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The Brain Injury Guidelines for Kids (kBIG)

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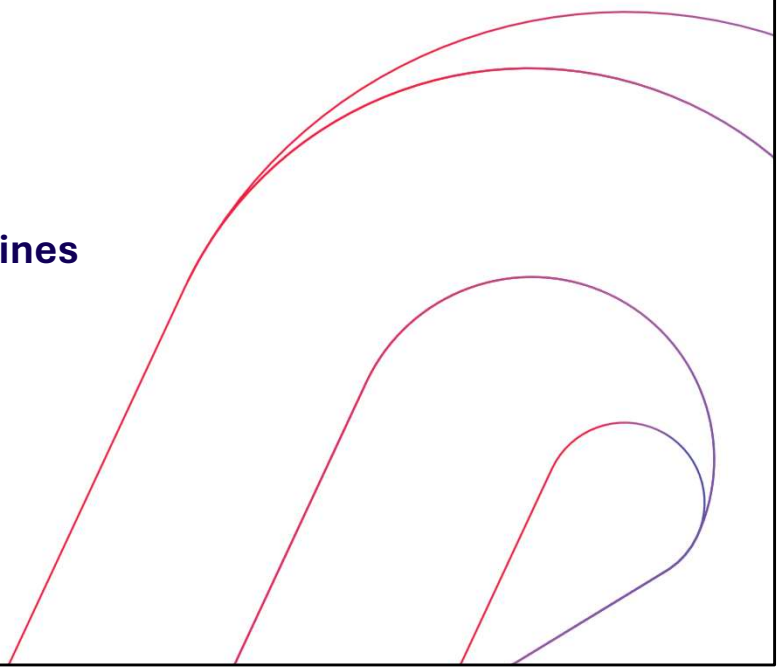

A Partnership in Managing Brain Injury

Adult and Pediatric Collaboration

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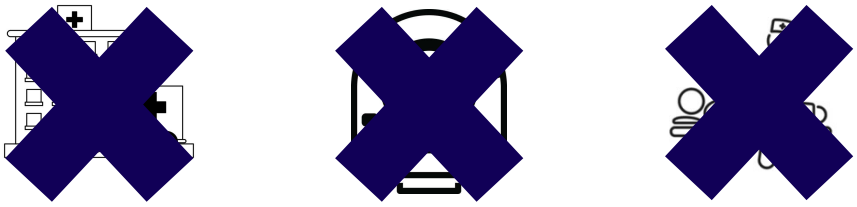
So, if it works for adult brain injury…what about for pediatric brain injury??
And this is why collaboration between adult and peds trauma care is SO important – we can learn from each other, we can work together.

What are the Brain Injury Guidelines?

The BIG

- **Validated** risk assessment model in adult patientdesigned to standardize classification and management of traumatic intracranial hemorrhage
- The BIG **reduce excess resource utilization** in a subset of low-risk patients



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		BIG 1	BIG 2	BIG 3
Exam	**Neurologic exam**	GCS 13-15	GCS 13-15	GCS ≤12
	Intoxication	No	Yes	Yes
Preinjury Meds	**Anticoagulation/antiplatelet**	No	No	Yes
Radiologic Findings	**Skull fracture**	No	Non-displaced	Displaced
	SDH	≤4 mm	5-7 mm	≥8 mm
	EDH	≤4 mm	5-7 mm	≥8 mm
	IPH	≤4mm	5-7 mm	≥8 mm or multiple
	SAH	≤3 sulci total	Single hemisphere and > 3 sulci	Bi-hemispheric and > 3 sulci
	IVH	No	No	Yes
		THERAPEUTIC PLAN		
	Hospitalization	No Observation (6 hrs)	Yes	Yes
	Repeat CT brain	No	No	Yes
	Neurosurgery Consultation	No	No	Yes

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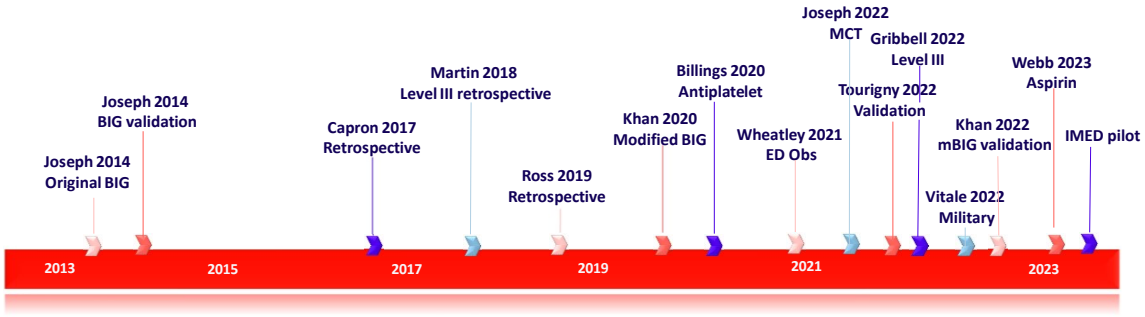
Isolated BIG 1 has implications for ED providers, who will now be responsible for managing these patients/assessing for safe discharge if no other indications for admission exist

A BIG Literature Timeline



10,000 patients over 10 years

No BIG 1 patients required a neurosurgical intervention

BIG 2 operative rate = 0.16%

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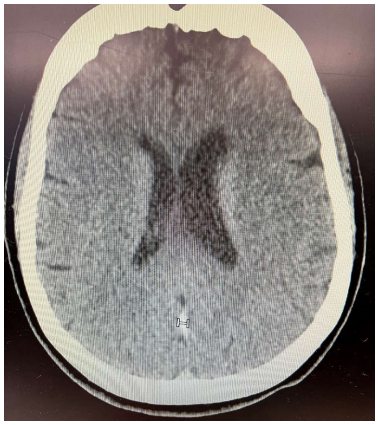
2300 BIG 1
1900 BIG 2 → less than 1% needed an intervention

Implementation of the Brain Injury Guidelines (BIG)

Intermountain Medical Center BIG Pilot (2022)



Original Research Article

First steps toward a BIG change: A pilot study to implement the Brain Injury Guidelines across a 24-hospital system

Annika Bickford Kay [a], Samantha A. Malone [a, *], Joseph R. Bledsoe [b], Sarah Majercik [a], David S. Morris [a]

[a] Division of Trauma Services and Surgical Critical Care, Intermountain Medical Center, Murray, UT, USA
[b] Department of Emergency Medicine, Intermountain Medical Center, Murray, UT, USA

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Another APP fellow project was the implementation of the BIG in adults with TBI at IMED – a pilot which we published and which set the stage for a systemwide implementation of the BIG across all IH hospitals in the Canyons/Desert Region.

Tackling Preventable Transfers

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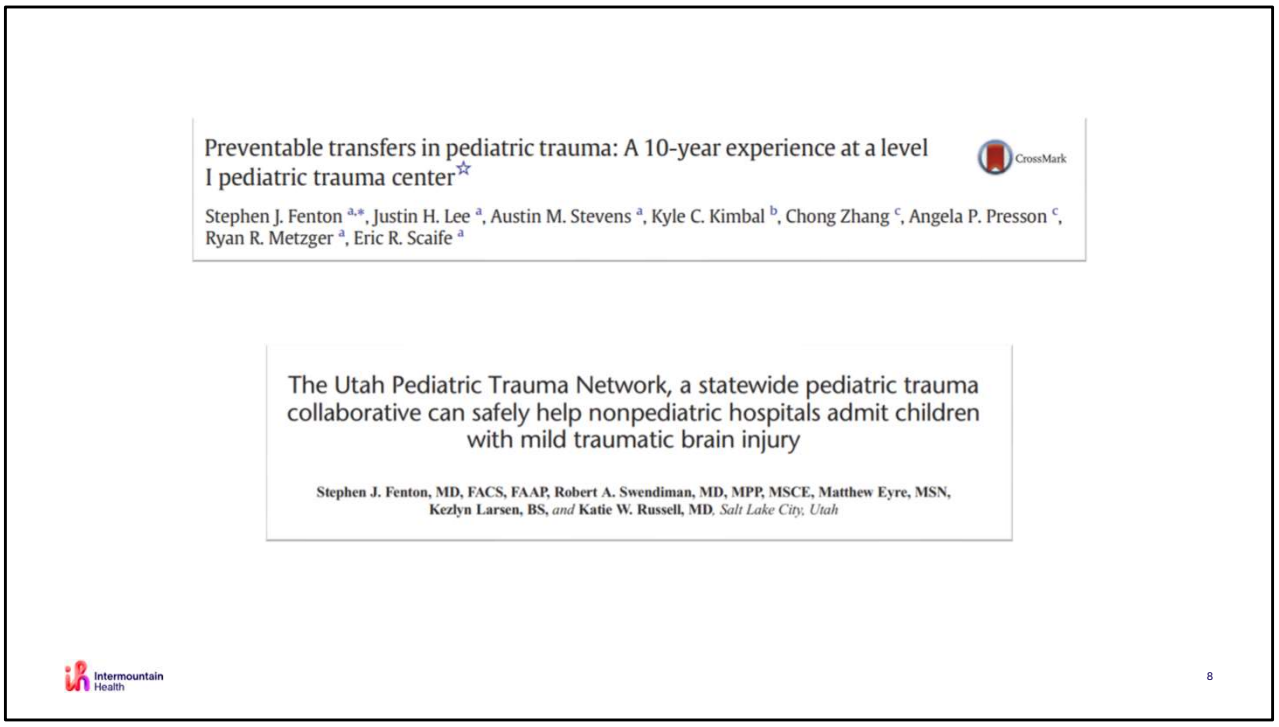

Preventable transfers in pediatric trauma: A 10-year experience at a level I pediatric trauma center☆

Stephen J. Fenton [a,*], Justin H. Lee [a], Austin M. Stevens [a], Kyle C. Kimbal [b], Chong Zhang [c], Angela P. Presson [c], Ryan R. Metzger [a], Eric R. Scaife [a]

The Utah Pediatric Trauma Network, a statewide pediatric trauma collaborative can safely help nonpediatric hospitals admit children with mild traumatic brain injury

Stephen J. Fenton, MD, FACS, FAAP, Robert A. Swendiman, MD, MPP, MSCE, Matthew Eyre, MSN, Kezlyn Larsen, BS, *and* Katie W. Russell, MD, *Salt Lake City, Utah*

PCH and UPTN have published important reports on preventable transfers and the impact of a UPTN supported mild TBI guideline.

First UPTN Initiative

Isolated Mild TBI

- Goal was to help the network understand which children with mild isolated TBI could be safely managed locally versus those who would be better served at a higher-level center
- Created TBI severity grading scale (GCS, LOC, CT scan)
- Significantly more (and younger) children with mild TBI were admitted to non-PED1 centers

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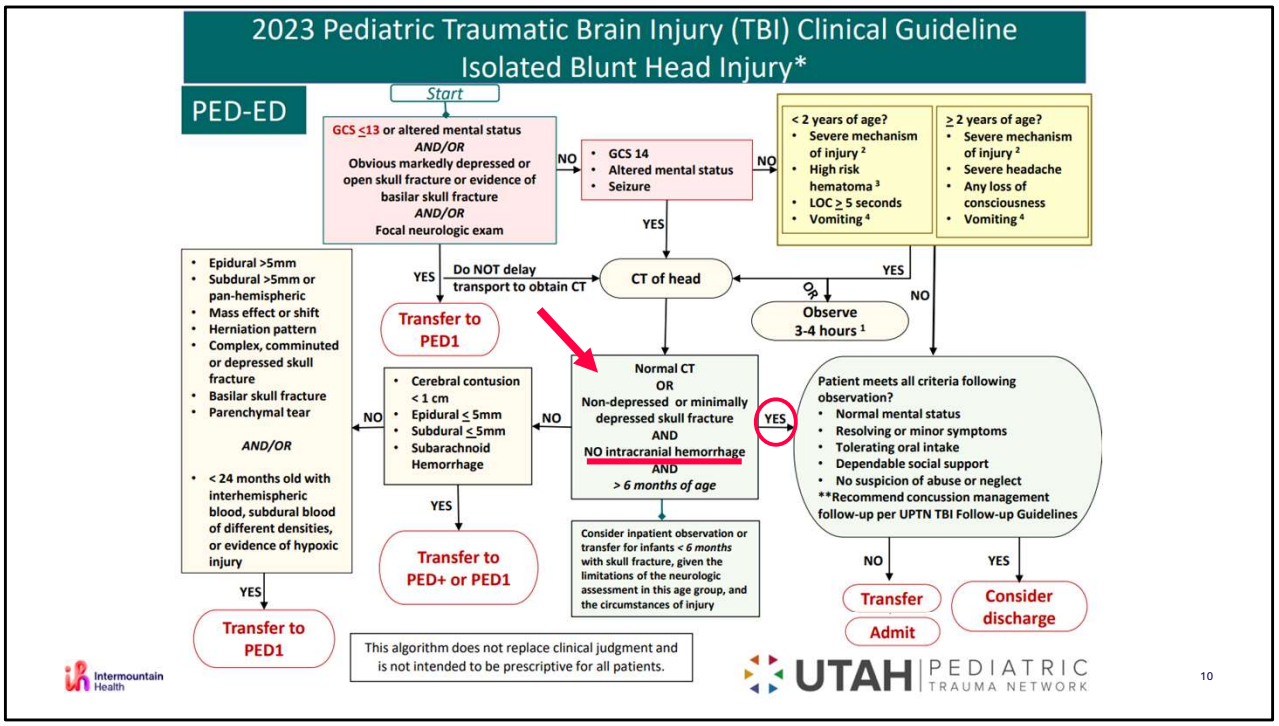
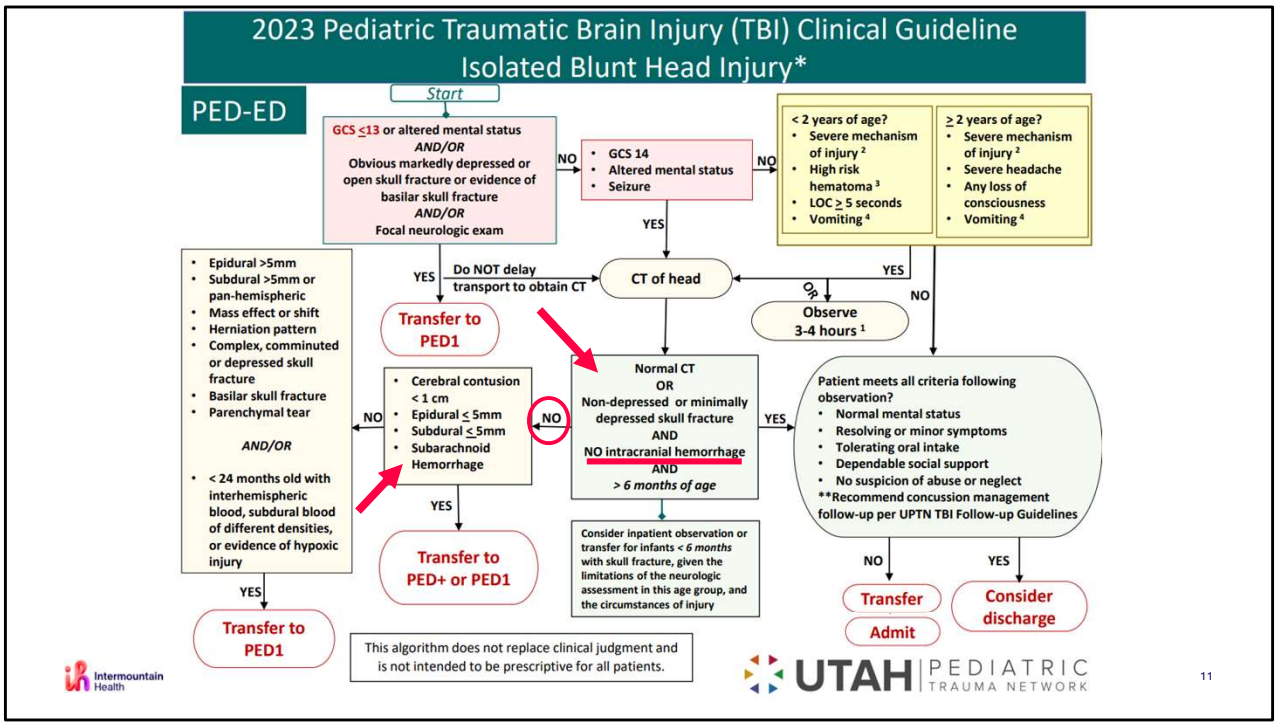
With no standard measure of severity established out there…they created a severity grading scale to guide transfer and admission decisions
Mild (very mild, mild, complicated mild based on GCS and CT)
Similar to our BIG in adults! Time to collaborate!



UPTN created a isolated blunt head injury guideline → ** if isolated skull fracture, could consider discharge

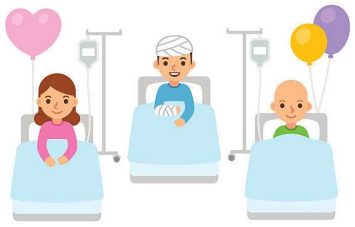


**If small ICH, mandates admission, PED+ allowed.

Why Does This Matter for Kids?

In Summary

- ✓TBI is the most common cause of pediatric injury and death
- ✓Over 1 quarter of pediatric transfers are potentially preventable and mild TBI is the most common indication
- ✓UPTN is on the forefront and has already made progress by demonstrating the safety of keeping kids with mild TBI locally
- ✓The BIG has shown potential in pediatric TBI



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So, can BIG be applied to kids?

Yes!

- Data suggest the BIG is effective and safe in kids
  - ➢Significant reduction in CT scans and neurosurgery consults
  - ➢No low-risk children required a surgical intervention or died from their TBI
- Some scoring adjustments proposed
- Potential for reduced transfers is acknowledged
- BUT… small sample sizes limit the application of these data

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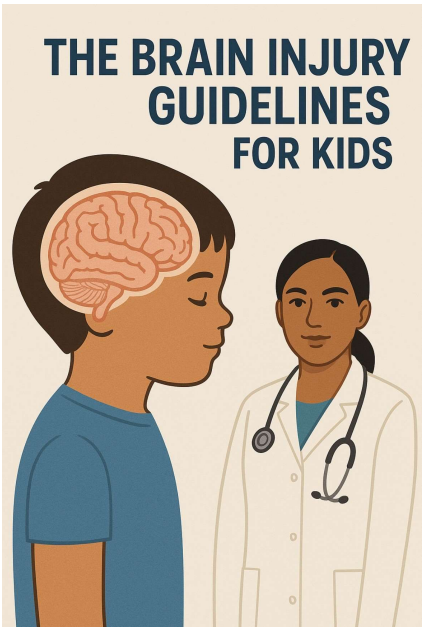
So what did those reports tell us about BIG in kids?
First and foremost…BIG can be safely applied (meaning no surg interventions in the lower risk categories)
Small sample sizes anywhere between 30 and a few hundred kids severely limit these data

Introducing: kBIG



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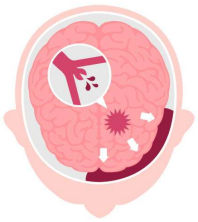
This represents an opportunity for partnership between pediatric and adult trauma care….align what we are doing in adults with kids!

Chart Review

- < 18 years old
- Seen at Primary Children's Medical Center
- Blunt mechanism of injury
- Radiographic abnormality on CT brain imaging
  - ➢Skull fracture
  - ➢Traumatic hemorrhage



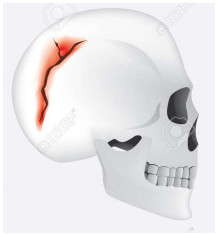


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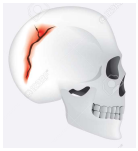
Chart review performed over 5 year period

1,894
Analyzed

1,455
Brain Bleed ± Skull fx

439
Isolated Skull Fx



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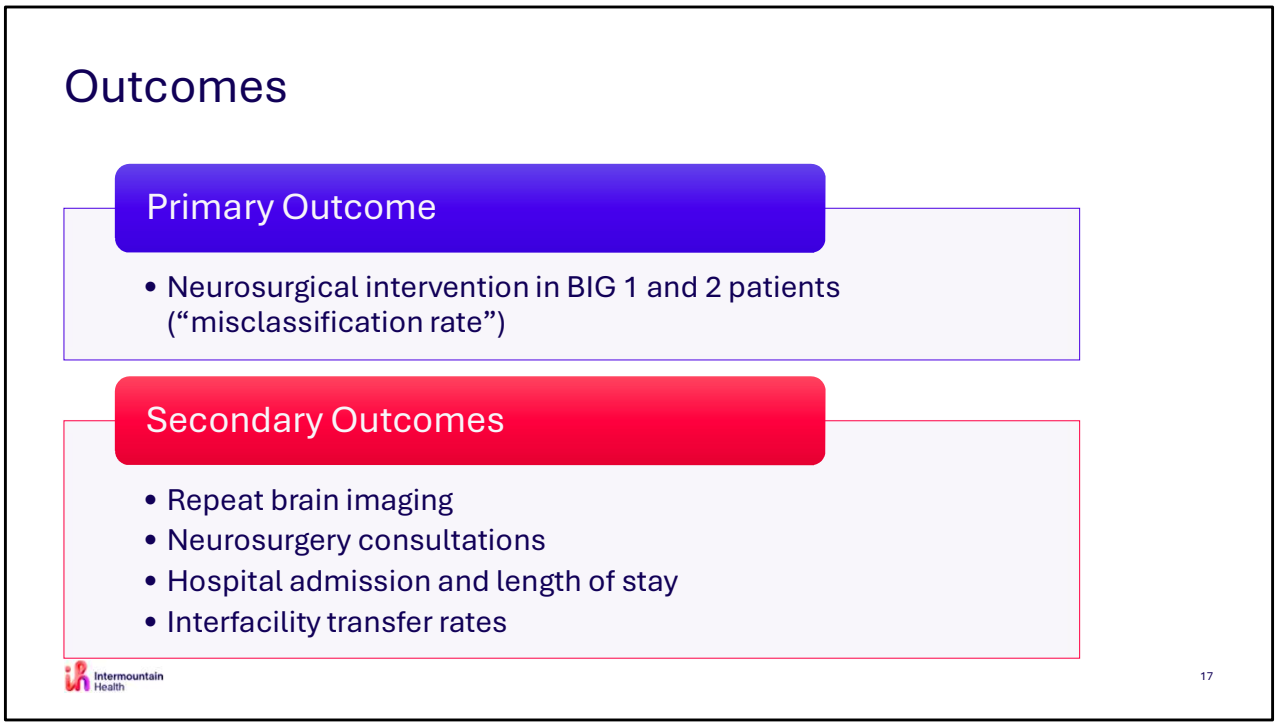
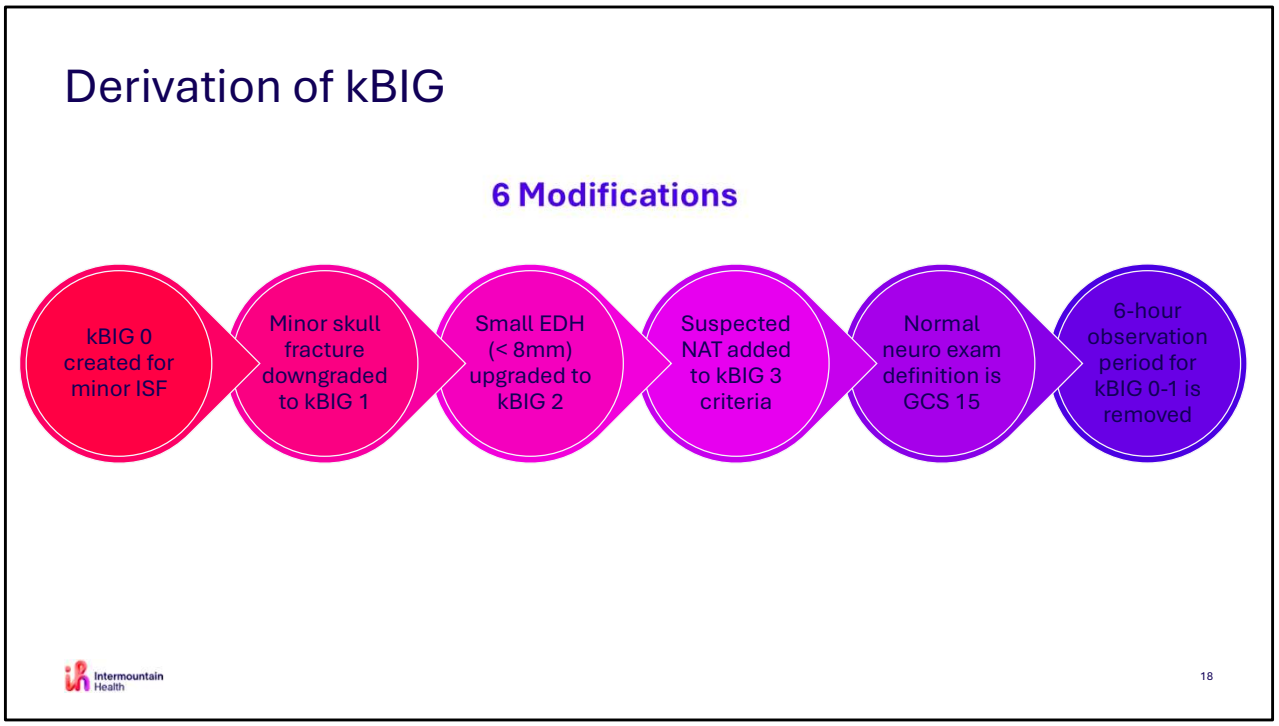


Simply put, we wanted to make NO BIG 1 kids, and an absolute minimal # of BIG 2, underwent a neurosurgery



Skull fracture is much more common in kids than adults (and represented 23% of this population)

1. We wanted this guideline to encompass ALL pediatric TBI with radiographic abnormalities, and the original BIG required presence of brain hemorrhage. So we decided to create an ISF category to guide management of these kids who have a fracture but no brain bleed initially
2. There has been precedence as I discussed to modify how presence of skull fx impacts TBI risk stratification. A significant portion of the population were BIG 2 just because of SFx (i.e. with BIG 1 size bleeds), and felt that recommending admission for these kids would be a step backward in our journey to safely minimize resources. Also, we saw that none of the BIG 2 patients that underwent an operation were BIG 2 solely because of SFX (they all had BIG 2 size bleeds)
3. For EDH, the original BIG allows small EDH to be a BIG 1 – while no child with a BIG 1 EDH had an intervention, there is simply a higher risk for expansion and so we wanted to adopt a more conservative approach. We need more data to better determine the risk of minor EDH.
4. NAT is unique to children, and you saw that a ¼ of NAT kids underwent an operation including the majority of the BIG 2 operative patients

Derivation of kBIG

- Skull fracture is much more common in kids than adults (23% of this population)
- Guideline designed to be inclusive and encompass all pediatric TBI

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Derivation of kBIG

Minor skull fracture downgraded to kBIG 1

- Significant portion of patients were BIG 2 solely due to minor skull fracture → too many patients would be unnecessarily admitted
- Presence of minor skull fracture did not impact intervention rates

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Derivation of kBIG

Small EDH (< 8mm) upgraded to kBIG 2

- No BIG 1 injury had an intervention
- With the downgrading of minor skull fracture we wanted to adopt a more conservative approach with epidural hemorrhage

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Derivation of kBIG

- Non-accidental trauma is unique to kids
- Different physiology (more chronic)
- A quarter of the study population with NAT underwent an operative intervention
- **Only relevant for kids with intracranial hemorrhage (isolated skull fracture and NAT concern → *safe and healthy families*)

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Derivation of kBIG

Normal neuro exam definition is GCS 15

- GCS is unreliable especially in pediatric patients
- GCS 13-14 does not preclude surgery in this population
- One patient with an isolated skull fracture developed a new EDH on day 2 (he was GCS 14)
- Kids must be at their baseline (GCS and symptom severity)

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With no room for error, kBIG is designed protect every single kid at risk for decline

Derivation of kBIG

6-hour observation period for kBIG 0-1 is removed

- More conservative approach to categorization with neurologic exam and symptoms makes it safe
- No kBIG 0-1 patients declined to need an operative intervention
- Adult literature suggests that observation for BIG 1 may not be needed
- This has been perceived as a major barrier to BIG implementation at smaller facilities (ED bedspace)

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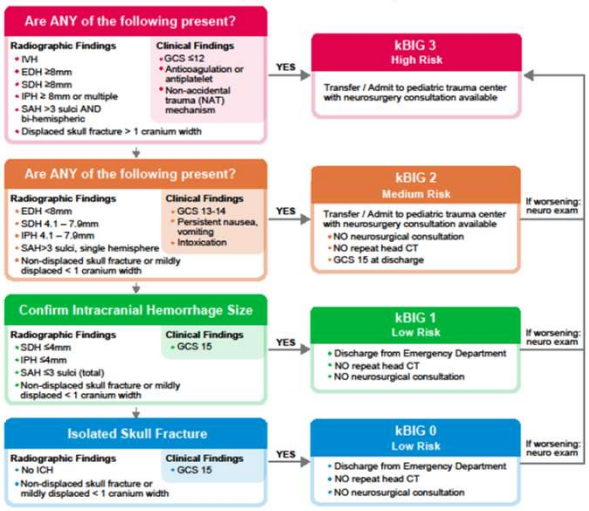
With no room for error, kBIG is designed protect every single kid at risk for decline

	kBIG 0	kBIG 1	kBIG 2	kBIG 3
Mechanism of Injury	Blunt TBI *may include NAT	Blunt TBI *excluding NAT	Blunt TBI *excluding NAT	Blunt TBI *including NAT
ED GCS	15	15	13-14	≤12
Intoxication	No	No	Yes	Yes
Anticoagulation	No	No	No	Yes
Skull fracture	Nondisplaced or Mildly displaced	Nondisplaced or Mildly displaced	Nondisplaced or Mildly displaced	Displaced (with or without bleed)
EDH	No	No	< 8 mm	≥8 mm
SDH	No	≤4 mm	5-7 mm	≥8 mm
IPH	No	≤4mm	5-7 mm	≥8 mm or multiple
SAH	No	≤3 sulci total	Single hemisphere and > 3 sulci	Bi-hemispheric and > 3 sulci
IVH	No	No	No	Yes
Management				
Hospitalization	No	No	Yes	Yes
Neurosurgery Consult	No	No	No	Yes
Repeat CT Brain	No	No	No	Yes

Pediatric Patient with Traumatic Brain Injury (TBI)

UTAH PEDIATRIC TRAUMA NETWORK

Patients with >1 intracranial injury should be automatically classified as kBIG3



Low risk skull fracture and concern for child physical abuse: please call safe and healthy families. Otherwise treat as kBIG 0.
(801) 442-SAFE (7233)

Abbreviations

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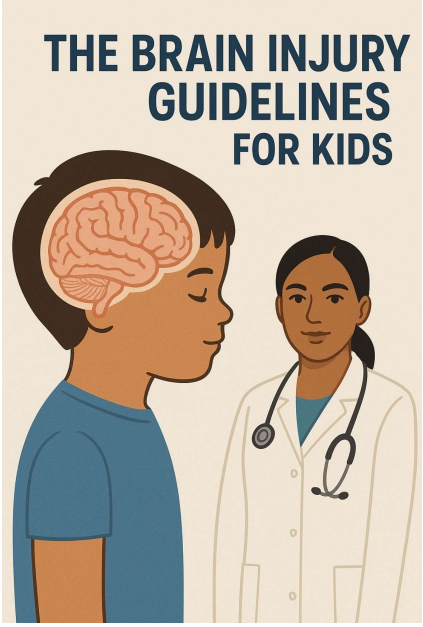
How Much of a Change is kBIG?

- UPTN is steps ahead with mild TBI!
- kBIG scoring is slightly different than UPTN definitions of severity
- **Allows small brain bleeds to be sent home**
- Disposition of kBIG 2 may be similar (PED +)?



Given the progress that the UPTN guideline made with reducing transfer to the PED 1, I think it is important to recognize that kBIG is far less a departure from the standard than it was for us with adults, where we had made no steps to minimize resource utilization in miniscule bleeds. **And I applaud you all for that.**

What is Next for kBIG?

- Accepted for publication with **Journal of Pediatric Surgery**
- Jan 1 went live at Primary Children's, including telehealth
  - Prospective tracking ongoing
- **kBIG is replacing UPTN guideline for TBI**
- Multicenter retrospective validation of kBIG is underway

Thank You!

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