene	5 (56%)	17 (68%)	6 (67%)	9 (75%)	0 (0%)	1 (20%)
Helicopter is used to transport patient to the hospital	4 (44%)	14 (56%)	5 (56%)	6 (50%)	0 (0%)	0 (0%)
General policy at the scene						
Scoop-and-run	4 (45%)	4 (16%)	6 (67%)	5 (42%)	3 (60%)	2 (33%)
Stay-and-play	3 (33%)	18 (72%)	3 (33%)	7 (58%)	2 (40%)	4 (67%)
Other	2 (22%)	3 (12%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Supplement 4. Person who makes the decision whether a MMT or helicopter will be sent to the scene

Variable	N (%)
The dispatcher	34 (50%)
The ambulance at the scene	4 (6%)
A doctor at the scene	7 (10%)
First responders	3 (4%)
Trauma cell	6 (9%)
NA	3 (4%)
Other*	11 (17%)

*Coordinator center, ambulance at the scene and doctor at the scene, principal of the hospital, several persons are allowed to make the decision

Supplement 5. Specialist present in MMT or helicopter service

Variable	N (%)
Anesthesiologist	53 (78%)
Orthopedic surgeon	3 (4%)
General surgeon	3 (4%)
Trauma surgeon	11 (16%)
Neurosurgeon	1 (2%)
Emergency physician	50 (59%)
General practitioner	6 (9%)
Cardiologist	1 (3%)
Other*	8 (12%)

It was allowed to provide more than one answer here

*Internal medicine, pediatrician, paramedic

Supplement 6. Target times for emergency services among 68 neurotrauma centers