

# Measuring Overuse and Underuse of Brain CTs in Pediatric Patients with mTBI in Two Canadian Emergency Departments

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Canada

# Background

## Pediatric Mild Traumatic Brain Injury (mTBI):

- One of the most frequent Chief Complain

## Brain CT for child with mTBI:

- **1:1000** risk of developing brain tumor/leukemia
- Highly expensive
- PECARN rule:
  - Guideline for the use of CT
  - Based on S/S reported by the patient
  - Stratify the risk of ciTBI (Low, moderate, high)
- **Overuse of Brain CT for mTBI patient:**
  - **58% (ped) and 41% (adult)**

(1) J. Brenner & al, American J of Roentgenology, 2001.

(2) T. Hurley and C. P., Archives of Disease in Childhood, 2016.

# Background – PECARN rule

Any 1 of following?

GCS 14  
Altered Mental Status ‡  
Signs of basilar skull #

Yes

(4.3% risk of ciTBI)

**High risk – CT-Scan Recommended**  
**Underuse when no CT performed**

No

1 or more of following?

LOC  
Hx vomiting  
Severe injury mechanism \*  
Severe headache

Yes

(0.9% risk of ciTBI)

**Moderate risk – Obs vs CT-Scan**

Use clinical picture to guide:

- Doctor's experience
- Multi vs isolated findings
- Worsening symptoms
- Parental preference

No (<0.05% risk of ciTBI)

**Low risk – CT-Scan not recommended**  
**Overuse when CT performed**

‡ Agitation, somnolence, repetitive questioning or slow response to verbal communication

\*Fall of more than 5 feet (3 for < 2yrs), MVA with death of a passenger / patient ejection, rollover, pedestrian or cyclist without helmet struck by motorised vehicle, head struck by a high impact object

**Difference < 2 yrs: + palpable skull fracture, not acting normally per parent**  
**- Signs of basilar skull #, severe headache**

N. Kuppermann & al., The Lancet, September 2009.

# Objectives

- 1) To measure the adherence - **overuse as well as underuse** - to the PECARN rule
  - Pediatrics with mTBI
  - Two Canadian emergency departments
  
- 2) For moderate risk categorized patients, to evaluate if there is a **correlation** between
  - The number of S/S reported
  - Decision to do a brain CT



# Methods

## Design

Retrospective chart review

Random data selection

## Settings

A. **Level III** pediatric trauma center  
(CHU Ste-Justine)

B. **Level I** general trauma center (Hôtel-Dieu-de-  
Lévis)

C. Jan to Dec 2016

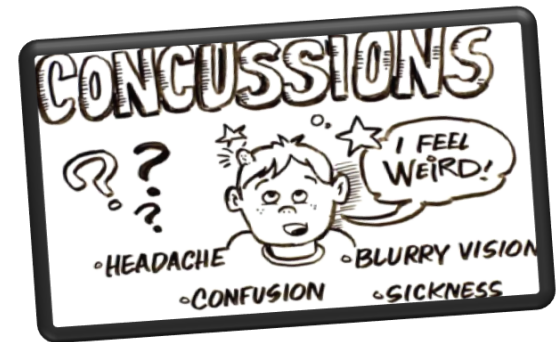
# Methods

## Inclusion criteria

1. Head trauma 24 hours before arrival to the ED
2. **mTBI criteria** after trauma and before arrival to ED:
  1. LOC, amnesia, drowsiness, confusion, vomiting, unusual fatigue, concentration disorder)
3. GCS > 13

## Exclusion criteria

1. Bleeding disorder
2. History of brain tumor
3. Ventricular shunt
4. Penetrating trauma
5. Suspicion of child abuse
6. Evidence of cerebral hemorrhage
7. Evidence of cerebral herniation
8. Suspected neurological condition leading to the trauma



# Methods

## Outcome

- **Overuse and underuse rates of brain CTs for pediatric with mTBI**

## Independent variables

- **Risk of ciTBI according to PECARN definition**
- **Demographic data (age and sex)**

# Procedure

- **Selection of all electronic records compatible with a mTBI under 17 years**
- **Random selection of charts**
- **Inclusion/exclusion → enrollment**
- **First classification according to **age****
- **Second classification according to **risk of ciTBI****



# Ethics

- **No written consent required**
- **Approved by institutional review board x 2**



# Results - Inter-rater reliability

- 40 (14%) charts reviewed – **inclusion/exclusion**

Principal investigator  **$\kappa = 0.83$**

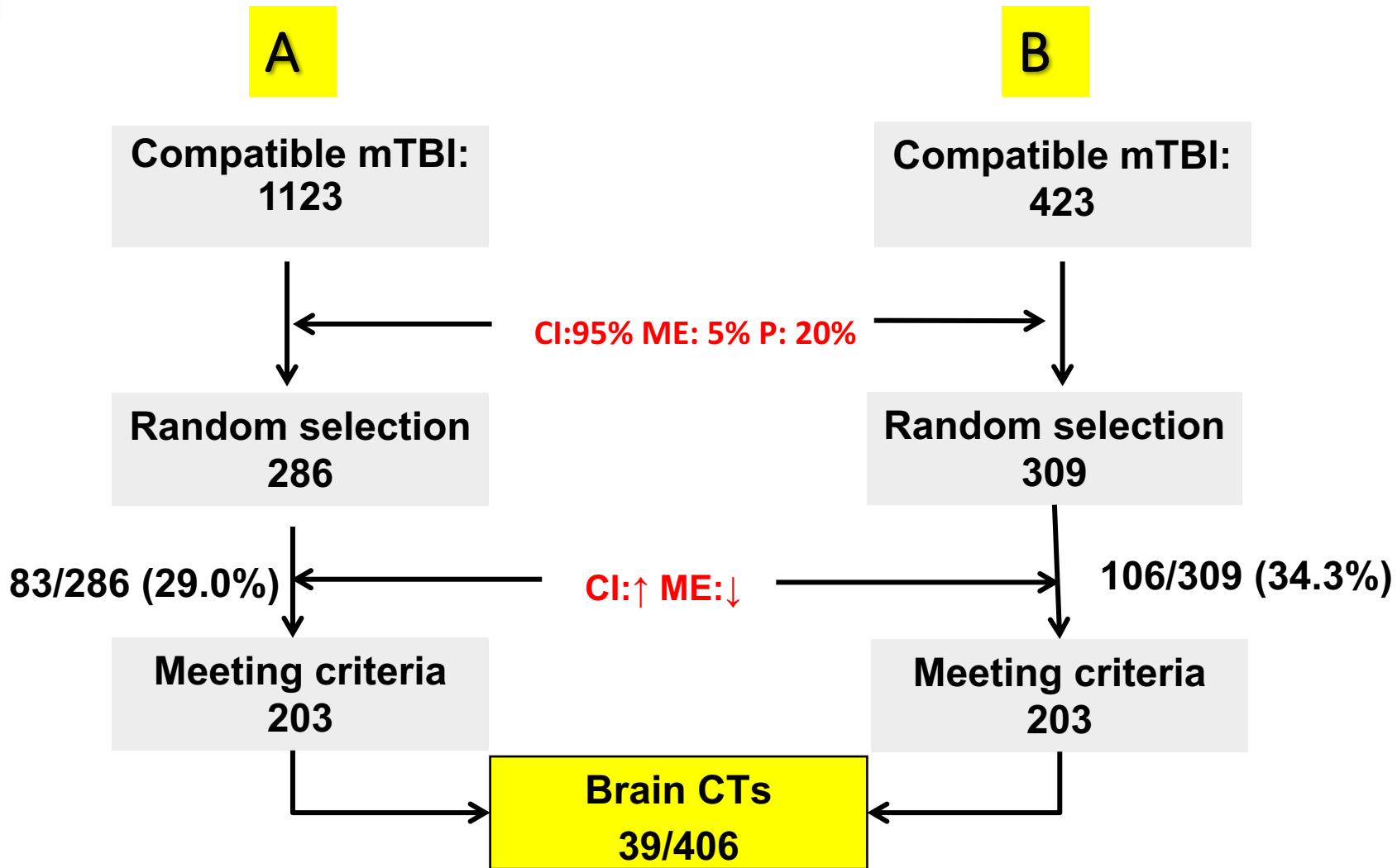
<b>Reviewer</b>	Inc/exc	Included	Excluded	Total
	Included	26	0	26
	Excluded	3	11	14
	Total	29	11	

- 26 charts accepted x 2 : **risk assessment**

Principal investigator  **$\kappa = 1.0$**

<b>Reviewer</b>	Risk	Low	Moderate	High	Total
	Low	18	0	0	18
	Moderate	0	8	0	8
	High	0	0	0	0
	Total	18	8	0	

# Results

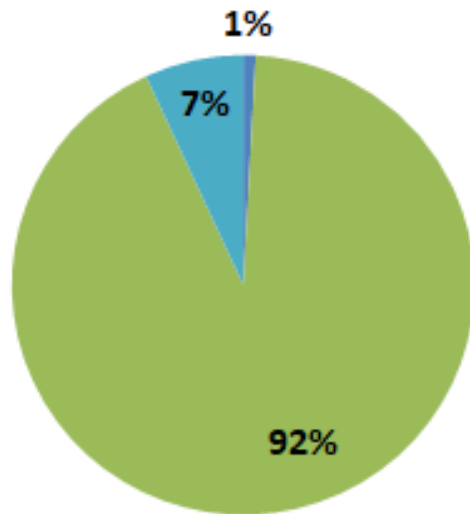


# Baseline characteristics

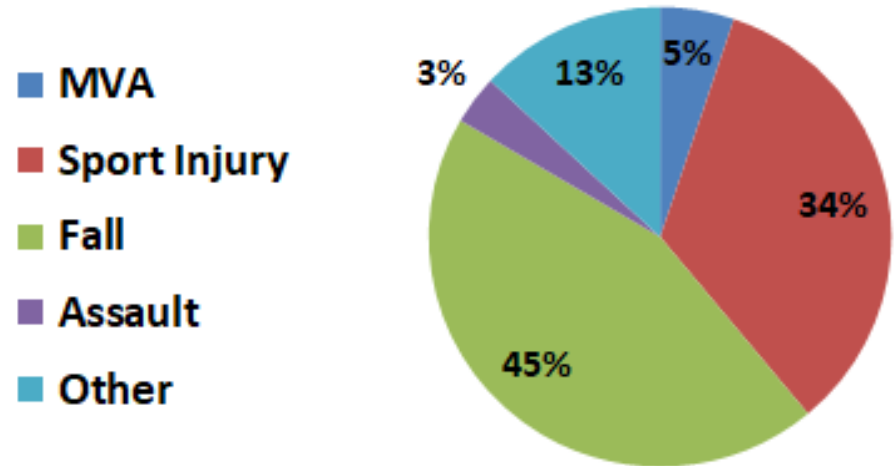
	< 2 yrs	≥ 2 years	Total (N)	Total (%)
<b>Age</b>	116	290	406	<b>100</b>
<b>Male</b>	62	178	240/406	<b>59,1</b>
<b>Low risk</b>	63	165	228/406	<b>56,2</b>
<b>Mod. risk</b>	49	98	147/406	<b>36,2</b>
<b>High risk</b>	3	23	26/406	<b>6,4</b>
<b>Brain CT</b>	4	36	40/406	<b>9,9</b>
<b>Abnormal dx</b>	0	7	7/40	<b>17,5</b>

# Mechanism of injury

< 2 yrs



≥ 2 yrs



- MVA
- Sport Injury
- Fall
- Assault
- Other

# Overuse and Underuse Rates

< 2 yrs	Brain CT N (%)		N (%)
	A (tertiary)	B (primary)	Total
<b>Low risk</b>	0/28 (-)	1/35 (2.9)	1/63 (1.6)
<b>Moderate risk</b>	0/22 (-)	0/27 (0)	0/49 (0)
<b>High risk</b>	3/3 (100%)	0/0 (-)	3/3 (100)

≥ 2 yrs	Brain CT N (%)		
	A (tertiary)	B (primary)	
<b>Low risk</b>	1/79 (1.3)	8/86 (9.4)	9/165 (5.5)
<b>Moderate risk</b>	4/52 (7.7)	8/46 (17.4)	12/98 (12.2)
<b>High risk</b>	8/14 (57.1)	7/9 (77.8)	15/23 (65.2)
<b>No CT - Underuse</b>	6/14 (42.9)	2/9 (22.2)	8/23(34.8)

# Moderate risk – S/S reported

Moderate risk	Level III N (%)	Level I N (%)	Total N (%)
<b>1 S&amp;S</b>	3/4 (75)	5/8 (62.5)	8/12 (66.7)
<b>2 S&amp;S</b>	1/4 (25)	2/8 (25)	3/12 (25)
<b>≥ 3 S&amp;S</b>	0/4 (0)	1/8 (12.5)	1/13 (8.3)

# Limitations

- ✓ **Retrospective study**
- ✓ **Handwriting...**
- ✓ **Modest sample size**





# Conclusion

## OVERUSE

**<2 years: Excellent agreement to the PECARN rule**

**≥ 2 years: Excellent agreement to the PECARN rule**

- Tertiary: 1.3% vs Primary: 9.4%
- Hurley and Curran: 58% (2016)
- University affiliated?

## UNDERUSE

**≥ 2 years: Problematic and surprising**

- 5.0% risk of ciTBI!
- 2/9 (22.2%) vs 6/14 (42.9%)
- Further investigation required!

## # OF S/S RELATED TO THE DECISION (MODERATE RISK)

- Obs versus CT-Scan
- **No correlation:** 66,7% reported only 1 S/S

# Conclusion

**Thank you**



# References

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