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United States Data on Abusive Head Trauma

- 2008 CDC Conference identified set of ICD-9 & ICD-10 medical care codes suggestive of AHT
- Validated with national hospital discharge data and clinical samples
- One dataset: KIDS.
  - National Pediatric discharge data for 80% of all US hospitalizations available at 3 year intervals
- Second dataset: All children born to active duty servicemen and women paid for by TriCare
### VII. Figure 1. ICD-9-CM Codes for Defining NonFatal Abusive Head Trauma in Children under the Age of 5 Years

<table>
<thead>
<tr>
<th>Clinical Diagnosis Code</th>
<th>Injury Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ICD-9-CM Narrow Definition</strong></td>
<td><strong>ICD-9-CM Broad Definition</strong></td>
</tr>
<tr>
<td>781.0-781.4, 781.8, 800.1-800.4, 800.6-800.9, 801.1-801.4, 801.6-801.9, 803.1-803.4, 803.6-803.9, 804.1-804.4, 804.6-804.9, 850.0-850.9, 851.0-851.99, 852.0-852.59, 853.0-853.19, 854.0-854.19, 950.0-950.3, 995.55**</td>
<td>781.0-781.4, 781.8, 800, 801, 803, 804.1-804.4, 804.6-804.9, 850, 851, 852.0-852.5, 853.0, 853.1, 854.0, 854.1, 925.1, 950.0-950.3, 959.01, 995.55**</td>
</tr>
</tbody>
</table>

- **Definite or Presumptive Abusive Head Trauma**
- **Probable Abusive Head Trauma**

* Exclude case in the presence of a fall or accident code (see Appendix 3)
** Does not require a cause code
### Figure 2. ICD-10 Codes for Defining Fatal Abusive Head Trauma in Children under the Age of 5 Years

<table>
<thead>
<tr>
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<th>Clinical Diagnosis Code</th>
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<tbody>
<tr>
<td></td>
<td>ICD-10 Narrow Definition</td>
<td>ICD-10 Broad Definition</td>
</tr>
<tr>
<td><strong>Definite or Presumptive Abusive Head Trauma</strong></td>
<td>S06.0-S06.9, S09.7-S09.8, T90.5</td>
<td>S02.0-S02.1, S02.7-S02.9, S04.0, S06.0-S06.9, S07.1, S07.8-S07.9, S09.7-S09.8, T90.2, T90.5, T90.8-T90.9</td>
</tr>
<tr>
<td><strong>Probable Abusive Head Trauma</strong></td>
<td>All of those above</td>
<td>All of those above</td>
</tr>
</tbody>
</table>
National AHT rates (95% CI) by CDC AHT definition among children <1 year of age (2000–2009).


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Infant Abusive Head Trauma in a Military Cohort

- ICD data: US Defense Department Birth & Infant Health Registry
- 676,827 infants born 1998-2005
- Used medical records & CPS determinations
- Estimated rate of AHT: 34.0/100,000 births
  - Army: 38/100,000
  - Navy, Coast Guard: 45.3/100,000
  - Air Force: 35.3/100,000
  - Enlisted (lowest ranks): 107.5/100,000
  - Officer: 5.6/100,000
  - No university degree: 49/100,000
  - Maternal age <21: 87.2/100,000
  - Dual military married: 72.9/100,000
1Application of the Ellingson case definition criteria to Registry infants; 2Rates for the probable case definition include counts for substantiated and probable cases; 3Rates for the possible case definition are cumulative and include substantiated, probable, and possible cases.
Anonymous Parent Self-Report of Shaking Infants - Survey Data

- “Whole lotta of shakin’ going on”
  - Song written by Dave “Curlee” Willams and recorded by Jerry Lee Lewis
Our 2003 Survey in 2 states

- Survey of 1435 families in North & South Carolina
  - Survey of mothers asking how they or partners disciplined a randomly selected child under 18 in household
  - 2.6% of parents of children less than 2 reported use of shaking
  - Mothers shook 1.6%, fathers 1%
World Survey of Abuse and the Family Environment (WorldSAFE)

- Project developed by International Clinical Epidemiology Network (INCLEN)
- Surveys of randomly selected mothers ages 15-49 in 5 countries from defined population
- Index child selected at random
- Female graduate student interviewed mother in home
- Samples from geographically defined population
- Ismailia, Egypt; Manila, Philippines; Sao Paulo, Brazil; Temuco, Chile; + 14 community samples in India (& US by phone)
Shaking of children <2 even more common in Low and Middle Income Countries (Runyan, et al. Pediatrics 2010)

Shaking as Reported on the Parent-Child Conflict Tactics Scale - in Last Year
WORLDSAFE: Shaking of Children <2 & Education Tied Together

CORRELATION = -0.66
Prevention
Prevention Programs Impact Parent Self-Report

- in 2005 Mark Dias published shaken baby prevention report in *Pediatrics*
- 2007- Telephone survey of 2738 mothers in NC only 1% of children <2 (29) reported shaken
  - 60% of hospitals already providing some SBS education
- 2008-2012- distribution of educational video and media campaign to all NC new parents
- 2010- New survey of 2727 mothers in North Carolina- 0.35% of children<2 shaken (p<0.01)
Prevention

- Should be low-hanging fruit.
- Median age for cases is 4 months, nearly all in first year.
- Educational intervention need only last 4-6 months (unlike smoking or obesity prevention) until child too large to shake.
  - Patient Contract & nurse education in newborn period.
  - Decline in incidence from 41.5 cases/100,000 live births to 22.2 cases /100,000 during 5 year study period.
  - No decline seen in Pennsylvania (another state).
Education program produced by Ron Barr & the National Center on Shaken Baby Syndrome

- Short video & booklet on infant crying with message that all children cry & some cry 4-5 hours or more a day
- Children will outgrow this crying
- “Walk, talk and hug” - If that doesn’t work, put baby down on back & walk away to collect yourself
- Video to be taken home to share with other caregivers

Question: *Will preparing parents for crying babies prevent AHT?*
PURPLE Crying Intervention in NC

- Objective: assess statewide AHT prevention program
- Design: Intervention developed & delivered to 405,060 parents. Pre and post design.
- Intervention: newborn nursery video & booklet sent home with parent, booster reminder at 2 month check, and media campaign in 3 large markets in state
- Outcomes assessed by measuring:
  - parent report of shaking
  - After-hours calls to nurse helpline for infant crying
  - Hospitalizations for AHT in state
NC PURPLE Intervention Results

- Parent calls for crying in first 3 months declined 20% (p<0.001) and 12% for children 3-12 months in age (p=.03)
- No reduction in state level AHT admissions and deaths using active surveillance of 11 PICUs
  - 34.01/100,000 before intervention
  - 36.04 /1000,000 after intervention
- Difference-in-difference analysis to control for onset of great recession: No change. Beta coefficient -1.43 (-13.3, 10.45)
- Conclusion: No impact on hospitalizations or Deaths from AHT after spending $3 million over 5 years to educate the parents of 400,000 babies.
An Alternative Approach

- For motor vehicles, structure & design have greater impact than driver education
  - High School driver education increased deaths
    - More teens drove
  - The MV death rate was 27/100,000 pop in 1973 and is currently 10/100,000 due to engineering safer cars & roads
- Can we restructure communities & families to prevent AHT?
  - In 2002 California enacted Paid Family Leave to pay workers with an ill relative or new child for up to 6 weeks. Benefits began in 2004. Payments averaged $405-$526 over the years.
PFL - California and AHT

- Analysis: Difference-in-difference analysis with 7 other states

Rates per 100,000 children for AHT for California and for Arizona, Colorado, Florida, Iowa, Maryland, Massachusetts, and Wisconsin.
Results II

- Reduction of admission in Difference-in-difference analysis
  
  For age less than 1: Adjusted estimate -5.113, p=.035
  For age less than 2: Adjusted difference -2.799; p=.036

  This despite low uptake 38% of eligible households in 2014.

Overall, a reduction of 5/100,000 children in state with paid family leave in first year of life.
Controversies

- Despite press & legal enthusiasm, new research does not question AHT
- Little question among clinicians
- Issues such as neck trauma & biomechanics have turned out to support AHT & Shaking
- Facts that support existence of AHT
  - Military hospitals don’t diagnose children differently; 12 fold rate differences by age & income of parents reflect real differences
  - If there is no AHT, there should be no impact of prevention
Some final thoughts

- Our NC prevention program didn’t reduce hospitalizations
- A case-control study by Keenan & Leventhal in Utah & a trial in Colorado also failed to find an impact for educational programs
- A program altering family life in California produced promising results – the child abuse equivalent of automobile safety-engineer the environment
- If AHT doesn’t exist, why are there clear relationships between parental age and income in the military where the same hospitals and doctors see the patients?
- If AHT doesn’t exist, why does it act like a social phenomena susceptible to economic trends and prevention?