Midnight Journal Club

2022.5.16

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今回の clinical question

頭を打って心配です！
CT、とってほしい！！

そんなに重症そうじゃないからCTいらなさそう…
被曝も気になるし
でもこんな必死なお母さんの申し出を断って、万一後から
出血が見つかったら、トラブルになりそうだな

とある日の外来で

駅のトイレでおむつを交換しようと思って
赤ちゃんを寝かせました

新しいおむつを準備している間に
赤ちゃんが下に落ちてしまいました

元気そうだけど、念のため
連れてきました

小児は成人より被曝の影響を受けやすい

- 子どもはおとなの2－3倍放射線に対して感受性が高い
- 放射線の健康への影響は一様ではない

こどもが成人より影響の大きいもの
感受性
認知、白内障、甲状腺結節
発がんのリスク
白血病、脳腫瘍、皮膚がん、乳がん、甲状腺がん

被曝の健康への影響を減らす

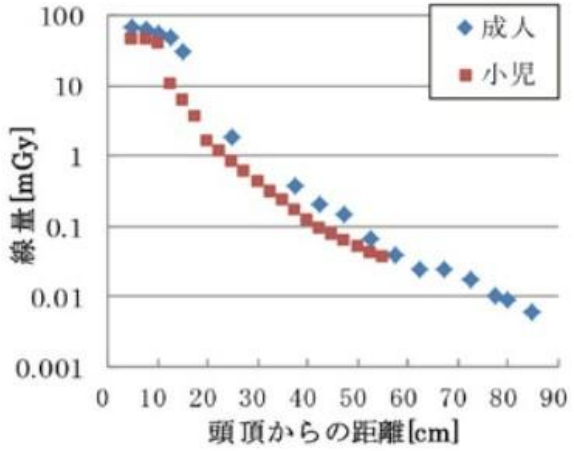


図 6. 頭部 CT検査におけるファントム中心線量

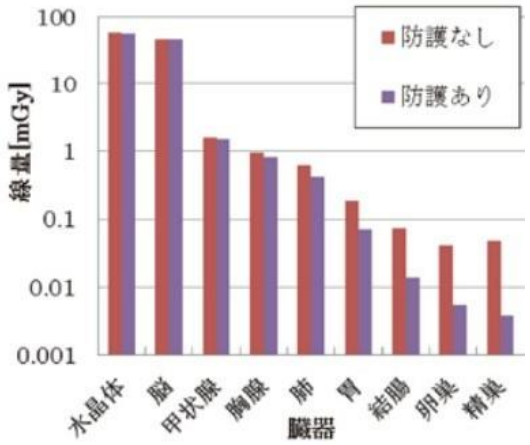


図 10. 防護の有無による小児臓器被ばく線量

新生児
50cm

1歳児
75cm

4歳
100cm

被曝量は検査部位(頭部)からの距離が影響する

防護をすることで被ばく線量は減少させられる

小児軽症頭部外傷スコア

CHALICE(2004)

PECARN(2009)

CATCH(2010)

いずれも①受傷起点、②身体所見、③臨床経過　をもとにCTの必要性を評価

受傷起点のうち、『転落・墜落の定義』、『高エネルギー外傷の定義』が
それぞれで異なる

(参考)小児軽症頭部外傷スコアの相違点

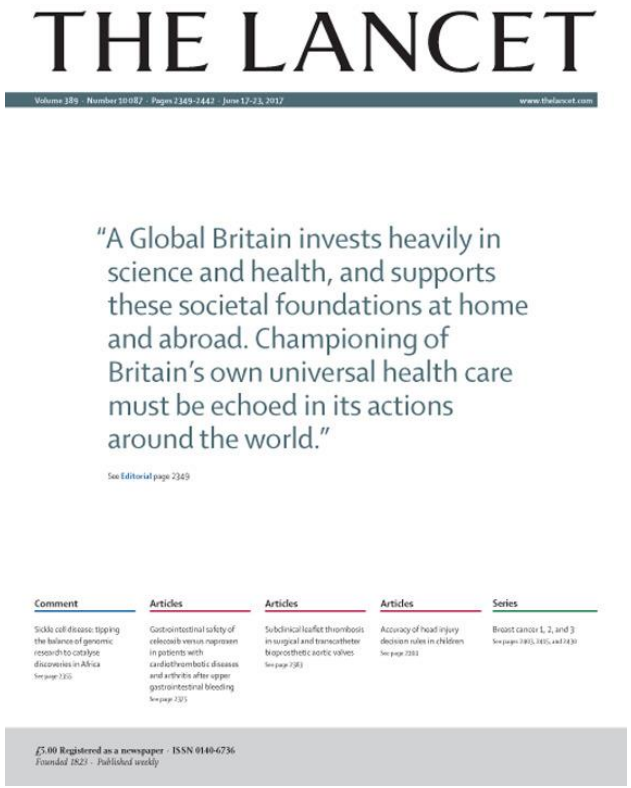
CHALICE(2004)

PECARN(2009)

CATCH(2010)

転落・墜落	3m以上からの墜落	<2歳　0.9mからの墜落 ≧2歳　1.5mからの墜落	0.9m以上からの墜落
高エネルギー外傷	64km/H以上のスピードでの事故 早く動く物体との衝突	車外放出 同乗者死亡 歩行者orヘルメットなしの 自転車と車の事故 衝撃の強いものに打撲	バイク事故 ヘルメットなしの自転車からの 転倒

本日の文献



Accuracy of PECARN, CATCH, and CHALICE head injury decision rules in children: a prospective cohort study

Franz E Babl, Meredith L Borland, Natalie Phillips, Amit Kochar, Sarah Dalton, Mary McCaskill, John A Cheek, Yuri Gilhotra, Jeremy Furyk, Jocelyn Neutze, Mark D Lyttle, Silvia Bressan, Susan Donath, Charlotte Molesworth, Kim Jachno, Brenton Ward, Amanda Williams, Amy Baylis, Louise Crowe, Ed Oakley, Stuart R Dalziel, for the Paediatric Research in Emergency Departments International Collaborative (PREDICT)

Summary

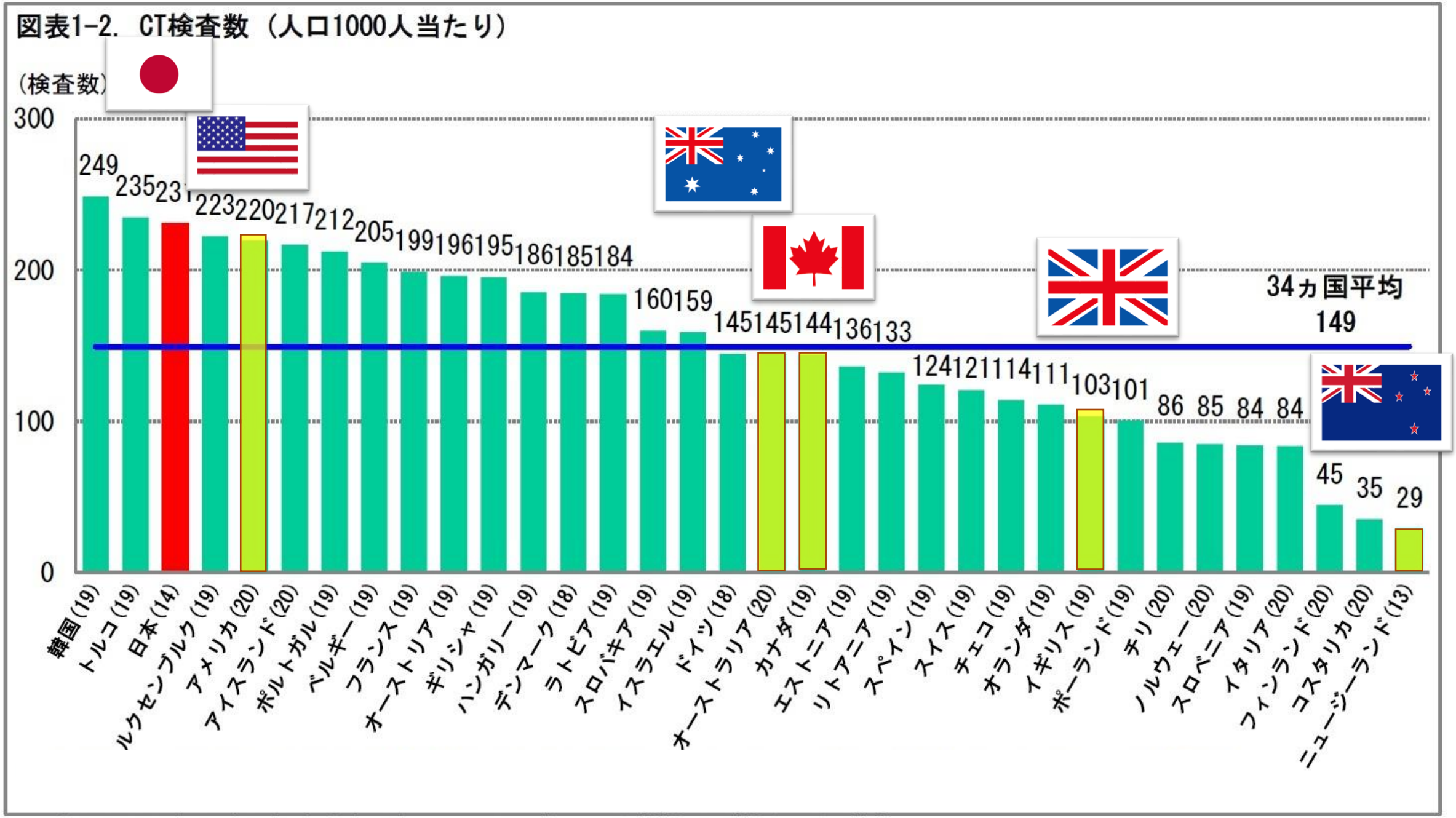
Background Clinical decision rules can help to determine the need for CT imaging in children with head injuries. We aimed to validate three clinical decision rules (PECARN, CATCH, and CHALICE) in a large sample of children.

Methods In this prospective observational study, we included children and adolescents (aged <18 years) with head injuries of any severity who presented to the emergency departments of ten Australian and New Zealand hospitals. We assessed the diagnostic accuracy of PECARN (stratified into children aged <2 years and ≥2 years), CATCH, and CHALICE in predicting each rule-specific outcome measure (clinically important traumatic brain injury [TBI], need for neurological intervention, and clinically significant intracranial injury, respectively). For each calculation we used rule-specific predictor variables in populations that satisfied inclusion and exclusion criteria for each rule (validation cohort). In a secondary analysis, we compiled a comparison cohort of patients with mild head injuries (Glasgow Coma Scale score 13–15) and calculated accuracy using rule-specific predictor variables for the standardised outcome of clinically important TBI. This study is registered with the Australian New Zealand Clinical Trials Registry, number ACTRN12614000463673.

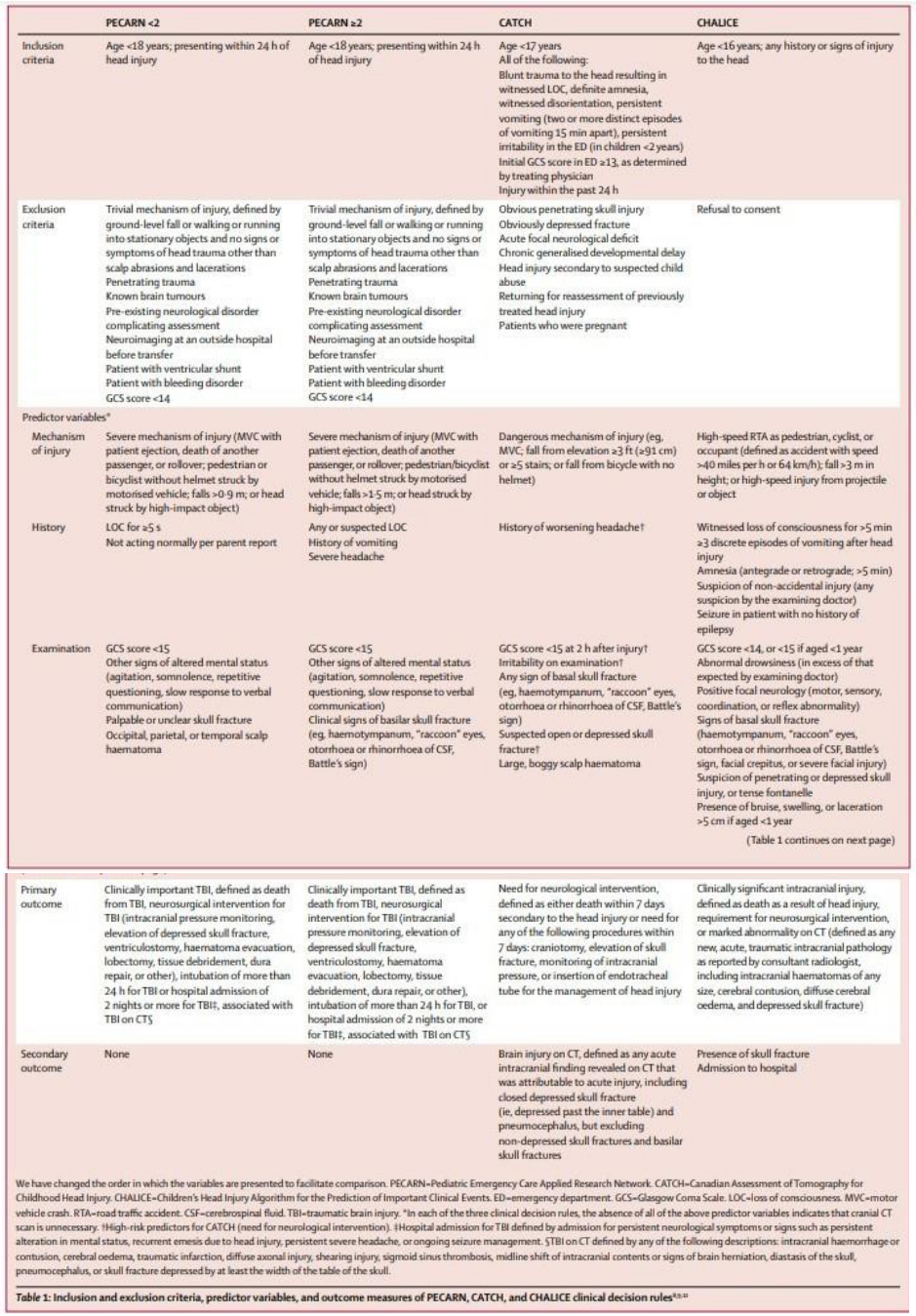
Findings Between April 11, 2011, and Nov 30, 2014, we analysed 20137 children and adolescents attending with head injuries. CTs were obtained for 2106 (10%) patients, 4544 (23%) were admitted, 83 (<1%) underwent neurosurgery, and 15 (<1%) died. PECARN was applicable for 4011 (75%) of 5374 patients younger than 2 years and 11152 (76%) of 14763 patients aged 2 years and older. CATCH was applicable for 4957 (25%) patients and CHALICE for 20029 (99%). The highest point validation sensitivities were shown for PECARN in children younger than 2 years (100·0%, 95% CI 90·7–100·0; 38 patients identified of 38 with outcome [38/38]) and PECARN in children 2 years and older (99·0%, 94·4–100·0; 97/98), followed by CATCH (high-risk predictors only; 95·2%; 76·2–99·9; 20/21; medium-risk and high-risk predictors 88·7%; 82·2–93·4; 125/141) and CHALICE (92·3%, 89·2–94·7; 370/401). In the comparison cohort of 18913 patients with mild injuries, sensitivities for clinically important TBI were similar. Negative predictive values in both analyses were higher than 99% for all rules.

Interpretation The sensitivities of three clinical decision rules for head injuries in children were high when used as designed. The findings are an important starting point for clinicians considering the introduction of one of the rules.

Funding National Health and Medical Research Council, Emergency Medicine Foundation, Perpetual Philanthropic Services, WA Health Targeted Research Funds, Townsville Hospital Private Practice Fund, Auckland Medical Research Foundation, A+Trust.


図表1-2. CT検査数（人口1000人当たり）
（検査数）
300
200
100
0
249
235
231
223
220
217
212
205
199
196
195
186
185
184
160
159
145
145
144
136
133
124
121
114
111
103
101
86
85
84
84
45
35
29
34ヵ国平均
149
韓国(19)
トルコ(19)
日本(14)
ルクセンブルク(19)
アメリカ(20)
アイスランド(20)
ポルトガル(19)
ベルギー(19)
フランス(19)
オーストリア(19)
ギリシャ(19)
ハンガリー(19)
デンマーク(18)
ラトビア(19)
スロバキア(19)
イスラエル(19)
ドイツ(18)
オーストラリア(20)
カナダ(19)
エストニア(19)
リトアニア(19)
スペイン(19)
スイス(19)
チェコ(19)
オランダ(19)
イギリス(19)
ポーランド(19)
チリ(20)
ノルウェー(20)
スロベニア(19)
イタリア(20)
フィンランド(20)
コスタリカ(20)
ニュージーランド(13)

3つのルールの比較



	PECARN <2	PECARN ≥2	CATCH	CHALICE
Inclusion criteria	Age <18 years; presenting within 24 h of head injury	Age <18 years; presenting within 24 h of head injury	Age <17 years All of the following: Blunt trauma to the head resulting in witnessed LOC, definite amnesia, witnessed disorientation, persistent vomiting (two or more distinct episodes of vomiting 15 min apart), persistent irritability in the ED (in children <2 years) Initial GCS score in ED ≥13, as determined by treating physician Injury within the past 24 h	Age <16 years; any history or signs of injury to the head
Exclusion criteria	Trivial mechanism of injury, defined by ground-level fall or walking or running into stationary objects and no signs or symptoms of head trauma other than scalp abrasions and lacerations Penetrating trauma Known brain tumours Pre-existing neurological disorder complicating assessment Neuroimaging at an outside hospital before transfer Patient with ventricular shunt Patient with bleeding disorder GCS score <14	Trivial mechanism of injury, defined by ground-level fall or walking or running into stationary objects and no signs or symptoms of head trauma other than scalp abrasions and lacerations Penetrating trauma Known brain tumours Pre-existing neurological disorder complicating assessment Neuroimaging at an outside hospital before transfer Patient with ventricular shunt Patient with bleeding disorder GCS score <14	Obvious penetrating skull injury Obviously depressed fracture Acute focal neurological deficit Chronic generalised developmental delay Head injury secondary to suspected child abuse Returning for reassessment of previously treated head injury Patients who were pregnant	Refusal to consent
Predictor variables*				
Mechanism of injury	Severe mechanism of injury (MVC with patient ejection, death of another passenger, or rollover; pedestrian or bicyclist without helmet struck by motorised vehicle; falls >0·9 m; or head struck by high-impact object)	Severe mechanism of injury (MVC with patient ejection, death of another passenger, or rollover; pedestrian/bicyclist without helmet struck by motorised vehicle; falls >1·5 m; or head struck by high-impact object)	Dangerous mechanism of injury (eg, MVC; fall from elevation ≥3 ft (≥91 cm) or ≥5 stairs; or fall from bicycle with no helmet)	High-speed RTA as pedestrian, cyclist, or occupant (defined as accident with speed >40 miles per h or 64 km/h); fall >3 m in height; or high-speed injury from projectile or object
History	LOC for ≥5 s Not acting normally per parent report	Any or suspected LOC History of vomiting Severe headache	History of worsening headache†	Witnessed loss of consciousness for >5 min ≥3 discrete episodes of vomiting after head injury Amnesia (antegrade or retrograde; >5 min) Suspicion of non-accidental injury (any suspicion by the examining doctor) Seizure in patient with no history of epilepsy
Examination	GCS score <15 Other signs of altered mental status (agitation, somnolence, repetitive questioning, slow response to verbal communication) Palpable or unclear skull fracture Occipital, parietal, or temporal scalp haematoma	GCS score <15 Other signs of altered mental status (agitation, somnolence, repetitive questioning, slow response to verbal communication) Clinical signs of basilar skull fracture (eg, haemotympanum, "raccoon" eyes, otorrhoea or rhinorrhoea of CSF, Battle's sign)	GCS score <15 at 2 h after injury† Irritability on examination† Any sign of basal skull fracture (eg, haemotympanum, "raccoon" eyes, otorrhoea or rhinorrhoea of CSF, Battle's sign) Suspected open or depressed skull fracture† Large, boggy scalp haematoma	GCS score <14, or <15 if aged <1 year Abnormal drowsiness (in excess of that expected by examining doctor) Positive focal neurology (motor, sensory, coordination, or reflex abnormality) Signs of basal skull fracture (haemotympanum, "raccoon" eyes, otorrhoea or rhinorrhoea of CSF, Battle's sign, facial crepitus, or severe facial injury) Suspicion of penetrating or depressed skull injury, or tense fontanelle Presence of bruise, swelling, or laceration >5 cm if aged <1 year
Primary outcome	Clinically important TBI, defined as death from TBI, neurosurgical intervention for TBI (intracranial pressure monitoring, elevation of depressed skull fracture, ventriculostomy, haematoma evacuation, lobectomy, tissue debridement, dura repair, or other), intubation of more than 24 h for TBI or hospital admission of 2 nights or more for TBI‡, associated with TBI on CT§	Clinically important TBI, defined as death from TBI, neurosurgical intervention for TBI (intracranial pressure monitoring, elevation of depressed skull fracture, ventriculostomy, haematoma evacuation, lobectomy, tissue debridement, dura repair, or other), intubation of more than 24 h for TBI, or hospital admission of 2 nights or more for TBI‡, associated with TBI on CT§	Need for neurological intervention, defined as either death within 7 days secondary to the head injury or need for any of the following procedures within 7 days: craniotomy, elevation of skull fracture, monitoring of intracranial pressure, or insertion of endotracheal tube for the management of head injury	Clinically significant intracranial injury, defined as death as a result of head injury, requirement for neurosurgical intervention, or marked abnormality on CT (defined as any new, acute, traumatic intracranial pathology as reported by consultant radiologist, including intracranial haematomas of any size, cerebral contusion, diffuse cerebral oedema, and depressed skull fracture)
Secondary outcome	None	None	Brain injury on CT, defined as any acute intracranial finding revealed on CT that was attributable to acute injury, including closed depressed skull fracture (ie, depressed past the inner table) and pneumocephalus, but excluding non-depressed skull fractures and basilar skull fractures	Presence of skull fracture Admission to hospital

We have changed the order in which the variables are presented to facilitate comparison. PECARN=Pediatric Emergency Care Applied Research Network. CATCH=Canadian Assessment of Tomography for Childhood Head Injury. CHALICE=Children's Head Injury Algorithm for the Prediction of Important Clinical Events. ED=emergency department. GCS=Glasgow Coma Scale. LOC=loss of consciousness. MVC=motor vehicle crash. RTA=road traffic accident. CSF=cerebrospinal fluid. TBI=traumatic brain injury. *In each of the three clinical decision rules, the absence of all of the above predictor variables indicates that cranial CT scan is unnecessary. †High-risk predictors for CATCH (need for neurological intervention). ‡Hospital admission for TBI defined by admission for persistent neurological symptoms or signs such as persistent alteration in mental status, recurrent emesis due to head injury, persistent severe headache, or ongoing seizure management. §TBI on CT defined by any of the following descriptions: intracranial haemorrhage or contusion, cerebral oedema, traumatic infarction, diffuse axonal injury, shearing injury, sigmoid sinus thrombosis, midline shift of intracranial contents or signs of brain herniation, diastasis of the skull, pneumocephalus, or skull fracture depressed by at least the width of the table of the skull.

Table 1: **Inclusion and exclusion criteria, predictor variables, and outcome measures of PECARN, CATCH, and CHALICE clinical decision rules**[8,9,11]

- 対象
- 除外条件
- 受傷起点
- 病歴
- 検査所見
- Primary outcome
- Secondary outcome

PECARN(2歳未満)

GCS14
意識レベルの変容
頭蓋骨骨折蝕知

NO

後頭部・頭頂部・側頭部に皮下血種
5秒以上の意識消失
高エネルギー外傷
親が普段と違うと感じる

NO

CT推奨なし

一つでもYES

一つでもYES

頭部CT推奨

条件付きCT考慮

除外条件：受傷起点が転倒のみ・静止している物体にぶつかったなどごく軽症
GCS≦13の重症

PECARN(2歳以上)

GCS14
意識レベルの変容
頭蓋骨骨折徴候

NO

意識消失
嘔吐
高エネルギー外傷
激しい頭痛

NO

CT推奨なし

一つでもYES

頭部CT推奨

一つでもYES

条件付きCT考慮

除外条件：受傷起点が転倒のみ・静止している物体にぶつかったなどごく軽症
GCS≦13の重症

CATCH

対象症例：外傷～24時間で病院受診した0～16歳
診察時意識レベル13～15
かつ鈍的外傷・失見当識・2回以上の嘔吐・2歳以下の易刺激性の少なくとも1つを認める症例

高リスク群(脳神経外科的治療介入が必要であった群)
①外傷後2時間以上でもGCS＜15
②開放性or陥没骨折
③悪化する頭痛
④診察時に興奮状態

中リスク群
(CT上頭蓋内病変の検出率が高い群)
⑤頭蓋底骨折所見あり
⑥頭皮に大きな血種
⑦高エネルギー外傷

①～⑦に1項目でも該当すれば頭部CTを推奨

CHALICE 

対象：16歳未満
以下の13項目に該当しなければ頭蓋内病変の可能性は低い

病歴

①意識消失5分未満

②健忘5分未満

③傾眠傾向

④嘔吐3回以下

⑤虐待の疑い

⑥てんかん既往歴(-)症例のけいれん

身体所見

⑦GCS＜14(1歳未満は<15)

⑧解放骨折・陥没骨折疑いor大泉門膨隆

⑨頭蓋底骨折所見

⑩神経学的局所所見

⑪<1歳での5cmより大きな皮下血種、挫創

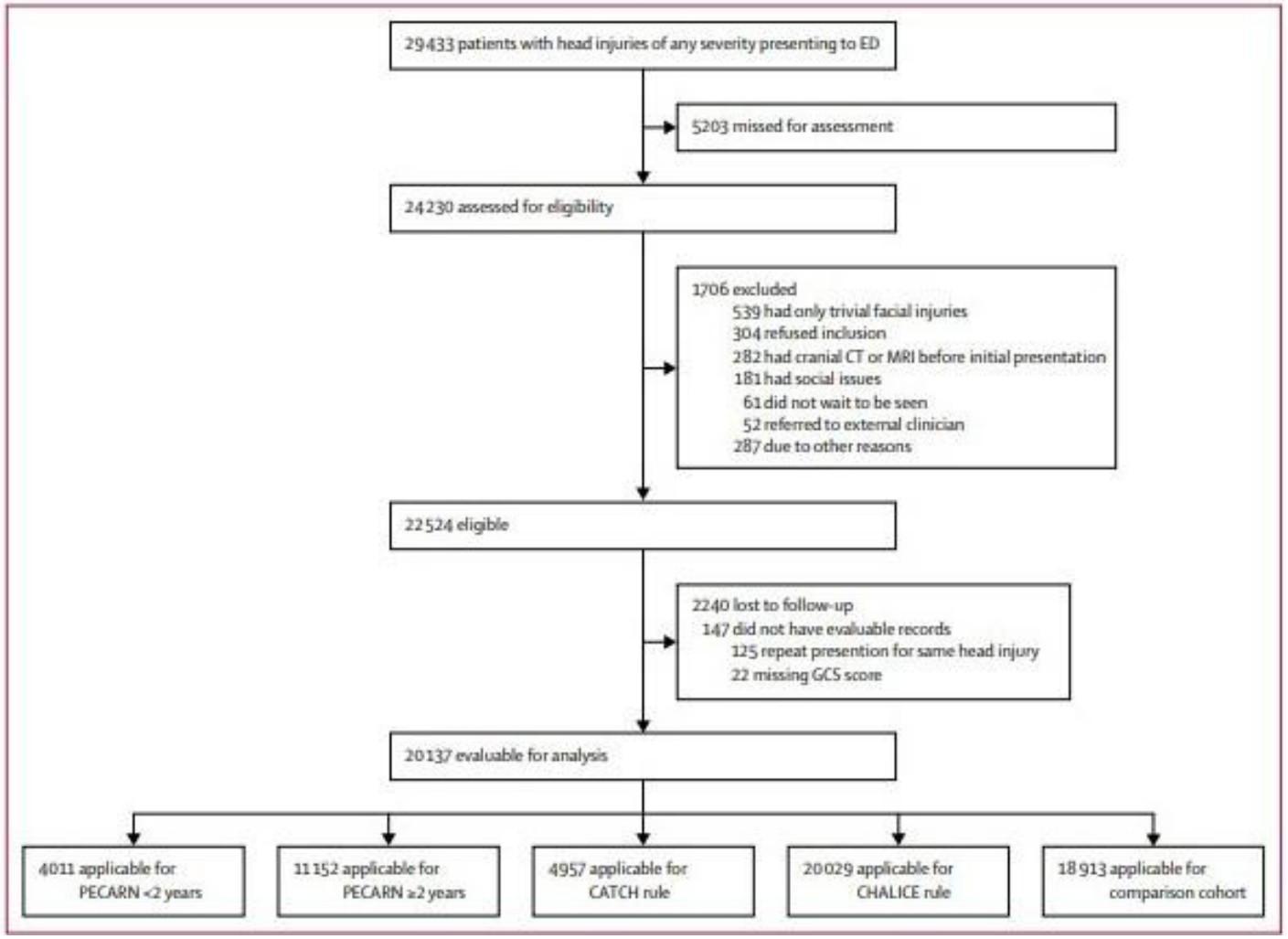
受傷機転

⑪64km/h以上での交通事故

⑫3m以上からの転落

⑬早く動く物体との衝突

症例



期間：2011.4～2014.11　(39か月間)
症例：20137例

PECARN(<2y.o.)適応	4011例
PECARN(≧2y.o.)適応	11152例
CATCH適応	4957例
CHALICE適応	20029例

症例

	Current study cohort (n=20 137)	PECARN cohort (n=42 412)	CATCH cohort (n=3866)	CHALICE cohort (n=22 772)
Demographic characteristics				
Mean age (years)	5·7 (4·7)	7·1 (5·5)	9·2 (NR)	5·7 (NR)
Patients <2 years	5374 (26·7%)	25·3%	7·2%	16·6%
Patients ≥2 years	14 763 (73·3%)	74·7%	92·8%	83·4%
Boys	12 828 (63·7%)	NR	65%	65%
Girls	7309 (36·3%)	NR	35%	35%
Clinician-assigned GCS score				
3–8	121 (0·6%)	..	..	NR
9–12	96 (0·5%)	..	..	NR
13	135 (0·7%)	..	2·5%	0·3%
14	578 (2·9%)	3·2%	7·3%	1·0%
15	19 207 (95·4%)	96·8%	90·2%	96·6%
Example symptoms and signs				
Known or suspected LOC	2707 (13·5%)	15·4%	32·8%*	5·2%*
History of amnesia	1688 (8·4%)†	NR	58·5%	3·2%
History of vomiting	3452 (17·1%)	13·2%	40·9%‡	21%
Headache	4127 (20·5%)†	46·1%†	NR	21%
Witnessed disorientation	2943 (14·6%)	NR	53·8%	NR
Mechanism of injury				
Fall-related	14 119 (70·1%)	44·2%	44·9%	NR
Motor vehicle incident	849 (4·2%)	8·8%	3·0%	NR
Head hit by high-impact object or projectile	1320 (6·6%)	NR	NR	2·0%
Suspected NAI	112 (0·6%)	NR	2·6%	0·3%
Outcomes				
Cranial CT	2106 (10·5%)	35·3%	52·8%	3·3%
Neurosurgery	83 (0·4%)	0·3%	0·6%	0·6%
Hospital admission	4544 (22·6%)§	14·0%	NR	NR
Death	15 (0·1%)¶	..	..	..
Clinically important TBI (PECARN)	280 (1·4%)	1·0%	NR	NR
Need for neurological intervention (CATCH)	185 (0·9%)	NR	0·6%	NR
Clinically significant intracranial injury (CHALICE)	403 (2·0%)	NR	NR	1·2%

Data are mean (SD) or n (%), unless otherwise stated. PECARN=Pediatric Emergency Care Applied Research Network. CATCH=Canadian Assessment of Tomography for Childhood Head Injury. CHALICE=Children's Head Injury Algorithm for the Prediction of Important Clinical Events. NR=not reported. GCS=Glasgow Coma Scale. LOC=loss of consciousness. NAI=non-accidental injury. TBI=traumatic brain injury. *Known LOC only. †Does not include pre-verbal children. ‡≥2 episodes. §Admission rates defined as admitted to inpatient ward, short-stay ward, or intensive care unit ¶Death due to head injury alone (n=13); due to multi-trauma with head injury (n=2).

Table 2: **Patient characteristics in current study, given alongside those from original PECARN, CATCH, and CHALICE validation studies**[8,9,11]

3つのルールごとの症例の特徴

ルールの適応基準は異なるが、
症例の特徴は、PECARN、CATCH、CHALICEの
いずれも症例全体の特徴と一致した

各ルールの精度

	PECARN		CATCH		CHALICE
	<2 years (n=4011)	≥2 years (n=11152)	All patients eligible within rule criteria (n=4957)	All patients eligible within rule criteria (n=4957)	All patients eligible within rule criteria (n=20029)
Predictors included	All	All	4 high-risk predictors	7 medium-risk and high-risk predictors	All
Outcome assessed*	Clinically important traumatic brain injury	Clinically important traumatic brain injury	Need for neurological intervention	Brain injury on CT	Clinically significant intracranial injury
Positive on criteria					
With outcome (n)	38	97	20	125	370
Without outcome (n)	1834	5987	779	2100	4303
Negative on criteria					
With outcome (n)	0	1	1	16	31
Without outcome (n)	2139	5067	4157	2716	15352
Sensitivity (95% CI)	100·0% (90·7–100·0)	99·0% (94·4–100·0)	95·2% (76·2–99·9)	88·7% (82·2–93·4)	92·3% (89·2–94·7)
Specificity (95% CI)	53·8% (52·3–55·4)	45·8% (44·9–46·8)	84·2% (83·2–85·2)	56·4% (55·0–57·8)	78·1% (77·5–78·7)
PPV (95% CI)	2·0% (1·4–2·8)	1·6% (1·3–1·9)	2·5% (1·5–3·8)	5·6% (4·7–6·7)	7·9% (7·2–8·7)
NPV (95% CI)	100·0% (99·8–100·0)	100·0% (99·9–100·0)	100·0% (99·9–100·0)	99·4% (99·1–99·7)	99·8% (99·7–99·9)

PECARN=Pediatric Emergency Care Applied Research Network. CATCH=Canadian Assessment of Tomography for Childhood Head Injury. CHALICE=Children's Head Injury Algorithm for the Prediction of Important Clinical Events. PPV=positive predictive value. NPV=negative predictive value. *See table 1 for detailed definitions.

Table 4: Diagnostic accuracy of PECARN, CATCH, and CHALICE clinical decision rules when analysed using rule-specific inclusion criteria, exclusion criteria, predictor variables, and outcome measures

各ルールの精度 1

	PECARN		CATCH		CHALICE
	<2y.o.	≧2y.o.	高リスク群	低リスク群	
感度	100	99.2	95.2	88.7	92.3
特異度	53.8	45.8	84.2	56.4	78.1
陽性的中率	2.0	1.6	2.5	5.6	7.9
陰性的中率	100	100	100	99.4	99.8
CT施行率	35.3		52.8		3.3
基準適応率	75	76	25		99

単位：%

各ルールの精度 2

	PECARN		CATCH	CHALICE
	<2 years (n=5046)	≥2 years (n=13 867)		
Clinically important traumatic brain injury*				
Positive on criteria				
With outcome (n)	42	117	147	148
Without outcome (n)	2047	6606	5560	4018
Negative on criteria				
With outcome (n)	0	1	13	12
Without outcome (n)	2957	7143	13193	14735
Sensitivity (95% CI)	100·0% (91·6–100·0)	99·2% (95·4–100·0)	91·9% (86·5–95·6)	92·5% (87·3–96·1)
Specificity (95% CI)	59·1% (57·7–60·5)	52·0% (51·1–52·8)	70·4% (69·7–71·0)	78·6% (78·0–79·2)
PPV (95% CI)	2·0% (1·5–2·7)	1·7% (1·4–2·1)	2·6% (2·2–3·0)	3·6% (3·0–4·2)
NPV (95% CI)	100·0% (99·9–100·0)	100·0% (99·9–100·0)	99·9% (99·8–99·9)	99·9% (99·9–100·0)
Traumatic brain injury on CT*				
Positive on criteria				
With outcome (n)	70	180	220	227
Without outcome (n)	2019	6543	5487	3939
Negative on criteria				
With outcome (n)	0	1	31	24
Without outcome (n)	2957	7143	13175	14723
Sensitivity (95% CI)	100·0% (94·9–100·0)	99·4% (97·0–100·0)	87·6% (82·9–91·5)	90·4% (86·1–93·8)
Specificity (95% CI)	59·4% (58·0–60·8)	52·2% (51·4–53·0)	70·6% (69·9–71·3)	78·9% (78·3–79·5)
PPV (95% CI)	3·4% (2·6–4·2)	2·7% (2·3–3·1)	3·9% (3·4–4·4)	5·4% (4·8–6·2)
NPV (95% CI)	100·0% (99·9–100·0)	100·0% (99·9–100·0)	99·8% (99·7–99·8)	99·8% (99·8–99·9)
Neurosurgery*				
Positive on criteria				
With outcome (n)	6	18	23	22
Without outcome (n)	2083	6705	5684	4144
Negative on criteria				
With outcome (n)	0	0	1	2
Without outcome (n)	2957	7144	13205	14745
Sensitivity (95% CI)	100·0% (54·1–100·0)	100·0% (81·5–100·0)	95·8% (78·9–99·9)	91·7% (73·0–99·0)
Specificity (95% CI)	58·7% (57·3–60·0)	51·6% (50·7–52·4)	69·9% (69·2–70·6)	78·1% (77·5–78·6)
PPV (95% CI)	0·3% (0·1–0·6)	0·3% (0·2–0·4)	0·4% (0·3–0·6)	0·5% (0·3–0·8)
NPV (95% CI)	100·0 (99·9–100·0)	100·0% (99·9–100·0)	100·0% (100·0–100·0)	100·0% (100·0–100·0)

PECARN=Pediatric Emergency Care Applied Research Network. CATCH=Canadian Assessment of Tomography for Childhood Head Injury. CHALICE=Children's Head Injury Algorithm for the Prediction of Important Clinical Events. PPV=positive predictive value. NPV=negative predictive value. *See table 1 for detailed definitions.

***Table 5*: Diagnostic accuracy of PECARN, CATCH, and CHALICE clinical decision rules in the comparative analysis of all patients with mild injury presenting within 24 h**

各ルールの精度 2

臨床的に重要なTBI

	PECARN		CATCH	CHALICE
	<2y.o.	≧2y.o.		
感度	100	99.2	91.9	92.5
特異度	59.1	52.0	70.4	78.6
陽性的中率	2.0	1.7	2.6	3.6
陰性的中率	100	100	99.9	99.9

TBI

	PECARN		CATCH	CHALICE
	<2y.o.	≧2y.o.		
感度	100	99.4	86.7	90.4
特異度	59.4	52.2	70.6	78.9
陽性的中率	3.4	2.7	3.9	5.4
陰性的中率	100	100	99.8	99.8

脳外科手術

	PECARN		CATCH	CHALICE
	<2y.o.	≧2y.o.		
感度	100	100	95.8	91.7
特異度	58.7	51.6	69.9	78.1
陽性的中率	0.3	0.3	0.4	0.5
陰性的中率	100	100	100	100

臨床的に重要なTBIへの感度
➡PECARNがNo.1

PECARN
・2歳未満の臨床的に重要なTBIの見逃しなし
・頭蓋底骨折で2日間の入院症例見逃し
➡臨床的に重要な所見はみられるが、
頭蓋底骨折には指標がなく弱い

CHALICE
・臨床的に重要なTBI12例を見逃し
（脳外科手術症例2例を含む）

特異度はCATCH、CHALICEが上回る

単位：%

各ルールの精度

	PECARN		CATCH		CHALICE
	<2 years (n=4011)	≥2 years (n=11152)	All patients eligible within rule criteria (n=4957)	All patients eligible within rule criteria (n=4957)	All patients eligible within rule criteria (n=20029)
Predictors included	All	All	4 high-risk predictors	7 medium-risk and high-risk predictors	All
Outcome assessed*	Clinically important traumatic brain injury	Clinically important traumatic brain injury	Need for neurological intervention	Brain injury on CT	Clinically significant intracranial injury
Positive on criteria					
With outcome (n)	38	97	20	125	370
Without outcome (n)	1834	5987	779	2100	4303
Negative on criteria					
With outcome (n)	0	1	1	16	31
Without outcome (n)	2139	5067	4157	2716	15352
Sensitivity (95% CI)	100·0% (90·7–100·0)	99·0% (94·4–100·0)	95·2% (76·2–99·9)	88·7% (82·2–93·4)	92·3% (89·2–94·7)
Specificity (95% CI)	53·8% (52·3–55·4)	45·8% (44·9–46·8)	84·2% (83·2–85·2)	56·4% (55·0–57·8)	78·1% (77·5–
PPV (95% CI)	2·0% (1·4–2·8)	1·6% (1·3–1·9)	2·5% (1·5–3·8)	5·6% (4·7–6·7)	7·9% (7·2–8
NPV (95% CI)	100·0% (99·8–100·0)	100·0% (99·9–100·0)	100·0% (99·9–100·0)	99·4% (99·1–99·7)	99·8% (99·7–

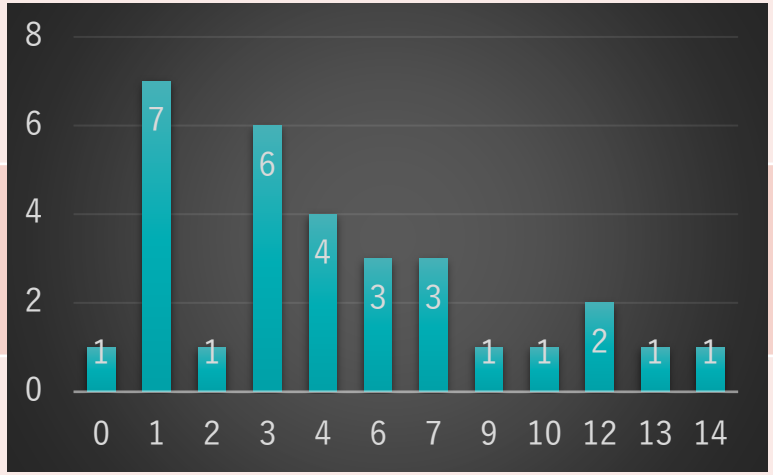
PECARN=Pediatric Emergency Care Applied Research Network. CATCH=Canadian Assessment of Tomography for Childhood Head Injury. CHALICE=Children's Head Inj
Algorithm for the Prediction of Important Clinical Events. PPV=positive predictive value. NPV=negative predictive value. *See table 1 for detailed definitions.

Table 4: **Diagnostic accuracy of PECARN, CATCH, and CHALICE clinical decision rules when analysed using rule-specific inclusion criteria, exclusion criteria, predictor variables, and outcome measures**

ルール上CT不要の判断となるも
臨床上重要なTBIを認めた症例

各ルールでpick upできない症例の特徴

	Pick upされなかった症例	特徴
PECARN(<2y.o.)	0	
PECARN(≧2y.o.)	1	年齢　　：15歳 受傷機転：暴行 外傷　　：脳出血
CATCH	1	年齢　　：6歳 受傷機転：落下物にぶつかる 外傷　　：脳出血
CHALICE	31	年齢　　： 受傷機転：3m以下からの落下、転倒が目立つ 外傷　　：脳出血　20例 骨折　　10例 脳浮腫　　1例



Take home message

こどもは成人より放射線感受性が高く、CT撮像など被曝を伴う検査は慎重に検討する必要がある

PECARNのルールが感度が高く本邦に適している