



Recognizing Delirium in Hospitalized Children: A Systematic Review of the Evidence on Risk Factors and Characteristics

The findings can facilitate earlier recognition and prevention of pediatric delirium.

Delirium is a frequent, underrecognized, complex neuropsychiatric syndrome. It is an acute state that is believed to be organically based. According to the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)*, characteristics of delirium include rapid onset; fluctuating course; and disturbances of attention, memory, thought, perception, and behavior that “do not occur within the context of a severely reduced level of arousal such as coma.”^{1,2} While delirium in hospitalized adults, and particularly older adults, is well documented, affecting between 42% and 80% of this population,³ its occurrence among hospitalized children is less clear. A recent literature review found the reported prevalence of delirium among hospitalized children to range from 13% to 28%; one study, which used “clinical suspicion” as its index, reported just 5%.⁴ Yet one retrospective study of children ages seven to 17 years who had been hospitalized found that more than 30% recalled having hallucinatory experiences during their stay.⁵ In almost all cases (94%), these delusional memories were “highly disturbing,”

with persistent and threatening content. Except in two cases, the location associated with these memories was the pediatric ICU (PICU).

Delirium in adults has been associated with longer hospital stays, poorer functional outcomes, and high mortality rates.⁶ Although there have been fewer studies among children, one study of pediatric psychiatric patients found that delirium was associated with prolonged hospital stays and high mortality rates.⁷ Factors that increase the likelihood of delirium in hospitalized patients include disturbed sleep, discomfort, dehydration, limited access to food and fluids, isolation, and immobility.⁸ In other words, the acute care hospital environment itself may be a precipitating factor. The specific pathophysiology of delirium remains largely unknown. That said, research in traumatic brain injury indicates that the immature, developing brain has different responses to oxygen deprivation and cytokine release than the adult brain, making children potentially more susceptible to occurrences of delirium.^{9,10}

In children, acute delirium can present in one of three subtypes: hypoactive, hyperactive, or mixed (also known as emerging or veiled) delirium.¹¹ Hypoactive

ABSTRACT

Purpose: The purpose of this study was to examine the evidence regarding the risk factors for and characteristics of acute pediatric delirium in hospitalized children.

Methods: The systematic review method within an epidemiological framework of person, place, and time was used. Fifty-two studies were selected for initial retrieval. Of these, after assessment for methodological quality, 21 studies involving 2,616 subjects were included in the review.

Results: Findings revealed five primary characteristics seen in children experiencing delirium: agitation, disorientation, hallucinations, inattention, and sleep–wake cycle disturbances. Children who were more seriously ill, such as those in a pediatric ICU (PICU) and those with a high Pediatric Risk of Mortality II (PRISM II) score, and children who were mechanically ventilated were at greater risk for development of delirium. Those with a developmental delay or a preexisting anxiety disorder were also more prone to delirium. Although delirium symptoms fluctuate, most episodes occurred at night. Boys were slightly more susceptible than girls, though this difference was not significant. A key finding of this review was that delirium is multifactorial, related to treatment (mechanical ventilation, for example) and to a hospital environment (such as a PICU) that deprives patients of normal sleep–wake cycles and familiar routines.

Conclusion: These findings will be useful in efforts to achieve earlier recognition and better management or prevention of pediatric delirium. This may also help to prevent unnecessary laboratory testing and imaging studies, which can cause children and parents unnecessary pain and anxiety and increase hospital costs.

Keywords: acute care, pediatric delirium, pediatric intensive care unit, risk factors, systematic review

delirium, thought to be related to the poorest outcomes, is characterized by inattention and lethargy. Hyperactive delirium is characterized by heightened psychomotor activity (such as agitation and pulling out catheters) and hallucinations. In mixed delirium, the patient fluctuates between the hyperactive and hypoactive subtypes. The patient may present with disturbed cognition or attention (or both) and severe anxiety “often accompanied with moaning and restlessness,” yet without clear agitation or lethargy.¹¹

Estimates of the economic burden of delirium vary. One U.S. study conducted among elderly patients found that delirium accounted for added health care costs of between \$16,303 and \$64,421 per patient annually, resulting in an overall annual burden of \$38 billion to \$152 billion.¹² A study in the Netherlands by Smeets and colleagues found that pediatric delirium increased the duration of PICU stay by an average of 2.39 days, which corresponded to an increase of 1.5% in direct medical costs.¹³ And in a study of costs associated with pediatric delirium, Traube and colleagues found that median total PICU costs were almost four times higher for patients with delirium than for those without (\$18,832 versus \$4,803, respectively).¹⁴ After controlling for age, sex, illness severity, and PICU length of stay, delirium was associated with an 85% increase in PICU costs.

It's likely that a better understanding of the risk factors and characteristics of pediatric delirium would lead to earlier identification, referrals to psychiatric consultation when appropriate, and the development of delirium reduction and prevention programs. These

approaches have been shown to improve outcomes,¹² and thus might also reduce costs.

Nurses, particularly pediatric nurses, are well positioned to recognize the risk factors for and characteristics of pediatric delirium and to address ways to reduce such risk. Thus, we framed the research question as, “How do nurses recognize the risk factors and characteristics of delirium in children?” The purpose of this study was to examine the evidence regarding the risk factors for and characteristics of acute pediatric delirium in hospitalized children.

METHODS

Design. A descriptive epidemiological systematic review method was used. Descriptive epidemiological studies examine the distribution of a disease or condition for the purposes of establishing prevention or management programs (or both) and informing their planning and evaluation.¹⁵ Such studies do so by describing the characteristics of people (race, age, and sex, for example), place (geographic location), and time (a specific year or span of time), rather than by examining the effects of an intervention. For this review, epidemiological study designs—including prospective and retrospective cohort studies with or without control groups, and cross-sectional and case-control studies that addressed nonemergent delirium (delirium unrelated to the administration of anesthesia, for example)—were sought.

The target population was hospitalized children, from birth through 21 years, who had been diagnosed with delirium. Studies were selected for inclusion if

Electronic Databases Searched

- Agency for Healthcare Research and Quality
- American Academy of Pediatrics
- CINAHL (EBSCO)
- ClinicalTrials.gov
- Cochrane Library
- Joanna Briggs Institute Library
- JSTOR
- Kaiser Family Foundation
- MEDLINE (Ovid)
- New York Academy of Medicine
- OpenDOAR
- ProQuest Dissertations and Theses
- PsycINFO (Ovid)
- Robert Wood Johnson Foundation
- ScienceDirect
- Scopus
- Theses Canada
- University of York Centre for Reviews and Dissemination
- Virginia Henderson International Nursing Library
- Web of Science

they involved this target population, used a delirium screening method, described risk factors for or characteristics of delirium episodes (or both), and were published in English. Single case studies, intervention studies, and qualitative studies, as well as non-English publications, were excluded.

Selection of studies for inclusion. A four-step search strategy for articles published in English from 1990 through 2015 was used. First, we searched MEDLINE and CINAHL using an initial list of keywords generated from a concept map based on the research question; this method also allowed us to identify additional keywords. Second, in consultation with a health sciences librarian, we used the expanded list of keywords to search 20 databases (see *Electronic Databases Searched*). Third, the reference lists of all identified articles were searched to identify additional studies. Lastly, we searched the selected Web of Science articles by author names to determine if any other relevant publications existed.

Two reviewers (CH and SP) screened all articles that were identified by title and abstract, using the inclusion criteria. The resulting list was then reviewed by the entire review team. Each article selected for retrieval was assessed independently by teams of two reviewers (all authors participated) for methodological quality, using the appropriate critical appraisal tool from the *Joanna Briggs Institute Reviewers' Manual*.¹⁶ Each team of reviewers compared the results of this assessment and jointly decided whether to include or exclude each study. Any disagreement was discussed

with the entire team until consensus was achieved. Studies were included if they met at least 80% of the methodological criteria in the critical appraisal tool. The appraisal criteria included questions regarding sample selection, sufficiency of sample descriptions, inclusion criteria, assessment of outcomes, reliability of outcome measures, and appropriateness of statistical measures used. (For details regarding the full search strategy, please contact the corresponding author.)

Data were extracted from articles using a pro forma data extraction tool. For each study, the following data were extracted: information on the sample (age, sex, diagnosis, preexisting conditions, sample size), study design, study location (PICU, non-PICU), delirium incidence, delirium screening method used, identified symptoms of delirium, and time of occurrence of such symptoms.

RESULTS

Of the 301 articles originally identified, 52 appeared to meet the inclusion criteria based on the abstract or title. The review team subsequently excluded 31 of these. Reasons for exclusion were as follows: six were single case studies; five used a duplicate sample; five were literature reviews; five were not full text (two were letters to the editor, three were abstracts only); four studied the wrong population (postdischarge patients); three were non-English publications; two were systematic reviews (one a review of interventions, the other a review of diagnostic tools); and one was about the validity and reliability of tool development. Our review examined the remaining 21 quantitative studies, of which 11 were cohort studies and 10 were case series or case reports. Of these 21 studies, 10 were conducted in the United States, seven in the Netherlands, three in India, and one in South Africa. (For a flow diagram of the search strategy, see Figure 1.) Per the Joanna Briggs Institute's levels of evidence,¹⁷ all 21 studies were graded as level 3 or 4.

Overall, the studies involved 2,616 children. Because of differences in how studies reported delirium diagnosis, it was not possible to determine an overall prevalence rate. Nor did all studies report sex. In the 10 studies that did report both sex and a diagnosis of delirium, 54% of the 633 subjects were boys and 46% were girls, although this difference was not significant. The majority of subjects were PICU patients and had been diagnosed with delirium using a delirium rating scale (22%), by a psychiatric consultation liaison team (14%), or both (64%).

Findings from the 21 studies that met the inclusion criteria are presented according to the purposes of this review: to identify delirium risk factors in children from birth through 21 years of age and to identify characteristics of acute pediatric delirium. (See Table 1 for full details.^{7, 11, 13, 18-35}) We defined risk factors as those conditions and circumstances that predispose

a child to the development of acute delirium. We defined characteristics as the individual symptoms and patterns of symptoms found in hospitalized children with acute delirium.

Risk factors for acute pediatric delirium. *Age.* Using the Cornell Assessment of Pediatric Delirium (CAPD) scale to assess PICU patients, Traube and colleagues found that delirium prevalence was lowest in children older than 13 years (3.6%).¹⁸ But Schievel and colleagues, using the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)* criteria for delirium with evaluation by a child neuropsychiatrist, found delirium prevalence ranging from 3% in children ages three years or younger to 19% in those ages 16 to 18 years.¹¹

Sex. As noted above, 10 studies reported both sex and a diagnosis of delirium, with delirium occurring overall in more boys than girls.^{11, 18-26} For example, Traube and colleagues reported that, of 111 PICU patients, the prevalence of delirium was 18.8% in girls and 21.7% in boys.¹⁸ And Smith and colleagues found that, of nine patients who developed delirium, 22.2% were girls and 77.8% were boys.²⁴ Similarly, in the other eight study populations, more boys than girls were diagnosed with delirium. This suggests that male sex may be a risk factor.

Anxiety. Jones and colleagues reported that children with preexisting anxiety were more likely than others “to exhibit apprehension toward staff, inattentiveness and distractibility, motor agitation when awake, and misbehavior and disobedience.”²⁷ They found that such children were at higher risk for developing psychological trauma and behavior problems that would require intervention, although they didn’t specifically cite delirium. Schievel and colleagues noted that anxiety was associated with a presentation of mixed delirium.¹¹

Developmental delay. Traube and colleagues found that children with developmental delay were diagnosed with delirium almost three times as often as children without such delay.¹⁸ In a pilot study of 50 PICU patients by Silver and colleagues, the prevalence of delirium was 29%, and the researchers noted that 24% of the overall sample had a prior diagnosis of developmental delay.²⁸

Mechanical ventilation. Van Dijk and colleagues investigated pediatric delirium in 29 PICU patients admitted over an eight-year period.²⁶ In their sample, 79% were mechanically ventilated. In a larger study of 877 PICU patients, Schievel and colleagues found that 85% of those with delirium were on mechanical ventilation.²⁹ Similarly, in a study of 147 PICU patients, Smeets and colleagues found that 84% of those with delirium were on mechanical ventilation, compared with 42% of those without delirium.¹³ Janssen and colleagues, studying 154 PICU patients, reported that 53.8% of those with delirium were mechanically

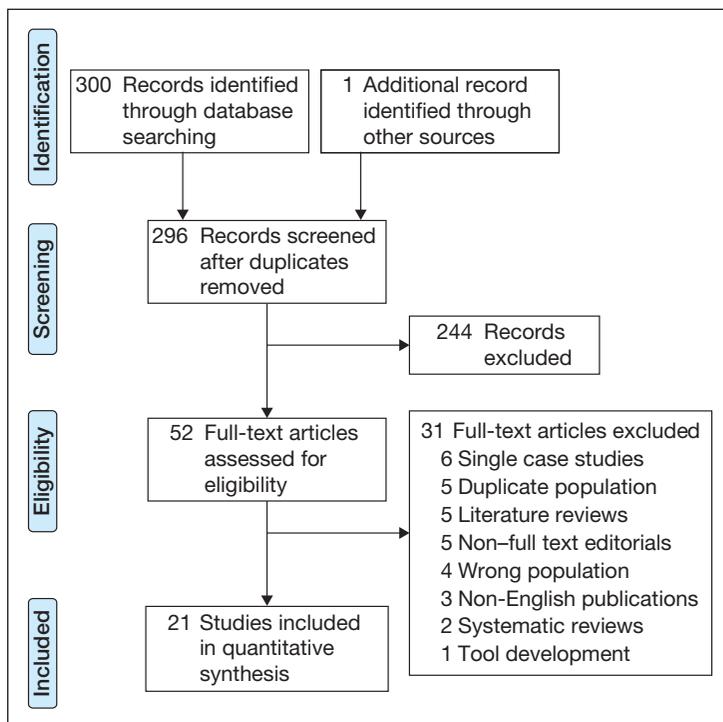
ventilated, compared with just 11.7% of those without delirium.²¹ And in the study by Traube and colleagues, the researchers found that delirium prevalence was lowest (5.2%) among children who were not on respiratory support.¹⁸

Children in acute care are especially susceptible to developing delirium.

A note on other potential risk factors. Our focus in this review was on noniatrogenic, nonpharmacological risk factors and characteristics that fit within the epidemiological framework of person, place, and time. Thus, we did not consider factors that may be secondary to the patient’s acute illness or iatrogenic in nature, including metabolic disturbances, acute infection, hypoxemia, anemia, acidosis, and hypotension. Some commonly used medications that are considered precipitating risk factors for delirium, such as opioids, anxiolytics, tricyclic antidepressants, and corticosteroids, were also excluded.

Characteristics of acute pediatric delirium identified in the 21 studies included agitation, disorientation,

Figure 1. PRISMA Flow Diagram of Study Selection



PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Table 1. Studies on Pediatric Delirium Included in this Review

Study	Level of Evidence	Research Question or Objective	Design	Sample and Setting	Screening Method	Risk Factors	Characteristics and Other Notes
Grover S, et al, ²⁰ 2009	4	To describe the clinical profile of children and adolescents referred to a psychiatric service over a 7-year period who were diagnosed with delirium by ICD-10 criteria	Cohort, retrospective chart review	215 children and adolescents age 14 years or younger referred to a psychiatric consultation liaison team; of these, 46 (21%) were diagnosed with delirium, and full records were available for 38 India	Patients were diagnosed with delirium per the ICD-10 and the psychiatric consultation liaison team.	Boys were more likely than girls to develop delirium. Underlying pathology was infection followed by neoplasms.	All children exhibited sleep-wake cycle disturbance and disorientation. Other common characteristics were inattention (89.5%), impaired short-term memory (84.2%), agitation (68.4%), and lability of affect (60.5%). Delusions and hallucinations were also reported.
Grover S, et al, ¹⁹ 2012	3	To develop a symptom profile of delirium in children and adolescents (with comparisons to adult and elderly profile)	Case series	30 children ages 8–18 years were compared with 120 adults ages 19–64 years and 109 elderly patients ages 65 and older. India	DSM-IV-TR criteria; DEC	Boys were more likely than girls to develop delirium. Most common risk factors were metabolic and endocrine causes, followed by infections (systemic or intracranial); most common etiologies were sepsis (53.3%), hypoxia (43.3%), anemia (40%), and trauma (23.3%), which included traumatic brain injury.	Commonly observed symptoms in children and adolescents with delirium were inattention, disorientation, sleep-wake cycle disturbances, short-term memory disturbances, and motor agitation. Delirium in children and adolescents was similar to that seen in adults and the elderly, with children having a higher frequency of lability of affect.
Grover S, et al, ³¹ 2014	4	To explore the frequency of different motor subtypes of delirium in children and adolescents, and to study the relationship of motor subtypes with other symptoms, etiologies, and outcomes	Cohort	49 children ages 8–19 years (48.9% male) diagnosed with delirium India	DSM-IV-TR criteria; DRS-R-98; amended DMSS; DEC; known risk factors	Girls were slightly more likely than boys to develop delirium. Common risk factors included metabolic or endocrine disturbances (49%) and systemic infection (34.6%).	The hyperactive type of delirium was most common (53%), followed by mixed (26.5%) and hypoactive (16%). Hallucinations were seen with the hyperactive and mixed subtypes.
Hatherill S, et al, ³⁵ 2010	4	To describe the demographic and clinical profile, mortality rates, and effectiveness of treatment in hospitalized children and adolescents with delirium referred to psychiatry	Cohort series	23 children ages 28 months to 16 years (52% female) diagnosed with delirium South Africa	Patients were diagnosed with delirium per DSM-IV-TR criteria and by a psychiatric consultation liaison team.	Girls were more likely than boys to develop delirium. In about half of cases (57%), prescribed medication was suspected as a risk factor. Of the 23 patients with delirium, 78% subsequently received anti-psychotic medication. Six of the 23 children (26%) died.	Common characteristics included agitation (83%), insomnia (78%), anxiety/fearfulness (61%), marked mood lability (57%), visual (52%) and auditory (35%) hallucinations, and inconsolability (50%), disinhibition (35%), motor retardation (30%), marked regression (26%), delusions (22%), aggression (22%), and apathy (17%). Onset was acute with marked fluctuation.

Janssen N, et al. ²¹ 2011	3	To investigate whether the DRS, the DRS-R-98, or the PAED were diagnostic in hospitalized children	Cohort, prospective panel study	154 children ages 1–17 years who were electively admitted to the PICU and were either ventilated or nonventilated; of these, 26 (54% male) were diagnosed with delirium Netherlands	PAED; DRS; DRS-R-98; and per <i>DSM-IV</i> criteria by pediatric neuropsychiatrist	Boys were more likely than girls to develop delirium. Primary PICU diagnoses for the delirium group were respiratory (30.8%), neurologic (26.9%), and circulatory (23.1%) disorders. In the delirium group, 53.8% were on mechanical ventilation.	In the full sample, observed characteristics included long- and short-term memory disturbances (65% and 57%, respectively), delusions (52%), perceptual disturbances and hallucinations (46%), disorientation (44%), inattention (36%), lability of affect (35%), and sleep-wake cycle disturbances (19%).
Jones SM, et al. ²⁷ 1992	3	To compare manifestations and severity of anxiety, depression, delirium, and withdrawal in PICU patients and general unit patients	Case series	43 children ages 6–17 years (44% male); of these, 18 were from the PICU or cardiovascular ICU, 25 were from private or semiprivate rooms in general units United States	Verbal assessment of communication ability; PRISM; DICA; DICA-P; HOBBS; sleep and parental visitation documentation by nurse	Girls were more likely than boys to develop delirium. Risk factors included PICU admission, more severe illness, longer hospitalization, history of previous hospitalizations, and preexisting anxiety or mood disorder.	ICU patients were more likely than general unit patients to exhibit behavioral expressions of anxiety, depression, and withdrawal. Patients with preexisting anxiety had more severe delirium symptoms.
Karnik N, et al. ³² 2007	4	To describe the onset of delirium in two adolescent girls with distinct delirium subtypes derived from different pre-existing disease states	Case reports	Two patients: a 16-year-old girl with a history of acute lymphoblastic leukemia and a 14-year-old girl with a history of systemic lupus erythematosus United States	Chart review; observation; DRS	Both girls developed delirium. The risk factors were central nervous system involvement from disease processes or treatment.	Characteristics of delirium included agitation, confusion, disorientation, hallucinations (auditory and visual), pressured speech, and yelling.
Kelly P, Frosch E. ²² 2012	3	To determine the frequency with which pediatric delirium is recognized in patients referred for psychiatric consultation for any reason and whether the diagnosis of delirium appeared on the discharge problem list	Cohort, retrospective chart review	515 patients admitted to any pediatric service at a large urban medical center over an 8-year period; of these, 53 (10.3%) were diagnosed with delirium United States	Six patients (1.2%) were diagnosed with delirium by the pediatric team, with confirmation by psychiatry using <i>DSM-IV-TR</i> criteria. An additional 47 patients (9.1%) were diagnosed by psychiatry using <i>DSM-IV-TR</i> criteria.	Boys were more likely than girls to develop delirium.	Only 8 of the 53 patients (15.1%) diagnosed with delirium by either method had this condition listed on the discharge problem list.
Leentjens A, et al. ²³ 2008	4	To describe the phenomenon of pediatric delirium in hospitalized children and compare it with adult and geriatric delirium	Cohort	46 children ages 0–17 years (64% male); comparison groups were 49 adult patients ages 18–65 years and 70 geriatric patients ages 66 years and older Netherlands	Chart review; <i>DSM-IV-TR</i> criteria, subject to consensus procedure; DRS	Boys were more likely than girls to develop delirium.	Delirium onset in children was more acute with a less fluctuating course. Children were likely to have more severe agitation, delusions, hallucinations, perceptual disturbances, and lability of mood, but fewer sleep-wake cycle disturbances.

Table 1. Continued

Study	Level of Evidence	Research Question or Objective	Design	Sample and Setting	Screening Method	Risk Factors	Characteristics and Other Notes
Schieveld J, et al, ¹¹ 2007	4	To study the phenomenology, clinical correlates, and responses to treatment of delirium in critically ill children	Case series, descriptive study of a cohort of child psychiatric consultations	40 children (25 boys, 15 girls) admitted to the PICU; 80% were younger than 9 years Netherlands	Assessment by child neuropsychiatrist using DSM-IV criteria for delirium. Provisional diagnoses were followed up via a multidisciplinary consensus meeting.	Underlying risk factors were neurological disorders (n = 21), infections (n = 20), and respiratory disorders (n = 12). In most cases there were a combination of these.	Characteristics that prompted a request for neuropsychiatric consultation included agitation, anxiety, moaning, discomfort, and behavioral disturbance.
Schieveld J, et al, ²⁹ 2008	4	To assess whether the PIM and the PRISM II scoring instruments are useful in the risk assessment and diagnosis of pediatric delirium in the PICU	Cohort, prospective observational study	Of 877 cases, 61 were referred for child psychiatric consultation; of these, 40 ages 4–17 years (63% male) were diagnosed with delirium Netherlands	Assessment by child neuropsychiatrist using DSM-IV-TR criteria for delirium	Boys were more likely than girls to develop delirium. Children with delirium were more likely than those without delirium to be on mechanical ventilation (85%) and to have a neurologic (40%) or respiratory disorder (30%).	Characteristics included unexplained confusion, agitation, anxiety, moaning, discomfort, and behavioral disturbances. Based on clinical presentation, 14 children were found to have hyperactive delirium; 9, hypoactive delirium; and 17, mixed delirium. A PIM or PRISM II score above the 60th percentile indicated a higher risk of delirium.
Schieveld J, Leentjens A, ³³ 2005	4	To describe delirium in severely ill young children	Case report, case series	Two female patients, ages 28 and 42 months, in a PICU Netherlands	Chart review; DSM-IV-TR, used retrospectively. Formal psychiatric evaluation was found to be impossible in both cases.	Both girls had delirium. Admitting diagnoses included meningococcal meningitis, septic shock, and pneumonia.	In very young severely ill children, the occurrence of psychiatric symptoms and behavioral disturbances should be considered as delirium. Regression to an earlier developmental stage, chaotic behavior, anxiety, and moaning should prompt suspicion of delirium.
Silver G, et al, ²⁸ 2012	4	To develop a screening tool for the detection of delirium in PICU patients through comparison with psychiatric evaluation using DSM-IV-TR criteria	Prospective blinded pilot study	50 children and adolescents (30 boys, 20 girls) ages 3 months–21 years; 46% were younger than 5 years United States	CAPD; evaluation by pediatric intensivist or child psychiatrist using DSM-IV-TR criteria to diagnose delirium. The two study teams ("screen team" and "psychiatry team") worked independently. Prevalence was comparable (28% and 29%, respectively).	Boys were more likely than girls to develop delirium. For all subjects, the primary admitting diagnoses were oncologic (26%), cardiac (16%), and neurosurgical (16%). Developmental delay was seen in 24% of those with delirium.	Symptom fluctuation was evident. The most common types diagnosed were hypoactive delirium (43%) and mixed delirium (43%). Hyperactive delirium was the least common type (14%).

Smeets I, et al, ¹⁹ 2010	3	To investigate, under circumstances of routine care, the impact of pediatric delirium on PICU lengths of stay, as well as on direct financial costs	Cohort	147 children ages 1–18 years; of these, 49 had delirium and 98 did not Netherlands	Symptomatic children were referred to child neuropsychiatrist for evaluation. Assessment was based on DSM-IV-TR criteria; recall of parents, nurses, and medical team; and the psychiatric evaluation. Final diagnosis reached via consensus of attending pediatric intensivist and child psychiatrist.	A diagnosis of delirium prolonged length of PICU stay by an average of 2.39 days, independent of severity of illness, age, sex, mechanical ventilation, or medical indication for admission.	Compared with children without delirium, those with delirium tended to be older, received more mechanical ventilation, and showed a trend toward higher PRISM II scores.
Smith H, et al, ²⁴ 2011	4	To validate the pCAM-ICU (which uses standardized, developmentally appropriate measurements) as a diagnostic tool for pediatric delirium in critically ill children, both ventilated and nonventilated	Cohort, prospective observational study	68 children (63% male) age 5 years or older United States	Daily assessment by two critical care clinicians using the pCAM-ICU, compared with evaluation by pediatric psychiatrist using DSM-IV-TR criteria	Boys were more likely than girls to develop delirium. The most common admission diagnoses were surgical intervention for congenital heart disease (18%) and respiratory insufficiency from status asthmaticus (12%).	The mean PRISM score was 8.6 (SD, 7), which puts it near the 60th percentile.
Traube C, et al, ¹⁸ 2014	4	To determine the validity and reliability of the CAPD, a rapid observational screening tool	Cohort	111 children ages 0–21 years (60% male) seen at a major urban academic medical center United States	Double-blind assessment by nurse using the CAPD; evaluation by pediatric intensivist or child psychiatrist using DSM-IV-TR criteria	Boys were more likely than girls to develop delirium. Developmental delay was a significant risk factor. Children younger than age 13 years, those on respiratory support, and those who were “sicker” were also more likely to develop delirium.	The fluctuating course of delirium was evident. There was a very low prevalence of delirium in adolescents older than 13 years and in children who weren’t on respiratory support. The rate of false positives was higher in children with developmental delays.
Traube C, et al, ³⁰ 2014	4	To describe the presentation and treatment of pediatric delirium in 4 children with neuroblastoma	Case series	4 patients ages 7 months to 3 years (75% female) United States	Twice-daily CAPD assessment by nurse; evaluation by pediatric intensivist or child psychiatrist using DSM-IV-TR criteria	All 4 patients developed delirium; 75% were girls. Other risk factors included having cancer and prolonged intubation.	Agitation, lack of eye contact, thrashing in bed, no sustained sleep

Table 1. Continued

Study	Level of Evidence	Research Question or Objective	Design	Sample and Setting	Screening Method	Risk Factors	Characteristics and Other Notes
Turkel SB, et al, ⁷ 2003	4	To evaluate the applicability of the DRS in pediatric patients	Case series, retrospective chart review	84 patients with delirium ages 6 months to 19 years (54% male, 46% female) United States	DRS, retrospectively calculated; diagnosis by child psychiatrist using DSM-III-R criteria; chart review	Boys were more likely than girls to develop delirium. The most common underlying cause of delirium was infection (32.1%).	All the children had impaired attention. A majority could be scored on one or more of the following DRS items: changes in psychomotor behavior, perceptual disturbances, cognitive dysfunction, sleep-wake cycle disturbances, and lability of affect; 51 children (60.7%) were able to be scored on all 10 DRS items.
Turkel SB, et al, ³⁴ 2012	4	To describe the use of atypical antipsychotics in controlling symptoms of delirium in children and adolescents	Case series, retrospective chart review	110 children (56 boys, 54 girls) United States	DRS-R-98, retrospectively calculated; pharmacy records	All children were seriously ill. Delirium was most likely multifactorial.	Observed symptoms of delirium included agitation, confusion, hallucinations, and insomnia.
Turkel SB, et al, ²⁵ 2013	4	To describe the use of atypical antipsychotics in controlling symptoms of delirium in infants and toddlers	Retrospective chart review	19 children ages 7–34 months (52.6% male) United States	DSM-IV-TR criteria; DRS, retrospectively calculated	Boys were more likely than girls to develop delirium. Many of the patients were seen in the ICU setting, and many were intubated.	Clinical observations included sleep disturbances (100%), agitation (94.7%), impaired attention (89.5%), and irritability (89.5%).
van Dijk M, et al, ²⁶ 2012	4	To confirm that symptoms of withdrawal overlap with symptoms of delirium	Cohort, retrospective chart review; letter to editor	29 children (17 boys, 12 girls) admitted to PICUs with child psychiatrist-confirmed diagnoses of delirium Netherlands	Chart review; symptoms were independently documented by two researchers; discrepancies were discussed until consensus was reached	Boys were more likely than girls to develop delirium. Admitting diagnoses included trauma (37.9%), cardiac conditions (24.1%), and respiratory conditions (10.3%); 79% of the children were on mechanical ventilation.	Most patients (86.2%) exhibited agitation, which included irritability; attempts to pull out lines, tubes, or catheters; and restlessness or fidgeting; 22 patients (76%) exhibited hallucinations, mostly visual. Delirium should be suspected in children if one or more of four characteristics are seen: disorientation (person, place, time); hallucinations (visual or auditory); impaired or confused speech; and forgetfulness or impaired memory.

CAPD = Cornell Assessment of Pediatric Delirium; DEC = Delirium Etiology Checklist; DICA = Diagnostic Interview for Children and Adolescents-Parents; DMSS = Delirium Motor Symptom Scale; DRS = Delirium Rating Scale; DRS-R-98 = Delirium Rating Scale Revised-98; DSM-III-R = Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; DSM-IV-TR = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision; HOBBS = Hospital Observed Behavior Scale; ICD-10 = International Classification of Diseases, 10th Revision; PICU = pediatric ICU; PAED = Pediatric Anesthesia Emergence Delirium scale; pCAM-ICU = Pediatric Confusion Assessment Method for the ICU; PIM = Pediatric Index of Mortality; PRISM = Pediatric Risk of Mortality; PRISM II = Pediatric Risk of Mortality II.

hallucinations (primarily visual), inattention, and sleep–wake cycle disturbances. Aggression, irritability, restlessness or fidgeting, and impaired memory were among others noted. Jones and colleagues reported that such characteristics were significantly more common in children in pediatric or cardiovascular ICUs than in children in general units.²⁷ In a case series of very young children with neuroblastoma, Traube and colleagues described a lack of sustained sleep, agitation (such as thrashing in bed), and a lack of eye contact as characteristics of postoperative delirium.³⁰

Patterns of delirium symptoms in children are similar to those seen in adults, especially older adults. In seven studies involving a total of 447 pediatric patients and use of the Delirium Rating Scale Revised-98 (DRS-R-98)—which incorporates the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, criteria and is often used to assess delirium in adults—all of the children exhibited characteristics of delirium according to the scale.^{7,21,23,31-34} This suggests that the presentation of delirium episodes in children and adolescents is similar to that in adults. In one study of 38 patients by Grover and colleagues, all of the subjects had sleep–wake cycle disturbances and disorientation, and a majority had impaired attention (89.5%), impaired short-term memory (84.2%), agitation (68.4%), and lability of affect (rapid changes in emotion unrelated to external events; 60.5%).²⁰ Karnik and colleagues reported that delirium symptoms observed in two hospitalized adolescents were comparable and included impaired attention, agitation, periods of confusion, memory loss, and sleep–wake cycle disturbances.³² In a study of 110 children by Turkel and colleagues, delirium symptoms included sleep–wake disturbances, motor agitation, altered thought process, disorientation, inattention, short- and long-term memory problems, and visual–spatial difficulties.³⁴

There was some evidence of differences in the presentation of pediatric and adult delirium. Another study by Grover and colleagues, conducted among 30 children ages eight to 18 years, concluded that although the pattern of delirium in this population was similar to that seen in adults, children had a higher frequency of lability of affect.¹⁹ Leentjens and colleagues, comparing delirium symptoms in 46 children and 119 adults, reported that children tended to have more severe perceptual disturbances, hallucinations, agitation, and lability of affect.²³ But children were less likely to exhibit sleep–wake cycle disturbances.

DISCUSSION

While the precise mechanism in the development of acute delirium is unknown, the results of this review indicate that children who are more severely ill or developmentally delayed are at higher risk. Children who are in a PICU, mechanically ventilated, and male may also be at greater risk, as are those with a high

Pediatric Risk of Mortality II (PRISM II) score (at or above the 60th percentile).

Early recognition of pediatric delirium can be enhanced by the routine use of valid screening tools in PICUs.

Overall, acute pediatric delirium presents with disturbances in behavior, circadian rhythm, cognition, consciousness, and perception (see *Characteristics of Pediatric Delirium*). The characteristics of pediatric delirium were found to be wide ranging. The five most common characteristics overall were agitation, disorientation, hallucinations (primarily visual), inattention, and sleep–wake cycle disturbances (see Table 2^{20,25,26,31,35}). Symptoms reflective of the hyperactive type of delirium were the most

Characteristics of Pediatric Delirium

Disturbances in behavior

- Aggression
- Agitation
- Fidgeting
- Increased activity level
- Restlessness

Disturbances in circadian rhythm

- Insomnia
- Sleep–wake cycle disturbance

Disturbances in cognition and mood

- Anxiety
- Depression
- Disorientation
- Impaired short-term memory
- Irritability
- Language disturbance
- Memory deficit
- Pressured speech

Disturbances in consciousness

- Confusion
- Disorientation

Disturbances in perception

- Apprehension
- Hallucinations
- Poor judgment (pulling out catheters or IV lines, for example)

Table 2. Common Characteristics of Acute Delirium in Children

Characteristic	Range, %	Selected Studies
Agitation, irritability ^a	68.4–94.7	Grover, et al, ²⁰ 2009 Grover, et al, ³¹ 2014 Hatherill, et al, ³⁵ 2010 Turkel, et al, ²⁵ 2013 van Dijk, et al, ²⁶ 2012
Disorientation	0–100	Grover, et al, ²⁰ 2009 Grover, et al, ³¹ 2014 Hatherill, et al, ³⁵ 2010 Turkel, et al, ²⁵ 2013 van Dijk, et al, ²⁶ 2012
Hallucinations ^b	1–75.8 (visual, 30.5–52; auditory, 7.9–35)	Grover, et al, ²⁰ 2009 Hatherill, et al, ³⁵ 2010 Turkel, et al, ²⁵ 2013 van Dijk, et al, ²⁶ 2012
Impaired attention	78–93.8	Grover, et al, ²⁰ 2009 Grover, et al, ³¹ 2014 Hatherill, et al, ³⁵ 2010 Turkel, et al, ²⁵ 2013
Sleep–wake cycle disturbances (including insomnia)	41.3–100	Grover, et al, ²⁰ 2009 Grover, et al, ³¹ 2014 Hatherill, et al, ³⁵ 2010 Turkel, et al, ²⁵ 2013 van Dijk, et al, ²⁶ 2012

^aMost studies considered agitation and irritability separately, but van Dijk and colleagues combined the two.

^bNot all studies listed auditory and visual hallucinations separately.

prevalent. These include aggression, agitation, hallucinations, and restlessness or fidgeting.

Early recognition of acute pediatric delirium can be enhanced by the routine use of valid screening tools in PICUs. Such assessment is an important basic element in timely recognition, management, and prevention strategies. Since the clinical course of delirium fluctuates, screening may be most useful if done at least once per shift. It stands to reason that frequent screening, leading to earlier detection and appropriate treatment, could also shorten lengths of stay. The CAPD, a recently developed eight-question rapid assessment tool, has the potential to facilitate early recognition.¹⁸ This tool has been found to be comparable to the use of *DSM-IV-TR* criteria and psychiatric evaluation in recognizing acute pediatric delirium.²⁸ The CAPD uses age-based developmental anchor points (newborn; four, six, eight, and 28 weeks; and one and two years), and can be completed by nurses in less than five minutes.¹⁸ It has shown excellent reliability and validity, and provides a structured, developmentally informed approach to the screening and assessment of delirium in children.^{18,35}

Given that delirium has a rapid onset and fluctuating course, it's essential to use delirium screening tools first at the time of admission to establish a baseline for comparison with later status. As Hatherill and colleagues stated, the “temporal aspect” of cognitive changes “underscor[es] the need for a longitudinal assessment and serial interviews.”³⁶ This is especially important for children with developmental delays or preexisting anxiety, as these conditions have been found to be risk factors for the development of delirium.^{18,27} The PRISM II score has also been found to be predictive of delirium for children scoring in the 60th percentile or above.^{13,29}

It's useful to consider the similarities between the characteristics of delirium in children and the elderly in the hospital setting. These include rapid onset, aggression, agitation, impaired attention, irritability, and memory disturbances.^{7,19,23,25} Two studies found that in children, symptoms were more often seen at night.^{19,26} In a study comparing symptoms in children and older adults, Grover and colleagues noted that children had more severe lability of affect, but less severe language, short-term memory, and visual–spatial disturbances.¹⁹ Furthermore, it's important to note that Traube and colleagues found that parents were often aware of their child's cognitive and behavioral changes before the hospital staff were.¹⁸

Implications. The clinical signs of delirium vary and are often dependent on a patient's age and, among infants and children, developmental stage. Of all health care professionals, nurses interact most closely and often with patients, and are thus vital to both early recognition and prevention of delirium in hospitalized children.

Delirium as a potential cause of agitation and sleeplessness must be considered. Indeed, Schievel and Leentjens found that in severely ill young children, psychiatric symptoms and behavior changes were more likely due to delirium than to a psychiatric disorder.³³ The early recognition and management of pediatric delirium may help prevent unwarranted laboratory testing and imaging studies, which can cause children and families unnecessary distress, as well as increasing hospital costs.

Measures to support and maintain a child's usual sleep–wake cycles include fostering a routine sleep schedule, reducing ambient noise, and lowering light levels at night.³⁷ Nurses and other hospital staff need to ensure that loud discussions don't take place near a sleeping child and that any unnecessary noise-producing equipment is shut off. Usual age-appropriate comfort measures are also important. These may include providing a pacifier or other favorite toy and singing songs to lessen fear and anxiety during both routine and nonroutine procedures, and encouraging parents to physically and verbally support and comfort their child.³⁸

Facilitating parental presence at the bedside and listening to parents' concerns about changes in their

child's behavior are also important for the early recognition of delirium. Parents may be the first to observe changes in their child's cognition or behavior that are symptomatic of delirium. Moreover, parental presence at the bedside may enhance the child's comfort and lessen anxiety, and might prevent delirium from developing. Parents need education regarding delirium prevention, treatment, and follow-up care, including the fact that delirium symptoms may persist after discharge.^{5,37} Emotional support for parents who witness the often upsetting behaviors of a child with delirium is essential. Because hallucinations are a commonly reported characteristic, staff education on the potential for delusional activity may be needed. Lastly, increased psychological monitoring and support for children with delirium and their families should be considered, as well as routine psychiatric consultation for children at risk for delirium.

The severity of delirium episodes could not be considered as an outcome measure because only a few of the studies assessed delirium using a standardized rating scale.

CONCLUSIONS

Acute delirium is reportedly among the top six preventable conditions in hospitalized older adults,³⁹ and may rank similarly high in the pediatric population. Children in acute care are especially susceptible to developing delirium. This systematic review examined the evidence regarding risk factors for and characteristics of pediatric delirium. It is our hope that the findings will lead to more timely recognition and enhance prevention.

In accordance with the epidemiological framework of person, place, and time, we found the following: risk factors may include male sex, preexisting anxiety,

The five most common characteristics of pediatric delirium include agitation, disorientation, hallucinations, inattention, and sleep–wake cycle disturbances.

Limitations. Per the Joanna Briggs Institute's levels of evidence,¹⁷ all 21 studies were graded as level 3 or 4, meaning that our findings must be viewed in light of their limitations. For example, several studies used a retrospective design, inferring data from recorded facts or narratives in the medical record. Because of the studies' low levels of evidence grades and varying methods of assessment, a meta-analysis was not possible. This review is further limited by its observational nature, which does not allow for causal attribution.

developmental delay, and being on mechanical ventilation (person); the five most common characteristics of pediatric delirium include agitation, disorientation, hallucinations (primarily visual), inattention, and sleep–wake cycle disturbances; patterns of delirium symptoms in children are similar to, but not exactly the same as, those found in adults and the elderly; among hospitalized children, the most susceptible were those admitted to a PICU (place); and, although the symptoms of pediatric delirium fluctuate, many

Table 3. Epidemiological Considerations in Assessing Acute Pediatric Delirium

Consideration	Definition	Findings of This Review
Person	Demographic information; personal characteristics	Children from birth through 21 years experienced delirium, with boys slightly more susceptible than girls. Children with developmental delays or preexisting anxiety disorders were also more prone to delirium.
Place	Information on the origins of the problem	Children admitted to a pediatric ICU were more likely to develop delirium than those admitted to a general unit. Studies in this review were conducted in four different countries; acute pediatric delirium may be a global issue.
Time	Information regarding the onset of the problem	The onset of delirium symptoms was acute and fluctuating, although most episodes occurred at night.

episodes occurred at night (time). (See Table 3.) A key finding of this review is that delirium is multifactorial, related to treatment (specifically, mechanical ventilation) and to a hospital environment (such as the PICU) that deprives patients of normal sleep-wake cycles and familiar routines. ▼

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REFERENCES

- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders: DSM-5*. 5th ed. Washington, DC; 2013.
- European Delirium Association, American Delirium Society. The DSM-5 criteria, level of arousal and delirium diagnosis: inclusiveness is safer. *BMC Med* 2014;12:141.
- Holly C, et al. Evidence-based practice for the identification, screening, and prevention of acute delirium in the hospitalized elderly: an overview of systematic reviews. *Curr Transl Geriatr Exp Gerontol Rep* 2013;2(1):7-15.
- Daoud A, et al. Diagnostic accuracy of delirium diagnosis in pediatric intensive care: a systematic review. *Crit Care* 2014;18(5):489.
- Colville G, et al. Children's factual and delusional memories of intensive care. *Am J Respir Crit Care Med* 2008;177(9):976-82.
- Schieveld JN, et al. Diagnostic considerations regarding pediatric delirium: a review and a proposal for an algorithm for pediatric intensive care units. *Intensive Care Med* 2009;35(11):1843-9.
- Turkel SB, et al. The delirium rating scale in children and adolescents. *Psychosomatics* 2003;44(2):126-9.
- Holly C, et al. Acute delirium: differentiation and care. *Crit Care Nurs Clin North Am* 2012;24(1):131-47.
- Maldonado JR. Neuropathogenesis of delirium: review of current etiologic theories and common pathways. *Am J Geriatr Psychiatry* 2013;21(12):1190-222.
- Potts MB, et al. Traumatic injury to the immature brain: inflammation, oxidative injury, and iron-mediated damage as potential therapeutic targets. *NeuroRx* 2006;3(2):143-53.
- Schieveld JN, et al. Pediatric delirium in critical illness: phenomenology, clinical correlates and treatment response in 40 cases in the pediatric intensive care unit. *Intensive Care Med* 2007;33(6):1033-40.
- Leslie DL, et al. One-year health care costs associated with delirium in the elderly population. *Arch Intern Med* 2008;168(1):27-32.
- Sneets IA, et al. Prolonged stay at the paediatric intensive care unit associated with paediatric delirium. *Eur Child Adolesc Psychiatry* 2010;19(4):389-93.
- Traube C, et al. Cost associated with pediatric delirium in the ICU. *Crit Care Med* 2016;44(12):e1175-e1179.
- Aschengrau A, Seage GR. *Essentials of epidemiology in public health*. 2nd ed. Sudbury, MA: Jones and Bartlett Publishers; 2008.
- Joanna Briggs Institute. *Joanna Briggs Institute Reviewers' Manual: 2014 edition*. Adelaide, South Australia: University of Adelaide; 2014. <http://joannabriggs.org/assets/docs/sumari/ReviewersManual-2014.pdf>.
- Joanna Briggs Institute. *New JBI levels of evidence*. Adelaide, South Australia: University of Adelaide; 2014. http://joannabriggs.org/assets/docs/approach/JBI-Levels-of-evidence_2014.pdf.
- Traube C, et al. Cornell Assessment of Pediatric Delirium: a valid, rapid, observational tool for screening delirium in the PICU. *Crit Care Med* 2014;42(3):656-63.
- Grover S, et al. Symptom profile of delirium in children and adolescent—does it differ from adults and elderly? *Gen Hosp Psychiatry* 2012;34(6):626-32.
- Grover S, et al. Delirium in children and adolescents. *Int J Psychiatry Med* 2009;39(2):179-87.
- Janssen NJ, et al. On the utility of diagnostic instruments for pediatric delirium in critical illness: an evaluation of the Pediatric Anesthesia Emergence Delirium Scale, the Delirium Rating Scale 88, and the Delirium Rating Scale-Revised R-98. *Intensive Care Med* 2011;37(8):1331-7.
- Kelly P, Frosch E. Recognition of delirium on pediatric hospital services. *Psychosomatics* 2012;53(5):446-51.
- Leentjens AF, et al. A comparison of the phenomenology of pediatric, adult, and geriatric delirium. *J Psychosom Res* 2008;64(2):219-23.
- Smith HA, et al. Diagnosing delirium in critically ill children: validity and reliability of the Pediatric Confusion Assessment Method for the Intensive Care Unit. *Crit Care Med* 2011;39(1):150-7.
- Turkel SB, et al. The diagnosis and management of delirium in infancy. *J Child Adolesc Psychopharmacol* 2013;23(5):352-6.
- van Dijk M, et al. Screening pediatric delirium with an adapted version of the Sophia Observation withdrawal Symptoms scale (SOS). *Intensive Care Med* 2012;38(3):531-2.
- Jones SM, et al. Behavioral changes in pediatric intensive care units. *Am J Dis Child* 1992;146(3):375-9.
- Silver G, et al. Detecting pediatric delirium: development of a rapid observational assessment tool. *Intensive Care Med* 2012;38(6):1025-31.
- Schieveld JN, et al. Pediatric illness severity measures predict delirium in a pediatric intensive care unit. *Crit Care Med* 2008;36(6):1933-6.
- Traube C, et al. Neuroblastoma and pediatric delirium: a case series. *Pediatr Blood Cancer* 2014;61(6):1121-3.
- Grover S, et al. Do motor subtypes of delirium in child and adolescent have a different clinical and phenomenological profile? *Gen Hosp Psychiatry* 2014;36(2):187-91.
- Karnik NS, et al. Subtypes of pediatric delirium: a treatment algorithm. *Psychosomatics* 2007;48(3):253-7.
- Schieveld JN, Leentjens AF. Delirium in severely ill young children in the pediatric intensive care unit (PICU). *J Am Acad Child Adolesc Psychiatry* 2005;44(4):392-5.
- Turkel SB, et al. Atypical antipsychotic medications to control symptoms of delirium in children and adolescents. *J Child Adolesc Psychopharmacol* 2012;22(2):126-30.
- Silver G, et al. Delirium screening anchored in child development: The Cornell Assessment for Pediatric Delirium. *Palliat Support Care* 2015;13(4):1005-11.
- Hatherill S, et al. Delirium among children and adolescents in an urban sub-Saharan African setting. *J Psychosom Res* 2010;69(2):187-92.
- Madden K, et al. Recurrent delirium after surgery for congenital heart disease in an infant. *Pediatr Crit Care Med* 2011;12(6):e413-e415.
- Porter S, et al. Infants with delirium: a primer on prevention, recognition, and management. *Pediatr Nurs* 2016;42(5):223-9.
- Rothschild JM, Leape LL. *The nature and extent of medical injury in older patients*. Washington, DC: AARP, Public Policy Institute; 2000 Sept. https://assets.aarp.org/rgcenter/health/2000_17_injury.pdf.