

# Injuries Associated With Cribs, Playpens, and Bassinets Among Young Children in the US, 1990–2008

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## KEY WORDS

injury, crib, playpen, bassinet, prevention, fall, trauma, National Electronic Injury Surveillance System, emergency department

## ABBREVIATIONS

CPSC—US Consumer Product Safety Commission

NEISS—National Electronic Injury Surveillance System

CI—confidence interval

[www.pediatrics.org/cgi/doi/10.1542/peds.2010-1537](http://www.pediatrics.org/cgi/doi/10.1542/peds.2010-1537)

doi:10.1542/peds.2010-1537

Accepted for publication Dec 2, 2010

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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**FINANCIAL DISCLOSURE:** *The authors have indicated that they have no personal financial relationships relevant to this article to disclose.*



**WHAT'S KNOWN ON THIS SUBJECT:** Previous research has focused on infant mortality attributed to suffocation and strangulation in the crib environment. No studies have investigated both fatal and nonfatal crib-related injuries.



**WHAT THIS STUDY ADDS:** This study is the first to use a nationally representative sample to investigate injuries among young children associated with cribs, playpens, and bassinets.

## abstract

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**OBJECTIVE:** To describe the epidemiology of injuries related to cribs, playpens, and bassinets among young children in the United States.

**METHODS:** A retrospective analysis was done using data from the National Electronic Injury Surveillance System for children younger than 2 years of age treated in emergency departments in the United States from 1990 through 2008 for an injury associated with cribs, playpens, and bassinets.

**RESULTS:** An estimated 181 654 (95% confidence interval: 148 548–214 761) children younger than 2 years of age were treated in emergency departments in the United States for injuries related to cribs, playpens, and bassinets during the 19-year study period. There was an average of 9561 cases per year or an average of 12.1 injuries per 10 000 children younger than 2 years old per year. Most of the injuries involved cribs (83.2%), followed by playpens (12.6%) and bassinets (4.2%). The most common mechanism of injury was a fall from a crib, playpen, or bassinet, representing 66.2% of injuries. Soft-tissue injuries comprised the most common diagnosis (34.1%), and the most frequently injured body region was the head or neck (40.3%). Patients with fractures were admitted 14.0% of the time, making them 5.45 (95% confidence interval: 3.80–7.80) times more likely to be hospitalized than patients with other types of injury. Children younger than 6 months were 2.97 (95% confidence interval: 2.07–4.24) times more likely to be hospitalized than older children.

**CONCLUSIONS:** This study is the first to use a nationally representative sample to examine injuries associated with cribs, playpens, and bassinets. Given the consistently high number of observed injuries, greater efforts are needed to ensure safety in the design and manufacture of these products, ensure their proper usage in the home, and increase awareness of their potential dangers to young children. *Pediatrics* 2011;127:479–486

Whether sleeping or awake, infants and young children spend much of their time in cribs, playpens, and bassinets. These products are unique among nursery products in that they are intended to be secure locations where parents can place their infant and walk away knowing their child is safe and protected even while alone and unattended. However, as evidenced by the more than 9 million cribs that have been recalled by the US Consumer Product Safety Commission (CPSC) since September 2007 because of safety issues,<sup>1</sup> cribs are not always as safe as parents believe. Poor design, product defects, faulty setup, and improper use have led to deaths, infant entrapments, and scores of other injuries to young children. Hazards associated with cribs have been an ongoing and unresolved issue for the past 4 decades. As early as 1973, the CPSC began releasing safety standards for the design and construction of cribs sold in the United States to protect children from strangulation, suffocation, and falls.<sup>2</sup> Despite efforts to reduce these risks, crib-related injuries accounted for more than 14 500 injuries to children younger than 5 years of age in 2009 and were associated with the majority of nursery product deaths.<sup>3</sup> Previous studies have investigated infant mortality attributed to suffocation and strangulation in cribs and adult beds,<sup>4</sup> risk factors for sudden unexpected death in infancy,<sup>5,6</sup> injuries attributed to crib bumper pads,<sup>7,8</sup> and deaths attributed to hanging, wedging, and positional asphyxia.<sup>9–11</sup> However, nonfatal injuries associated with cribs have been largely overlooked in research, although these events are far greater in number than fatalities associated with cribs and can result in serious morbidity.

This is the first nationally representative study to examine the epidemiology of injuries to young children associ-

ated with cribs, playpens, and bassinets treated in emergency departments in the United States. The goal of this research is to provide information to educate parents, other child caregivers, and health professionals about these injuries; help improve product design; and ultimately prevent injuries associated with these products among young children.

## METHODS

### Data Source

The National Electronic Injury Surveillance System (NEISS) is operated by the CPSC to provide data on consumer product-related and sports activity-related injuries treated in emergency departments in the United States. The NEISS collects data from a network of ~100 hospitals, including 8 children's hospitals, representing a stratified probability sample of the 6100 hospitals in the United States and its territories with a 24-hour emergency department with at least 6 beds.<sup>12</sup> Every year, NEISS supplies data on a projected 500 000 injury-related emergency-department visits and permits estimation of the number and epidemiology of these injuries for the entire United States. The data set is updated daily by professional NEISS coders, who review all emergency-department records and transcribe data on patient age, gender, injury diagnosis, disposition from the emergency department, body region injured, and product(s) involved, along with a brief narrative describing the incident.<sup>12</sup>

Crib-related injuries among children younger than 2 years of age treated in emergency departments from January 1, 1990, through December 31, 2008, were identified by NEISS consumer product codes (1543, 1529, 1545, 1513, 1537, and 1542), which include cribs, portable cribs, crib springs, play pens, play yards, bassinets, cradles, playpen pads, infant mattresses, and bumper

pads. In addition, injuries associated with toddler beds, pillows, infant pillow wedges, water pillows, blankets, sheets, other bedding, crib dolls, mobiles, crib gyms, and monitoring devices (codes 4082, 4050, 0662, 0689, 4051, 4054, 5004, 1526, and 0555) were reviewed to identify relevant cases. Each case was examined for potential miscoding, and cases were excluded if the narrative description indicated that the injury occurred outside the crib environment or that cribs, playpens, and bassinets were not involved in the injury. Cases involving diaper rash, animal bites, scratches, dermatitis, and conjunctivitis were excluded from this study. When used in this article, the term "crib-related injury" refers to an injury associated with a crib, playpen, or bassinet and does not necessarily imply that the product caused the injury.

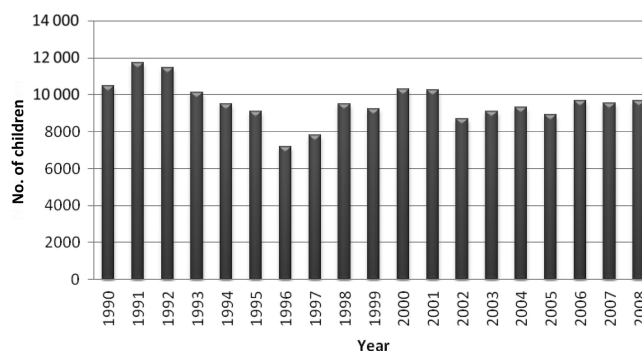
### Variables

NEISS case narratives were reviewed to classify the mechanism of injury, for which a new 4-level variable was created: (1) fell or jumped out of the crib; (2) hit, cut on, or fell inside the crib; (3) caught or wedged in the crib; and (4) other. Another variable also was created from information contained in the narratives, which identified whether another individual was involved in the injury event (sibling or other child, parent or caretaker, or no other person involved). The NEISS categories for the injured body region were grouped as head or neck, face (including eyeball, mouth, and ear), upper extremity (including arm, elbow, wrist, hand, and finger), lower extremity (including leg, knee, ankle, foot, and toe), and other (shoulder, trunk, pubic region, internal, 25% to 50% of the body, and 50% to 100% of the body). Disposition from the emergency department was grouped into 4 categories: (1) treated and released from the emergency department; (2) hospitalized (including

treated and admitted to the hospital, transferred to another hospital, or held for observation); (3) fatalities; and (4) left against medical advice. Types of injury were grouped into 5 categories: (1) concussion or closed head injury (internal organ injury to the head region); (2) soft-tissue injury (including contusion, abrasion, and hematoma); (3) lacerations (including lacerations, amputations, and punctures); (4) fracture; and (5) other (including ingested or aspirated foreign object, foreign bodies, burns, crushing, dislocation, dental injury, strain and sprain, anoxia, hemorrhage, electric shock, poisoning, and avulsion).

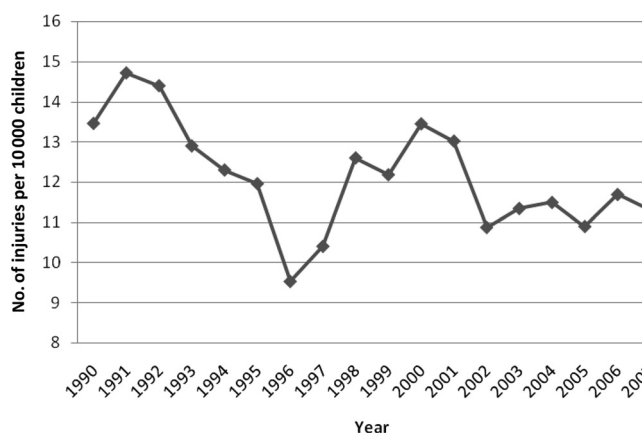
### Statistical Analysis

Data were analyzed by using SPSS version 17.0 (SPSS Inc, Chicago, IL), SAS version 9.1 (SAS Institute, Cary, NC), SUDAAN 9.0 (Research Triangle Institute, Research Triangle Park, NC), and Epi Info 6.04 (USD, Stone Mountain, GA). Statistical weights provided by the CPSC were used to calculate national injury estimates. Data reported in this article are national estimates unless specified as actual unweighted cases. Unweighted numbers of cases less than 20 were excluded from analyses to prevent unstable estimates, and missing values were omitted from analyses. US Census Bureau population estimates from 1990 to 2007 were used to calculate injury rates; specific 2008 population estimates were not available for children younger than 2 years of age; therefore, 2008 injury rates were not calculated. Statistical analyses included linear regression,  $\chi^2$  analysis, and relative risks with 95% confidence intervals (CIs). The level of significance used for all statistical tests was  $\alpha = 0.05$ . This study was approved by the institutional review board of the Research Institute at Nationwide Children's Hospital.



**FIGURE 1**

Estimated number of children younger than 2 years of age treated in emergency departments in the United States for injuries associated with cribs, playpens, and bassinets, 1990–2008.



**FIGURE 2**

Rate of crib-, playpen-, and bassinet-related injuries per 10 000 children younger than 2 years of age treated in emergency departments in the United States, 1990–2007.

## RESULTS

### Demographic Features and Overall Injury Trends

From 1990 through 2008, an estimated 181 654 (95% CI: 148 548–214 761) crib-, playpen-, and bassinet-related injuries among children younger than 2 years of age were treated in emergency departments in the United States. This yields an average of 9561 (95% CI: 9076–10 045) cases per year or an average of 12.14 (95% CI: 12.08–12.20) injuries per 10 000 children younger than 2 years of age in the United States. There was a nonsignificant decrease in the number of injuries during the 19-year study period (Fig 1). However, injury rates showed a statistically significant decrease over the study period ( $m = -0.138$ ;  $P <$

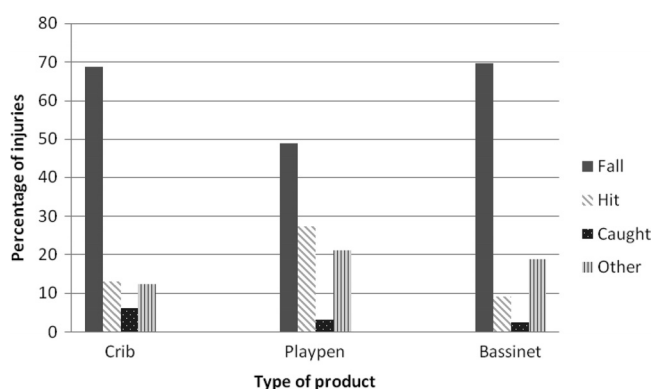
.017) (Fig 2). Boys accounted for 56.1% of cases (Table 1). The mean age of patients was 12.2 months (median: 12 months). Infants 6 to 11 months of age constituted the largest group, with 34.6% of cases, followed by children 12 to 17 months of age (33.4%). Of 83.7% of injuries for which a location was documented, 97.8% of injuries (148 677 of 152 024 cases) occurred in the home.

### Mechanism of Injury, Type of Injury, and Body Region Injured

Most of the injuries involved cribs (83.2%), followed by playpens (12.6%) and bassinets (4.2%). Falling from a crib, playpen, or bassinet was the most common mechanism of injury (Fig 3), accounting for 66.2% of injuries or an

**TABLE 1** Characteristics of Childhood Crib-, Playpen-, and Bassinet-Related Injuries Treated in Emergency Departments in the United States, 1990–2008

|                                       | National Estimate<br>(95% CI) | Percentage of<br>Total National<br>Estimate |
|---------------------------------------|-------------------------------|---|
| Gender                                |                               |   |
| Male                                  | 101 893 (84 060–119 726)      | 56.1  |
| Female                                | 79 761 (63 662–95 860)        | 43.9  |
| Age, mo                               |                               |   |
| 0–5                                   | 19 271 (14 755–23 787)        | 10.6  |
| 6–11                                  | 62 852 (49 509–76 194)        | 34.6  |
| 12–17                                 | 60 658 (50 175–71 142)        | 33.4  |
| 18–23                                 | 38 873 (30 620–47 126)        | 21.4  |
| Type of Injury                        |                               |   |
| Concussion or closed head injury      | 37 883 (27 656–48 110)        | 21.1  |
| Soft-tissue injury                    | 61 239 (48 245–74 233)        | 34.1  |
| Laceration                            | 25 578 (21 069–30 087)        | 14.3  |
| Fracture                              | 21 573 (17 550–25 597)        | 12.0  |
| Other                                 | 33 128 (26 436–39 820)        | 18.5  |
| Mechanism of injury                   |                               |   |
| Fell or jumped out of crib            | 120 319 (98 537–142 101)      | 66.2  |
| Hit, cut, or fell in crib             | 26 650 (21 430–31 870)        | 14.7  |
| Caught or wedged in crib              | 9908 (7578–12 238)            | 5.5   |
| Other                                 | 24 777 (18 056–31 498)        | 13.6  |
| Body region injured                   |                               |   |
| Head or neck                          | 70 736 (56 151–85 322)        | 40.3  |
| Face                                  | 48 247 (38 483–58 010)        | 27.5  |
| Upper extremity                       | 25 238 (19 761–30 716)        | 14.3  |
| Lower extremity                       | 14 193 (11 631–16 755)        | 8.1   |
| Other                                 | 17 223 (13 366–21 079)        | 9.8   |
| Type of product                       |                               |   |
| Crib                                  | 151 075 (121 860–180 290)     | 83.2  |
| Playpen                               | 22 978 (18 904–27 052)        | 12.6  |
| Bassinet                              | 7602 (5782–9421)              | 4.2   |
| Disposition from emergency department |                               |   |
| Treated and released                  | 170 374 (139 133–201 615)     | 93.9  |
| Admitted, transferred, or held        | 7204 (5291–9117)              | 4.0   |
| Died                                  | 2140 (1038–3241)              | 1.2   |
| Left against medical advice           | 1665 (827–2502)               | 0.9   |



**FIGURE 3** Percentage of injuries by mechanism and product.

average of 8.06 (95% CI: 8.01–8.11) injuries per 10 000 children younger than 2 years of age in the United States. The percentage of injuries at-

tributed to falls increased with age. Falls accounted for 38.1% of injuries among children younger than 1 month through 5 months old, 65.2% of injuries

for children 6 months through 11 months old, 71.0% of injuries for children 12 months through 17 months old, and 74.4% of injuries for children 18 months through 23 months old. The second most common mechanism of injury was becoming struck by or against the crib, and these events included a hit, cut, or fall inside a crib, accounting for 14.7% of injuries. Soft-tissue injury (34.1%) was the most common diagnosis, whereas concussion or closed head injury was the second most frequent diagnosis (21.1%) (Table 1). The head or neck was the most frequently injured body region (40.3% of injuries), followed by the face (27.5%).

In comparison with other mechanisms of injury, concussions and closed head injuries were 3.31 times (95% CI: 2.58–4.26) more likely to occur when children fell from a crib, playpen, or bassinet, whereas lacerations were 4.13 times (95% CI: 3.53–4.83) more likely to occur when children were hit, cut, or fell inside a crib. When children were caught or wedged in a crib, lower-extremity injuries (relative risk: 8.31 [95% CI: 6.80–10.16]) and upper-extremity injuries (relative risk: 2.84 [95% CI: 2.18–3.69]) were more likely to occur relative to other injury mechanisms. Children 12 months of age or older were 2.47 times (95% CI: 1.97–3.09) more likely to be treated for fractures than children younger than 12 months old. For all ages, injuries to the face were 9.23 times (95% CI: 7.32–11.64) more likely to be a laceration than another type of injury, and upper-extremity injuries were 7.46 times (95% CI: 6.23–8.95) more likely to be a fracture than another injury type or injury. The injury event involved a sibling or another child in 3.4% of cases and involved a parent or adult caretaker in 2.1% of cases. Only 1.4% of fall-related injuries

involved another person (child or adult).

### Disposition and Case Fatalities

The majority of patients (93.9%) with injuries associated with cribs, playpens, and bassinets were treated and released from the emergency department (Table 1). Children younger than 6 months of age were 2.97 times (95% CI: 2.07–4.24) more likely to be hospitalized than children 6 months of age or older. Patients younger than 6 months old were hospitalized 9.8% (1867 of 19 140 cases) of the time and sustained a fatal injury 7.8% (1496 of 19 140 cases) of the time. Children who became caught or wedged in a crib, playpen, or bassinet were 1.74 times (95% CI: 1.01–3.00) more likely to be hospitalized than those who were injured by other mechanisms. Patients with fractures were admitted, transferred, or held for observation 14.0% of the time (3010 of 21 538 patients), making them 5.45 times (95% CI: 3.80–7.80) more likely to be hospitalized than children with other types of injury. An estimated 2140 children died, accounting for 1.2% of patients. The mechanism of injury categories accounting for the greatest number of fatalities were becoming caught or wedged in the crib and category of “other.” The majority (71.1%) of the fatality case-narrative descriptions included a diagnosis of cardiopulmonary arrest or sudden infant death syndrome, and more than two-thirds (69.9%) of all deaths occurred among infants younger than 6 months of age.

### DISCUSSION

Crib safety is a unique and critical issue. Unlike other nursery products, cribs, playpens, and bassinets are supposed to provide a safe place where caregivers can leave an infant unattended with peace of mind. Although many studies have examined crib-related deaths, there is a dearth of

studies on nonfatal crib-related injuries, although these nonfatal events account for the majority of injuries associated with these products. To our knowledge, this is the first study to report national estimates, rates, and trends of nonfatal crib-related injuries among young children.

Our investigation found that nearly two-thirds of crib-related injuries resulted from falls. This echoes the findings from the 2010 CPSC report indicating that the most common mechanism of all nursery product-related injuries was a fall<sup>5</sup> and the 2009 *Kids In Danger* report stating that two-thirds of crib-related injuries and nearly 30% of crib recalls were associated with falls.<sup>13</sup> Our results also parallel those of the CPSC report, showing that the most frequently injured body region was the head, and among the 3 types of products, most of the injuries involved cribs, followed distantly by playpens and bassinets.

Although the rate of crib-related injury decreased significantly over the 19-year study period, the total number of injuries associated with cribs did not show a significant decrease during the same period. Thus, despite the attention given to crib safety during the past 2 decades, the number of crib-related injuries remains consistently high, averaging 26 children injured per day in the United States. This represents an unacceptable level of danger, highlighting the need for continued improvements in product design, especially to prevent falls from cribs, to protect young children. The average annual rate of crib-related fall injury was 8.1 per 10 000 children younger than 2 years of age in the United States, and the most commonly injured body region was the head or neck. This high injury rate and predominance of head injuries is a result, in part, of young children's higher center of gravity, which causes them to tum-

ble head first, for example, over the side of a crib. Only 1.4% of fall-related injury events involved another person. The percentage of injuries attributed to falls increased with each age group in this study, likely reflecting the influence of increasing mobility and the development of standing and climbing skills with increasing age. Children 18 months of age or older represented a smaller proportion of injury cases than children 6 to 11 months or 12 to 17 months of age, likely reflecting the choice made by many parents to move their child from a crib to a bed as they become more mobile.

During the first 2 years of life, children's developmental skills and coordination rapidly evolve and motor skills increase, as does their eagerness to explore their environment. Placing a crib tent or mesh canopy over the crib is not a viable solution to keep children from climbing out because they may become entrapped and strangled by the netting.<sup>14</sup> In addition, children who climb out of cribs risk strangulation from catching their clothing around the neck on hardware projecting from cribs such as knobs and posts.<sup>9,15,16</sup>

There was an average of 113 crib-related deaths per year in this study, accounting for slightly more than 1% of patients. This is an underestimate of all crib-related deaths because the NEISS underestimates deaths, given that not all prehospital deaths are transported to an emergency department and some deaths occur after admission to the hospital from the emergency department. Recent studies<sup>4,17</sup> have reported that cribs are the leading nursery product associated with infant fatalities and that infant mortality rates attributed to unintentional suffocation and strangulation in bed (not limited to cribs) have increased fourfold in the last 20 years. In almost all of the more than 2000 deaths in this

study, the child was put down in the crib and later found unresponsive, often face down in blankets or pillows or wedged between the mattress or pad and the side of the crib. Although the cause of death was not always stated in the NEISS case narratives or diagnosis, most were recorded as anoxia or described in the narrative as sudden infant death syndrome or suffocation. Our findings are similar to previous studies<sup>4,6,11</sup> that describe major causes of crib-related death as anoxia, suffocation, and asphyxia and include soft bedding as a contributing factor in many deaths with infants in a prone position. This problem is compounded by the fact that infants have bigger and heavier heads relative to their small body size and less developed neck muscles, making it easier for their heads to become trapped in and harder to extricate from a dangerous position. Several cases in our study involved an infant becoming wedged between the mattress and crib or between the mattress and bumper pad. The use of crib bumper pads is strongly discouraged because the possibility for serious injury, including suffocation and strangulation, greatly outweighs any minor injury they may prevent.<sup>7,8</sup> Our findings support the recommendations in the 2000 American Academy of Pediatrics Task Force report regarding the importance of an infant's sleeping environment in reducing the risk of sudden infant death syndrome.<sup>5</sup>

Consistent with previous studies, some injuries in our study were related to the unique characteristics of each product, such as bassinet collapse, broken slats and stabilizing clips of cribs, playpen collapse, playpen modifications, and incorrect assembly.<sup>17</sup> All of these may cause infants to be placed into a perilous position, as is the case with suspended rocking cradles and mesh-sided cots,

which have been associated with asphyxiation.<sup>6,18–22</sup> The American Society for Testing and Materials International (ASTM) recently revised its voluntary standards to reduce hazards associated with full-size cribs (failure of mattress-support hardware, glued or bolted connections, drop-side latch, and teething rails), bassinets (suffocation, tip over, collapse, and hood detachment), and non–full-size cribs and play yards (entrapment in drop-side units, entanglement on hardware, dislodgment of slats, strangulation in mesh openings, and collapse of locking devices, floor, or sides).<sup>23–25</sup> Voluntary standards can be implemented more quickly than the mandatory standards promulgated by the CPSC, allowing design changes to reach the marketplace relatively rapidly.<sup>17</sup>

Additional efforts have been undertaken during the last 2 years to improve crib safety. In the *Federal Register* (2008), the CPSC announced options to address crib safety hazards and requested comments and information regarding the risks of injury associated with cribs, including information about hardware, assembly, and instructional problems.<sup>26</sup> A roundtable on cribs and other infant sleeping environments was held in Bethesda, Maryland, in April 2009 to examine the effectiveness of current voluntary and mandatory standards.<sup>27</sup> Drop-side cribs caused increasing concern in 2009 because warnings escalated from the recalls of 400 000 Simplicity cribs in July 2009 to 600 000 Delta Enterprise cribs in October 2009 and up to 2.1 million Stork Craft cribs in November 2009, the latest of which is the largest crib recall in United States history.<sup>28</sup> In May 2010, the CPSC issued a warning about drop-side cribs, citing 32 fatalities in these cribs during the previous 9 years.<sup>29</sup> Major manufacturers have proposed a ban on drop-side cribs after repeated re-

calls, entrapments, and deaths. Many falls from cribs in our study were a result of drop sides being left down unintentionally or falling down, which allowed children to roll out. The American Academy of Pediatrics has strongly recommended that the CPSC mandate the ASTM crib standards for all full-size and non–full-size cribs. The CPSC collaborated with the American Academy of Pediatrics and Keeping Babies Safe to launch a national campaign on crib safety in October 2010 and promoted an educational video that informs new parents how to provide a safe sleep environment for their child.<sup>30</sup> Collectively, these actions should help to prevent many of the nonfatal and fatal injuries seen in our investigation. Furthermore, the CPSC advises parents to put an infant to sleep on its back in a crib that adheres to current standards; not to use old, broken, or modified cribs; not to add extra mattresses, pillows, and cushions; and to watch out for strangulation and entrapment hazards, such as gaps between loose components, broken slats, and other parts.<sup>31</sup> Despite the potential perils, cribs still are considered to be the safest location for sleeping infants because there have been many suffocation deaths reported for infants sleeping in adult beds and on other alternate surfaces.<sup>32</sup> Caregivers need to be aware of their important role in the correct use of cribs and related products, such as checking routinely for compromised structural integrity of the crib and keeping track of their child's developmental milestones to assess the changing risks of injury.<sup>33</sup> However, it is unreasonable to expect parents and caregivers to supervise children at all times while they are in the crib, playpen, or bassinet or to always anticipate hazards and take action to prevent injuries. Thus, active prevention strategies alone are not enough; automatic, or passive, prevention

measures through improved product design must be achieved to effectively protect young children in sleep environments.

Several limitations exist in our study. This study underestimates the total number of crib-related injuries because only injuries of patients treated in emergency departments were included. The number of deaths reported also is an underestimate because fatalities also are incompletely captured by the NEISS. The findings of this study may not be representative of injuries treated in other types of health care facilities or injuries that did not receive any medical treatment. Data reported to the NEISS are limited by the detail provided in the emergency-department medical records; thus, the narrative portion of the NEISS database may lack detail about the height of the fall; the surface on which the patient landed; the type of activity taking place at the time of the injury event;

the type of crib, playpen, or bassinet being used; other factors that may have contributed to the injury event; and injury severity. In addition, the use of product coding to examine injury trends has drawbacks because NEISS codes may change over time and only a maximum of 2 product codes per injury incident are documented in the database. Despite these limitations, the strength of this study is that it uses a large, nationally representative sample of data regarding crib-related injury that spans 19 years.

## CONCLUSIONS

Crib-, playpen-, and bassinet-related injuries, particularly those attributed to falls from or child contact with the product, are an important source of injury for children younger than 2 years of age. Given the consistently high numbers of these injuries over the 19-year study period, current prevention strategies are clearly insufficient, and greater efforts are required

to minimize the hazards associated with these nursery products. Additional attention should be given to the design and manufacture of these products to enhance the prevention of falls and entrapments. Crib, playpen, and bassinet safety standards must continue to be strengthened and rigorously enforced to protect young children from harm. Health care professionals, child care providers, parents, and other child caregivers also should be cognizant of the recommendations for proper use of these products.

## ACKNOWLEDGMENTS

The authors gratefully acknowledge The Samuel J Ressler Memorial Medical Scholarship Fund for financial stipend support for Elaine S Yeh while conducting this study.

We also gratefully acknowledge the technical support of Brenda J Shields, MS.

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