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Management of mild traumatic brain injury at the emergency department and hospital admission in Europe: A survey of 71 neurotrauma centers participating in the CENTER-TBI study

Running Title:

Management of mild traumatic brain injury in Europe

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Abstract

Previous studies have indicated that there is no consensus about management of mild traumatic brain injury (mTBI) at the emergency department (ED) and during hospital admission. We aim to study variability between management policies for TBI patients at the ED and hospital ward across Europe. Centers participating in the Collaborative European NeuroTrauma Effectiveness Research in Traumatic Brain Injury (CENTER-TBI) study received questionnaires about different phases of TBI care. These questionnaires included 71 questions about TBI management at the ED and at the hospital ward. We found differences in how centers defined mTBI. For example, 40 centers (59%) defined mTBI as a Glasgow Coma Scale (GCS) score between 13-15 and 26 (38%) as a GCS score between 14-15. At the ED various guidelines for the use of head CT in mTBI patients were used; 32 centers (49%) used national guidelines, 10 centers (15%) local guidelines and 14 centers (21%) used no guidelines at all. Also differences in indication for admission between centers were found. After ED discharge, 7 centers (10%) scheduled a routine follow-up appointment, while 38 (54%) did so only after ward admission. In conclusion, large between-center variation exists in policies for diagnostics, admission and discharge decisions in patients with mTBI at the ED and in hospital. Guidelines are not always operational in centers, and reported policies systematically diverge from what is recommended in those guidelines. The results of this study may be useful in the understanding of mTBI care in Europe and show the need for further studies on the effectiveness of different policies on outcome.

Keywords: traumatic brain injury, emergency department, admission, guideline, survey

Introduction

Traumatic brain injury (TBI) is a common reason for presentation at the emergency department (ED) and hospital admission in Europe.¹ A recent systematic review estimated the number of annual hospital admissions at 262 per 100,000 persons.² However, many more patients are seen at the Emergency Department (ED) each year. TBI is associated with significant long-term disability and has become a major socioeconomic and health burden throughout the world.

Among the TBI patients presenting at the ED, the large majority (75-90%) are classified as ‘mild’ TBI. The most frequently used definition of mild TBI is a GCS score between 13-15 and loss of consciousness of less than 30 minutes or amnesia not extending beyond 24 hours after blunt head injury.³

⁴ Because of the low risk of intracranial damage, a computed tomography (CT) scan of the head or hospital admission is not always necessary in these patients. To estimate the risk of intracranial abnormalities in mild TBI, various prediction rules and guidelines have been developed, for example the Canadian CT head rule, National Institute for Health and Care Excellence (NICE) guidelines for head injury and CT in Head Injury Patients (CHIP) rule.⁵⁻⁸ Based on a set of minor and major risk factors, these prediction rules recommend whether a CT scan of the head should be performed. The results of the CT scan subsequently influence the decision on whether a patient should be admitted to the hospital or could be safely discharged home.

After mild TBI, patients may experience post-traumatic symptoms such as headaches, dizziness and memory or concentration problems, resulting in significant disability. In many cases these symptoms dissolve over time, however a group of patients (estimated between 5% and 30%) may suffer from prolonged symptoms⁹. Studies showed that handing out discharge information and scheduling routinely follow-up sessions could reduce these post-traumatic symptoms.^{10, 11}

However, still little is known about the optimal treatment of mTBI and there is no consensus about management of these patients.¹² Therefore, variation in structure and process of mTBI care is expected, which may result in variation in outcome. In this study, we aim to describe the current management of mild TBI at the emergency departments and hospital wards in Europe. Specifically, we

aim to provide insight in the use of diagnostics, admission policy and discharge policy at the ED and hospital ward.

Methods

Questionnaires

Between 2014 and 2016, we approached the principal investigators of 71 centers from 19 European countries and Israel, participating in the CENTER-TBI (Collaborative European NeuroTrauma Effectiveness Research in Traumatic Brain Injury) study, a multicenter prospective observational study on TBI,¹³ with the request to complete a set of 11 questionnaires about structure and process of care for TBI patients: The Provider Profiling (PP) questionnaires. The questionnaires were developed based on literature and expert validation and were subsequently pilot-tested. Questionnaires were discussed during presentations, workshops and email conversations. Reliability, which was assessed by calculating concordance rates between duplicate questions (5% of the questions) in all 11 questionnaires, was adequate (median concordance rate of 0.85). More detailed information about the development, administration and content of the total set of provider profiling questionnaires is available in a previous publication.¹⁴

For this study, we analyzed the results of a questionnaire about ED and a questionnaire about hospital admission policy, for a total of 71 questions (Appendix 1). Topics included structural characteristics of hospital and ED, imaging, guidelines, treatment, admission policy, observation and discharge policy at the ED and in hospital ward.

Question formats and definitions

Most questions had a multiple choice format where one or more answers could be selected. Two questions had an open format. Questions addressed structures (e.g. “is overnight observation at the ED available for patients with TBI”) and processes (e.g. “are guidelines or protocols used to decide when mild TBI patients are discharged from the ED”). The questions about processes refer to general policies rather than individual treatment preferences. General policy was defined as the way the majority of patients with a certain indication would be treated (>75%).

Statistical analysis

We used standard descriptive statistics. Categorical variables were presented as frequencies and percentages and continuous variables were presented as medians and interquartile ranges (IQR). Analysis was performed using IBM Statistical Package for Social Sciences (SPSS) version 21.

Results

All 71 centers completed the ‘Hospital admission’ questionnaire and 68 centers completed the ‘ED’ questionnaire (response rates 100% and 96% respectively). Among the centers that did not complete the ED questionnaire, three centers (4%) indicated that their center had no ED since they were specialized in severe neurotrauma or collaborated with the ED of another hospital. The questionnaires were answered by ED physicians, neurosurgeons, neurologists, intensivists and administrative staff members. The majority of participating centers were academic (n = 65; 92%), level 1 trauma centers (n = 48; 68%) situated at an urban location (n = 70; 99%).

Classification of TBI

It appeared that different definitions of severity levels for TBI were used (Table 1). Forty centers (59%) defined mild TBI as a patient with a GCS score between 13-15 and 26 centers (38%) as a GCS score between 14-15. Moderate TBI was considered a GCS score between 9-12 in 38 centers (56%) and 9-13 in 22 (32%). The majority of the centers considered severe TBI as a GCS score between 3-8 (n = 62; 91%).

Diagnostics at the ED

ED physicians (n = 35; 49%) and neurosurgeons (n = 15; 21%) were most often in charge for the treatment of TBI patients at the ED. At the ED various rules or guidelines for the use of head CT in patients with mild TBI were used: more than half of the centers used (multi)national guidelines, such as NICE-guidelines (n = 16; 24%), Scandinavian guidelines (n = 7; 10%), other (inter)national guidelines (n = 12; 17%). Only few of the centers use prediction rules such as the Canadian CT Head rule (n = 4; 6%), New Orleans criteria (n = 1; 1.5%) and CHIP rule (n = 4; 6%). In addition 10 centers (15%) used other local guidelines and 14 centers (20.5%) used no guidelines at all. More than 90% (n = 62) of the centers considered their CT scanning policy liberal. Most centers (n = 45; 66%) stated to be more restrictive in the use of a CT scan in children compared to adults. CT scans at the ED were mostly ordered by ED physicians (n = 37; 54%) and neurosurgeons (n = 16; 24%). Only in 7% of the centers (n = 5, including 4

centers from the Netherlands) neurologists order the CT scans. Most centers standardly perform a CT scan in patients with clinical signs of skull base fracture, any neurologic deficit or a seizure (Figure 1). In some situations the indication for CT differs among centers. For example 50 centers (74%) standardly use a CT scan in patients on anticoagulant therapy, while 15 (22%) indicated that they would do this often. The CT scanning guidelines were mainly implemented by written protocols and algorithms (n = 38; 56%) or via verbal direction from senior doctors in 22 centers (32%, Appendix 2). In half of the centers guideline development and maintenance is overseen by multidisciplinary groups (Appendix 2). The majority of centers have not performed audits to check for adherence to guideline at ED (n = 27; 40%, Appendix 2)

Magnetic Resonance Imaging (MRI) was used in addition to the CT scan if there was discrepancy between clinical symptomatology and presence of CT abnormalities in mild TBI patients (75% of the centers). In six centers (9%) from Austria, Denmark, Spain, Sweden and United Kingdom, s100B is routinely determined as a prognostic biomarker for neurologic deterioration. Many centers had the availability of overnight observation at the ED for TBI patients before they were discharged (n = 54; 79%).

Admission at the ward

At the hospital ward, neurosurgeons (n = 56; 79%) were most often in charge for the treatment of TBI patients. Forty-four (65%) centers indicated to use guidelines in the decision on whether mild TBI patients should be admitted to the hospital ward. Most centers admitted TBI patients to the neurosurgical ward (n = 53; 75%). In addition, TBI patients were routinely admitted to the neurology (n = 16; 23%) or surgery ward (n = 15; 21%). Patients with cerebrospinal fluid (CSF) leak, CT progression, new CT abnormalities and shock were standardly admitted to the ward. For other admission indications, the policy was more diverse. For example 25 centers (37%) indicated that patients with pre-injury anticoagulation were routinely admitted to the ward, while 27 centers (39%) indicated that they would only admit these patients to the ward if other risk factors are present (Figure 2).

When patients are admitted at the ward, GCS is assessed systematically to detect neurological deterioration. About half of the centers ($n = 37$; 52%) used the scheme ‘half-hour for 2 hours, then 1-hourly for 4 hours, then 2-hourly’, thus in accordance with the NICE guidelines. The other half of the centers had another frequency of GCS assessment, ranging from hourly to every 24 hours. In 11 centers (16%) the Galveston Orientation and Amnesia Test (GOAT), a test for PTA, is systematically used at the ward and 12 centers (17%) use another form of PTA assessment.

Fifty-three centers (75%) have step down beds for patients who no longer need ICU care but are also not well enough for a routine hospital ward. At these high care wards, neurosurgeons ($n = 32$; 60%) and intensivists ($n = 13$; 25%) were most often in charge of the patients. Reasons for admission to the high care wards in isolated TBI patients included decreased consciousness level ($n = 48$; 68%), to monitor vital functions ($n = 45$; 63%), frequent GCS assessments ($n = 38$; 54%), confusion ($n = 35$; 49%) and intracranial complications ($n = 32$; 45%).

Treatment

Fifty-four centers (79%) state that they reverse pre-injury oral anticoagulation use if CT abnormalities are present, 46 (68%) do so if surgery was considered and 2 (3%) centers reverse anticoagulation in all patients admitted to the ward. Anticoagulation was commonly reversed with vitamin K ($n = 62$; 91%) or prothrombin complex concentrate ($n = 55$; 81%). Other treatments mentioned in this context were: FFP ($n = 47$; 69%), platelets ($n = 40$; 59%), fibrinogen ($n = 20$; 29%) or recombinant factor VII ($n = 11$; 16%).

If TBI patients have a cerebrospinal fluid leak (with possibly an increased risk of infections), 34 of the centers (48%) would employ a strategy of watchful waiting before they start treatment with antibiotics. In contrast, 26 centers (37%) start antibiotics immediately and 9 (13%) start antibiotics only if patients have a fever.

TBI patients with an early seizure (a posttraumatic seizure occurring within 7 days of the trauma) receive anti-epileptic drugs (AED) immediately in 39 centers (55%). About one third ($n = 22$) start AED only in patients with CT abnormalities and an early seizure and 7 centers (10%) never start AED in TBI

patients with early seizure. Additionally, there are differences in the use of anti-seizure prophylaxis in patients with specific characteristics (Appendix 3).

Discharge information

In 38 centers (56%) guidelines are used to decide whether patients with mild TBI could be discharged from the ED. In 54 centers (79%) printed discharge information is available in the ED and hospital ward to hand out to patients who are discharged home. After discharge from the ED, 42 centers (62%) provide information about post-traumatic symptoms verbally, while 55 centers (78%) do so after discharge from the hospital ward. Overall, more information is provided verbally than in written form (Table 2).

Follow-up policy

A routine follow-up appointment at the outpatient clinic is scheduled in 7 centers (10%) after discharge from the ED, at a median period of 4 weeks after discharge (IQR 2.5-6). After discharge from the hospital ward, 38 centers (54%) routinely schedule a follow-up appointment at a median period of 6 weeks (IQR 4-7.8). In 16 centers (24%) patients are referred to the general practitioner, regardless of persisting symptoms. In case of persisting symptoms, the patients are advised to go back to the general practitioner (ED n = 30; 44% and ward n = 17; 24%) or hospital (ED n = 34; 50% and ward n = 24; 34%).

Discussion

This study provides a broad overview of the current care for mild TBI patients in Europe and shows that there are wide between-center variations in diagnostic, admission and discharge policies. The most striking findings are the large variation in; GCS scores that are considered a specific TBI severity, the use of CT guidelines, and policies for patients on anticoagulants. We also found large variation in follow-up policy after discharge, where the majority of patients is not receiving routinely follow-up, despite the existing evidence and guidelines for TBI.

Our findings are in line with previous research. For example, in 2001 de Kruijk et al.¹⁵ performed a survey study in 67 European centers. They also reported a lack of consensus of mild TBI management (e.g. definitions, guidelines) in Europe at ED and hospital admission. Pulhorn et al.¹⁶ investigated management of mild TBI at 19 hospital wards in Britain and also found variation in the assessment of GCS at the ward and discharge recommendations. Our study confirms results of Stern et al.¹⁷, they performed a survey study at the ED in 72 centers in New England and found significant variability in the use of guidelines and management of mild TBI care as well.

What this study adds to previous research is that it shows that not only guidelines are not always operational in centers, but also that actual policies systematically diverge from what is recommended in those guidelines. Audits to check for adherence to the guidelines could give more insight in this, but the majority of the centers have not performed audits in the last five years. Moreover, our survey pinpoints areas of clinical controversy, that could do well with more clinical research.

In recent years the use of prognostic biomarkers such as s100B has been studied extensively.^{18, 19} The Scandinavian guideline for mild TBI even incorporated s100B in their CT scan recommendations.²⁰ However, in our study we observed that S100B is used as a prognostic biomarker in only 6 centers, of which 3 centers are Scandinavian.

Future research is needed to investigate whether the variation in guideline use and policies is associated with outcome. Currently, all the participating centers are collecting patient outcome data for the CENTER-TBI study.¹³ By combining current data with data on patient outcomes, we will be able to

investigate whether between-center differences in policy are associated with patient outcomes, and subsequently explore the effectiveness of different policy strategies in comparative effectiveness research (CER). CER requires variation to study effectiveness of treatments or policies by comparing centers who routinely perform an intervention to centers who do not, or at least less frequently.¹² In our study we found large between-center differences which enable further study with CER approaches. For example, we can compare centers that routinely perform follow-up at the outpatient clinic, with centers that do not routinely perform follow-up and analyze the relation with outcome. And we can compare the effects of routinely giving platelets to patients on antiplatelet drugs, a procedure which has been associated with poor outcome in spontaneous ICH, but has not been studied in TBI. Thus, in the CER context, we are actually satisfied with the observed variation in care because this provides the opportunity to compare outcomes between centers with different treatment policies.

This study has some limitations that should be taken into account when interpreting the data. The reliability of the results depends on the interpretation and willingness of the investigators to be truthful and transparent in their answers. We tried to enhance this by explicitly asking for general policy rather than individual preferences and explained all answer options carefully. Furthermore, because the majority of participating centers were academic level 1 trauma centers, the findings might not be generalizable to centers with a lower trauma center designation. However, we believe the variation in policies will only increase when also lower trauma center designations would be included.

In conclusion, large between-center variations exist in policies for diagnostics, admission and discharge decisions in patients with TBI at the emergency department and hospital ward. The results of this study may be useful in the understanding of TBI care in Europe and show the need for further studies on the effect of different policies on patient outcome.

Conflict of interest

Conflict of interest: none declared.

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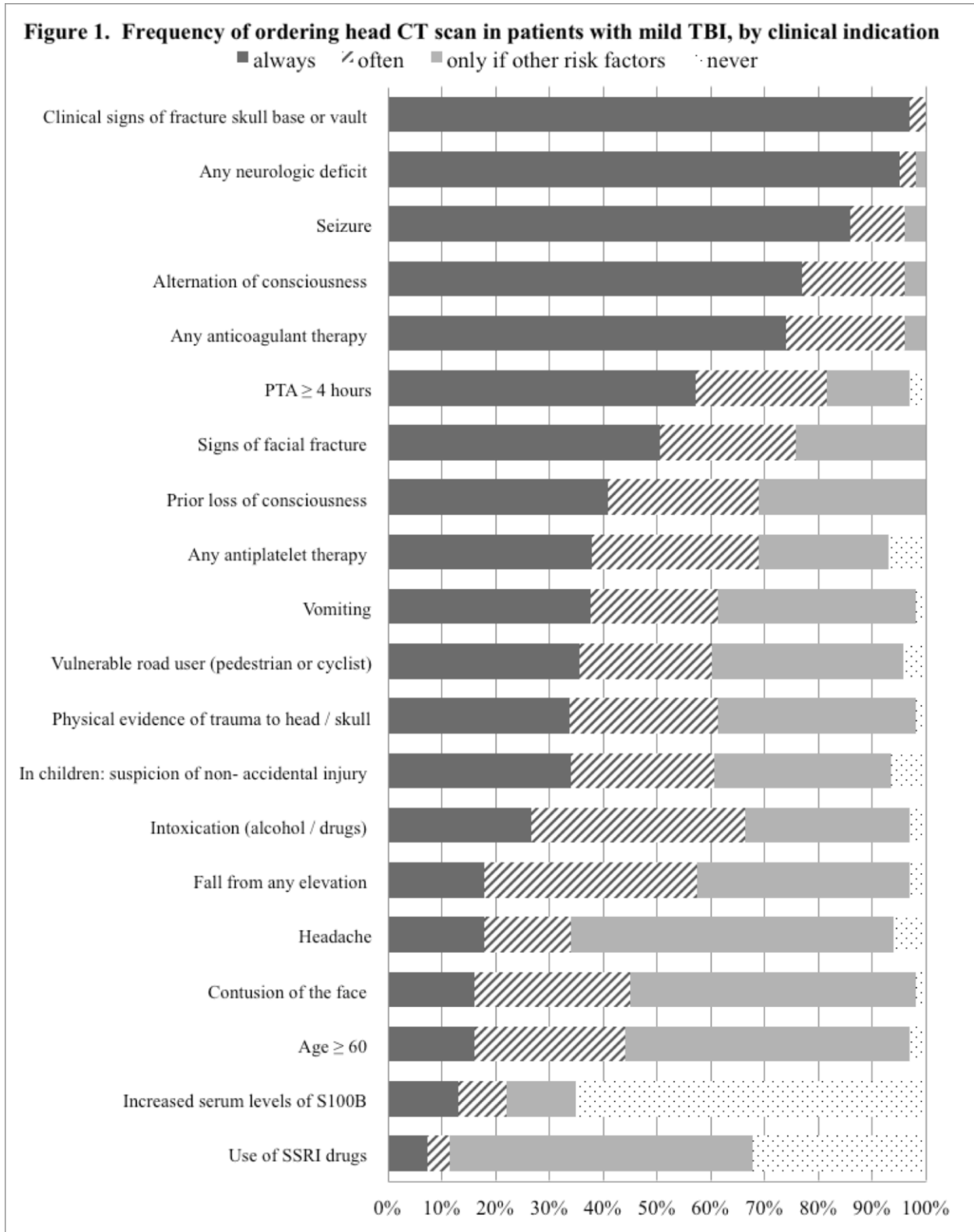


Figure 1. Frequency of ordering head CT scan in patients with mild TBI, by clinical indication

Legend

Note. Per situation the responders had to choose the correct policy for their center: *Always/general policy:* if the situation is, in general, a reason for ward admission in your hospital. This must represent a general consensus among colleagues, rather than individual preference; *Often/partial:* the situation is often seen as a reason for ward admission in your hospital. However, it is not general practice, because not everyone in your hospital agrees or admission is only general policy in a subset of the patients; *Only in the presence of other risk factors:* if the situation is never solely a reason for ward admission, but it might be a reason in combination with one or more other risk factors; *Never:* if the situation is never the only reason for ward admission.

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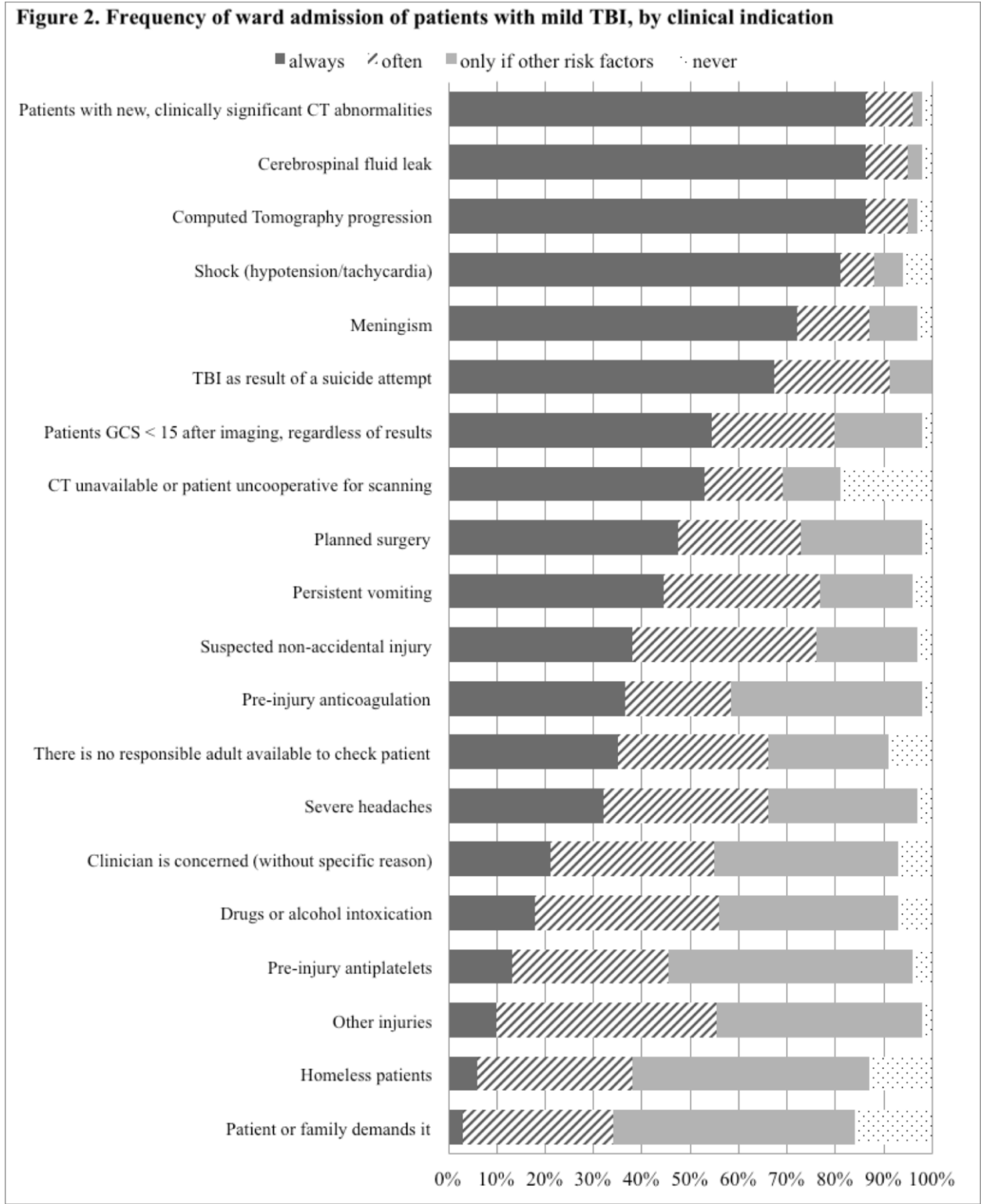


Figure 2. Frequency of ward admission of patients with mild TBI, by clinical indication

Legend

Note. Per situation the responders had to choose the correct policy for their center: *Always/general policy:* if the situation is, in general, a reason for ward admission in your hospital. This must represent a general consensus among colleagues, rather than individual preference; *Often/partial:* the situation is often seen as a reason for ward admission in your hospital. However, it is not general practice, because not everyone in your hospital agrees or admission is only general policy in a subset of the patients; *Only in the presence of other risk factors:* if the situation is never solely a reason for ward admission, but it might be a reason in combination with one or more other risk factors; *Never:* if the situation is never the only reason for ward admission.

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Table 1. GCS scores that are considered as mild, moderate and severe TBI

GCS score	N (%)
Mild TBI	
11-14	1 (1.5%)
12-15	1 (1.5%)
13-15	40 (59%)
14-15	26 (38%)
Moderate TBI	
8-11	1 (1.5%)
8-12	2 (3%)
9-12	38 (56%)
9-13	22 (32%)
9-14	1 (1.5%)
10-13	1 (1.5%)
11-13	1 (1.5%)
11-14	1 (1.5%)
12-13	1 (1.5%)
Severe TBI	
3-7	1 (1.5%)
3-8	62 (91%)
3-9	2 (3%)
3-10	2 (3%)
3-11	1 (1.5%)

Legend:

Note. The responders were asked to enter the lowest and highest GCS score per TBI group, the bold GCS range represents the range most common in the literature.

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Table 2. General discharge information provided at discharge from the ED and hospital ward

Information	ED		Hospital ward	
	Verbally	Written	Verbally	Written
	n (%)	n (%)	n (%)	n (%)
Details of nature and severity of injury	49 (72%)	40 (59%)	51 (72%)	47 (66%)
Symptoms that prompt patients to return for consultation	42 (62%)	58 (85%)	52 (73%)	44 (62%)
Details about the recovery process, including the fact some patients may appear to make quick recovery but later experience difficulties or complication	51 (75%)	38 (56%)	58 (82%)	30 (42%)
Contact details of community and hospital services in case of delayed complication	37 (54%)	50 (74%)	40 (56%)	45 (63%)
Information about return to everyday activities, including school/work/sports/driving	44 (65%)	37 (54%)	52 (73%)	39 (55%)
Information about post-concussion syndrome/ persisting symptoms and what to do in this situation	42 (62%)	38 (56%)	55 (78%)	22 (31%)
Information about use of pain killers and other medication	45 (66%)	45 (66%)	46 (65%)	45 (63%)
Details of support organization	39 (57%)	8 (12%)	39 (55%)	22 (31%)

Appendix 2 Implementation of CT guidelines at ED by no of centers

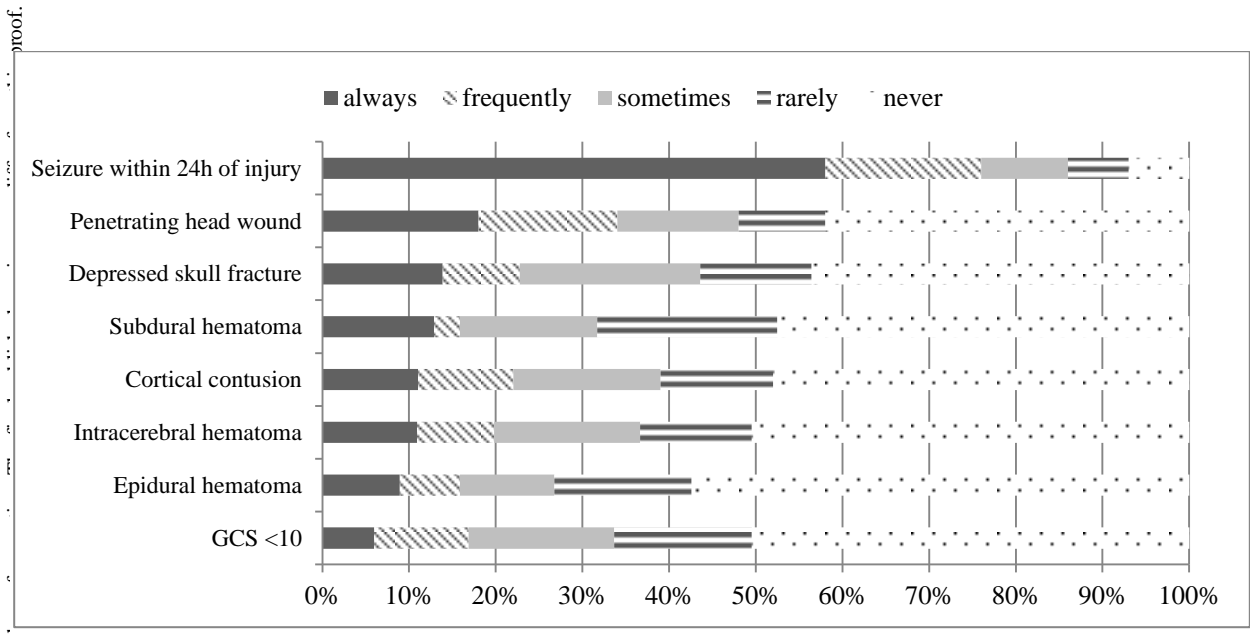
	N (%)
Implementing	
No formal implementation of guidelines	12 (18%)
Verbal direction from clinical managers/ clinical directors/senior doctors	22 (32%)
Written protocols and algorithms	38 (56%)
Training organized by your own hospital / department	15 (22%)
E-learning	3 (4%)
Flowchart/algorithms/protocols in the patient data management system of ED	10 (15%)
Periodic feedback on adherence to the guideline	6 (9%)
Structural attention for protocol adherence during clinical rounds	5 (7%)
Other	2 (3%)
Who oversees guideline development and maintenance at ED	
Individual	5 (7%)
Group: ED physicians	7 (10%)
Group: neurosurgeons	3 (4%)
Group: trauma surgeons	1 (2%)
Group: neurologist	2 (3%)
Group: multidisciplinary	33 (49%)
Neither	13 (19%)
Time period of audits* to check for adherence to guidelines at ED	
Not in the last five years	27 (40%)
Once in the last five years	9 (14%)
Approximately 2-4 times in the last five years	11 (16%)
On a yearly basis	9 (13%)
Several times a year	5 (7%)
Adherence to the CT guidelines at ED considered	
0-25% of cases	3 (4%)
25-50% of cases	4 (6%)
50-75% of cases	21 (31%)

75-100% of cases	28 (41%)
N/A	11 (16%)

*An audit is a process by which your hospital / ED assesses how well guidelines are followed.

This paper has been peer-reviewed and accepted for publication, but has yet to undergo copyediting and proof correction. The final published version may differ from this proof.

Appendix 3 Frequency of anti-epileptic drug prescription, by indication



Journal of Neurotrauma
 Management of mild traumatic brain injury at the emergency department and hospital admission in Europe: A survey of 71 neurotrauma centers participating in the CENTER-TBI study (doi: 10.1089/neu.2016.4919)
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This paper has been peer-reviewed and accepted for publication, but has yet to undergo copyediting a

Provider Profiling Questionnaire



Questionnaire 4: Emergency Department (ED)

This questionnaire can be completed an ED physician

For the completion of this questionnaire, we advise you to ask help from a data manager, administrative staff member and/or someone from the financial department in your hospital, since we ask for hospital data in this questionnaire. It is very important that this information is accurate, and searched for in annual reports, registries and other data sources rather than estimated.

This questionnaire also includes questions about the general policy in your hospital. The responses to these questions should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences. Consequently, you should provide responses that describe not what you would do personally, but how the majority of patients would generally be treated in your centre.

There are no 'right' or 'wrong' answers so please give us a realistic and honest view of how the care in your hospital is organized. Your answers will only be used to answer the scientific questions in CENTER TBI and no information in any form will be reported on individual centre level. Some of the questions may seem similar, but please answer all questions.

If you have any questions or problem, please contact:
Maryse Cnossen, PhD student (m.c.cnossen@erasmusmc.nl)

Information about the completer of the questionnaire

Other than the CENTER-TBI investigator, which of the following individuals was involved in completion of this questionnaire?

Select all that apply

- Neurologist
- Neurosurgeon
- Trauma Surgeon
- Emergency Department (ED) physician
- Administrative staff member / data manager / financial department
- Other, please specify.....
- NA. The questionnaire was completed solely by the CENTER TBI local investigator

The Local investigator is the senior clinician(s) at your hospital involved in supervision of CENTER TBI

General

1. How many acute resuscitation rooms (resuscitation beds) do you have in your Emergency Department (ED) ?

.....

2. Do you have a special facility for overnight observation (this does not refer to admission for observation or overnight stay in a normal inpatient ward)?

- No
- Yes

2b. If yes: how many observation beds do you have?

.....

3. What is the maximal observation time in this facility?

- ≤ 6 hours
- 7 - 12 hours
- 13 - 24 hours
- Overnight
- Other, please specify.....

4. Does your hospital have separate 24/7 emergency operation rooms?

- No
- Yes

The response to this question should address operating rooms that are exclusively used for emergency surgery, and **not** used for planned or elective surgery

5. How many Emergency Department (ED) physicians (in FTE) work at your ED?

.....FTE ED physicians

.....FTE trainees in residency training

.....FTE trainees not in residency training

FTE = Full time equivalent. '1 FTE' may be constituted by one person who works on a fulltime basis, but can also refer to two persons who work half-time.

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The amount of FTEs do not have to be a whole number. If the amount of FTE is, for example, 3.3, please write down '3.3' here and not '3'!

If there are persons with out of hours work that is contracted and paid for, you can count them as > 1 FTE. For example, if there is a physician that is paid for 60 hours a week and 48 hours a week is considered as a FTE for a doctor in your hospital, you can count this physician as $60/48 = 1.25$ FTE

The term 'trainee not in residency training' refers to a clinician working in your hospital who is not qualified as a specialist, but is also not part of a formal training scheme towards becoming a specialist (ED physician in this case)

6. What is the total number of Emergency Department (ED) visits in your hospital annually?

2012:
 2013:

The response to this question should include all ED attendees – not just patients with TBI

7. What is the total number of Traumatic Brain Injury (TBI) patients (all severities) visiting the Emergency Department (ED) in your hospital annually?

2012:
 2013:

8. Where did you find this information?

.....

Name the source: for example annual report, registry

Definition of mild, moderate and severe Traumatic Brain Injury (TBI) in your hospital

9. What Glasgow Coma Scale (GCS) scores are considered as mild, moderate and severe TBI in your hospital?

	Lowest GCS value	Highest GCS values
Mild TBI
Moderate TBI
Severe TBI

There are differences between countries and hospitals in how they classify mild, moderate and severe TBI. Please give the lowest and highest GCS values that you consider as mild, moderate and severe. For example: severe TBI might have a lowest value of 3 and a highest value of 8.

You can use hospital or national guidelines here. If these are not available, we would recommend, for example, an email exchange with colleagues to check that the answer that you provide us here represents the view of most of the persons in your department.

This questionnaire includes many questions that are specifically about mild, moderate and/or severe TBI. Please ensure that you answer these questions in the context of TBI severity specified, and based on the GCS classification you have provided here.

Acute trauma care

10. Are severe Traumatic Brain Injury (TBI) patients usually directly transferred to your hospital or most often indirectly after initial resuscitation and/or early Computed Tomography (CT) elsewhere?

- Directly
- Indirectly
- Both

Direct transfer = when a patient is directly transferred from the place where the accident occurred to your hospital. A patient is not seen in another hospital before he/she is referred to your hospital
 Secondary transfer = when a patient is first seen in another hospital. The patients is transferred from the place where the accident occurred to another hospital. After this, the patient is referred to your hospital. This can occur directly after arrival in the other hospital or after some treatment and diagnostics.

This question refers to the majority of TBI patients, recognizing that there may be exceptions. You can read this as: how would >75% of the severe TBI patients be referred to your hospital.

Only select both if both direct and secondary transfer for severe TBI patients can be mentioned as general policy.

11. Is there an in-hospital multidisciplinary team which will be alerted if a serious trauma victim comes in?

- No
- Yes

Some hospitals have a multidisciplinary team that is alerted when a serious trauma victim is expected. The function is early triage and treatment

11b. If the response to the previous question is yes:

What specialties are standard represented in the trauma team (present upon reception of the patient)?

	Staff member	Trainee (not) in residency training
ED physician	<input type="checkbox"/>	<input type="checkbox"/>
Anesthesiologist	<input type="checkbox"/>	<input type="checkbox"/>
Trauma surgeon	<input type="checkbox"/>	<input type="checkbox"/>
Neurologist	<input type="checkbox"/>	<input type="checkbox"/>
Neurosurgeon	<input type="checkbox"/>	<input type="checkbox"/>
General or orthopaedic surgeon	<input type="checkbox"/>	<input type="checkbox"/>
Radiologist	<input type="checkbox"/>	<input type="checkbox"/>
Orthopaedic	<input type="checkbox"/>	<input type="checkbox"/>
Other, please specify	<input type="checkbox"/>	<input type="checkbox"/>
.....		

This question refers to the specialties that are routinely part of the trauma team and not to the specialties that are consulted if necessary. The members are physically present upon reception.
 In this response, the term 'trauma surgeon' refers to an individual who specializes in trauma surgery, not a general surgeon or orthopaedic surgeon who happens to perform damage control surgery as part of wider responsibilities.

Imaging

These questions are about mild traumatic brain injury only! See question 9 for your centre specific definition of mild TBI

Computed Tomography (CT) scan

12. Are (inter)national or local guidelines used to determine which mild Traumatic Brain Injury (TBI) patients should have an initial head CT in your Emergency Department (ED)?

- We do not use guidelines for determining who should get an initial CT
- NICE guidelines
- Canadian CT head rule
- New Orleans criteria
- CHIP rule

- Scandinavian guidelines for initial management of minimal, mild and moderate head injury
- Other international guideline, please specify
- Other national guideline, please specify.....
- Other local, regional or hospital guideline, please specify
- No guideline

12b. If you selected other local, regional or hospital guideline:

If available, please send a pdf/internet link of your protocol/guideline

13. How are guidelines and protocols regarding CT scanning implemented at your Emergency Department (ED)?

Select all that apply

- No formal implementation of guidelines
- Verbal direction from clinical managers/ clinical directors/senior doctors
- Written protocols and algorithms
- Training organized by an external organisation
- Training organized by your own hospital / department
- E-learning
- flowchart / algorithms / protocols in the patient data management system of your ED
- Periodic feedback on adherence to the guideline
- Structural attention for protocol adherence during clinical rounds Other (please specify)
.....

14. Is there a group or individuals who oversee guideline development and maintenance at your Emergency Department (ED)?

- Neither
- Individual
- Group
 - Single discipline: ED physicians / trauma surgeons / neurosurgeons / neurologists (please circle correct response)
 - Multidisciplinary
- N/A. Guidelines are not implemented at our ED

15. Have there been audits to check for adherence to guidelines at your Emergency Department (ED)?

- Not in the last five years
- Once in the last five years
- Approximately 2-4 times in the last five years
- On a yearly basis
- Several times a year
- N//A. Guidelines are not implemented at our ED

An audit is a process by which your hospital / ED assesses how well guidelines are followed

16. How do you consider the adherence to the CT guidelines at your Emergency Department (ED)?

- Guidelines are used in (almost) no cases (0-25%)
- Guidelines are used in some cases (25-50%)
- Guidelines are used in most cases (50-75%)

- Guidelines are used in (almost) all cases (75-100%)
- N/A. Guidelines are not implemented at our ED

The responses to this question should represent, as best as practicable, a general consensus, rather than your personal opinion.

If CT guidelines are implemented at your ED (Question 12 is not “We do not use guidelines for determining who should get an initial CT”):

17. What do you judge as being the reasons for nonadherence to CT guidelines in patients with mild Traumatic Brain Injury (TBI)?

	Never (0-10%)	Rarely (10-30%)	Sometimes (30-70%)	Frequently (70-90%)	Always (90-100%)
Lack of knowledge among clinicians about CT scan guidelines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Every patient is unique; whether a CT scan needs to be performed should be managed by clinical judgment rather than by a guideline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inadequate time to consult CT guidelines for urgent decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Guidelines on TBI do not apply due to extracranial trauma or comorbidity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inadequate resources to apply guidelines (no CT scanner available, lack of personnel)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Defensive medicine leads to performing a CT scan even if not required by the guidelines*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other, please specify.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Defensive medicine refers to the practice of performing a CT scan that is not necessarily the best option for the patient, but an option that mainly serves the function to protect the physician against the patient as potential plaintiff.

The responses to this question should represent, as best as practicable, a general consensus, rather than your personal opinion.

If CT guidelines are implemented at your ED (Question 12 is not “We do not use guidelines for determining who should get an initial CT”):

18. Who answered the above mentioned questions about adherence to guidelines?

- ED physician
- ED trainee in residency training
- Trauma surgeon
- Email exchange in multidisciplinary ED team
- Other, please specify.....

19. In which of the following situations would you perform a CT scan in a mild Traumatic Brain Injury (TBI) patient?

This question is about indications in which you would perform a CT scan in a patient with mild TBI.

Select NEVER in factors considered not important in the treatment decision whether someone should get a CT scan.

Select ONLY IN THE PRESENCE OF OTHER RISK FACTORS if the factor is never solely a reason for a CT scan, but it might be a reason in combination with one or more other risk factors. For example: a hospital may consider headache, intoxication and the use of anticoagulant drugs in isolation as risk factors that are not sufficient to perform a CT scan. However, if these present together, their combined presence might constitute an indication for CT scanning. Respondents from such a hospital should tick ‘only in the presence of other risk factors’ after headache, intoxication and the use of anticoagulant drugs.

Select OFTEN / PARTIAL is the risk factor is often seen as a reason for CT scanning in your hospital. However, it is not general practice, because not everyone in your hospital agrees or CT scanning is only general policy in a subset of the patients. For example, it might be general policy to scan patients aged over 70 when presenting to your ED, but not patients aged 60-70. You can complete age => 60 with OFTEN/PARTIAL.

Select ALWAYS/GENERAL POLICY when the criteria are, in general, a reason for CT scanning in your hospital (>75% of the patients with this indication). When you select ALWAYS/GENERAL POLICY this must represent a general consensus among colleagues, rather than individual preference.

Where you are in doubt whether this is the appropriate response to the question, we would recommend, for example, either a verbal discussion or an email exchange with colleagues to check consensus.

	Never	Only in the presence of other risk factors	Often / Partial	Always / General Policy
Prior loss of consciousness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Headache	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vomiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Age >=60	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Any anticoagulant therapy (not including anti-platelet therapy)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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 Journal of Neurotrauma centers participating in the CENTER-TBI study (doi: 10.1089/neu.2020.0000) at the emergency department and hospital admission in Europe: A survey of 71 neurotrauma centers participating in the CENTER-TBI study (doi: 10.1089/neu.2020.0000)

Any antiplatelet therapy (not including anticoagulant therapy)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of SSRI drugs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intoxication (alcohol / drugs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Seizure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vulnerable road user (pedestrian or cyclist)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fall from any elevation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PTA >= 4 hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Alternation of consciousness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Any neurologic deficit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinical signs of fracture skull base or vault	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical evidence of trauma to head / skull	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Signs of facial fracture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contusion of the face	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In children: suspicion of non-accidental injury	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased serum levels of S100B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20. Does your Emergency Department (ED) – in general- have a liberal or restrictive policy regarding CT scanning?

- Liberal
- Restricted
- Unknown

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences.

21. What percentage of all mild Traumatic Brain Injury (TBI) patients attending at your Emergency Department (ED) do get a CT scan? Can you give us an estimate?

-%
- Unknown

The responses to this question should represent, as best as practicable, a general consensus, rather than individual thoughts.

22. Who generally orders the CT for patients with mild TBI in your Emergency Department (ED)?

Select one answer here.

- ED physician
- Neurologist
- Neurosurgeon
- (Trauma)surgeon
- Other, please specify.....

The responses to this question should represent your general policy. You can read this question as: Who would order a CT scan in >75% of the mild TBI patients at your ED.
If there are multiple persons ordering a CT scan in the majority of patients, select other and then list the physicians who order a CT scan in >75%

23. Is your Emergency Department (ED) more restrictive in performing CT examinations in children with Traumatic Brain Injury (TBI) than in adults?

- No
- Yes
- Unknown

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences.

Magnetic Resonance Imaging (MRI) scan

24. What are indications for MRI scanning in patients with Traumatic Brain Injury (TBI)?

Select all that apply

- Discrepancy between clinical symptomatology and (lack of) CT abnormalities
- Suspicion non-metal foreign object
- Instead of CT (limiting radiation exposure)
- Suspicion of spinal cord lesion
- Other, please specify

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences.

25. How often is the MRI scanner used as primary investigation (instead of the CT scanner) in patients with (suspected) Traumatic Brain Injury (TBI)?

- Never (0-10%)
- Rarely (10-30%)
- Sometimes (30-70%)
- Frequently (70-90%)
- Always (90-100%)

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences.

Consultation

26. When one wants to consult a specialist for patients with TBI, what specialty is most often consulted in the following situations?

Select one specialist in every severity level.

	Neurosurgeon	Neurologist	Trauma Surgeon	Other specialist. Please specify	No consultation
Mild TBI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moderate TBI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Severe TBI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Any polytrauma patient, irrespective of Glasgow Coma Scale (GCS) score	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

See question 9 for your centre specific definition of mild, moderate and severe TBI. Select the specialist that is in most (>75%) of the patients consulted. When there is no consultation in most of the patients, select no consultation. Consultation refers to a situation in which the specialist physically examines the patient and provides an advice about further treatment, imaging, admission, and/or discharge. In this response, the term 'trauma surgeon' refers to an individual who specializes in trauma surgery, not a general surgeon or orthopaedic surgeon who happens to perform damage control surgery as part of wider responsibilities.

27. Is S100B routinely determined as a prognostic biomarker for neurological deterioration?

- No
- Yes

Laboratory turnaround time

28. What maximum laboratory turnaround times are recorded in the lab Standard Operating Procedures (SOP) at your Emergency Department (ED) for a severely injured patient?

- 15 minutes
- 15-20 minutes
- 20-30 minutes
- 30-45 minutes
- 45-60 minutes
- More than 60 minutes
- NA. There is no lab SOP that determines the maximum laboratory turnaround time for severely injured patients

Note here the time that is recorded in the SOP and not the average actual time

Management of Emergency Department overcrowding

Overcrowding is defined as a situation in which there are more patients in the ER than the ER can handle (due to lack of beds, lack of personnel, access block etc)

29. How often does it occur that patients are placed in the hallway?

- Multiple times a day
- Approximately once a day
- On a weekly basis
- On a monthly basis

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- Seldom
- It hasn't occurred in the last five years

30. How often does it occur that it takes > 2 hours to get to a ward once the decision to admit has been made (access block)?

- Multiple times a day
- Approximately once a day
- On a weekly basis
- On a monthly basis
- Seldom
- It hasn't occurred in the last five years

31. What is the average number of patients per week leaving the Emergency Department (ED) without being seen or treated?

.....

32. What is the average time until triage at your Emergency Department (ED) (including all presenting diagnoses)?

.....

33. Is overcrowding considered as a problem in your Emergency Department (ED)?

- No. Never
- Sometimes
- We consider ED overcrowding as a frequent problem in our ED

The response to this question could include the following considerations:

- Ability of ambulances to offload patients,
- Number of patients who leave without being seen or treated,
- Time until triage,
- Frequency of ED occupancy rate >100%,
- Time until physician first see a patient,
- ED boarding time,
- Number of patients boarding in the ED,
- Lab turn-around times,
- Time to imaging.

The responses to this question should represent, as best as practicable, a general consensus, rather than an individual opinion.

34. What are the rates for ambulance diversion?

Can you give an estimate of the last year:

- Never
- <6/year
- 6/year – 1/month
- 1/month – 1/week.
- 1/week – 2/week
- > 2/week

Ambulance diversion refers to a situation in which an ambulance that arrived at the hospital has to go to another hospital in the area as a result of overcrowding.

Anticoagulation

These questions are about mild traumatic brain injury only. (See question 9 for your centre specific definition of mild TBI)

Select ALWAYS/GENERAL POLICY when the criteria are, in general, a reason for ward admission in your hospital. When you select ALWAYS/GENERAL POLICY this must represent a general consensus among colleagues, rather than individual preference. Where you are in doubt whether this is the appropriate response to the question, we would recommend, for example, either a verbal discussion or an email exchange with colleagues to check consensus.

	Never	Only in the presence of other risk factors	Often / Partial	Always / General Policy
Patients with new, clinically significant abnormalities on imaging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computed Tomography (CT) progression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patients whose Glasgow Coma Scale (GCS) score has not returned to 15 after imaging, regardless of the imaging results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When a patient has indications for CT scanning but this cannot be done within the appropriate period, either because CT is not available or because the patient is not sufficiently cooperative to allow scanning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Persistent vomiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Severe headaches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinician is concerned (without specific reason)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drugs or alcohol intoxication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other injuries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shock (hypotension/tachycardia)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suspected non-accidental injury	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meningism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cerebrospinal fluid leak	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patient or family demands it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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There is no responsible adult available to check on the patient regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TBI as a result of a suicide attempt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Preinjury anticoagulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Preinjury antiplatelets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Homeless patients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planned surgery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other, please specify.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

39. When would you admit moderate Traumatic Brain Injury (TBI) to the hospital ward (exclude moderate TBI patients in which ICU admission is indicated)?

- Never
- Only in the presence of other risk factors (like premorbid anticoagulant use, older age, CT progression)
- It is our general policy to admit all moderate TBI patients to the hospital ward (based on Glasgow Coma Scale)

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences.

40. In which of the following situations would you admit a patient with moderate Traumatic Brain Injury (TBI) to the Intensive Care Unit (ICU)?

Please provide us the general clinical practice at your centre. This does not have to be the same as stated in the guidelines you use

This question is about indications for ICU admission in patients with moderate TBI. See question 9 for your centre specific definition of moderate TBI.

Select NEVER in factors considered not important in the decision whether moderate TBI patients should be admitted to the ICU

Select ONLY IN THE PRESENCE OF OTHER RISK FACTORS if the factor is never solely a reason for ICU admission, but it might be a reason in combination with one or more other risk factors. For example: a hospital may consider CT progression, persistent vomiting and severe headache in isolation as risk factors that are not sufficient to admit a patient to the ICU. However, if these present together, their combined presence might be considered an indication. Respondents from such a hospital should tick 'only in the presence of other risk factors' after CT progression, persistent vomiting and headache.

Select OFTEN / PARTIAL is the risk factor is often seen as a reason for ICU admission in your hospital. However, it is not general practice, because not everyone in your hospital agrees or admission is only general policy in a subset of the patients. For example, it might be general policy to admit patients intoxicated with drugs to the ICU but not patients intoxicated with alcohol. Respondents from such a hospital should tick 'often/partial' in 'drugs or alcohol intoxication'.

Discharge home

41. Do you use protocols/guidelines to decide when patients with mild Traumatic Brain Injury (TBI) are discharged from the Emergency Department (ED) ?

- No
- Yes

42. Is printed discharge information available in the Emergency Department (ED) to hand out to patients who are discharged?

- No
- Yes

43. What discharge information is routinely given verbally and/or written to the patient upon discharge?

	Verbally	Written
Details of the nature and severity of the injury	<input type="checkbox"/>	<input type="checkbox"/>
Symptoms that prompt patients to return for consultation	<input type="checkbox"/>	<input type="checkbox"/>
Details about the recovery process, including the fact some Patients may appear to make a quick recovery but later experience difficulties or complication	<input type="checkbox"/>	<input type="checkbox"/>
Contact details of community and hospital services in case of Delayed complication	<input type="checkbox"/>	<input type="checkbox"/>
Information about return to everyday activities, including school, work, sports and driving	<input type="checkbox"/>	<input type="checkbox"/>
Information about post concussion syndrome/persisting symptoms and what to do in this situation	<input type="checkbox"/>	<input type="checkbox"/>
Information about the use of pain killers and other medication	<input type="checkbox"/>	<input type="checkbox"/>
Details of support organization	<input type="checkbox"/>	<input type="checkbox"/>
Other, please specify.....	<input type="checkbox"/>	<input type="checkbox"/>

What kind of follow-up treatment is scheduled when someone with mild Traumatic Brain Injury (TBI) is discharged home after Emergency Department (ED)?

Select all that apply

- No scheduled follow-up.
- Routinely scheduled outpatient follow up after Weeks/days
- Referred to general practitioner (regardless of persisting symptoms)
- The patient is advised to contact the general practitioner if symptoms persist
- The patient is advised to come back to the hospital if symptoms persist
- Other, please specify

Outcome

44. Does your hospital routinely assess the outcome at follow-up according to the Glasgow Outcome Scale (extended)?

- No
- Yes
- Unknown

44b. If yes: Is a structural interview used to assess the Glasgow Outcome Scale (extended)?

- No
- Yes
- Unknown

44c. If yes: Who usually assesses the GOS(E)?

Select all that apply

- Research nurse
- Nurse
- Clinician
- Other, please specify....

45. Which of the following reasons for disability does your hospital include or exclude in your assessment of the GOS(E)?

In the responses below, you can choose either “include” or “Exclude” as a response to each item. If you tick “Include” means that you assess all of the disability as part of categorizing the patient on the GOSE. If you tick “Exclude” this means that where the disability is thought to be the consequence of an injury other than TBI, it will not be included in the assessment, and you would assign the GOS(E) as if that disability did not exist.

	Include	Exclude
Effects of health conditions that existed before the injury, such as cognitive impairment or physical limitations.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of injuries sustained on the same occasion to parts of the body other than the head, such as paralysis due to spinal cord injury or injuries to the limbs.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of external damage to the head or injury to the skull, such as limitations in activities due to a missing bone flap.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of illness arising after TBI treatment, such as pulmonary complications after ventilation.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of a subsequent illness unconnected to TBI, such as pneumonia after flu.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of a subsequent operation, such as hip replacement, that is unconnected to TBI.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of changed social circumstances, such as lower income after injury.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of depression that has arisen since the TBI.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of post-traumatic stress disorder that has appeared since the TBI.	<input type="checkbox"/>	<input type="checkbox"/>
Effects of post-injury anxiety states, such as the development of agoraphobia.	<input type="checkbox"/>	<input type="checkbox"/>

Withdraw life support

46. Occasionally, in patients with severe trauma, the presence of an irretrievable intracranial injury may prompt a decision not to continue with active therapy. In these cases, how is the decision reached to withhold/withdraw life-sustaining measures (e.g. mechanical ventilation, vasoactive medication, CVVH, intravenous fluid administration)?

Select all that apply

- Based on objective medical criteria (as GCS, age, comorbidity)) during multidisciplinary deliberation in which one physician (veto, for example the most senior person or the ED director) has to agree
- Based on objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which the majority (more than 50%) has to agree
- Based on objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which there has to be unanimous consensus among all participating doctors
- Based on subjective opinion (among which objective medical criteria) of a senior physician
- Based on opinions and objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which the majority (more than 50%) has to agree
- Based on opinions and objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which there has to be unanimous consensus among all participating doctors
- We never withdraw treatment in the ED
- Other, please specify

47. How is a decision reached to not treat patients surgically, because the primary brain damage is considered too devastating (poor prognosis)?

Select all that apply

- Based on objective medical criteria (as GCS, age, comorbidity) by one physician (veto)
- Based on objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which the majority (more than 50%) has to agree
- Based on objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which there has to be unanimous consensus among all participating doctors
- Based on subjective opinion (among which objective medical criteria) of one physician (veto)
- Based on opinions and objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which the majority (more than 50%) has to agree
- Based on opinions and objective medical criteria (as GCS, age, comorbidity) during multidisciplinary deliberation in which there has to be unanimous consensus among all participating doctors
- Other, please specify

48. If the patient ‘appears’ brain dead (GCS 3, fixed dilated pupils, apnea), do you:

Select all that apply

- Stop all life-sustaining measures on the ED
- Arrange transfer to the ICU for further observation
- Arrange transfer to the ICU for possible organ donation

49. Do you admit very elderly (80 years and older) patients with severe Traumatic Brain Injury (TBI) on the ICU for treatment?

Select all that apply

- No, never
- Yes, if the patient is intubated and ventilated in the ED setting
- Yes, if the patient needs ICU treatment with the prospect of saving his/her life
- Yes, but highly depending on the severity of co-morbidity
- Yes, but only if the relatives ask me

Questionnaire 5: Admission

Patient Identification Information

**For a
printable
form to
fill out**

[Click Here](#)

Please, save your answers frequently by pressing the save buttons placed throughout the questionnaire.

This questionnaire can be completed by a neurologist, neurosurgeon or another doctor familiar with the hospital ward

The topic of this questionnaire is admission. Admission refers to staying for at least one night at the hospital ward. We do NOT refer to staying at the Intensive Care Unit (ICU) here (see ICU questionnaire) or staying in the observation unit for one night (see Emergency Department questionnaire).

For the completion of this questionnaire, we advise you to ask help from a data manager, administrative staff member and/or someone from the financial department in your hospital, since we ask for hospital data in this questionnaire. It is very important that this information is accurate, and searched for in annual reports, registries and other data sources rather than estimated.

This questionnaire also includes questions about the general policy in your hospital. The responses to these questions should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences. Consequently, you should provide responses that describe not what you would do personally, but how the majority of patients would generally be treated in your centre. Some of the questions may seem similar, but please answer all questions.

There are no 'right' or 'wrong' answers so please give us a realistic and honest view of how the care in your hospital is organized. Your answers will only be used to answer the scientific questions in CENTER-TBI and no information in any form will be reported on individual centre level

If you have any questions or problem, please contact:
Maryse Crossen, PhD student m.c.crossen@erasmusmc.nl

Start Date & Time

End Date & Time

Other than the CENTER-TBI investigator, which of the following individuals was involved in the completion of this questionnaire?

Select all that apply

Neurologist

Neurosurgeon

Trauma Surgeon

Emergency Department (ED) physician

Administrative staff member, data manager or financial department

Other Please specify other:

NA. The questionnaire was completed solely by the CENTER-TBI Local investigator

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The Local investigator is the senior clinician(s) at your hospital involved in the supervision of CENTER-TBI.

General

1. To what hospital ward(s) are patients with Traumatic Brain Injury (TBI) who do not require Intensive Care Unit (ICU) care most often admitted?

Select all that apply

- Neurological hospital ward
- General surgery hospital ward
- Trauma surgery hospital ward
- Neurosurgical hospital ward
- Other ward

Please specify other:

Please answer the following questions about the ward(s) that you selected here.

2. Do you have an electronic patient record in your hospital as a whole (not just confined to the ICU)? No Yes

"Electronic patient record" refers to a system that stores all patient information (for example laboratory values, CT scans, observatory notes, letters to the GP) electronically and not in paper format.

Definition of Traumatic Brain Injury

3. What Glasgow Coma Scale (GCS) scores are considered as mild, moderate and severe TBI in your hospital:

Mild TBI	Lowest GCS	Highest GCS
	<input type="text"/>	<input type="text"/>
Moderate TBI	<input type="text"/>	<input type="text"/>
Severe TBI	<input type="text"/>	<input type="text"/>

There are differences between countries and hospitals in how they classify mild, moderate and severe TBI. Please give the lowest and highest GCS values that is considered as mild, moderate and severe. For example: severe TBI might have a lowest value of 3 and a highest value of 8.

You can use hospital or national guidelines here. If these are not available, we would recommend, for example, an email exchange with colleagues to check that the answer that you provide us here represents the view of most of the persons in your department.

4. In which of the following situations would you admit a patient with mild Traumatic Brain Injury (TBI) to the hospital ward? Please provide us the general clinical practice at your centre. This does not have to be the same as stated in the guidelines you use.

This question is about indications for hospital ward admission in patients with mild TBI. See the above question for your centre specific definition of mild TBI.

Select NEVER in factors considered not important in the decision whether mTBI patients should be admitted to the ward.

Select ONLY IN THE PRESENCE OF OTHER RISK FACTORS if the factor is never solely a reason for ward admission, but it might be a reason in combination with one or more other risk factors. For example: a hospital may consider severe headache and drugs or alcohol intoxication in isolation as risk factors that are not sufficient to admit a patient to the ward. However, if these present together, their combined presence might be considered an indication. Respondents from such a hospital should tick 'only in the presence of other risk factors' after severe headache and drugs or alcohol intoxication.

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Select OFTEN / PARTIAL is the risk factor is often seen as a reason for ward admission in your hospital. However, it is not general practice, because not everyone in your hospital agrees or admission is only general policy in a subset of the patients. For example, it might be general policy to admit patients with drugs intoxication to the ward, but not those with alcohol intoxication. You can complete 'drugs or alcohol intoxication' with OFTEN/PARTIAL

Select ALWAYS/GENERAL POLICY when the criteria are, in general, a reason for ward admission in your hospital. When you select ALWAYS/GENERAL POLICY this must represent a general consensus among colleagues, rather than individual preference. Where you are in doubt whether this is the appropriate response to the question, we would recommend, for example, either a verbal discussion or an email exchange with colleagues to check consensus.

Patients with new, clinically significant abnormalities on imaging

- Never
 Only in the presence of other risk factors
 Often/Partial
 Always/General Policy

Computed Tomography (CT) progression

- Never
 Only in the presence of other risk factors
 Often/Partial
 Always/General Policy

Patients whose Glasgow Coma Scale (GCS) score has not returned to 15 after imaging, regardless of the imaging results

- Never
 Only in the presence of other risk factors
 Often/Partial
 Always/General Policy

When a patient has indications for CT scanning but this cannot be done within the appropriate period, either because CT is not available or because the patient is not sufficiently cooperative to allow scanning

- Never
 Only in the presence of other risk factors
 Often/Partial
 Always/General Policy

Persistent vomiting

- Never
 Only in the presence of other risk factors
 Often/Partial
 Always/General Policy

Severe headaches

- Never
 Only in the presence of other risk factors
 Often/Partial
 Always/General Policy

Clinician is concerned (without specific reason)

- Never
 Only in the presence of other risk factors
 Often/Partial
 Always/General

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Drugs or alcohol intoxication

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

Other injuries

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

Shock (hypotension/tachycardia)

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

Suspected non-accidental injury

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

Meningism

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

Cerebrospinal fluid leak

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

Patient or family demands it

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

There is no responsible adult available to check on the patient regularly

- Policy
- Never
- Only in the presence of other risk factors
- Often/Partial
- Always/General

TBI as a result of a suicide attempt

- Policy
- Never
- Only in the presence of other risk factors

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Preinjury anticoagulation

- Often/Partial
- Always/General Policy
- Never
- Only in the presence of other risk factors

Preinjury antiplatelets

- Often/Partial
- Always/General Policy
- Never
- Only in the presence of other risk factors

Homeless patients

- Often/Partial
- Always/General Policy
- Never
- Only in the presence of other risk factors

Planned surgery

- Often/Partial
- Always/General Policy
- Never
- Only in the presence of other risk factors

Other

- Often/Partial
- Always/General Policy
- Never
- Only in the presence of other risk factors

Please specify other:

5. Would you admit patients with isolated moderate Traumatic Brain Injury (TBI) to the hospital ward (exclude moderate TBI patients in which ICU admission is indicated)?

- Never
- Only in the presence of other risk factors (like pre-morbid anticoagulant use, older age, CT progression)
- It is our general policy to admit all moderate TBI patients to the hospital ward (based on GCS)

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences.

Guidelines

6. Are guidelines / protocols implemented for patients with Traumatic Brain Injury (TBI) at your hospital ward (for example about CT scanning, timing of discharge, neurological examination)?

- No, we do not have guidelines for TBI patients
- We do not have specific guidelines for TBI patients, but we do have other guidelines that are applied to TBI patients
- Yes, we do have specific guidelines for TBI patients (for example about CT scanning, timing of discharge etc)

If available, please upload a pdf/internet link of your protocol/guideline. To upload, click on Documentation tab above after completing the questionnaire

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Observation

7. How often is the Glasgow Coma Scale (GCS) assessed at the hospital ward?

- Half-hourly for 2 hours, then 1-hourly for 4 hours; then 2-hourly
- Less
- More
- Other

Please specify your scheme:

Please specify your scheme:

Please specify your scheme:

8. Is posttraumatic amnesia systematically assessed at your hospital ward? No

- Yes, Galveston amnesia and orientation test
- Other structured approach

Please specify other:

Routinely repeated CT scans

9. Are routinely repeated CT scans used in patients with Traumatic Brain Injury (TBI) at your hospital ward? No Yes

With routine repeat CT scan we mean CT scans that are performed at predetermined time points regardless of clinical symptoms.

This question refers to the general policy in your hospital. You can read this as: would you perform routine repeat CT scans in the majority (>75%) of the patients?

10a. If yes, which type of Traumatic Brain Injury (TBI) patients are routinely repeated CT scans used:

Select all that apply

- Yes in mild TBI patients
- Yes in moderate TBI patients
- Yes in severe TBI patients

See for the definition of mild, moderate and severe TBI, your answer to question 3.

10b. What are indications for routine repeat Computer Tomography (CT) scans in Traumatic Brain Injury (TBI):

Select all that apply

- For all TBI patients that are admitted to the ward, routine repeat CT scans are scheduled
- Any abnormality on initial CT scan
- Glasgow coma scale < 15
- Substance abuse prior to the TBI
- Patient on anticoagulants/antiplatelets
- Other

Please specify other:

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual opinions.

c. If routine repeat CT scans are scheduled, do you have a protocol of how often and over what time period patients are scanned? No Yes

d. Please specify the time period in hours after initial scan

can 2 hours after initial CT scan

can 3 hours after initial CT scan

can 4 hours after initial CT scan

Note here what is stated in the protocol.

0. Is S100B routinely determined as a prognostic biomarker for neurological deterioration? No Yes

Management of confused patients

1. What is the treatment policy in patients who show confusion:

Select all that apply

- Analgesics / pain killers
- Anxiolytics
- Antipsychotics (eg. haloperidol)
- Restraints
- Verbal interaction
- Other Please specify other:

A combination Please specify combination:

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual opinions.

Treatment

2. Anti-seizure prophylaxis is used in our center

Please first rank how often you use anti-seizure prophylaxis in TBI patients in general. You can choose between never, rarely, sometimes, frequently and always. The percentages can help you define what we mean by never till always. After that you can answer this question for subgroups of TBI patients.

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual management preferences.

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Please use the following ranges:

- Never (0-10%)
- Rarely (10-30%)
- Sometimes (30-70%)
- Frequently (70-90%)
- Always (90-100%)

- Glasgow Coma Scale score <10 Never Rarely Sometimes Frequently Always
- Cortical contusion Never Rarely Sometimes Frequently Always
- Depressed skull fracture Never Rarely Sometimes Frequently Always
- Subdural hematoma Never Rarely Sometimes Frequently Always
- Epidural hematoma Never Rarely Sometimes Frequently Always
- Intracerebral hematoma Never Rarely Sometimes Frequently Always
- Penetrating head wound Never Rarely Sometimes Frequently Always
- Seizure within 24h of injury Never Rarely Sometimes Frequently Always
- Other Never Rarely Sometimes Frequently Always

Please specify other:

3. What is your general policy for a Traumatic Brain Injury (TBI) with an early seizure*?

- Anti epileptic drugs in all TBI patients with an early seizure
- Anti epileptic drugs in TBI patients with an early seizure AND a CT abnormality
- We never prescribe anti-epileptic drugs in TBI patients with an early seizure
- Other

Please specify other:

*Early posttraumatic epileptic insults are defined as seizures occurring within 7 days of trauma.

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual opinions.

14. What is the general policy regarding the use of antibiotics in patients who have CSF leak following Traumatic Brain Injury (TBI)?

- Antibiotics
- We only prescribe antibiotics when the patient has fever
- We will wait first
- Other

Please specify other:

*Watchful waiting refers to an approach in which time is allowed to pass before a medical intervention (e.g. antibiotics) is used. During this time, repeated testing may be performed.

The responses to this question should represent, as best as practicable, a general consensus on treatment at your centre, rather than individual opinions.

Intermediate/Step-down Care

An intermediate or step-down bed or a medium care facility is a facility in between the Intensive Care Unit (ICU) and the hospital ward. It is often used for patients who improved at the ICU and no longer need the intensity of care delivered by the ICU, but are also not well enough for a routine hospital ward. The care provided at the stepdown beds/intermediate

care unit is less intensive than the care provided at the ICU but more intensive than hospital ward care.

5. Do you have step down beds or medium care facilities for patients with traumatic brain injury? No Yes

How many step down beds do you have?

16. What are the main reasons for medium care admission (instead of ward admission or ICU admission) in patients with isolated Traumatic Brain Injury (TBI)?

Select all that apply

- Decreased consciousness
- Intracranial complications
- To monitor vital functions
- Frequent GCS assessments
- Confusion
- Other

Please specify other:

17. What specialty is generally responsible for Traumatic Brain Injury (TBI) patients in the intermediate care or step down unit?

- Neurologist
- Intensivist
- General surgeon
- Neurosurgeon
- Other
- Trauma surgeon

Please specify other:

In this response, the term 'trauma surgeon' refers to an individual who specializes in trauma surgery, not a general surgeon or orthopaedic surgeon who happens to perform damage control surgery as part of wider responsibilities

Discharge

8. Is printed discharge information available at the ward to hand out to patients discharged? No Yes

19. What discharge information is given verbally and/or written to the patient upon ward discharge: Verbally Written

Details of the nature and severity of the injury	<input type="checkbox"/>	<input type="checkbox"/>
Symptoms that mean patients need to return for consultation	<input type="checkbox"/>	<input type="checkbox"/>
Details about the recovery process, including the fact some patients may appear to make a quick recovery but later experience difficulties or complication	<input type="checkbox"/>	<input type="checkbox"/>
Contact details of community and hospital services in case of delayed complication	<input type="checkbox"/>	<input type="checkbox"/>
Information about return to everyday activities, including school, work, sports and driving	<input type="checkbox"/>	<input type="checkbox"/>
Information about post concussion syndrome / persisting symptoms and what to do in this situation	<input type="checkbox"/>	<input type="checkbox"/>
Information about the use of pain killers and other medication	<input type="checkbox"/>	<input type="checkbox"/>
Details of support organization	<input type="checkbox"/>	<input type="checkbox"/>

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Other

Please specify other verbal:

Please specify other written:

20. What kind of follow-up treatment is usually scheduled after ward admission for Traumatic Brain Injury (TBI):

Select all that apply

- No scheduled follow-up
- Routinely scheduled outpatient follow up
- Referred to general practitioner (regardless of persisting symptoms)
- The patient is advised to contact the general practitioner if symptoms persist
- The patient is advised to come back to the hospital if symptoms persist
- Other

After how many weeks do you usually schedule the first appointment?

Please specify other:

Outcome

21. Does your hospital routinely assess the outcome at follow-up according to the Glasgow Outcome Scale (extended)?

- No
- Yes
- Unknown

21b. Is there a structural interview to assess the Glasgow Outcome Scale (extended)?

- No
- Yes
- Unknown

21c. Who usually assesses the GOS(E)?

Select all that apply

- Research nurse
- Nurse
- Clinician
- Other

Please specify other:

22. Which of the following reasons of disability do you include or exclude in your assessment of the GOS(E)?

In the responses below, you can choose either "Include" or "Exclude" as a response to each item. If you tick "Include" means that you assess all of the disability as part of categorizing the patient on the GOSE. If you tick "Exclude" this means that where the disability is thought to be the consequence of an injury other than TBI, it will not be included in the assessment, and you would assign the GOS(E) as if that disability did not exist.

Effects of health conditions that existed before the injury, such as cognitive impairment or physical limitations.

- Include
- Exclude

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- Effects of injuries sustained on the same occasion to parts of the body other than the head, such as paralysis due to spinal cord injury or injuries to the limbs. Include Exclude
- Effects of external damage to the head or injury to the skull, such as limitations in activities due to a missing bone flap. Include Exclude
- Effects of illness arising after TBI treatment, such as pulmonary complications after ventilation. Include Exclude
- Effects of a subsequent illness unconnected to TBI, such as pneumonia after flu. Include Exclude
- Effects of a subsequent operation, such as hip replacement, that is unconnected to TBI. Include Exclude
- Effects of changed social circumstances, such as lower income after injury. Include Exclude
- Effects of depression that has arisen since the TBI. Include Exclude
- Effects of post-traumatic stress disorder that has appeared since the TBI. Include Exclude
- Effects of post-injury anxiety states, such as the development of agoraphobia. Include Exclude

End of List ***