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## Maltreatment-Related Emergency Department Visits Among Children 0 to 3 years Old in the United States

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### Abstract

The emergency department (ED) is a vital entry point in the health care system for children who experience maltreatment. This study fills a gap in the maltreatment literature by presenting systematic, national estimates of maltreatment-related ED visits in the United States by children 3 years old, from 2006 to 2011, using the Nationwide Emergency Department Sample (NEDS). Children who experienced and likely experienced maltreatment were identified via *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnostic codes. Maltreatment was classified as physical or sexual abuse, neglect, or poly-victimization. The clinical and demographic profiles of children who experienced maltreatment were described. Approximately 10,095 children who experienced maltreatment (0.1% of total ED visits) and 129,807 children who likely experienced maltreatment (1.2% of total ED visits) were documented each year. Maltreatment was associated with significantly greater risk of injury, hospitalization, and death in the ED setting. Physical abuse was the most common explicit maltreatment diagnosis (33 ED visits per 100,000 children 3 years old) and neglect was the most common likely maltreatment diagnosis (436 ED visits per 100,000 children 3 years old). This study established the NEDS as a valuable complement to existing surveillance efforts of child maltreatment from a public health perspective.

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## Keywords

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The emergency department (ED) is a vital entry point in the health care system for children who experience maltreatment (Guenther, Knight, Olson, Dean, & Keenan, 2009). Children who have been maltreated will present to the ED because of the acute nature of their injury, lack of access to primary care, expanded hours of operation of the ED, choice of the ED as usual source of care, or because of unrelated conditions but are discovered by ED personnel to have been maltreated (Keshavarz, Kawashima, & Low, 2002). The ED offers an opportunity to prevent further harm to children through appropriate recognition by emergency medicine staff (Clark & Winchell, 2004). The important role of health professionals in identifying child maltreatment is recognized by the American College of Emergency Physicians, the American Academy of Pediatrics, and the World Health Organization (American College of Emergency Physicians [ACEP], 2009; Kellogg, 2005, 2007; Butchart, Phinney-Harvey, Mian, & Furniss, 2006).

Recognition of cases of maltreatment occurs in the health care system, child protective services (CPS), law enforcement, and in other community contexts. Many cases remain hidden completely from the public. An exhaustive ascertainment of all cases of maltreatment is difficult if not impossible. While still an incomplete listing, documenting cases in the ED setting with a standardized and reproducible methodology may offer an innovative tool for the surveillance of child maltreatment. Studying maltreatment-related morbidity and mortality in ED settings may help to elevate child maltreatment as a public health concern (McKenzie & Scott, 2011; Schnitzer, Slusher, Kruse, & Tarleton, 2011).

This study uses a publically available national database of ED visits to complement existing surveillance of children 3 years old who experience maltreatment. Children 3 years have higher rates of maltreatment than older age-groups (Administration on Children Youth and Families [ACYF], 2012) and are the most vulnerable. Infants and young children spend the most time in direct contact with caregivers and have the least ability to protect themselves from a frustrated caregiver. They are more likely to require medical evaluation and/or die from abuse than older children, who typically experience abuse of less physical severity, and thus represent a disproportionate percentage of patients hospitalized for issues related to abuse and neglect (Leventhal, Martin, & Gaither, 2012; Palusci & Covington, 2014; Russo, Hambrick, & Owens, 2008). The strategy of limiting the population of the current study to children 3 years old was supported by previous work using administrative hospital data to identify maltreatment severe enough to require hospitalization (Farst, Ambadwar, King, Bird, & Robbins, 2013; Leventhal, Martin, & Asnes, 2008).

This study first aimed to generate the rate of maltreatment-related ED visits by children 3 years old in the general U.S. population from 2006 to 2011. Overall and age-specific rates of ED visits for physical abuse, sexual abuse, neglect, and poly-victimization were computed. In previous work, incidence of hospitalizations for abuse was shown to be most common in infants <1 year old and to decline with age (Farst et al., 2013; Leventhal et al., 2012). Infants

less than 1 year old are most dependent on caregivers for their needs and least able to protect themselves from the abuse they experience. ED visits by children who experienced any type of maltreatment were therefore hypothesized to be highest in less than 1-year-olds and to decrease with age.

The second aim of the study was to describe the demographic and clinical characteristics of maltreated ED patients, including age, gender, primary coverage, socioeconomic status, urban/rural designation of patient residence, region, injury severity, and reason for discharge from the ED. Previous descriptive studies found that children 3 years old who were hospitalized for abuse were more likely to be male gender, publicly insured, and seriously injured (Farst et al., 2013; Leventhal et al., 2012). In the absence of national data on the characteristics of young victims in the ED setting, this study described the children who experience any form of maltreatment severe enough to require emergent medical attention. Because of the likelihood of abusive injury requiring urgent medical care, maltreatment victims as a group were hypothesized to experience greater severity of injury, likelihood of hospitalization, and risk of death in the ED than that of nonmaltreated children (Gilbert et al., 2009; Rovi, Chen, & Johnson, 2004). Similarly young children who presented to the ED for physical abuse were hypothesized to be younger, to have sustained more severe injuries, and to be at greater risk of hospitalization and death in the ED setting than children who experienced other types of maltreatment (Sege et al., 2002). Because personnel in the ED primarily focus on stabilizing emergent patients, recognition and diagnosis of neglect were expected to be less commonly identified in the ED than in physical abuse. Sexual abuse was hypothesized to be more common in females, to increase with age, and to be associated with lower risk of injury or hospitalization (Brown, Cohen, Johnson, & Salzinger, 1998; Gilbert et al., 2009; Kellogg, 2005).

A final aim explored the rates of ED visits by young children who received a diagnosis of suggestive maltreatment. The complexity of a maltreatment evaluation is often beyond the scope of the ED's encounter with a child. We used a previously validated definition of suggestive maltreatment to consider the possible upper bound of the true population of children 3 years old who may have experienced maltreatment severe enough to require medical care at the ED (Schnitzer et al., 2011). Based on this previous work, we expected a substantial increase in rate when using the broader suggestive compared to the narrower specified definition of maltreatment (Schnitzer et al., 2011).

## Method

### Study Data and Population

This study examined ED visits from 2006 to 2011 from the Nationwide Emergency Department Sample (NEDS) of the Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality. Hospital-based EDs included in the NEDS were selected from a 20% stratified random sample of all hospitals from the American Hospital Association annual survey, and all ED visits from a sampled hospital were included in the NEDS. The largest all-payer database of ED visits in the United States, the NEDS provides information on over 26 million unique ED encounters from over 950 hospitals in 25 states annually (NEDS, 2013). HCUP provides encounter-level weights in the data

files to facilitate nationally representative analyses. Relevant clinical information in the NEDS for this study comes from E-codes and *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnoses codes, based on the *ICD-9-CM* (U.S. Department of Health and Human Services, 1998).

ED patients 3 years old and younger were included. Patients discharged from the ED to another short-term hospital were excluded to avoid double counting those who were transferred between EDs among sampled hospitals. ED patients with missing demographic and clinical information were excluded from the analysis of maltreatment patient characteristics.

## Outcomes

**Definition of maltreatment.**—Two mutually exclusive definitions were used to identify maltreatment. In general, children who received 1 maltreatment-related diagnosis across any clinical diagnostic field were identified. This study first applied a definition of specified maltreatment to the ED population based on precedent from Schnitzer, Slusher, and van Tuinen (2004) and from Leventhal et al. (2012) and on confirmation from coauthors with experience in pediatric emergency medicine (M.J. and K.F.) and in child abuse pediatrics (K.F.). The *ICD-9-CM* and E-codes used to identify children receiving an explicit diagnosis of maltreatment are presented in bold type in Table 1. A second definition of suggestive maltreatment was then applied to the remaining ED population not specified for maltreatment based on precedent from Schnitzer, Slusher, Kruse, and Tarleton (2011). The *ICD-9-CM* and E-codes used to identify children who likely experienced maltreatment are presented in non-bold type in Table 1. The study by Schnitzer et al. (2011) first compiled a comprehensive list of potentially suggestive maltreatment diagnoses from an extensive literature review guided by an advisory panel of child abuse and neglect experts. A sample of hospital discharges and ED visits ( $n = 2,826$ ) from a statewide administrative database containing any potentially suggestive diagnoses were linked to patient medical records and reviewed by two registered nurses with training in child abuse. A diagnosis was determined to be suggestive of maltreatment if information in the medical records strongly suggested a possibility of maltreatment in 66% of the total sampled hospital discharges and ED visits containing that diagnostic code. Results from this rigorous study provided 37 separate *ICD-9-CM* and E-codes to identify suggestive maltreatment.

**Category of maltreatment.**—Based on the organization of *ICD-9-CM* codes listed in Table 1, maltreatment was preliminarily categorized as physical abuse, sexual abuse, or neglect. However, children at the ED could be simultaneously diagnosed for multiple types of maltreatment. A fourth category, poly-victimization, was then constructed from children who experienced more than one type of maltreatment (Finkelhor, Ormrod, & Turner, 2007). For example, children who experienced physical and sexual abuse were categorized as poly-victims. Children who only experienced one type of maltreatment were categorized as victims of physical abuse, sexual abuse, or neglect.

## Independent Variables

**Demographic characteristics.**—ED patients were demographically characterized by age (0, 1, 2, and 3 years), gender (female vs. male), household income (Quartile 1: “low,” Quartiles 2 and 3: “medium,” and Quartile 4: “high”), location of patient residence (metropolitan vs. rural), hospital region (Northeast, South, Midwest, and West), and year of visit (2006–2011). The NEDS provided a quartile classification of the estimated median household income for the zip code of residence of each patient, which varied from 2006 to 2011. The interquartile range for household income was US\$38,000–US\$61,999 in 2006, US\$39,000–US\$62,999 in 2007, US\$39,000–US\$63,999 in 2008, US\$40,000–US\$65,999 in 2009, US\$41,000–US\$66,999 in 2010, and US\$39,000–US\$63,999 in 2011. The NEDS provided a six-category classification of the urban–rural designation for the county of patient residence developed by the National Center for Health Statistics (NCHS) for use in health services research. This study defined counties in smaller metropolitan areas of 50,000–999,999 population and central and fringe counties in larger metropolitan areas of 1,000,000 population as metropolitan; NCHS-designated micropolitan and “not metropolitan or micropolitan” counties were considered rural.

**Clinical characteristics.**—ED patients were described clinically by primary payer status (Medicaid, private, uninsured, and “other” which include workers compensation, military coverage, and disability), discharge status (discharged alive, hospitalized, or death at the ED), and injury severity (no injury, minor injury, and severe injury). ICDMAP90 software was used to measure the severity of injury sustained by each child (Mackenzie & Sacco, 1997). For those ED claims that included an *ICD-9-CM* diagnosis code between 800.x and 959.x, ICDMAP90 computed an Injury Severity Score (ISS) ranging from values of 1 to 75, with higher scores indicating more serious injuries. This study categorized ISSs into an ordinal-level measure of injury severity: no injury information (ISS = 0), minor (ISS = 1–8), and severe (ISS = 9–75; Clark & Winchell, 2004). A value of 0 was assigned to ED patients who did not contain an injury-related diagnosis as defined by ICDMAP90. Examples of *ICD-9-CM* diagnoses consistent with minor injuries (ISS = 1–8) among all ED encounters in the NEDS by children 3 years old included head contusions, closed fractures of the extremities, and concussions. Severe injuries (ISS = 9–75) most often involved third-degree burns, convulsions, and major trauma to the head or chest.

## Statistical Analysis

The analysis of maltreatment rates and the analysis of maltreatment patient characteristics each used retrospective cross-sectional data. All statistical analyses were weighted to produce national estimates and adjusted for the complex sampling design of NEDS data. Statistical significance was set to  $p < .05$ . Population-based rates of maltreatment-related ED visits were calculated as the weighted sum of ED visits with a maltreatment diagnosis from 2006 to 2011 in the NEDS divided by the census-based population estimate in the United States from 2006 to 2011 in the American Community Survey. The rate of ED visits specified for maltreatment and of ED visits suggestive of maltreatment were separately reported per 100,000 in the population. Rates were stratified by type of maltreatment and by single-year age-group of children.

Patient demographic and clinical characteristics were compared between maltreated and nonmaltreated ED patients using the Pearson  $\chi^2$  statistic with Rao and Scott correction for complex sample data (Rao & Scott, 1981). The characteristics of children who experienced physical abuse, sexual abuse, neglect, and poly-victimization were similarly compared. A single multivariable logistic regression model was used to predict the probability of a child presenting to the ED for maltreatment, while controlling for patient demographic and clinical characteristics. To describe the patient profiles of children who experienced different types of abuse, four multivariable logistic regression models were used to predict presentation for each type of maltreatment (e.g., physical) versus the other three types of maltreatment (e.g., sexual, neglect, and poly-victimization). All regression analyses were performed when the outcome of ED visits was specified maltreatment and when the outcome for ED visits was suggestive of maltreatment for a total of 10 models.

Based on the recommendations of Karaca-Mandic, Norton, and Dowd (2012) and Norton, Wang, and Ai (2004), patient characteristics were evaluated as potential predictors of maltreatment using the method of marginal effects, because conventional interpretation of odds ratios typically relies on frequency of outcome <10% (Grimes & Schulz, 2008). The method of marginal effects involved computing mean predicted probability (MPP) and relative marginal effects (RME). An average probability of outcome, or MPP, was computed for each category of each independent variable, based on the maximum-likelihood estimates of the  $\beta$ -coefficients from a logistic regression model. For example, the MPP for girls was calculated by first predicting the probability of outcome for every included ED patient, holding gender constant as female and controlling for the covariate information of each included ED patient, and then averaging probabilities across the final sample population. To provide effect estimates, the ratio of MPPs between comparator and referent categories of an independent variable, or RME, was computed. The RME for gender was computed by dividing the MPP for boys (comparator group) by the MPP for girls (reference group). Interpretation of RME follows that of the conventional adjusted odds ratio. By estimating MPP and RME, this study provided an absolute and relative measure of the strength of the associations of each patient characteristic with child maltreatment. Data cleaning was performed using SAS/STAT software, Version 9.3 of the SAS system for Microsoft (Copyright © 2011 SAS Institute Inc., Cary, North Carolina). Statistical analyses were performed using StataMP 12.0 (Copyright © 2011 StataCorp LP, College Station, Texas).

## Results

### Rates of ED Visits for Maltreatment in the Population

Of children 3 years old who presented to the ED in the United States from 2006 to 2011, approximately 1.3% of ED visits were specified for or suggestive of maltreatment. The number of children receiving a diagnosis suggestive of maltreatment exceeded those receiving a specified maltreatment diagnosis by 12-fold, 60,567 ED visits (10,095 per year) to 778,843 ED visits (129,807 per year). Rates of maltreatment-related ED visits, overall and stratified by patient age, are presented in Table 2. To accurately represent the prevalence of ED visits related to any physical abuse, any sexual abuse, or any neglect, rates were alternatively computed while allowing children who experienced poly-victimization to

simultaneously appear in more than one category of maltreatment. Of results not reported in tables, 37 ED visits specified for any physical abuse were estimated per 100,000 children 3 years old, 4 specified for any sexual abuse, and 5 specified for any neglect. Likewise, 50 ED visits suggestive of any physical abuse were estimated per 100,000 children 3 years old, 51 suggestive of any sexual abuse, and 440 suggestive of any neglect.

### Characteristics of Maltreated ED Patients

**Specified maltreatment.**—Of results not reported in the tables, unadjusted results indicated that children 3 years old in the ED receiving a specified maltreatment diagnosis were significantly different ( $p < .01$ ) from nonmaltreated children based on each patient characteristic except for year of visit ( $p = .712$ ) and location of patient residence ( $p = .577$ ). Compared to other ED patients, more of the specified maltreatment population resided in lower versus middle-income neighborhoods (40% vs. 34%), were Medicaid enrolled or uninsured (76% vs. 65%), sustained minor to serious injury (60% vs. 14%), required hospitalization (29% vs. 5%), and died in the ED (2.7 per 1,000 vs. 0.1 per 1,000 ED visits). Demographic and clinical characteristics of each type of specified maltreatment are presented in Table 3. Adjusted comparisons of the specified maltreatment and nonmaltreated patient populations are presented on the right side of Table 4 and were significantly reflective of the unadjusted results ( $p < .01$ ).

Adjusted predictions of each type of specified maltreatment are presented on the left side of Table 4. The probability of physical abuse was highest among <1-year-old specified maltreatment victims ( $p < .01$ ) and decreased with age (Table 4). Physical abuse was 9% more likely in male-than in female-specified maltreatment victims ( $p < .01$ ). Nearly all specified maltreatment victims documented with either minor (93% of total) or severe injury (98% of total) experienced physical abuse. The probability of sexual abuse was smallest among <1-year-old specified maltreatment victims, increased with age, and was significantly greater for female than for male specified maltreatment victims ( $p < .01$ ; Table 4). Neglect was 65% less likely in 3-year-old than in <1-year-old specified maltreatment victims ( $p < .01$ ) and was substantially less likely in young victims documented with minor or severe injury than those with no injury ( $p < .01$  and  $p < .01$ , respectively; Table 4). However, neglect was 50% more likely in hospitalized young victims than those discharged from the ED ( $p < .01$ ). Of results not reported in the tables, approximately 13% of children who experienced physical abuse were poly-victims, 67% of children who experienced sexual abuse were poly-victims, and 37% of children who experienced neglect were poly-victims.

**Suggestive maltreatment.**—Adjusted predictions for any suggestive maltreatment and for each type of suggestive maltreatment are presented in Table 5. Results indicated that suggestive maltreatment was least likely in <1-year-old ED patients (0.7% vs. 1.4%, 1.8%, 1.4%;  $p < .01$ ) but do not provide evidence of association between suggestive maltreatment with publicly funded coverage or lower household income. However, the probability of any suggestive maltreatment was 2 times greater for ED patients who required hospitalization and 5 times greater for those who died in the ED setting than for those discharged from the ED ( $p < .01$  and  $p < .01$ , respectively).

## Discussion

Since a complete population-based registry of child maltreatment in the United States does not currently exist, surveillance efforts from as many sources as possible are needed to fully understand the burden of child abuse on society. This study examined the true burden of maltreatment in U.S. EDs among children 3 years old, using publicly available data and a valid, systematic, and reproducible methodology supported by previous literature (Farst et al., 2013; Leventhal et al., 2012; Schnitzer et al., 2011; Schnitzer, Slusher, & van Tuinen, 2004). Results indicated that in the United States, approximately 1.3% of ED visits by children 3 years old were explicitly for or likely for maltreatment, well below the commonly quoted estimate of 10% (Pless, Sibald, Smith, & Russell, 1987). The population-based rate of specified maltreatment was highest for physical abuse, followed in order by poly-victimization, neglect, and sexual abuse. The population-based rate for specified maltreatment was highest in children <1 year old.

Although estimates of specified maltreatment from the NEDS likely undercounted the true number of children 3 years old who experienced maltreatment severe enough to require emergent medical attention, the demographic and clinical profile of explicitly identified victims coincided with established trends in the literature (Gilbert et al., 2009; Rovi et al., 2004; Schnitzer et al., 2004). ED patients receiving an explicit maltreatment diagnosis were more likely than other ED patients to be covered by publicly funded dollars and to reside in lower income neighborhoods and in metropolitan areas. Children who received a specified maltreatment diagnosis also were more likely to have sustained severe injury, require hospitalization, and faced a significantly higher risk of death in the ED, lending support to the NEDS as an important surveillance tool of vulnerable children.

Results also indicated that the NEDS could potentially distinguish between children who experienced different types of maltreatment. Specified physical abuse was most common in <1-year-olds, boys, and patients documented with serious injury at the ED. Children with an explicit physical abuse diagnosis were no more likely than victims of other types of maltreatment to require hospitalization, a finding driven by the frequency of hospitalization of children who experienced neglect. The NEDS was able to document approximately twice as many ED visits for physical abuse as compared to the number of hospitalizations for physical abuse captured by the Kids' Inpatient Database (Leventhal et al., 2012) and the National Inpatient Sample (Farst et al., 2013) for children of equivalent ages. These findings highlight the value of the NEDS for surveillance of children who experience physical abuse serious enough to require emergent medical care but not necessarily hospitalization.

The characteristics of children who experienced sexual abuse and poly-victimization seemed to collectively point toward an overlapping patient population (Finkelhor et al., 2007). Consistent with previous research, sexual abuse and poly-victimization were most common in 3-year-olds, girls, and children who were not documented with any injury (Kellogg, 2005). However, poly-victimization was associated with a higher rate of hospitalization and was documented 3 times more often than sexual abuse alone. Two thirds of children who experienced sexual abuse also experienced physical abuse, a finding consistent with previous research of a larger age range of children (2–17 years), showing that 57% of sexual abuse



occurs in poly-victims (Finkelhor et al., 2007). Although sexual abuse appeared to be the least prevalent type of explicitly identified maltreatment, the NEDS separately identified an annual average of 12,000 ED visits suggestive of sexual abuse, with the characteristics of these children largely coinciding with those of explicitly identified sexual abuse victims. Consistent with Schnitzer et al. 2011, clinical observation after alleged abuse and contusions of the genital organs were diagnosed in nearly all children 3 years old who were identified as likely sexually abused. These findings at a minimum serve to raise awareness from the public health perspective that the potential for sexual abuse exists even in the youngest children in the United States.

A particular strength of this study was the ability of the NEDS to address the lack of observational data on child neglect in the maltreatment literature. While relatively few children who received an explicit diagnosis of neglect were identified, neglect was the most common diagnosis of suggestive maltreatment. The fact that the NEDS documented so many more children who received a suggestive instead of an explicit diagnosis of neglect seemed to reflect the well-documented complexity of identifying neglect in a medical setting (Schnitzer et al., 2011). Children who received a specified neglect diagnosis were more often <1 year old, uninsured, and though less commonly documented with injury were often hospitalized, likely as a means of shelter. Suggestive neglect was most prevalent in 1- and 2-year-olds and was associated with private coverage, a decreased risk of hospitalization and increased risk of death in the ED. Consistent with Schnitzer et al. 2011, tobacco smoke inhalation, second-and third-degree burns of the body, and nonfatal drowning were the most common diagnoses among children who likely experienced neglect. Some cases of neglect could be difficult to distinguish from tragic accidents. The near drowning of a 14-month-old in a household bathtub might be reported as neglect by ED personnel at a children's hospital and might not by those at a general, nonteaching hospital. Children in this study who received a specified neglect diagnosis likely experienced sequelae of maltreatment serious enough to require emergent medical attention (Schnitzer et al., 2004). The observed differences in characteristics of children who experienced different types of specified maltreatment were in general consistent with previous clinical and epidemiological reports (Hobbs & Bilo, 2009; Keshavarz et al., 2002).

Results from the NEDS could also be used to document children 3 years old who presented to the ED and likely experienced maltreatment. The observed 12-fold increase in the rate of ED visits likely for maltreatment over the rate of ED visits explicitly for maltreatment in the NEDS was substantially greater than the 3-fold increase previously observed in the state of Missouri (Schnitzer et al., 2011). Suggestive maltreatment was generally associated with 1-year-olds and residence in rural areas but not necessarily residence in lower income neighborhoods. Children who likely experienced maltreatment were more likely than other ED patients to present with severe injury, require hospitalization, and die in the ED. Deriving a meaningful clinical context from statistically significant comparisons of characteristics of suggestive maltreatment was difficult because of the large sample size and the previous gap in the maltreatment literature in describing the epidemiology of this patient population.

Estimates from 2006 to 2011 from the NCANDS registry database indicated that an average of 20,187 maltreated children 3 years old each year in the United States were first reported to CPS by medical professionals (ACF, 2012). This compares to an annual average from the NEDS of 10,095 children 3 years old who presented to the ED and received an explicit diagnosis of maltreatment. NCANDS estimates might exceed NEDS estimates for several reasons. Some victims might not appear in the NEDS because their abuse was recognized in health care settings outside the emergency room, such as in primary care, in a school nurse's office, or in other community health centers. Other children who appeared in the NEDS and were reported to CPS by ED personnel might not have received any maltreatment-related diagnosis or only received a suggestive maltreatment diagnosis. Combining children in the NEDS who received an explicit or likely maltreatment diagnosis increased the average to 139,901 ED visits, well above the annual estimate reported by NCANDS. Placing this upper-bound estimate of maltreatment-related ED visits into the context of reports from NCANDS may indicate that opportunity exists for improving recognition and diagnosis of child maltreatment in EDs in the United States and highlight a critical opportunity to prevent revictimization in an especially vulnerable pediatric population.

### Limitations

This study is limited by the *ICD-9-CM* methodology used to describe ED utilization by children who experience and likely experience maltreatment. *ICD-9-CM* diagnostic codes depend on ED personnel to record maltreatment in the medical chart and on hospital coders to accurately and consistently convert medical records to reimbursable diagnosis codes. ED medical professionals are primarily responsible for documenting physical ailments and injury and reporting suspicion of abuse or consulting with a child abuse specialist. Parents, parental guardians, and other nonrelated adults can provide misleading histories and ED personnel can feel uncomfortable diagnosing given the legal implications of a report of abuse (Guenther, Olsen, et al., 2009). In this context, clinical documentation may be incomplete or speculative, possibly leaving coders unable to assign the diagnostic codes necessary to identify maltreatment (McKenzie & Scott, 2011). Thus the definition of explicit child maltreatment used in this study almost certainly underestimates the true burden of child maltreatment in EDs in the United States but is useful as a conservative, lower bound estimate of prevalence (Schnitzer et al., 2011).

Despite this limitation, children identified using explicit *ICD-9-CM* codes are most often confirmed by CPS as having experienced abuse (Schnitzer et al., 2004). Two separate studies found that 90–93% of children who received an *ICD-9-CM* code for maltreatment in the hospital were known by CPS and that 29–30% of known cases by CPS were first notified by hospital personnel (McKenzie & Scott, 2011; O'Donnell et al., 2010). While incomplete, the definition of specified maltreatment used in this study was presumed to be sufficiently specific and to complement surveillance estimates of abuse and neglect reported by CPS.

This study did not consider children who received generic *ICD-9-CM* codes (995.50; 995.59) that identify “other and unspecified abuse.” The maltreatment experienced by these children could not be categorized as physical abuse, sexual abuse, or neglect and was therefore selected out of the final analysis. Acknowledging these children as true victims of

maltreatment increased the overall rate of maltreatment from 42 to 43 ED visits per 100,000 children 3 years old.

This study was limited in its ability to describe the severity of injury of children. Since many *ICD-9-CM* codes identifying maltreatment fell outside the range of codes defined as injury related by ICDMAP90 software, the ISS variable was largely dependent on secondary diagnoses in the administrative record of ED patients. Nearly one third of children receiving a specified maltreatment diagnosis did not return an ISS value. The most recent version of ICDMAP90 was designed for use with the 1990 version of *ICD-9-CM* codes and does not recognize recent *ICD-9-CM* coding changes. It is certainly reasonable to consider nearly all children who experience maltreatment severe enough to require emergent medical care in a hospital to be injured. Results from NEDS data nonetheless found that children who experienced and likely experienced maltreatment were significantly more likely to have sustained minor and/or severe injuries than other ED patients. Use of the ISS variable enabled this study to quantifiably operationalize the clinical severity of these children in a manner agnostic of rates of admission to the hospital floor and mortality in the ED setting.

This study identified relatively few specified cases of neglect despite neglect being the most common form of child maltreatment included in most surveillance systems (ACF, 2012). Many children who experienced neglect would be recognized by others in the community since neglect often does not require emergent medical attention (ACF, 2012). Other children with neglect issues related to their health status (such as noncompliance with medical care and failure to thrive) were likely recognized in primary care or community health settings. *ICD-9-CM* coding is moreover widely accepted as inadequate for documenting explicit diagnoses of neglect (McKenzie, Scott, Waller, & Campbell, 2011; Schnitzer et al., 2004). As previously noted by Scott, Tonmyr, Fraser, Walker, and McKenzie (2009), ICD-9 based ED claims are not well suited to determine intentionality. This study nevertheless aimed to address the lack of observational data in the maltreatment literature to describe the burden of neglect on the health care system and offered an innovative method for future surveillance efforts of children who experience neglect.

The majority of current information on child maltreatment in the United States comes from registries such as NCANDS that attempt to amass every allegation of abuse and neglect received by a CPS agency. The definitions of maltreatment and thoroughness of subsequent investigations vary across different jurisdictions, and the reports are thought to be underestimates. Given that no single system provides a complete capture of cases, this study established the value of a national, administrative database of ED visits in raising awareness from a public health perspective about the maltreatment of especially vulnerable children in the United States.

### Future Directions and Implications

While limited to children 3 years old who presented to the ED for care, estimates from this study are derived from publicly available data, based on standardized definitions, and reproducible over time. Conservative estimates of child maltreatment identified in the ED setting using the specified maltreatment definition could potentially be useful in tracking diagnostic trends and demographics associated with maltreatment trends. The

suggestive definition might be useful in identifying an at-risk cohort that might benefit from interventions and used to evaluate the efficacy of such programs. The methodology used in this study could also be applied to measure outcomes of training to improve the recognition and reporting of maltreatment in EDs in the United States. In the absence of a complete ascertainment of cases of child maltreatment in the United States, this study provides evidence that the NEDS is an additional tool to complement other strategies of surveillance of maltreatment in infants and young children.

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**Table 1.**Specified and Suggestive Maltreatment *ICD-9-CM* and E-codes.

Category of maltreatment—title of diagnosis	<i>ICD-9-CM/E-code</i>
Physical abuse	
<b>Child abuse—physical</b>	<b>995.54</b>
<b>Shaken infant syndrome</b>	<b>995.55</b>
<b>Injury by unarmed fight or brawl</b>	<b>E960.0</b>
<b>Injury by assault</b>	<b>E961.0-E969.0<sup>a</sup></b>
Retinal hemorrhage	362.81
Fracture of vault of skull	800.00–800.99
Fracture of vertebral column	805.00–805.98
Fracture of ribs	807.00–807.19
Fracture of scapula	811.00–811.19
Subarachnoid hemorrhage	852.00–852.09
Subdural hemorrhage	852.20–852.29
Intracranial hemorrhage, unspecified	853.00–853.09
Injury to unspecified intrathoracic organs	862.0–862.9
Injury to stomach and small intestine	863.1–863.39
Injury to spleen	865.00–865.19
Injury to spinal cord	952.00–952.09
Injury by undetermined intent	E988.0-E988.9
Sexual abuse	
<b>Child abuse—sexual</b>	<b>995.53</b>
<b>Injury by rape</b>	<b>E960.1</b>
Genital herpes	054.10–054.19
Gonococcal infection	098.0–098.89
Pelvic inflammatory disease, unspecified	614.9
Contusion of genital organs	922.4
Observation after alleged rape	V71.50
Observation for abuse/neglect	V71.81
Neglect	
<b>Deprivation of food</b>	<b>994.20</b>
<b>Deprivation of water</b>	<b>994.30</b>
<b>Child abuse—psychological/emotional</b>	<b>995.51</b>
<b>Child abuse—neglect</b>	<b>995.52</b>
<b>Accidental abandonment of infant</b>	<b>E904.0</b>
<b>Accidental starvation and dehydration</b>	<b>E904.1-E904.2</b>
<b>Injury by criminal neglect</b>	<b>E968.4</b>
Other severe malnutrition	262.0
Dental carries	521.00–521.09
Fracture of pelvis	808.0–808.99
Traumatic pneumothorax	860.0–860.5

<b>Category of maltreatment—title of diagnosis</b>	<b>ICD-9-CM/E-code</b>
Injury to heart or lung	861.00–861.32
Injury to GI tract, unspecified	863.80–863.89
Injury to liver	864.0–864.19
Injury to kidney	866.0–866.13
Burn of head and trunk	941.00–942.59
Burn of leg and multiple sites	945.00–946.5
Poisoning by drugs/medicinals	960.0–979.9
Drowning, nonfatal submersion	994.1
Adverse household circumstances	V60.0–V60.9
Second-hand tobacco smoke	E869.4
Swimming accident	E910.2
Near drowning accident	E910.4–E910.9
Injury by poisoning, undetermined intent	E980.0–E980.9
Injury by firearm, undetermined intent	E985.0–E985.7

*Note.* ICD-9-CM *International Classification of Diseases, Ninth Revision, Clinical Modification*. Diagnoses that are in boldface indicate specified maltreatment. Diagnoses that are not bold indicate suggestive maltreatment.

<sup>a</sup>Excludes E968.4 (criminal neglect).



**Table 2.**

Rates of ED Visits for Maltreatment per 100,000 U.S. Population 3 years Old, NEDS 2006–2011.

	Physical	Sexual	Neglect	Poly-Victimization	Any Maltreatment
Specified diagnosis					
Age					
0	48.3	0.3	5.4	4.2	58.3
1	29.4	0.8	3.3	3.5	37.0
2	25.0	1.4	2.4	4.1	32.9
3	27.6	2.9	1.7	7.0	39.1
0–3	32.5	1.4	3.2	4.7	41.8
Suggestive diagnoses					
Age					
0	97.7	24.5	247.6	3.4	373.1
1	36.5	34.6	629.8	4.9	705.7
2	27.7	59.5	563.6	4.3	655.2
3	23.2	81.1	309.9	3.8	418.1
0–3	46.0	50.4	436.3	4.1	536.7

*Note.* ED = emergency department; NEDS = Nationwide Emergency Department Sample. Estimated values were weighted to adjust for the complex sampling design of the NEDS data. Estimates of ED visits for maltreatment (i.e., the numerator) were derived from the NEDS. Estimates of age-specific populations (i.e., the denominator) were derived from the Public Use Microdata Sample of the American Community Survey.

**Table 3.** Characteristics of ED Visits Specified for Maltreatment, by Type, Children 3 years Old, NEDS 2006–2011.

	Poly-victimization			<i>p</i> <sup>a</sup>
	Physical ( <i>n</i> = 47,139)	Sexual ( <i>n</i> = 1,990)	Neglect ( <i>n</i> = 4,602)	
Age, %				<.001
0	36.8	5.2	42.4	22.0
1	21.7	14.1	24.8	17.8
2	19.7	26.1	19.5	22.4
3	21.7	54.6	13.4	37.8
Gender, %				<.001
Female	45.1	82.4	47.5	67.1
Male	54.9	17.6	52.5	32.9
Primary payer, %				<.001
Private	20.1	20.5	14.9	17.5
Medicaid	66.1	56.5	63.4	64.8
Uninsured	9.6	13.1	18.2	12.2
Other	4.2	9.9	3.5	5.5
Household income, %				0.124
Low	39.1	43.6	41.6	40.8
Medium	49.8	49.8	49.6	50.0
High	11.1	6.5	8.9	10.3
Urbanization, %				.360
Metropolitan	81.8	77.3	82.7	80.7
Rural	18.2	22.7	17.3	19.3
Injury severity, %				<.001
No injury information	27.9	91.9	86.1	82.1
Minor	56.5	7.9	12.9	15.0
Severe	15.6	—	1.0	3.0
Discharge status, %				<.001
Discharged alive	68.8	96.8	74.2	74.8
Hospitalized	30.9	2.7	25.6	25.0

	Physical	Sexual	Neglect	Poly-victimization	<i>p</i> <sup>a</sup>
Death at the ED <sup>b</sup>	( <i>n</i> = 47,139) 2.8	( <i>n</i> = 1,990) —	( <i>n</i> = 4,602) —	( <i>n</i> = 6,837) 1.9	

*Note.* ED = emergency department; NEDS = Nationwide Emergency Department Sample. Estimated values were weighted to adjust for the complex sampling design of the NEDS data. Covariates not presented: Year of ED visit; region. H0: The distribution of a given independent variable does not differ between the four separate categories of maltreatment. Empty cell values reflected column percentages based on <11 weighted cases.

<sup>a</sup>Calculated *p* values from the Pearson  $\chi^2$  statistic with Rao and Scott correction.

<sup>b</sup>Cell values reflect the death rate per 1,000 ED visits of column heading.

Multivariable Logistic Regression Models to Predict ED Visits Specified for Maltreatment, by Type and Overall, Children 3 years Old, NEDS 2006–2011.

**Table 4.**

	Physical <sup>a</sup>			Sexual <sup>a</sup>			Neglect <sup>a</sup>			Poly-Victimization <sup>a</sup>			Any Maltreatment <sup>b</sup>		
	(77.8% of total)			(3.3% of total)			(7.6% of total)			(11.3% of total)			(0.1% of total)		
	MPP	RME	RME <sup>d</sup>	MPP	RME	RME	MPP	RME	RME	MPP	RME	RME	MPP	RME	RME
Age															
0 (reference)	81.18	—	—	0.75	—	—	10.22	—	—	7.51	—	—	0.12	—	—
1	78.10	0.96**	—	2.39	3.19**	0.92	9.39	0.92	—	10.06	1.34**	—	0.07	0.58**	—
2	77.06	0.95**	—	3.55	4.73**	0.67**	6.88	0.67**	—	12.51	1.67**	—	0.08	0.67**	—
3	74.85	0.92**	—	5.28	7.04**	0.35**	3.59	0.35**	—	16.03	2.13**	—	0.12	1.00	—
Gender															
Female (reference)	75.02	—	—	4.39	—	—	6.56	—	—	13.87	—	—	0.11	—	—
Male	81.40	1.09**	—	1.50	0.34**	1.30**	8.55	1.30**	—	8.29	0.60**	—	0.09	0.82**	—
Primary payer															
Private (reference)	78.99	—	—	3.59	—	—	6.48	—	—	10.94	—	—	0.05	—	—
Medicaid	78.39	0.99	—	2.97	0.83	1.13	7.32	1.13	—	11.32	1.03	—	0.12	2.40**	—
Uninsured	74.75	0.95*	—	3.14	0.87	1.59*	10.30	1.59*	—	11.74	1.07	—	0.16	3.20**	—
Other	75.24	0.95	—	5.68	1.58	0.93	6.00	0.93	—	12.30	1.12	—	0.11	2.20**	—
Household income															
Low (reference)	77.39	—	—	3.51	—	—	7.60	—	—	11.54	—	—	0.11	—	—
Medium	77.97	1.01	—	3.25	0.93	0.99	7.53	0.99	—	11.22	0.97	—	0.09	0.82**	—
High	79.74	1.03	—	2.31	0.66*	0.87	6.62	0.87	—	11.20	0.97	—	0.07	0.64**	—
Urbanization															
Metropolitan (reference)	77.84	—	—	3.32	—	—	7.56	—	—	11.30	—	—	0.10	—	—
Rural	78.23	1.01	—	3.10	0.93	0.93	7.06	0.93	—	11.58	1.02	—	0.09	0.90*	—
Injury severity															
No injury information (reference)	52.97	—	—	5.58	—	—	18.14	—	—	23.23	—	—	0.04	—	—

	Physical <sup>d</sup>		Sexual <sup>d</sup>		Neglect <sup>d</sup>		Poly-Victimization <sup>d</sup>		Any Maltreatment <sup>b</sup>	
	(77.8% of total)		(3.3% of total)		(7.6% of total)		(11.3% of total)		(0.1% of total)	
	MPP <sup>c</sup>	RME <sup>d</sup>	MPP	RME	MPP	RME	MPP	RME	MPP	RME
Minor	93.39	1.76 <sup>**</sup>	0.58	0.10 <sup>**</sup>	2.09	0.12 <sup>**</sup>	3.92	0.17 <sup>**</sup>	0.47	11.75 <sup>**</sup>
Severe	97.58	1.84 <sup>**</sup>	0.32	0.06 <sup>**</sup>	0.38	0.02 <sup>**</sup>	2.00	0.09 <sup>**</sup>	2.96	74.00 <sup>**</sup>
Discharge status										
Discharged alive (reference)	79.91	—	3.45	—	6.84	—	9.79	—	0.07	—
Hospitalized	68.36	0.86 <sup>**</sup>	1.15	0.33 <sup>**</sup>	10.34	1.51 <sup>**</sup>	20.03	2.05 <sup>**</sup>	0.60	8.57 <sup>**</sup>
Death at the ED	82.29	1.03	5.13	1.49	3.48	0.51	8.60	0.88	0.34	4.86 <sup>**</sup>

Note. ED = emergency department; NEDS = Nationwide Emergency Department Sample; MPP = mean predicted probability; RME = relative marginal effect. Estimated values were weighted to adjust for the complex sampling design of the NEDS data. Covariates not presented: year of ED visit; region. H0: The predicted probability of Y = 1 is the same for referent and comparator categories of an independent variable. Indices of fit: CPhysical = .828; CSexual = .881; CNeglect = .821; CPoly-victimization = .799; CAny Maltreatment = .750.

<sup>d</sup>Only ED patients with nonmissing patient characteristic information were included (NUnweighted = 12,691).

<sup>b</sup>Only ED patients with nonmissing patient characteristic information were included (NUnweighted = 13,490,344).

<sup>c</sup>MPP is first predicted per ED patient, controlling for their respective covariate values, and then averaged across the entire sample population.

<sup>d</sup>RME is the ratio of MPPs between comparator and referent categories of an independent variable.

\* p < .05.

\*\* p < .01.

Multivariable Logistic Regression Models to Predict ED Visits Suggestive of Maltreatment, by Type and Overall, Children 3 years Old, NEDS 2006–2011.

Table 5.

	Physical <sup>a</sup>		Sexual <sup>d</sup>		Neglect <sup>d</sup>		Poly-victimization <sup>d</sup>		Any maltreatment <sup>b</sup>	
	(8.5% of total)		(9.4% of total)		(81.3% of total)		(0.8% of total)		(1.2% of total)	
	MPP	AME	MPP	AME	MPP	AME	MPP	AME	MPP	AME
Age										
0 (reference)	16.47	—	7.53	—	73.21	—	0.41	—	0.69	—
1	5.67	0.34**	4.91	0.65**	88.66	1.21**	0.82	2.00**	1.36	1.97**
2	6.23	0.38**	8.78	1.17**	83.78	1.14**	0.98	2.39**	1.77	2.57**
3	6.37	0.39**	18.57	2.47**	73.25	1.00	1.07	2.61**	1.41	2.04**
Gender										
Female (reference)	8.43	—	12.70	—	77.87	—	0.73	—	1.33	—
Male	8.62	1.02	6.24	0.49**	84.32	1.08**	0.76	1.04	1.19	0.89**
Primary payer										
Private (reference)	9.54	—	6.42	—	83.30	—	0.64	—	1.29	—
Medicaid	8.02	0.84**	10.28	1.60**	81.02	0.97**	0.80	1.25**	1.21	0.94**
Uninsured	7.17	0.75**	12.77	1.99**	78.69	0.94**	0.74	1.16	1.40	1.09**
Other	9.11	0.95	15.17	2.36**	74.07	0.89**	0.96	1.50**	1.35	1.05
Household income										
Low (reference)	8.05	—	10.36	—	80.79	—	0.86	—	1.22	—
Medium	8.62	1.07*	9.30	0.90**	81.37	1.01	0.71	0.83*	1.28	1.05**
High	9.21	1.14*	7.46	0.72**	82.22	1.02	0.64	0.74**	1.25	1.02
Urbanization										
Metropolitan (reference)	8.62	—	9.64	—	80.98	—	0.75	—	1.22	—
Rural	8.12	0.94	8.64	0.90*	82.57	1.02**	0.75	1.00	1.38	1.15**
Injury severity										
No injury information (reference)	1.12	—	9.88	—	88.26	—	0.05	—	1.01	—

	Physical <sup>d</sup>		Sexual <sup>d</sup>		Neglect <sup>a</sup>		Poly-victimization <sup>a</sup>		Any maltreatment <sup>b</sup>	
	(8.5% of total)		(9.4% of total)		(81.3% of total)		(0.8% of total)		(1.2% of total)	
	MPP <sup>c</sup>	AME <sup>d</sup>	MPP	AME	MPP	AME	MPP	AME	MPP	AME
Minor injury	16.41	14.65**	8.58	0.87**	72.69	0.82**	1.33	26.60**	2.28	2.26**
Severe injury	49.90	44.55**	0.27	0.03	24.49	0.28**	5.65	113.00**	31.59	31.28**
Discharge status										
Discharged alive (reference)	7.44	—	10.06	—	81.60	—	0.48	—	1.18	—
Hospitalized	12.88	1.73**	1.30	0.13**	79.00	0.97**	1.42	2.96**	2.93	2.48**
Death at the ED	9.99	1.34	0.90	0.09**	88.67	1.09**	1.47	3.06*	6.77	5.74**

Note. ED = emergency department; NEDS = Nationwide Emergency Department Sample; MPP = mean predicted probability; RME = relative marginal effect. Estimated values were weighted to adjust for the complex sampling design of the NEDS data. Covariates not presented: year of ED visit; region. H0: The predicted probability of Y = 1 is the same for referent and comparator categories of an independent variable. Indices of fit: CPhysical = .862; CSexual = .749; CNeglect = .769; CPoly-victimization = .758; CAny Maltreatment = .682.

<sup>a</sup> Only ED patients with nonmissing patient characteristic information were included ( $n_{unweighted} = 167,028$ ).

<sup>b</sup> Only ED patients with nonmissing patient characteristic information were included ( $n_{unweighted} = 13,490,344$ ).

<sup>c</sup> MPP is first predicted per ED patient, controlling for their respective covariate values, and then averaged across the entire sample population.

<sup>d</sup> RME is the ratio of MPPs between comparator and referent categories of an independent variable.

\*  $p < .05$ .

\*\*  $p < .01$ .