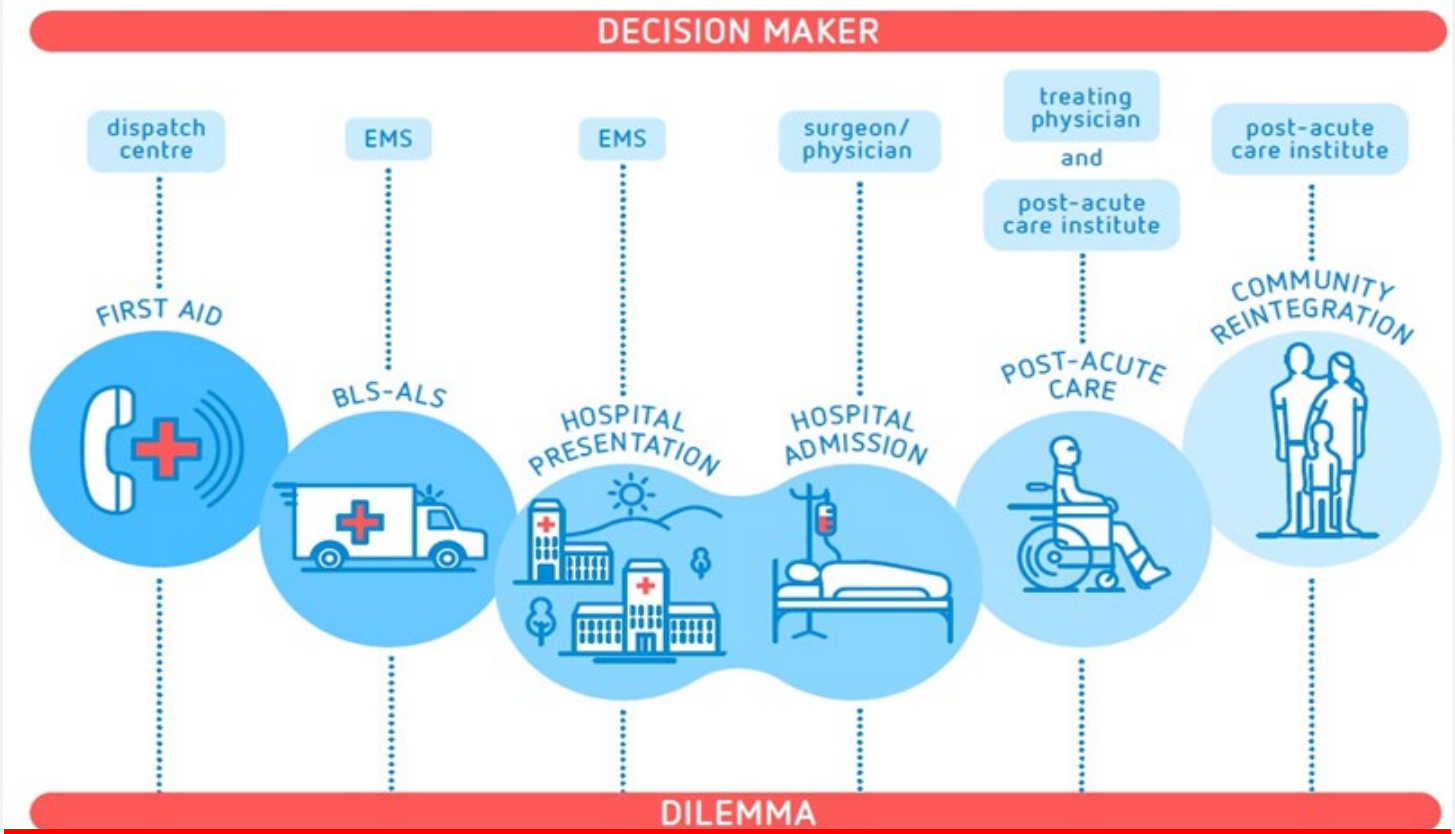
CENTER-TBI
Collaborative European NeuroTrauma Effectiveness Research in TBI
A 2020 vision: Generating knowledge for improving TBI outcomes

PROGNOSE NEUROTRAUMA: NIEUWE BEHANDELINZICHTEN



A study across the continuum of care across all severities of TBI

nazl
netwerk acute zorg limburg

9 Juni, 2022

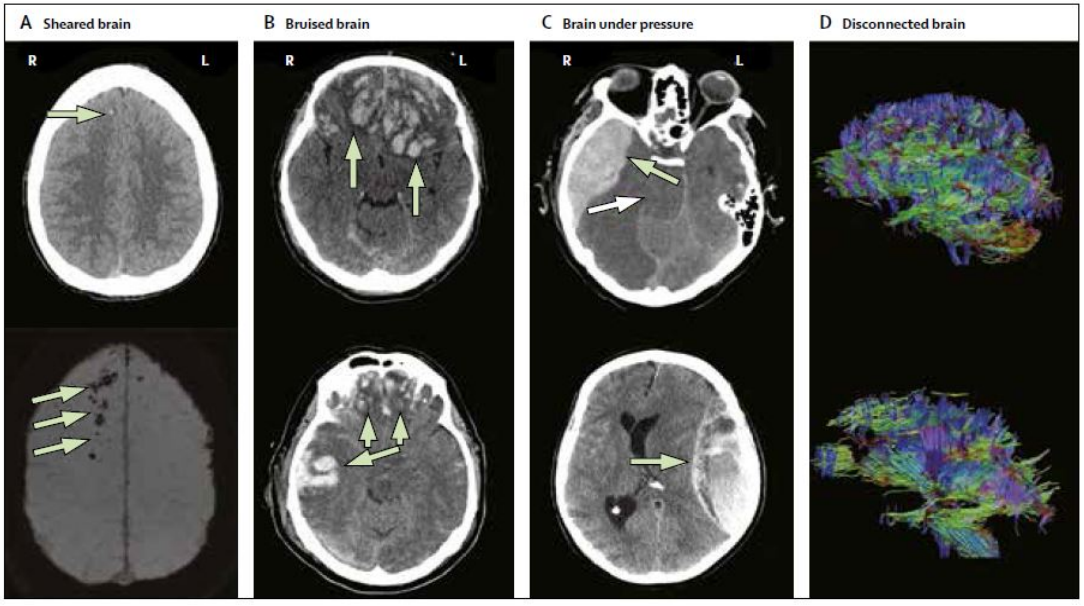
Andrew I.R. Maas, on behalf of the CENTER-TBI Investigators and Participants

Brainstorm, hoofdzaken en kopzorgen

CENTER-TBI

SEVENTH FRAMEWORK PROGRAMME

Need for improved Characterization and Classification



New approaches are needed to improve the precision of diagnosis, classification and characterization of TBI using multidomain approaches.

TBI Classification 2018

Symptom Classification

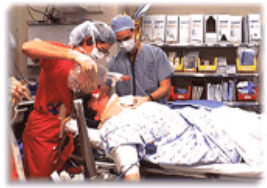
Glasgow Coma Score

using GCS

MILD (13-15)

MODERATE (9-12)

SEVERE (≤ 8)



The Glasgow Coma Scale at 40 years: standing the test of time

Graham Teasdale, Andrew Maas, Fiona Lecky, Geoffrey Manley, Nino Stocchetti, Gordon Murray

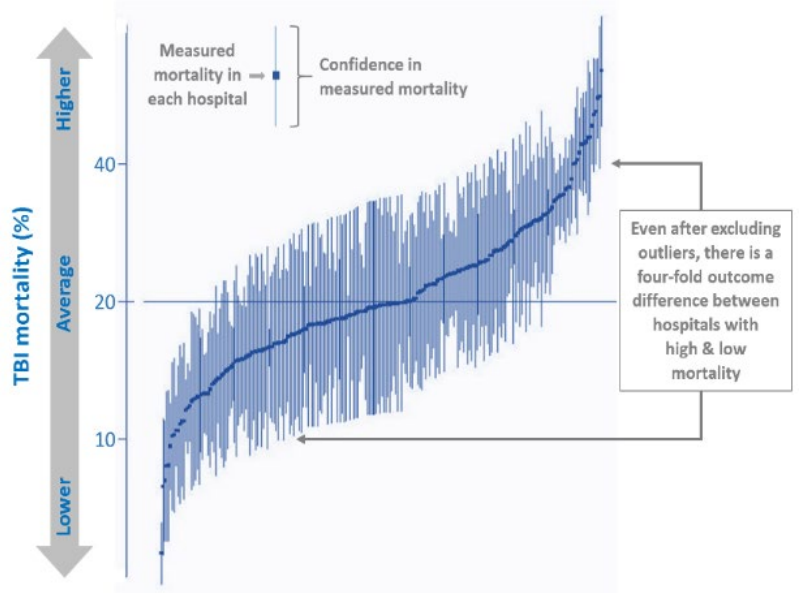
CHECK	OBSERVE	STIMULATE	RATE
For factors Interfering with communication, ability to respond and other injuries	Eye opening , content of speech and movements of right and left sides	Sound: spoken or shouted request Physical: Pressure on finger tip, trapezius or supraorbital notch	Assign according to highest response observed

CENTER-TBI

SEVENTH FRAMEWORK PROGRAMME

Obtaining New Evidence: Make Use Of The Existing Heterogeneity

- → Do **not** limit heterogeneity
- → Comparative Effectiveness Research
- → Identification of Best Practices



Large Between-Center Differences in Outcome After Moderate and Severe Traumatic Brain Injury in the International Mission on Prognosis and Clinical Trial Design in Traumatic Brain Injury (IMPACT) Study

Hester F. Lingsma, MSc*
Bob Roozenbeek, MD*‡
Bayoue Li, MSc§
Juan Lu, MD¶
James Weir, Msc‖
Isabella Butcher, PhD‖
Anthony Marmarou, MD, PhD†¶
Gordon D. Murray, PhD‡
Andrew I.R. Maas, MD, PhD‡
Ewout W. Steyerberg, PhD*

BACKGROUND: Differences between centers in patient outcome after traumatic brain injury are of importance for multicenter studies and have seldom been studied.

OBJECTIVE: To quantify the differences in centers enrolling patients in randomized clinical trials (RCTs) and surveys.

METHODS: We analyzed individual patient data from 9578 patients with moderate and severe traumatic brain injury enrolled in 10 RCTs and 3 observational studies. We used random-effects logistic regression models to estimate the between-center differences in unfavorable outcome (dead, vegetative state, or severe disability measured with the Glasgow Outcome Scale) at 6 months adjusted for differences in patient characteristics. We calculated the difference in odds of unfavorable outcome between the centers at the higher end vs those at the lower end of the outcome distribution. We analyzed the total database, Europe and the United States separately, and 4 larger RCTs.

	Unadjusted for case mix	Adjusted for case mix
IMPACT database (n=9578)	2.4	3.3
IMPACT – US (n=3325)	2.0	2.4
IMPACT – EU (n=5706)	2.4	3.8
CRASH (n=9978)	9.6	6.6

Global aims CENTER-TBI

Our global aims are:

- To improve characterization and classification of TBI in Europe, with inclusion of emerging technologies.

- To identify the most effective clinical care and to provide high quality evidence in support of treatment recommendations and guidelines.

49 scientific Participants

Evolved into a Global Initiative with Patient data from:

- **China**
- India
- Australia

SEVENTH FRAMEWORK PROGRAMME

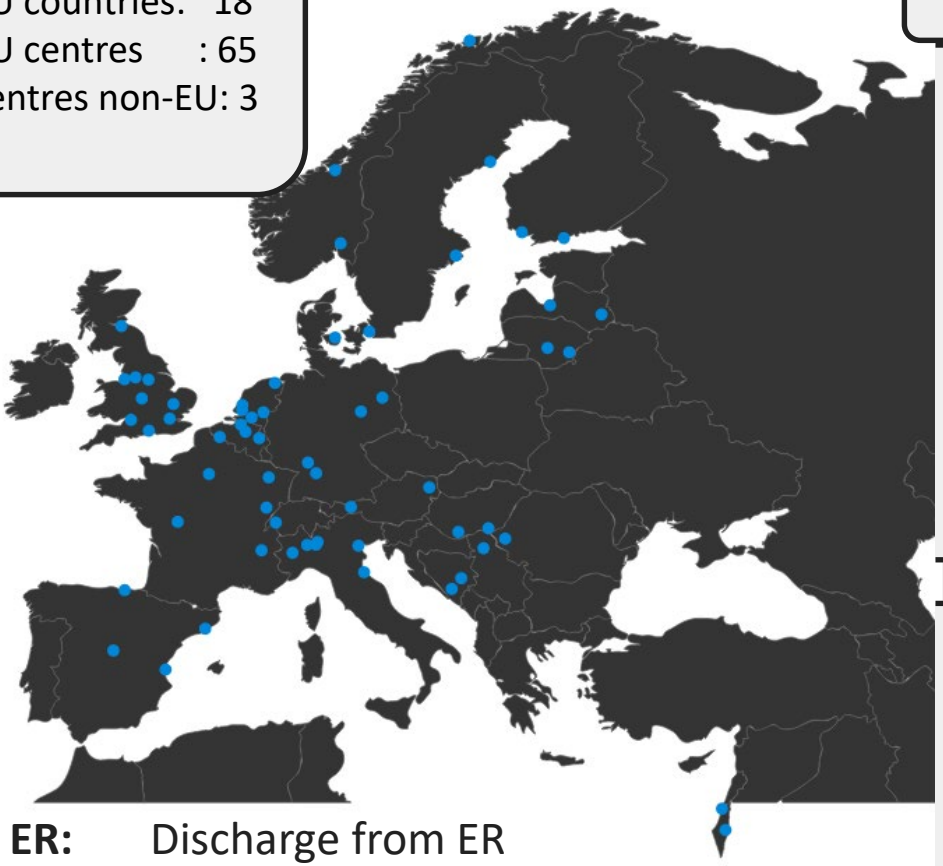
Recruitment to CENTER-TBI differentiated by Care Pathway

- **ER Stratum:** Discharged out of hospital from the ER
- **Adm Stratum:** Admitted to hospital ward
- **ICU Stratum:** Primarily admitted to ICU

CENTER-TBI: The data

Core Study:
Number EU countries: 18
Number EU centres : 65
Number centres non-EU: 3

FPI: 19 December 2014



ER: Discharge from ER
Adm: Primary admission to ward
ICU: Primary admission to ICU

Recruitment Status

CORE Data EU/Israel	**4,509**
ER	848
ADM	1,523
ICU	2,138
Core Data India	**1,046**
Core Data Australia	**198**
TOTAL Core	**5753**

Registry:	**39,891**
EU	22,849
China	13,138
India	3,904

LPI: 17 December 2017

CENTER-TBI

SEVENTH FRAMEWORK PROGRAMME

GCS and stratum

	N (%)	ER (N, %)	Adm (N, %)	ICU (N, %)
Core Study GCS baseline (median (IQR))	15 (10-15)	15 (15-15)	15 (14-15)	9 (4-14)
Total Core Study **Mild (13-15)** **Moderate (9-12)** **Severe (3-8)**	**4330** 2955 (68%) 389 (9.0%) 986 (23%)	**832** **826 (99%)** 2 (0.2%) 4 (0.5%)	**1489** **1409 (93%)** 59 (3.9%) 21 (1.4%)	**2009** **720 (36%)** 328 (15%) 961 (45%)
Total Registry **Mild (13-15)** **Moderate (9-12)** **Severe (3-8)**	**20626** **18477 (89.6%)** 888 (4.3%) 1261 (6.1%)	**9427** **9276 (98%)** 96 (1%) 55 (0.6%)	**8217** **7735 (94%)** 369 (4.5%) 113 (1.4%)	**2982** **1466 (49%)** 423 (14%) 1093 (37%)

Conclusion: Mild TBI is the most common form of TBI

Over 95% of patients in ER and Adm strata have a mTBI

Over one third of patients admitted to ICU have a mTBI

“Mild” TBI is not so mild

A normal CT ≠ absence of structural damage

30% of patients with mild TBI and a normal CT scan on presentation have an abnormal MR at 2-3 weeks

Outcome at 6 months:

- GOSE <8: 51%
- SF12v2: 25%
- RPQ: 26%
- Incomplete Recovery: 60%

90% of centers do not routinely schedule follow-up for patients with mild TBI on ER discharge, and only 46% do so on discharge from the ward.

Outcome predictors differ between mild and moderate/severe TBI. In mod/severe TBI, outcome is mainly dependent on injury severity, whilst in mild TBI it is more “what the patient brings to the injury”

CT and MR agreement for 384 MR early (<3 weeks) scans (derived from central review)

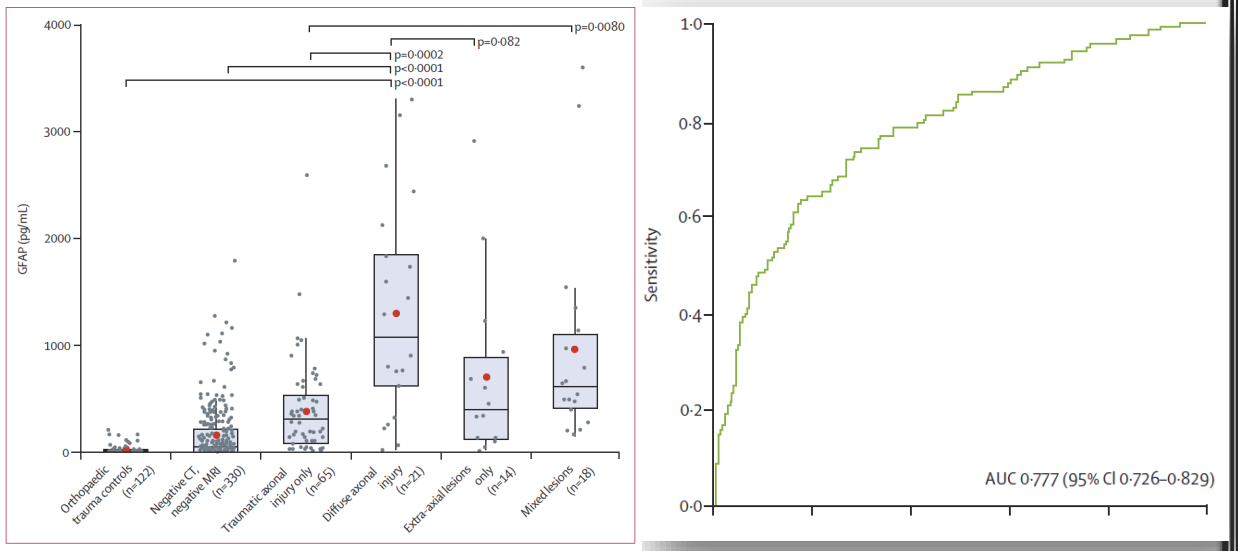
- Abnormalities on MRI were found in 60 (30%) of 202 patients with a normal admission CT scan
- MRI was normal in 32 (18%) of 182 patients with traumatic abnormalities on CT obtained at presentation
- MRI showed more contusions and traumatic axonal injuries than did CT, but CT detected more tSAH and epidural haematoma

Conclusion:
A normal CT at presentation does not mean absence of structural damage

Steyerberg et al 2019, Lancet Neurology

Association between plasma GFAP concentrations and MRI abnormalities in patients with CT-negative traumatic brain injury in the TRACK-TBI cohort: a prospective multicentre study

John K Yue, Esther L Yuh*, Frederick K Korley*, Ethan A Winkler, Xiaoying Sun, Ross C Puffer, Hansen Deng, Winward Choy, Ankush Chandra, Sabrina R Taylor, Adam R Ferguson, J Russell Huie, Miri Rabinowitz, Ava M Puccio, Pratik Mukherjee, Mary J Vassar, Kevin K W Wang, Ramon Diaz-Arrastia, David O Okonkwo, Sonia Jain, Geoffrey T Manley, and the TRACK-TBI Investigators†*

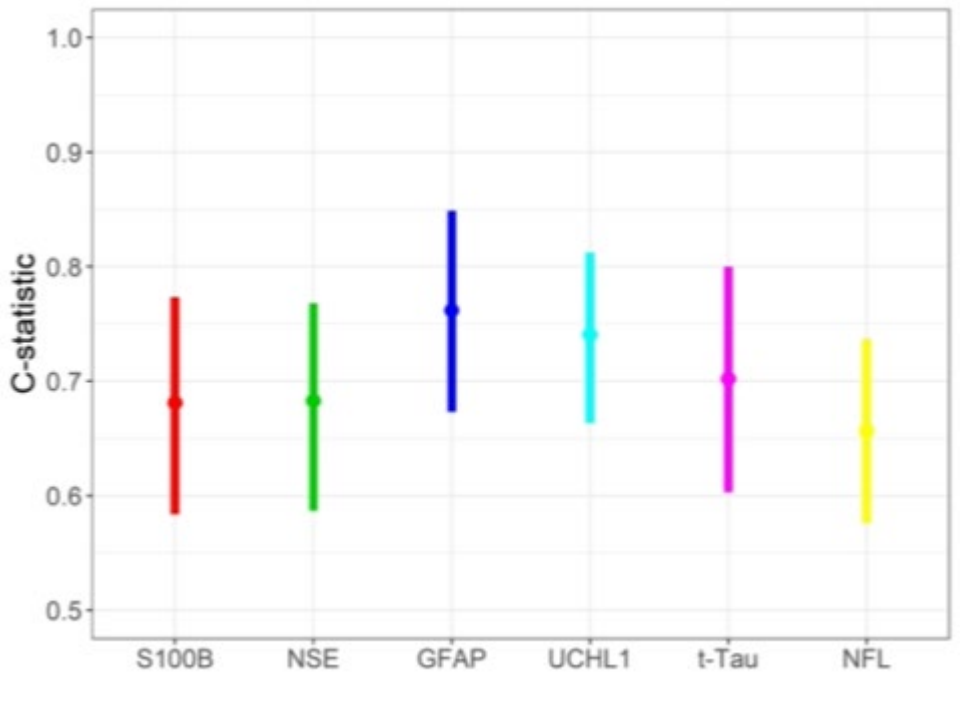


450 patients with mTBI and normal CT, of whom 120 had pos MR

Plasma samples within 24 hrs of injury

Yue JK et al. Lancet Neurol. 2019 Oct;18(10):953-961

DIAGNOSTIC VALUE OF BIOMARKER VALUES WITH MR POSITIVITY IN PATIENTS WITH NEGATIVE CT SCAN (44/152) – NOT ADJUSTED.



“Mild” TBI is not so mild: Outcome at 6 months

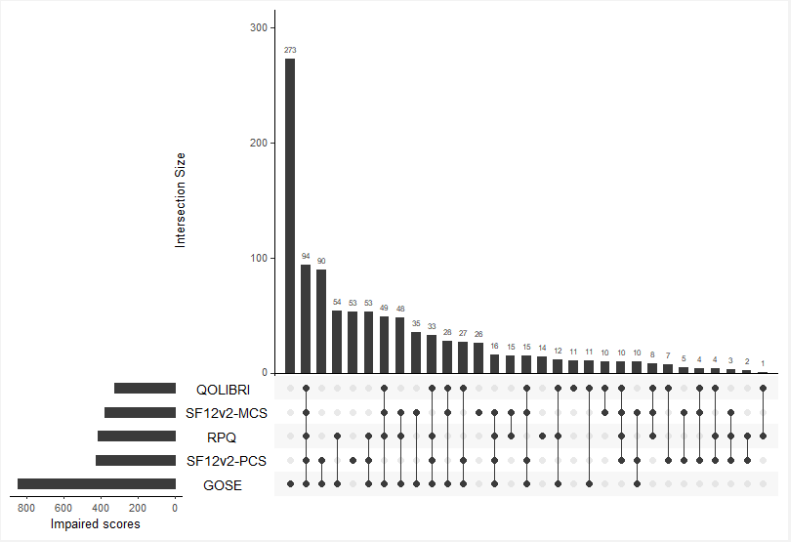
2464 patients with mTBI (GCS13-15) and available GOSE at 6 months:

- GOSE <5: 11%
- **GOSE <8: 51%**

1685 patients with mTBI and other outcomes available

- Qolibri-OS < 52 20%
- SF12v2
  - MCS<40 23%
  - PCS<40 26%
- RPQ ≥ **16**: 26%

Incomplete Recovery: 60%



Incomplete Recovery: Impaired score on one or more instruments

The Contemporary Landscape of TBI in Europe: Gender effects

Males are prone to TBI

Core study	ED (N, %)	Admission (N, %)	ICU (N, %)
Male sex	473 (55.8)	988 (64.9)	1561 (73.1)

Females with mild TBI less likely to be admitted to the ICU:

[OR] 0.6, 95% CI: 0.4-0.8

Females have poorer outcome

Moderate/severe TBI: No difference in GOSE: OR 1.1, CI [0.8-1.4], but
Higher rate of more severe post-concussion symptoms: OR 1.7, CI [1.1-2.6]

Mild TBI: Poorer outcome across all domains

Core Study	GOSE<8	Qolibri-OS <52	SF12-MCS< 40	SF12-PCS<40	RPQ>11
Male (1842)	48%	17%	20%	23%	31%
Female (1020)	56%	27%	30%	34%	42%

The Contemporary Landscape of TBI in Europe: Age

Core Study	ED (N, %)	Admission (N, %)	ICU (N, %)
Total number of patients	848	1523	2138
Age (median, IQR)	48 (29-64)	53 (32-69)	49 (29-65)
Age			
• 0-18 years	28 (3.3)	95 (6.2)	132 (6.1)
• 18-65 years	611 (72.1)	937 (61.4)	1464 (68.1)
• >65 years	209 (24.6)	493 (32.3)	552 (25.7)

Older patients have more co-morbidities and receive medication for these
Both comordities and medication may modulate disease course and outcome

The Contemporary Landscape of TBI in Europe: Comorbidity and anticoagulants

	ER (N, %)	Admission (N, %)	ICU (N, %)
Total number of patients	848	1523	2138
Severe systemic disease	93 (11%)	159 (11%)	210 (10%)
Anticoagulants	46 (5.5%)	133 (8.8%)	119 (6%)
Platelet aggregation Inhibitors	85 (10%)	178 (12%)	211 (11%)

Pre-injury AC use associated with poorer outcome

- Mortality increased 3x
- Unfav. outcome higher in APAC (52 vs 24%)
- Confirmed in China registry: OR for hospital mortality: 3.85

Disparities in Care

Low energy Falls:

- occur in 40% of patients
- have similar rates of CT brain scan abnormalities and in-hospital mortality as those injured by other mechanisms
- 50% less likely to receive critical care or emergency interventions.

High energy transfer should no longer inform injury scene and emergency department TBI triage of injured older people

Lecky et al: CENTER-TBI Participants and Investigators. The burden of traumatic brain injury from low-energy falls among patients from 18 countries in the CENTER-TBI Registry: A comparative cohort study. PLoS Med. 2021 Sep 14;18(9)

Unmet rehabilitation needs:

- 90% of patients with mod/severe TBI reported rehabilitation needs
- BUT only 30% received in-patient rehabilitation and 15% out-patient rehabilitation
- Substantial between country variation

Andelic et al.: Unmet Rehabilitation Needs after Traumatic Brain Injury across Europe: Results from the CENTER-TBI Study. Journal of Clinical Medicine, 2021: 10(5), 1035

PRE-HOSPITAL CARE HAS IMPROVED

Second insults in patients with moderate/severe TBI

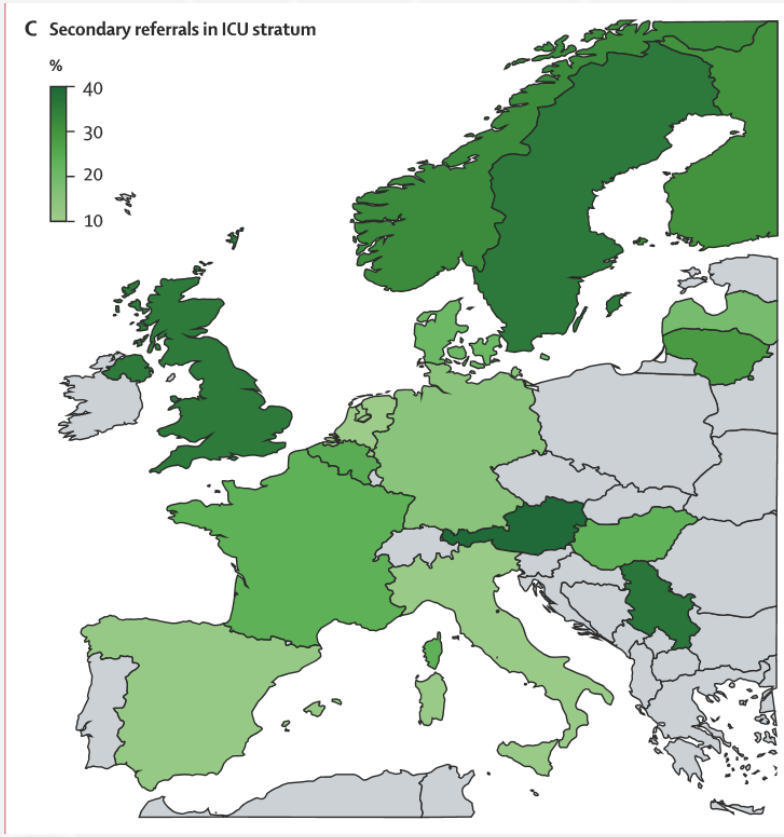
	IMPACT studies 1984 - 1997	CENTER-TBI 2014-2017
Hypoxia	20.3% [1150/5661]	5.5% [64/1160])
Hypotension	18.3% [1211/6629]	10.6% [124/1160]

Secondary insults are less common

Between country differences in secondary referrals

adjusted for case-mix MOR: 1.69

Secondarily referred mod/severe TBI patients presented more often with a CT abnormality:
mass lesion (52% vs 34%),
midline shift (54% vs 36%)
ASDH (77% vs 65%).



Percentage of patients in the intensive care unit stratum (n=2138) referred from another hospital, per country.

Secondary referral was not significantly associated with fav. outcome
OR: 1.07, 95% CI: 0.78-1.69
or with survival at discharge
OR: 1.05, 95% CI: 0.58-1.90

Interpretation: Within a system of care that embeds appropriate and rapid transfer following initial presentation to a regional hospital, outcome is comparable to that observed in patients directly transported to a trauma centre

Guidelines as Framework of care

- **BTF guidelines:** most widely used medical management guidelines in TBI
- 4 editions: 1996, 2000, 2007, 2016 – increasing methodological rigor

➢10 "original" topics

➢5 new topics added in 2007, 2 extra topics added in 2016

- More Recommendations **removed or downgraded** than **added or upgraded**
- **Substantial delays** between searches and publication
- **Adherence is relatively low** (Cnossen et al 2016)

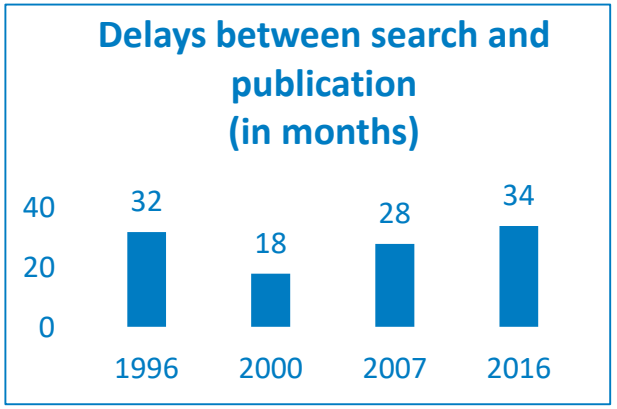
➢Evidence-practice gap

➢Consensus-based efforts may bridge this gap:

➢SIBICC

➢TQIP

➢CREVICE



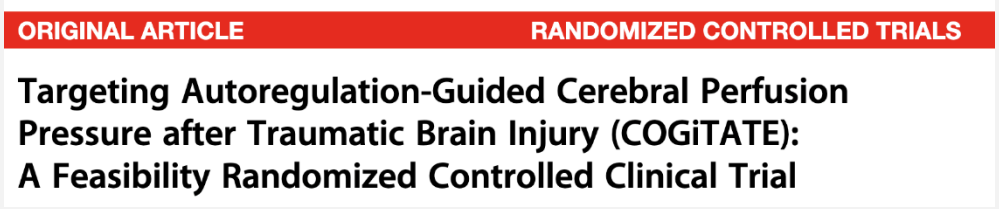
MOVING TOWARDS INDIVIDUALIZED CARE

Guidelines are best thought of as a framework for care

- applicable to population averages
- deviations may be appropriate in the context of individualized management, when undertaken by knowledgeable experts

Current approaches to individualizing management:

- ICP and CPP thresholds are not absolute, and depend on autoregulation
- CPPopt: COGITATE trial
- Multimodality monitoring


ORIGINAL ARTICLE RANDOMIZED CONTROLLED TRIALS

Targeting Autoregulation-Guided Cerebral Perfusion Pressure after Traumatic Brain Injury (COGiTATE): A Feasibility Randomized Controlled Clinical Trial

Tas et al, J. Neurotrauma 38: 2790-2800

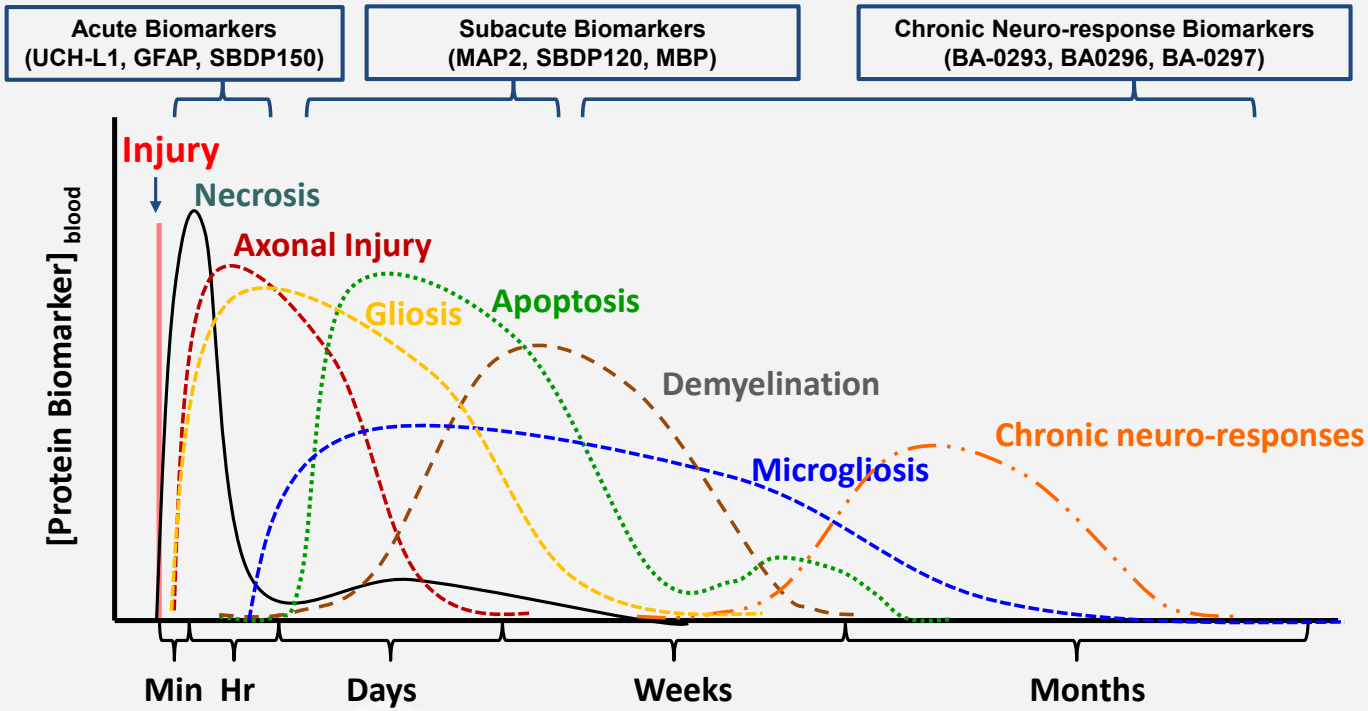
CER added to research armamentarium

Applied in CENTER-TBI

- Fluid management
- DVT prophylaxis
- Surgical management (ASDH, t-ICH and DC)

Individualizing management requires better characterisation and understanding of the disease process

Traumatic Brain Injury Pathophysiology – A Continuum of Biomarkers



Mondello S, et al. 2013 Med Res Rev. 34(3):503-31

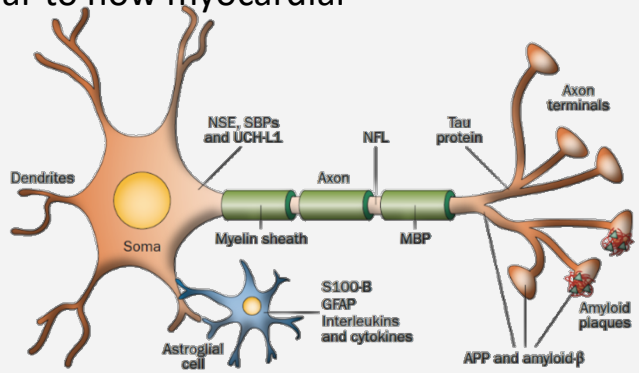
Triaging patients with mTBI for CT scanning

Clinical decision rules:

- New Orleans Criteria (NOC)
- Canadian CT head rule (CCHR)
- CHIP (CT in Head Injury)
- NICE Guideline for Head Injury
- Scandinavian Guidelines

Biomarkers in mild TBI:"Troponin for the Brain"

Biomarkers found in blood after patients have suffered a TBI could potentially be used in the ER to inform a diagnosis of TBI, similar to how myocardial infarct patients are diagnosed with troponin.

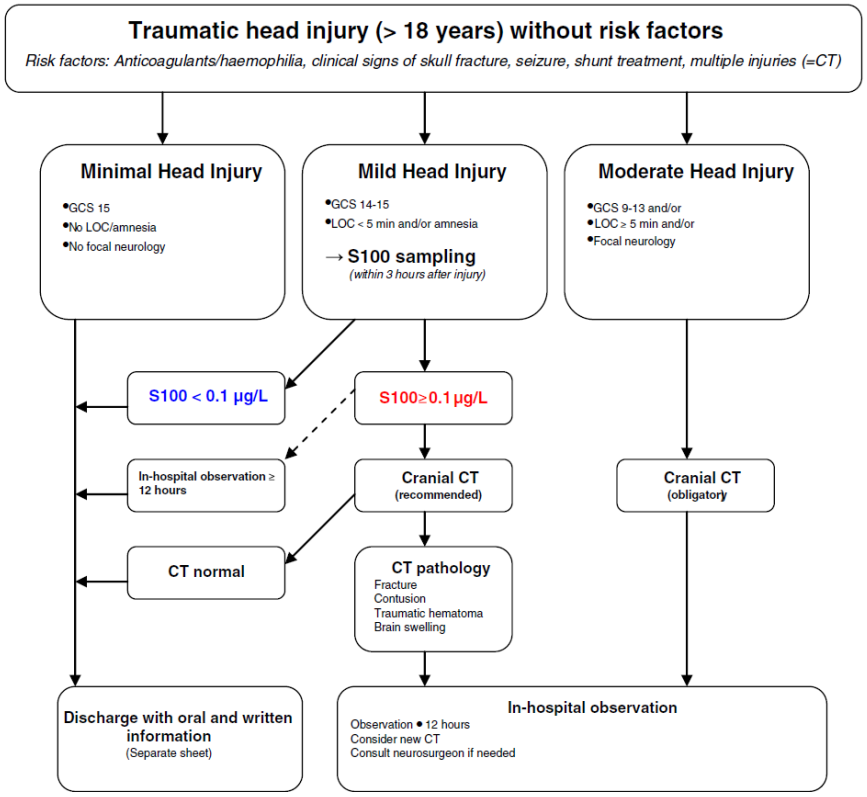


SCANDINAVIAN GUIDELINES

GUIDELINE Open Access

Scandinavian guidelines for initial management of minimal, mild and moderate head injuries in adults: an evidence and consensus-based update

Johan Undén[1*], Tor Ingebrigtsen[2] and Bertil Romner[3], for the Scandinavian Neurotrauma Committee (SNC)



BMC Medicine 2013

THE DIAGNOSTIC VALUE OF BIOMARKERS IN MILD TBI

What is the evidence?

Is S100B the best choice?

- Affected by extracranial injuries
- Affected by sampling time

Do Biomarkers provide “added” value over CDRs?

Serum GFAP and UCH-L1 for prediction of absence of intracranial injuries on head CT (ALERT-TBI): a multicentre observational study

Jeffrey J Bazarian, Peter Biberthaler*, Robert D Welch, Lawrence M Lewis, Pal Barzo, Viktoria Bogner-Flatz, P Gunnar Brolinson, Andras Büki, James Y Chen, Robert H Christenson, Dallas Hack, J Stephen Huff, Sandeep Johar, J Dedrick Jordan, Bernd A Leidel, Tobias Lindner, Elizabeth Ludington, David O Okonkwo, Joseph Ornato, W Frank Peacock, Kara Schmidt, Joseph A Tyndall, Arastoo Vossough, Andy S Jagoda*

Summary

Background More than 50 million people worldwide sustain a traumatic brain injury (TBI) annually. Detection of intracranial injuries relies on head CT, which is overused and resource intensive. Blood-based brain biomarkers hold the potential to predict absence of intracranial injury and thus reduce unnecessary head CT scanning. We sought to validate a test combining ubiquitin C-terminal hydrolase-L1 (UCH-L1) and glial fibrillary acidic protein (GFAP), at predetermined cutoff values, to predict traumatic intracranial injuries on head CT scan acutely after TBI.

Methods This prospective, multicentre observational trial included adults (≥18 years) presenting to participating emergency departments with suspected, non-penetrating TBI and a Glasgow Coma Scale score of 9–15. Patients were eligible if they had undergone head CT as part of standard emergency care and blood collection within 12 h of injury. UCH-L1 and GFAP were measured in serum and analysed using prespecified cutoff values of 327 pg/mL and 22 pg/mL, respectively. UCH-L1 and GFAP assay results were combined into a single test result that was compared with head CT results. The primary study outcomes were the sensitivity and the negative predictive value (NPV) of the test result for the detection of traumatic intracranial injury on head CT.

Findings Between Dec 6, 2012, and March 20, 2014, 1977 patients were recruited, of whom 1959 had analysable data. 125 (6%) patients had CT-detected intracranial injuries and eight (<1%) had neurosurgically manageable injuries. 1288 (66%) patients had a positive UCH-L1 and GFAP test result and 671 (34%) had a negative test result. For detection of intracranial injury, the test had a sensitivity of 0·976 (95% CI 0·931–0·995) and an NPV of 0·996 (0·987–0·999). In three (<1%) of 1959 patients, the CT scan was positive when the test was negative.

Interpretation These results show the high sensitivity and NPV of the UCH-L1 and GFAP test. This supports its potential clinical role for ruling out the need for a CT scan among patients with TBI presenting at emergency departments in whom a head CT is felt to be clinically indicated. Future studies to determine the value added by this biomarker test to head CT clinical decision rules could be warranted.

Lancet Neurol 2018

Published Online July 24, 2018 http://dx.doi.org/10.1016/S1474-4422(18)30231-X

See Online/Comment http://dx.doi.org/10.1016/S1474-4422(18)30275-8

*Contributed equally

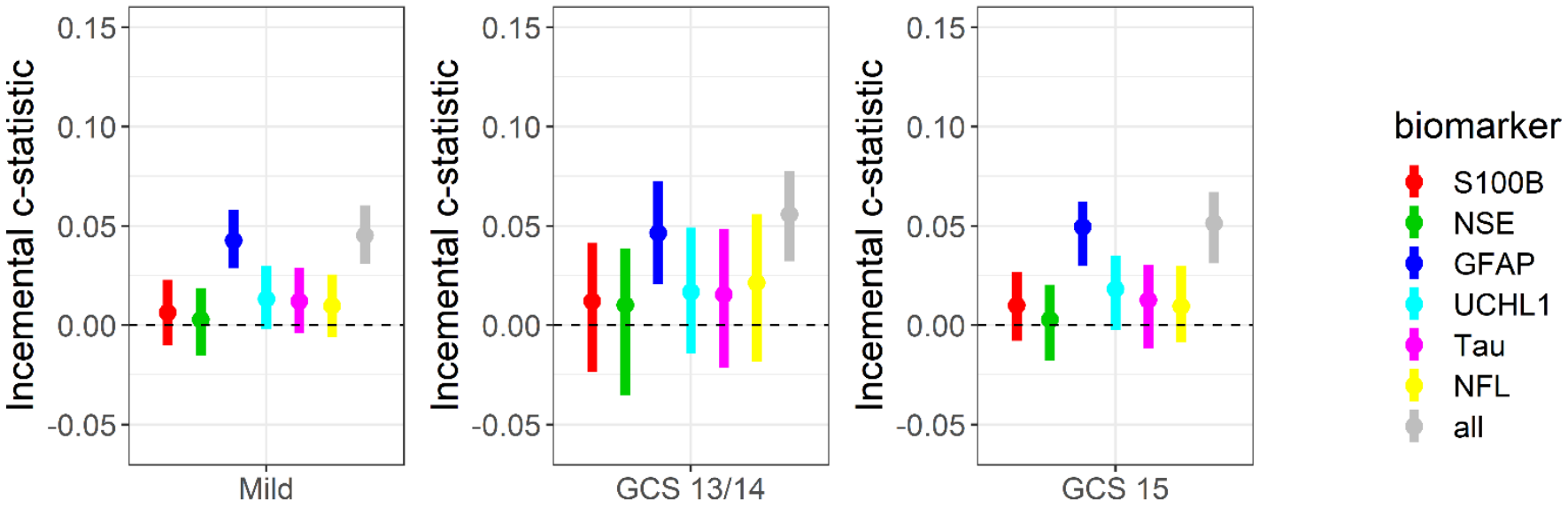
Department of Emergency Medicine, University of Rochester School of Medicine and Dentistry, Rochester, NY, USA (J J Bazarian MD); Technical University of Munich, Klinikum rechts der Isar, Munich, Germany (P Biberthaler MD); Department of Emergency Medicine, Wayne State University, Detroit Receiving Hospital, Detroit, MI, USA (R D Welch MD); Division of Emergency Medicine, Washington University, St Louis, MO, USA (L M Lewis MD); University of Szeged, Szeged, Hungary (P Barzo MD); Department of Trauma Surgery, Ludwig Maximilians University, Munich, Germany

Open questions:

- Does the test offer “added value” over current practice?
- Are 2 biomarkers better than one?
- Are thresholds valid?

Bazarian JJ, Biberthaler P, Welch RD, et al. Serum GFAP and UCH1-L1 in prediction of absence of intracranial injuries on head CT (ALERT-TBI): a multicenter observational study. Lancet Neurol 2018; published online July 24.

Incremental diagnostic value of biomarkers for triaging CT scanning in mTBI



Blood biomarkers on admission in acute traumatic brain injury: Relations to severity, CT findings and care path in the CENTER-TBI study

Endre Czeiter[a,b,c,1,*], Krisztina Amrein[a,b,1], Benjamin Y. Gravesteijn[d,1], Fiona Lecky[e,f], David K. Menon[g], Stefania Mondello[h], Virginia F.J. Newcombe[g], Sophie Richter[g], Ewout W. Steyerberg[d,i], Thijs Vande Vyvere[j,k], Jan Verheyden[j], Haiyan Xu[l], Zhihui Yang[l], Andrew I.R. Maas[m,1], Kevin K.W. Wang[l,n,1], András Büki[a,b,1], CENTER-TBI Participants and Investigators[2]

Analysis of 2867 patients, of whom 1951 with mild TBI (GCS 13/14: 457; GCS 15: 1494
All samples (serum) obtained within 24 hours of injury

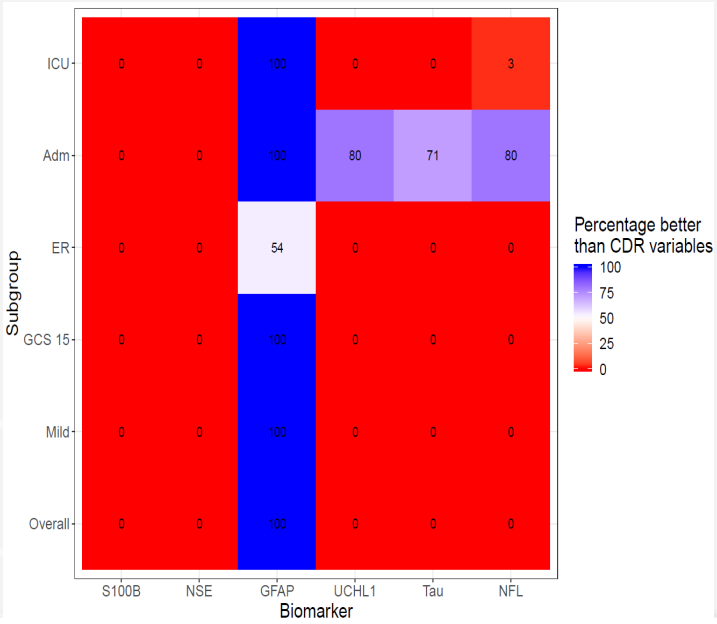
Ebiomedicine 2020

CENTER-TBI

SEVENTH FRAMEWORK PROGRAMME

Biomarkers for triaging CT scanning in mTBI

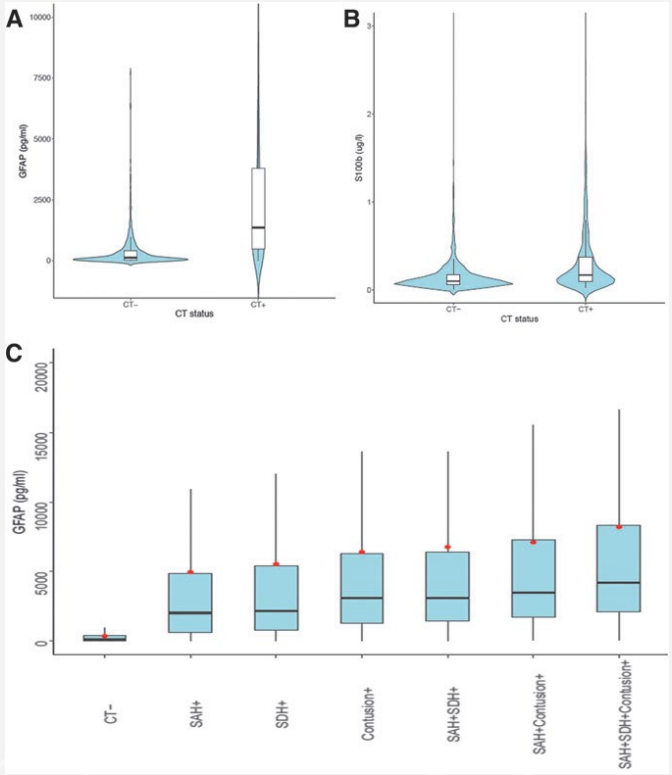
The biomarker GFAP should be included in decision rules for triaging patients with mild TBI for CT scanning.
In patients with mild TBI, GFAP showed incremental diagnostic value: discrimination increased from 0.84 [95%CI: 0.83-0.86] to 0.89 [95%CI: 0.87-0.90] when GFAP was included

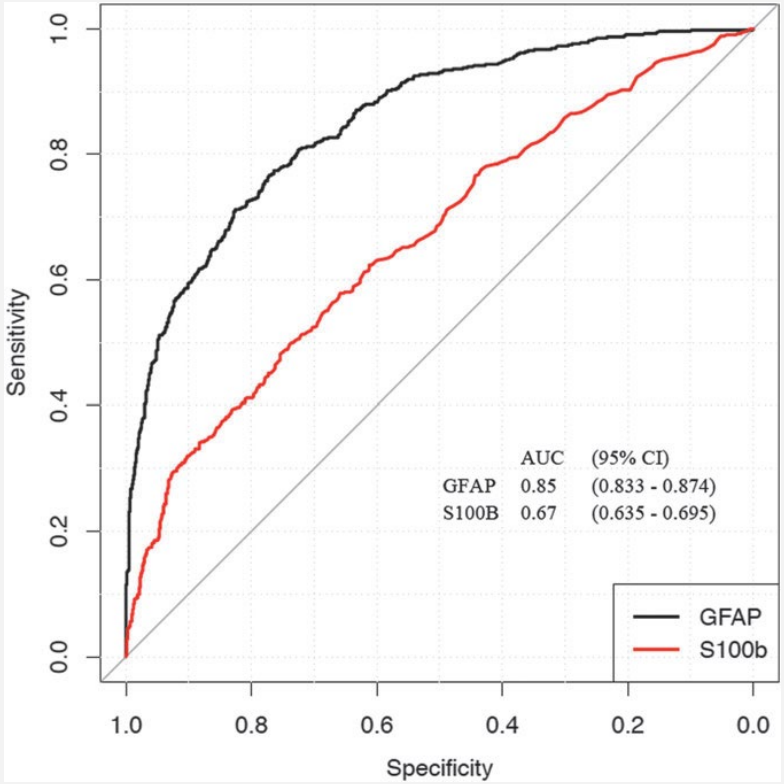


CENTER-TBI

SEVENTH FRAMEWORK PROGRAMME

TRACK-TBI: GFAP PERFORMS BETTER THAN S100B IN PREDICTING CT ABNORMALITIES





1359 patients with TBI (GCS 3-15)
GFAP: plasma, point-of-care
S100B: serum

Okonkwo et al; J. Neurotrauma 202

CENTER-TBI

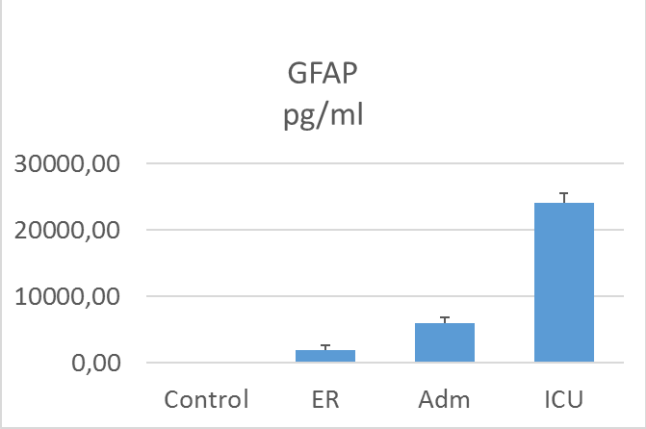
SEVENTH FRAMEWORK PROGRAMME

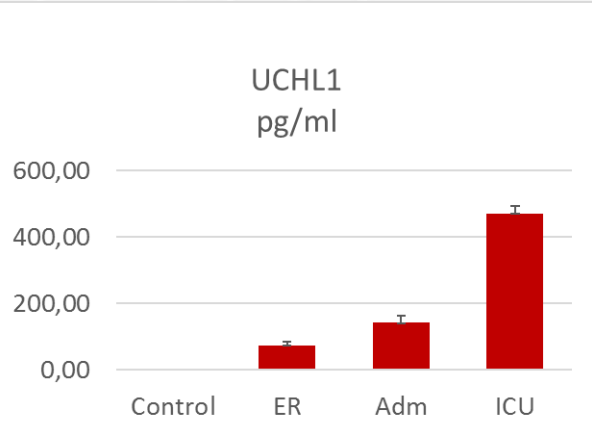
CONCLUSIONS ON DIAGNOSTIC VALUE OF BIOMARKERS

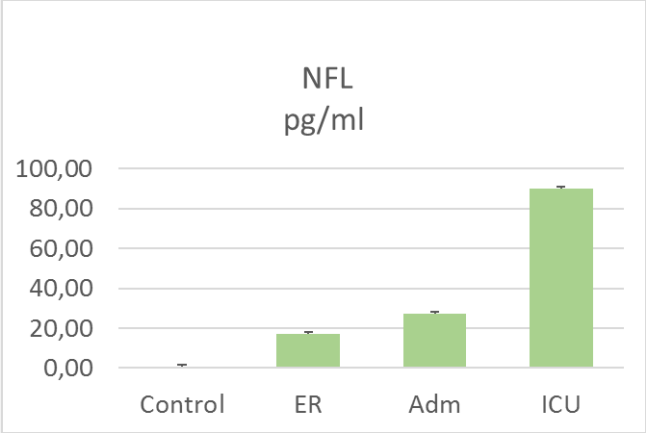
- GFAP performs better than S100B
- GFAP performs as well as all biomarkers combined
- No added value of combining GFAP with UCHL1
- GFAP outperforms CDRs
- GFAP can predict traumatic abnormalities on MR in patients with a normal CT

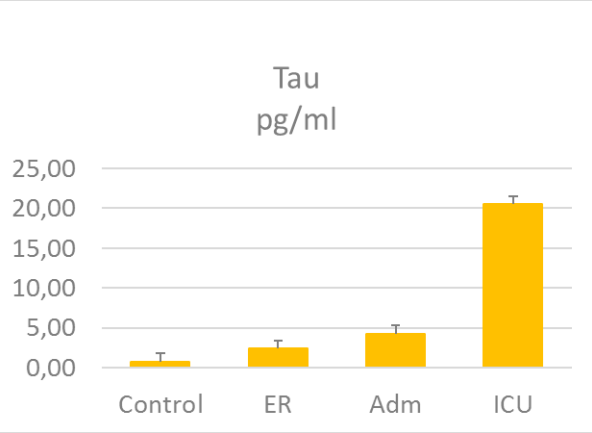
Relation to Injury Severity and Prognostic Value

CENTER-TBI: Biomarker levels differentiated by stratum









THE CURRENT PICTURE OF TBI IN THE ICU

- **36% have Mild TBI (GCS 13-15)**
- **Median age: 49 (IQR: 29-65); 26% > 65 years**
  - *Co-morbidity: 42% (10% severe)*
  - *Use of APAC: 17%*
    - Pre-injury AC use associated with poorer outcome
    - Mortality increased 3x; Unfav. outcome higher in APAC (52 vs 24%)
    - Confirmed in China registry: OR for hospital mortality: 3.85
- **Male sex 73% (vs 56 and 65% in ER and ADM strata)**
- **Cause of Injury: 45% RTI; 41% Falls**
  - *Alcohol involved: 20% in RTI; 33% in Falls*
- **Extracranial Injuries (AIS>=3): 55% (thorax 35%; spine 18%)**
- **Complications: 45%; AKI in 20%**
  - *AKI risk greater with osmotics (HR 2.08) or hypernatraemia (HR: 1.88)*

Conclusion: The TBI population in the ICU has changed

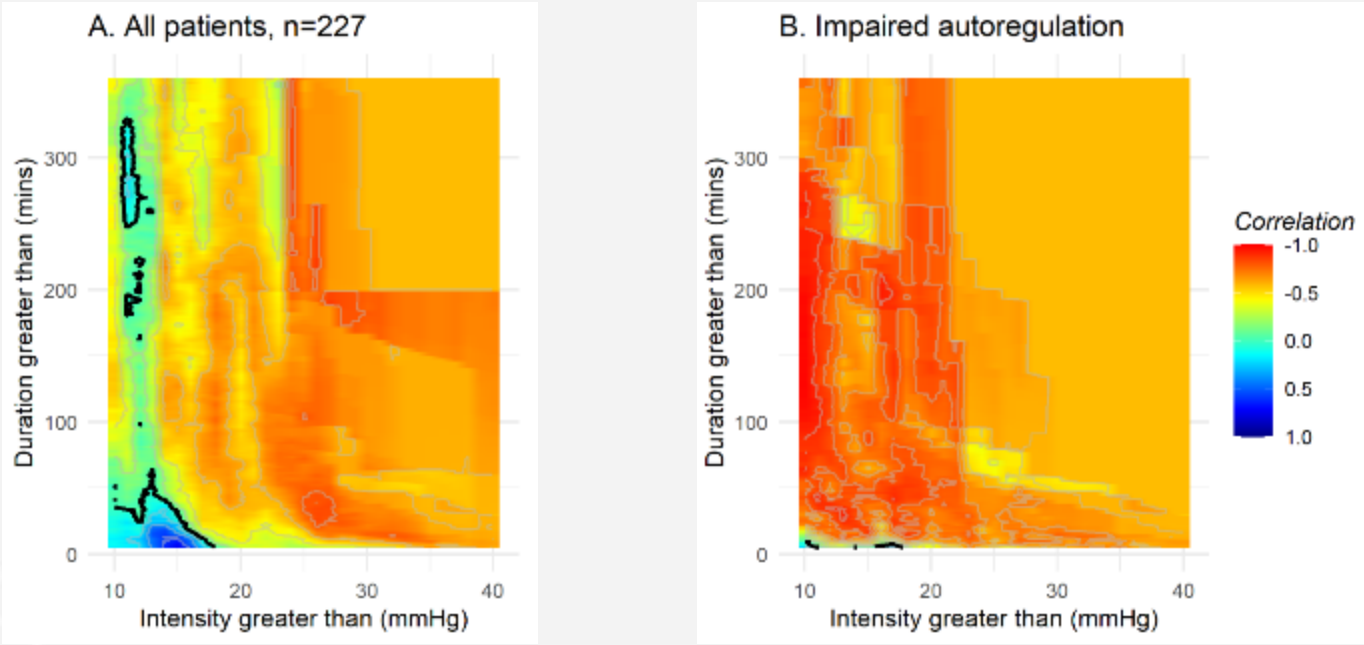
A HISTORICAL PERSPECTIVE ON "TREATMENT STYLE" FOR SEVERE TBI

Intracranial hypertension	**Classic Style**
Cerebral ischemia due to relative hypoperfusion	CPP Style
Cerebral ischaemia due to ICP ↑ resulting from intracranial hyperaemia	Optimized Hyperventilation Style
Cerebral ischemia due to ICP ↑ resulting from vasogenic (hydrostatic) oedema	Hydrostatic Oedema Style LUND Therapy

Practice recommendations

ICP monitoring: The concept of ICP dose

- The recommended threshold in the Guidelines of 22 mmHg for treating raised ICP is not absolute. We found a threshold of 18 +/- 4 mm Hg
- Treatment for raised ICP should be individualized, taking autoregulatory status into account.



Airway Management

- **Prehospital intubation** is associated with better functional outcome in patients with higher AIS scores in thoracic and abdominal regions (p=0.009, and p=0.02, respectively)
- **In-hospital intubation** had a significant beneficial effect on outcome in patients with GCS scores of 10 or lower (p=0.01)
- **Early tracheostomy** (within one week) for patients requiring ventilator support is associated with better outcome (OR 1.7 CI: 1.1-2.7) and reduced LOS in ICU (39 vs 49 days)

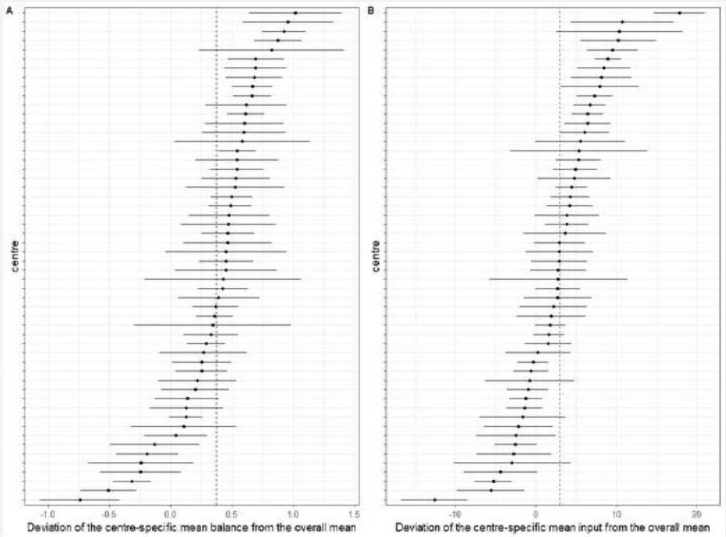
Gravesteijn et al; CENTER-TBI collaborators. Prehospital Management of Traumatic Brain Injury across Europe: A CENTER-TBI Study. Prehosp Emerg Care. 2021 Sep-Oct;25(5):629-643.

Robba et al; CENTER-TBI ICU Participants and Investigators. Tracheostomy practice and timing in traumatic brain-injured patients: a CENTER-TBI study. Intensive Care Med. 2020 May;46(5):983-994.

Practice recommendations

Fluid input and balance

Maintaining a neutral fluid balance in ICU patients is associated with better outcome, but is not common practice. Poorer outcome increases per 0·1L increase of fluid balance with an OR of 1·10 [95%CI:1·07–1·13] for ICU mortality and 1·03 [95%CI:1·02–1·05] for functional outcome.



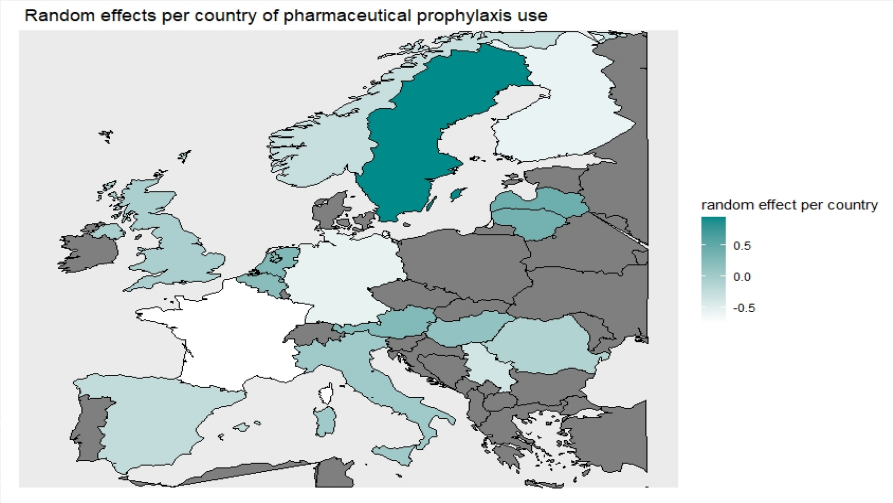
CENTER-TBI

SEVENTH FRAMEWORK PROGRAMME

Practice recommendations

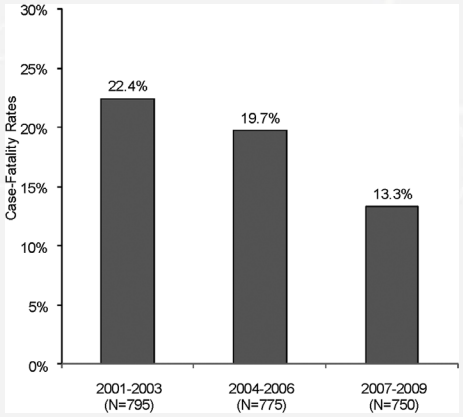
DVT prophylaxis

A moderate association with improved outcome was found at the centre-level (OR: 1.2 [0.7-2.1]), and patient-level (propensity adjusted OR: 1.4 [1.1-1.7]). Survival over time was higher with the use of pVTE prophylaxis ($p<0.001$).



HAS OUTCOME IMPROVED?

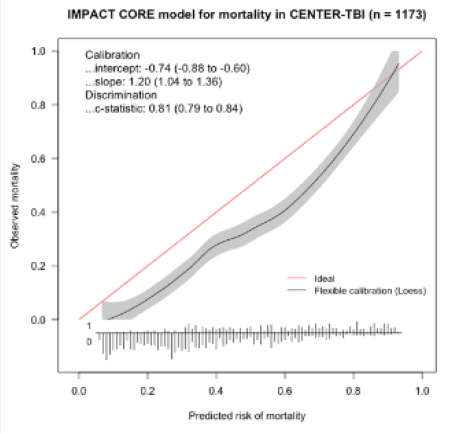
Claims have been made that the implementation of BTF guidelines has led to a 50% reduction of mortality in severe TBI – *Gerber et al 2013*

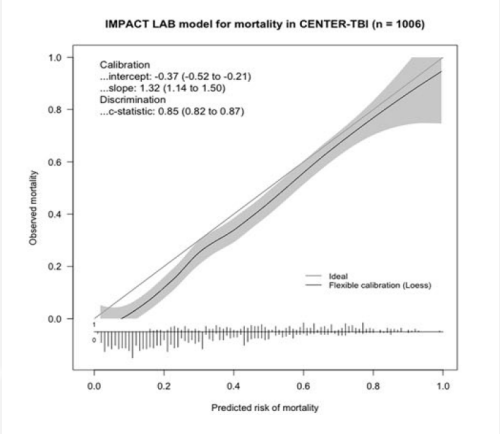


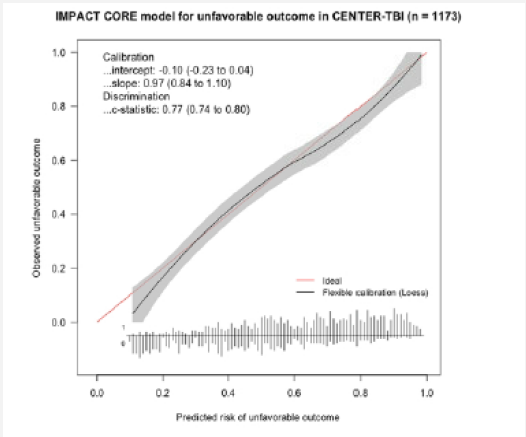
The facts:

Mortality in severe TBI	
1984 (Lu et al)	39%
1996 (Lu et al)	27%
CENTER-TBI (2014-2017)	27.8%

Observed vs expected outcome in CENTER-TBI







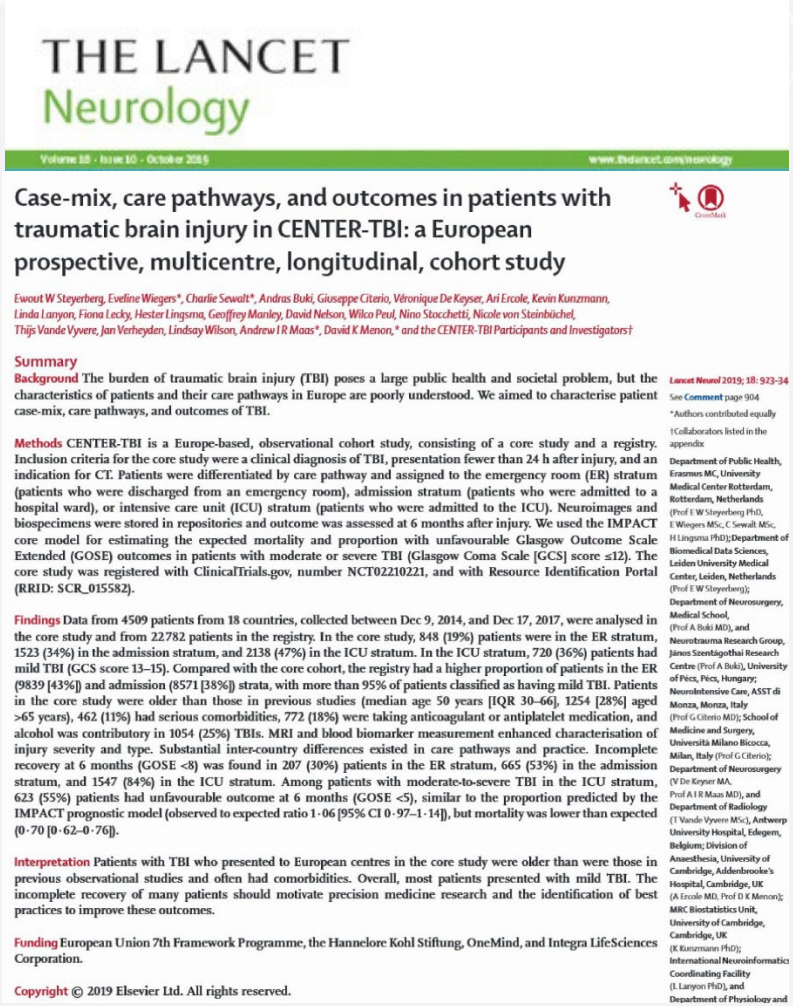
Conclusion: Mortality may have decreased slightly, but if so, this has come at a cost of more patients with severe disability

The CENTER-TBI Potential towards the future

- Large observational datasets – fully curated
- Includes Imaging, genetic and serum repositories
- Highly productive (to date >250 publications)
- Many analyses still ongoing – more to come
- Integrating all results into “the Bigger Picture” continues
- Expectations on meta-analysis across InTBIR studies are high
- CENTER-TBI is a unique data source with the largest imaging and blood repositories on TBI in the world
- The CENTER-TBI community is committed to facilitating further analyses by external researchers

https://www.center-tbi.eu/publications

TBI Is A Field In Medicine With High Unmet Needs



Many Thanks to all contributing Investigators!

CENTER-TBI

SEVENTH FRAMEWORK PROGRAMME