

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

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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. In this study we describe how actual management policies for TBI patients at the ED and in hospital diverge between centers in 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 77 questions about TBI management at the ED and in hospital. We found differences in how centers defined mTBI. For example, 40 centers (59%) define 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 are used; 32 centers (49%) use national guidelines, 10 centers (15%) local guidelines and 14 centers (21%) use no guidelines at all. Also differences in indication for admission between centers were found. After ED discharge, 7 centers (10%) schedule a routine follow-up appointment, while 38 (54%) do so 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. 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. 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 effect 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 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 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 decrease 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 will provide information on the use of diagnostics, admission policy and discharge policy at the ED and hospital ward.

Methods

Questionnaires

Between 2014 and 2016, the principal investigators of 71 centers from 19 European countries and Israel, participating in CENTER-TBI (Collaborative European NeuroTrauma Effectiveness Research in Traumatic Brain Injury), a multicenter prospective observational study on TBI,¹³ were approached 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 disseminated 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 Emergency department and a questionnaire about hospital admission policy, in total 77 questions. 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 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 rate 96%). 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 centers were located in 19 European countries and Israel and give a good representation of Europe including middle- and high-income countries.¹⁴ The questionnaires were answered by a combination of 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%). For more information on the participating centers see our previous publication.¹⁴

Classification of TBI

It appeared that different definitions of severity levels for TBI were used (Table 1). Forty centers (59%) define 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 is considered a GCS score between 9-12 in 38 centers (56%) and 9-13 in 22 (32%). The majority of the centers consider 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 Canadian CT Head rule (n = 4; 6%), New Orleans criteria (n = 1; 1.5%) and CT in Head Injury Patients rule (n = 4; 6%). In addition 10 centers (15%) use other local guidelines and 14 centers (20.5%) use no guidelines at all. More than 90% (n = 62) of the centers consider their CT scanning policy liberal. Most centers (n = 45; 66%) are more restrictive in the use of a CT scan in children compared to adults. CT scans at the ED are 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 1). In half of the centers guideline development and maintenance is overseen by multidisciplinary groups (Appendix 1).

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 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 indication studied, the policy was more diverse. For example 25 centers (37%) indicated that patients with pre-injury anticoagulation were standardly 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 2).

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 variation in diagnostic, admission and discharge policies. 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. Moreover, our survey pinpoints areas of clinical controversy, that could do well with more clinical research.

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.

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 found that S100B is used as a prognostic biomarker in only 6 centers.

Future research is needed to investigate whether the variation in guideline use and policies influences 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 uses the existing variation to study effectiveness of treatments or policies by comparing centers who routinely perform an intervention to centers who do not.¹² In our study we found large between-center differences which could be further studied in CER. For example, we could compare centers that routinely perform follow-up at the outpatient clinic, with centers that do not routinely perform follow-up and assess the effect on outcome. Or we could 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.

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.

In conclusion, large between-center variation exists 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.

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Conflict of interest

Conflict of interest: none declared.

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References

1. Tagliaferri, F., Compagnone, C., Korsic, M., Servadei, F. and Kraus, J. (2006). A systematic review of brain injury epidemiology in Europe. *Acta Neurochir (Wien)* 148, 255-268; discussion 268.
2. Peeters, W., van den Brande, R., Polinder, S., Brazinova, A., Steyerberg, E.W., Lingsma, H.F. and Maas, A.I. (2015). Epidemiology of traumatic brain injury in Europe. *Acta Neurochir (Wien)* 157, 1683-1696.
3. Teasdale, G., Maas, A., Lecky, F., Manley, G., Stocchetti, N. and Murray, G. (2014). The Glasgow Coma Scale at 40 years: standing the test of time. *Lancet Neurol* 13, 844-854.
4. Esselman, P.C. and Uomoto, J.M. (1995). Classification of the spectrum of mild traumatic brain injury. *Brain Inj* 9, 417-424.
5. Stiell, I.G., Wells, G.A., Vandemheen, K., Clement, C., Lesiuk, H., Laupacis, A., McKnight, R.D., Verbeek, R., Brison, R., Cass, D., Eisenhauer, M.E., Greenberg, G. and Worthington, J. (2001). The Canadian CT Head Rule for patients with minor head injury. *Lancet* 357, 1391-1396.
6. National Clinical Guideline, C. (2014).
7. Smits, M., Dippel, D.W., Steyerberg, E.W., de Haan, G.G., Dekker, H.M., Vos, P.E., Kool, D.R., Nederkoorn, P.J., Hofman, P.A., Twijnstra, A., Tanghe, H.L. and Hunink, M.G. (2007). Predicting intracranial traumatic findings on computed tomography in patients with minor head injury: the CHIP prediction rule. *Ann Intern Med* 146, 397-405.
8. Borg, J., Holm, L., Cassidy, J.D., Peloso, P.M., Carroll, L.J., von Holst, H., Ericson, K. (2004). Diagnostic procedures in mild traumatic brain injury: results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. *J Rehabil Med*, 61-75.
9. Carroll, L.J., Cassidy, J.D., Peloso, P.M., Borg, J., von Holst, H., Holm, L., Paniak, C., Pepin, M. (2004). Prognosis for mild traumatic brain injury: results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. *J Rehabil Med*, 84-105.
10. Borg, J., Holm, L., Peloso, P.M., Cassidy, J.D., Carroll, L.J., von Holst, H., Paniak, C., Yates, D. (2004). Non-surgical intervention and cost for mild traumatic brain injury: results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. *J Rehabil Med*, 76-83.

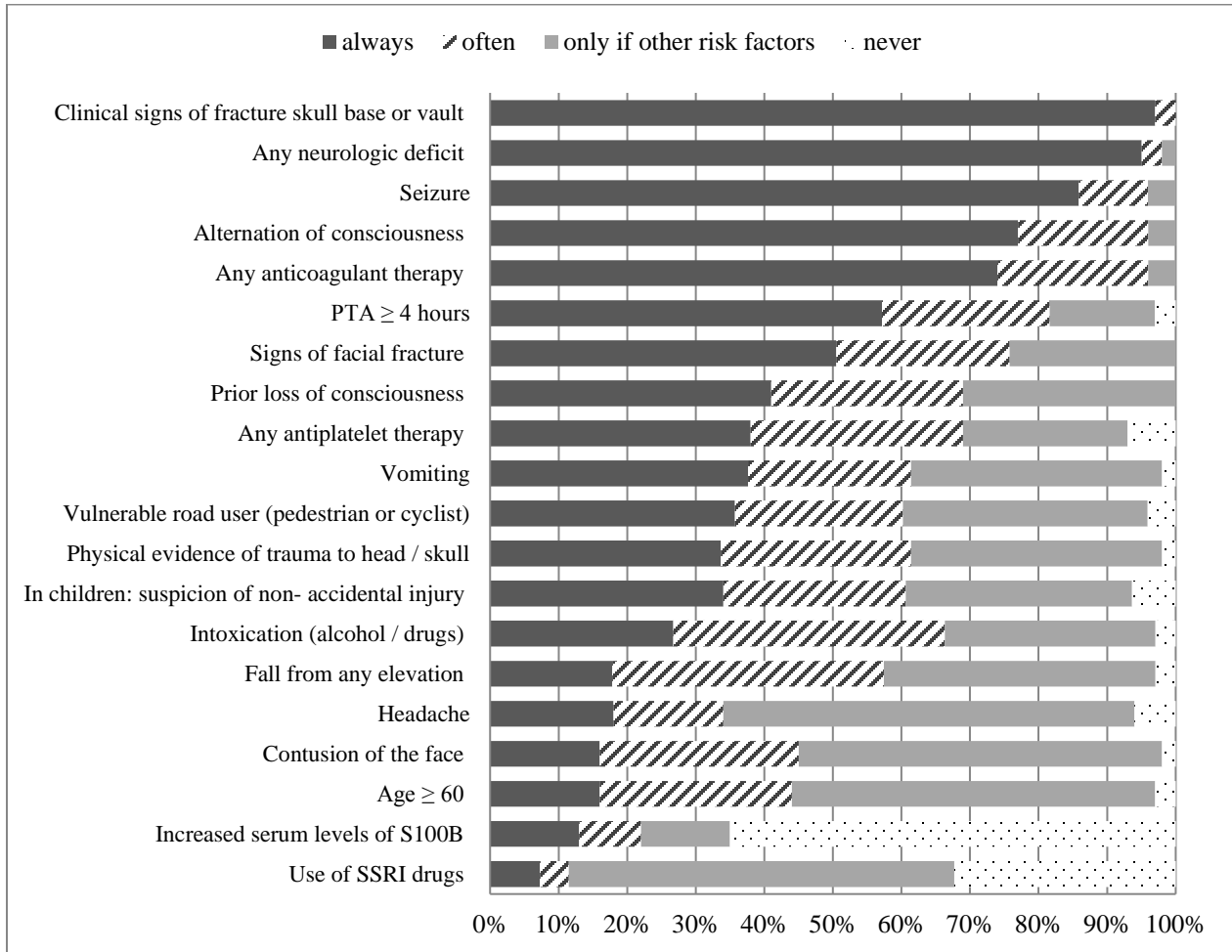
11. Vos, P.E., Battistin, L., Birbamer, G., Gerstenbrand, F., Potapov, A., Prevec, T., Stepan Ch, A., Traubner, P., Twijnstra, A., Vecsei, L., von Wild, K. and European Federation of Neurological, S. (2002). EFNS guideline on mild traumatic brain injury: report of an EFNS task force. *Eur J Neurol* 9, 207-219.
12. Maas, A.I., Menon, D.K., Lingsma, H.F., Pineda, J.A., Sandel, M.E. and Manley, G.T. (2012). Re-orientation of clinical research in traumatic brain injury: report of an international workshop on comparative effectiveness research. *J Neurotrauma* 29, 32-46.
13. Maas, A.I., Menon, D.K., Steyerberg, E.W., Citerio, G., Lecky, F., Manley, G.T., Hill, S., Legrand, V., Sorgner, A., Participants, C.-T. and Investigators (2015). Collaborative European NeuroTrauma Effectiveness Research in Traumatic Brain Injury (CENTER-TBI): a prospective longitudinal observational study. *Neurosurgery* 76, 67-80.
14. Cnossen, M.C., Polinder, S., Lingsma, H.F., Maas, A.I., Menon, D., Steyerberg, E.W., Investigators, C.-T. and Participants (2016). Variation in Structure and Process of Care in Traumatic Brain Injury: Provider Profiles of European Neurotrauma Centers Participating in the CENTER-TBI Study. *PLoS One* 11, e0161367.
15. De Kruijk, J.R., Twijnstra, A., Meerhoff, S. and Leffers, P. (2001). Management of mild traumatic brain injury: lack of consensus in Europe. *Brain Inj* 15, 117-123.
16. Pulhorn, H., Westmoreland, L. and McMahon, C. (2016). The management of minor head trauma (GCS 15-13) across a Trauma Network. *Br J Neurosurg* 30, 536-540.
17. Stern, R.A., Seichepine, D., Tschoe, C., Fritts, N.G., Alosco, M.L., Berkowitz, O., Burke, P., Howland, J., Olshaker, J., Cantu, R.C., Baugh, C.M. and Holsapple, J.W. (2016). Concussion Care Practices and Utilization of Evidence-Based Guidelines in the Evaluation and Management of Concussion: A Survey of New England Emergency Departments. *J Neurotrauma*.
18. Hergenroeder, G.W., Redell, J.B., Moore, A.N. and Dash, P.K. (2008). Biomarkers in the clinical diagnosis and management of traumatic brain injury. *Mol Diagn Ther* 12, 345-358.
19. Topolovec-Vranic, J., Pollmann-Mudryj, M.A., Ouchterlony, D., Klein, D., Spence, J., Romaschin, A., Rhind, S., Tien, H.C. and Baker, A.J. (2011). The value of serum biomarkers in prediction models of outcome after mild traumatic brain injury. *J Trauma* 71, S478-486.
20. Uden, L., Calcagnile, O., Uden, J., Reinstrup, P. and Bazarian, J. (2015). Validation of the Scandinavian guidelines for initial management of minimal, mild and moderate traumatic brain injury in adults. *BMC Med* 13, 292.

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%)

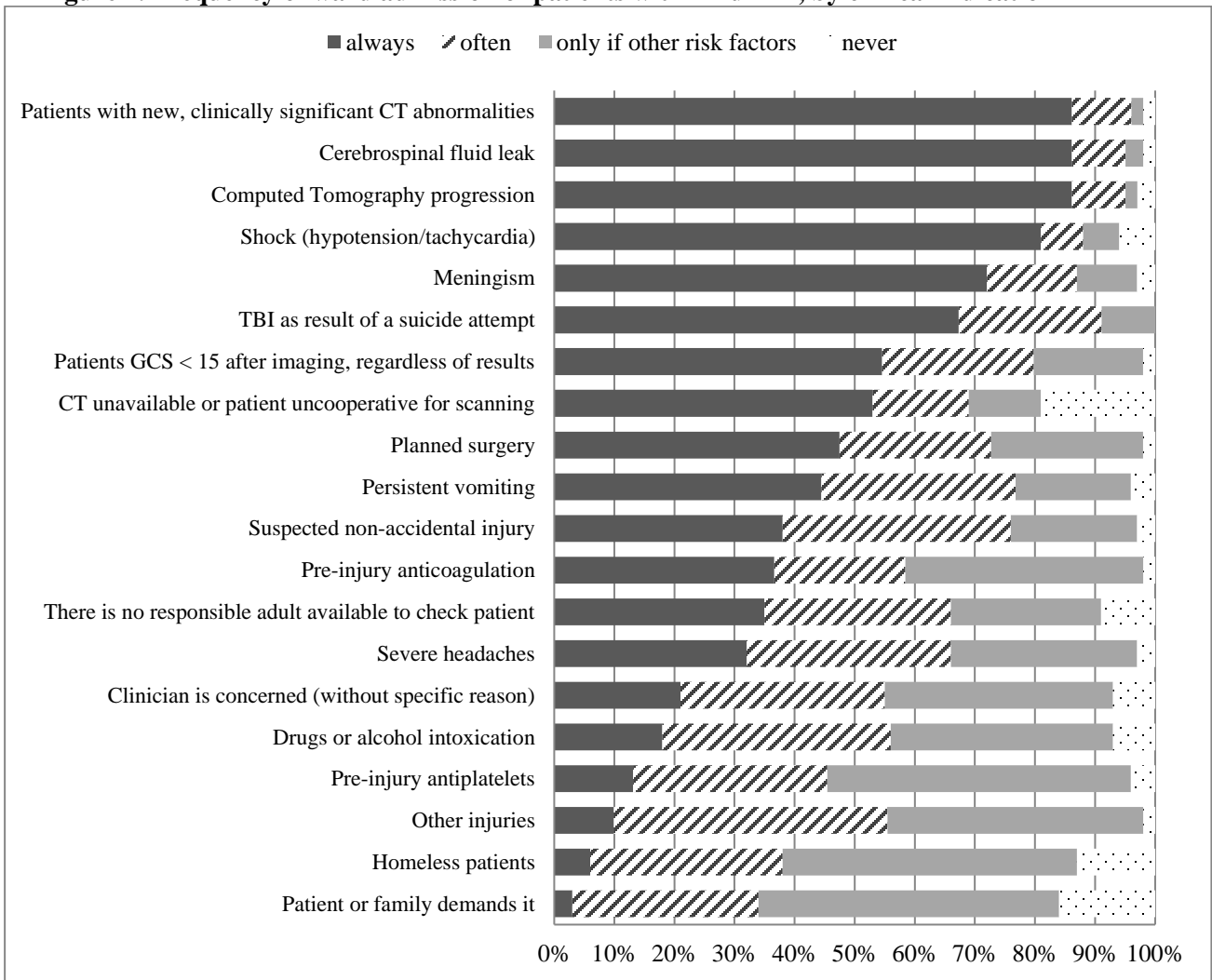
The responders were asked to enter the lowest and highest GCS score per TBI group, the bold GCS range represents the range most common in the literature.

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



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.

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



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.

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

Information	ED		Hospital ward	
	Verbally n (%)	Written n (%)	Verbally n (%)	Written 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 1

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.

Appendix 2

Frequency of anti-epileptic drug prescription, by indication

