Hospitalizations for Pediatric Intoxication in Washington State, 1987-1997

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Background: Intoxication (or poisoning) that necessitates hospitalization remains an important source of morbidity in children.

Objective: To determine changes, during an 11-year period (1987-1997), in the incidence of hospitalization due to intoxication among children in Washington State and circumstances of ingestion, agents used, hospital length of stay, charges, and mortality.

Methods: A computerized database of all hospital discharges (Comprehensive Hospital Abstract Reporting System [CHARS] database) in Washington was used. Cases included all children younger than 19 years with a primary or secondary diagnosis for an intoxication or with an external cause of injury code (E code) for an intoxication from 1987 to 1997.

Results: There were 7322 hospitalizations (45 per 100000 children per year); the annual rate significantly decreased during the study period. Most patients (75%) were teenagers. Sixty-five percent were female. Pharmaceutical agents were used in 80% of cases. Analgesics were the most commonly used (34%), followed by antidepressants (12%) and psychotropic drugs (8%). Nonpharmaceutical agents were more prevalent in children younger than 12 years than in teenagers. Self-inflicted intoxication was the most frequent cause identified by E codes (47%). Median length of stay was 1 day, and median hospital charges were $2096. Mortality was low (0.2%) and did not change significantly over time.

Conclusions: Acute intoxication continues to be an important cause of hospitalization in children. The type of agent involved did not change significantly over time. Teenage girls continue as the highest risk group for suicide attempt from ingestions. Self-inflicted intoxications were associated with higher costs, length of stay, and readmissions. Although preventive measures and development of poison centers have contributed to decrease mortality from acute intoxication in children in the last 50 years, efforts need to be targeted toward suicide prevention, especially among teenage girls.

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CUTE INTOXICATION (or poisoning) in children can lead to serious complications, hospitalization, and even death. Pediatric mortality from intoxications has declined considerably in the last 30 years because of multiple preventive measures. In 1950, there were 834 deaths from intoxications among US children younger than 5 years; this number decreased to less than 50 per year in 1997.1 Nevertheless, acute intoxication remains an important cause of illness in children. In 1997, 66 participating US poison centers reported 2192088 human exposure cases.2 Children younger than 20 years were involved in two thirds of the cases.

The kind of agents used, the cause of intoxication, and the population at risk may change over time; recognition of such changes might enhance preventive measures and treatments to reduce morbidity and mortality related to childhood intoxications. Few studies have evaluated childhood intoxication that results in hospitalization. Our study describes the population of children hospitalized for intoxication, from 1987 through 1997, in Washington State. We determined the incidence of acute intoxications leading to hospitalization in children and evaluated changes in intoxicating agents during the study period. We also evaluated the circumstances of the intoxication to determine if changes occurred during the study time. Finally, fatalities, hospital length of stay (LOS), and hospital charges associated with acute intoxication were calculated.

RESULTS

There were 7322 hospitalizations for intoxication from 1987 to 1997 in Washington State. The average incidence of hospitalization for intoxication in children was 45 per 100000 children per year, and in-
METHODOLOGY

METHODS

After institutional review board approval by the University of Washington and the State of Washington Health and Human Services Department, we obtained computerized information for persons hospitalized in Washington from 1987 through 1997. Data from 100 hospitals in Washington were included. All hospitalized patients (younger than 19 years) with a discharge diagnosis of intoxication were identified in the Comprehensive Hospital Abstract Reporting System (CHARS) database. Subjects were included if they had a primary or secondary diagnosis code for intoxication by drugs, medicinal, and biological substances (International Classification of Diseases, Ninth Revision [ICD-9] codes 960-979); toxic effects of substances chiefly nonmedical (codes 980-989); or nondependent abuse of drugs (code 305). However, cases with only nondependent use of tobacco (code 305.1) were excluded because we did not consider it to be a primary reason for hospitalization. The following external causes of injury codes (ICD-9 codes) were also identified to determine the cause of the intoxication: unintentional poisoning by drugs, medicinal substances, and biological substances (E850-E858); unintentional poisoning by other solid and liquid substances, gases, and vapors (E860-E869); suicide and self-inflicted poisoning by solid or liquid substances or by gases (E950-E952); assault by poisoning (E962); and poisoning undetermined whether unintentional or purposely inflicted (E980-E982). Children with E codes for intoxication were included as cases. All newborns and patients transferred from other hospitals were excluded to avoid counting the same patient twice. We also excluded all intoxication (ICD-9 codes) that were associated with an adverse reaction E code (E930-E949) to avoid cases where the intoxication was iatrogenic or occurred during a hospitalization.

Demographic data (age, sex), hospital data (total charges, LOS, mortality), and agents used were analyzed. Patients records were linked, and all subsequent hospital admissions for intoxication during the study period were also evaluated.

The incidence of hospitalization for intoxication was determined using census data in Washington (average of annual populations for a specified period). Normally distributed continuous data were compared using the t test and 1-way analysis of variance. The Tukey B test was used to adjust for multiple pairwise comparisons among the years of study. Nonparametric data are reported as medians and 25th to 75th quartiles. Nonparametric data were compared with the Kruskal-Wallis test and the Mann-Whitney test. Categorical data were examined using the χ² test. SPSS 9.0 for Windows (SPSS Inc, Chicago, Ill) was used for all statistical calculations. Statistical significance was defined as P < .05.

toxication accounted for 0.06% of all pediatric hospitalizations during the 11-year study period. Children aged 12 to 18 years were the largest patient group (75%), followed by children aged 0 to 5 years (20%) and children aged 6 to 11 years (5%). Adolescents constituted most of the sample, and global results mainly reflect this category of patients. Ingestions with more than 1 agent were reported in 10% of cases. The median LOS was 1 day (range, 1-3 days); the median hospital charges were $2096 (range, $1246-$3519). Only 15 children (0.2%) died.

Pharmaceutical agents were identified in 80% of the intoxications (Table 1). Analgesic agents were used in a third of cases (34%), and acetaminophen was the most common medication in this category (18%). Antidepressant agents constituted the next most common category of medication leading to hospital admission (12%), fol-

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Table 1. Agents Involved in Hospitalized Pediatric Intoxications

<table>
<thead>
<tr>
<th>Agent</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmaceutical</td>
<td>5623 (80)</td>
</tr>
<tr>
<td>Analgesics</td>
<td>2466 (34)</td>
</tr>
<tr>
<td>Acetaminophen</td>
<td>1345 (18)</td>
</tr>
<tr>
<td>Salicylates</td>
<td>703 (10)</td>
</tr>
<tr>
<td>Nonsteroidal anti-inflammatory</td>
<td>181 (3)</td>
</tr>
<tr>
<td>Narcotics and opiates</td>
<td>129 (2)</td>
</tr>
<tr>
<td>Others</td>
<td>108 (1)</td>
</tr>
<tr>
<td>Antidepressants (tricyclics and monoamine oxidase inhibitors)</td>
<td>963 (12)</td>
</tr>
<tr>
<td>Psychotropic drugs</td>
<td>624 (8)</td>
</tr>
<tr>
<td>Benzodiazepine hydrochloride</td>
<td>213 (3)</td>
</tr>
<tr>
<td>Tranquilizers</td>
<td>163 (2)</td>
</tr>
<tr>
<td>Sedatives</td>
<td>102 (1)</td>
</tr>
<tr>
<td>Barbiturates</td>
<td>85 (1)</td>
</tr>
<tr>
<td>Others</td>
<td>56 (1)</td>
</tr>
<tr>
<td>Anxiolytics and antiemetics</td>
<td>455 (6)</td>
</tr>
<tr>
<td>Anticonvulsants</td>
<td>326 (5)</td>
</tr>
<tr>
<td>Antidiabetics</td>
<td>192 (3)</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>190 (3)</td>
</tr>
<tr>
<td>Cardiac drugs</td>
<td>182 (2)</td>
</tr>
<tr>
<td>Nervous system drugs</td>
<td>159 (2)</td>
</tr>
<tr>
<td>Hormones</td>
<td>123 (2)</td>
</tr>
<tr>
<td>Iron</td>
<td>93 (1)</td>
</tr>
<tr>
<td>Cold drugs</td>
<td>42 (0.6)</td>
</tr>
<tr>
<td>Others</td>
<td>128 (1)</td>
</tr>
<tr>
<td>Nonpharmaceutical</td>
<td>1610 (22)</td>
</tr>
<tr>
<td>Alcohol</td>
<td>456 (6)</td>
</tr>
<tr>
<td>Ethanol</td>
<td>412 (5)</td>
</tr>
<tr>
<td>Other alcohols (ethyleneglycol, methyl, isopropyl)</td>
<td>44 (1)</td>
</tr>
<tr>
<td>“Street” drugs</td>
<td>312 (4)</td>
</tr>
<tr>
<td>Stimulants and amphetamines</td>
<td>208 (3)</td>
</tr>
<tr>
<td>Hallucinogens</td>
<td>71 (1)</td>
</tr>
<tr>
<td>Cannabis</td>
<td>17 (0.2)</td>
</tr>
<tr>
<td>Cocaine</td>
<td>16 (0.2)</td>
</tr>
<tr>
<td>Fumes</td>
<td>207 (3)</td>
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<tr>
<td>Gas and vapor (petroleum, chlorine gas)</td>
<td>161 (2)</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>46 (1)</td>
</tr>
<tr>
<td>Cleaning products</td>
<td>179 (3)</td>
</tr>
<tr>
<td>Solvents and hydrocarbons</td>
<td>156 (2)</td>
</tr>
<tr>
<td>Bites and venoms</td>
<td>148 (2)</td>
</tr>
<tr>
<td>Food and plants</td>
<td>95 (1)</td>
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<tr>
<td>Insecticides</td>
<td>32 (0.4)</td>
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<tr>
<td>Metals</td>
<td>25 (0.3)</td>
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<tr>
<td>Unspecified</td>
<td>184 (3)</td>
</tr>
<tr>
<td>Others</td>
<td>125 (2)</td>
</tr>
<tr>
<td>Total*</td>
<td>7542 (107)</td>
</tr>
</tbody>
</table>

*The total number of agents exceeds the number of cases and the total percentage of agents is more than 100 because of intoxication where more than 1 agent was used at the same time.
followed by psychotropic agents (8%) and anti-allergy or antiemetic drugs (6%). Nonpharmaceutical agents were identified in 22% of patients with an intoxication. The most common agents were alcohol (6%), followed by “street” drugs (4%) and fumes (3%).

Features of the intoxication are presented by age categories in Table 2. Girls were significantly more likely to have a hospital admission due to an intoxication in the teenager group (2.5 times more frequent); boys were more frequently involved in all younger groups. Comparing the 3 different age categories, analgesic ingestions were significantly more common in teenagers (42%). Nonpharmaceutical agents were more frequently involved in children younger than 12 years (36%) than in teenagers (17%). Nonpharmaceutical agents included mainly bites or venom, fumes, cleaning agents, and solvents or hydrocarbons. Multiple agents and self-inflicted intoxications were significantly more common in teenagers compared with younger children. Unintentional intoxications were least common among teenagers (13%) compared with younger children (58% in the 6- to 11-year-old group and 75% in the 0- to 5-year-old group). Number of readmissions, LOS, and hospital charges were also significantly higher in teenagers.

Features of the intoxications and the relationship to years of study are presented in Table 4. E codes were not included in the statewide data set for 1987 and 1988. When these years were included, the cause of the intoxication was undetermined in 25% of cases. Patients without an identified cause were excluded from the table. Self-inflicted intoxication or suicide attempt was the most frequent cause of intoxication (48%) and was more common in teenagers (99%) and girls (77%). Self-inflicted intoxications were associated with significantly longer hospital LOS and higher charges compared with unintentional intoxications and assaults. Analgesics were the most frequent agents involved in all categories, but were significantly more common in self-inflicted intoxications compared with unintentional intoxications. Likewise, antidepressants were significantly more common in self-inflicted intoxications compared with unintentional intoxications.

Table 2. Features of 7322 Intoxication Hospitalizations by Age Group

<table>
<thead>
<tr>
<th>Feature</th>
<th>0-5 y</th>
<th>6-11 y</th>
<th>12-18 y</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (%)</td>
<td>1497</td>
<td>302</td>
<td>5523</td>
</tr>
<tr>
<td>M/F ratio</td>
<td>1:3:1</td>
<td>1.5:1</td>
<td>1:2.5:1</td>
</tr>
<tr>
<td>Agents, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesic</td>
<td>8</td>
<td>9</td>
<td>42§</td>
</tr>
<tr>
<td>Antidepressant</td>
<td>0</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Psychotropic</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Antihistamine</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Alcohol</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Solvent or hydrocarbon</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Anticonvulsant</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Bites or venom</td>
<td>0</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Fumes or vapors</td>
<td>8</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Cleaning products</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
| Multiple ingestion, No. (%)   | 70 (5)| 13 (4) | 673 (12)|§
| Cause, No. (%)                |       |        |         |
| Self-inflicted                | 3 (0.2)| 30 (10)| 3422 (62)|§
| Unintentional                 | 1119 (75)| 175 (58)| 713 (13)|§
| Assault                       | 5 (0.3)| 1 (0.3)| 3 (0.1) |
| Undetermined                  | 370 (25)| 96 (32)| 1385 (25)|
| Length of hospital stay, d*   | 1 (1, 2)| 1 (1, 2)| 2 (1, 3)|§
| Hospital charges, $††         | 1385 (676, 2403)| 1527 (951, 2910)| 2323 (1428, 3767)|§
| Readmission, No. (%)‡         | 26 (2) | 5 (2)  | 481 (9)  |
| Deaths, No. (%)               | 1 (0.1)| 4 (1.3)| 10 (0.2) |

*Median (25th, 75th quartiles).
†Does not include professional fees and data are not adjusted for inflation.
‡Readmission during the study period at least 1 more time with an intoxication.
§P<.05, 12-18 years > all other groups.
||P<.05, 12-18 years < all other groups.
†P<.05, 6-11 years > all other groups.

Median hospital LOS did not change; however, hospital charges significantly increased. The causes of intoxication did not change between 1990 and 1993 compared with 1994 to 1997 (data before 1990 are not precise enough to conclude the cause for this period). The most common agents involved in children hospitalized for intoxication remained fairly constant during the 11-year period. However, intoxication with analgesics, antidepressants, and psychotropic drugs was significantly more frequent in the last period compared with the first 2 periods. Acetaminophen ingestions became significantly more frequent over time (increased from 15% to 22%; P<.001), whereas salicylic acid use declined significantly (14% to 8%; P<.001).

Causes of the intoxications are presented in Table 4.
There were 15 fatalities. Deaths were more frequent in girls (73%) and were more frequently caused by self-poisoning (47%). The agents involved in the deaths were fumes (n=4), barbiturates (n=2), tricyclic antidepressants (n=2), unspecified agents (n=2), and alcohol, plant, anticonvulsant, cardiac medication, and acetaminophen (n=1 each). The highest mortality rate was for children aged 6 to 11 years (1.3%); the higher mortality in this group was due to cases of fatal fume intoxications. Multiple ingestions were not reported in any child who died. Hospital charges were significantly greater in children who died ($9078) compared with children who did not ($2093); however, LOS was similar in children who died (2 days) and those who survived (1 day).

Table 3. Features of the 7322 Intoxication Hospitalizations by Time Period

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (%)</td>
<td>2289 (31)</td>
<td>2551 (35)</td>
<td>2482 (34)</td>
</tr>
<tr>
<td>Incidence (per 100,000 children)</td>
<td>56</td>
<td>44</td>
<td>40</td>
</tr>
<tr>
<td>Admissions per year</td>
<td>763</td>
<td>638</td>
<td>620</td>
</tr>
<tr>
<td>M/F ratio</td>
<td>1:1.8</td>
<td>1:1.8</td>
<td>1:1.9</td>
</tr>
<tr>
<td>Agents, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesic</td>
<td>33</td>
<td>33</td>
<td>36†</td>
</tr>
<tr>
<td>Salicylic acid</td>
<td>14</td>
<td>11</td>
<td>8§</td>
</tr>
<tr>
<td>Acetaminophen</td>
<td>15</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Antidepressant</td>
<td>10</td>
<td>11</td>
<td>14†</td>
</tr>
<tr>
<td>Psychotropic</td>
<td>8</td>
<td>8</td>
<td>10†</td>
</tr>
<tr>
<td>Antihistamine</td>
<td>5</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Alcohol</td>
<td>7</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Multiple ingestion, No. (%)</td>
<td>232 (10)</td>
<td>236 (9)</td>
<td>288 (12‡)</td>
</tr>
<tr>
<td>Cause, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-inflicted</td>
<td>434 (19)</td>
<td>1500 (59)</td>
<td>1471 (59)</td>
</tr>
<tr>
<td>Unintentional</td>
<td>291 (13)</td>
<td>874 (34)</td>
<td>842 (34)</td>
</tr>
<tr>
<td>Assault</td>
<td>1 (0.04)</td>
<td>7 (0.3)</td>
<td>1 (0.04)</td>
</tr>
<tr>
<td>Undetermined</td>
<td>1513 (66)</td>
<td>170 (7)</td>
<td>168 (7)</td>
</tr>
<tr>
<td>Length of hospital stay, d*</td>
<td>1 (1, 2)</td>
<td>1 (1, 3)</td>
<td>1 (1, 3)</td>
</tr>
<tr>
<td>Hospital charges, $†‡</td>
<td>1410 (866, 2398)</td>
<td>2174 (1287, 3576)</td>
<td>2761 (1798, 4365)</td>
</tr>
<tr>
<td>Deaths, No. (%)</td>
<td>8 (0.3)</td>
<td>5 (0.2)</td>
<td>2 (0.1)</td>
</tr>
</tbody>
</table>

Table 4. Causes of 7322 Intoxication Hospitalizations

<table>
<thead>
<tr>
<th></th>
<th>Self-inflicted</th>
<th>Unintentional</th>
<th>Assault</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (%)</td>
<td>3455 (47)</td>
<td>2007 (27)</td>
<td>9 (0.1)</td>
</tr>
<tr>
<td>M/F ratio</td>
<td>1:3.2</td>
<td>1:1.2</td>
<td>1:1.25</td>
</tr>
<tr>
<td>Agents, %/No.*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesic</td>
<td>48</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Antidepressant</td>
<td>16</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Psychotropic</td>
<td>10</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Antihistamine</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alcohol</td>
<td>4</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Solvent or hydrocarbon</td>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Anticonvulsant</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>“Street” drug</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hormones</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Antidiarrheal</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Multiple ingestion, No. (%)</td>
<td>474 (14)</td>
<td>104 (5)</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Length of hospital stay, d†</td>
<td>2 (1, 3)</td>
<td>1 (1, 2)</td>
<td>2 (1, 15)</td>
</tr>
<tr>
<td>Hospital charges, $†‡</td>
<td>2676 (1726, 4226)</td>
<td>1734 (1042, 3008)</td>
<td>1833 (886, 17569)</td>
</tr>
<tr>
<td>Readmission, No. (%)‡</td>
<td>342 (10)</td>
<td>55 (3)</td>
<td>0</td>
</tr>
<tr>
<td>Deaths, No. (%)§</td>
<td>7 (0.2)</td>
<td>2 (0.1)</td>
<td>0</td>
</tr>
</tbody>
</table>

*Given as percentage for self-inflicted and unintentional groups and as number of cases for assault group.
†Median (25th, 75th quartiles).
‡Does not include professional fees and data are not adjusted for inflation.
§Readmission during the study period at least 1 more time with an intoxication.
||P<.05, self-inflicted > unintentional.
A total of 244 patients had multiple admissions for intoxication during the study period (520 admissions). Twenty-four had more than 2 admissions (79 admissions). Six patients were hospitalized 4 to 5 times. Readmissions were significantly more frequent among teenagers (93%) and girls (73%). In patients with multiple admissions, self-inflicted intoxications were significantly more common (66%) compared with unintentional poisoning (11%). Antidepressant medications were the most common agents ingested by children with more than 2 hospital admissions. Hospital LOS and hospital charges also significantly increased with subsequent readmission; however, mortality did not increase.

COMMENT

We found that the number of children in Washington State admitted to a hospital for acute intoxication declined during the 11 years studied. The medications and toxic agents involved in pediatric intoxications that required hospitalization did not substantively change during the study period. Likewise, the percentage of children with intoxication leading to hospital admission due to self-inflicted intoxications did not change during the study period.

Our results differ from those of Rodriguez and Sattin, who found no significant difference between annual rates of hospitalizations from poisonings between 1979 and 1983 in children (0-9 years old) in the United States. We cannot fully explain these differences; however, they may be due to regional differences in health care, our study population, or the longer period of our study. Washington has a larger proportion of managed care (average of 16% during the study period) than many other states, which may lead to differences in access to primary and emergency care. Differences in referral patterns and treatment advice provided by poison centers may exist. Differences may in part be due to ethnic or socioeconomic differences in the populations. Washington has a relatively homogeneous ethnic population, with 91% white Americans in 1990. In the study by Rodriguez and Sattin, children of other ethnic backgrounds had a hospitalization rate for poisoning that was 2.4 times that of white children.

In our study, the mortality rate was low (0.2%) and declined slightly over time. This could be due to better recognition of intoxications or improved prehospital or hospital care; however, we cannot determine which factors accounted for the decline. It could also be because deaths occurring in the emergency department or at home were not included. The fatal ingestions in our study were similar to fatal intoxications reported in the Toxic Exposure Surveillance Systems of the American Association of Poison Control Centers (TESS) database.

In our study, analgesics constituted the most common cause of acute intoxication leading to hospital admission in children. Our findings agree with prior reports. Ferguson et al reported that the most common agents involved in intoxication leading to hospitalizations were analgesics and that the number of salicylic acid intoxications was declining, whereas the number of intoxications from acetaminophen had increased. We found the same decline in salicylic acid intoxication, probably because salicylic acids have largely been replaced by acetaminophen as the first-line antipyretic and analgesic therapy, to prevent Reye syndrome. We also found that analgesic ingestions were more common in older children compared with younger children. This is probably because these medications are present in almost every home and teenagers tend to act impulsively. Trinkoff and Baker pointed out that the availability of an agent was important in both unintentional intoxications of preschool children and intentional intoxications among adolescents.

Similar to other reports, we found that children aged 12 to 18 years and 0 to 5 years were the most likely to be admitted to the hospital with acute intoxication. As expected, toddlers and school-aged children were usually involved in unintentional intoxication, whereas teenagers generally had intentional intoxications. Most patients were adolescents, thus influencing the agents used and the cause of intoxications for the whole group.

Self-inflicted intoxication was the leading identified cause of intoxication-related hospitalizations in Washington for children younger than 19 years. Poisoning is a well-known method for suicide attempt in adolescent girls. From 1990 to 1997, the incidence of hospitalization for self-inflicted intoxications did not significantly change. Hospitalization secondary to self-inflicted intoxication did not increase in younger age groups either (<12 years old). The number of self-inflicted intoxications from 1986 to 1989 was lower than in the later periods. Many undetermined E codes were used in this period; therefore, we cannot estimate the actual number of self-inflicted intoxications or unintentional intoxications. Nevertheless, from 1986 to 1989, the ratio of self-inflicted intoxication or unintentional intoxication is approximately the same as in the other 2 periods (1.7:1 vs 1.5:1). No prior population-based study was available to compare these results. A hospital-based study by McEvedy in London, England, showed a 108% increase of suicide attempts by poisoning during a 4-year period and an increase in suicide attempts in younger age groups over time. Unfortunately, our results cannot be compared with those of this study because the populations are different. Furthermore, the cause of the intoxications in our study was identified by E codes. Assignment of the E codes relies on the medical record and was limited by missing data that we could not verify.

Ingestion of multiple agents was more frequent in teenagers and when the cause of intoxication was intentional. The use of multiple agents did not increase during the study. These findings agree with the data from the TESS report, where multiple ingestions account for 11% of cases. Multiple agent intoxications were more common in children who were admitted more than twice with intoxications but were not associated with increased mortality. Readmission was associated with use of potentially more toxic medications but was not associated with higher mortality.

By using a hospital-based data set, we evaluated intoxication leading to hospitalizations only. Thus, we report on a subset of intoxications, the ones necessitating prolonged medical supervision and treatment. We cannot determine how many intoxication-related deaths occurred outside the hospital or in the emergency depart-
Acute intoxication (or poisoning) in children can lead to serious complications, hospitalization, and even death. Pediatric mortality from intoxications has declined considerably in the last 30 years because of multiple preventive measures. Nevertheless, acute intoxication remains an important cause of illness in children. Our study describes the population of children hospitalized for intoxication, from 1987 through 1997, in Washington State. The incidence of hospitalizations for intoxication was 45 per 100,000 children per year; the annual rate decreased during the 11-year period. Mortality was low (0.2%) and did not change significantly over time. The type of agent involved did not change significantly over time; acetaminophen remained the most common ingestion. Teenage girls continue as the highest risk group for suicide attempt from ingestions. Self-inflicted intoxications were associated with higher costs, length of stay, and number of readmissions. Although preventive measures and development of poison centers have contributed to decrease mortality from acute intoxication in children, efforts need to be targeted toward suicide prevention, especially among teenage girls.

What This Study Adds

Acute intoxication (or poisoning) in children can lead to serious complications, hospitalization, and even death. Pediatric mortality from intoxications has declined considerably in the last 30 years because of multiple preventive measures. Nevertheless, acute intoxication remains an important cause of illness in children. Our study describes the population of children hospitalized for intoxication, from 1987 through 1997, in Washington State. The incidence of hospitalizations for intoxication was 45 per 100,000 children per year; the annual rate decreased during the 11-year period. Mortality was low (0.2%) and did not change significantly over time. The type of agent involved did not change significantly over time; acetaminophen remained the most common ingestion. Teenage girls continue as the highest risk group for suicide attempt from ingestions. Self-inflicted intoxications were associated with higher costs, length of stay, and number of readmissions. Although preventive measures and development of poison centers have contributed to decrease mortality from acute intoxication in children, efforts need to be targeted toward suicide prevention, especially among teenage girls.

REFERENCES