

Trends in Pediatric Head CT Use: Looking Beyond the Ivory Tower

Eric Coon, MD, MS, Susan L. Bratton, MD, MPH

In this month's *Pediatrics*, Burstein et al¹ report disappointing statistics in their work entitled "Use of CT for Head Trauma: 2007–2015." Using the National Hospital Ambulatory Medical Care Survey, a representative data set for emergency department (ED) visits,² they found that 32% of pediatric patients presenting for head trauma had computed tomography (CT) imaging as part of their evaluation. This proportion was unchanged over the study period despite publication of algorithms^{3–5} and an international effort intended to safely decrease unnecessary radiation exposure from head CTs among infants and children with head injuries. Additionally, they reported that ~90% of US children received their trauma care at general (nonteaching and nonchildren's) hospitals, where CT use was higher.¹

Some history regarding CT use for pediatric head injury is helpful. In 1999, the American Academy of Pediatrics reviewed treatment of minor head injury and divided recommended evaluation and treatment by whether there was brief loss of consciousness (LOC).⁶ Head CT imaging was recommended for patients with LOC. If the LOC was brief, then 12 to 24 hours of hospital observation was recommended. Together, these recommendations resulted in hospital admission for nearly one-third of patients with head injuries at that time. Unfortunately, broader CT use was encouraged by a rationale that, if the head CT was normal among the subset of neurologically normal patients, the child could be discharged without hospital observation because

"they were at extremely low risk for subsequent problems."^{7,8}

The association between radiation from medical imaging and subsequent malignancy,⁹ especially among infants and preschool-aged children, and the rising use of CT imaging in mild traumatic brain injury (TBI) spurred investigations into how to safely limit radiation exposure in this setting.¹⁰ The Pediatric Emergency Care Applied Research Network (PECARN) developed and validated guidelines for identification of children at low risk of clinically important traumatic brain injury (ciTBI) after head trauma.⁴ The network performed a large prospective cohort study in 2006 of children seen within 24 hours with mild TBI (Glasgow Coma Scale of 14–15) but excluded those with trivial injury (skin or soft tissue), a preexisting neurologic condition, or penetrating head trauma. Overall, 35% had a CT, and 5.2% had traumatic injuries on CT. Nine percent were admitted to the hospital. Among those with a CT scan, 0.9% had ciTBI, defined as any of the following caused by TBI: death, receipt of neurosurgery, intubation >24 hours, or hospital admission >2 days associated with TBI on CT. Although Burstein et al¹ found a similar CT rate (32%), the current study hospital admission rate was only 2%, revealing a sustained use of CT scans despite apparently, on average, less severely injured patients compared with patients in the earlier PECARN cohort.

The PECARN algorithms differ for patients <2 years of age or ≥2 years of age and revealed that absence of all clinical risk factors in the algorithms

FREE

Department of Pediatrics, School of Medicine, University of Utah, Salt Lake City, Utah

Opinions expressed in these commentaries are those of the authors and not necessarily those of the American Academy of Pediatrics or its Committees.

DOI: <https://doi.org/10.1542/peds.2018-2137>

Accepted for publication Jul 11, 2018

Address correspondence to Susan L. Bratton, MD, MPH, Department of Pediatrics, School of Medicine, University of Utah, 295 Chipeta Way, Salt Lake City, UT 84108. E-mail: susan.bratton@hsc.utah.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2018 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

COMPANION PAPER: A companion to this article can be found online at www.pediatrics.org/cgi/doi/10.1542/peds.2018-0814.

To cite: Coon E and Bratton SL. Trends in Pediatric Head CT Use: Looking Beyond the Ivory Tower. *Pediatrics*. 2018;142(4):e20182137

had negative predictive values for ciTBI of >99.9%. The factors assessed were altered mental status, scalp hematoma, LOC, high-impact mechanism of injury, palpable skull fracture and/or signs of basilar fracture, vomiting, severe headache, and parental assessment of acting “normal.” Excess CT use was reported in 24% of subjects <2 years old and 21% of those ≥2 years old because they had low predicted risk of ciTBI. Subsequent publication regarding implementation of the prediction algorithms reported declining CT use.^{11–15} However, the patients studied were limited to those cared for at children’s hospitals or affiliated sites. Burstein et al¹’s findings reveal that improvements achieved in refining CT use at children’s and teaching hospitals were the exception, with no measurable change on a broader, national level.

It is disappointing that US children have generally not benefitted from current best practice research and continue to experience unnecessary radiation exposure. This is a reminder that pediatric research and education efforts are frequently not focused where most US children receive their medical care. Nationally representative data sources, such as the National Hospital Ambulatory Medical Care Survey used by Burstein et al,¹ reveal that the vast majority of children receive ED care at nonteaching, nonpediatric EDs, but the majority of funding for pediatric research is centered in a handful of academic institutions.¹⁶ Better diffusion of best practices is likely possible if attention is given to care delivered outside of children’s hospitals. A recent study of a community ED revealed that a maintenance of certification program sponsored by a children’s hospital was associated with lowered CT scan use from 29% to 17%.¹⁷ If the medical community aims to accurately describe and

comprehensively improve pediatric health care to benefit all children, then greater research in nonacademic health care settings and a stronger commitment to dissemination and implementation beyond children’s hospitals are sorely needed.

ABBREVIATIONS

ciTBI: clinically important traumatic brain injury
 CT: computed tomography
 ED: emergency department
 LOC: loss of consciousness
 PECARN: Pediatric Emergency Care Applied Research Network
 TBI: traumatic brain injury

REFERENCES

- Burstein B, Upton JEM, Fuzaro Terra H, Neuman MI. Use of CT for head trauma: 2007–2015. *Pediatrics*. 2018;142(4):e20180814
- Centers for Disease Control and Prevention; National Center for Healthcare Statistics. National Healthcare Surveys, National Hospital Ambulatory Medical Care Survey (NHAMCS). Available at: https://www.cdc.gov/nchs/data_access/ftp_data.htm. Accessed July 28, 2018
- Dunning J, Daly JP, Lomas JP, Lecky F, Batchelor J, Mackway-Jones K; Children’s Head Injury Algorithm for the Prediction of Important Clinical Events Study Group. 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):885–891
- Kuppermann N, Holmes JF, Dayan PS, et al; Pediatric Emergency Care Applied Research Network (PECARN). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet*. 2009;374(9696):1160–1170
- Osmond MH, Klassen TP, Wells GA, et al; Pediatric Emergency Research Canada (PERC) Head Injury Study Group. CATCH: a clinical decision rule for the use of computed tomography in children with minor head injury. *CMAJ*. 2010;182(4):341–348
- The management of minor closed head injury in children. Committee on Quality Improvement, American Academy of Pediatrics. Commission on Clinical Policies and Research, American Academy of Family Physicians. *Pediatrics*. 1999;104(6):1407–1415
- Homer CJ, Kleinman L. Technical report: minor head injury in children. *Pediatrics*. 1999;104(6). Available at: www.pediatrics.org/cgi/content/full/104/6/e78
- Coombs JB, Davis RL; Subcommittee on Management of Minor Head Injury for the American Academy of Pediatrics/American Academy of Family Physicians. A synopsis of the American Academy of Pediatrics’ practice parameter on the management of minor closed head injury in children. *Pediatr Rev*. 2000;21(12):413–415
- Miglioretti DL, Johnson E, Williams A, et al. The use of computed tomography in pediatrics and the associated radiation exposure and estimated cancer risk. *JAMA Pediatr*. 2013;167(8):700–707
- Blackwell CD, Gorelick M, Holmes JF, Bandyopadhyay S, Kuppermann N. Pediatric head trauma: changes in use of computed tomography in emergency departments in the United States over time. *Ann Emerg Med*. 2007;49(3):320–324
- Taylor AM, Nigrovic LE, Saillant ML, et al. Trends in ambulatory care for children with concussion and minor head injury from eastern Massachusetts between 2007 and 2013. *J Pediatr*. 2015;167(3):738–744
- Parker MW, Shah SS, Hall M, Fieldston ES, Coley BD, Morse RB. Computed tomography and shifts to alternate imaging modalities in hospitalized children. *Pediatrics*. 2015;136(3). Available at: www.pediatrics.org/cgi/content/full/136/3/e573
- Lodwick DL, Cooper JN, Kelleher KJ, Brillli R, Minneci PC, Deans KJ. Variation

in utilization of computed tomography imaging at tertiary pediatric hospitals. *Pediatrics*. 2015;136(5). Available at: www.pediatrics.org/cgi/content/full/136/5/e1212

14. Coon ER, Newman TB, Hall M, Wilkes J, Bratton SL, Schroeder AR. Trends in imaging findings, interventions, and outcomes among children with isolated head trauma [published online ahead of print April 24, 2018]. *Pediatr Emerg Care*. doi:10.1097/PEC.0000000000001475
15. Nigrovic LE, Stack AM, Mannix RC, et al. Quality improvement effort to reduce cranial CTs for children with minor blunt head trauma. *Pediatrics*. 2015;136(1). Available at: www.pediatrics.org/cgi/content/full/136/1/e227
16. Good M, McElroy SJ, Berger JN, Wynn JL. Name and characteristics of National Institutes of Health R01-funded pediatric physician-scientists: hope and challenges for the vanishing pediatric physician-scientists. *JAMA Pediatr*. 2018;172(3):297–299
17. Jennings RM, Burtner JJ, Pellicer JF, et al. Reducing head CT use for children with head injuries in a community emergency department. *Pediatrics*. 2017;139(4):e20161349

Trends in Pediatric Head CT Use: Looking Beyond the Ivory Tower

Eric Coon and Susan L. Bratton

Pediatrics 2018;142;

DOI: 10.1542/peds.2018-2137 originally published online September 4, 2018;

Updated Information & Services

including high resolution figures, can be found at:
<http://pediatrics.aappublications.org/content/142/4/e20182137>

References

This article cites 16 articles, 10 of which you can access for free at:
<http://pediatrics.aappublications.org/content/142/4/e20182137#BIBL>

Subspecialty Collections

This article, along with others on similar topics, appears in the following collection(s):
Administration/Practice Management
http://www.aappublications.org/cgi/collection/administration:practice_management_sub
Compliance
http://www.aappublications.org/cgi/collection/compliance_sub
Head and Neck Injuries
http://www.aappublications.org/cgi/collection/head_neck_injuries_sub
Traumatic Brain Injury
http://www.aappublications.org/cgi/collection/traumatic_brain_injury_sub

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
<http://www.aappublications.org/site/misc/Permissions.xhtml>

Reprints

Information about ordering reprints can be found online:
<http://www.aappublications.org/site/misc/reprints.xhtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Trends in Pediatric Head CT Use: Looking Beyond the Ivory Tower

Eric Coon and Susan L. Bratton

Pediatrics 2018;142;

DOI: 10.1542/peds.2018-2137 originally published online September 4, 2018;

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/142/4/e20182137>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2018 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

