Acute Traumatic Intracranial Hemorrhage in Adults
The Modified Brain Injury Guidelines (mBIG)

Intermountain Canyons and Desert Regions

The Intermountain Emergency and Trauma specialty operating lane developed this care process model (CPM) in multidisciplinary collaboration with radiology, neurosurgery, physical medicine and rehabilitation, both urban and community hospitals, and Intermountain Health administration. It contains the most recent evidence-based practice for classifying and managing adult traumatic intracranial hemorrhage (tICH) patients and outlines the use of the mBIG guidelines in the Emergency Departments of Intermountain Canyons and Desert Regions.

Key Points

Use of validated risk-assessment tools for traumatic intracranial hemorrhage (tICH) can be safe while being cost-effective.

- The Brain Injury Guidelines (BIG) stratify patients with tICH into one of three categories (1, 2, or 3), providing a standard measure of severity and an associated clinical management plan.[1-12]
- The modified BIG (mBIG) refine the original guidelines to improve reproducibility and patient safety while preserving healthcare resources.[4,5]

The mBIG stipulate that a subset of low-risk tICH patients can be managed safely without repeat head CT, neurosurgical consultation, or hospital transfer/admission.

- Neurosurgical consultation and repeat imaging are not recommended for mBIG 1 and mBIG 2 patients.
- Patients who meet mBIG 1 criteria (low risk) and have no other indications for hospital admission can be safely discharged home after a 6–hour ED observation period described in the *Observation Algorithm on page 3*.
- Patients who meet mBIG 2 criteria (moderate risk) can be admitted to a hospital for 24–48 hours with neurologic monitoring only (no repeat imaging or neurosurgery consult).

Considerations for mBIG calculation include:

- Patients with more than one intracranial injury type should be classified according to the most severe injury type, and the presence of multiple intracranial hemorrhage types does not automate an mBIG 3 score.
- Radiology template developed to support standard reporting of all intracranial hemorrhage measurements is needed to calculate the mBIG score. See *Stratification and Disposition algorithm on page 2.*
- Low-dose aspirin (≤81 mg) is no longer considered an antiplatelet medication of significance warranting mBIG 3 classification. [13,14]

Key Supporting Evidence

- Validating the Brain Injury Guidelines: Results of an American Association for the Surgery of Trauma prospective multi-institutional trial. *J Trauma Acute Care Surg.* 2022;93(2):157-16
- A multicenter validation of the modified brain injury guidelines: Are they safe and effective? *J Trauma Acute Care Surg.* 2022;93(1):106-112

What's Inside?

Intermountain Measures

- mBIG protocol adherence
  - Transfers and admissions avoided in isolated mBIG 1 patients
  - Repeated CT brain scans and neurosurgery consults avoided in mBIG 1 and mBIG 2 patients
  - Hospital transfers, admission, repeat CT brain scans and neurosurgery consults in mBIG 3 patients
- Safety net measures for mBIG 1,2,3
  - Return to ED visits within 14 days for TBI-related indications
  - Hospital readmission within 30 days for TBI-related indications
  - Neurosurgical interventions and TBI-related deaths
- Associated cost savings of systemwide mBIG implementation

Intermountain Health

Modified Brain Injury Guidelines (mBIG): Stratification and Disposition

Adult patient with traumatic intracranial hemorrhage*
Patients with >1 intracranial injury type should be classified according to the most severe injury

* mBIG are designed to manage traumatic ICH only; If history of traumatic mechanism is unclear or if concerned for aneurysmal bleed, consult Trauma Telehealth.

Trauma Telehealth is available 24/7 as needed.

Are ANY of the following present?

Radiographic Findings
- Intraventricular hemorrhage (IVH)
- Epidural hematoma (EDH)
- Subdural hematoma (SDH) ≥8mm
- Intraparenchymal hemorrhage (IPH) ≥8mm or multiple
- Subarachnoid hemorrhage (SAH) >3 sulci AND bi-hemispheric AND non-aneurysmal*
- Displaced skull fracture

Clinical Findings
- Abnormal neuro exam[A]
- Anticoagulation or antiplatelet[B]

yes → **mBIG 3**

High Risk
Transfer/Admit to trauma center with neurosurgery consult available

no

Are ANY of the following present?

Radiographic Findings
- SDH 4.1–7.9 mm
- IPH 4.1–7.9 mm
- SAH >3 sulci AND single hemisphere AND non-aneurysmal*
- Nondisplaced skull fracture

Clinical Findings
- Intoxication[C]

yes → **mBIG 2**

Medium Risk
- Hospital admission for 24–48 hours
- Consult Trauma Telehealth to discuss admission location
- *NO* repeat head CT
- *NO* neurosurgery consult
- Neurological assessment every 2 hours
- GCS 15 at discharge[D]
- Give *discharge education on page 4*

if worsening neuro exam[A] → mBIG 3

no

Confirm Intracranial Hemorrhage Size

- SDH ≤4mm
- IPH ≤4mm
- SAH ≤3 sulci (total) AND non-aneurysmal*

→ **mBIG 1**

Low Risk
- Up to 6 hours ED observation.[E] Use *mBIG 1 ED Observation Algorithm on page 3*
- *NO* repeat head CT
- *NO* neurosurgery consult
- GCS 15 at discharge[D]
- Give *discharge education on page 4*

if worsening neuro exam[A] → mBIG 3

Clinical Considerations

A. Abnormal neuro exam (ANY of below)
- GCS<13
- Focal neurologic or pupillary abnormalities
- Any decline in GCS from baseline presentation escalates to mBIG 3 pathway

B. Anticoagulation / Antiplatelet
- Warfarin
- Clopidogrel
- Enoxaparin
- Aspirin > 81mg/day
- DOACs
- LMWH
- Heparin
- Consider lab-confirmed coagulopathy (INR >1.5 or platelet count < 80 K/mcL)
- DOES NOT include NSAIDs

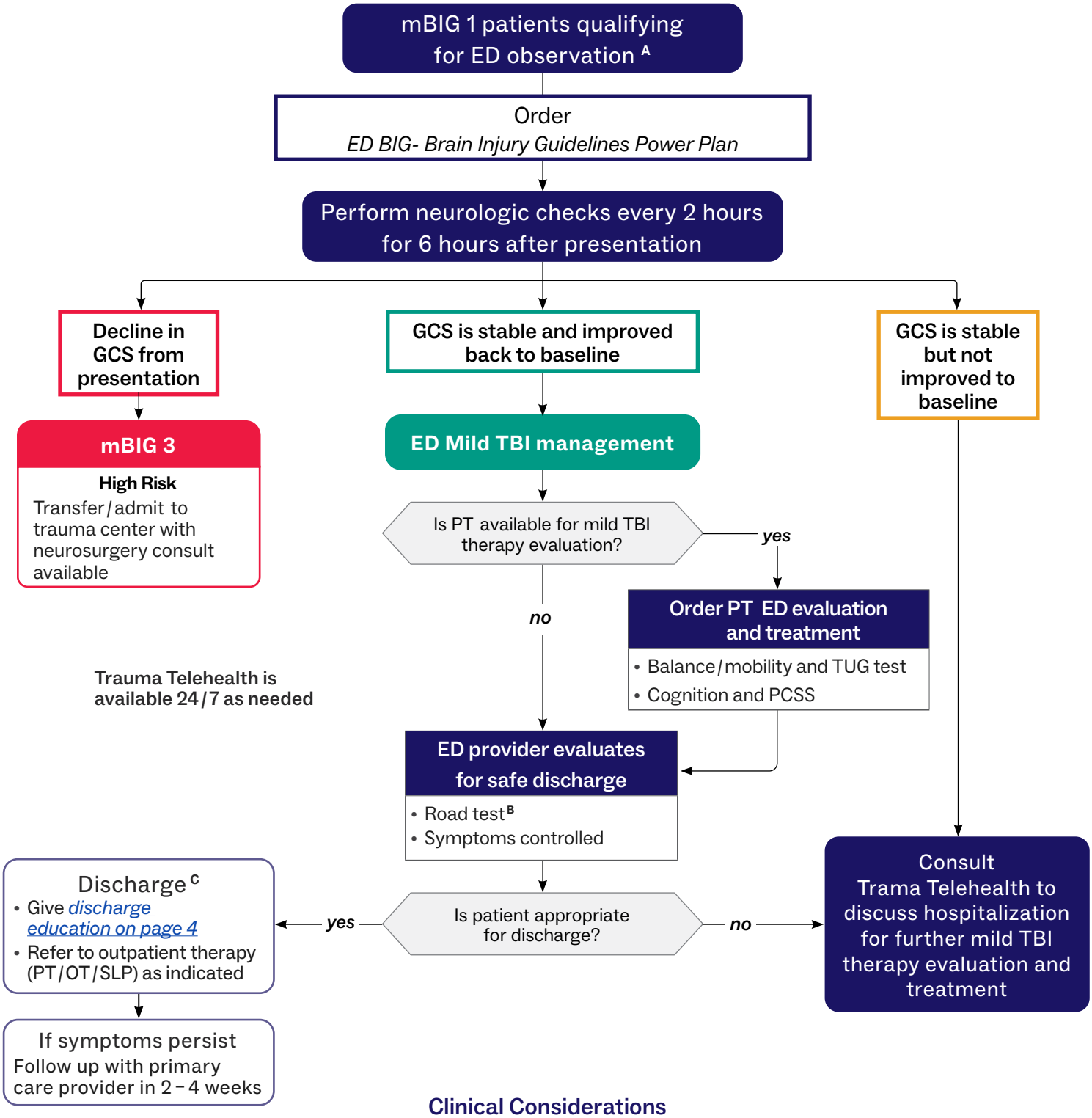
C. Intoxication
- Intoxication suggested definition for blood alcohol level only (EtOH >80 mg/dL)
- At provider discretion to observe and allow intoxication effect to clear prior to determining mBIG category

D. Discharge: A GCS 15 or return to neurologic baseline required for ED or hospital discharge in mBIG 1–2 patients

E. Observation of mBIG 1 in ED
- T=0 at presentation
- ED provider oversees 6 hour observation period
- Observation may be shortened if > 24 hours between injury and presentation
- ED BIG- Brain Injury Guidelines Power Plan
- Neurologic checks every 2 hours

CT=computed tomography; DOAC=direct oral anticoagulant; ED= Emergency Department; EtOH=ethanol; GCS= Glasgow Coma Scale; INR=international normalized ratio; LMWH=low-molecular-weight-heparin; NSAIDs=nonsteroidal anti-inflammatory drugs

Modified Brain Injury Guidelines (mBIG) 1 ED Observation Algorithm



Clinical Considerations

A. Convulsions/Seizures
For patients with convulsions immediately following TBI who have returned to pre-injury mental status, admission or transfer is not necessary.
For patients who may have had a longer seizure, a longer interval between injury and seizure (>2 min.), or a seizure leading to the injury, the decision to admit or transfer should be based on seizure management, not BIG 1 status.

B. Road Test
A provider-witnessed trial of assisted ambulation to assess current ambulatory status.

C. Baby aspirin (≤81 mg/day)
Patients on baby aspirin should be counseled to safely resume aspirin 2–4 weeks post-injury if indication is for primary cardiovascular preventive care.

ED= Emergency Department; GCS= Glasgow Coma Scale; mBIG=modified brain injury guidelines; OT=occupational therapy; PCSS= post-concussion symptom scale; PT=physical therapy; SLP=speech language therapy ; TUG= timed up and go

Care Process Model Expert Consultants

Annika Kay, PA
Jenn Avery, RN
Joey Bledsoe, MD
Brett Nance, DO
Sarah Majercik, MD
Dave Morris, MD
Heidi Thompson, PhD
Caroline Vines, MD

This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base. Send feedback to Annika Kay PA, Trauma Services; *annika.kay@imail.org* OR Dave Morris MD, Associate Medical Director Trauma Surgery; *dave.morris2@imail.org*

Discharge Education for Patients

- *Complicated Mild Traumatic Brain Injury (English)*/*(Spanish)*
- *Fatigue After Brain Injury: Tips to promote a speedy recovery (English)*/*(Spanish)*
- *Outpatient Clinical Resources (English)*/*(Spanish)*

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