Child Physical Abuse: Development of a Screening Guideline

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Disclosure

There are no relevant disclosures to present.
Objectives

1. Identify the risk factors and systematic screening programs that may help avoid escalation injuries which contribute to worse outcomes

2. Develop a Process Improvement Plan to effectively monitor screening for child abuse

3. Recognize that 48% child fatalities each year are a result of physical abuse, and 29.7% of the child fatalities had at least one prior Child Protective Services (CPS) contact.

4. Endorse the concept of child physical abuse as a traumatic disease that justifies the resource utilization of a trauma system to assess, stabilize and manage this patient population in a standardized fashion
Definitions I – Child Maltreatment

• The CDC definition of child maltreatment is “any act or series of acts of commission or omission by a parent or other caregiver that results in harm, potential for harm, or threat of harm to a child.” [1]

• Child maltreatment refers to acts of commission (deliberate or intentional inflicted injury referred to as child abuse or nonaccidental trauma [NAT]) or omission (failure to provide for a child’s needs resulting in harm or injury referred to as neglect) in children under 18 years of age.
  • Physical abuse, sexual abuse, and psychological abuse are types of abuse resulting from acts of commission.
  • Acts of omission or neglect (e.g., delay in bringing the injured child to care, not using vehicle restraints, or inappropriate supervision) can worsen outcomes when the child is abused.

Definitions II – Physical Abuse

• **Physical abuse** includes physical acts ranging from those leaving no physical mark on the child to those causing permanent disability, disfigurement, or death. It can result from discipline or physical punishment. Physical acts can include hitting, kicking, punching, beating, stabbing, biting, pushing, shoving, throwing, pulling, dragging, dropping, shaking, strangling/choking, smothering, burning, scalding, and poisoning. [1]

• “In the trauma bay, let’s call ‘non-accidental trauma’ (NAT) what it is: blunt force trauma. To be even more accurate, we should call it blunt force trauma or assault secondary to child physical abuse, with or without neglect.” [2]

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• The Child Abuse Prevention and Treatment Act (CAPTA) (P.L. 100-294) (amended by the CAPTA Reauthorization Act of 2010 [P.L. 111–320]) establishes the standard legal definition of child abuse and neglect as “any recent act or failure to act on the part of a parent or caretaker which results in death, serious physical or emotional harm, sexual abuse or exploitation; or an act or failure to act, which presents an imminent risk of serious harm.” [1]

• All states, the District of Columbia and the U.S. Territories have laws that mandate the reporting of suspected child abuse to Child Protective Services (CPS).

Background

- 48% child fatalities each year are a result of physical abuse. [1]
- ~ 78.0% of child fatalities involved parents, and 29.7% of the child fatalities had at least one prior Child Protective Services (CPS) contact.
- The majority of these children are < 4 years old. [1]
- An estimated 1,750 children died from maltreatment in 2016, a 7.4% increase from 2012. [1]
- The annual societal cost of child abuse and neglect is estimated to be over $103 billion. [2]
- Identification of risk factors and systematic screening programs may help avoid escalation injuries. [3,4]
- Only 56% of cases are evaluated by a pediatric surgeon. [5]

Sentinel Injuries

• Sentinel injuries are injuries suspicious for physical abuse.

• These are poorly explained visible or detectable minor injuries such as bruising, musculoskeletal, head or minor oral injury including torn labial frenum (or frenulum) in a pre-cruising infant.[1]

• An expanded definition includes any injury with rates of abuse high enough to warrant routine evaluation for abuse.[1]

• Recognizing sentinel injuries provides an opportunity to identify and intervene with a child before the abuse.[2, 3]

Escalation Injuries

• After a child sustains one injury and remains in the same abusive environment without intervention, the child is more likely to sustain repeat events potentially resulting in a more severe or even fatal injury (escalation injury).

• Approximate 30% of children with abusive head trauma are evaluated by a physician and NAT is not recognized, and 30% were reinjured after the missed diagnosis, resulting in death in many cases. [1]

• Two additional studies reported similar findings associated with skeletal fractures in which physical abuse was previously missed. [2, 3]

• Recurrent NAT children significantly higher mortality 24.5% vs 9.9% for initial episode of NAT. [4]

Clinical Screening

• **Mass screening.** A tool is applied across the entire population of patients coming to the ED. Several Dutch studies (CHAIN-ER) about a mass screening program led investigators to caution others to consider cost effectiveness, as well as clinical and societal implications about this approach.

• **Selective screening.** A tool is applied to selected high-risk groups. Keep in mind that first the presenting injury must be detected and recognized as a sentinel injury. Screening tools with reasonable validity evidence include TEN-4 FACESp Bruising Clinical Decision Rule (BCDR), burns, and head injury (PEDIBIRN, PIBIS, PredAHT).

• **Multiphase screening.** Two or more screenings are applied at different times.
Timeline

- **Q2 2012:** Team of concerned physicians, led by pediatric surgery, begin ad-hoc meetings to discuss improving management of NAT cases
- **Q3 2012:** NAT Subcommittee formalized under MBCH Pediatric Trauma Committee
- **Q1 2013:** Hospital Practice Committee, Emergency Services Committee, and Quality Steering Council endorse system-wide initiative to address suspected NAT
- **Q2 2013:** Review of literature and development of standardized assessment tool begins
- **Q3 2013:** System-wide training about NAT and management of suspected NAT commences for emergency department staff
- **Q4 2013:** Philanthropic funds ($10,000) committed to retrospective analysis of NAT management in the absence of a standardized evaluation process in collaboration with MultiCare Institute for Research & Innovation
- **Q1 2014:**
  - System-wide implementation of standardized NAT assessment tool for suspected NAT
  - Retrospective review of NAT cases managed between 2010-2013 **without** standardized tool begins
- **Q3 2014:** Philanthropic funds ($30,000) committed to prospective analysis of NAT management using the standardized assessment tool (Heidner Charitable Trust and the MultiCare Health Foundation)
- **2014-2016:** Prospective evaluation of the utilization of resources following implementation of standardized NAT assessment tool
Red Flags

Thorough literature review identified three types of red flags:

**MEDICAL/SOCIAL HISTORY**
- Missing/inconsistent history
- Unwitnessed injury
- Delay in seeking care
- Prior ED visit(s)
- Domestic violence in home
- Premature infant
- Low birth weight or IUGR
- Chronic medical condition(s)
- Referral for suspected NAT

**PHYSICAL EXAM FINDINGS**
- Torn frenulum
- Failure to thrive
- Large head in infant
- Bruises on non-ambulating child
- Bruises in non-exploratory location (torso, ears, neck) in children < 4 years
- Bruises, marks, or scars in patterns suggesting hitting with an object
- Perineal bruising or injury

**RADIOGRAPHIC FINDINGS**
- Fractures in children < 2 years
- Rib fractures in infants
- Any fracture in non-ambulating children
- Undiagnosed, healing fractures
- Subdural or subarachnoid hemorrhage in children < 1 year

Adapted from Children’s Hospital of Pittsburgh of UPMC Clinical Guidelines © 2010
Publications


“The association of non-accidental trauma with historical factors, exam findings and diagnostic testing during the initial trauma evaluation.”


# Summary of Findings

<table>
<thead>
<tr>
<th>Category</th>
<th>Select associations with NAT, compared to non-abused children</th>
<th>Select “take home” messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bruising</td>
<td><strong>TEN-4 clinical prediction rule:</strong> bruising in children &lt; 4 years on trunk, ears, neck; or any bruising in infants &lt; 4 months</td>
<td><strong>TEN-4 bruising</strong> 97% sensitive, 84% specific for NAT → child abuse workup</td>
</tr>
<tr>
<td></td>
<td>Patterned, petechiae, large size, cheeks, ear, neck, head, truck, buttocks, arms</td>
<td>“When you don’t cruise, you don’t bruise.”</td>
</tr>
<tr>
<td></td>
<td>Less likely from abuse: Front of body, bony prominences, however “expected” bruising depends on developmental age/disability of the child</td>
<td></td>
</tr>
</tbody>
</table>

![Image of bruised area on chest and buttocks]
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<tbody>
<tr>
<td>Burns</td>
<td>Independent associations with confirmed abuse – age (2.1 vs. 5.0 years); chemical burn; contact burn; scald burn; feet; buttocks; perineum</td>
<td>Up to 25% children admitted to burn centers have been abused</td>
</tr>
<tr>
<td></td>
<td>Less likely from abuse: beverages, spill injuries with irregular margins, burns to chest and head (spills)</td>
<td>Most intentional burn injury is from scalds to buttocks, perineum, bilateral lower limbs, feet, unilateral limbs, multiple contact burns, or clearly demarcated edges ➔ child abuse workup.</td>
</tr>
</tbody>
</table>

Any burn in age < 5 years ➔ child abuse workup.
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<tbody>
<tr>
<td>Intra-cranial injury</td>
<td>Subdural hemorrhage, hypoxic-ischemic injury, diffuse axonal injury, metaphyseal fractures, rib fractures, retinal hemorrhages, apnea, seizures</td>
<td><strong>PEDIBIRN clinical prediction rule</strong> 96% sensitive, 43% specific for abusive head trauma (AHT) 1+ feature* in child &lt; 3 years ➔ child abuse workup</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PredAHT clinical prediction rule</strong> 72% sensitive, 86% specific for AHT 3+ features** in child &lt; 3 years ➔ child abuse workup</td>
</tr>
</tbody>
</table>

*Acute respiratory compromise before admission; bruising of the torso, ears, or neck; bilateral or interhemispheric subdural hemorrhages or collections; and any skull fractures other than an isolated, unilateral, nondiastatic, linear, parietal fracture

** Retinal hemorrhage, rib and long-bone fractures, apnea, seizures, and head or neck bruising
## Summary of Findings

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</tr>
</thead>
<tbody>
<tr>
<td>Abdominal injury</td>
<td>Children with NAT and abdominal injury have a higher ISS, higher mortality, and often need an operation. It is important to note that intraabdominal injury may be found without bruising but in the presence of elevated LFTs.</td>
<td>Hollow viscus injury, particularly duodenal injury, in children &lt;4 years, combined hollow viscus + solid organ injury  ➔ child abuse workup</td>
</tr>
</tbody>
</table>
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<th>Category</th>
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</table>
| Skeletal injury                 | Fractures in children < 3 years and/or non-ambulating child  
Fractures proximal and mid-shaft humerus, femur fractures + non-ambulating child  
Rib fractures in absence of major trauma                                                                                                                                                                                                             | Fracture patterns inconsistent with degree of mobility and child age → child abuse work up  
Skeletal survey to screen for occult fractures is indicated for any child < 2 years with suspected NAT                                                                                                                                          |
# Skeletal Survey

<table>
<thead>
<tr>
<th>Complete</th>
<th>Skeletal Portion</th>
<th>Views to Obtain</th>
</tr>
</thead>
</table>
| Skeletal Survey | APPENDICULAR SKELETON (individual bilateral views) | Humerus (AP)  
Forearm (AP)  
Hand (PA)  
Femur (AP)  
Lower leg (AP)  
Foot (AP or PA) |
|          | AXIAL SKELETON                        | Thorax (AP), lateral, right and left obliques), to include sternum, ribs, thoracic and upper lumbar spine  
Pelvis (AP), to include the mid lumbar spine  
Lumbosacral spine (lateral)  
Cervical spine (AP and lateral)  
Skull (frontal and lateral) |
## Follow-Up Skeletal Survey

<table>
<thead>
<tr>
<th>Limited</th>
<th>Skeletal Portion</th>
<th>Views to Obtain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up Skeletal Survey</td>
<td>APPENDICULAR SKELETON (individual bilateral views)</td>
<td>Humerus (AP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forearm (AP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Femur (AP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower leg (AP)</td>
</tr>
<tr>
<td></td>
<td>AXIAL SKELETON</td>
<td>Chest (AP), bilateral oblique to include bilateral ribs</td>
</tr>
</tbody>
</table>

*Mary Bridge Children's MultiCare*
## Summary of Findings

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<th>Select associations with NAT, compared to non-abused children</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Oral injury</td>
<td>Frena injury + non-ambulating child</td>
<td>Lip injury is extremely common in accidental trauma and does not justify a child abuse work up</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td>Historical factors</td>
<td>Delay in care, inconsistent or implausible history, a history that changes or is developmentally incompatible, a report or concern for harm to the child, domestic violence</td>
<td>Children who present with a change in behavior + skeletal injuries, subdural hemorrhage with suspicious history, injury inconsistent with history, and delay in seeking care → child abuse workup</td>
</tr>
</tbody>
</table>
Conclusions

• The American College of Surgeons’ (ACS) Resources for Optimal Care of the Injured Patient mandates a process to generally assess, screen, treat, or refer a child suspected of maltreatment in all Level I and Level II pediatric trauma centers.

• Similarly, the ACS Optimal Resources for Children’s Surgical Care advocates for a child abuse team to be available full-time.

• All states, D.C. and the U.S. Territories have laws that mandate the reporting of suspected child abuse to CPS. The definitions are based on federal standards (CAPTA), although each state has its own standards.

• Most states require professionals to notify CPS in cases of suspected child abuse, but some states require all people to report their concerns.
Future Collaborations
Best Practice Guideline for Trauma Center Recognition of Family Violence: Child Abuse

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• The Ray E. Helfer Society

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Questions?
“Red Flag” - History of Present Injury

• No history or inconsistent history
• Changing history
• Unwitnessed injury
• Delay in seeking care
• Prior ED visit
• Domestic violence in home
• Premature infant (<37 weeks)
• Low birth weight/IUGR
• Chronic medical conditions
• Referral for suspected child abuse
“Red Flag” - Physical Exam Findings

• Torn frenulum
• FTT (weight, length, head circumference)
• Large heads in infants (consider measuring of OFC in children < 1yr)
• Any bruise in any non-ambulating child – “if you don’t cruise you don’t bruise:
  • Any bruise in a non-exploratory location TEN < 4
    • Torso – area covered by a girl’s bathing suit
    • Ears
    • Neck
• Bruises, marks, or scars in patterns that suggest hitting with an object
Sentinel Injuries

• Type of injury: Bruising 80%, intraoral injury 11% and other 7%.

• Occurred early in infancy: 66% at <3 months and 95% at or before 7 months of age.
“If you don’t cruise, you don’t bruise.”

TEN-4

• Torso
• Ears
• Neck

≤ 4 years of age
• Any region for infants < 4 months of age
• 97% sensitivity and 84% specificity

Bruises

• Bruises are the most common indication of physical abuse.

• Normally active children are likely to have bruises over bony prominences such as knees, shins, elbows, chin and forehead.
Abdominal Bruising
Bruises

- Bruises to side of face and neck
Bruises

- Bruises to side of face and neck
- Some injuries are “pathognomonic” for child abuse
Bruises

• Bruises to side of face and neck

• Some injuries are “pathognomonic” for child abuse
  • Patterned markings
Bruises

- Bruises to side of face and neck
- Some injuries are “pathognomonic” for child abuse
  - Patterned markings
  - Cigarette burns
Burns

- Immersion burn
Retinal hemorrhages and pathology
“Red Flag” - Radiographic Findings

- Metaphyseal fractures (corner) in infants
- Rib fractures (especially posterior) in infants
- Any fracture in a non-ambulating infant
- An undiagnosed healing fracture
- SDH and/or SAH on neuroimaging in young children, particularly in the absence of skull fracture < 1 year
Fractures

• Corner or “bucket handle” fractures: avulsion of a metaphyseal fragment from the lucent epiphyseal cartilage secondary to a twisting motion of the extremity.
Posterior rib fracture
Posterior rib fracture
Standardized NAT Assessment Tool

• Consult form built into the electronic medical record
• Prompts providers suspecting NAT to:
  • Collect data on all red-flags
  • Complete a standardized history & physical exam
  • Order a standard set of labs & skeletal surveys
  • Create referrals to ophthalmology (< 1 year old), child abuse intervention department, and pediatric surgery
• Put into system-wide use January 1, 2014
### MARY BRIDGE NON-ACCIDENTAL TRAUMA SCREEN CONSULT

**NAT Consult Form**

**Sample Screen Shot**

**Table:**

- **Chief complaint:**
  - @CC@

- **Physical Exam:**
  - Vital Signs: @VS@
  - Head circumference: [YES/NO:103916]
  - Length: [YES/NO:103916]
  - General Appearance: {APPEARANCE:104362}
  - Head: {PEDS PE HEAD:111905}
  - Eyes: {EYES:104341}
  - ENT:
    - [PEDS PE ENT:555150]
    - Torn frenulum? [YES/NO:103916]
  - Neck: {NECK:104343}
  - Chest: {PE lungs peds comprehensive:810514}
  - CV: {PEDS PE CV:555154}
  - Abdomen: {PE abd peds comprehensive:810517}
  - Anus: {ANUS:104769}
  - Perineal bruising or injury? [YES/NO:103916]
  - Genitourinary: {GENITOURINARY:104347}
  - Extremities: {EXTREMITIES:104348}
  - Neurological: {NEURO:104349}
  - Skin:
    - [Pods PE Skin:555157]
    - Bruising? [YES/NO:103916]
      - Age < 4 YO? [YES/NO:103916]; if yes:
        - Torso? [YES/NO:103916]
        - Ears? [YES/NO:103916]
        - Neck? [YES/NO:103916]
    - Scarring? [YES/NO:103916]
Tests Ordered/Reviewed:
- {SURG TESTS:104351}.
- **

LABS:
@LAB48R@
@AMYLASESERIAL@
@LIPASESERIAL@
@CRPSERIAL@
@ESRSERIAL@

LAST IMAGING:
- **
  - LFT's elevated? {YES/NO:103915}
    - If LFT's elevated to twice normal, then order CT of the abdomen & pelvis.
  - NAT Screen (Radiology)
    - Metaphyseal fractures (comer) {YES/NO:103915}
    - Rib fractures (especially posterior) in infants {YES/NO:103915}
    - Any fracture in a non-ambulating infant {YES/NO:103915}
    - An undiagnosed healing fracture {YES/NO:103915}
    - SDH and/or SAH on neuro-imaging in young children, particularly in the absence of skull fracture < 1 year {YES/NO:103915}

Impression:
- The patient is a @AGE@ @SEX@ who presents with **.
- Is there a suspicion for NAT? {YES/NO:103916}

Plan:
- **
  - {PLAN:104369}.
  - {CONSENT:107413}
  - The risks include but are not limited to: {Risks Surgical:113991}.
    - CAID referrals {YES/NO:103916}
    - Opho referrals {YES/NO:103916}
    - Skeletal surveys {YES/NO:103916}
    - Admission {YES/NO:103916}

Discussed with {FAMILY:104444} who expressed understanding and agreement with plan as outlined above.
I also updated Dr *** who consulted me for this patient.
Discharge

• Prior to hospital discharge: Care Team “HUDDLE INCLUDING ALL MEMBERS INVOLVED IN THE PATIENT’S CARE.”

• Phone communication team may be utilized as necessary

• Outpatient CAID (Child Abuse Intervention Department) follow-up as needed
Communication

• Inform parents if a CPS referral has been filed and/or if Child Advocacy is consulted

• Be direct and objective. Inform parents inflicted trauma is part of diagnostic consideration

• Keep the focus on the child. Avoid appearing judgmental. Assure parents of thoroughness of evaluation.

• If you are unable to have this conversation with the parents, ask SW or a senior colleague to do so.

• Developing a brochure to educate key external and internal stakeholders
ACE – Adverse Childhood Event

• Repetitive abuse may be verbal, visual, physical, sexual
• Altered cortisol levels
• Altered development of the amygdala and hippocampus
Retrospective Study

- 117 NAT patients seen from 2010 – 2013
- 37% (N=43) female, 63% (N=74) male
- 68% (N=80) of cohort < 1 year old
- 92% (N=108) of cohort < 4 years old
Medical/Social History

• Inconsistent or missing history provided by the caregivers in 89% of cases (N=104)
• Injury reported as unwitnessed in 79% of cases (N=88; NA=6)
• 38% of patients had a prior ED visit (N=43; NA=3)
  • 58% of these patients were < 1 year old (N=25)
• 41 – 73% of patients missing social history data
Physical Exam

• Bruising present in 57% of cohort (N=67)
  • 34% of these patients < 6 months old (N=23)
  • 45% of these patients < 9 months old (N=30)
  • 54% of these patients < 1 year old (N=36)

• Bruising in non-exploratory location (torso, ears, neck) present in 43% of patients < 4 years old (N=46)

• Perineal bruising or injury in 9% of cohort (N=11)
  • 73% of these patients < 4 years old (N=8)
  • 27% of these patients died from NAT injuries (N=3)
Radiographic Findings

• New fractures in 60% of the cohort < 1 year old (N=48)
• Undiagnosed, healing fractures in 29% of the cohort (N=32; NA=5)
• Of 50 patients with a subdural or subarachnoid hemorrhage (44% of cohort; NA=3), 86% < 1 year old (N=43)

• NA = MISSING DATA. Percentages are calculated with denominators based on available data.
Rib Fractures in Patients < 1 Year Old

• 33% of patients < 1 year old had rib fractures (N=26)
• Of these patients:
  • 88% also had undiagnosed healing fractures (N=23)
  • 77% male (N=20)
  • 77% ≤ 6 months old (N=20)
  • 54% also had extremity fractures (N=14)
  • 50% had an Injury Severity Score ≥ 16 (severe) (N=13)
Mortality

- 9 fatalities (7.7%) (8/9 bruising, 8/9 no or inconsistent history)

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Prior ED Visits</th>
<th>CPS History</th>
<th>Domestic Violence</th>
<th>Fractures</th>
<th>Hemorrhaging</th>
<th>Surgery</th>
<th>ED LOS (hours)</th>
<th>Hospital LOS (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3 mo</td>
<td>F</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>None</td>
<td>NA</td>
<td>No</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>4-5 mo</td>
<td>M</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Neuro</td>
<td>0.6</td>
<td>5</td>
</tr>
<tr>
<td>4-5 mo</td>
<td>M</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
<td>None</td>
<td>Yes</td>
<td>No</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>8-9 mo</td>
<td>F</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
<td>None</td>
<td>Yes</td>
<td>No</td>
<td>1.6</td>
<td>3</td>
</tr>
<tr>
<td>1.7 yr</td>
<td>F</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td>No</td>
<td>3.1</td>
<td>1</td>
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<tr>
<td>2.1 yr</td>
<td>M</td>
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<td>No</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>No</td>
<td>1.9</td>
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<td>4.7 yr</td>
<td>M</td>
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<td>No</td>
<td>Yes</td>
<td>None</td>
<td>NA</td>
<td>Ped</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
NAT ISS

Injury Severity Score ≥ 16 considered severe injury
Percentage of ISS ≥ 16 for NAT patients vs. all trauma patients

ISS ≥ 16

<table>
<thead>
<tr>
<th>Year</th>
<th>NAT Patients</th>
<th>All Trauma Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>39%</td>
<td>11%</td>
</tr>
<tr>
<td>2011</td>
<td>48%</td>
<td>11%</td>
</tr>
<tr>
<td>2012</td>
<td>52%</td>
<td>10%</td>
</tr>
<tr>
<td>2013</td>
<td>41%</td>
<td>11%</td>
</tr>
</tbody>
</table>
Prospective Study

• Implementation of standardized tool in 2014 to present
• Utilization of resources
# Study Cohorts

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 117</td>
<td></td>
<td>N = 72</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>%</td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Female</td>
<td>43</td>
<td>37%</td>
<td>33</td>
<td>46%</td>
</tr>
<tr>
<td>&lt; 1 year old</td>
<td>80</td>
<td>68%</td>
<td>43</td>
<td>60%</td>
</tr>
<tr>
<td>&lt; 4 years old</td>
<td>108</td>
<td>92%</td>
<td>64</td>
<td>89%</td>
</tr>
</tbody>
</table>

- Four patients in the retrospective cohort died in the Emergency Department
- One patient in the prospective cohort died in the Emergency Department
## NAT within Trauma Population

<table>
<thead>
<tr>
<th>Year</th>
<th>NAT</th>
<th>All Trauma</th>
<th>% NAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>23</td>
<td>354</td>
<td>6.5%</td>
</tr>
<tr>
<td>2011</td>
<td>23</td>
<td>442</td>
<td>5.2%</td>
</tr>
<tr>
<td>2012</td>
<td>27</td>
<td>609</td>
<td>4.4%</td>
</tr>
<tr>
<td>2013</td>
<td>44</td>
<td>557</td>
<td>7.9%</td>
</tr>
<tr>
<td>2014</td>
<td>33</td>
<td>530</td>
<td>6.2%</td>
</tr>
<tr>
<td>2015</td>
<td>39</td>
<td>582</td>
<td>6.7%</td>
</tr>
<tr>
<td>Total</td>
<td>189</td>
<td>3074</td>
<td>6.2%</td>
</tr>
</tbody>
</table>
Referrals

• Child Abuse Specialist referrals increased 97% to 100%

• Pediatric Surgery referrals for admitted patients increased 81% to 100%
## Severe ISS by Age Group

<table>
<thead>
<tr>
<th>Age group</th>
<th>Retrospective</th>
<th>Prospective</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>% Age Group</td>
</tr>
<tr>
<td>0 - 12 months</td>
<td>40</td>
<td>50%</td>
</tr>
<tr>
<td>1 - 4 years</td>
<td>10</td>
<td>36%</td>
</tr>
<tr>
<td>≥ 4 years</td>
<td>2</td>
<td>22%</td>
</tr>
<tr>
<td>Total</td>
<td>52</td>
<td>44%</td>
</tr>
</tbody>
</table>
## Mortality

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Prior ED Visits</th>
<th>CPS History</th>
<th>Domestic Violence</th>
<th>Fractures</th>
<th>Hemorrhaging</th>
<th>Surgery</th>
<th>ED LOS (hours)</th>
<th>Hospital LOS (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 mo</td>
<td>F</td>
<td>No</td>
<td>NA</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>2.2</td>
<td>1</td>
</tr>
<tr>
<td>1-2 mo</td>
<td>M</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>0.7</td>
<td>22</td>
</tr>
<tr>
<td>1-2 mo</td>
<td>F</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>2.0</td>
<td>24</td>
</tr>
<tr>
<td>2-3 mo</td>
<td>F</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>1.3</td>
<td>5</td>
</tr>
<tr>
<td>4-5 mo</td>
<td>F</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>6-7 mo</td>
<td>M</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>3.5 yr</td>
<td>M</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>1.3</td>
<td>3</td>
</tr>
</tbody>
</table>

Mortality: 7/72 (9.7%)
Use of Head CT

• Retrospective
  99/117 (84.6%)

• Prospective
  55/72 (76.4%)

Chi-squared p = .16
8.2% difference
95% CI: -3.6%, 20.0%
## ED LOS

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrospective</td>
<td>3.9 (2.4)</td>
<td>.3 – 11.1 hours</td>
</tr>
<tr>
<td>Prospective</td>
<td>4.1 (2.4)</td>
<td>.7 – 11.3 hours</td>
</tr>
</tbody>
</table>

### ED Length of Stay

![Box plot showing ED Length of Stay for Retrospective and Prospective methods.](image)
Admissions

• Retrospective
  106/113  93.8% required admission

• Prospective
  56/71   78.9% required admission

Chi-squared p = .002
14.9% difference
95% CI: 4.4 – 25.4%