Prevention of Unintentional Childhood Injury

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Unintentional injury accounts for 40 percent of childhood deaths annually, most commonly from motor vehicle crashes. The proper use of child restraints is the most effective strategy to prevent injury or death. Motor vehicle restraint guidelines have recently been revised to an age-based system that delays the progression in type of restraint for most children. Strategies to prevent suffocation in children include using appropriate bedding, positioning babies on their backs to sleep, and removing items from the sleep and play environment that could potentially entrap or entangle the child. Fencing that isolates a swimming pool from the yard and surrounding area and “touch” adult supervision (i.e., an adult is in the water and able to reach and grab a child) have been shown to be most effective in preventing drownings. Swimming lessons are recommended for children older than four years. Poison prevention programs have been shown to improve prevention behavior among caregivers, but may not decrease poisoning incidence. Syrup of ipecac is not recommended. Smoke detector maintenance, a home escape plan, and educating children about how to respond during a fire emergency are effective strategies for preventing fire injuries or death. Fall injuries may be reduced by not using walkers for infants and toddlers or bunk beds for children six years and younger. Consistent helmet use while bicycling reduces head and brain injuries. Although direct counseling by physicians appears to improve some parental safety behaviors, its effect on reducing childhood injuries is uncertain. Community-based interventions can be effective in high-risk populations. (Am Fam Physician. 2013;87(7):502-509. Copyright © 2013 American Academy of Family Physicians.)
Family Physicians (AAFP) strongly recommends that physicians actively promote the proper use of motor vehicle restraints for all patients.\textsuperscript{21} The National Highway Traffic Safety Administration (NHTSA) publishes guidance on the correct choice and installation of child safety seats, and provides consumer information about purchasing the seats, safety recall notices, and locations of inspection stations (many locations provide this service at no charge).\textsuperscript{22}

The NHTSA and the American Academy of Pediatrics (AAP) recently revised child safety seat recommendations from a weight-based to an age-based algorithm (Figure 4).\textsuperscript{4,5} As in previous guidelines, children should systematically progress from a rear-facing to a forward-facing safety seat, then to a belt-positioning booster seat, and finally to a lap and shoulder belt only. The new age-based transition allows early progression only if a child has exceeded the manufacturer’s recommendations for height or weight, and will delay transitions for most children.\textsuperscript{4,5} Research indicates that parent- and child-directed education improves the use of safety seats.\textsuperscript{2,3}

Driver education for teenagers has long been regarded as an important component of community motor vehicle safety programs. Although one study found a small, but statistically significant, increase in driver-attributed crashes among those who completed a formal driver education class,\textsuperscript{23} the AAFP continues to recommend driver education for young drivers, ideally in a progressive, graduated program.\textsuperscript{24}

Pedestrian injury accounts for approximately 30,000 childhood injuries annually. Children are more susceptible to pedestrian injuries because of their small size. Individual risk factors include male sex, age five to nine years, and black race. Social risk factors include living in an urban environment, a low socioeconomic area, or a neighborhood with increased traffic density. Community- and school-based educational interventions have not shown consistent ability to improve children’s safety behaviors, and it is not clear if these programs reduce injury rates.\textsuperscript{25}

**Suffocation**

Although the link between sudden infant death syndrome and suffocation is controversial, the incidence of suffocation deaths quadrupled between 1984 and 2004 despite a decrease in cases of sudden infant death.

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**Figure 1.** Annual incidence of unintentional injury in children.\textsuperscript{1}

**Figure 2.** Annual incidence of unintentional deaths in children.\textsuperscript{1}
The most common causes of suffocation deaths in infants in playpens and cribs are wedging of the infant against the bedding, mattress, or crib wall; the infant lying in a facedown position on soft bedding or plastic material; twisting of a blanket around the infant’s neck; and collapse of a playpen wall. Other causes in children older than one year include wedging of the child between crib slats, entrapment between a playpen and another object, and entanglement in cords or strings near or in the crib.

Parents of infants and newborns should

Table 1. Strategies to Prevent Unintentional Childhood Injury

<table>
<thead>
<tr>
<th>Cause of injury</th>
<th>High-risk groups</th>
<th>Prevention strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle crashes</td>
<td>All children</td>
<td>Implement parent- and child-directed education to improve use of booster seats in four- to eight-year-olds(^2,3)</td>
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<tr>
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<td>Follow recommendations for the proper use of child safety seats (Figure 4)(^4,5)</td>
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<tr>
<td>Suffocation</td>
<td>Infants</td>
<td>Position newborns on their backs for sleeping(^6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid loose bedding; use properly assembled, approved cribs; remove cords and other objects that pose strangulation or entrapment risk(^7)</td>
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<tr>
<td>Drowning</td>
<td>One to 14 years of age</td>
<td>Use fencing that isolates a swimming pool from the yard and surrounding area(^8)</td>
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<tr>
<td></td>
<td></td>
<td>Use “touch” supervision (i.e., an adult is in the water and able to reach and grab a child)(^9)</td>
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<tr>
<td></td>
<td></td>
<td>Administer immediate cardiopulmonary resuscitation after a near drowning(^9,10)</td>
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<td></td>
<td>Use approved flotation devices(^11)</td>
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<td></td>
<td></td>
<td>Formal swimming lessons are recommended for children older than four years(^9)</td>
</tr>
<tr>
<td>Poisoning</td>
<td>Toddlers and teens</td>
<td>Contact poison control or emergency medical services immediately after a possible poisoning(^12)</td>
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<td></td>
<td>Do not use syrup of ipecac(^12)</td>
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<tr>
<td>Fires</td>
<td>Younger than five years</td>
<td>Maintain a functional smoke detector(^13,14)</td>
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<tr>
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<td></td>
<td>Have a home fire escape plan and ensure children know what to do in the event of a fire(^13)</td>
</tr>
<tr>
<td>Falls</td>
<td>Younger than six years</td>
<td>Do not use walkers for infants and toddlers(^15,16)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do not use bunk beds for children younger than six years(^15)</td>
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<tr>
<td>Bicycling</td>
<td>All children</td>
<td>Helmets reduce head injury(^15)</td>
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<td></td>
<td>Physician counseling(^15) and community- and school-based interventions(^17) increase helmet use</td>
</tr>
</tbody>
</table>

Information from references 2 through 17.
**Recommendations for Child Safety Seats**

<table>
<thead>
<tr>
<th>Younger than two years of age</th>
<th>Rear-facing infant safety seat in rear seat of vehicle</th>
<th>or</th>
<th>Convertible child safety seat in rear-facing configuration in rear seat of vehicle</th>
<th>or</th>
<th>Three-in-one child safety seat in rear-facing configuration in rear seat of vehicle</th>
</tr>
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</table>

- Assess for early transition: has the child outgrown the manufacturer’s height or weight recommendations for the seat?
  - Yes
    - Forward-facing child safety seat with harness in rear seat*
  - No
- Two to four years of age
  - Assess for early transition: has the child outgrown the manufacturer’s height or weight recommendations for the seat?
    - Yes
      - Forward-facing child safety seat with harness in rear seat*
    - No
- Four to eight years of age
  - Assess for early transition: has the child outgrown the manufacturer’s height or weight recommendations for the seat?
    - Yes
      - Booster in rear seat
    - No
- Nine to 12 years of age
  - Lap and shoulder belt in rear seat
- 13 years and older
  - May sit in the front seat of the vehicle with a lap and shoulder belt

*—The American Academy of Pediatrics recommends a rear-facing seat for most children up to two years of age. The National Highway Traffic Safety Administration recommends rear-facing seats up to four years of age.

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**Drowning**

A Cochrane review found limited evidence that pool fencing is an effective drowning prevention strategy. Fencing that isolates the pool from the yard and surrounding areas was shown to be more effective than perimeter fencing that encases both the pool and surrounding areas. Poolside adult supervision is not adequate to prevent drowning because submerged children may not make any noise and are difficult to see from the surface of the water. For these reasons, the AAP recommends “touch” supervision (i.e., an adult is in the water and able to reach and grab a child). In the event of a near drowning, early cardiopulmonary resuscitation has been shown to improve outcomes. All caregivers should be trained in performing cardiopulmonary...
resuscitation. U.S. Coast Guard–approved personal flotation devices and the presence of lifeguards have been shown to decrease drowning risk. Parents should be cautioned that many flotation rings and armbands are not approved devices and are considered toys subject to deflation or malfunction.26

The role of swimming lessons to prevent drowning is controversial. Two studies demonstrated a reduction in the risk of drowning-related death among children who have taken formal swimming lessons, but this association was statistically significant only in one- to four-year-olds.11,26 These studies have been criticized for their small sample size and possible selection bias. The AAP maintains that children are not likely to be developmentally ready for formal swimming lessons until four years of age, and recommends lessons in all children after that age.10 Parents must be cautioned that completion of formal swimming lessons is only one part of a multifactorial drowning prevention strategy.

The AAFP additionally recommends poolside access to a telephone with emergency numbers, arm’s length supervision for children younger than four years by a dedicated adult who is not distracted by other activities, and safety drains that cannot cause entrapment in all pools and hot tubs.27

Poisoning

Most accidental poisonings involve toddlers, and usually result in minor clinical symptoms with few or no adverse outcomes.28 Conversely, most deaths from unintentional poisonings occur in teens and preteens.1

About 60 percent of accidental poisonings involve oral supplements and prescription and nonprescription drugs. Despite significant advances in product labeling and child-resistant packaging, 57 percent of products involved in childhood accidental poisonings adhere to the requirements of the Poison Prevention Packaging Act.28

Poisoning prevention education programs (specifically those that provide free or low-cost cabinet locks and poison control stick-

ers) have been shown to improve safe storage behavior in the home. Although evidence indicates that educational programs can improve safety behavior, it is unclear if they result in fewer accidental poisonings.29 Syrup of ipecac is not recommended for acute poisoning in children, and parents should be advised not to keep it at home.29 Caregivers should be prepared to contact a poison control center, such as the National Capital Poison Center (800-222-1222, http://www.poison.org), or emergency services immediately if a potential poisoning occurs.12

Fire

Risk factors for fire-related injury in children include age younger than four years, low socioeconomic status, black or Native American race, lack of a functioning smoke detector in the home, use of alternative heating sources, and lack of appropriate child supervision.30 Residential fires are the greatest cause of childhood fire-related mortality, and smoking is the leading cause of fatal residential fires.31 Two-thirds of homes in which children are injured or killed by fire have no functional smoke detectors.32 In many communities, having nonfunctioning smoke detectors is more common than the absence of smoke detectors.

Physicians should counsel all patients about installing smoke detectors, but more importantly, about strategies to ensure that they are operational. Counseling should also include creating a home escape plan and educating children about what to do in the event of a fire.13 Community-based educational efforts appear to be beneficial, especially for high-risk groups.14

Although only about 5 percent of residential fires are attributed to children playing with fire, these fires are responsible for 40 percent of fire-related deaths in children.32 Parents should be counseled to keep matches and lighters out of reach of children and to have age-appropriate discussions about the dangers of playing with fire.

Falls

Risk factors for fall injury include age younger than six years, low socioeconomic
status, and male sex. Children who use walkers have a significantly higher risk of injury from a stairway fall (relative risk = 4.26). Increased severity of injury associated with falls off of a bunk bed is associated with age of six years or younger, low socioeconomic status, unfamiliarity with new bunk beds, and uncarpeted bedroom surfaces.

**Bicycling**

An estimated 66 per 100,000 U.S. children use emergency department services for bicycle-related injuries annually, with $200 million spent in related hospital admissions. Use of bicycle helmets has been shown to significantly reduce the risk of head and brain injuries, regardless of the involvement of a motor vehicle.

In one small cross-sectional analysis, physician counseling in the previous 30 days was associated with an increase in reported helmet use by five- to 14-year-olds. Helmet use is improved when strictly enforced and modeled by parents and peers. A Cochrane review demonstrated that bicycle helmet legislation aimed at children has increased helmet use, decreased head injuries, and decreased bicycle-related mortality. Community-based, nonlegislative programs that provide free helmets significantly improve helmet use. School-based education programs also effectively increase helmet use, but to a lesser extent than community-based programs.

The AAFP recommends that physicians take an active role in advancing legislation to enact or sustain mandatory helmet use by all bicyclists. The NHTSA also recommends that bicyclists wear brightly colored and reflective clothing, obey all traffic laws, and ride with the flow of traffic.

**Effectiveness of Counseling and Interventions**

Family physicians are ideally positioned to provide focused safety counseling to individuals and families. They can also be active advocates for childhood safety in their communities. Evidence for the effectiveness of counseling and other interventions by medical personnel is inconclusive.

A Cochrane review involving 80 studies demonstrated that anticipatory education improved some parental safety behaviors, including reduced hot water temperatures, increased use of functional smoke detectors, and improved medication storage. However, the review did not
demonstrate a statistically significant reduction in childhood injury rates. Conversely, another Cochrane review showed that such interventions decreased injury rates specifically in high-risk children (i.e., those with low socioeconomic status, premature birth, or learning disabilities). One study reported increased use of child safety seats when education was directed at preschoolers rather than their parents.

Access to low-cost safety equipment through community-based programs seems to be effective. A study found good evidence that multifaceted home intervention programs that included provision of safety equipment improved prevention practices.

In a busy physician office, providing all of the recommended childhood safety counseling can be daunting. One practical strategy is to involve nursing staff and/or use screening questionnaires to identify risk factors for individual children, then provide specific safety counseling. Safety topics can also be integrated into existing office systems. For example, questions about cardiopulmonary resuscitation training or medication storage could be integrated into prenatal counseling checklists or well-child forms.

**Data Sources:** The Cochrane database was searched using the term injury prevention with the terms child, infant, and adolescent. American Academy of Pediatrics policy statements were also reviewed. A PubMed search was conducted using the terms child, infant, and adolescent with preschool and accident prevention, lead poisoning, poisoning/ prevention and control, falls, wounds, injuries/prevention and control, burns/prevention and control, accident/prevention and control, head protective devices, accidents traffic/prevention and control, accidents home/prevention and control, drowning, sudden infant death, and accidental falls. The search included meta-analyses, randomized controlled trials, guidelines, case studies, policy papers, Agency for Healthcare Research and Quality evidence reports, U.S. Preventive Services Task Force, and Bandolier. Search dates: March 29, 2011, through May 30, 2011.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army Medical Department or the U.S. Army Service at large.

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