OAKLEY ED (Orcid ID: 0000-0002-3712-6200)
Furyk Jeremy (Orcid ID: 0000-0002-9503-0928)
Cheek John (Orcid ID: 0000-0002-3615-3821)
Babl Franz (Orcid ID: 0000-0002-1107-2187)
Phillips Natalie (Orcid ID: 0000-0002-7616-5712)

Imaging and Admission Practices in Paediatric Head Injury across Emergency Departments in Australia and New Zealand: A PREDICT study

Natalie Phillips MBBS [a,b], Stuart R. Dalziel[c,d], PhD, Meredith L. Borland [e,f], MBBS, Sarah Dalton[g], BMed, Mark D Lyttle[h,i,j], MBChB, Silvia Bressan[h,k], PhD, Ed Oakley[h,l,m], MBBS, Stephen JC Hearps[h], MBiostat, Amit Kochar[n] MD, Jeremy Furyk[o] MBBS, John A. Cheek[h,l] MBBS, Yuri Gilhotra [a,b] MBBS, Jocelyn Neutze[p], Franz E. Babl[h,l,m], MD, on behalf of the Paediatric Research in Emergency Department International Collaborative (PREDICT) group*

Affiliations:

[a] Queensland Children's Hospital, Brisbane, Queensland, Australia

[b]Child Health Research Centre, School of Medicine, The University of Queensland, Queensland, Australia

[c]Starship Children's Health, Auckland, New Zealand

[d]Liggins Institute, University of Auckland, Auckland, New Zealand

[e]Perth Children's Hospital, Perth, Western Australia, Australia

[f]Divisions of Paediatrics and Emergency Medicine, School of Medicine, University of Western Australia, Western Australia, Australia

[g] The Children's Hospital at Westmead, Sydney, New South Wales, Australia

[h]Murdoch Children's Research Institute, Melbourne, Victoria, Australia

[i]Bristol Royal Hospital for Children, Bristol, United Kingdom

[j]Academic Department of Emergency Care, University of the West of England, Bristol, United Kingdom

[k]Department of Women's and Children's Health, University of Padova, Padova, Italy

[l]Royal Children's Hospital, Melbourne, Victoria, Australia

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/1742-6723.13396

[m]Department of Paediatrics, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne, Melbourne, Victoria, Australia

[n]Women's & Children's Hospital, Adelaide, South Australia, Australia

[o]The Townsville Hospital, Townsville, Queensland, Australia

[p] KidzFirst Middlemore Hospital, Auckland New Zealand

Author Contributions:

NP conceptualised and contributed to the data collection for the original study, conceptualised this study, interpreted the data for this study and drafted the initial manuscript and revised the manuscript.

FB conceptualised and devised the data collection tools, contributed to collection, coordinated and supervised data collection for the original study and reviewed and revised the manuscript for this study

SRD, MB, SD, ML, SB, EO, AK, JF, JC,YG, JN conceptualised and contributed to the data collection for the original study. They reviewed and revised the manuscript for this study.

SH performed the statistical analysis for this study and reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Short Title: ED Management Variation in Paediatric Head Injury

Address at which work was carried out:

Royal Children's Hospital, 50 Flemington Rd, Parkville, VIC, 3052, Australia.

Monash Medical Centre, 246 Clayton Rd, Clayton, VIC, 3186, Australia.

Princess Margaret Hospital for Children, Roberts Rd, Subiaco, Perth, WA, 6008, Australia.

Royal Children's Hospital, Herston Rd, Herston, QLD, 4029, Australia.

Mater Children's Hospital, Stanley Street, South Brisbane, 4101, Australia

The Townsville Hospital, 100 Angus Smith Dr, Douglas, QLD, 4814, Australia.

Women's & Children's Hospital, 72 King William St, North Adelaide, SA, 5006, Australia.

The Children's Hospital at Westmead, 212 Hawkesbury Rd, Westmead, NSW, 2145, Australia.

Starship Children's Health, 2 Park Rd, Grafton, Auckland, 1023, New Zealand.

Kidzfirst Middlemore Hospital, 100 Hospital Rd, Auckland, 2025, New Zealand.

Address correspondence to:

Natalie Phillips

Senior Staff Specialist, Emergency, Queensland Children's Hospital, Stanley St, South Brisbane, 4101.

Phone +61 7 3068 1111

Email: natalie.phillips@health.qld.gov.au

Word Count: 2494

Clinical Trial Registration: Registered with the Australian New Zealand Clinical Trials Registry (ANZCTR)

ACTRN12614000463673

http://www.anzctr.org.au/TrialSearch.aspx?searchTxt=ACTRN12614000463673&isBasic=True

TITLE: Imaging and Admission Practices in Paediatric Head Injury across Emergency Departments in Australia and New Zealand: A PREDICT study

ABSTRACT (Words 245)

Introduction

Variation in the management of paediatric head injury has been identified worldwide. This prospective study describes imaging and admission practices of children presenting with head injury across 10 hospital emergency departments (ED) in Australia and New Zealand.

Methods

Prospective observational multicentre study of 20,137 children (under 18 years). All presentations with head injury without prior imaging were eligible for inclusion. Variations in rates of computed tomography of the brain (CTB) and admission practices between sites, ED type and country were investigated, as were clinically important traumatic brain injuries (ciTBI) and abnormal CTBs within CTBs.

Results

Among the 20,137 enrolled patients, the site adjusted CTB rate was 11.2% (95%CI 7.8-14.6); individual sites ranged from 2.6% to 18.6%. Clinically important traumatic brain injury (ciTBI) was found in 0.4% to 2.2%, with abnormal scans documented in 0.7% to 6.5%.

As a percentage of CTBs undertaken, ciTBIs were found in 12.8% (95%CI 10.8-14.7) with individual site variation of 8.8-16.9%, and no statistically significant difference noted, and traumatic abnormalities in 29.3% (95%CI 26.2-32.3) with individual site variation between 19.4 and 35.6%.

Among those under 2 years, traumatic abnormalities were found in greater than 50% of CTBs at 90% of sites.

Admission rate overall was 24.0% (site adjusted) with wide variation between sites (5.0% to 48.9%).

Conclusion

Across the ten, largely tertiary EDs included in this study, the overall CTB rate was low with no significant variation between sites when adjusted for ciTBIs.

KEY WORDS (MESH): CHILD; CRANIOCEREBRAL TRAUMA; EMERGENCY SERVICE, HOSPITAL; TOMOGRAPHY, X-RAY COMPUTED

INTRODUCTION

Head injury is a common reason children present to the Emergency Department (ED). Although most injuries are minor, traumatic brain injury (TBI) remains a significant cause of morbidity and mortality worldwide. Computed tomography scan of the brain (CTB) is the investigation of choice for detecting injuries in the acute setting but carries significant risks and costs. These include radiation exposure and increased lifetime cancer risk,[1-3]sedation risk in the unco-operative or young child[4] and resource costs.[5] The difficulty for the clinician rests in deciding which children should receive imaging and in whom it can be safely avoided. Clinical decision rules (CDRs) have been developed to guide this decision.[6-8] Observation is also increasingly being recognised as an alternate management strategy in some children. [6,9,10]

Variation in management practices in paediatric head injury, in particular, the use of neuroimaging, but also of observation and admission, have been described worldwide.[6,11] These differences often persist within countries and regions, and may vary according to hospital type and individual clinician training background.[11-14] Australian and New Zealand clinical data indicate a lower rate of CTB use than in North America,[6,8,12-15] however, it is unclear if there is variation of care between hospitals especially when controlling for head injury severity. Recognising and understanding variation in care may allow opportunities to reduce unwarranted variation and standardize management.

We undertook a prospective observational study[15,16] to compare three high quality CDRs (PECARN–Paediatric Emergency Care Applied Research Network, CHALICE-Children's Head Injury Algorithm for the prediction of Important Clinical Events, CATCH–Canadian Assessment of Tomography for Childhood Head Injury) which guide the use of CTB in paediatric head injuries.[6-8] In a planned secondary analysis, we examined variation in the management of paediatric head injury presentations across ten emergency departments (EDs) in Australia and New Zealand. In particular, we set out to assess site differences in neuroimaging rates and correlated this with injury severity, as defined by the presence of clinically important brain injury (ciTBI) and abnormality on CTB.

METHODS

Study design, setting and patients

This was a planned secondary analysis of the Australasian Paediatric Head Injury Rule Study (APHIRST) of children younger than 18 years with head injury presenting between April 2011 and June 2014 to 10 EDs in Australia and New Zealand[15,16]associated with the Paediatric Research in Emergency Department International Collaborative (PREDICT) research network.[17] A detailed protocol has been published.[16]

All published CDR-specific predictor and outcome variables were collected. Patients were enrolled by the treating ED clinician, who recorded predictive clinical data prior to neuroimaging. ED and hospital management data were collected after the ED visit, and telephone follow up conducted for patients who had not received neuroimaging. Senior radiologist reports at the local sites were used to extract CTB findings.

Participating hospitals included seven paediatric tertiary and three large mixed EDs. Hospital sites were considered independently, and according to both type (mixed versus paediatric only EDs) and country (Australia, New Zealand). All sites had 24-hour access to imaging; in six this was provided by an off-site on-call radiographer at certain times of day (from 1700 in most affected sites). Nine sites had the capacity to perform acute paediatric neurosurgical intervention and all sites could observe children, albeit in different locations (ED, short stay, inpatient unit). Eight hospitals were the designated paediatric trauma centres for their region.

In this analysis, we assessed variation between participating hospitals in severity of injury presentations and management practices. The former included the presence of clinically important traumatic brain injury (ciTBI),[6] any traumatic head injury on CT (abnormal CTB) and need for neurosurgical intervention. The latter included CTB rates and admission/observation practices. Location and "admission descriptors" were highly variable between sites. Admission was as defined by local hospital practice. To allow comparison between sites and as a proxy for observation, we assessed the percentage of presentations with a length of stay (LOS) ≥4hours from time of arrival and median LOS. Differences in age and sex of presenting populations were explored. Children under 2 years of age were considered as a separate subgroup given previously reported differences in the

management of younger children across sites. [11,14] CTB rates were also considered in the context of injury severity, as defined by the presence of ciTBI and abnormal CTBs, to account for possible site differences in the prevalence of more severe injuries.

Definitions

ciTBI: death from TBI, neurosurgery, endotracheal intubation for more than 24 hours for TBI or hospital admission of 2 nights or longer associated with an abnormal CTB.[6]

Abnormal CTB: any traumatic abnormality on CTB including all skull fractures and intracranial injuries (but excluding scalp haematoma).

Neurosurgical intervention: intracranial pressure monitoring, elevation of depressed skull fracture, ventriculostomy, haematoma evacuation, lobectomy, tissue debridement or dura repair.

Ethics and trial registration

The institutional ethics committees at each site approved the study. We obtained informed verbal consent from parents/guardians, apart from instances of significant life-threatening or fatal injuries, where a waiver of consent was granted.

The trial protocol[16] was registered with the Australian New Zealand Clinical Trials Registry, ACTRN12614000463673.

Statistical analysis

Data were entered into Epidata(Odense, Denmark) and later REDCap(Research Electronic Data Capture),[18] and analysed using Stata 15(Statacorp, Texas, USA). Descriptive statistics were calculated for key variables with 95% confidence intervals (CI) where relevant. Comparison categorical variables between individual sites, ED type and country, were carried out using chi-square tests (or Fisher's exact where expected cell counts were <5). Group age means were compared using an analysis of variance (ANOVA) model, and median age and LOS

using a Kruskal Wallis test. Site-adjusted totals were also calculated using generalised estimating equation (GEE) models, and presented with 95%CI. The level of significance was set at 0.05.

RESULTS

Individual Sites

A total of 20,137 children were included for analysis; 63.7% were male and median age spanned 3.6 to 4.8 years across sites. Two sites accounted for 48% of participants. Site enrolment rates of eligible patients ranged from 63% to 94%.

Variation between sites in injury severity, imaging and admission rates are summarized in **Table 1**. Across all patients enrolled, 10.5% received CTBs, with individual sites ranging between 2.6% and 18.6%. When adjusted for the site, CTB rate was 11.2% (95%CI 7.8-14.6). Less than 1% required neurosurgery at all sites and ciTBIs were found in 0.4% to 2.2%. Among the cohort receiving a CTB, the site-adjusted ciTBI incidence was 12.8% (95%CI 10.8-14.7); site rates varied between 8.8% (95%CI 4.4-13.1) and 16.9% (95%CI 13.9-19.9), with no statistically significant difference noted between sites. Abnormal CTBs were documented in 0.7% to 6.5% of all participants at each site. Among children receiving a CTB, these traumatic abnormalities were reported in 29.3% (95%CI 26.2-32.3, site-adjusted), with individual site variation between 19.4% (95%CI 13.2-25.5) and 35.6% (95%CI 26.3-45) (p 0.02).

Admission rates were highly variable between sites, ranging from 5.0% to 48.9%. Admission locality also differed. The percentage with LOS≥4hours ranged from 13% to 39%, although median LOS varied more narrowly at between 1.8 (95%CI 1.2-3) and 3.2hours (95%CI 1.8-6.6) **(Table 1).** There was no consistent relationship between LOS≥4hours and CTB rates across sites, although a general trend to LOS≥4hours with higher CTB rates may exist (**Figure 1**).

Children under 2 years of age

Children under 2 years accounted for 22.6% to 31.4% of all participants across sites **(Table 1).**

The CTB rate in the under twos was lower than in the "all ages" cohort at all sites, although the percentage of ciTBI detected was similar. As a result, the percentage of CTBs with a ciTBI was higher in this age group at every hospital. The percentage of CTBs showing a traumatic abnormality (abnormal CT) was also higher; 9 sites had rates of greater than 50%. At 8 sites, the admission rate and LOS≥4hours were at least as low, if not lower, in the under two years group when compared to the all ages group. There were no differences between sites in ciTBI or neurosurgical rate although overall numbers were low.

Mixed vs Paediatric only EDs

Sixteen percent of children enrolled were seen in mixed EDs. The overall CTB rate was lower in mixed EDs (8.6% vs 10.8%), as was the number of abnormal scans as a percentage of all children seen **(Table 2).** These differences resolved when CTB rate was adjusted for injury rates (percentage of abnormal CTBs, CTBs with ciTBI). There was a trend to a lower incidence of ciTBI and neurosurgery (not statistically significant) in mixed EDs. Children in these hospitals were less likely to have a LOS≥4hours (19.8% vs 27.2%). No neurosurgery was performed in children under 2 years presenting to mixed EDs.

Australia-New Zealand Differences

The CTB rate was significantly higher at New Zealand sites compared to Australian sites (13.8% vs 10.0%) although the ciTBI, neurosurgical rate, and abnormal scan rate (as a percentage of all CTB) were not. Admission rates were lower at New Zealand sites and the percentage with a LOS≥4hours higher **(Table 3).**

DISCUSSION

While variation between hospitals, type of ED and country exist, the CTB rate at all sites was less than 20%, with an overall site adjusted rate of 11.2%. Overall imaging rates described in this prospective study are similar to rates described in an earlier retrospective Australasian PREDICT study between 2001 and 2010, suggesting little change over time.[13] Australasian CTB rates are considerably lower and less variable than the paediatric CTB rates described in many other settings; in two large North American cohorts scanning rates across EDs varied between 19 and 58% (overall rate 36%)[19] and 19.2 and 69.2% (35.3%)[12] respectively. This latter PECARN study[12] found interhospital variation in the number of CTBs per ciTBI varied between 14.5 and 111.7; in our cohort this ranged from 5.9 to 11.4. An earlier retrospective Canadian study[20] showed CTB rates of 6-26% (15% overall). Lower rates have been described in other countries although limited published data are available on interhospital variation.[7,21-24] Results from the APHIRST study[15,25] demonstrate that clinicians at our centres are missing very few significant injuries, suggesting that the imaging rate is not inappropriately low. Imaging rates were also considerably lower than theoretical imaging rates would be if each of the clinical decision rules (CDRS) examined in APHIRST were applied strictly as a rule[15], highlighting the importance of considering CDRs as a tool, rather than a rule per se.

While there were differences in CTB rates between sites in our setting, there were no significant differences in the percentage of CTBs associated with clinically important injuries (ciTBI). This finding differs from several other studies where either no association was found between rate of injury and CTB use or imaging variation persisted even after accounting for injury prevalance.[12,19,20] Physician background and training was not collected as part of this study but has been associated with differential scanning rates in other studies.[12,14] Furthermore, while access to, and clinician comfort with, admission or observation in Australia and New Zealand as an alternative to immediate CTB may explain differences between our rates and those noted internationally, there was no consistent relationship between LOS≥4hours and CTB rates across sites. Some sites which scanned fewer children also admitted less; at others, the inverse relationship applied.

Findings in the under two years old group bear some consideration. In our cohort, this group had a lower rate of CTB use and a lower admission rate. Lower scan rates have been noted elsewhere,[11,19] although this has not been universally reported.[14]The lower scan rate in this group may be driven by concerns about the age related lifetime cancer risks with radiation exposure.[1-3] Interestingly, the admission rate and LOS≥4hours in the under 2 years group was at least as low as in the all ages group in most hospitals. This may indicate that this group contains either a more dichotomized population than the all ages group with some very low risk infants (low mechanism, few/no symptoms) such as those that present for caregiver reassurance, or simply that there is a more conservative approach to scanning among clinicians given known radiation and sedation risks. Young children may also simply complain less of certain head injury related symptoms that earn older children a scan or admission. While no missed injuries were reported in this age group,[15]over 50% of CTBs showed trauma related abnormalities at 90 % of sites in this study. This rate is high, raising the possibility that not all abnormalities are being detected with current low CTB rates.

When considered as a group, mixed EDs had both lower scan and admission/LOS≥4hours rates than paediatric specific EDs. This difference in CTB rates resolves when the rate of abnormal scans is used for comparison, suggesting a possible population/injury severity related difference, rather than true practice variation. Internationally published studies have found both higher rates of CTB use in non-free standing paediatric hospitals and suburban hospitals(USA)[12] and lower rates(UK).[11] Significant regional variation was also described in the UK. It must be noted that the number of mixed EDs in our study was small, and all are large metropolitan hospitals with a strong paediatric focus. As variation in practice may represent opportunities for health care improvement, it will be important to investigate head injury management practice across a wider range of hospitals to assess whether findings here are generalizable to the broader Australasian context. Recognising and understanding any such variation would be an integral step in the development of national guideline that would meet the needs of hospitals across Australia and New Zealand, irrespective of size or location.

Limitations

This study has several limitations. Missed enrolment rate varied (1-34%) across sites; this may affect result validity. Similarly, two sites accounted for nearly half of enrolled patients. Certain parameters and groupings have relatively low numbers and thus a difference may not be detected where it actually exists. Differences in presenting population and injury severity have been approximated using gross parameters such as sex, age, ciTBI and abnormal CTB rates; more complex factors such as social demographics (e.g.non-accidental injury prevalence, high risk adolescent activities) and the frequency of different known predictors of intracranial injury may have influenced site specific practices. Similarly, factors identified in other studies, such as physician training background were not assessed. Imaging practices may have been influenced by the CDR predictor variables collected as part of the parent study. However, among PREDICT site clinicians no CDR was widely used prior to the APHIRST study[26] and CTB rates were stable over a 10 year period beginning prior to CDR publication.[13,25] Admission practices, particularly for the purpose of observation, were also difficult to accurately identify. The most pragmatic measures (LOS≥4hours, median LOS) have been used to allow comparison, but these do not adjust for time to be seen by clinicians, and in particular, review by senior clinical decision makers. Finally, as previously discussed, the findings in this study may have limited generalizability to other centres in Australia and New Zealand.

CONCLUSION

While some variation in the management of paediatric head injury exists between the sites studied, overall imaging rates were low, and observation and admission is a widely used management strategy. The study sites were predominately tertiary centres; investigation of imaging and admission practices at non tertiary EDs of varied locality and type is required to ascertain if findings reflect broader ED practice across Australia and New Zealand.

Acknowledgements: We thank the participating families and emergency department staff at participating sites. We thank research staff from the following sites: Kaya Gardiner, Nicola Williams, Elle Goss, Triona Stephens, Marta Arpone, and Joseph Mabuti (The Royal Children's Hospital, Melbourne, VIC, Australia); Sharon O'Brien, Timothy Loy, Jeremy Rogers, Samantha Oosterhof, and Verity Watt (Princess Margaret Hospital, Perth, WA, Australia); Susan Montgomery (The Townsville Hospital, Townsville, QLD, Australia); Rebecca Saul, Meegan Price, Petrina Hetherington, Emily Casey, Mary Lang, Jane O'Shea, Anne Cook, Kerrie-Ann Abel, and Bronwyn Griffin (The Royal Children's Hospital, Brisbane, QLD, Australia); Tamara Brunton (Monash Medical Centre, Melbourne, VIC, Australia); Shirley Lawrence (Kidzfirst Children's Hospital, Middlemore, Auckland, New Zealand); Megan Bonisch (Starship Children's Hospital, Auckland, New Zealand); Carey Alymer and Simone Green (Women's and Children's Hospital Adelaide, SA, Australia); Laura Phillips and Elizabeth Moss (Children's Hospital Westmead, Sydney, NSW, Australia); and Meg Jepperson (Mater Children's Hospital, Brisbane, QLD, Australia).

Funding Source: The study was funded by grants from the National Health and Medical Research Council (project grant GNT1046727, Centre of Research Excellence for Paediatric Emergency Medicine GNT1058560), Canberra, Australia; the Murdoch Children's Research Institute, Melbourne, Australia; the Emergency Medicine Foundation (EMPJ-11162), Brisbane, Australia; Perpetual Philanthropic Services (2012/1140), Australia; Auckland Medical Research Foundation (No. 3112011) and the A + Trust (Auckland District Health Board), Auckland, New Zealand; WA Health Targeted Research Funds 2013, Perth, Australia; the Townsville Hospital and Health Service Private Practice Research and Education Trust Fund, Townsville, Australia; and supported by the Victorian Government's Infrastructure Support Program, Melbourne, Australia. FEB's time was part funded by a grant from the Royal Children's Hospital Foundation and the Melbourne Campus Clinician Scientist Fellowship, Melbourne, Australia and an NHMRC Practitioner Fellowship, Canberra, Australia. SRD's time was part funded by the Health Research Council of New Zealand (HRC13/556).

Financial Disclosure: No authors have a financial relationship to this article to disclose

Conflict of Interest: No authors have conflicts of interest to disclose

References

1. Miglioretti DL, Johnson E, Williams A, Greenlee RT, Weinmann S, Solberg LI, et al. The use of computed tomography in pediatrics and the associated radiation exposure and estimated cancer risk. JAMA pediatrics. 2013;167(8):700-7.
2. Pearce MS, Salotti JA, Little MP, McHugh K, Lee C, Kim KP, et al. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study. Lancet. 2012;380(9840):499-505.
3. Mathews JD, Forsythe AV, Brady Z, Butler MW, Goergen SK, Byrnes GB, et al. Cancer risk in 680,000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. BMJ. 2013;346:f2360.
4. Goldwasser T, Bressan S, Oakley E, Arpone M, Babl FE. Use of sedation in children receiving computed tomography after head injuries. European journal of emergency medicine : official journal of the European Society for Emergency Medicine. 2015;22(6):413-8.
5. Dalziel K, Cheek JA, Fanning L, Borland ML, Phillips N, Kochar A, et al. A Cost-Effectiveness Analysis Comparing Clinical Decision Rules PECARN, CATCH, and CHALICE With Usual Care for the Management of Pediatric Head Injury. Ann Emerg Med. 2018.
6. Kuppermann N, Holmes JF, Dayan PS, Hoyle JD, Jr., Atabaki SM, Holubkov R, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. Lancet. 2009;374(9696):1160-70.
7. Dunning J, Daly JP, Lomas JP, Lecky F, Batchelor J, Mackway-Jones K, et al. Derivation of the children's head injury algorithm for the prediction of important clinical events decision rule for head injury in children. Arch Dis Child. 2006;91(11):885-91.
8. Osmond MH, Klassen TP, Wells GA, Correll R, Jarvis A, Joubert G, et al. CATCH: a clinical decision rule for the use of computed tomography in children with minor head injury. CMAJ. 2010;182(4):341-8.
9. Nigrovic LE, Schunk JE, Foerster A, Cooper A, Miskin M, Atabaki SM, et al. The effect of observation on cranial computed tomography utilization for children after blunt head trauma. Pediatrics. 2011;127(6):1067-73.
10. National Clinical Guideline C. National Institute for Health and Clinical Excellence: Guidance. Head Injury: Triage, Assessment, Investigation and Early Management of Head Injury in Children, Young People and Adults. London: National Institute for Health and Care Excellence (UK)

Copyright (c) National Clinical Guideline Centre, 2014.; 2014.
11. Kemp A, Nickerson E, Trefan L, Houston R, Hyde P, Pearson G, et al. Selecting children for head CT following head injury. Arch Dis Child. 2016;101(10):929-34.
12. Stanley RM, Hoyle JD, Jr., Dayan PS, Atabaki S, Lee L, Lillis K, et al. Emergency department practice variation in computed tomography use for children with minor blunt head trauma. J Pediatr. 2014;165(6):1201-6 e2.
13. Oakley E, May R, Hoeppner T, Sinn K, Furyk J, Craig S, et al. Computed tomography for head injuries in children: Change in Australian usage rates over time. Emerg Med Australas. 2017;29(2):192-7.

14. Miescier MJ, Dudley NC, Kadish HA, Mundorff MB, Corneli HM. Variation in Computed Tomography Use for Evaluation of Head Injury in a Pediatric Emergency Department. Pediatr Emerg Care. 2017;33(3):156-60.
15. Babl FE, Borland ML, Phillips N, Kochar A, Dalton S, McCaskill M, et al. Accuracy of PECARN, CATCH, and CHALICE head injury decision rules in children: a prospective cohort study. Lancet. 2017;389(10087):2393-402.
16. Babl FE, Lyttle MD, Bressan S, Borland M, Phillips N, Kochar A, et al. A prospective observational study to assess the diagnostic accuracy of clinical decision rules for children presenting to emergency departments after head injuries (protocol): the Australasian Paediatric Head Injury Rules Study (APHIRST). BMC Pediatr. 2014;14:148.
17. Babl F, Borland M, Ngo P, Acworth J, Krieser D, Pandit S, et al. Paediatric Research in Emergency Departments International Collaborative (PREDICT): first steps towards the development of an Australian and New Zealand research network. Emerg Med Australas. 2006;18(2):143-7.
18. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. Journal of biomedical informatics. 2009;42(2):377-81.
19. Mannix R, Meehan WP, Monuteaux MC, Bachur RG. Computed tomography for minor head injury: variation and trends in major United States pediatric emergency departments. J Pediatr. 2012;160(1):136-9 e1.
20. Klassen TP, Reed MH, Stiell IG, Nijssen-Jordan C, Tenenbein M, Joubert G, et al. Variation in utilization of computed tomography scanning for the investigation of minor head trauma in children: a Canadian experience. Acad Emerg Med. 2000;7(7):739-44.
21. Bressan S, Romanato S, Mion T, Zanconato S, Da Dalt L. Implementation of adapted PECARN decision rule for children with minor head injury in the pediatric emergency department. Acad Emerg Med. 2012;19(7):801-7.
22. Elliot RR, Sola Gutierrez Y, Harrison R, Richards R, Cannon B, Witham F. Cautious observation or blanket scanning? An investigation into paediatric attendances to an emergency department after head injury. Injury. 2011;42(9):896-9.
23. Ghosh R, Docherty E, Schickerling S, Heinz P, Campbell-Hewson G, Boyle A. Application of the 2007 NICE guidelines in the management of paediatric minor head injuries in a UK emergency department. Emerg Med J. 2012;29(3):197-200.
24. Lorton F, Poullaouec C, Legallais E, Simon-Pimmel J, Chene MA, Leroy H, et al. Validation of the PECARN clinical decision rule for children with minor head trauma: a French multicenter prospective study. Scandinavian journal of trauma, resuscitation and emergency medicine. 2016;24:98.
25. Babl FE, Oakley E, Dalziel SR, Borland ML, Phillips N, Kochar A, et al. Accuracy of Clinician Practice Compared With Three Head Injury Decision Rules in Children: A Prospective Cohort Study. Ann Emerg Med. 2018.
26. Lockie FD, Dalton S, Oakley E, Babl FE. Triggers for head computed tomography following paediatric head injury: Comparison of physicians' reported practice and clinical decision rules. Emerg Med Australas. 2013;25(1):75-82.

x

Table 1: see attachment Landscaped page

Figure 1: see attachment

Table 2 Comparison of Imaging and Management Practices between Mixed and Paediatric only Sites

CTB- CT Brain; ciTBI - clinically important brain injury; LOS - length of stay; SSU - short stay unit; ICU - intensive care, HI - head injury: IQR - interquartile range; SD - standard deviation

Hospital Type	Mixed			Paediatric Only		
	n	%	(95%CI)	n	%	(95%CI)
Number	3193			16944		
Sex [male]	2069	64.9	(63.2-66.5)	10754	63.5	(62.8-64.2)
Age						
Range			(0.0-18.0)			(0.0-18.0)
Mean (SD)		6.1	(4.9)		5.7	(4.6)
Median (IQR)		4.5	(2.0-9.8)		4.1	(1.9-8.9)
<2years	788	24.7	(23.2-26.2)	4586	27.1	(26.4-27.7)
CTB	274	8.6	(7.6-9.6)	1832	10.8	(10.3-11.3)
ciTBI (of total)	33	1.0	(0.7-1.4)	247	1.5	(1.3-1.6)
ciTBI (of CTBs)	33	12.0	(8.2-15.9)	247	13.5	(11.9-15.0)
Abnormal CTB (of total)	72	2.3	(1.7-2.8)	554	3.3	(3.0-3.5)
Abnormal CTB (of CTBs)	72	26.3	(21.1-31.5)	554	30.2	(28.1-32.3)
Neurosurgery	7	0.2	(0.1-0.4)	76	0.4	(0.3-0.6)
Any admission for HI	569	17.8	(16.5-19.1)	3975	23.5	(22.8-24.1)
Admitted to SSU	448	79.9	(76.5-83.2)	2718	68.7	(67.3-70.2)
Admitted to ward	109	19.4	(16.1-22.7)	1224	30.9	(29.5-32.4)
Admitted to ICU	17	3.0	(1.6-4.5)	164	4.1	(3.5-4.8)
Median LOS (IQR)		2.25	(1.3-3.6)		2.47	(1.4-4.3)
LOS ≥4h	630	19.8	(18.4-21.1)	4600	27.2	(26.6-27.9)
Admitted ≥ 2 days, 2 nights	67	2.1	(1.6-2.6)	548	3.2	(3.0-3.5)

Table 3 Comparison of Imaging and Management Practices between Australia and New Zealand

CTB- CT Brain; ciTBI - clinically important brain injury; LOS - length of stay; SSU - short stay unit; ICU - intensive care, HI - head injury: IQR - interquartile range; SD - standard deviation

Country	New Zealand			Australia		
	n	%	(95%CI)	n	%	(95%CI)
Number	2296			17841		
Sex [male]	1462	63.7	(61.7-65.6)	11361	63.7	(63.0-64.4)
Age						
Range			(0.0-15.7)			(0.0-18.0)
Mean (SD)		5.8	(4.4)		5.7	(4.7)
Median (IQR)		4.5	(2.0-9.2)		4.1	(1.9-9.0)
<2y	577	25.1	(23.4-26.9)	4797	26.9	(26.2-27.5)
CTB	317	13.8	(12.4-15.2)	1789	10.0	(9.6-10.5)
ciTBI (of total)	38	1.7	(1.1-2.2)	242	1.4	(1.2-1.5)
ciTBI (of CT scans)	38	12.0	(8.4-15.6)	242	13.5	(11.9-15.1)
Abnormal CTB (of total)	98	4.3	(3.4-5.1)	528	3.0	(2.7-3.2)
Abnormal CTB (of CTBs)	98	30.9	(25.8-36.0)	528	29.5	(27.4-31.6)
Neurosurgery	9	0.4	(0.1-0.7)	74	0.4	(0.3-0.5)
Any admission for HI	183	8.0	(6.9-9.1)	4361	24.4	(23.8-25.1)
Admitted to SSU	5	2.8	(0.4-5.2)	3161	72.9	(71.6-74.2)
Admitted to ward	158	88.3	(83.5-93.0)	1175	27.1	(25.8-28.4)
Admitted to ICU	25	14.0	(8.9-19.1)	156	3.6	(3.0-4.2)
Median LOS (IQR)		3.14	(2.0-4.5)		2.32	(1.3-4.0)
LOS ≥4h	741	32.3	(30.4-34.3)	4489	25.2	(24.6-25.9)
Admitted ≥ 2 days, 2 nights	75	3.3	(2.5-4.0)	540	3.0	(2.8-3.3)

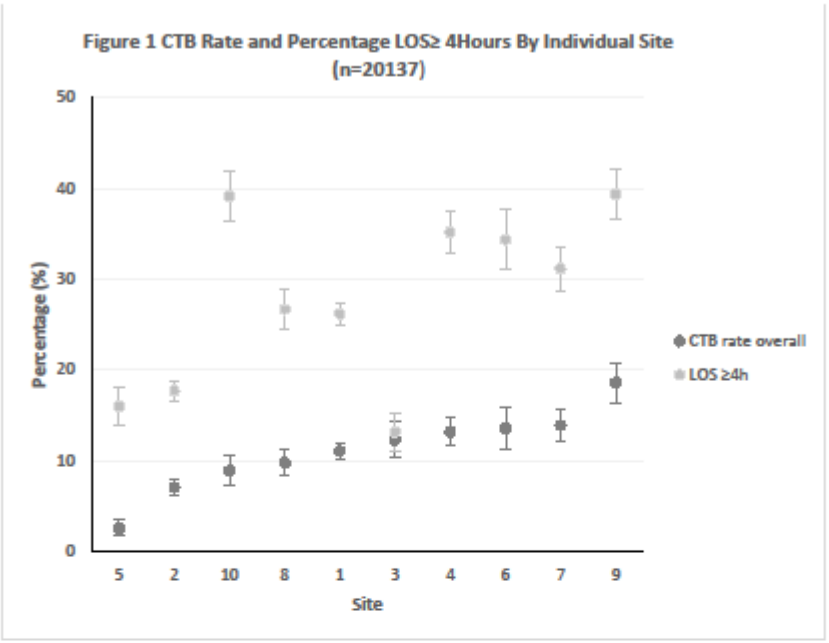

Table 1 Comparison of Imaging and Admission Practices across all Sites

CTB- CT Brain; ciTBI - clinically important brain injury; LOS - length of stay; SSU - short stay unit; ICU - intensive care, HI - head injury: IQR - interquartile range; SD - standard deviation

HOSPITAL	1			2			3			4			5			6			7			8	
	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%
Demographics																							
Enrolment rate (%)		66.0			87.2			82.7			98.3			82.0			90.6			99.1			90
Number included	**5372**			**4373**			**1049**			**1710**			**1330**			**814**			**1482**			**1630**	
Sex [male]	3490	65.0	(63.7-66.3)	2712	62.0	(60.6-63.5)	678	64.6	(61.7-67.5)	1103	64.5	(62.2-66.8)	864	65.2	(62.6-67.7)	527	64.7	(61.5-68.0)	935	63.1	(60.6-65.5)	1002	61
Age																							
Range			(0.0-18.0)			(0.0-16.4)			(0.0-18.0)			(0.0-17.9)			(0.0-17.9)			(0.0-14.9)			(0.0-15.7)		
Mean (SD)		5.9	(4.8)		5.1	(4.3)		6.4	(5.0)		5.9	(4.5)		6.2	(5.0)		5.6	(4.5)		5.9	(4.4)		6
Median (IQR)		4.2	(1.9-9.6)		3.7	(1.8-7.5)		4.8	(2.2-10.2)		4.5	(2.1-9.4)		4.7	(2.0-9.8)		4.2	(1.8-9.2)		4.8	(2.1-9.2)		4
<2 years	**1420**	26.4	(25.3-27.6)	**1229**	28.1	(26.8-29.4)	**237**	22.6	(20.1-25.1)	**411**	24.0	(22.0-26.1)	**332**	25.0	(22.6-27.3)	**219**	26.9	(23.9-29.9)	**358**	24.2	(22.0-26.3)	**426**	26
Investigation and Management: all children																							
CTB rate overall	598	11.1	(10.3-12.0)	309	7.1	(6.3-7.8)	129	12.3	(10.3-14.3)	225	13.2	(11.6-14.8)	34	2.6	(1.7-3.4)	111	13.6	(11.3-16.0)	206	13.9	(12.1-15.7)	160	9
ciTBI (of total)	101	1.9	(1.5-2.2)	43	1.0	(0.7-1.3)	16	1.5	(0.8-2.3)	21	1.2	(0.7-1.8)	5	0.4	(0.1-0.7)	12	1.5	(0.7-2.3)	26	1.8	(1.1-2.4)	14	0
ciTBI (of CTBs)	101	16.9	(13.9-19.9)	43	13.9	(10.1-17.8)	16	12.4	(6.7-18.1)	21	9.3	(5.5-13.1)	5	14.7	(2.6-26.8)	12	10.8	(5.0-16.6)	26	12.6	(8.1-17.2)	14	8
Abnormal CTB (of total)	184	3.4	(2.9-3.9)	100	2.3	(1.8-2.7)	29	2.8	(1.8-3.8)	58	3.4	(2.5-4.3)	9	0.7	(0.2-1.1)	34	4.2	(2.8-5.5)	64	4.3	(3.3-5.4)	31	1
Abnormal CTB (of CTBs)	184	30.7	(27.0-34.4)	100	32.4	(27.1-37.6)	29	22.5	(15.3-29.7)	58	25.8	(20.1-31.5)	9	26.5	(11.4-41.5)	34	30.6	(22.0-39.2)	64	31.1	(24.7-37.4)	31	19
Neurosurgery	35	0.7	(0.4-0.9)	9	0.2	(0.1-0.3)	6	0.6	(0.1-1.0)	6	0.4	(0.1-0.6)	1	0.1	(0.0-0.2)	0	0.0	(0.0-0.0)	9	0.6	(0.2-1.0)	6	0
Any admission for HI	962	17.9	(16.9-18.9)	754	17.2	(16.1-18.4)	155	14.8	(12.6-16.9)	738	43.2	(40.8-45.5)	373	28.0	(25.6-30.5)	41	5.0	(3.5-6.5)	142	9.6	(8.1-11.1)	528	32
Admitted to SSU	537	56.6	(53.5-59.8)	476	63.4	(59.9-66.8)	114	75.5	(68.6-82.4)	633	85.7	(83.1-88.2)	334	90.3	(87.3-93.3)	0	0.0	(0.0-0.0)	5	3.6	(0.5-6.7)	427	81
Admitted to ward	399	41.9	(38.8-45.0)	286	38.1	(34.6-41.6)	34	22.5	(15.8-29.2)	94	12.7	(10.3-15.1)	38	10.3	(7.2-13.4)	37	92.5	(84.2-100.0)	121	87.1	(81.5-92.7)	118	22
Admitted to ICU	69	7.2	(5.6-8.9)	20	2.7	(1.5-3.8)	11	7.3	(3.1-11.4)	19	2.6	(1.4-3.7)	2	0.5	(0.0-1.3)	4	10.0	(0.6-19.4)	21	15.1	(9.1-21.1)	14	2
Median LOS (IQR)		2.55	(1.4-4.1)		1.8	(1.2-3.0)		1.83	(1.1-3.0)		2.58	(1.2-5.1)		2.08	(1.3-3.4)		3.15	(1.9-4.7)		3.14	(2.1-4.4)		2.1
LOS ≥4h	1399	26.2	(25.0-27.4)	774	17.7	(16.6-18.8)	138	13.2	(11.1-15.2)	600	35.2	(32.9-37.4)	213	16.0	(14.1-18.0)	279	34.4	(31.1-37.6)	462	31.2	(28.9-33.6)	435	26
Admitted ≥2 days, 2 nights	232	4.3	(3.8-4.9)	96	2.2	(1.8-2.6)	25	2.4	(1.5-3.3)	44	2.6	(1.8-3.3)	18	1.4	(0.7-2.0)	24	3.0	(1.8-4.1)	51	3.4	(2.5-4.4)	35	2
Investigation and Management: Under 2 years																							
CTB rate overall	88	6.2	(4.9-7.5)	57	4.6	(3.5-5.8)	11	4.6	(2.0-7.3)	35	8.5	(5.8-11.2)	6	1.8	(0.4-3.2)	26	11.9	(7.6-16.2)	40	11.2	(7.9-14.4)	28	6
ciTBI (of total)	18	1.3	(0.7-1.9)	9	0.7	(0.3-1.2)	3	1.3	(0.0-2.7)	4	1.0	(0.0-1.9)	1	0.3	(0.0-0.9)	4	1.8	(0.1-3.6)	7	2.0	(0.5-3.4)	4	0
ciTBI (of CTBs)	18	20.2	(11.8-28.6)	9	15.8	(6.2-25.3)	3	27.3	(0.0-54.9)	4	11.4	(0.7-22.1)	1	16.7	(0.0-49.3)	4	15.4	(1.2-29.5)	7	17.5	(5.6-29.4)	4	14
Abnormal CTB (of total)	51	3.6	(2.6-4.6)	32	2.6	(1.7-3.5)	7	3.0	(0.8-5.1)	19	4.6	(2.6-6.7)	2	0.6	(0.0-1.4)	14	6.4	(3.1-9.6)	23	6.4	(3.9-9.0)	14	3
Abnormal CTB (of CTBs)	51	57.3	(47.0-67.6)	32	56.1	(43.1-69.1)	7	63.6	(33.8-93.5)	19	54.3	(37.5-71.0)	2	33.3	(0.0-74.7)	14	53.8	(34.3-73.4)	23	57.5	(42.0-73.0)	14	50
Neurosurgery	7	0.5	(0.1-0.9)	2	0.2	(0.0-0.4)	0	0.0	(0.0-0.0)	1	0.2	(0.0-0.7)	0	0.0	(0.0-0.0)	0	0.0	(0.0-0.0)	1	0.3	(0.0-0.8)	1	0
Any admission for HI	204	14.4	(12.5-16.2)	173	14.1	(12.1-16.0)	33	13.9	(9.5-18.3)	170	41.4	(36.6-46.1)	81	24.4	(19.8-29.0)	12	5.5	(2.5-8.5)	33	9.2	(6.2-12.2)	151	35
LOS ≥4h	259	18.3	(16.3-20.4)	174	14.2	(12.2-16.1)	24	10.1	(6.3-14.0)	138	33.7	(29.1-38.2)	43	13.0	(9.4-16.6)	66	30.3	(24.2-36.4)	112	31.3	(26.5-36.1)	107	25
Admitted ≥2 days, 2 nights.	39	2.8	(1.9-3.6)	24	2.0	(1.2-2.7)	4	1.7	(0.0-3.3)	8	2.0	(0.6-3.3)	5	1.5	(0.2-2.8)	8	3.7	(1.2-6.2)	9	2.5	(0.9-4.1)	10	2

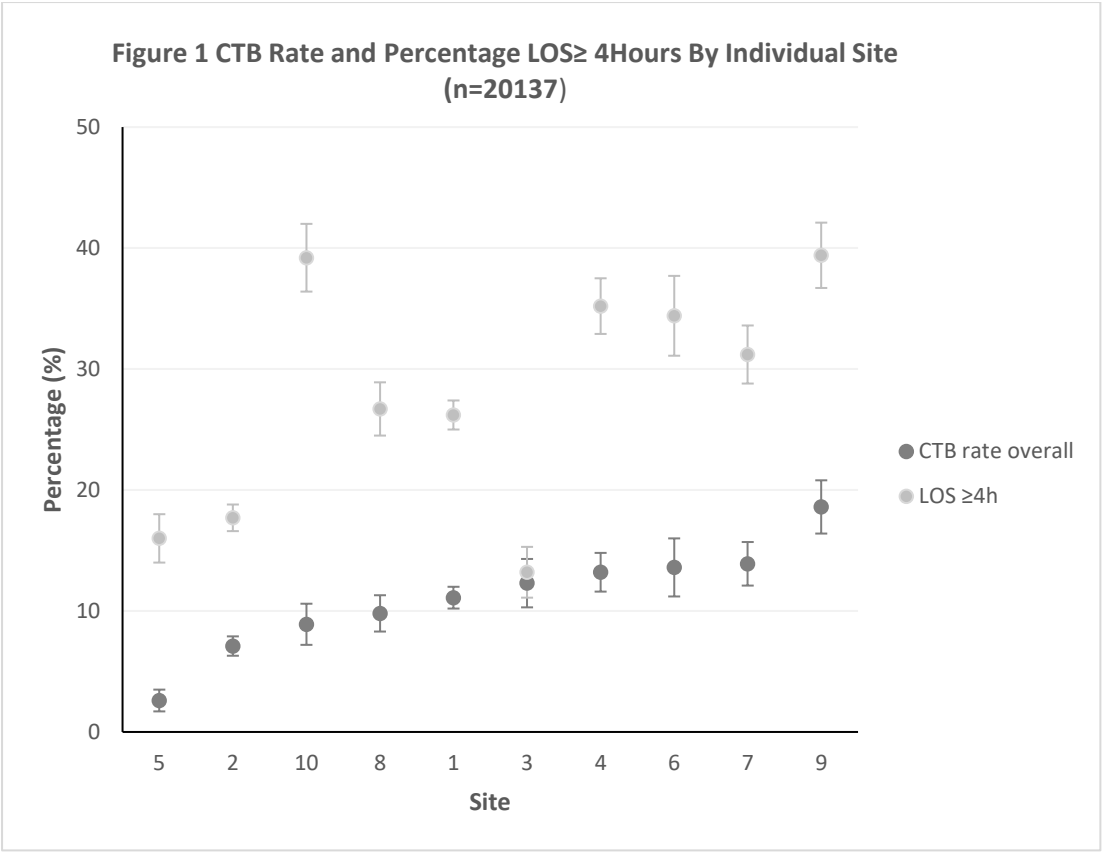

Table 1 Comparison of Imaging and Admission Practices across all Sites

CTB- CT Brain; ciTBI - clinically important brain injury; LOS - length of stay; SSU - short stay unit; ICU - intensive care, HI - head injury: IQR - interquartile range; SD - standard deviation

HOSPITAL	1			2			3			4			5			6			7			8			9			10			Total			p	Site adjusted	
	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)	n	%	(95%CI)		%	95% CI
Demographics																																			
Enrolment rate (%)		66.0			87.2			82.7			98.3			82.0			90.6			99.1			90.3			74.1			67.5						
Number included	**5372**			**4373**			**1049**			**1710**			**1330**			**814**			**1482**			**1630**			**1255**			**1122**			**20137**						
Sex [male]	3490	65.0	(63.7-66.3)	2712	62.0	(60.6-63.5)	678	64.6	(61.7-67.5)	1103	64.5	(62.2-66.8)	864	65.2	(62.6-67.7)	527	64.7	(61.5-68.0)	935	63.1	(60.6-65.5)	1002	61.5	(59.1-63.8)	793	63.2	(60.5-65.9)	719	64.1	(61.3-66.9)	12823	63.7	(63.0-64.4)	0.076	63.7	(62.8-64.6)
Age																																				
Range			(0.0-18.0)			(0.0-16.4)			(0.0-18.0)			(0.0-17.9)			(0.0-17.9)			(0.0-14.9)			(0.0-15.7)			(0.0-17.9)			(0.0-16.6)			(0.0-17.6)			(0.0-18.0)			
Mean (SD)		5.9	(4.8)		5.1	(4.3)		6.4	(5.0)		5.9	(4.5)		6.2	(5.0)		5.6	(4.5)		5.9	(4.4)		6.3	(5.1)		5.4	(4.6)		5.1	(4.4)		5.7	(4.7)	<0.001		
Median (IQR)		4.2	(1.9-9.6)		3.7	(1.8-7.5)		4.8	(2.2-10.2)		4.5	(2.1-9.4)		4.7	(2.0-9.8)		4.2	(1.8-9.2)		4.8	(2.1-9.2)		4.7	(1.9-10.0)		4.0	(1.7-8.5)		3.6	(1.6-7.6)		4.2	(1.9-9.0)	<0.001		
<2 years	**1420**	26.4	(25.3-27.6)	**1229**	28.1	(26.8-29.4)	**237**	22.6	(20.1-25.1)	**411**	24.0	(22.0-26.1)	**332**	25.0	(22.6-27.3)	**219**	26.9	(23.9-29.9)	**358**	24.2	(22.0-26.3)	**426**	26.1	(24.0-28.3)	**390**	31.1	(28.5-33.6)	**352**	31.4	(28.7-34.1)	**5374**	26.7	(26.1-27.3)	<0.001		
Investigation and Management: all children																																				
CTB rate overall	598	11.1	(10.3-12.0)	309	7.1	(6.3-7.8)	129	12.3	(10.3-14.3)	225	13.2	(11.6-14.8)	34	2.6	(1.7-3.4)	111	13.6	(11.3-16.0)	206	13.9	(12.1-15.7)	160	9.8	(8.4-11.3)	234	18.6	(16.5-20.8)	100	8.9	(7.2-10.6)	2106	10.5	(10.0-10.9)	<0.001	11.2	(7.84-14.62)
ciTBI (of total)	101	1.9	(1.5-2.2)	43	1.0	(0.7-1.3)	16	1.5	(0.8-2.3)	21	1.2	(0.7-1.8)	5	0.4	(0.1-0.7)	12	1.5	(0.7-2.3)	26	1.8	(1.1-2.4)	14	0.9	(0.4-1.3)	27	2.2	(1.4-3.0)	15	1.3	(0.7-2.0)	280	1.4	(1.2-1.6)	<0.001	1.4	(1.0-1.7)
ciTBI (of CTBs)	101	16.9	(13.9-19.9)	43	13.9	(10.1-17.8)	16	12.4	(6.7-18.1)	21	9.3	(5.5-13.1)	5	14.7	(2.6-26.8)	12	10.8	(5.0-16.6)	26	12.6	(8.1-17.2)	14	8.8	(4.4-13.1)	27	11.5	(7.4-15.6)	15	14.9	(7.9-21.8)	280	13.3	(11.8-14.7)	0.112	12.8	(10.8-14.7)
Abnormal CTB (of total)	184	3.4	(2.9-3.9)	100	2.3	(1.8-2.7)	29	2.8	(1.8-3.8)	58	3.4	(2.5-4.3)	9	0.7	(0.2-1.1)	34	4.2	(2.8-5.5)	64	4.3	(3.3-5.4)	31	1.9	(1.2-2.6)	81	6.5	(5.1-7.8)	36	3.2	(2.2-4.2)	626	3.1	(2.9-3.4)	<0.001	3.3	(2.2-4.4)
Abnormal CTB (of CTBs)	184	30.7	(27.0-34.4)	100	32.4	(27.1-37.6)	29	22.5	(15.3-29.7)	58	25.8	(20.1-31.5)	9	26.5	(11.4-41.5)	34	30.6	(22.0-39.2)	64	31.1	(24.7-37.4)	31	19.4	(13.2-25.5)	81	34.6	(28.5-40.7)	36	35.6	(26.3-45.0)	626	29.7	(27.8-31.6)	0.023	29.3	(26.2-32.3)
Neurosurgery	35	0.7	(0.4-0.9)	9	0.2	(0.1-0.3)	6	0.6	(0.1-1.0)	6	0.4	(0.1-0.6)	1	0.1	(0.0-0.2)	0	0.0	(0.0-0.0)	9	0.6	(0.2-1.0)	6	0.4	(0.1-0.7)	7	0.6	(0.1-1.0)	4	0.4	(0.0-0.7)	83	0.4	(0.3-0.5)	0.009	0.4	(0.2-0.5)
Any admission for HI	962	17.9	(16.9-18.9)	754	17.2	(16.1-18.4)	155	14.8	(12.6-16.9)	738	43.2	(40.8-45.5)	373	28.0	(25.6-30.5)	41	5.0	(3.5-6.5)	142	9.6	(8.1-11.1)	528	32.4	(30.1-34.7)	302	24.1	(21.7-26.4)	549	48.9	(46.0-51.9)	4544	22.6	(22.0-23.1)	<0.001	24.0	(15.4-32.6)
Admitted to SSU	537	56.6	(53.5-59.8)	476	63.4	(59.9-66.8)	114	75.5	(68.6-82.4)	633	85.7	(83.1-88.2)	334	90.3	(87.3-93.3)	0	0.0	(0.0-0.0)	5	3.6	(0.5-6.7)	427	81.0	(77.7-84.4)	146	48.5	(42.9-54.2)	494	90.0	(87.5-92.5)	3166	70.1	(68.8-71.5)	<0.001	53.3	(33.6-72.9)
Admitted to ward	399	41.9	(38.8-45.0)	286	38.1	(34.6-41.6)	34	22.5	(15.8-29.2)	94	12.7	(10.3-15.1)	38	10.3	(7.2-13.4)	37	92.5	(84.2-100.0)	121	87.1	(81.5-92.7)	118	22.4	(18.8-25.9)	148	49.2	(43.5-54.8)	58	10.6	(8.0-13.1)	1333	29.5	(28.2-30.8)	<0.001	40.4	(24.2-56.6)
Admitted to ICU	69	7.2	(5.6-8.9)	20	2.7	(1.5-3.8)	11	7.3	(3.1-11.4)	19	2.6	(1.4-3.7)	2	0.5	(0.0-1.3)	4	10.0	(0.6-19.4)	21	15.1	(9.1-21.1)	14	2.7	(1.3-4.0)	14	4.7	(2.3-7.0)	7	1.3	(0.3-2.2)	181	4.0	(3.4-4.6)	<0.001	5.1	(2.1-8.1)
Median LOS (IQR)		2.55	(1.4-4.1)		1.8	(1.2-3.0)		1.83	(1.1-3.0)		2.58	(1.2-5.1)		2.08	(1.3-3.4)		3.15	(1.9-4.7)		3.14	(2.1-4.4)		2.77	(1.7-4.1)		3.24	(1.8-6.6)		3.21	(1.7-5.3)		2.4	(1.4-4.1)	<0.001	*not calculable*	
LOS ≥4h	1399	26.2	(25.0-27.4)	774	17.7	(16.6-18.8)	138	13.2	(11.1-15.2)	600	35.2	(32.9-37.4)	213	16.0	(14.1-18.0)	279	34.4	(31.1-37.6)	462	31.2	(28.9-33.6)	435	26.7	(24.6-28.9)	491	39.4	(36.7-42.1)	439	39.2	(36.4-42.1)	5230	26.1	(25.4-26.7)	<0.001	27.8	(21.9-33.8)
Admitted ≥2 days, 2 nights	232	4.3	(3.8-4.9)	96	2.2	(1.8-2.6)	25	2.4	(1.5-3.3)	44	2.6	(1.8-3.3)	18	1.4	(0.7-2.0)	24	3.0	(1.8-4.1)	51	3.4	(2.5-4.4)	35	2.1	(1.4-2.9)	63	5.1	(3.8-6.3)	27	2.4	(1.5-3.3)	615	3.1	(2.8-3.3)	<0.001	2.9	(2.2-3.6)
Investigation and Management: Under 2 years																																				
CTB rate overall	88	6.2	(4.9-7.5)	57	4.6	(3.5-5.8)	11	4.6	(2.0-7.3)	35	8.5	(5.8-11.2)	6	1.8	(0.4-3.2)	26	11.9	(7.6-16.2)	40	11.2	(7.9-14.4)	28	6.6	(4.2-8.9)	58	14.9	(11.3-18.4)	26	7.4	(4.7-10.1)	375	7.0	(6.3-7.7)	<0.001	7.8	(5.3-10.3)
ciTBI (of total)	18	1.3	(0.7-1.9)	9	0.7	(0.3-1.2)	3	1.3	(0.0-2.7)	4	1.0	(0.0-1.9)	1	0.3	(0.0-0.9)	4	1.8	(0.1-3.6)	7	2.0	(0.5-3.4)	4	0.9	(0.0-1.9)	9	2.3	(0.8-3.8)	6	1.7	(0.3-3.1)	65	1.2	(0.9-1.5)	0.205	1.2	(0.9-1.6)
ciTBI (of CTBs)	18	20.2	(11.8-28.6)	9	15.8	(6.2-25.3)	3	27.3	(0.0-54.9)	4	11.4	(0.7-22.1)	1	16.7	(0.0-49.3)	4	15.4	(1.2-29.5)	7	17.5	(5.6-29.4)	4	14.3	(1.1-27.5)	9	15.5	(6.1-24.9)	6	22.2	(6.2-38.2)	65	17.2	(13.4-21.1)	0.961	*not calculable*	
Abnormal CTB (of total)	51	3.6	(2.6-4.6)	32	2.6	(1.7-3.5)	7	3.0	(0.8-5.1)	19	4.6	(2.6-6.7)	2	0.6	(0.0-1.4)	14	6.4	(3.1-9.6)	23	6.4	(3.9-9.0)	14	3.3	(1.6-5.0)	33	8.5	(5.7-11.2)	17	4.8	(2.6-7.1)	212	3.9	(3.4-4.5)	<0.001	4.4	(2.9-5.8)
Abnormal CTB (of CTBs)	51	57.3	(47.0-67.6)	32	56.1	(43.1-69.1)	7	63.6	(33.8-93.5)	19	54.3	(37.5-71.0)	2	33.3	(0.0-74.7)	14	53.8	(34.3-73.4)	23	57.5	(42.0-73.0)	14	50.0	(31.1-68.9)	33	56.9	(44.0-69.8)	17	63.0	(44.4-81.5)	212	56.2	(51.2-61.3)	0.976	*not calculable*	
Neurosurgery	7	0.5	(0.1-0.9)	2	0.2	(0.0-0.4)	0	0.0	(0.0-0.0)	1	0.2	(0.0-0.7)	0	0.0	(0.0-0.0)	0	0.0	(0.0-0.0)	1	0.3	(0.0-0.8)	1	0.2	(0.0-0.7)	1	0.3	(0.0-0.8)	2	0.6	(0.0-1.4)	15	0.3	(0.1-0.4)	0.715	*not calculable*	
Any admission for HI	204	14.4	(12.5-16.2)	173	14.1	(12.1-16.0)	33	13.9	(9.5-18.3)	170	41.4	(36.6-46.1)	81	24.4	(19.8-29.0)	12	5.5	(2.5-8.5)	33	9.2	(6.2-12.2)	151	35.4	(30.9-40.0)	89	22.8	(18.6-27.0)	207	58.8	(53.7-64.0)	1153	21.5	(20.4-22.6)	<0.001	23.9	(14.7-33.2)
LOS ≥4h	259	18.3	(16.3-20.4)	174	14.2	(12.2-16.1)	24	10.1	(6.3-14.0)	138	33.7	(29.1-38.2)	43	13.0	(9.4-16.6)	66	30.3	(24.2-36.4)	112	31.3	(26.5-36.1)	107	25.1	(21.0-29.2)	144	37.1	(32.3-41.9)	158	44.9	(39.7-50.1)	1225	22.8	(21.7-24.0)	<0.001	25.7	(18.7-32.7)
Admitted ≥2 days, 2 nights.	39	2.8	(1.9-3.6)	24	2.0	(1.2-2.7)	4	1.7	(0.0-3.3)	8	2.0	(0.6-3.3)	5	1.5	(0.2-2.8)	8	3.7	(1.2-6.2)	9	2.5	(0.9-4.1)	10	2.3	(0.9-3.8)	22	5.7	(3.4-8.0)	11	3.1	(1.3-5.0)	140	2.6	(2.2-3.0)	0.013	2.7	(2.0-3.3)