CLINICAL PATHWAYS – INTRODUCTION

Clinical Pathways are guidelines used to assist in the delivery of high-value, effective, efficient, safe, and family-centered care. Pathways have been shown to improve the quality of care for hospitalized children with many conditions and in different settings (1)

A definition of a clinical 'pathway' needs to satisfy four criteria (2)

(1) It is a structured multidisciplinary plan of care.
(2) It is used to translate guidelines or evidence into local practices.
(3) It details the steps in a course of treatment of care in a plan, pathway, algorithm,guideline, protocol, or other "inventory of actions."
(4) It is aimed to assist in standardizing care of a specific population.

These Clinical Decision-Support (CDS) tools are aimed to assist clinicians at the bedside to deliver evidence-based care. The **Algorithm (SECTION 2**) is a visual aid that helps guide clinicians, step-by-step through the timing, indications, and details of recommended tests and treatments for managing specific conditions.In this case, **acute head trauma** is being addressed.

These PATHWAYS and their specific SECTIONS were developed by a consensus of a subject-matter-expert (SME) team, organized by the Clinical Effectiveness and Pathways (CEP) program at Nicklaus Children's Health System (NCHS). The SME team included clinicians from multiple disciplines and pediatric sub-specialties (see SECTION 7).

These clinical pathways are intended to be used as a compilation of best practice recommendations for practitioners. The practice of evidence-based pediatric medicine involves the use of pathways, the clinicians' experiences and judgment, and finally the patient's perspectives and values.
However, these clinical pathways are not intended to constitute specific medical recommendations for treatment. The practitioners must exercise their own independent judgment in applying these tools. These clinical pathways are not a script or 'cookbook' applicable to all patients. NCHS cannot certify that CDS documents are accurate or complete in every aspect. NCHS is not responsible for any errors or omissions in the use of clinical pathways or for any outcomes a patient might experience where a clinician consulted or followed these CDS in providing clinical care.

1-Rising utilization of inpatient pediatric asthma pathways.Kaiser SV, et al. J Asthma. 2017.
2-Lawal AK RT, Kinsman L, Machotta A, Ronellenfitsch U, Scott SD, Goodridge D, et al. What is a clinical pathway? Refinement of an operational definition to identify clinical pathway studies for a Cochrane systematic review. BMC Med 2016;14)

Acute Head Trauma

UCC Phase

Nicklaus Children's Health System

If suspected child abuse, follow Abuse Reporting Pathway

Severe Mechanisms of Injury
- Fall from > 3 ft for patients < 2 years
- Fall from > 5 ft for patients ≥ 2 years
- MVA with ejection
- MVA with rollover
- MVA with associated fatality
- Pedestrian or bicyclist without helmet struck by a motorized vehicle
- Head struck by a high-impact object

Signs of Basilar Skull Fracture
- Battle's sign (bruising of the mastoid process of the temporal bone)
- Raccoon eyes (periorbital bruising)
- CSF otorrhea or rhinorrhea
- Cranial nerve palsy
- Hemotympanum

Patient meeting inclusion criteria

- Vital signs as per nursing protocol
- History and PE
- Focus on neurological exam
- Obtain GCS
- Social History

GCS ≤ 13? — Yes → Call 911 and transfer to ED

No

Inclusion Criteria
- 0-20yr patients with acute head trauma

Exclusion Criteria
- Recurrent head injury
- Penetrating head injury
- Disorders of coagulation
- Prior neurosurgical history
- Suspected child abuse

High Risk Factors

PATIENTS < 2 YEARS
any of the following?:
- Altered Mental Status (GCS = 14 or agitation, somnolence, repetitive questioning, slow response to verbal communication)
- Palpable skull fracture

PATIENTS ≥ 2 YEARS
any of the following?:
- Altered Mental Status (GCS = 14 or agitation, somnolence, repetitive questioning, slow response to verbal communication)
- Signs of Basilar skull fracture

Intermediate Risk Factors

PATIENTS < 2 YEARS
any of the following?:
- LOC > 5 sec
- Non-frontal hematoma
- Not acting normally per family
- Severe mechanism of injury

PATIENTS ≥ 2 YEARS
any of the following?:
- Hx of LOC
- History of vomiting
- Severe headache
- Severe mechanism of injury

Does Patient meet high risk factors? — No → Intermediate Risk Factors

Does Patient meet high risk factors? — Yes → Transfer to ED for further management

Does Patient meet intermediate risk factors? — Yes → Shared decision making between clinician and family on decision to observe for 4hr at UCC or transfer to ED

Does Patient meet intermediate risk factors? — No → No imaging necessary

If decision to observe: Any worsening of clinical status during observation? — Yes → Transfer to ED for further management

If decision to observe: Any worsening of clinical status during observation? — No → Patient meets discharge criteria?

Patient meets discharge criteria? — Yes → • Discharge with close f/u by PCP • Concussion clinic f/u if concerns for concussion

Patient meets discharge criteria? — No → Transfer to ED

Discharge Criteria
1. GCS 15
2. No altered mental status
3. Normal neurological exam
4. Tolerating PO
5. Adequate follow-up care
6. No concerns for home care

Version 2.0. Last updated 9/17/2024

Acute Head Trauma

ED Phase

Nicklaus Children's Health System

If suspected child abuse, follow Abuse Reporting Pathway

Patient meeting inclusion criteria

- Vital signs as per nursing protocol
- History and PE
- Focus on neurological exam
- Obtain GCS
- Social History

GCS ≤ 13? — Yes → **Activate trauma alert**

No →

Inclusion Criteria
- 0-20yr patients with acute head trauma

Exclusion Criteria
- Recurrent head injury
- Penetrating head injury
- Suspected open skull fracture
- Disorders of coagulation
- Prior neurosurgical history
- Suspected child abuse

Severe Mechanisms of Injury
- Fall from > 3 ft for patients < 2 years
- Fall from > 5 ft for patients ≥ 2 years
- MVA with ejection
- MVA with rollover
- MVA with associated fatality
- Pedestrian or bicyclist without helmet struck by a motorized vehicle
- Head struck by a high-impact object

High Risk Factors

PATIENTS < 2 YEARS
any of the following?:
- Altered Mental Status (GCS = 14 or agitation, somnolence, repetitive questioning, slow response to verbal communication)
- Palpable skull fracture

PATIENTS ≥ 2 YEARS
any of the following?:
- Altered Mental Status (GCS = 14 or agitation, somnolence, repetitive questioning, slow response to verbal communication)
- Signs of Basilar skull fracture

Does Patient meet high risk factors?

No →

Intermediate Risk Factors

PATIENTS < 2 YEARS
any of the following?:
- LOC > 5 sec
- Non-frontal hematoma
- Not acting normally per family
- Severe mechanism of injury

PATIENTS ≥ 2 YEARS
any of the following?:
- Hx of LOC
- History of vomiting
- Severe headache
- Severe mechanism of injury

Does Patient meet intermediate risk factors?

No → No imaging necessary

Yes →

Shared decision making between clinician and family on decision to observe for 4 hours vs head CT without contrast

Yes →

- Head CT w/o contrast recommended
- Assess if patient meets trauma activation criteria

Signs of Basilar Skull Fracture
- Battle's sign (bruising of the mastoid process of the temporal bone)
- Raccoon eyes (periorbital bruising)
- CSF otorrhea or rhinorrhea
- Cranial nerve palsy
- Hemotympanum

Is CT obtained?

Yes → CT positive for injury?

No →

Any worsening of clinical status during observation?

Yes → (back to Head CT)

No →

CT positive for injury?

Yes → Injury Type

No → Patient meets discharge criteria?

Injury Type

Any of the Following:
- Intracranial injury
- Depressed skull fx
- Basilar skull fx
- Fx in multiple areas

→ Consult Neurosurgery and Surgery

→ **Admission disposition per Surgery and Neurosurgery recommendations**
Neurosurgery clinic f/u after discharge

Isolated linear non-depressed skull fracture without intracranial injury → Patient meets discharge criteria?

Patient meets discharge criteria?

No → **Consult Surgery**
Admit under Surgery

Yes → **Discharge**
PCP f/u
Concussion clinic f/u if concerns for concussion

Discharge Criteria
1. GCS 15
2. No altered mental status
3. Normal neurological exam
4. Tolerating PO
5. Adequate follow-up care
6. No concerns for home care

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Nicklaus Children's Hospital

MIGUEL "MIKE" B. FERNANDEZ FAMILY PEDIATRIC TRAUMA CENTER

Trauma Activation Criteria

Local EMS Trauma Criteria **Red**	Nicklaus Children's Trauma Criteria **Trauma A**
Size:	☐ **All <u>Trauma Alerts</u> via Fire Rescue**
Airway: ☐ Assisted or Intubated	**Physiologic:** ☐ GCS ≤ 9, or deteriorating by 2, with a mechanism of trauma ☐ Altered mental status or LOC >5 min ☐ Age specific hypotension: systolic blood pressure less than 70mmHg + (2 x age in years) ☐ Severe respiratory compromise ☐ Insecure airway or Intubated ☐ Receiving blood products ☐ Pulseless injured extremity ☐ Suspected spinal injury
Consciousness: ☐ Altered Mental Status	
Circulation: ☐ Weak or no Pulse ☐ SBP < 50	
Fracture: ☐ Any Open Long Bone Fracture ☐ Multiple Fractures ☐ Pelvic Fracture	**Mechanism:** ☐ Penetrating injury and or GSW to the head, neck, chest, or abdomen ☐ Blast/Explosive Injury
Cutaneous: ☐ Major Tissue Disruption ☐ 2nd or 3rd degree Burns >10% TBSA ☐ Amputation ☐ Penetrating Trauma to head/neck/ torso	**Anatomic:** ☐ Limb amputation (excluding digits) ☐ Trauma with burns /Burns >20% BSA ☐ Unstable pelvic fracture ☐ Pneumothorax/Hemothorax, Flail chest ☐ Severe maxillofacial trauma ☐ Emergency Physician Discretion
Other: ☐ Paralysis/Suspected Spinal Cord Injury	

Nicklaus Children's Health System

Local EMS Trauma Criteria

Blue

(MUST MEET 2 BELOW)

Size:

☐ < or = 11 kg (< 24 lbs.)

Airway:

Consciousness:

☐ Amnesia

☐ LOC

Circulation:

☐ SBP 50 -90

Fracture:

☐ Single Closed Long Bone

Other:

☐ Ejection from car or death of occupant in same passenger compartment

Nicklaus Children's Trauma Criteria

Trauma B

Physiologic:

☐ GCS 11-13

☐ LOC 1-5 min (or any LOC if <=11kg)

☐ Lethargy associated with LOC

☐ Limb paralysis or major peripheral neurologic deficit (sensory or motor)

Mechanism:

☐ Falls > 10ft or 2 times height of child

☐ Ejection from motor vehicle

☐ Auto-pedestrian/ auto-bicycle with significant impact (i.e. speed ≥ 20 mph)

☐ Death in same passenger compartment

☐ Unrestrained passenger with rollover

☐ Drowning associated with trauma

Anatomic:

☐ Pelvic fracture

☐ Two or more proximal long bone fractures

☐ Extremity with significant bleeding

☐ Burns <20% BSA

Trauma Consult

☐ Patients who may have met trauma level A or level B criteria but have been triaged by time (>24 hrs from time of injury) and/or prior inpatient hospitalization.

☐ Patient who suffers an isolated orthopedic or neurosurgical traumatic injury as a result of the above criteria that requires admission.

☐ Patient who initially does not meet criteria for Trauma Alert but is later found out to have an injury which would qualify (ie 2 long bone fractures.)

Paramedic Judgment

If a patient does not meet any of the above **LOCAL EMS** criteria. Paramedic Judgement may be used as criteria to transport to a Trauma Center. Such injuries would include, but are not limited to, those sustained in a motor vehicle collision requiring prolonged extrication, penetrating extremity wounds without distal pulses, or gunshot wounds to upper thigh or arm without an exit should be transported to a Trauma Center.

Once a Trauma Alert is declared based upon EMT/Paramedic Judgement, no one is to downgrade the Trauma Alert

Glasgow Coma Scale and Pediatric Glasgow Coma Scale

Sign	Glasgow Coma Scale[1]	Pediatric Glasgow Coma Scale[2]	Score
Eye opening	Spontaneous	Spontaneous	4
	To command	To sound	3
	To pain	To pain	2
	None	None	1
Verbal response	Oriented	Age-appropriate vocalization, smile, or orientation to sound; interacts (coos, babbles); follows objects	5
	Confused, disoriented	Cries, irritable	4
	Inappropriate words	Cries to pain	3
	Incomprehensible sounds	Moans to pain	2
	None	None	1
Motor response	Obeys commands	Spontaneous movements (obeys verbal command)	6
	Localizes pain	Withdraws to touch (localizes pain)	5
	Withdraws	Withdraws to pain	4
	Abnormal flexion to pain	Abnormal flexion to pain (decorticate posture)	3
	Abnormal extension to pain	Abnormal extension to pain (decerebrate posture)	2
	None	None	1
Best total score			**15**

The Glasgow Coma Scale (GCS) is scored between 3 and 15, with 3 being the worst and 15 the best. It is composed of 3 parameters: best eye response (E), best verbal response (V), and best motor response (M). The components of the GCS should be recorded individually; for example, E2V3M4 results in a GCS of 9. Traditionally, the GCS defines the severity of traumatic brain injury (TBI) as follows: ≤8: severe brain injury, 9 to 12: moderate injury, and a score ≥13 or higher: mild injury. However, a significant minority of patients with TBI and a GCS score of 13 have potentially life-threatening intracranial lesions. While a revised classification has not been widely adopted, a GCS score of 9 through 13 likely best represents the TBI population at moderate risk for death or long-term disability (ie, "potentially severe").

The Pediatric Glasgow Coma Scale (PGCS) was validated in children 2 years of age or younger.

Data from:

1. *Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. Lancet 1974; 2:81.*
2. *Holmes JF, Palchak MJ, MacFarlane T, Kuppermann N. Performance of the pediatric Glasgow coma scale in children with blunt head trauma. Acad Emerg Med 2005; 12:814.*

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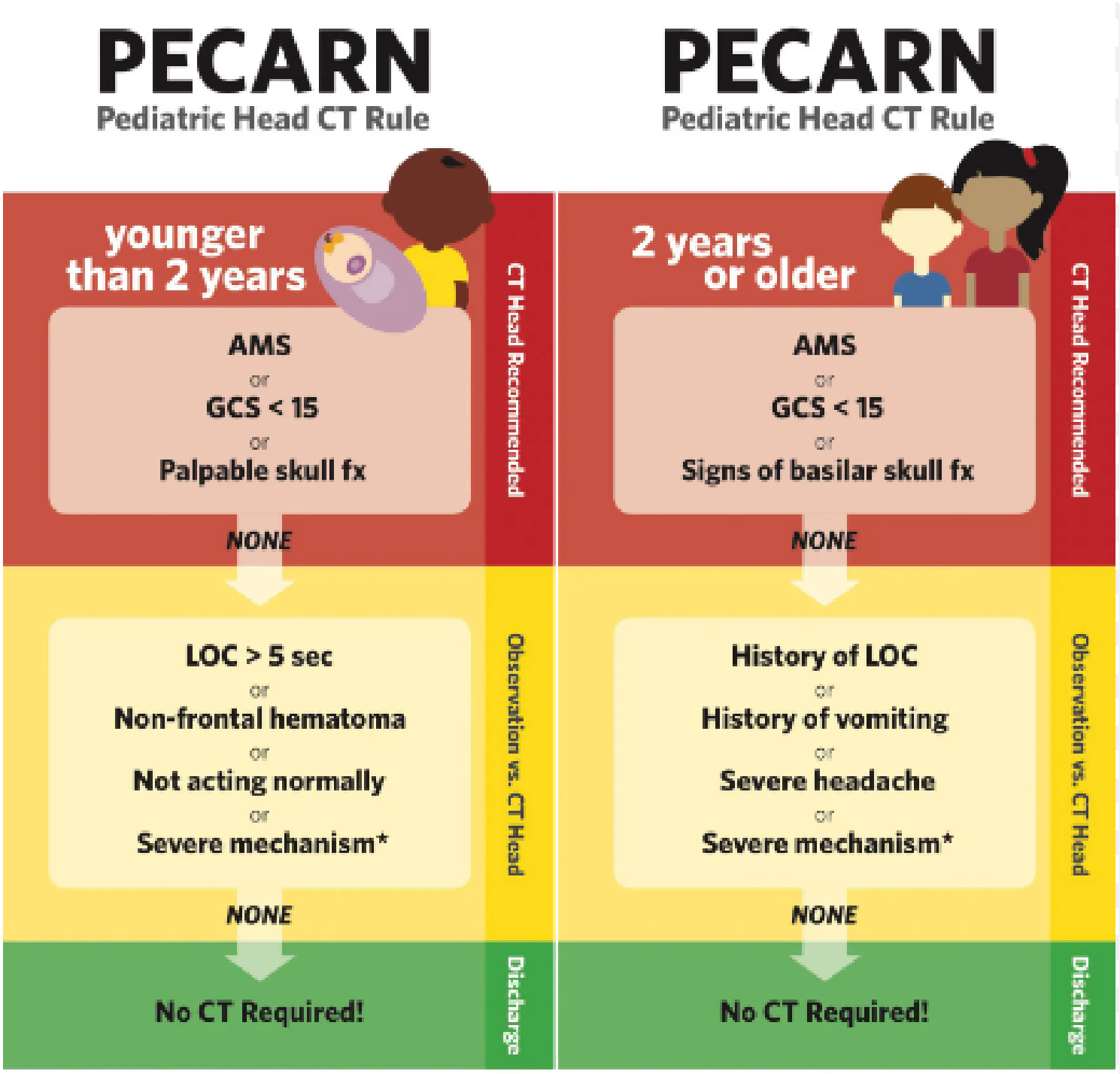

Reference: Dhir, B., & Woods, J., MD. (2020, May 1). *PECARN: Its relevance and importance in pediatric emergency care*. ALiEM. https://www.aliem.com/pecarn-relevance-importance-pediatric-emergency-care/

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2. Cho, S., Hwang, S., Jung, J. Y., Kwak, Y. H., Kim, D. K., Lee, J. H., Jung, J. H., Park, J. W., Kwon, H., & Suh, D. (2022). Validation of Pediatric Emergency Care Applied Research Network (PECARN) rule in children with minor head trauma. *PloS one*, *17*(1), e0262102. https://doi.org/10.1371/journal.pone.0262102

3. Dhir, B., & Woods, J., MD. (2020, May 1). *PECARN: Its relevance and importance in pediatric emergency care*. ALiEM. https://www.aliem.com/pecarn-relevance-importance-pediatric-emergency-care/

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5. Runde, D., & Beiner, J. (2018). PECARN Pediatric Head Injury/Trauma Algorithm. In Pediatric Emergency Medicine Practice, *Pediatric Emergency Medicine Practice*. https://www.ebmedicine.net/media_library/files/Calculated%20Decisions%20P1111%20PECARN.pdf

6. The Glasgow structured approach to assessment of the Glasgow Coma Scale. (n.d.). Glasgow Coma Scale. https://www.glasgowcomascale.org/

7. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. Lancet 1974; 2:81.

Return to UCC Phase

Return to ED Phase

Approval and Citation

Nicklaus Children's Health System

Emergency Department

1.Frequency of patients treated according to the pathway
2.Frequency of patients treated and discharged from the ED who had a head/brain CT scan for minor head injury
3.LOS
4.Revisit to ED within 72hr
5.Direct Cost

ICD-10 Codes

- Acute Head Trauma (S09.90XA)
- Concussion (S06.060A)

Return to UCC Phase

Return to ED Phase

Approval and Citation

Nicklaus Children's Health System

CLINICAL EFFECTIVENESS / PATHWAYS PROGRAM

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Executive Approval

Marcos Mestre: VP and Chief Medical Officer

Approval by CE Program : 9/17/24
NCHS- SYSTEM-WIDE Go-live Date: 9/18/24