Concussion
Clinical Pathway Synopsis

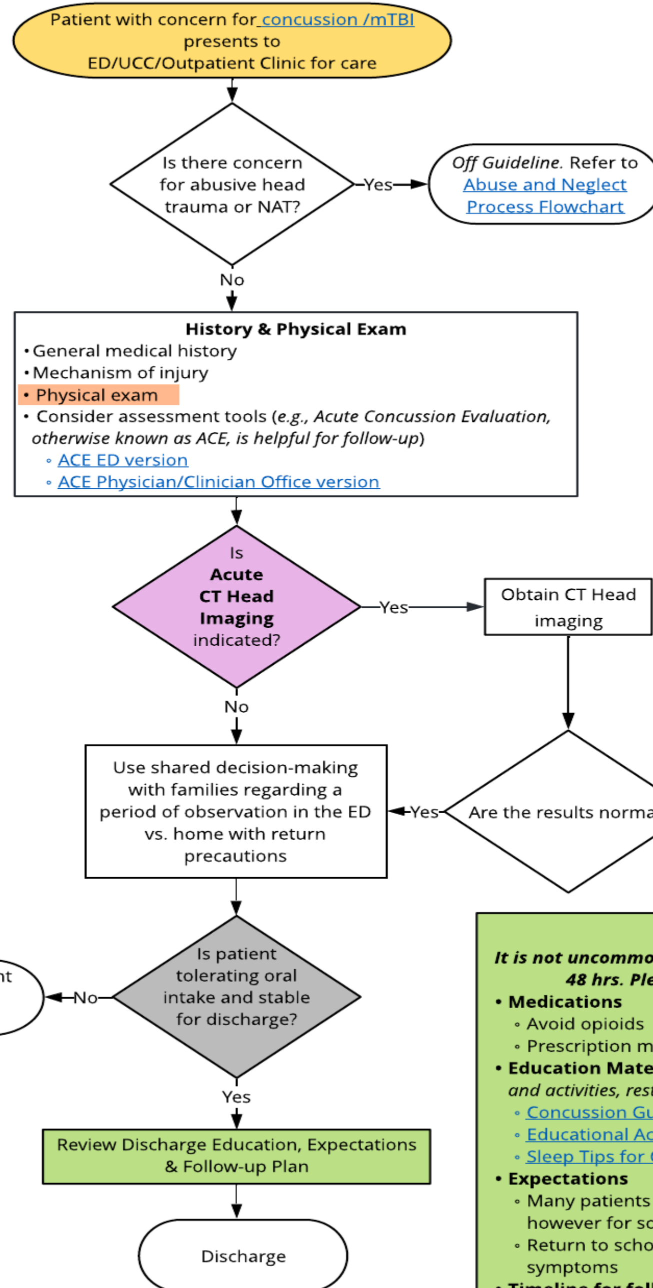
Concussion Algorithm

Inclusion criteria:
- Children ≥ 5 years of age with concern for concussion/mTBI
- GCS 14 - 15

Exclusion criteria:
- GCS <14
- Concern for stroke (*refer to Stroke: Suspected*)
- Concern for C-spine injury
- Child with global developmental delay

Children meeting any of the above exclusion criteria may require a more extensive evaluation

Physical Exam
- Head and neck exam
- Age appropriate neurological exam
- Consider Vestibular/Ocular-Motor Screening (VOMS)
- Balance assessment



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Acute CT Head Imaging Indications
- Signs of altered mental status
  - Agitation
  - Somnolence
  - Repetitive questioning
  - Slow response to verbal communications
- Signs of basilar skull fracture

Additional Considerations (*Observation vs. CT based on clinical findings*)
- Combination or ≥ 2 of the following:
  - Loss of consciousness (*witnessed or documented*)
  - Severe or worsening headache
  - Multiple vomiting episodes
- Worsening symptoms or signs
- Severe mechanism of injury
  - Motor vehicle crash with patient ejection, death of another passenger, or rollover
  - Pedestrian or bicyclist without helmet
  - Helmet struck by a motorized vehicle
  - Falls of more than 1.5 meters (5 feet)
  - Head struck by a high impact object
- Physician/clinician experience

Off Guideline. Treatment based on abnormal results

Discharge Checklist

It is not uncommon for concussion symptoms to develop within 48 hrs. Please consult PCP if symptoms develop
- **Medications**
  - Avoid opioids
  - Prescription medications are often not necessary
- **Education Materials** (*includes information on return to school and activities, rest, headache management and screen time*)
  - Concussion Guidance
  - Educational Accommodations for Concussion
  - Sleep Tips for Children and Teens
- **Expectations**
  - Many patients will have symptom resolution within 3 weeks, however for some it may take a month or longer
  - Return to school may occur prior to full resolution of symptoms
- **Timeline for follow-up**
  - Within 2 weeks for reassessment of symptoms
- **Follow-up**
  - Competitive sports/athletes, follow-up with Sports Medicine
  - All others should follow-up with PCP initially

May consider hospital admission for any of the following, though not limited to:
- Trouble ambulating (*significant risk of fall/injury*)
- Persistent vomiting
- Uncontrolled pain

Abbreviations :
mTBI = Mild traumatic brain injury
GCS = Glasgow coma scale
NAT = Non-accidental trauma

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Objective of Clinical Pathway

To provide care standards for the child presenting to the Emergency Department (ED), Urgent Care Center (UCC), or Outpatient clinic with concern for concussion/mild traumatic brain injury (mTBI). The Concussion Clinical Pathway addresses evaluation, clinical decision making, discharge education, expectations, and the follow-up plan to minimize care variation.

Background

Concerns for suspected traumatic brain injury in children and adolescents account for more than 800,000 emergency department or urgent care visits and result in approximately 200,000 diagnosed concussions annually (Corwin et al., 2020; Peterson et al., 2019). However, the approximate numbers reported are believed to be underestimated, not reflecting those children and adolescents with concussions that go untreated, are seen in primary care offices or specialty centers, or are considered managed at the site of injury (Arbogast et al., 2016; Corwin et al., 2020; Dufour et al., 2020; Lumba-Brown et al., 2018).

Unintentional falls, inadvertent striking of or being struck by an object, and motor vehicle accidents tend to be the most common mechanisms of injury accounting for up to 78% of cases, for which medical attention is sought through the emergency department or an urgent care center and manifest in a variety of clinical presentations (Master et al., 2020; Peterson et al., 2019). Much of the literature has focused on sports-related concussions in children 12 or older. By comparison, studies conducted on non-sports related concussions in children between the ages of 5 to 11 years identified similarities in clinical presentations, rendering the initial acute care process to be similar (Arbogast et al., 2016; Black & Zablotsky, 2021; Bretzin et al., 2018; Corwin et al., 2020; Kerr et al., 2018; Lumba-Brown et al., 2018; Pederson et al, 2019; Semrud-Clikeman & Klipfel, 2016).

Since the inception of the Concussion Clinical Pathway in September 2016, the Concussion Clinical Pathway Committee has consistently recommended following the clinical decision rule (Kuppermann et al., 2009) when determining the need for a computerized tomography (CT) scan for a child following a concussion (Canty et al., 2016). Generally, a CT scan is recommended when a child shows signs of altered mental status or a basilar skull fracture. However, when these signs are absent, other clinical factors must be considered to determine whether to observe versus proceed with a CT scan (Kuppermann et al., 2009). While this element of the Concussion Clinical Pathway remains consistent with previous versions, the 2023 Concussion Clinical Pathway Committee sought to address gaps with the most recent update. The Concussion Clinical Pathway aims to provide an evidence-based pathway for the provider caring for a child or adolescent with concern for concussion, often described as a mTBI. The care process provides guidance regarding initial evaluation, clinical decision-making, discharge education, expectations, and the follow-up plan to minimize care variation.

Target Users

- Physicians (Emergency Department, Urgent Care, Primary Care, Outpatient Clinics, Fellows, Residents)
- Advanced Practice Nurses
- Nurses (Emergency Departments, Urgent Care Centers, and Outpatient Clinics)

Target Population

Inclusion Criteria

- Children ≥ 5 years of age
- Concern for concussion/mTBI
- Glasgow Coma Score (GCS) 14 - 15

Exclusion Criteria

- GCS < 14
- Concern for stroke
- Concern for cervical spine injury
- Child with global developmental delay

AGREE II

The Centers for Disease Control and Prevention guideline provided guidance to the Concussion Clinical Pathway Committee (Lumba-Brown et al., 2018). See Table 1 for AGREE II.

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Table 1

AGREE II[a] Summary for the Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children (Lumba-Brown, 2018)

Domain	Percent Agreement	Percent Justification^
Scope and purpose	99%	The aim of the guideline, the clinical questions posed and target populations **were** identified.
Stakeholder involvement	96%	The guideline **was developed** by the appropriate stakeholders and represents the views of its intended users.
Rigor of development	89%	The process used to gather and synthesize the evidence, and the methods to formulate the recommendations **were** stated. The guideline developers **did not** provide the date the guidelines will be updated.
Clarity and presentation	97%	The guideline recommendations **are** clear, unambiguous, and easily identified; in addition, different management options are presented.
Applicability	68%	The guideline **did not clearly** address implementation barriers and facilitators, utilization strategies, nor resource costs associated with implementation.
Editorial independence	100%	The recommendations **were not** biased with competing interests.
Overall guideline assessment	92%	
See Practice Recommendations		

Note: Four EBP Scholars completed the AGREE II on this guideline.
^Percentage justification is an interpretation based on the Children's Mercy EBP Department standards.

Practice Recommendations

Please refer to the Centers for Disease Control and Prevention (Lumba-Brown et al., 2018) Clinical Practice Guideline for full practice recommendations, evaluation, and treatment recommendations.

Additional Questions Posed by the Clinical Pathway Committee

No clinical questions were posed for this review.

Updates from Previous Versions of the Clinical Pathway

- Prior versions addressed sports-related concussion and excluded concussion from non-sport related causes, whereas the updated Concussion Clinical Pathway addresses concern for concussion/mTBI considering both sport-related and non-sport related causes.
- Prior versions included children and adolescents 8 – 18 years of age, whereas the updated Concussion Clinical Pathway includes children ≥ 5 years of age.
- The updated Concussion Clinical Pathway includes discharge education materials to address return to school and activities, rest, headache management and screen time, providing guidance regarding expectations, and follow-up.

Recommendation Specific for Children's Mercy

Children's Mercy adopted the majority of the practice recommendations made by the Centers for Disease Control and Prevention Clinical Practice Guideline (Lumba-Brown et al., 2018). Variations/Additions include:

- Lumba-Brown et al., (2018) recommend that all children ≤ 18 years of age be included in the care process, whereas the Children's Mercy care process includes children ≥ 5.
- Lumba-Brown et al., (2018) recommend that children with a GCS of 13 - 15 be included in the care process, whereas the Children's Mercy care process includes children with a GCS of 14 – 15.

Measures

- Utilization of the Concussion Clinical Pathway

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Value Implications

The following improvements may increase value by reducing healthcare costs and non-monetary costs (e.g., missed school/work, loss of wages, stress) for patients and families and reducing costs and resource utilization for healthcare facilities.

- Decreased risk of overdiagnosis
- Decreased risk of overtreatment (i.e., routinely ordering CT head imaging, prescribing pain medications)
- Decreased unwarranted variation in care

Potential Organizational Barriers and Facilitators

Potential Barriers

- Variability of acceptable level of risk among providers
- Challenges with follow-up faced by some families

Potential Facilitators

- Collaborative engagement across care continuum settings during clinical pathway development
- High rate of use of the clinical pathway

Diversity/Equity/Inclusion

Our aim is to provide equitable care. These issues were discussed with the Committee, reviewed in the literature, and discussed prior to making any practice recommendations.

Power Plans

- No power plans were identified to be directly associated to the Concussion Clinical Pathway

Associated Policies

- No policies were identified to be directly associated to the Concussion Clinical Pathway

Education Materials

- Concussion Guidance
  - Intended to be discussed and provided to child or adolescent's family at time of discharge
  - Found in Cerner depart process, available through the Concussion Clinical Pathway algorithm or the Concussion Clinical Pathway website page
  - Available in English and Spanish
- Educational Accommodations for Concussion
  - Intended to be discussed with the child or adolescent's family at time of discharge and provided to the child or adolescent's school
  - Found in Cerner depart process, available through the Concussion Clinical Pathway algorithm or the Concussion Clinical Pathway website page
  - Available in English
- Sleep Tips and Strategies for Children and Teens
  - Intended to be discussed and provided to the child or adolescent's family at the time of discharge
  - Found in Cerner depart process, available through the Concussion Clinical Pathway algorithm or the Concussion Clinical Pathway website page
  - Available in English and Spanish

Clinical Pathway Preparation

This product was prepared by the Evidence Based Practice (EBP) Department in collaboration with the Concussion Clinical Pathway Committee composed of content experts at Children's Mercy Kansas City. The development of this product supports the Quality Excellence and Safety Division's initiative to promote care standardization that is evidenced by measured outcomes. If a conflict of interest is identified, the conflict will be disclosed next to the committee member's name.

Concussion Clinical Pathway Committee Members and Representation

- Greg Canty, MD | Orthopedic Surgery, Sports Medicine Center | Committee Co-Chair
- Sathya Vadivelu, DO | Rehabilitation Medicine | Committee Co-Chair

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- Amanda Nedved, MD | Urgent Care | Committee Member
- Ariel Alden, APRN, FNP-C, CPN | Urgent Care | Committee Member
- Ayman Abdul-Rauf, MD, FAAP | Emergency Department | Committee Member
- Trevor Gerson, MD | Neurology | Committee Member
- Maria Korth, PhD | Developmental and Behavioral Health | Committee Member
- Jill Vickers, MSN, RN-BC-CPN | Clinical Practice and Quality | Committee Member
- David Garcia, MD | Neurosurgery | Committee Member

Patient/Family Committee Member

- Kirsten Hudson | Committee Member

EBP Committee Members

- Jarrod Dusin, MS, RD, LD, CPHQ | Evidence Based Practice
- Todd Glenski, MD, MSHA, FASA | Anesthesiology, Evidence Based Practice
- Kelli Ott, OTD, OTR/L | Evidence Based Practice

Clinical Pathway Development Funding

The development of this clinical pathway was underwritten by the following departments/divisions: Orthopedic Surgery, Rehabilitation Medicine, Urgent Care, Emergency Department, Neurology, Development and Behavioral Health, Clinical Practice and Quality, Neurosurgery, Patient and Family Engagement, and Evidence Based Practice.

Conflict of Interest

The contributors to the Concussion Clinical Pathway have no conflicts of interest to disclose related to the subject matter or materials discussed.

Approval Process

- This product was reviewed and approved by the Concussion Clinical Pathway Committee, Content Expert Departments/Divisions, and the EBP Department.
- Products are reviewed and updated as necessary every 3 years within the EBP Department at CMKC. Content expert teams are involved with every review and update.

Review Requested

Department/Unit	Date Obtained
Sports Medicine/Orthopedic Surgery	August 2023
Rehabilitation Medicine	August 2023
Urgent Care	August 2023
Emergency Department	July 2023
Neurology	August 2023
Developmental and Behavioral Health	August 2023
Neurosurgery	August 2023
Clinical Practice and Quality	August 2023
Primary Care Clinic	June 2023
Evidence Based Practice	July 2023

Version History

Date	Comments
September 2016	Version one (algorithm developed, synopsis developed, four critically appraised topics published)
March 2019	Version two (algorithm revised)
August 2023	Version three (algorithm revised, synopsis revised, educational materials revised)

Date for Next Review:

- August 2026

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Implementation & Follow-Up

- Once approved, the clinical pathway was presented to appropriate care teams and implemented. Care measurements will be assessed and shared with appropriate care teams to determine if changes need to occur.
- Education tools were reviewed by Health Literacy and the Family Advisory Board.
- Education was provided to all stakeholders:
  - Nursing units where the Concussion Clinical Pathway is used
  - Providers from the Emergency Department and Urgent Care Center
  - Resident physicians
- Additional institution-wide announcements were made via email, hospital website, and relevant huddles.
- Metrics will be assessed and shared with appropriate care teams to determine if changes need to occur.

Disclaimer

When evidence is lacking or inconclusive, options in care are provided in the supporting documents and the power plan(s) that accompany the clinical pathway.

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References

Arbogast, K.B., Curry, A.E., Pfeiffer, M.R., Zonfrillo, M.R., Haarbauer-Krup, J., Breiding, M.J., Coroado, V.G., & Master, C.L. (2016). Point of health care entry for youth with concussion within a large pediatric care network. *Journal of the American Medical Association Pediatrics, 170*(7), e160294. https://doi.org/10.1001/jamapediatrics.2016.0294

Black, L. I. & Zablotsky, B. (2021*). Concussions and brain injuries in children: Unites States, 2020* [NCHS Data Brief, No. 423]. National Center for Health Statistics. https://dx.doilorg/10.15620/cdc:111174

Bretzin, A.C., Covassin, T., Fox, M.E., Petit, K.M., Savage, J.L., Walker, L.F., & Gould, D. (2018). Sex differences in the clinical incidence of concussions, missed school days, and time loss in high school student-athletes: Part 1. *American Journal of Sports Medicine, 46*(9), 2263-2269. https://doi.org/10.1177/0363546518778251

Canty, G., Abdul-Rauf, A., Bickel, J., Bjelich, J., Davis, J., Hunter, M., Korth, M., Stokes, P., Bontrager, T., Gutierrez, C., Leamon, J., Thompson, L., Tobin, T., Williams, T., Allen, N., Bartlett, J., Michael, J., & Dusin, J.(2016). *Management of sports related concussion in the ED.* Children's Mercy Hospital and Clinics, Evidence Based Practice. https://www.childrensmercy.org/contentassets/0ce4632ea7bf4ba8b8902c1c287efcf2/concussion-synopsis-final-october-19-2016.pdf

Chrisman, S.P., Haaland, W.L., Herring, S.A., Kroshus, E., Hoopes, T.R., Higgins, S.K., & Rivara, F.P. (2018). Longitudinal study of concussion in 6-14 year old football players measuring incidence, risk factors and duration of symptoms. *Medical Science Sports Exercise, 50,* 3. https://doi.org/10.1249/01.mss.0000535090.86485.e5

Corwin, D.J., Arbogast, K.B., Haber, R.A., Pettijohn, K.W., Zonfrillo, M.R., Grady, M.F., & Master, C.L. (2020). Characteristics and outcomes for delayed diagnosis of concussion in pediatric patients presenting to the emergency department. *The Journal of Emergency Medicine, 59*(6), 795-804. https://doi.org/10.1016/j.jemermed.2020.09.017

Dufour, S.C., Syko Adams, R., Brody, D.L., Puente, A.N., & Gray, J.C. (2020). Prevalence and correlates of concussion in children: Data from the adolescent brain cognitive development study. *Cortex, 131,* 237-250. https://doi.org/10.1016/j.cortz.2020.07.003

Gioia, G., & Collins, M. (2006). *Acute Concussion Evaluation (ACE): Emergency Department (ED) Version v1.4.* https://www.cdc.gov/headsup/pdfs/providers/ace_ed-a.pdf

Gioia, G., & Collins, M. (2006). *Acute Concussion Evaluation (ACE): Physician/Clinician Office Version.* https://www.cdc.gov/headsup/pdfs/providers/ace_v2-a.pdf

Kerr, Z.Y., Wilkerson, G.B., Caswell, S.V., Currie, D.W., Pierpoint, L.A., Wasserman, E.B., Knowles, S.B., Dompier, T.P., Comstock, R.D., & Marshall, S.W. (2018). The first decade of web-based sports injury surveillance: Descriptive epidemiology of injuries in United States high school football (2005-2006 through 2012-2014) and national collegiate athletic association football (2004-2005 through 2013-2014). *Journal of Athletic Training, 53*(8), 738-751. https://doi.org/10.4085/1062-6050-144-17

Kuppermann, N., Holmes, J. F., Dayan, P. S., Hoyle, J. D., Jr., Atabaki, S. M., Holubkov, R., Nadel, F.M., Monroe, D., Stanley, R.M., Borgialli, D.A., Badawy, M.K, Schunk, J.E., Quayle, K.S., Mahahan, P., Lichenstein, R., Lillis, K.A., Tunik, M.G., Jacobs, E.S., Callahan, J.M., . . . Wootton-Gorges, S. L. (2009). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet, 374*(9696), 1160-1170. https://doi.org/10.1016/S0140-6736(09)61558-0 [pii]

Lumba-Brown, A., Yeates, K.O., Sarmiento, K., Breiding, M.J., Haegerich, T.M., Gioia, G.A., Turner, M., Benzel, E.C., Suskauer, S.J., Giza, C.C., Joseph, M., Broomand, C., Weissman, B., Gordon, W., Wright, D.W., Moser, R.S., McAvoy, K., Ewing-Cobbs, L., Duhaime, A.C., Putakian, M., …Timmons, S.D. (2018). Centers for Disease Control and Prevention Guideline on the diagnosis and management of mild traumatic brain injury among children. *Journal of the American Medical Association Pediatrics, 172*(11), e182853. https://doi.org/10.1001/jamapediatrics.2018

Master, C.L., Curry, A.E., Pfeiffer, M.R., Metzger, K.B., Kessler, R.S., Haarbauer-Krupa, J., DePadilla, L., Greenspan, A., Breiding, M.J., & Arbogast, K.B. (2020). Characteristics of concussion in elementary school-aged children: Implications for clinical management. *Journal of Pediatrics, 223,* 128-135. https://doi.org/10.1016/j.jpeds.2020.04.001

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Patricios, J.S., Schneider, K.J., Dvorak, J., Hassan Ahmed, O, Blauwet, C, Cantu, R.C., Davis, G.A., Echemendia, R.J, Makdissi, M., McNamee, M., Broglio, S., Emery, C., Feddermann-Demont, N., Ward Fuller, G., Giza, C.C., Guskiewicz, K.M., Hainline B., Iverson G.L., Kutcher, J.S.,… Meeuwisse, W. (2023). Consensus statement on concussion in sport: the 6th international conference on concussion in sport- Amsterdam, October 2022. *British Journal of Sports Medicine, 57,* 695-711. https://doi.org/10.1136/bjsports-2023-106898

Peterson, A.B., Likang, X., Daugherty, J., & Breiding, M.J. (2019). *Surveillance report of traumatic brain injury-related emergency department visits, hospitalizations, and deaths – United States, 2014.* National Center for Injury Prevention and Control (U.S.). https://stacks.cdc.gov/view/cdc/78062

Semrud-Clikeman, M. & Klipfel, K. (2016). TBI and concussions in student athletes: How do severity of injury, age, and gender influence recovery. *Journal of Pediatric Neuropsychology, 2,* 58-69. https://doi.org/10.1007/s40817-015-0010-8

Yaramothu, C., Goodman, A.M., & Alvarez, T.L. (2019). Epidemiology and incidence of pediatric concussions in general aspects of life. *Brain Sciences, 9*(10), 257. https://doi.org/10.3390/brainsci9100257

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