Pediatric Toxicology: Toddler & Teens

ACMT Annual Scientific Meeting
Huntington Beach, CA
March 19, 2016

Harvard Medical Toxicology Fellowship
MA/RI Poison Control Center
Boston Children’s Hospital Division of Emergency Medicine

Michele M. Burns, MD, MPH
Outline

• Epidemiology

• Approach to the Poisoned Patient: A, B, C, D, E
  ▫ Exam (Toxicidromes)
  ▫ Work-Up: Labs (D-stick), EKG

• Cases

• Poisoning Prevention
Epidemiology

What percentage of cases called to Poison Centers nationally involve “pediatric” cases (< 20 years)?

- A. 25%
- B. 33%
- C. 50%
- D. 67%
- E. 75%
Clinical Toxicology


James B. Mowry, Daniel A. Spyker, Louis R. Cantilena Jr, Naya McMillan & Marsha Ford

Clinical Toxicology 2014; 52: 1032-1283
Poisoning Epidemiology

- 2.2 million exposures reported to Poison Centers in 2013
  - 47.9% in children < 6 years old
  - 1218 fatalities overall with Top 7:
    - Sedative/Hypnotic/Antipsychotics
    - Cardiovascular Medications
    - Opioids
    - Stimulants and Street Drugs
    - Miscellaneous Alcohols
    - Acetaminophen (alone or in combination)

_Clinical Toxicology_ 2014; 52: 1032-1283
Figure 3. Health Care Facility (HCF) Exposure Calls and HCF Information Calls by Day since January 1, 2000. Regression lines show least-squares second-order regressions for HCF Exposure and HCF Information Calls. All terms shown were statistically significant for each of the two regressions (colour version of this figure can be found in the online version at www.informahealthcare.com/ctx).

Clinical Toxicology 2014; 52: 1032-1283
Figure 4. Change in Encounters by Outcome from 2000. The figure shows the percent change from baseline for Human Exposure Calls divided among the 10 Medical Outcomes. The More Serious Exposures (Major, Moderate, and Death) increased. The Less Serious Exposures (no effect, minor effect, not followed (non-toxic), not followed (minimal toxicity possible), unable to follow (potentially toxic), and unrelated effect) decreased after 2008. Solid lines show least-squares linear regressions for the change in More Serious Exposures per year (□) and Less Serious Exposures (○). Broken lines show 95% confidence intervals on the regression (colour version of this figure can be found in the online version at www.informahealthcare.com/ctx).

Clinical Toxicology 2014; 52: 1032-1283
Figure 5. Substance Categories with the Greatest Rate of More Serious Exposure Increase (Top 4). Solid lines show least-squares linear regressions for More Serious Human Exposure Calls per year for that category (□). Broken lines show 95% confidence interval on the regression. More Serious Exposures include Medical Outcome of Moderate, Major and Death (colour version of this figure can be found in the online version at www.informahealthcare.com/ctx).

Clinical Toxicology 2014; 52: 1032-1283
Table 3A. Age and Gender Distribution of Human Exposures.

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Male</th>
<th>Female</th>
<th>Unknown gender</th>
<th>Total</th>
<th>Cumulative total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>% of age group total</td>
<td>N</td>
<td>% of age group total</td>
<td>N</td>
</tr>
<tr>
<td>Children (&lt;20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1</td>
<td>58,132</td>
<td>51.83</td>
<td>53,698</td>
<td>47.88</td>
<td>329</td>
</tr>
<tr>
<td>1</td>
<td>172,707</td>
<td>52.03</td>
<td>158,747</td>
<td>47.82</td>
<td>508</td>
</tr>
<tr>
<td>2</td>
<td>174,346</td>
<td>52.40</td>
<td>157,886</td>
<td>47.45</td>
<td>498</td>
</tr>
<tr>
<td>3</td>
<td>81,745</td>
<td>54.55</td>
<td>67,776</td>
<td>45.23</td>
<td>319</td>
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<td>4</td>
<td>42,045</td>
<td>55.87</td>
<td>33,019</td>
<td>43.88</td>
<td>190</td>
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<tr>
<td>5</td>
<td>25,725</td>
<td>56.58</td>
<td>19,585</td>
<td>43.07</td>
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<tr>
<td>Unknown ≤ 5</td>
<td>953</td>
<td>46.24</td>
<td>809</td>
<td>39.25</td>
<td>299</td>
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<td>Child 6–12</td>
<td>78,140</td>
<td>57.82</td>
<td>55,802</td>
<td>41.29</td>
<td>1,203</td>
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<tr>
<td>Teen 13–19</td>
<td>63,767</td>
<td>41.64</td>
<td>88,527</td>
<td>57.81</td>
<td>843</td>
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<td>Unknown Child</td>
<td>1,685</td>
<td>41.05</td>
<td>1,385</td>
<td>33.74</td>
<td>1,035</td>
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<tr>
<td>Subtotal</td>
<td>699,245</td>
<td>52.11</td>
<td>637,234</td>
<td>47.49</td>
<td>5,383</td>
</tr>
<tr>
<td>Adults (≥20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20–29</td>
<td>87,238</td>
<td>46.45</td>
<td>100,402</td>
<td>53.46</td>
<td>173</td>
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<tr>
<td>30–39</td>
<td>63,400</td>
<td>43.11</td>
<td>83,524</td>
<td>56.80</td>
<td>130</td>
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<tr>
<td>40–49</td>
<td>52,726</td>
<td>41.51</td>
<td>74,213</td>
<td>58.42</td>
<td>89</td>
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<tr>
<td>50–59</td>
<td>47,450</td>
<td>40.19</td>
<td>70,556</td>
<td>59.76</td>
<td>68</td>
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<tr>
<td>60–69</td>
<td>30,050</td>
<td>37.99</td>
<td>49,011</td>
<td>61.96</td>
<td>39</td>
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<td>70–79</td>
<td>17,030</td>
<td>35.90</td>
<td>30,382</td>
<td>64.04</td>
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<td>80–89</td>
<td>9,729</td>
<td>34.04</td>
<td>18,823</td>
<td>65.96</td>
<td>15</td>
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<td>≥ 90</td>
<td>1,962</td>
<td>31.41</td>
<td>4,276</td>
<td>68.45</td>
<td>9</td>
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<td>Unknown adult</td>
<td>35,885</td>
<td>38.88</td>
<td>53,889</td>
<td>58.43</td>
<td>2,486</td>
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<tr>
<td>Subtotal</td>
<td>345,440</td>
<td>41.44</td>
<td>485,087</td>
<td>58.19</td>
<td>3,036</td>
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<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Unknown age</td>
<td>4,385</td>
<td>34.83</td>
<td>5,656</td>
<td>44.93</td>
<td>2,547</td>
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<tr>
<td>Total</td>
<td>1,049,070</td>
<td>47.95</td>
<td>1,127,977</td>
<td>51.55</td>
<td>10,966</td>
</tr>
</tbody>
</table>
Epidemiology

What types of ingestions are called to Poison Centers nationally in “pediatric” cases (< 20 years)?

- A. Alcohols
- B. Antidepressants
- C. Cardiac medications
- D. Cleaning substances
- E. Hormones
Table 17C. Substance Categories Most Frequently Involved in Pediatric (≤ 5 years) Exposures (Top 25)*.

<table>
<thead>
<tr>
<th>Substance (major generic category)</th>
<th>All substances</th>
<th>%b</th>
<th>Single substance exposures</th>
<th>%c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cosmetics/personal care products</td>
<td>151,154</td>
<td>13.82</td>
<td>148,040</td>
<td>14.52</td>
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<tr>
<td>Cleaning substances (household)</td>
<td>113,872</td>
<td>10.41</td>
<td>109,548</td>
<td>10.75</td>
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<tr>
<td>Analgesics</td>
<td>106,639</td>
<td>9.75</td>
<td>97,388</td>
<td>9.55</td>
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<tr>
<td>Foreign bodies/toys/miscellaneous</td>
<td>75,184</td>
<td>6.88</td>
<td>73,366</td>
<td>7.20</td>
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<tr>
<td>Topical treatments</td>
<td>66,893</td>
<td>6.12</td>
<td>65,756</td>
<td>6.45</td>
</tr>
<tr>
<td>Vitamins</td>
<td>47,816</td>
<td>4.37</td>
<td>43,355</td>
<td>4.25</td>
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<td>Antihistamines</td>
<td>45,250</td>
<td>4.14</td>
<td>40,983</td>
<td>4.02</td>
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<tr>
<td>Pesticides</td>
<td>35,254</td>
<td>3.22</td>
<td>34,246</td>
<td>3.36</td>
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<tr>
<td>Plants</td>
<td>29,346</td>
<td>2.68</td>
<td>28,296</td>
<td>2.78</td>
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<tr>
<td>Gastrointestinal preparations</td>
<td>28,481</td>
<td>2.60</td>
<td>25,883</td>
<td>2.54</td>
</tr>
<tr>
<td>Antimicrobials</td>
<td>27,928</td>
<td>2.55</td>
<td>26,294</td>
<td>2.58</td>
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<tr>
<td>Cold and cough preparations</td>
<td>25,708</td>
<td>2.35</td>
<td>23,647</td>
<td>2.32</td>
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<tr>
<td>Dietary supplements/herbs/homeopathy</td>
<td>24,638</td>
<td>2.25</td>
<td>22,550</td>
<td>2.21</td>
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<td>Cardiovascular drugs</td>
<td>23,124</td>
<td>2.11</td>
<td>14,645</td>
<td>1.44</td>
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<tr>
<td>Arts/crafts/office supplies</td>
<td>20,736</td>
<td>1.90</td>
<td>20,126</td>
<td>1.97</td>
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<tr>
<td>Hormones and hormone antagonists</td>
<td>20,522</td>
<td>1.88</td>
<td>15,869</td>
<td>1.56</td>
</tr>
<tr>
<td>Electrolytes and minerals</td>
<td>20,071</td>
<td>1.84</td>
<td>18,293</td>
<td>1.79</td>
</tr>
<tr>
<td>Deodorizers</td>
<td>17,555</td>
<td>1.61</td>
<td>17,354</td>
<td>1.70</td>
</tr>
<tr>
<td>Other/unknown nondrug substances</td>
<td>13,261</td>
<td>1.21</td>
<td>12,627</td>
<td>1.24</td>
</tr>
<tr>
<td>Sedative/hypnotics/antipsychotics</td>
<td>12,676</td>
<td>1.16</td>
<td>9,844</td>
<td>0.97</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>11,526</td>
<td>1.05</td>
<td>8,343</td>
<td>0.82</td>
</tr>
<tr>
<td>Alcohols</td>
<td>11,026</td>
<td>1.01</td>
<td>10,756</td>
<td>1.06</td>
</tr>
<tr>
<td>Information Calls</td>
<td>9,984</td>
<td>0.91</td>
<td>9,389</td>
<td>0.92</td>
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<tr>
<td>Hydrocarbons</td>
<td>9,947</td>
<td>0.91</td>
<td>9,622</td>
<td>0.94</td>
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<tr>
<td>Asthma therapies</td>
<td>9,923</td>
<td>0.91</td>
<td>9,112</td>
<td>0.89</td>
</tr>
</tbody>
</table>

*aIncludes all children with actual or estimated ages ≤ 5 years old. Results do not include “Unknown Child” or “Unknown Age”.

*bPercentages are based on the total number of substances reported in pediatric exposures (N = 1,093,578).

*cPercentages are based on the total number of single substance pediatric exposures (N = 1,019,297).

Clinical Toxicology 2014; 52: 1032-1283
Table 17E. Substance Categories Most Frequently Involved in Pediatric (≤ 5 years) Deathsa.

<table>
<thead>
<tr>
<th>Substance (major generic category)</th>
<th>All substances</th>
<th>%b</th>
<th>Single substance exposures</th>
<th>%c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fumes/gases/vapors</td>
<td>11</td>
<td>17.46</td>
<td>7</td>
<td>16.28</td>
</tr>
<tr>
<td>Analgesics</td>
<td>10</td>
<td>15.87</td>
<td>5</td>
<td>11.63</td>
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<tr>
<td>Unknown drug</td>
<td>7</td>
<td>11.11</td>
<td>6</td>
<td>13.95</td>
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<tr>
<td>Batteries</td>
<td>4</td>
<td>6.35</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>Alcohols</td>
<td>3</td>
<td>4.76</td>
<td>3</td>
<td>6.98</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>3</td>
<td>4.76</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Antihistamines</td>
<td>3</td>
<td>4.76</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Sedative/hypnotics/antipsychotics</td>
<td>3</td>
<td>4.76</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Cleaning substances (household)</td>
<td>2</td>
<td>3.17</td>
<td>2</td>
<td>4.65</td>
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<tr>
<td>Hydrocarbons</td>
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<td>3.17</td>
<td>2</td>
<td>4.65</td>
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<tr>
<td>Other/unknown nondrug substances</td>
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<td>3.17</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Pesticides</td>
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<td>3.17</td>
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<td>2.33</td>
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<td>Anesthetics</td>
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<td>2.33</td>
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<tr>
<td>Antineoplastics</td>
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<td>1.59</td>
<td>1</td>
<td>2.33</td>
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<tr>
<td>Bites and envenomations</td>
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<td>1</td>
<td>2.33</td>
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<tr>
<td>Cold and cough preparations</td>
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<td>1.59</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Deodorizers</td>
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<td>1.59</td>
<td>1</td>
<td>2.33</td>
</tr>
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<td>Foreign bodies/toys/miscellaneous</td>
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<td>Gastrointestinal preparations</td>
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<td>Industrial cleaners</td>
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<td>Miscellaneous drugs</td>
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<td>1</td>
<td>2.33</td>
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<td>Muscle relaxants</td>
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<td>0.00</td>
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<td>Stimulants and street drugs</td>
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<td>1.59</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>63</strong></td>
<td><strong>100.00</strong></td>
<td><strong>43</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

aIncludes all children with actual or estimated ages ≤ 5 years old. Results do not include “Unknown Child” or “Unknown Age”. Includes death and death, indirect regardless of RCF.
bPercentages are based on the total number of substances reported in pediatric fatalities (N = 63).
cPercentages are based on the total number of single substance pediatric fatalities (N = 43).
Pediatric Poisonings: Children < 6 years old

- Ingestions tend to be single agent, exploratory

- Though children < 6 years account for 47.9% of all exposures, they represented only 2.4% of reported fatalities

  - 2013 – 29 fatalities in children < 6 reported
    - 24/29 unintentional
    - 3/29 malicious
    - 2/29 unknown

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Which one is the drug?
Pediatric Poisoning: Children > 6 years old

- 6 fatalities reported in children ages 6-12
  - 4 environmental, 2 unknown

- 64 fatalities reported in children ages 13-19
  - 25% due to presumed suicides
  - 42% due to substance abuse/misuse

*Clinical Toxicology 2014; 52: 1032-1283*
Epidemiology:

Toddlers vs. Adolescents

- Male
- Unintentional
- Single Substance
- ↓ Fatalities
- **Substance Type**
  - Household
  - Plants
  - Analgesics
  - OTC meds

**Difficult History:**
- Uncooperative/preverbal patient
- Abuse
- Fear of parental discipline
- Get the Bottle!
- Safety/Prevention

- Female
- Intentional
- “Polypharmacy”
- ↑ Fatalities
- **Substance Type**
  - Drugs of Abuse
  - Prescription Meds
BCH Poisoning Admissions

Admissions by Age and Type of Ingestion

Type of Ingestion
- Unintentional
- Suicide
- Abuse/Intox
- Medication Error
- Other/Unknown

Number of Admissions

Age

O’Donnell KA & Burns M. Poster, PAS 2008.
Outline

• Epidemiology

• Approach to the Poisoned Patient: A,B,C,D,E
  ▫ Exam (Toxidromes)
  ▫ Work-Up: Labs (D-stick), EKG

• Cases

• Poisoning Prevention
Approach to the Poisoned Patient

**STEP ONE:** Remember your ABCs...

- **A** = Airway
- **B** = Breathing
- **C** = Circulation
- **D** = Disability, Dstick, Decontamination
- **E** = Exposure (Pockets, Needles, Tattoos)
  - “Evaluation” (Labs, EKG, XR, Antidotes, Enhanced Elimination)
Approach to the Poisoned Patient

- **STEP TWO**: Take an **AMPLE** history....

  - **A = Allergies**
  - **M = Medications**, including all medications in the home/place where the patient was found. Any **visitors** with medications? (ie Grandparents, etc)
  - **P = Past medical history**
  - **L = Last meal**
  - **E = Events leading up to presentation.** Where was the patient **found**? Description of the scene by first responders. **Intentional** or unintentional?
The Physical Exam: Toxidrome

- **Vital signs** (HR, BP, RR, O2 sat)
- **Pupils** – size? reactivity?
- **Mental status** – Agitated? Sedated? Confused? Psychotic? Comatose?
- **Skin** – Flushed? Diaphoretic? Dry?
- **Bowel sounds** – Increased? Decreased?
Anticholinergic Toxidrome

- **Hot as a Hare** – febrile, warm to touch
- **Mad as a Hatter** – agitated delirium, hallucinations
- **Blind as a Bat** – mydriasis
- **Dry as a Bone** – dry skin and mucous membranes
- **Red as a Beet** – flushed

Examples: diphenhydramine, tricyclic antidepressants, atropine, Jimson weed
Sympathomimetic Toxidrome

- Agitated
- Mydriasis
- Hyperthermia
- Hypertension
- Tachycardia
- Diaphoresis
- Normal to increased bowel sounds

Examples: Cocaine, amphetamines, pseudoephedrine
Anticholinergic vs. Sympathomimetic Toxidrome?

1) SKIN EXAM:
   Anticholinergic?
   Sympathomimetic?

2) BOWEL SOUNDS:
   Anticholinergic?
   Sympathomimetic?
Cholinergic Toxidrome

- D – Diarrhea
- U – Urination
- M – Miosis
- B – Bronchorrhea
- B – Bronchospasm
- E – Emesis
- L – Lacrimation
- S – Salivation

Examples:
- Nerve Gases
- Organophosphates
- Alzheimer’s meds (Cholinesterase inhibitors)
Opioid Toxidrome

- CNS Depression
- **Respiratory Depression**
- Miosis
- Bradycardia
- Hypothermia

**Examples**: morphine, methadone, heroin, suboxone
Sero\textit{tonin Syndrome}

- **A Triad of:**
  - Autonomic instability: hypertension, tachycardia
  - Mental status changes: agitation to coma
  - **Neuromuscular hyperactivity:** clonus and hyperreflexia, Lower Ext\textgreater\textgreater Upper Ext
  - Exposure to pro-serotonergic meds: ??????
Serootonin Syndrome

A Triad of:

- Autonomic instability: hypertension, tachycardia
- Mental status changes: agitation to coma
- Neuromuscular hyperactivity: clonus and hyperreflexia, Lower Ext>>Upper Ext

- Exposure to pro-serotonergic meds: SSRIs, MAOIs, Lithium, Linezolid, Tramadol, Meperidine, etc
Serotonin Syndrome

Figure 2. Findings in a Patient with Moderately Severe Serotonin Syndrome. Hyperkinetic neuromuscular findings of tremor or clonus and hyperreflexia should lead the clinician to consider the diagnosis of the serotonin syndrome.

Labs: Importance of the D-stick

- **Hyperglycemia:**
  - Methylxanthines
  - Corticosteroids, Epi
  - $B_2$ receptor agonists

- **Hypoglycemia:** “HOBBIES”
  - Hypoglycemics
  - Other (unripe ackee fruit, antimalarials)
  - BB: Beta blockers (low glycogen stores)
  - I: Insulin (iatrogenic)
  - E: Ethanol (low glycogen stores)
  - S: Salicylates (late in course)
EKG

- **QRS**: Na channel
  - TCA
  - Cocaine
  - Carbamazepine
  - Diphenhydramine

- **QTc**: K channel
  - Antipsychotics
  - Azithromycin
  - Ondansetron
  - Cisapride
EKG

- **QRS**: Na channel
  - V. tach/fib
  - QRS > 100 msec
  - Na bicarbonate
  - Hypertonic saline 3%
  - Intralipids

- **QTc**: K channel
  - Torsades de Pointe
  - QTc > 500 msec
  - Magnesium
Cases

• Incorporate History and Exam

• Differential: Toxidromes
Case

• A 2 year old male presents to your ED with MGM.

• Vitals: 36.7, 120, 12, 100/62, 95% RA
• Pupils: 3 mm B
• Mental Status: “Acting funny”, sleepy
• Skin: Warm and dry, no lesions
Opioid Toxidrome

- CNS Depression
- Respiratory Depression
- Miosis
- Bradycardia
- Hypothermia

**Ingestion: suboxone**
Buprenorphine

- Approved for treatment of opioid addiction.
- Partial agonist-antagonist: demonstrates partial agonism at mu (euphoria) receptors and weak antagonism at kappa (dysphoria) receptors.

- Combination products with naloxone intended to decrease recreational misuse by injection.
  - Naloxone has poor oral bioavailability, so has essentially no effects when taken PO.
- Typically taken sublingually (increased bioavailability)
  - Peak effects seen 100min post-ingestion
  - Elimination half-life (sublingual) = 37hrs

“Between 2003 and 2004, there was a 7-fold increase in the number of buprenorphine-containing tablets distributed by US pharmacies.” Geib et al. 2006.
Baby Boy Dies; Was Given Pills as a Toy

The New York Times

October 14, 2011

• A 13-month-old boy died after he swallowed pills from a bottle of Suboxone® that his parents had given him to play with as a rattle.
• 9 PM put to bed: Checked “short time later”—Bottle open, pills in crib, one pill wet, bottle of milk
• 7:45 AM: Unconscious in crib; DOA in Hospital after 911 called
• Parents charged with reckless endangerment, 4 y/o sib custody of Children’s Services
The Growing Impact of Pediatric Pharmaceutical Poisoning

G. Randall Bond, MD\textsuperscript{1,2}, Randall W. Woodward\textsuperscript{1}, and Mona Ho, MS\textsuperscript{1}

**Objective** To understand which medications, under which circumstances, are responsible for the noted increase in pediatric medication poisonings, resource use, and morbidity.

**Study design** Patient records from 2001-2008 were obtained from the National Poison Data System of the American Association of Poison Control Centers for children aged \( \leq 5 \) years evaluated in a health care facility following exposure to a potentially toxic dose of a pharmaceutical agent. Pharmaceutical agents were classified as over-the-counter or prescription and by functional category. Exposures were classified as child self-ingested the medication or as therapeutic error. For the 8-year period, emergency visits, admissions, significant injuries, and trends in these events were calculated for each substance category.

**Results** We evaluated 453,559 children for ingestion of a single pharmaceutical product. Child self-exposure was responsible for 95\% of visits. Child self-exposure to prescription products dominated the health care impact with 248,023 of the visits (55\%), 41,847 admissions (76\%), and 18,191 significant injuries (71\%). The greatest resource use and morbidity followed self-ingestion of prescription products, particularly opioids, sedative-hypnotics, and cardiovascular agents.

**Conclusions** Prevention efforts have proved to be inadequate in the face of rising availability of prescription medications, particularly more dangerous medications. (\textit{J Pediatr} 2012;160:265-70).
95% Self-Ingestions

43% increase in Moderate/Serious Injuries
36% increase in Admissions
28% increase in ED visits

*J Pediatr* 2012; 160: 265-70
### Table II. Children ≤5 years seen in an ED following ingestion of a single pharmaceutical product volume admissions injuries

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unintentional all</td>
<td>453,559</td>
<td>100%</td>
<td>28%</td>
<td>54,943</td>
<td>12%</td>
<td>-</td>
<td>25,651</td>
<td>6%</td>
<td>-</td>
</tr>
<tr>
<td>Unintentional (self-ingestion) Rx</td>
<td>248,023</td>
<td>55%</td>
<td>32%</td>
<td>41,847</td>
<td>17%</td>
<td>-</td>
<td>18,192</td>
<td>7%</td>
<td>18%</td>
</tr>
<tr>
<td>Analgesic (opioid)</td>
<td>29,368</td>
<td>7%</td>
<td>101%</td>
<td>34,086</td>
<td>12%</td>
<td>86%</td>
<td>16,222</td>
<td>6%</td>
<td>92%</td>
</tr>
<tr>
<td>Analgesic (nonopioid)</td>
<td>7,551</td>
<td>2%</td>
<td>-</td>
<td>4,37</td>
<td>6%</td>
<td>-</td>
<td>85</td>
<td>1%</td>
<td>-</td>
</tr>
<tr>
<td>CNS: anticonvulsants</td>
<td>11,254</td>
<td>2%</td>
<td>13%</td>
<td>2,757</td>
<td>24%</td>
<td>-31%</td>
<td>1,332</td>
<td>12%</td>
<td>-33%</td>
</tr>
<tr>
<td>CNS: antidepressants</td>
<td>28,792</td>
<td>6%</td>
<td>-</td>
<td>5,236</td>
<td>18%</td>
<td>-</td>
<td>1,075</td>
<td>4%</td>
<td>-</td>
</tr>
<tr>
<td>CNS: neuroleptics</td>
<td>10,206</td>
<td>2%</td>
<td>13%</td>
<td>2,760</td>
<td>27%</td>
<td>-</td>
<td>1,483</td>
<td>15%</td>
<td>-</td>
</tr>
<tr>
<td>CNS: sedative-hypnotics</td>
<td>35,131</td>
<td>8%</td>
<td>68%</td>
<td>7,444</td>
<td>21%</td>
<td>-</td>
<td>4,322</td>
<td>12%</td>
<td>14%</td>
</tr>
<tr>
<td>CNS: stimulants</td>
<td>14,149</td>
<td>3%</td>
<td>26%</td>
<td>2,404</td>
<td>17%</td>
<td>-</td>
<td>1,977</td>
<td>14%</td>
<td>-</td>
</tr>
<tr>
<td>CV drugs</td>
<td>39,709</td>
<td>9%</td>
<td>27%</td>
<td>8,033</td>
<td>20%</td>
<td>-</td>
<td>1,697</td>
<td>4%</td>
<td>33%</td>
</tr>
<tr>
<td>Hormonal-hypoglycemia inducing</td>
<td>8,506</td>
<td>2%</td>
<td>10%</td>
<td>4,811</td>
<td>49%</td>
<td>-</td>
<td>1,729</td>
<td>20%</td>
<td>-</td>
</tr>
<tr>
<td>Rx other (antibiotics, hormones, Resp, Gl, etc)</td>
<td>63,157</td>
<td>14%</td>
<td>15%</td>
<td>5,127</td>
<td>8%</td>
<td>14%</td>
<td>2,869</td>
<td>5%</td>
<td>-</td>
</tr>
</tbody>
</table>

*J Pediatr 2012; 160: 265-70*
Table III. Pediatric pharmaceutical deaths 2001-2008

<table>
<thead>
<tr>
<th>Medication group</th>
<th>No. of deaths, 2001-2004</th>
<th>No. of deaths, 2005-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetaminophen</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Aspirin</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Cough/cold</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Antihistamine</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Prescription</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opioid analgesics and cough</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Cardiovascular drugs</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Central nervous system drugs</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Total of 90 directly reported deaths were reviewed; 66 were ingestion and related, and 8 of 66 included >1 medication.

*J Pediatr* 2012; 160: 265-70
Malicious Use of Pharmaceuticals in Children

Shan Yin, MD, MPH

Objective To describe malicious administration of pharmaceutical agents to children.

Study design We performed a retrospective study of all pharmaceutical exposures involving children <7 years old reported to the US National Poison Data System from 2000 to 2008 for which the reason for exposure was coded as “malicious.”

Results A total of 1439 cases met inclusion criteria. The mean number of cases per year was 160 (range, 124 to 189) that showed an increase over time. The median (IQR) age was 2 (1.5) years. Outcome data were available for 1244 (86.4%) patients. Of these exposures, 172 resulted in moderate or major outcomes or death. 9.7% of cases involved >1 exposed substance. The most common reported major pharmaceutical categories were analgesics, stimulants/street drugs, sedatives/hypnotics/antipsychotics, cough and cold preparations, and ethanol. In 51% of cases there was an exposure to at least one sedating agent. There were 18 (1.2%) deaths. Of these, 17 (94%) were exposed to sedating agents, including antihistamines (8 cases) and opioids (8 cases).

Conclusions Malicious administration of pharmaceuticals should be considered an important form of child abuse. (J Pediatr 2010;157:832-6).
Pediatric Risk Factors: Major Outcome & Death

<table>
<thead>
<tr>
<th>Factor</th>
<th>Death/major outcome</th>
<th>Other outcome</th>
<th>Unadjusted OR (CI)</th>
<th>Adjusted OR (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypharmacy Exposure</td>
<td>15/50 (30.0%)</td>
<td>104/1194 (8.7%)</td>
<td>4.4 (2.3-8.3)</td>
<td>3.0 (1.6-6.0)</td>
</tr>
<tr>
<td>Exposure to a sedating agent</td>
<td>38/47 (80.9%)</td>
<td>520/1086 (47.9%)</td>
<td>4.6 (2.3-10.3)</td>
<td>3.6 (1.7-7.7)</td>
</tr>
<tr>
<td>Age ≤2 years</td>
<td>32/50 (64.0%)</td>
<td>588/1184 (49.7%)</td>
<td>1.8 (1.01-3.3)</td>
<td>1.9 (1.02-3.6)</td>
</tr>
</tbody>
</table>

*J Pediatr* 2010; 157: 832-6
NAS Clinical Features
Opioid Receptors: CNS & GI

**TABLE 3 Clinical Features of the Neonatal Narcotic Abstinence Syndrome**

<table>
<thead>
<tr>
<th>Neurologic Excitability</th>
<th>Gastrointestinal Dysfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tremors</td>
<td>Poor feeding</td>
</tr>
<tr>
<td>Irritability</td>
<td>Uncoordinated and constant sucking</td>
</tr>
<tr>
<td>Increased wakefulness</td>
<td>Vomiting</td>
</tr>
<tr>
<td>High-pitched crying</td>
<td>Diarrhea</td>
</tr>
<tr>
<td>Increased muscle tone</td>
<td>Dehydration</td>
</tr>
<tr>
<td>Hyperactive deep tendon reflexes</td>
<td>Poor wt gain</td>
</tr>
<tr>
<td>Exaggerated Moro reflex</td>
<td>Autonomic signs</td>
</tr>
<tr>
<td>Seizures</td>
<td>Increased sweating</td>
</tr>
<tr>
<td>Frequent yawning and sneezing</td>
<td>Nasal stuffiness</td>
</tr>
<tr>
<td></td>
<td>Fever</td>
</tr>
<tr>
<td></td>
<td>Mottling</td>
</tr>
<tr>
<td></td>
<td>Temperature instability</td>
</tr>
</tbody>
</table>

*Pediatrics* 2012; 129 (2): e540-559
Differential Diagnosis of NAS

- Neonatal sepsis/meningitis
- Hypoglycemia/hypocalcemia
- Non-accidental trauma
- Corneal abrasions
- Hair tourniquet
- “Colic”
- Poor social support
CLINICAL REPORT

Neonatal Drug Withdrawal

abstract

Maternal use of certain drugs during pregnancy can result in transient neonatal signs consistent with withdrawal or acute toxicity or cause sustained signs consistent with a lasting drug effect. In addition, hospitalized infants who are treated with opioids or benzodiazepines to provide analgesia or sedation may be at risk for manifesting signs of withdrawal. This statement updates information about the clinical presentation of infants exposed to intrauterine drugs and the therapeutic options for treatment of withdrawal and is expanded to include evidence-based approaches to the management of the hospitalized infant who requires weaning from analgesics or sedatives. *Pediatrics* 2012;129:e540–e560

Mark L. Hudak, MD, Rosemarie C. Tan, MD, PhD, THE COMMITTEE ON DRUGS, and THE COMMITTEE ON FETUS AND NEWBORN
Management of Opioid Analgesic Overdose

Edward W. Boyer, M.D., Ph.D.

Life-threatening effects in overdose
Normal pharmacokinetic properties disrupted in overdose
Duration of action various among opioid formulations

*N Eng J Med* 2012; 367: 146-55
Case

- A 16 year old female presents to your ED.

- Vitals: 37.7, 160, 24, 140/100, 99% RA
- Pupils: 6 to 4 mm B reactive
- Mental Status: Agitated
- Skin: Warm but wet, no lesions
Sympathomimetic Toxidrome

- Agitated
- Mydriasis
- Hyperthermia
- Hypertension
- Tachycardia
- Diaphoresis
- Normal to increased bowel sounds

Examples: bupropion (amphetamine nucleus) + proserotonergic
Serotonin Syndrome

Figure 2. Findings in a Patient with Moderately Severe Serotonin Syndrome. Hyperkinetic neuromuscular findings of tremor or clonus and hyperreflexia should lead the clinician to consider the diagnosis of the serotonin syndrome.

**EKG**

- **QRS**: Na channel
  - TCA
  - Cocaine
  - Carbamazepine
  - Diphenhydramine

- **QTc**: K channel
  - Antipsychotics
  - Azithromycin
  - Ondansetron
  - Cisapride
Case

• An 18 month old female presents to your ED.

• Vitals: 37.4, 140, 24, 105/60, 99% RA
• Pupils: 4 mm B reactive
• Mental Status: Hard to arouse
• Skin: Warm, diaphoretic, no lesions

• Dstick: 25 mg/dl
• Differential
The “3 E’s” of Injury Prevention

**Education:**
- Poison Prevention Week
- Healthy People 2020: 10% ↓ poisonings < 5 yrs

**Engineering:**
- Child resistant caps
- Needless syringe/one-way valve liquid preps

**Enforcement:**
- Social Work/Child Protection Teams
- Maternal & Infant Health

*J Pediatr* 2012; 160: 190-91
Injury Prevention Strategies

- **Passive:**
  - Child-Resistant Packaging Act 1970: CPSC
  - Smoke Detectors: Nicole’s Law

- **Active:**
  - Safe Medication Storage
  - DEA Take Back Program
Education: Prevention

Up and Away Medication Safety Tip Sheet

POISON Help
1-800-222-1222
Efficacy of Flow Restrictors in Limiting Access of Liquid Medications by Young Children

Maribeth C. Lovegrove, MPH¹, Stephanie Hon, PharmD³, Robert J. Geller, MD³,⁴, Kathleen O. Rose, RN, BSN¹,², Lee M. Hampton, MD, MSc¹, Jill Bradley, BS, BA¹,², and Daniel S. Budnitz, MD, MPH¹

Objective To assess whether adding flow restrictors (FRs) to liquid medicine bottles can provide additional protection against unsupervised medication ingestions by young children, even when the child-resistant closure is not fully secured.

*J Pediatr* 2013; 163: 1134-39
Figure 1. FR designs. The adapters are added to the neck of a standard liquid medicine bottle to limit the release of liquid. The FR marked with an asterisk is no longer on the market; it has been improved to minimize the risk of pushing the FR into the bottle during syringe insertion.

Results

Table 1. Demographic data

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number (%) of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, months</td>
<td></td>
</tr>
<tr>
<td>36-41</td>
<td>14 (13)</td>
</tr>
<tr>
<td>42-47</td>
<td>37 (34)</td>
</tr>
<tr>
<td>48-53</td>
<td>23 (21)</td>
</tr>
<tr>
<td>54-59</td>
<td>36 (33)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>47 (43)</td>
</tr>
<tr>
<td>Male</td>
<td>63 (57)</td>
</tr>
<tr>
<td>Site</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>22 (20)</td>
</tr>
<tr>
<td>2</td>
<td>22 (20)</td>
</tr>
<tr>
<td>3</td>
<td>26 (24)</td>
</tr>
<tr>
<td>4</td>
<td>18 (16)</td>
</tr>
<tr>
<td>5</td>
<td>22 (20)</td>
</tr>
<tr>
<td>Total</td>
<td>110 (100)</td>
</tr>
</tbody>
</table>

*J Pediatr* 2013; 163: 1134-39
Figure 2. Time required for children to empty open control bottles, incompletely closed control bottles, and bottles with FRs. The bottles were considered empty when the tester noted pauses of ≥1 second between drops of test liquid when fully inverted (control bottles), or following manual inspection by the tester after a child who had been successfully removing test liquid appeared unable to remove additional amounts (FR bottles). Weighing of all bottles confirmed removal of ≥88% of test liquid in all cases. *Time was not recorded for 1 trial with an incompletely closed control bottle.

Outline

• Epidemiology

• Approach to the Poisoned Patient: A,B,C,D,E
  ▫ Exam (Toxidromes)
  ▫ Work-Up: Labs (D-stick), EKG

• Cases

• Poisoning Prevention
Questions