

# Recognizing Nonaccidental Trauma in a Pediatric Tertiary Hospital: A Quality Improvement Imperative

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## Abstract

**Introduction:** Abusive injuries can go unrecognized or improperly managed by medical providers. This study sought to standardize the nonaccidental trauma (NAT) workup and improve NAT evaluation completion for children <7 months with concerning injuries in the pediatric emergency department (PED) and inpatient settings at an urban, tertiary care children's hospital. **Methods:** The quality improvement (QI) team created hospital guidelines for suspected NAT, including age-based recommendations (care bundle). The team embedded an order for NAT evaluation into the electronic health record (EHR). The QI team provided education on child abuse identification and evaluation across the hospital. Hospital providers received written guides focused on enhancing communication with families. Outcome measures included monthly NAT bundle use and cases between incomplete bundles in children with suspicious injuries. Chart review of incomplete bundles helped accurately identify patients who needed NAT bundles and improved accurate NAT bundle completion for appropriate patients. **Results:** Appropriate NAT bundle completion increased from 31% during the baseline period in January 2019 to 100% in April 2020 and remained at 100% for the remainder of the study period, ending June 2021. The number of patients between missed bundles was 11 from August 2019 until March 2020, when it increased to 583. There were no missed bundles from March 2020 through June 2021. **Conclusions:** Standardizing NAT evaluation and creating a NAT care bundle to facilitate the appropriate evaluation preceded an increase in appropriate bundle completion in patients <7 months old with possible NAT in the PED and inpatient units. (*Pediatr Qual Saf* 2023;8:e644; doi: 10.1097/pq9.000000000000644; Published online April 10, 2023.)

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## INTRODUCTION

### Background

In 2020 in the United States, 618,000 children were victims of child maltreatment, including 1750 deaths.<sup>1</sup> Subtle injuries and variation in provider recognition create challenges in identifying children with nonaccidental trauma (NAT).<sup>2-8</sup> Our hospital recently participated in the Timely Recognition of Abusive Injuries (TRAIN) Collaborative, a statewide quality improvement (QI) project to increase provider recognition and response to NAT.<sup>3,4</sup>

Following the TRAIN collaborative, our hospital recognized an ongoing need to improve identifying and managing patients with suspected NAT. As a result, our hospital has implemented institution-wide efforts to reduce preventable harm, including the “Zero Hero” concept (a goal to eliminate all avoidable patient harm<sup>9</sup>) and improve asthma care and sepsis management.<sup>10,11</sup> The strength of our QI infrastructure facilitated this project's success, which aimed to standardize the management of children with potentially abusive injuries.

### Evidence

Approximately 28% of infants diagnosed with physical abuse present to medical care with subtle injuries or

sentinel injuries, such as bruising or oral injuries.<sup>12</sup> These subtle injuries may be accompanied by occult abuse-related internal injuries that go undetected without further medical screening.<sup>13</sup> One study found 59 of 232 patients diagnosed with abuse-related head trauma had at least one opportunity in a medical setting to detect abusive injury before presenting with a head injury.<sup>14</sup> Recurrent or escalating abuse may occur if a child's care environment is unchanged.<sup>15,16</sup> Our analyses focused on patients <7 months old, as infants comprise nearly half (46%) of child abuse fatalities.<sup>1</sup> Infants typically develop more mobility around 6 months, making them more likely to sustain accidental injuries that may not warrant NAT evaluation.<sup>17</sup>

The American Academy of Pediatrics (AAP) and the American College of Radiology published suspected physical abuse evaluation recommendations,<sup>17,18</sup> though they have not been universally adopted.<sup>3,7,13,14</sup> Previous QI work evaluated the impact of screening tools, including checklists or electronic screening forms, to identify possible physical abuse.<sup>19–31</sup> Other studies targeted specific aspects of the NAT workup, including increased consults to a hospital child protection team.<sup>25,32–36</sup> One hospital developed pediatric emergency department (PED) NAT evaluation guidelines for patients <3 years old and observed modest improvement in provider adherence.<sup>37</sup> In contrast, our project implemented a multidisciplinary, hospital-wide suspected NAT clinical guideline based on AAP recommendations.

### Specific Aim

Our overall goal was to increase the completion of AAP-recommended workups (care bundles or “bundles”) in patients in the PED and inpatient settings with possible abusive injuries. Bundle elements included a social work consult for all patients and radiographic and laboratory studies based on patient age. For infants <7 months, the bundle included head computed tomography (CT), skeletal survey, AST, ALT, and social work consult. Figure 1 contains clinical guidelines created through this project, and Figure 2 lists indications for the care bundle.

We had 3 main project goals. Goal 1 was, “Are patients getting the appropriate NAT workup?” Goal 2 was, “Are we doing the bundle on the right patients?” For Goal 2, we utilized chart reviews for patients with incomplete bundles to determine if those patients should have received the entire bundle. Goal 3 was, “Are we sustaining our efforts to do the right workup on the right patients?” Once we better categorized patients with possible NAT by chart review of incomplete bundles, the rate of complete bundles in suspicious injuries was nearly 100%. Therefore, for Goal 3, we began counting cases of suspicious injuries with complete bundles between patients with suspicious injuries with incomplete bundles. Our specific aim was to increase the number of cases of suspicious injuries with complete bundles between cases of

suspicious injuries and incomplete bundles from 10 to 60 cases from 2019 to 2020.

## METHODS

### Context

Nationwide Children's Hospital (NCH) is a large, free-standing, urban pediatric tertiary care center. The PED encounters over 90,000 unique patients annually. NCH has uninterrupted laboratory and radiology capabilities and in-person PED social work (SW) coverage. The Child Assessment Team (CAT), a team of child abuse pediatricians and SW, performs in-person consults on admitted patients with suspected NAT and phone consults for the PED and any NCH or community provider. NCH's Institutional Review Board exempted this project from human subject research review.

### Definitions

**NAT care bundle:** physical abuse workup based on AAP guidelines. For age < 7 months, the bundle included a head computed tomography (CT), skeletal survey, AST, ALT, and social work consult.

**Suspicious injury with a complete bundle (suspicious/complete case):** all NAT bundle elements obtained on a patient with concerning injuries.

**Suspicious injury with an incomplete bundle (suspicious/incomplete case):** a patient with a concerning injury who did not get all NAT bundle elements. Example: a patient with an injury concerning for NAT who had all bundle elements obtained except the AST level.

**Accidental injury without completed bundle (accidental/not complete case):** the entire NAT bundle was not indicated on a patient with accidental injury. Example: a patient with a dog bite who did not get the bundle.

**Inclusion Criteria:** Patients were included if they had at least 1 of the following:

- 1) hospital encounter billed with ICD-10 injury codes from a predefined TRAIN list (see supplemental data <http://links.lww.com/PQ9/A475>);
- 2) skeletal survey order;
- 3) radiology order with indication including “abuse” or “nonaccidental trauma”;
- 4) completed SW note;
- 5) report to child protective services (CPS) and/or law enforcement.

**Denominator:** All patients <7 months meeting at least 1 inclusion criteria

**Numerator for Goal 1:** patients <7 months meeting inclusion criteria who underwent all NAT bundle elements

**Numerator for Goal 2, or “Appropriate Bundle Application”:** eligible patients with suspicious injuries undergoing all bundle elements or patients with accidental injuries without a completed bundle. Of note, a patient



## Evidence Based Practice Guideline Non-Accidental Trauma

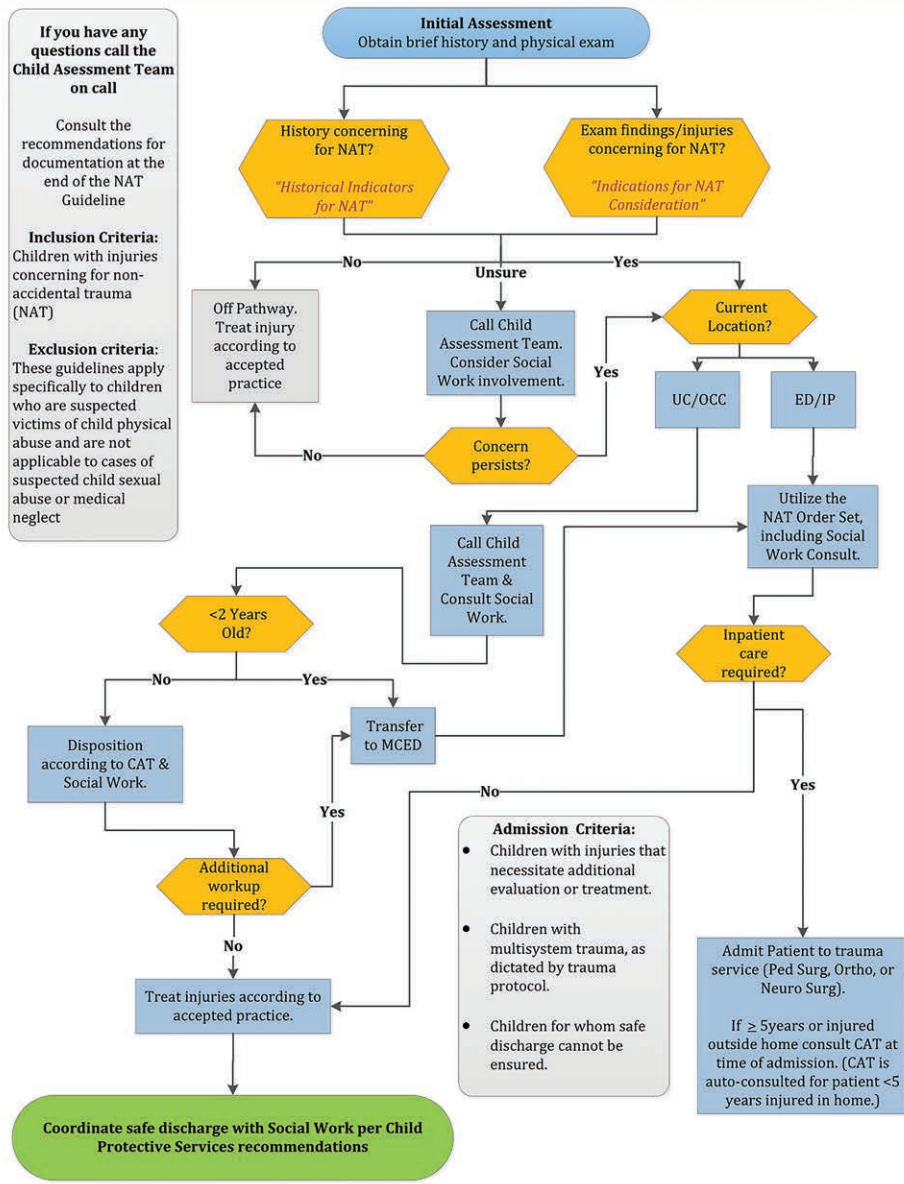


Fig. 1. Evidence-based practice guideline for nonaccidental trauma.

with an accidental injury might have had some bundle elements (ie, a skeletal survey) and still could be considered an “appropriate bundle application.”

### Interventions

This QI effort started in 2018 and involved individuals from departments likely to care for injured patients, including PED, CAT, SW, trauma surgery, orthopedic surgery, hospital pediatrics, and primary care. The team used Institute for Healthcare Improvement processes to

develop a key driver diagram, intervention strategies, and analyses (Fig. 3).

We initially focused on interventions to help providers order correct labs, imaging, and social work consult for suspected NAT. First, the primary intervention involved creating and implementing a NAT clinical guideline in the PED and inpatient settings in January 2020, with a correlating suspected NAT order bundle. The clinical guideline was stratified by age per AAP guidelines (Fig. 1).<sup>16</sup> The hospital integrated the

# Indications for NAT Consideration

<7 months	7-12 months	12-24 months	2-5 years	>5 years
Unexplained fussiness, vomiting or altered mental status Cutaneous injuries (single bruise, burn, bite mark) Intraoral injury Subconjunctival hemorrhage Intracranial hemorrhage Fractures: • Rib • Scapula • Vertebral • Sternum • Hands/feet • Any long bone • Metaphyseal fracture • Multiple fractures Sibling of child with suspected physical abuse	Unexplained fussiness, vomiting or altered mental status Bruising: • Unusual location • Pinna • Neck • Torso • Buttocks Patterned bruising, burns, or bite mark Subconjunctival hemorrhage w/o persistent cough or vomiting Intraoral injury w/o plausible accidental mechanism (including frenula) Fractures: • Rib • Scapula • Vertebral • Sternum • Hands/feet • Any long bone • Metaphyseal fracture • Multiple fractures Injury inconsistent with developmental ability or with accidental mechanism described Sibling of child with suspected physical abuse	Unexplained altered mental status and vomiting Bruising: • Unusual location • Pinna • Neck • Torso • Buttocks Patterned bruising, burns, or adult bite mark Subconjunctival hemorrhage w/o persistent cough or vomiting Fractures: • Rib • Scapula • Vertebral • Sternum • Hands/feet • Multiple fractures Injury inconsistent with developmental ability or with accidental mechanism described Sibling of child with suspected physical abuse	Unexplained altered mental status Bruising: • Unusual location • Pinna • Neck • Torso • Buttocks Patterned bruising, burns, or adult bite mark Subconjunctival hemorrhage w/o persistent cough or vomiting Fractures: • Rib • Scapula • Vertebral • Sternum • Hands/feet • Multiple fractures Injury inconsistent with developmental ability or with accidental mechanism described Sibling of child with suspected physical abuse	Unexplained altered mental status Bruising: • Unusual location • Pinna • Neck • Torso • Buttocks Patterned bruising, burns, or adult bite mark Fractures: • Rib • Scapula • Vertebral • Sternum • Hands/feet • Multiple fractures Injury inconsistent with developmental ability or with accidental mechanism described Sibling of child with suspected physical abuse

If any of these indications are noted, utilize the NAT Order Set. If you have any questions, call the Child Abuse Team on call.

Fig. 2. Indications for nonaccidental trauma consideration.

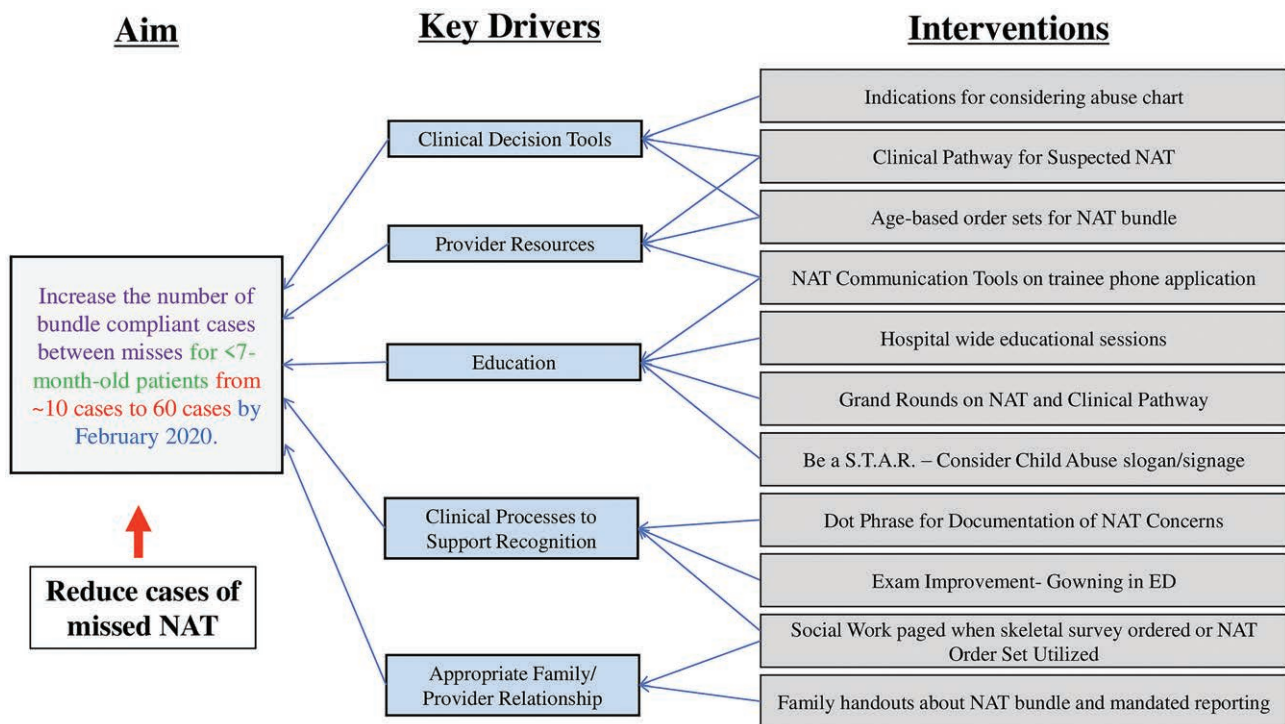


Fig. 3. Key Driver Diagram.

bundle into the electronic health record (EHR; Epic Systems Corporation, Verona, Wis.) using an age-based order set. There was no EHR prompt for providers to

complete the bundle; the order set was available as a suggested order set, or providers could search for the order set.

Second, the QI team created a visual chart, “Indications for NAT Consideration” (Fig. 2), which included age-based examples of injuries often associated with abuse. Providers accessed the guidelines and indications chart through the hospital intranet or paper copies placed at workstations throughout the institution.

Third, CAT providers taught sessions reviewing NAT identification and evaluation. Hospital pediatrics, pediatric emergency medicine, orthopedic surgery, trauma surgery, radiology, primary care providers, nursing, physical therapy, and occupational therapy participated in 20- to 60-minute educational sessions. Finally, to highlight the new guideline, CAT providers gave a Pediatric Grand Rounds presentation in February 2020.

Fourth, aligning with institution-wide “Zero Hero” safety initiatives, the QI team worked with hospital marketing to develop a NAT-specific communication tool.<sup>14</sup> “Be a S.T.A.R. - Consider Child Abuse” was incorporated into presentations, handouts, and digital signage throughout the institution (see supplemental material <http://links.lww.com/PQ9/A474>).

Fifth, the QI team provided multiple electronic and written resources to facilitate family communication and documentation of NAT concerns because hospital staff had requested scripting materials. SW created 2 caregiver handouts: 1 described the NAT workup, and the other provided information regarding mandated reporting. The QI team developed written scripts for medical trainees with strategies to discuss NAT with families. CAT providers produced standardized EHR phrases providers could utilize to document NAT concerns.

Sixth, a protocol was developed for the PED and hospital-affiliated urgent cares (UC) to undress and gown patients ≤12 months to facilitate head-to-toe cutaneous exams and injury identification. This practice was dubbed “One and Down in a Gown.” The QI group targeted infants at higher risk for undetected nonaccidental injuries.<sup>1</sup> CAT providers included the importance of complete skin examinations in their educational sessions. Posters in workrooms served as reminders. Nurses used in-person audits and an EHR flowsheet to verify infant gowning.

### Outcome Measures

#### GOAL 1: Do the right work up

To measure the effects of the interventions, we sought to capture the proportion of eligible patients with the entire bundle completed (Fig. 4 – January through July 2019).

#### GOAL 2: Completing the bundle for the right patients

Inclusion criteria were intentionally broad to capture as many patients as possible; therefore, many eligible patients did not truly need a bundle. Before the study, CAT providers reviewed a subset of patients and estimated that 45% of eligible patients would have suspicious findings requiring the bundle. At the project onset, there was no method to accurately differentiate patients with suspicious injuries who needed the bundle versus patients with

an accidental injury in whom a bundle was not indicated (eg, laceration from a fingernail trim).

To identify patients requiring a bundle, we flagged eligible patients with 1 or more missing bundle elements as “cases requiring review.” Then, starting in August 2019, CAT providers performed manual chart reviews on all “cases requiring review” and determined if a bundle was indicated. Reviews occurred quarterly, and no patient care interventions were completed retroactively.

Before starting the chart review, the project numerator was eligible patients who received a NAT bundle, regardless if the injury was accidental or suspicious. After the initiation of chart review, the numerator included patients with accidental injuries without completed bundles (accidental/not complete cases) and suspicious injuries with complete bundles (suspicious/complete cases) (Fig. 4). The denominator was unchanged and included all patients <7 months meeting inclusion criteria.

#### GOAL 3—Sustaining the Right Workup for the Right Patients

As a result of more granular data collection from the “cases requiring review,” the QI team more accurately categorized patients into the numerator. The rate of suspicious/complete cases plus accidental/not complete cases (ie, “appropriate bundle application”) rose to 100% and was sustained. We, therefore, shifted to count the number of cases with appropriately applied bundles between suspicious/incomplete cases (Fig. 5). As suspicious/incomplete cases were uncommon, we utilized a g-chart/t-chart as a more nuanced measure of change.

### Process Measure

The PED and UC protocol for undressing infants 12 months and under (“One and Down in a Gown”) utilized a p-chart to assess the shift in the percentage of infants placed in a gown before the provider’s examination (Fig. 6). In addition, we gathered information about patient gown status from in-person audits and nursing EHR flowsheets.

### Analyses

The team utilized statistical process control charts to assess baseline data, outcomes, and process measures. The process stage mean was plotted on a p-chart along with a monthly percentage of appropriate bundle applications. Nelson rules determined centerline shifts.<sup>38</sup> Special cause variation was applied to the outcome measure G-chart due to a data point outside the control limits.

## RESULTS

### Study Population

There were 952 patients <7 months who met the study inclusion criteria. Approximately 25.5% of included patients were identified by criteria other than ICD-10 codes.

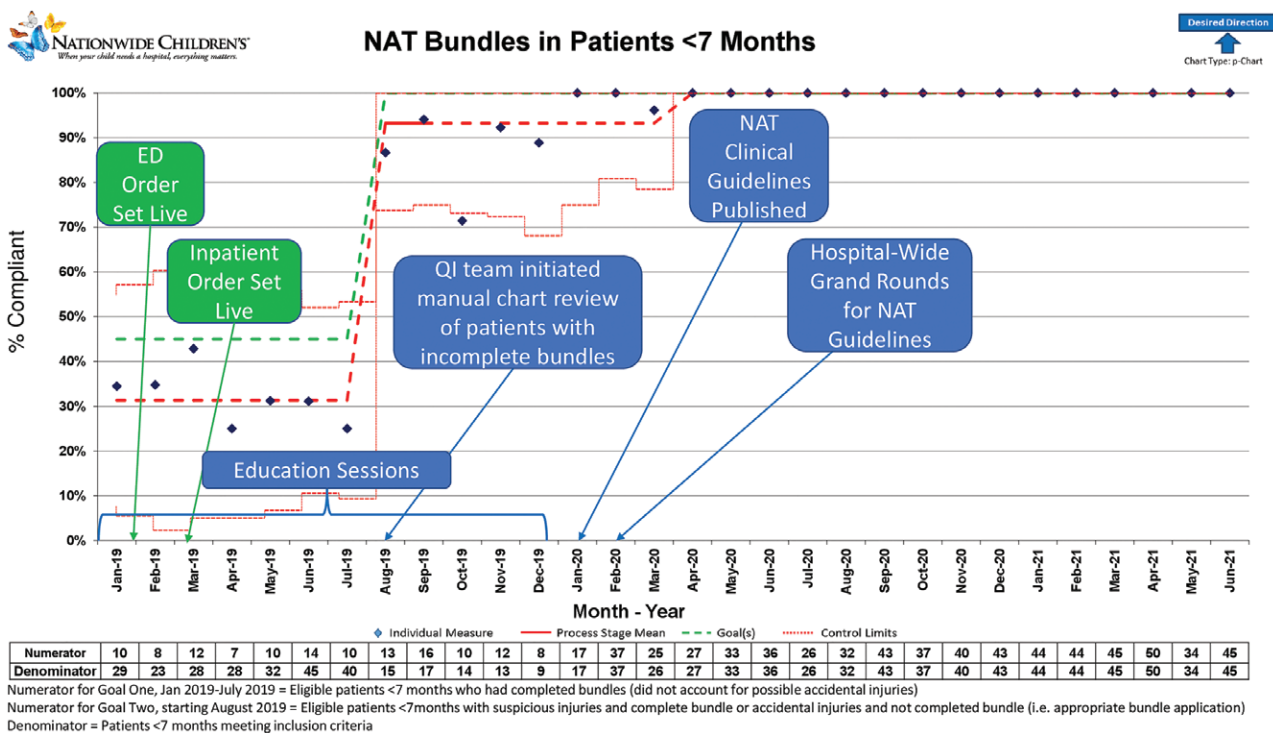


Fig. 4. NAT Bundles in Patients <7 months old.

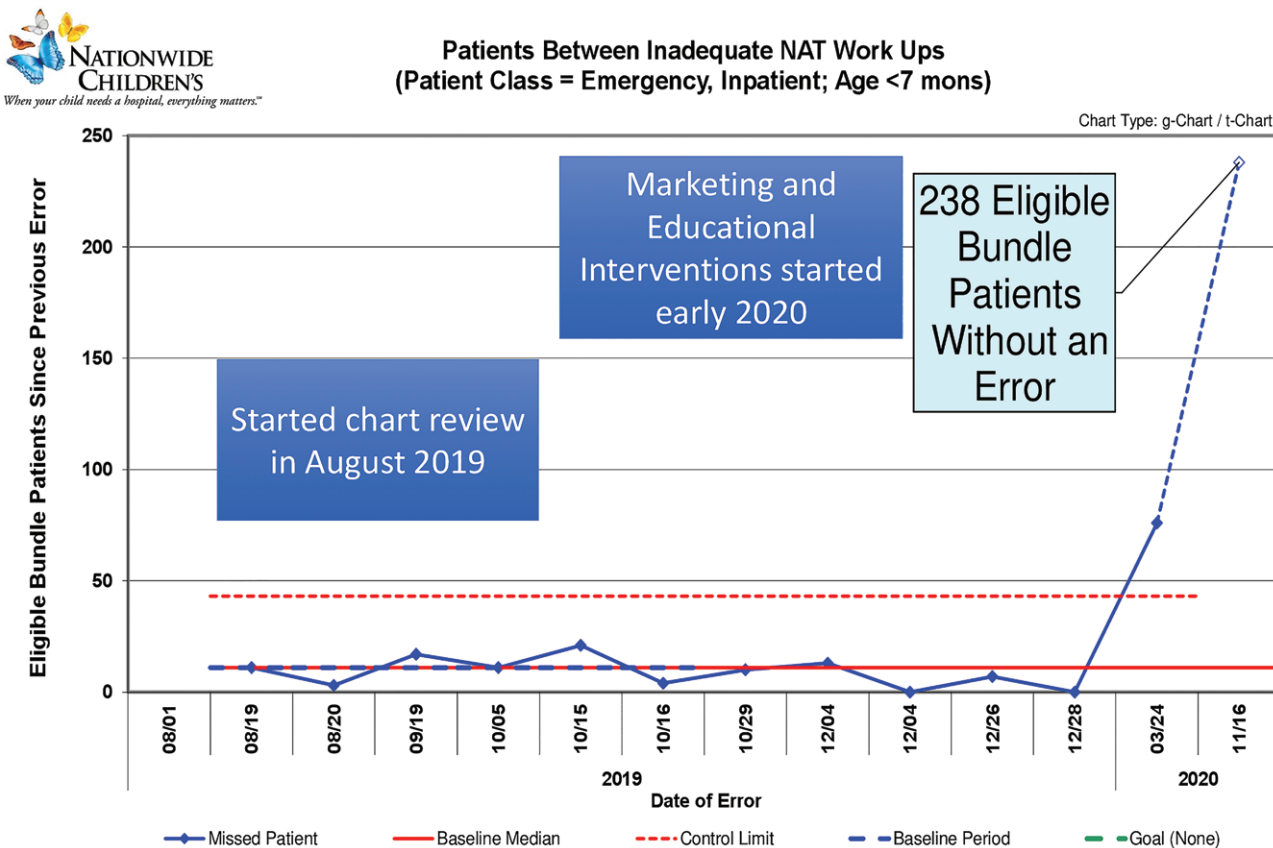


Fig. 5. Patients between inadequate nonaccidental trauma (NAT) workups.

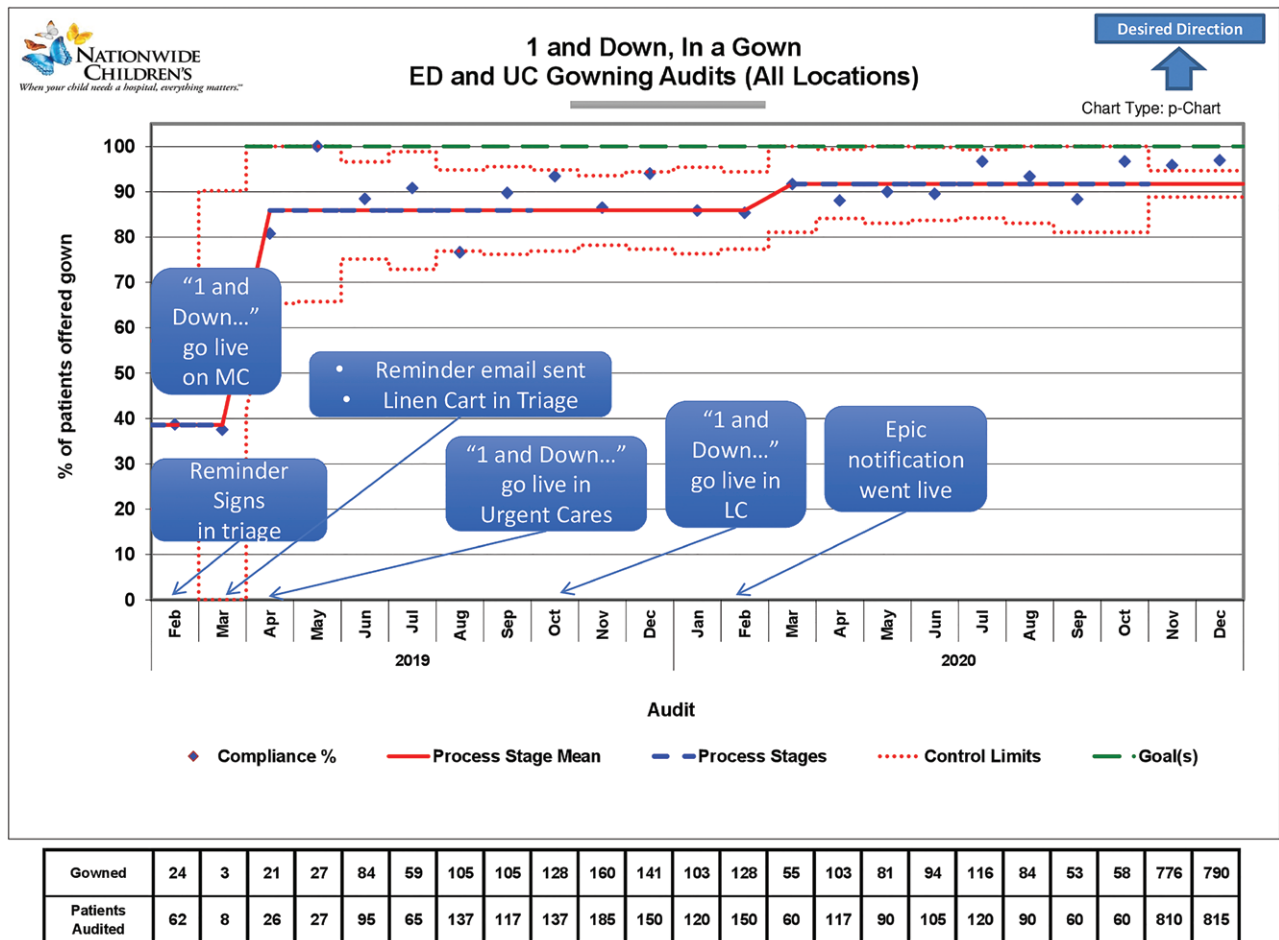


Fig. 6. “One and Down in a Gown” process measure.

**Outcome Measure – NAT Bundles in Patients <7 Months**

The initial proportion of completed NAT bundles among all eligible patients was 31% in early 2019; then, the proportion increased to 90% in mid-2019 (Fig. 4.) Another increase in the proportion of appropriate bundle applications went from 93% to 100% with narrowed control limits which occurred in March 2020. The centerline remained at 100% after March 2020. Figure 5 shows cases between suspicious/incomplete cases increased from 11 to 76 patients in March 2020. From March 2020 to June 2021, 583 consecutive eligible patients had appropriate bundle applications, with no suspicious/incomplete cases.

**Cases Requiring Review**

Of the 559 “cases requiring further review,” 481 were accidental injuries without a completed bundle, which is considered an appropriate bundle application. Forty patients had suspicious injuries and a complete bundle but were inaccurately reported as incomplete; 22 died before NAT evaluation, and 12 left without being seen by a provider. Four cases (0.7%) reviewed were suspicious injuries with an incomplete bundle.

**Child Protective Service Reports**

From March 2019 through June 2021, NCH made 313 CPS reports for physical abuse concerns among patients <7 months old, with 182 reports from the PED. Fifty percent (157/313) of reports were made in patients < 3 months old.

CAT physicians established a physical abuse follow-up clinic in October 2020 for patients with NAT evaluations. Patients under 2 years had follow-up skeletal surveys just before the clinic visit. Seven clinic patients had repeated CPS reports due to findings during follow-up visits or follow-up skeletal surveys.

**Process Measure – One and Down in a Gown**

Two months before implementing the “One and Down in a Gown” process, in-person audits of gowning practices revealed a baseline of 38% of infants gowned in the PED and UC (Fig. 6). However, after the intervention in April 2019, the number of infants gowned increased from 38% to 86%. Another increase from 86% to 92% occurred in March 2020. Therefore, the QI team began utilizing data from EHR nursing flowsheets in November 2020 to track gowned infants rather than in-person audits. After this

approach, the percentage of infants in gowns increased to 95% (Fig. 6).

## DISCUSSION

This study implemented a NAT clinical guideline and order set. It demonstrated an increase in patients <7 months with appropriate bundle application—that is, suspicious injuries with a completed AAP-recommended NAT evaluation (care bundle) or accidental injuries without a completed bundle. The rates of appropriate bundle application remained high after interventions and chart review. Other studies on improving NAT evaluations focused on specific elements, such as a skeletal survey<sup>33–35</sup> or child abuse specialist consultation.<sup>27,32</sup> Some published interventions relied on the EHR to aid in detecting abuse concerns<sup>28,30</sup> or patient screening tools.<sup>19–26,29,31</sup> One QI project improved NAT bundle adherence from 47% to 69% among 640 eligible patients <3 years old. However, this study only included the PED and had narrower inclusion criteria.<sup>37</sup> In contrast, our study included broad inclusion criteria to capture as many NAT cases as possible, and education targeted multiple specialties across the institution.

We initiated a chart review by CAT providers to ensure appropriate bundle application (Goal 2). This review revealed improved rates of suspicious/complete and accidental/incomplete cases. We do not consider chart review a discrete intervention as it did not change the action of providers, although it is an improvement in outcome measurement. We believe the increase in suspicious/complete and accidental/not complete cases was related to QI interventions and ongoing NAT education sessions, as the increase in Figure 4 followed the institutional NAT clinical pathway release in January 2020 and the Pediatric Grand Rounds presentation in February 2020 by CAT providers. Scripting materials for providers may have increased appropriate bundle application by boosting medical providers' confidence in discussing abuse concerns with caregivers. Encouraging SW involvement with suspected NAT provided additional support to providers.

We did not eliminate cases of accidental injuries with completed NAT workups. We did not want to negate providers' concerns for NAT, and our target was to reduce suspicious/incomplete cases rather than reduce accidental cases with complete bundles. We recognize that eliminating accidental cases with completed bundles would affect the outcome measure and could lower the centerline in Figure 4. Future studies to decrease unnecessary NAT evaluations could be useful.

An increase in the percentage of patients <7 months with injuries receiving appropriately applied bundles occurred in early 2020. The last suspicious/incomplete case occurred in March 2020. There was also an increase in "One and Down in a Gown" compliance around this time. The COVID-19 pandemic and subsequent decrease

in patient volumes might have led to providers having more time to consider NAT or gowning infants. Still, the Grand Rounds presentation on NAT and the clinical guideline release also likely helped. While the pandemic limits generalizability, the cases between suspicious/incomplete cases remained consistently low since patient volumes have normalized.

Our study increased gowning of infants to facilitate head-to-toe examinations in ED and UC settings to help with injury identification. Barriers to gowning included increased laundry costs, patient discomfort, and concern for patient hypothermia. Hospital leadership and frontline staff support were instrumental to successful implementation. For example, patient care assistants recommended the placement of blanket warmers in strategic locations to offset patient discomfort concerns. We could not find literature on infant gowning practices to facilitate cutaneous exams. However, the authors are anecdotally aware of sites utilizing a similar policy. Our study did not evaluate if more cutaneous injuries were identified, although this could be a future analysis.

The overall goal of this QI work was to increase the detection of possibly abusive injuries in children and standardize our institutional NAT approach. As a result, our hospital had 583 consecutive eligible patients with suspicious injuries undergoing complete bundles versus our baseline of 11 eligible patients between suspicious/incomplete cases. Although our inclusion criteria may not identify all abused patients, the decreased suspicious/incomplete cases indicate that our hospital-wide, multidisciplinary interventions and education positively impacted abuse identification and evaluation.

### Limitations

Calculating NAT rate changes is challenging because we can never ensure that we have identified every abuse case. The hospital coding staff or providers may not have assigned appropriate ICD-10 injury diagnoses. It is difficult to define inclusion criteria for NAT evaluation without knowing which children are abused. This study did not investigate if patients had previous healthcare encounters with concerning injuries and no NAT workup (ie, possible missed abuse). Appropriate bundle completion was a proxy in this study for child abuse identification.

Our institution offered significant resources to support this initiative which might not be available at all institutions, such as readily accessible child abuse pediatricians, SW, and laboratory/radiology services. Additionally, manual chart review requires significant time and may not be feasible at a hospital without adequate resources.

### Next Steps

Future analyses could include NAT evaluations in older children, CPS report outcomes, and assessment of balancing measures such as PED length of stay or unneeded head CTs, skeletal surveys, or laboratory testing.



## CONCLUSIONS

This QI study demonstrated that a standardized age-based NAT evaluation guideline and order bundle for the PED and inpatient units increased appropriate physical abuse workups in children <7 months old. Chart review of incomplete bundles more accurately categorized patient injuries as accidental versus suspicious for abuse. Multiple disciplines, including surgical subspecialties and SW, were integrated into the QI group to maximize the involvement of teams caring for injured patients. These practices could be employed at other children's hospitals or emergency departments or adapted to ambulatory settings to improve physical abuse identification and evaluation.

## DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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