

# Detection of Missed Injuries in a Pediatric Trauma Center With the Addition of Acute Care Pediatric Nurse Practitioners

Julia Resler, RN, MSN, CPNP-AC ■ Jodi Hackworth, MPH, CSTR ■ Erin Mayo, RN, MSN, CPNP-AC ■ Thomas M. Rouse, MD, FACS

## ABSTRACT

Missed injuries contribute to increased morbidity in trauma patients. A retrospective chart review was conducted of pediatric trauma patients from 2010 to 2013 with a documented missed injury. A significant percentage of missed injuries were identified (3.01% during July 2012 to December 2013 vs 0.39% during January 2010 to July 2012) with the addition of acute care trained pediatric nurse practitioners to the trauma service at a pediatric trauma center. The increase is thought to be due to improvement in charting, consistent personnel performing tertiary examinations, and improved radiology reads of outside films.

## Key Words

Missed injuries, Nurse practitioner, Pediatric

The role of the nurse practitioner (NP) continues to evolve at a rapid pace. Once relegated only to the primary care realm, acute care nurse practitioners have become more common and are now taking on more challenging areas of care. Many pediatric hospitals choose to employ only acute care trained pediatric nurse practitioners (ACPNPs) in their inpatient settings. Pediatric trauma NPs have been shown to increase satisfaction with bedside nurses when compared with residents, particularly in the areas of pain management and response time to pages.<sup>1</sup> The incorporation of NPs

into an academic surgical program can be beneficial in providing a consistent and organized approach to the tertiary survey and identification of missed injuries. A recent literature review reveals a missed injury rate of 4% to 5% in the adult population.<sup>2</sup> Very little information on missed injuries exists for pediatric trauma. However, missed injuries in pediatric articles typically center on orthopedic injuries.<sup>3,4</sup> We examine our experience with the addition of ACPNPs to our trauma program and their impact on identifying missed injuries.

Riley Hospital for Children at Indiana University Health is an American College of Surgeons verified level I pediatric trauma center and is the only level I pediatric trauma center in the state of Indiana. The trauma center sees approximately 1200 patients per year, with nearly 92% of the patients suffering blunt trauma. The trauma service consists of 8 attending surgeons, 2 to 3 fellows, 4 to 5 residents, 2 ACPNPs, and other multidisciplinary staff.

The roles of the ACPNPs versus the surgical residents vary. The ACPNPs had multiple years of nursing and NP experience within pediatric critical care and pediatric cardiovascular surgery prior to the implementation of this role in July 2012. The NPs care only for trauma patients, in collaboration with the attending surgeon and fellows, Monday through Friday. Each ACPNP responds to and actively manages the patients from their presentation and resuscitation in the trauma bay throughout their hospitalization or transfer them to another service or rehabilitation unit. The ACPNPs round daily on the patients, write daily progress notes, perform tertiary examinations, provide consultations as needed, and manage the care of the patients in conjunction with the rest of the team. The residents, on the contrary, come from multiple surgical specialties, rotate monthly, and include interns, junior residents, and senior residents, making their skill mix and knowledge related to childhood trauma quite variable. The pediatric surgery rotation may be the first exposure for the resident to both pediatrics and pediatric trauma. On the nights and the weekends, residents admit and care for trauma patients in collaboration with fellows and attending surgeons. Residents are also responsible for care of the general surgical patients on the service in addition to participating in surgical cases.

**Author Affiliations:** Department of Trauma Services, Riley Hospital for Children at IU Health, Indianapolis, Indiana (Mss Resler, Hackworth, and Mayo and Dr Rouse); Department of Surgery, Indiana University School of Medicine, Riley Hospital for Children at IU Health, Indianapolis, Indiana (Dr Rouse).

The authors declare no conflicts of interest.

**Correspondence:** Julia Resler, RN, MSN, CPNP-AC, Riley Hospital for Children at Indiana University Health, 705 Riley Hospital Dr, Ste 2500, Indianapolis, IN 46202 (jresler1@iuhealth.org).

DOI: 10.1097/JTN.0000000000000080

## METHODS

A retrospective chart review was conducted of pediatric trauma patients from 2010 to 2013. After the Institutional Review Board approval, patients were identified in the pediatric trauma registry. The pediatric trauma registry includes more than 300 data points on all trauma patients. Patients were selected if they had a documented missed injury during this time period. A missed injury was defined as an injury found after completion of the primary and the secondary surveys and after admission, with a tertiary examination, or after discharge. Tertiary examinations are performed the morning after admission, prior to mobilization, or when the child regains consciousness, in addition to daily ongoing examinations. Missed injuries are documented within the trauma registry by a process improvement indicator and each case is reviewed with the ACPNPs, clinical nurse specialist, and trauma medical director.

The data were collected as 2 data sets: before the addition of the ACPNPs (2010 to June 2012) and after the addition of the ACPNPs (July 2012 to July 2013) and compared. Data points examined included dates of admission and discharge, length of stay (LOS), admitting service, trauma activation type, and missed injury. After the identification of the patients with a missed injury, a chart review was conducted to verify the information in the registry.

## RESULTS

A total of 29 missed injuries were identified in 28 patients for the entire time period; 8 prior to the implementation of the ACPNPs and 21 since their arrival (Table).

Missed injuries included orthopedic injuries, additional or different injuries identified on internal radiology reading of outside studies, previously undiagnosed infection found on imaging, and identification of injuries during repeated examinations by the ACPNP.

During January 2010 to June 2012, there were a total of 2052 inpatients included in the trauma registry. Eight identified missed injuries (0.39%; 8/2052) were documented. Beginning in mid-2012, data points for trauma service as primary service, trauma patients comanaged with other trauma surgical services, and trauma consults were initiated and entered into the trauma registry. From July 2012 to December 2013, there were 697 patients. Twenty-one missed injuries were identified (3.01%; 21/697). The percent difference between the 2 time periods is significant at  $P < .05$  level with a 154.12% increase in identification of missed injuries (Table). Of the 21 patients, 9 were admitted under different service lines, such as orthopedics or neurosurgery, but trauma provided a consult. Length of stay and activation type did not impact the percentage of missed injuries.

Three examples are provided below on how the ACPNPs have identified injuries that may or may not have been missed without their expertise:

1. An 11-year-old male patient presented as a trauma alert after riding his bike into a motorized vehicle. His only complaint at presentation was left thigh pain. X-ray imaging revealed a left femur fracture. The patient was taken to the operating room with the orthopedic service for intramedullary nail fixation. A left-lower-extremity computed

**TABLE Documented Missed Injuries 2010-2013**

Categories of Missed Injuries	No. of Missed Injuries Before Nurse Practitioners (2010-June 2012)	No. of Missed Injuries After Nurse Practitioners (July 2012-December 2013)
Radiology misread at outside hospital	3	7
Inadequate imaging/evaluation	2	4
Orthopedic injuries	1	6
Identified after discharge	1	0
Documentation missing/injury not addressed	1	3
Medical issue not related to trauma	0	1
Total number of missed injuries identified	8	21
Total number of inpatients during time period	2052	697
Percentage of missed injuries identified	0.39%	3.01%
Percent difference between 2 groups	154.12% Increase $P \leq .00001$ and is statistically significant at $P < .05$	

tomography (CT) scan with rotational profile was ordered postoperatively to evaluate fixation and alignment of the fracture. On evaluation of the CT scan by radiology and the ACPNP, the CT scan revealed a left ischium and left acetabular fracture not identified previously because of no pelvic imaging. The orthopedic service was notified of the additional injuries, which were managed nonoperatively.

2. A 13-year-old male patient was an unrestrained passenger in a bus collision. He had a transient loss of consciousness. Initial evaluation of the child demonstrated a cervical spine CT negative for injury. His cervical collar was removed by the emergency department physician. The child continued to have persistent neck pain, which was initially attributed to muscle spasms. Upon additional examinations by the ACPNP, the child was placed back into a cervical collar and additional imaging was obtained. Flexion/extension films of the cervical spine revealed anterolisthesis of approximately 3 mm of C2 on C3. Neurosurgery recommended cervical spine magnetic resonance imaging which revealed improved alignment with the collar in place and evidence of ligamentous injury. The child's pain improved after placement of the collar and his injury was managed nonoperatively with neurosurgery follow-up.
3. A 6-year-old male patient was involved in a collision with a fire hydrant while sledding. He had no loss of consciousness, but immediate pain in right thigh and some abrasions to his chest. Head, chest, abdomen, and pelvis CT scans performed at the referring hospital were read as negative for injury with plain films of the right femur positive for a femur fracture. The child went to the operating room with the orthopedic service for intramedullary nailing of the fracture in his leg. The ACPNP had re-reads of the imaging from the outside hospital done. Additional reads of the previous imaging revealed a left-clavicle fracture and acute sinusitis, not previously addressed. The clavicle fracture was managed nonoperatively with a sling and the acute sinusitis with oral antibiotics.

## DISCUSSION

Missed injuries in trauma patients have been shown to occur at a rate of 4% to 5%.<sup>2</sup> These injuries can be discovered during a tertiary examination, repeated examinations during the course of hospitalization, during imaging for other purposes, or postdischarge.<sup>2-5</sup> The injuries identified in this study rarely contributed to mortality but did contribute to morbidity. Reading of images by those

inexperienced in pediatrics or trauma can lead to missed injuries as well as the need for additional imaging and increased radiation exposure.<sup>6</sup> Prior to the implementation of the ACPNPs, missed injuries were identified by the residents during morning rounds. However, there was no clear documentation for a tertiary examination, though it was done, and no means of communication for missed injuries as a performance improvement indicator. As evidenced by the results, prior to the ACPNPs starting, only 8 missed injuries were documented in the trauma registry versus 21 missed injuries (0.39% vs 3.01%).

Follow-up is an area of future investigation and improvement. Our pediatric trauma center is the only verified level I center in the state and pulls a very large geographic area, including some patients from neighboring states. Currently, many children do not require follow-up other than with their primary care physician, seek services at other institutions, or are lost to follow-up. In addition, many families may not be able to accommodate a return trip to the trauma center, unless absolutely necessary. As a result, additional injuries due to the trauma may never be known. A possible solution to local families with the ability to return to the trauma center is a trauma follow-up clinic staffed by an ACPNP along with a trauma surgeon. This could be especially beneficial to families with complex medical and social needs requiring assistance coordinating services.

The addition of ACPNPs to the pediatric trauma service resulted in a significant increase in identification of missed injuries at our institution. While this may seem counterintuitive to the idea of better care provided by NPs, it is believed that staff dedicated solely to the trauma service has improved patient outcomes. Outside films are re-read at the trauma center to verify injuries identified at the outside facility as well as to ascertain additional injuries. The trauma NP is responsible for overseeing completion of this task.

In addition, a clear and consistent method of performing tertiary examinations and chart documentation was implemented. A trauma NP evaluates the patient in the timeframe established for the tertiary examination and conducts a full subjective assessment of the child in conjunction with the family along with a complete head-to-toe physical examination. Examination also includes mobility, as some injuries become apparent upon mobilization of the child. The tertiary examination is documented within the daily progress notes completed by the trauma NP and the progress note title includes notation of a tertiary examination. The daily progress notes now include a comprehensive injury/problem list that is updated daily. Injuries are clearly delineated along with improvements, surgical interventions, and changes. This format was developed by the trauma NPs to highlight each patient's injuries or problems. The new format

helps the trauma registrar and/or process improvement specialist identify the missed injuries and track real-time issues that need to be addressed not only in specific patient management, but also throughout the broader trauma system. The detailed charting also assists other service lines in identifying potential issues. Therefore, having dedicated advanced practice staff with the trauma service has identified injuries that may have been missed during the primary and secondary surveys, as well during hospitalization, and each is able to be addressed in a timelier manner.

## CONCLUSION

Missed injuries were identified before the hiring of ACPNPs; however, with improvement in the chart documentation to include more thorough detail, there is now a consistent format for maintaining an ongoing injury/problem list, which is updated daily. Level I pediatric trauma centers are verified by the American College of Surgeons every 3 years. The ACPNPs now provide better documentation within the medical record as well as within the trauma registry. The result is a more robust process improvement program within our trauma center that can be demonstrated to the American College of Surgeons. In conclusion, a potential decrease in LOS could occur if missed injuries are identified and ad-

dresssed sooner. As the ACPNPs continue to practice in this role, we may be better able to identify if the care that they provide results in a decreased LOS for our patients. Future studies could look not only at LOS in the emergency department, but also at overall LOS in the hospital as well as staff and family satisfaction.

## REFERENCES

1. Shebesta K, Cook B, Schweer L, et al. Pediatric trauma nurse practitioners increase bedside nurses' satisfaction with pediatric trauma patient care. *J Trauma Nurs.* 2006;13(2):66-69.
2. Keijzers G, Campbell D, Hooper J, et al. A prospective evaluation of missed injuries in trauma patients, before and after formalising the trauma tertiary survey. *World J Surg.* 2014;38:222-232.
3. Karmazyn B, Lewis M, Jennings S, Hibbard RA, Hicks RA. The prevalence of uncommon fractures on skeletal surveys performed to evaluate for suspected abuse in 930 children: should practice guidelines change? *Am J Roentgenol.* 2011;197:W159-W163.
4. Chew E, Chong A. Hand fractures in children: epidemiology and misdiagnosis in a tertiary referral hospital. *J Hand Surg Am.* 2012;37(8):1684-1688.
5. Letton R, Worrell V, APSA Committee on Trauma Blunt Intestinal Injury Study Group. Delay in diagnosis and treatment of blunt intestinal injury does not adversely affect prognosis in the pediatric trauma patient. *J Pediatr Surg.* 2010;45:161-166.
6. Cook S, Fielding J, Phillips J. Repeat abdominal computed tomography scans after pediatric blunt abdominal trauma: missed injuries, extra costs, and unnecessary radiation exposure. *J Pediatr Surg.* 2010;45:2019-2024.

For more than 24 additional continuing education articles related to trauma nursing, go to [NursingCenter.com/CE](http://NursingCenter.com/CE).