New York State Trauma Advisory Council – Pediatric Subcommittee

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Agenda

Old Business

- Trauma Quality Improvement Project (TQIP) - Pediatric collaborative report
  - How to leverage collaborative data (KW & DW)
  - Pediatric Intensive Care Unit (PICU) Traumatic Brain Injury (TBI) TQIP Project (LP)
- Pediatric readiness/Always Ready for Children update (AE)
- Trauma imaging quality improvement (QI) project – discuss statewide QI project (DW)

New Business - Discussion

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New Business - Discussion

TQIP-Peds collaborative report

- Use TQIP collaborative to identify high and low performers
- High performers to teach low performers
  - All Teach, All Learn
  - Self identify

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New Business - Discussion

Problem: Prolonged Mechanical Ventilation Days Following Traumatic Brain Injury

Spring 2019 TQIP Report

VI. Patient Characteristics

Table 9: Resource Utilization by Cohort

		Patients	Length of Stay (days)	ICU Utilization [1] (days)		Mechanical Ventilation [2] (days)		Missing LOS (%)		
Cohort	Group	N	Median (IQR)	ICU Care (%)	Median (IQR)	Mechanical Ventilation (%)	Median (IQR)	Hospital	ICU	Ventilator
All Patients	All Hospitals	102,585	2 (2-4)	21.1	2 (2-4)	7.4	3 (2-6)	0.6	1.4	0.7
	Your Hospital	457	3 (2-4)	27.6	2.5 (2-4)	9.2	2 (2-6)	0.0	0.0	0.0
Age 0-13	All Hospitals	76,750	2 (2-3)	19.2	2 (2-4)	6.2	3 (2-6)	0.7	1.4	0.6
	Your Hospital	296	2 (2-3)	24.3	2 (1-3.5)	7.1	2 (2-4)	0.0	0.0	0.0
Age 14-18	All Hospitals	25,835	3 (2-5)	26.6	3 (2-5)	11.1	2 (2-6)	0.4	1.4	0.8
	Your Hospital	161	3 (2-6)	33.5	3 (2-5)	13.0	2 (1-12)	0.0	0.0	0.0
TBI All	All Hospitals	3,848	9 (4-20)	95.2	5 (3-13)	94.1	3 (2-9)	0.9	2.4	2.5
	Your Hospital	16	9.5 (3-21)	93.8	4 (2-21)	87.5	8.5 (3-14)	0.0	0.0	0.0
TBI Age 0-13	All Hospitals	2,512	9 (4-19)	95.6	5 (3-12)	93.9	3 (2-8)	1.0	2.3	2.5
	Your Hospital	8	4 (2.5-9.5)	87.5	3 (2-4)	75.0	4 (2-5)	0.0	0.0	0.0
TBI Age 14-18	All Hospitals	1,336	10 (3-20)	94.5	6 (3-14)	94.5	3 (2-10)	0.8	2.7	2.5
	Your Hospital	8	20 (9-23.5)	100.0	19 (8.5-21)	100.0	12 (7.5-14.5)	0.0	0.0	0.0

[1] Among patients requiring ICU care
[2] Among patients requiring ventilator support

TBI = traumatic brain injury
ICU = Intensive Care Unit
LOS = Length of Stay
IQR = Interquartile Range

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Extent of Problem: Financial

Financial

- Day one critical care costs with mechanical ventilation: $10,794
- Day two critical care costs: $4,796
- Subsequent days: $3,968

Financial Comparison

- Our center average cost: $53,004
- TQIP average: $19,558
- **Difference of $33,446**

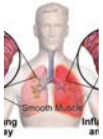
Dasta et al., 2005

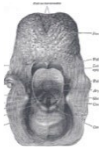
Extent of Problem: Side Effects of Prolonged Intubation and Critical Care Days

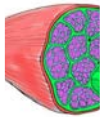

Aspiration


Ventilator-associated pneumonia

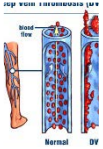

Delirium


Airway swelling


Vocal cord paralysis


Muscle weakness


Mental health disorders


Venous stasis


Weight loss


Acute kidney injury


Pressure injuries


Poor wound healing

Morgan, A. 2021

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Local Needs Assessment

What are the common themes amongst patients with a traumatic brain injury and prolonged time of mechanical ventilation?

No common themes in approach to management

Intervention

GCS = Glasgow Come Score
yr = year
pg = pager
PICU = Pediatric Intensive Care Unit
CT = computed tomography
EEG = electroencephalogram
ICP = intracranial pressure
HOB = head of bed
MAP = mean arterial pressure
CPP = Cerebral Perfusion Pressure
Na = sodium
Hgb = hemoglobin
Temp = temperature
min = minutes
CSF = cerebrospinal fluid
C = cervical
MRI = magnetic resonance imaging
hrs = hours
EVD = external ventricular drain

Initial Management

Inclusion Definitions

- History of acute traumatic brain injury
- Post resuscitative GCS less than or equal to 8
- Age 18_{yr} or younger

Communication

- **Neurosurgery #6-5849** (pg. # 7154) – call at presentation, acutely changing neuro exam, monitoring equipment issues, any concerns or questions
- **PICU Attending #3-3203**
- **Adult Neuro ICU # 4-4569** call for any consultative needs

ED Management

- Neurosurgery consult
- Level 1 Trauma Activation
- Access and labs
- Rapid sequence intubation
- Non-Contrast head CT
- Administer loading Levetiracetam
- If clinical seizure, treat, order cEEG
- If concern for herniation see **Acute Herniation** box below

Initial PICU Management

- ICP monitor placement if GCS less than 9
- Arterial line placement
- Central venous line placement
- Foley placement
- EEG monitoring

Baseline Care Goals

- HOB at 30°, mid-line position
- Normal MAP for age (see box)
- ICP less than 20_{mmHg}
- CPP $_{(mmHg)}$ greater than 40 ($0\text{-}5_{yr}$); greater than 50 (older than 5_{yr})
- Euvolemia
- Na $140\text{-}150_{mEq/L}$
- Glucose $100\text{-}180_{mg/dL}$
- Hgb greater than $7_{g/dL}$
- Core Temp $36\text{-}37_{°C}$
- P_aCO_2 37 ± 2 mmHg
- O_2 saturation greater than 93%
- Early enteral nutrition
- Maintain sedation / analgesia
- Seizure prophylaxis

If ICP is greater than **20_{mmHg}** sustained more than **5_{min}** progress to Tier 1

Tier 1
- Recheck Baseline Care Goals (Positioning, temp, fluid status)
- Check Monitors (ICP monitor tubing patent, zeroed, good waveform)
- Evaluate Seizure Activity

If ICP is greater than **25_{mmHg}** sustained more than **5_{min}** progress to next tier, call Neurosurgery

Tier 2
- CSF Drainage (Drain 5_{mL} of CSF, over max of 10_{min})
- Mild Hyperventilation (P_aCO_2 Goal = 33 - 37 $_{mmHg}$)
- 3% Hypertonic Saline (5_{mLAg} over 15_{min} [Goal Na = $150\text{-}160_{mEq/L}$])
- Increase Sedation

Tier 3
- Neuromuscular Blockade
- Administer Mannitol
- High Dose Pentobarbital Therapy
- Transient Aggressive Hyperventilation (Goal = P_aCO_2 $28\text{-}34_{mmHg}$)
- Repeat CT Scan (if surgical options being considered)
- Surgical Decompression per Neurosurgical Team

Mean Arterial Pressure for Age

Age ($_{year}$)	Minimum MAP ($_{mmHg}$)
Less than 1	50
1-3	60
4-9	70
Greater than 9	70-72

C-Spine Clearance

- Trauma service will be responsible for c-spine clearance
- In unresponsive/uncooperative patient, a negative MRI within 72_{hrs} can radiographically clear c-spine
- No need for MRI if low likelihood of ligamentous injury based on mechanism of injury, CT alone may be sufficient

Acute Herniation

At any time if signs of **acute herniation**:
- Unequal pupils
- Hypertension / bradycardia
- Extensor posturing

Call Attending Physician and prepare for the following interventions:
- Manual bagging
- 3% Hypertonic Saline / Mannitol
- Consider 23.4% Hypertonic Saline
- Pack patient in ice packs
- Open EVD to continuous drainage

Standardize approach using best practice guidelines

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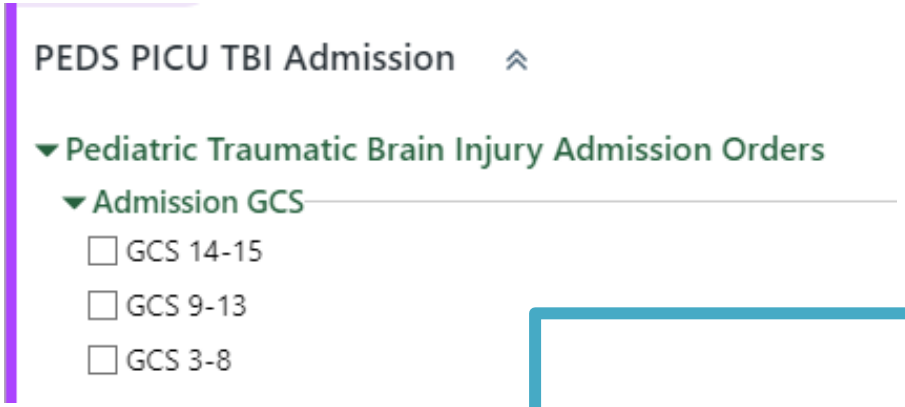
Intervention

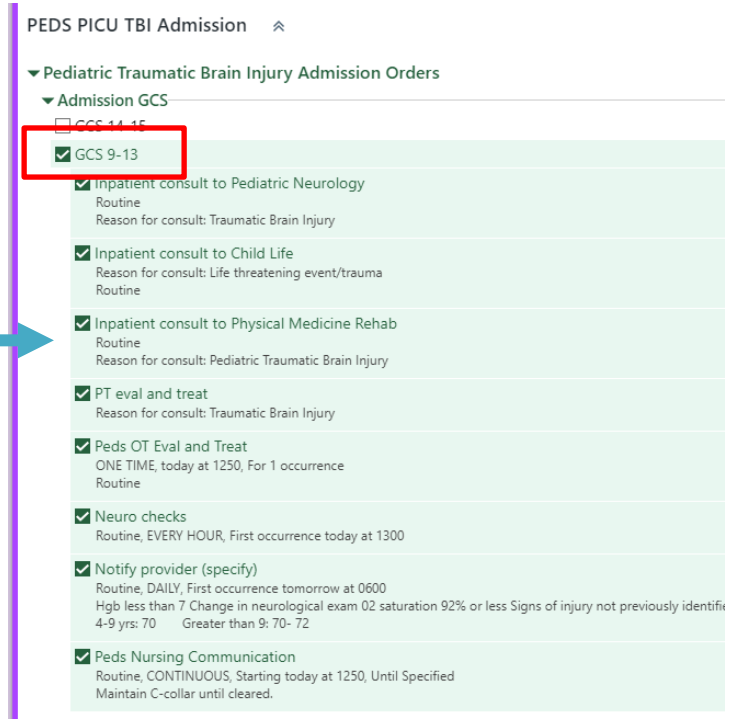
Will creating a guideline result in everyone using the guideline?

- Stressful admission
- Rotating resident teams
- The guidelines does not include management for a Glasgow Coma Scale greater than 8 or include additional consulting teams

Intervention

PT = physical therapy
eval = evaluate
Peds OT = Pediatric Occupational Therapy





Consults to physical medicine and rehabilitation to provide information on prognosis, recommendations for treatments, and discharge planning

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Intervention

CVL = central venous line
NG = nasogastric
OG = orogastric
SBS = State Behavioral Scale

- [ ] Continuous video EEG monitoring
  STAT, If concern for seizures.
- [ ] EEG
  Routine, If no concern for seizures
- [x] Inpatient consult to Pediatric Neurology
  Routine
  Reason for consult: Traumatic Brain Injury
- [x] Inpatient consult to Physical Medicine Rehab
  Routine
  Reason for consult: Pediatric Traumatic Brain Injury
- [x] Peds OT Eval and Treat
  ONE TIME, today at 1258, For 1 occurrence
  Routine
- [x] PT eval and treat
  Reason for consult: Traumatic Brain Injury
- [x] Inpatient consult to Nutrition
  Reason for consult: Traumatic Brain Injury
  Reason for consult: Eval and Treat
  Routine
- [x] Vital signs
  Routine, EVERY HOUR, First occurrence today at 1300
- [x] Insertion CVL
  Routine, ONE TIME, today at 1258, For 1 occurrence
- [x] Insert arterial line
  Routine, ONE TIME, today at 1258, For 1 occurrence
- [x] Arterial pressure monitoring
  Routine, CONTINUOUS, Starting today at 1258, Until Specified
- [x] Neuro checks
  Routine, EVERY HOUR, First occurrence today at 1300
- [x] ICP monitoring
  Routine, CONTINUOUS, Starting today at 1258, Until Specified
- [x] Replogle Tube Placement
  Routine, ONE TIME, today at 1258, For 1 occurrence
  NG/OG tube suction: Low intermitent wall suction
- [x] SBS Goal -2
  Routine, CONTINUOUS, Starting today at 1258, Until tomorrow, For 24 hours
- [x] Maintain the head of the bed at 30 degrees with midline cervical spine positioning
  Routine, CONTINUOUS, Starting today at 1258, Until Specified

Glasgow Coma Scale 3 to 8

- Sedation goal automatically expires after 24 hours
- Physical medicine and rehabilitation consult
  - Setting goals to extubate
  - Having plans for agitation

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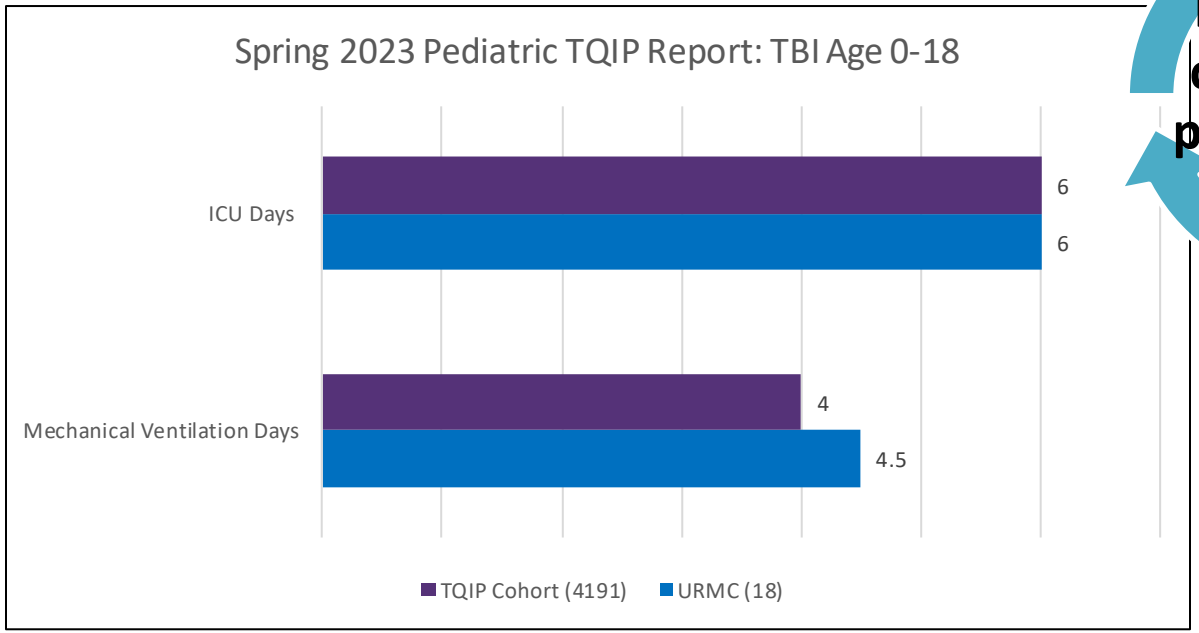
Results



The average cost savings per patient is $16,786

URMC: University of Rochester Medical Center

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Project Sustainability

2022: order set used frequently

- Average ventilator days: 5

2023: order set use decreasing

- Average ventilator days: **8.5**

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2024 Review

Data Points

Patients 0-15 with an injury

January 1, 2024, to July 31, 2024, = *164*

Excluded SPARCS = *133*

Narrowed by

- AIS Head: any positive value
- Critical care disposition from ED: PICU or OR
- = *18* patients

Adjusted numbers for one patient

- Traumatic brain injury with cervical spine injury
- 72 days intubated in facility
- Time of arrival to time of trauma sign-off: 10 days

Patient Breakdown

Ages

- Mean: 5.19
- Median: 3.6

Mechanism

- *17 blunt*
- *1 crush*
- CPA:2
- Motor vehicle-related: 6
- Recreational vehicle: 4
- Fall: 5
- Struck with object: 1

Operative: 5

- Neurosurgery: 3
  - combined with plastic surgery
- Ortho & Vascular: 1
- Trauma: 1

Mortalities: 3

SPARCS = Statewide Planning and Research Cooperative System
AIS = Abbreviated Injury Scale
ED = emergency department
OR = operating room
CPA = child physical abuse

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2024 Review

Of the 18 patients admitted to critical care with a traumatic brain injury, the order set was used twice (January 1, 2024, to July 31, 2024)

Seven intubated patients

Physical medicine and rehabilitation orders were placed on four patients

One placed on day one

Earlier consults for the rehabilitation team

Decreased mechanical ventilation days

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The Gaps and Next Steps

- Sustainment plan
  - Did not trend the process measure
  - Noticed a problem when the outcome measure declined
- The project manager became the intervention
  - Review all orders during admission
  - Request covering provider enter the orders

Now what?

- Trend compliance of entering orders within two hours of admission
- Share with stakeholders
- Include in resident education

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New Business - Discussion

Discussion

- Guidelines:
  - Who has pediatric trauma imaging guidelines?
    - Rochester (Head, Cervical-spine, chest, abdomen/pelvis)
    - Albany

Discussion

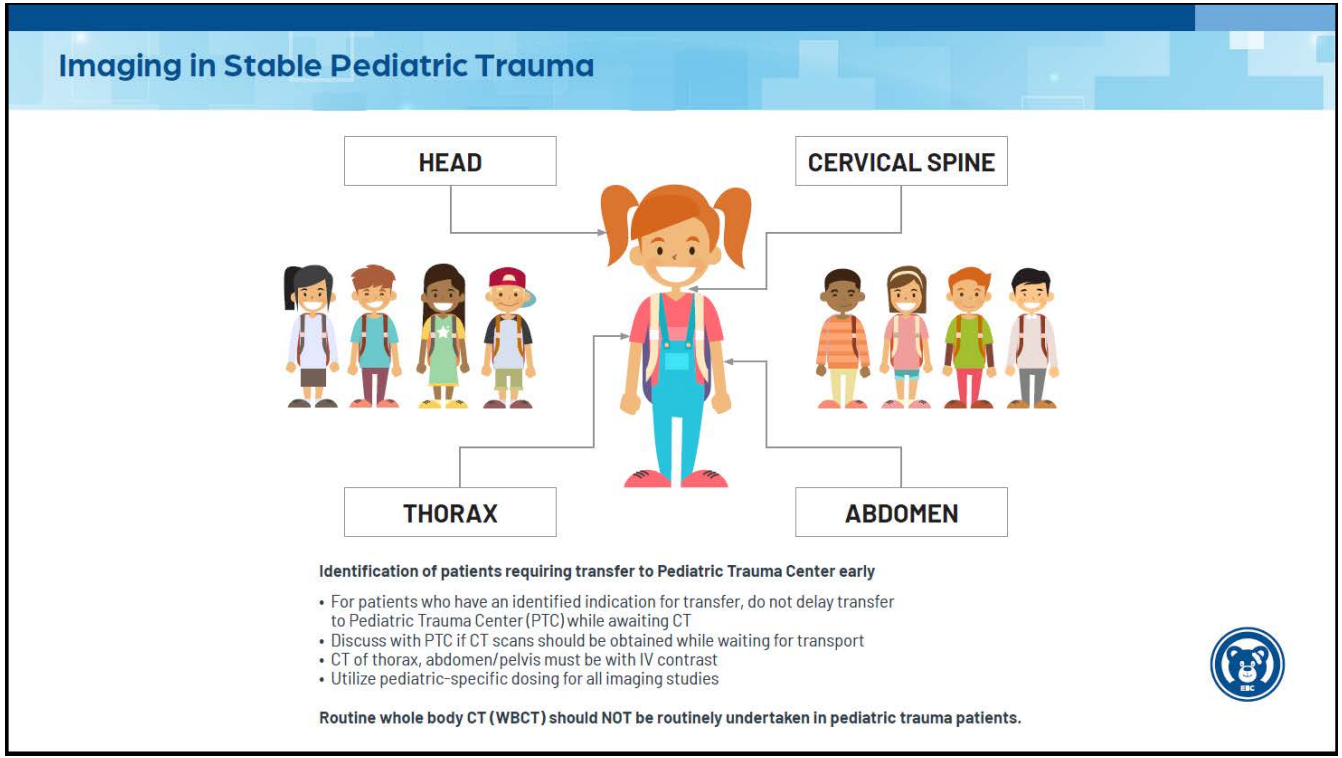
- Any interest in a statewide QI project?
  - Jacobi
  - NYP-Morgan Stanley (Columbia)
  - Kings County
  - Harlem
  - Maria Fareri (Westchester)
  - Rochester

Discussion

- Questions?
  - All agree to use same guidelines
  - **Track compliance with our own guidelines**

- Timing
  - University of Rochester happy to lead, but may need to wait until after reverification in March 2025
  - More to come

Emergency Medical Services for Children (EMSC) Innovation and Improvement Center (EEIC) Guideline



CT = computed tomography
IV = intravenous

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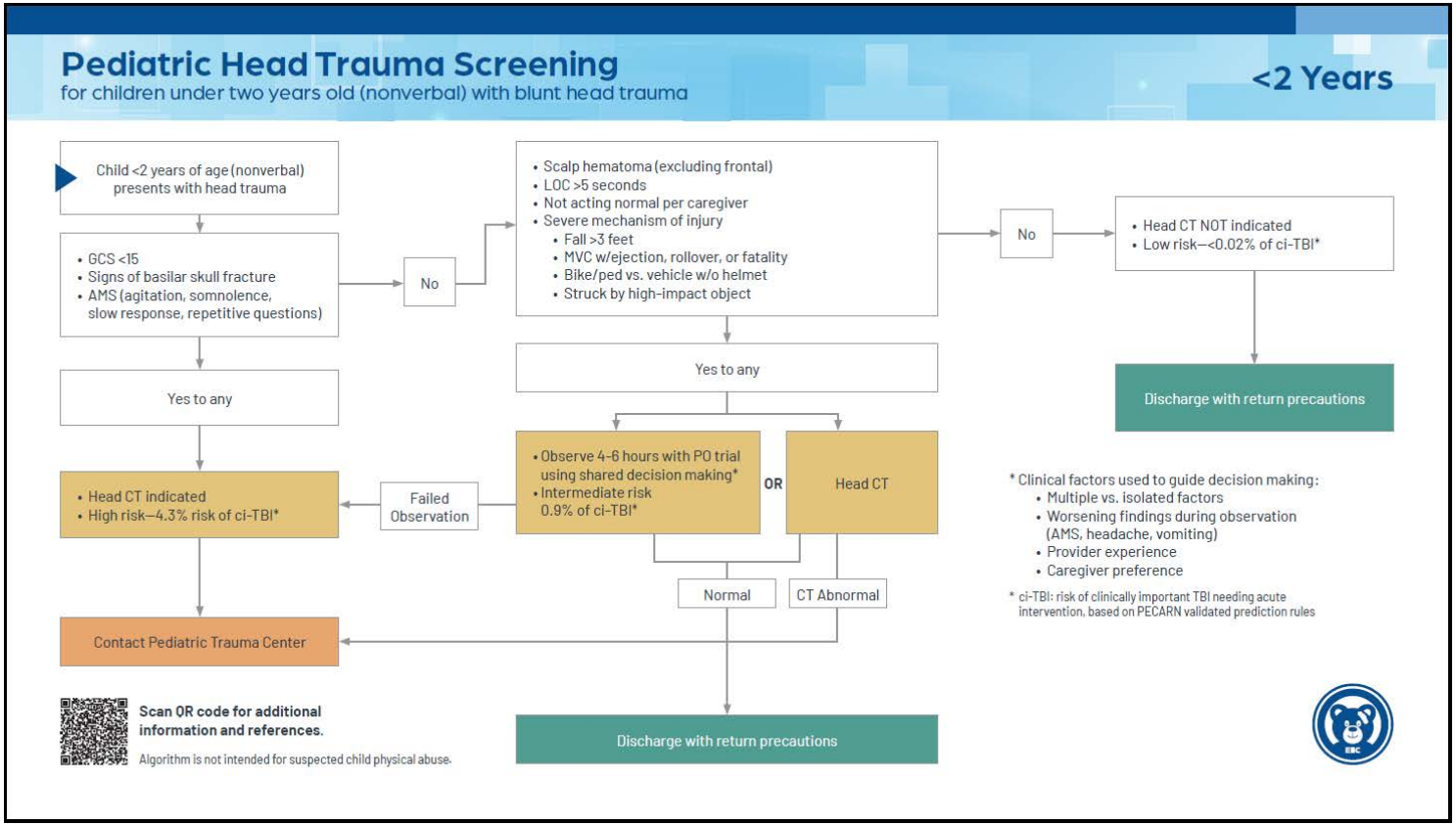
EEIC Head Imaging Guideline



CT = computed tomography
GCS = Glasgow Coma Score
AMS = altered mental status
LOC = loss of consciousness
MVC = motor vehicle collision
ped = pedestrian
w/o = without
PO = per os (by mouth)
ci = clinically important
TBI = traumatic brain injury
PECARN = Pediatric Emergency Care Applied Research Network

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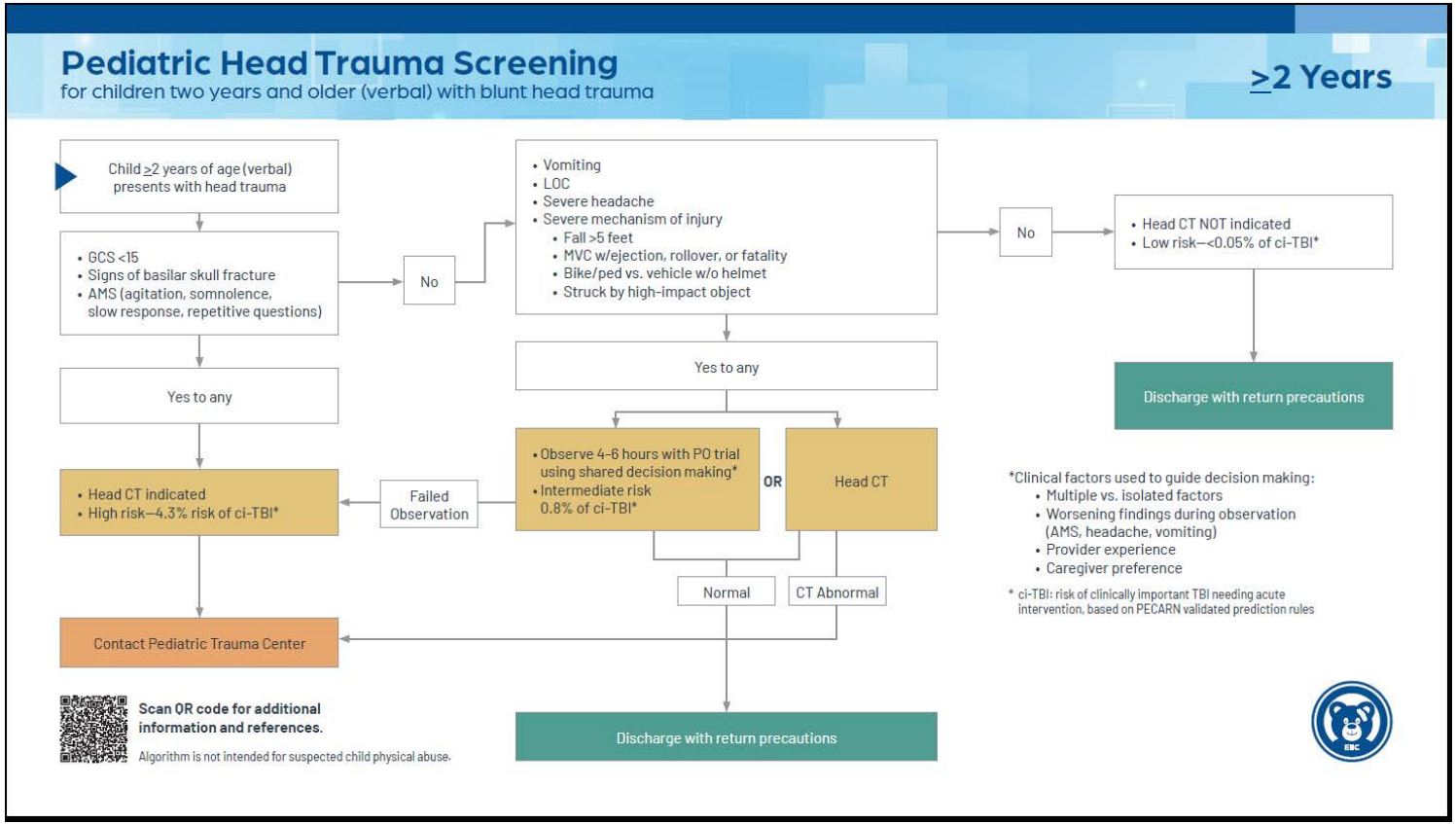
EEIC Head Imaging Guideline



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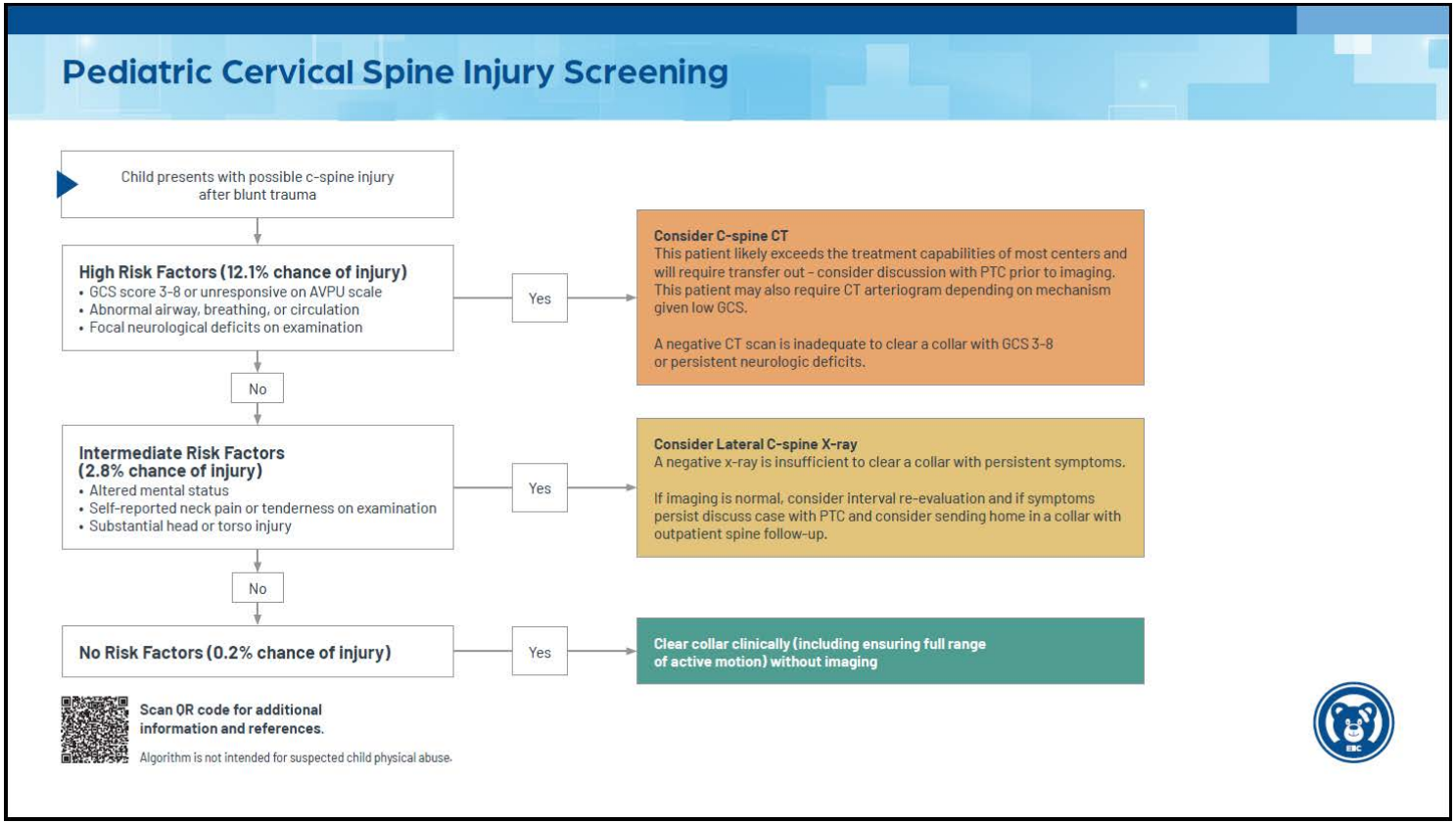
EEIC Cervical Spine Imaging Guideline



CT = computed tomography
c = cervical
GCS = Glasgow Coma Score
AVPU = alert, verbal, pain, unresponsive
PTC = pediatric trauma center
AMS = altered mental status

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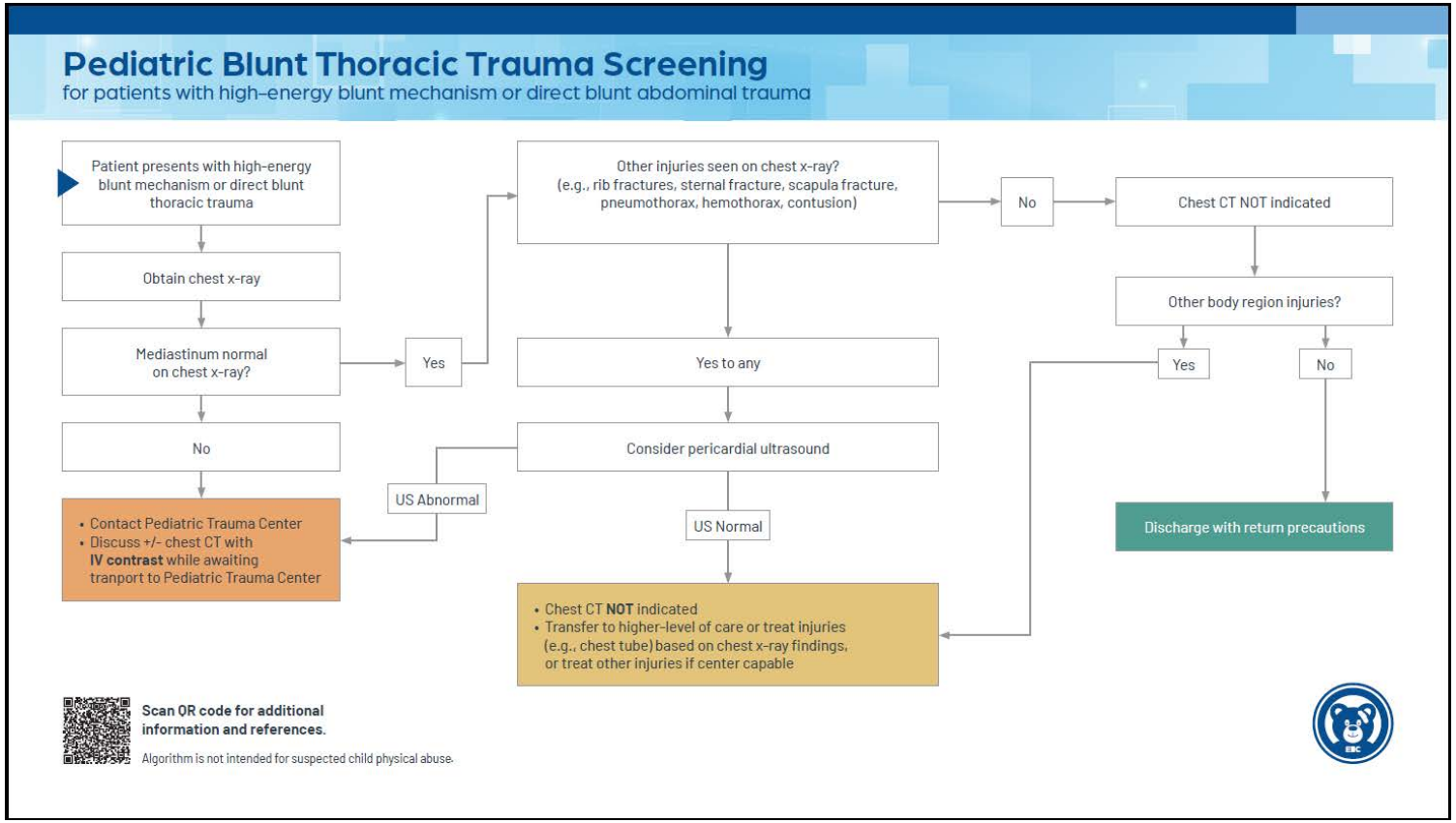
EEIC Chest Imaging Guideline



CT = computed tomography
IV = intravenous
e.g. = for example
US = ultrasound

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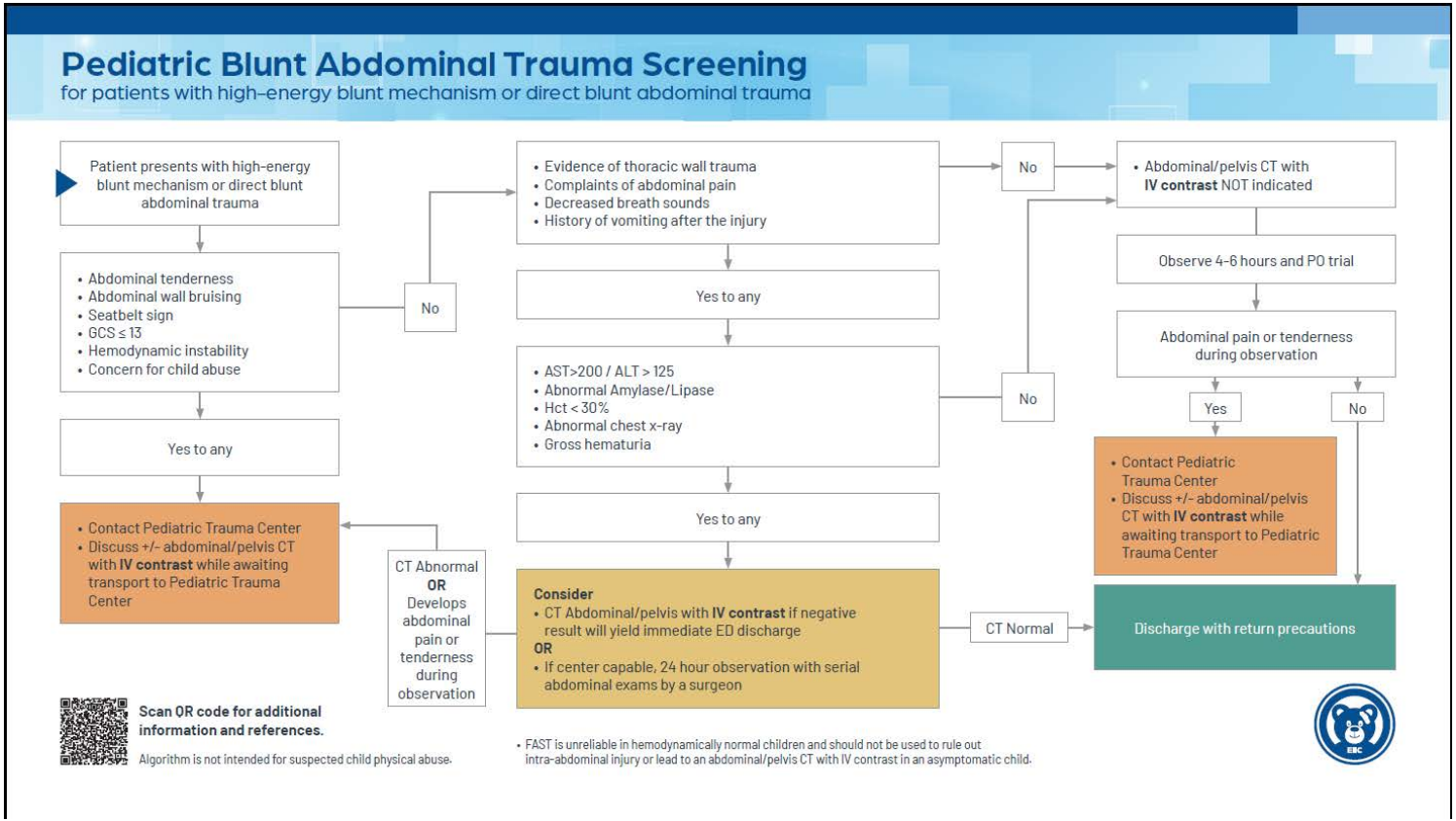
EEIC Abdomen Imaging Guideline



CT = computed tomography
GCS = Glasgow Coma Score
IV = intravenous
e.g. = for example
AST = aspartate aminotransferase
ALT = alanine transaminase
Hct = hematocrit
ED = emergency department
FAST = focused assessment with sonography in trauma
PO = per os (by mouth)

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Discussion

- These are meant more for referring centers, but can be helpful

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