Chapter 5
Fatal Child Abuse

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Background and History

From early Greek mythology (Stavrianos et al. 2008) to recent sensational headlines (Auburn and Grady 2012), child abuse fatalities have persisted through ages and cultures. For over 150 years, the medical literature has described child abuse fatalities. One of the earliest discussions of fatal child abuse was published in 1860 by Ambroise Tardieu, a French Professor of Legal Medicine in Paris. His classic paper, reprinted in 2005 (Roche et al. 2005) described the autopsy findings of 32 child fatalities of Parisian children – 19 of whom were killed by their parents.

Coupled with the descriptions in the literature of child abuse fatalities are calls for prevention. Just as Tardieu's calls for French physicians and society to address child fatalities were ignored, so have been recent efforts. In 1995, Donna Shalala, then Secretary of the Department of Health and Human Services, called Child Abuse Fatalities "the Nation's shame" (U.S. Advisory Board 1995). Not much has been done by our federal government to address the problem in the almost 20 years since that publication, except for a recent GAO report recommending improvements in data collection (United States GAO 2011). Few events challenge our child protection system as much as the death of infants and children – whether by violent beatings or shakings, suffocation, deliberate or incidental poisoning, or as a result of neglect (either supervisional or emotional).

The first challenge in trying to address child abuse fatalities arises from a lack of data on the exact number of child abuse deaths in this country. Under ascertainment of child abuse fatalities has been recognized since the 1990s (Herman-Giddens et al. 1999; Crume et al. 2002). Current fatality rates are estimates and child death investigations vary from community to community. Without accurate data and clear risk factors, prevention remains elusive. This chapter will review the current literature on the epidemiology of fatal child abuse, the role of child death investigations in ascertaining the cause of death, the causes of child abuse fatalities, and current prevention efforts.

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Epidemiology of Fatal Child Maltreatment

U.S. data from NCANDS (National Child Abuse and Neglect Data System) report 1,770 cases of fatal child maltreatment in 2009 and 1,560 in 2010. These numbers represent 2.3 cases per 100,000 in 2009 and 2.07 cases per 100,000 in 2010. It is likely that these numbers underestimate the true number of child maltreatment fatalities, because not all fatalities are identified as maltreatment, and not all identified cases of fatal maltreatment are reported to state child welfare agencies (U.S. GAO 2011). As many as 50–60 % of child maltreatment deaths may be missed in official reports (Crume et al. 2002; Herman-Giddens et al. 1999). The challenges in identifying all child maltreatment fatalities make it difficult to determine trends in maltreatment fatalities over time. While data from NCANDS indicate a 46 % increase in fatalities between 1993 and 2007, data from the FBI and national vital statistics show an approximate 40 % decline in fatal maltreatment during the same time period (Finkelhor and Jones 2012).

The largest percentage of fatalities occurs among the youngest children. Nearly half (47.7 %) of child maltreatment fatalities in the U.S. in 2010 were among infants (<1 year of age), 14 % were among 1 year olds, 17 % were among 2–3 year olds, and 11 % were among 4–7 year olds. Neglect accounted for the largest proportion of deaths, with 68.1 % of deaths attributable to neglect alone, or neglect and another form of maltreatment. Forty-five percent of deaths involved physical abuse, with or without another form of maltreatment.

Boys are at higher risk of fatal maltreatment than girls (2.5 vs. 1.7 cases per 100,000 in 2010). White children make up the largest percentage of maltreatment fatalities (43.6 %); however rates of fatal maltreatment are higher among African-American (3.9/100,000), Native American/Alaskan Native (1.9/100,000), and Hispanic children (1.9/100,000) compared to whites (1.7/100,000).

A number of studies have identified abusive head trauma as the most common cause of fatal maltreatment, accounting for 42–45 % of deaths (Collins and Nichols 1999; Kajese et al. 2011). Asphyxia, including drowning, accounts for an additional 22–25 %, and abdomino-throacic trauma accounts for approximately 12 % of deaths. Identified triggers include crying, toileting, and general noncompliance (Kajese et al. 2011).

When examining all maltreatment deaths, mothers are the most frequently identified perpetrator. Mothers were solely responsible for 29 % of child maltreatment fatalities in 2010, mother and father were jointly responsible for 22 %, and mother and "other" were responsible for 9 %. Fathers were solely responsible for 17 % of deaths. Non-parent perpetrators accounted for only 12 % of fatalities. One major difference has been noted when looking specifically at deaths from physical abuse compared to those from all forms of maltreatment. While females, mostly mothers, are the most common perpetrator when all forms of fatal maltreatment are considered, males are the primary perpetrators of physical abuse fatalities, accounting for about two-third of these deaths (Stiffman et al. 2002; Schnitzer and Ewigman 2005).

A number of factors may increase the risk for fatal maltreatment. Data from Missouri child fatalities showed an eightfold increased likelihood of death from maltreatment when an unrelated adult was living in the home, and a 4.7-fold increased likelihood of death from maltreatment if the child lived with step, foster, or adoptive parents (Stiffman et al. 2002). Additional risk factors include teenage pregnancy and maternal failure to complete high school (Kajese et al. 2011; Schnitzer and Ewigman 2005), caregiver substance abuse and intimate partner violence in the home (US DHHS 2011), late prenatal care, poverty, and prior CPS reports (Schnitzer and Ewigman 2005). A large number of children in the home may be a specific risk factor for fatal neglect. In one study comparing deaths from neglect to those from abuse, 41 % of families with fatal neglect had five or more members. Families with neglect deaths had more children living in the home than those with deaths from abuse (mean of 3.3 vs. 1.8 children, p <0.001) (Margolin 1990).

At least three studies have specifically examined fatal maltreatment during the first year of life (Paulozzi and Sells 2002; Overpeck et al. 1998; Herman-Giddens et al. 2003). Each of these studies identified the first week of life as a particularly high risk period for homicide, with a second peak at 2–3 months. About 9 % of infant homicides took place during the first week of life; mothers were responsible for the vast majority of these first week deaths (Overpeck et al. 1998; Herman-Giddens et al. 2003). Risk factors for infant homicide include mother's age <15 years, a second child to a teenage mother, lack of prenatal care, and less than 12 years of education.

Child Death Evaluation

As noted above, the actual number of child abuse fatalities in the United States is an estimate, and not an exact number. Often death certificates do not reflect the fact that a child died as a result of abuse (Herman-Giddens et al. 1999; Crume et al. 2002). To understand why child abuse fatality determination is so difficult, it is important to first understand the status of cause of death determination in the United States. No uniform system for death determination exists in this country as some states have a coroner system, others have a medical examiner system, and others have a mixture of both (Fig. 5.1). In general, medical examiners are forensic pathologists trained in the autopsy and forensic investigations, while coroners are elected or appointed officials who may or may not be physicians. Currently, there are 2,000 distinct jurisdictions for death investigation in the United States, ranging in size from a small county to an entire state. Unfortunately, there are only 1,000 forensic pathologists in the United States and even fewer with specialized training in pediatric pathology. The subsequent variability that exists in investigation technique and quality is one reason for a significant underestimate in the 2,000 child abuse fatalities annually in the United States.

Two major efforts have tried to address the issue of inadequate death investigations. The first was the development of a standardized child fatality review process (Covington et al. 2005). The second and
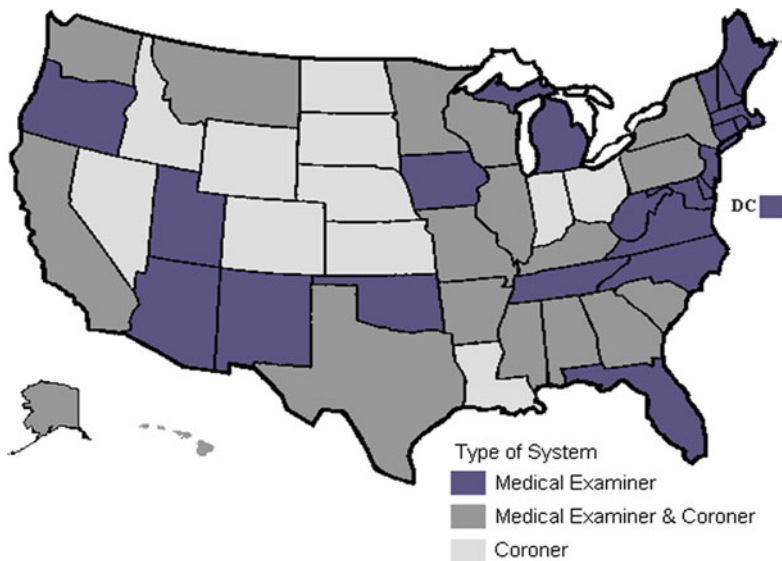

Fig. 5.1 System of death investigation by state (Reproduced from Krugman and Krugman 2007)

more recent was the creation of standardized protocols for child death investigation and corresponding database through the Centers for Disease Control. Examples of these protocols for infant death scene investigation and autopsy can be found at: http://www.childdeathreview.org/investigation.htm and http://www.cdc.gov/SIDS/PDF/SUIDIforms.pdf.

Ideal Process for Child Death Investigation

A thorough and complete death investigation of any sudden and unexpected death in a child has three stages: scene investigation, autopsy, and collateral history from involved professionals. The scene investigation has been made popular recently by television crime shows such as CSI, but it is the stage of the investigation that is most likely overlooked or inadequately completed. Many jurisdictions will utilize specific protocols for infant or childhood scene investigation and use trained homicide detectives to respond to the home or location of death immediately after the child dies. In the ideal situation, trained police officers will respond immediately to the scene of every sudden and unexplained child death and conduct a thorough scene investigation, often in conjunction with investigators from the medical examiner's office. The scene investigation should assess where the child was found, who the child was with, and what the child was doing at the time of death. In the case of a child found dead in a bed or crib, the position in which the child was put to sleep, the position in which the child was found, and the presence of other objects in the bed should be documented. The presence of cigarette smoke, toxic or illegal substances, or any other evidence should be collected and documented. Blood and other body fluids should be collected for forensic analysis, and photos of the entire scene should be taken.

The autopsy of a dead child also must be done by a pathologist familiar with causes of childhood death. A complete autopsy includes an external examination, internal examination, histological examination, toxicological studies, microbiological tests, and metabolic screening for genetic conditions. Most infant deaths should include a skeletal survey or CT scan to evaluate for occult or healing fractures. Often, crucial organs such as the brain, eyes, or heart need to be sent to pathological specialists for evaluation.

Finally, before determining a cause of death, the coroner or medical examiner should evaluate the past medical and social history of the child. The past medical history can help elucidate the cause of death in circumstances such as children with seizure disorders or cardiac conditions. A high risk social situation may lead the examiner to list the cause of death as undermined when a definitive cause cannot be identified. The term SUDI (Sudden Unexplained Death of Infancy) is often used in this situation. Unfortunately, there is not universal agreement on use of the term and it varies from locale to locale. In many states, however, this term is used to describe the cause of death in infants who died suddenly and unexpectedly, but do not meet the criteria for SIDS because of potential social or environmental risk factors. Over the past decade, the rate of SIDS has decreased significantly, but the SUDI rate has increased, likely because of the re-classification into the latter group of children who used to be called SIDS before thorough investigations were routine (American Academy of Pediatrics 2005).

Child Fatality Review Teams

The child fatality review process completes the second part of the cause of death determination for children. Child fatality review (CFR) began in the late 1970s. Local teams were founded in Los Angeles, Oregon and North Carolina with the goal of better identifying child abuse fatalities

(Michigan Public Health Institute 2005a). In the 1990s, studies from Missouri (Ewigman et al. 1993), New York (Herman-Giddens et al. 1999), and Colorado (Crume et al. 2002) demonstrated that up to 61 % fatalities due to child abuse were not coded as such on death certificates, which artificially lowered the true rate of child abuse fatalities in vital statistics records. The CFR process was able to better classify the deaths. In 1993, the federal Child Abuse Prevention and Treatment Act (CAPTA) required states to include information on child death review in their state program plans. In the past decade, CFR teams have been formed in all 50 states and the District of Columbia, and many teams focus on determining the cause of all child deaths, not just those secondary to child abuse. Many teams will consist of medical, forensic, law enforcement, social services, school, and citizen representatives who meet regularly to review all sudden and unexpected child deaths.

The CFR process is best understood as a quality control/process improvement system. While there is some variation in focus among teams, the majority of teams are a multidisciplinary group that conducts reviews of all unexpected childhood deaths in a community with the purpose of better understanding why the child died in order to prevent future deaths. This goal is broader than the original teams which only sought to identify fatal child abuse, but the broader goal has helped create process improvements in the identification of fatal child abuse. One of the primary objectives of CFR teams is to "ensure the accurate identification and uniform, consistent reporting of the cause and manner of every child death" (Michigan Public Health Institute 2005b). By reviewing every unexpected death in a locale, each community can ensure that their death investigators are conducting appropriate scene investigations and autopsies which are crucial in cause of death determination. Other objectives of CFR include improving agency responses to evaluating deaths in general, homicides in particular, and protecting other siblings in a family (Michigan Public Health Institute 2005b). Each of these efforts in a community will lead to improved case ascertainment as well as prevention of future deaths from fatal child abuse.

More information on local and state CFR teams, a "how-to" manual, and further information can be accessed at the National MCH Center for Child Death Review's website at http://www.childdeathreview.org.

Causes of Fatal Child Abuse Deaths

Abusive Head Trauma

Abusive head trauma (AHT) describes a constellation of abusive head injuries to children including shaking, shaking with an impact, and direct blows to the head (Christian et al. 2009). While some controversy exists regarding the exact mechanism of "Shaken Baby Syndrome" multiple publications of perpetrator confessions (Starling et al. 2004) and comparative studies to accidental injuries (Vinchon et al. 2010; Bechtel et al. 2004) implicate shaking as a mechanism of traumatic brain injury in young children. A thorough analysis of the biomechanical controversies of the entity "Shaken Baby Syndrome" is beyond the focus of this chapter. AHT as an entity is the most frequent cause of fatal child abuse in infants under 1 year old.

Estimates for the incidence of AHT vary from 5/100,000 to 41.5/100,000 depending on the definition and methodology (Wirtz and Trent 2008; Dias et al. 2005). In general, a broader definition of AHT and younger ages will lead to higher estimates as compared to narrow definitions using passive surveillance methods, like hospital discharges (Wirtz and Trent 2008). Recent publications using active prospective surveillance in North Carolina (Keenan 2008) and Edinburgh, Scotland (Minns et al. 2008), and analysis of national inpatient databases (Ellingson et al. 2008) place the incidence around 20/100,000 births.

Risk factors for AHT can be categorized according to the child, the family and the adult perpetrator. Male children are at higher risk than females. Premature infants and those with disabilities are also at higher risk (Herman et al. 2011; Starling et al. 1995, 2004). Young parents, military parents, unstable family situations, and lower socioeconomic status are family-related risk factors for AHT (Herman et al. 2011) while substance abuse, psychiatric disorders or an unreasonable expectation of child behavior are adult risk factors (Herman et al. 2011; Schnitzer and Ewigman 2005). Most often, the perpetrator is the baby's father or mother's boyfriend, while female babysitters and mothers follow (Herman et al. 2011; Starling et al. 1995).

The majority of the cases of AHT occur in young infants between 2 and 6 months of age. The age-specific incidence overlaps with a slight lag to the peak months of infant crying (Barr et al. 2006; Lee et al. 2007). Coping with a crying infant can be difficult, especially for men. Shaking an infant appears to be a response to disciplining a child under 2 years of age across many cultures. Parents worldwide report using shaking as discipline, with a rate of 2.6 % in North Carolina to 25 % in Chile, and over 40 % in India slums (Runyan 2008). Shaking an infant may provide a positive-feedback loop for caregivers (Barr and Runyan 2008): as shaking quiets the infant and leaves no external marks that could be perceived as an unacceptable cultural practice.

Infants who die from AHT often present to the hospital in extremis. Recent research has demonstrated that children who present for medical care with initial Glasgow Coma Scores (GCS) of 5 or below had a 58 times greater odds of dying than children with a GCS of 12 or higher (Shein et al. 2012). The initial presentation of fatal AHT often includes seizures, apnea or coma, while mild AHT cases can present with fussiness or vomiting (Herman et al. 2011). The intracranial findings most often include subdural hemorrhages and subarachnoid hemorrhages, while contusions and other parenchymal injuries such as axonal injury can also occur (Herman et al. 2011). Secondary injuries from hypoxia can lead to cerebral edema or hypoxic-ischemic injuries (Herman et al. 2011). The overall mortality rate for AHT victims ranges from 11 % to 35.7 % (Shein et al. 2012; Chiesa and Duhaime 2009; Keenan et al. 2003) while almost two thirds of victims will have some neurologic sequelae (Chiesa and Duhaime 2009).

Fatal Munchausen's Syndrome by Proxy

Munchausen's Syndrome by Proxy (MSBP), also referred to as pediatric condition falsification, and medical child abuse is a cluster of symptoms that include illness in a child that is either fabricated or produced by a caregiver leading to frequent physician or hospital visits for medical treatment. The etiology of the symptoms is denied by the perpetrator, and symptoms resolve once the child is removed from the perpetrator's care (Rosenberg 1987).

Estimates of the incidence of MSBP are difficult to ascertain, as the diagnosis can be challenging, many cases go undiagnosed, and many are not reported. The best studies have used either prospective or retrospective surveillance to identify cases and national census data for population estimates. McClure and colleagues calculated a rate of 0.5/100,000 for children <16 years of age, and 2.8/100,000 for children <1 year of age in the UK and Ireland. These estimates included cases of non-accidental poisoning and suffocation (McClure et al. 1996). Denny and colleagues (2001) estimated an incidence of 2/100,000 in New Zealand using a survey of all pediatricians in the country.

Data on MSBP fatality rates have also been variable. None of the cases in Denny's study were fatal, possibly because he only requested information from pediatricians (Denny et al. 2001). Rosenberg reported a 9 % fatality rate (Rosenberg 1987), and two separate studies found rates of approximately 6 % (McClure et al. 1996; Sheridan 2003). Alexander and colleagues (1990) calculated a mortality rate of 31 %. However, their sample included five index cases and eight siblings of the index cases.

Fatal MSBP is most often due to poisoning or suffocation. Poisoning or suffocation was identified as the cause of death in all cases in the Alexander and McClure series (Alexander et al. 1990; McClure et al. 1996). Two articles examining only cases of smothering both demonstrated high mortality rates; 18 % in one and 33 % in the other (Rosen et al. 1986; Meadow 1999). Sheridan's study did not provide data on the cause of death, bud did list patient symptoms. Among the 27 deaths in her series, approximately half had symptoms of apnea, 22 % had a history of cyanosis, 22 % had vomiting, and 18 % had anorexia or feeding problems (Sheridan 2003). Case reports of fatal MSBP have typically cited poisoning or suffocation as the cause of death (Vennemann et al. 2005; Valentine et al. 1997; Meadow 1993; Bartsch et al. 2003; Schneider et al. 1996). Causes of poisoning have included barbiturates, benzodiazepines, ipecac, tricyclic antidepressants, and salt (Vennemann et al. 2005; Valentine et al. 1997; Meadow 1993; Bartsch et al. 2003; Schneider et al. 1996).

Suffocation Versus SIDS

The determination of an infant suffocation death can be extremely difficult to differentiate from Sudden Infant Death Syndrome (SIDS). SIDS was first defined in the 1970s by consensus statement as a diagnosis of exclusion in which a child under the age of 1 year dies with no known cause. The vast majority of children who die from SIDS are under 6 months and found in an unsafe sleep position, such as prone sleeping. In order to assign SIDS as the cause of death of an infant, a complete and thorough death investigation must occur as described above. Unfortunately, because of poor death investigations and because suffocating an infant with a pillow can occur despite a completely unremarkable scene investigation and no findings on autopsy, it is estimated between 1 % and 5 % of SIDS cases are actually due to infanticide (American Academy of Pediatrics 2006).

The confusion and debate among professionals between SIDS and suffocation became an issue at the first description of SIDS. The "apnea hypothesis," in which infants who have recurrent episodes of apnea later die of SIDS, was one of the first hypotheses for the etiology of SIDS. For decades, researchers in a few areas of the country believed that perinatal pneumograms (sleep studies monitoring heart rates and oxygen levels) could predict future risk of SIDS by identifying infants with apnea. Additionally, siblings of SIDS victims were placed on monitors to prevent SIDS as there was general acceptance that siblings carried a higher risk of dying from SIDS (Kelly et al. 1982). Unfortunately, the hypothesis was based primarily on the deaths of infants whose mothers were repeatedly suffocating them (Steinschneider 1972; Firstman and Talan 1997) and the likelihood of infanticide increases as the number of infants in the same family die of SIDS. Many studies at the time additionally disproved the apnea hypothesis and risk of sibling deaths (Meadow 1990; Southall et al. 1982; Schechtman et al. 1991).

Only a thorough death investigation will have the possibility of discriminating death by suffocation from SIDS (American Academy of Pediatrics 2006). Findings that may suggest suffocation include pulmonary intraavleolar hemorrhages on autopsy and a history of oropharyngeal blood (Southall et al. 1997), but neither is specific enough to conclusively diagnose suffocation (Krous et al. 2007). The majority of suffocation deaths have no forensic findings in either the scene investigation or autopsy, making it challenging to ascertain the cause of death and the exact number of suffocation deaths each year.

Fatal Poisoning

Poisoning can occur when a child ingests, inhales, or aspirates a toxic substance, or when a toxin is injected or absorbed through the skin. Several different types of child maltreatment can lead to death by

poisoning. These include neglect, MSBP, severe punishment gone awry, and manslaughter/homicide. Poisoning in the context of MSBP has already been discussed. This section will therefore focus on neglect, severe punishment, and homicide.

Fatal poisoning can be due to neglect in situations where the caregivers' lack of supervision leads to the ingestion of a toxic substance. In the context of poisoning from illegal drugs, the caregivers' possession and use of illegal substances inherently places the child at risk of harm, and these cases should routinely be reported to child protective services. When a mobile child ingests, inhales, or aspirates a household product or medication, it may be challenging to determine whether neglect was involved, and whether the case should be reported to child protective services. However, fatal poisoning from several common household products should raise concern for exposure to illegal drug production (Farst et al. 2007). For example, pseudophedrine and ephedrine are precursors for methamphetamine production. Solvents (e.g. acetone, paint thinner, kerosene), reducing agents (e.g. red phosphorus from match strike plates, iodine, ammonia, and lithium), bases (e.g. sodium hydroxide from drain opener, and ammonium hydroxide from household cleaners), and acids (e.g. hydrochloric or sulfuric acid) are used in the production of methamphetamine (Farst et al. 2007).

The most frequently reported toxins implicated in fatal poisoning as punishment include pepper, salt, and water. Death has been reported in a number of children who were force fed black pepper. The cause of death in all cases was aspiration (Henretig et al. 2009; Cohle et al. 1988). Punishment by forced water ingestion may cause hyponatremia, seizures, and cerebral edema (Tilelli and Ophoven 1986; Dine and McGovern 1982; Keating et al. 1991), which can be fatal. Force feeding of salt, often in conjunction with fluid restriction may be used as punishment, frequently for enuresis (Baugh et al. 1983; Dockery 1992; Feldman and Robertson 1979).

Poisoning of children with sedatives to stop crying or keep them quiet may be considered a subset of poisoning as punishment. Case reports have included a 3-year old poisoned with diphenhydramine for sedation and emesis cessation (Pragst et al. 2006) and a 4-year old given haloperidol to punish his bad behavior and make him sleep (Satar et al. 2001). In other cases, a 10-month old was injected with heroin by mother's boyfriend to keep the infant quiet, and a 1-year old was fed rum and coke to keep him quiet (Henretig et al. 2009).

Parents who choose to commit suicide may decide to kill their children at the same time through poisoning or other means. Two case series from Hong Kong described instances of suicide/homicide. Of the 15 total families, there were three child deaths from poisoning. Two of the 14 were poisoned, one by coal gas, and another two by carbon monoxide from burning charcoal (Hon 2011; Lee et al. 2002). In these cases, the majority of perpetrators were mothers, who committed suicide by jumping from buildings (Hon 2011). These cases differ from the poisonings seen in MSBP because there is no history of frequent medical visits or unusual or inexplicable illness symptoms. A final form of homicide involves the use of children as drug mules – having them ingest drugs for surreptitious transport (Beno et al. 2005; Traub et al. 2004).

Fatal Neglect

Fatal neglect can encompass a broad range of causes of death. Many involve a lack of supervision, as with drowning, falls, leaving a child unattended in a hot vehicle, or burns and suffocation from residential fires. Fatal neglect may also occur from poor parental decision making, such as placement of an infant in an unsafe sleeping environment, driving with a child while intoxicated, or failure to use a car seat or seat belt for the child. A third category of fatal neglect includes medical neglect, in which the death could have been prevented with medical intervention. Fatal medical neglect may be the result of parental religious beliefs or use of unproven, non-traditional forms of treatment. Finally, nutritional neglect may lead to fatal starvation.

Determining whether an unintentional injury death involves neglect can be challenging, particularly in instances of lack of supervision and failure to protect. Professionals may be reluctant in these situations to report to child protective services, believing that the family has already suffered enough, and that they don't want to blame the family for an "accident" (Ewigman et al. 1993). Even child fatality review teams may have difficulty labeling a lapse of supervision or failure to protect as neglect because of differing definitions, lack of standards regarding supervision, and changing norms (Schnitzer et al. 2011). Therefore, the number and percentage of child deaths involving some degree of neglect are probably vastly underestimated.

NCANDS data from 2010 indicate about two-thirds of child maltreatment fatalities involve some component of neglect (US DHHS 2011). About half of these deaths are the result of neglect alone, and another half involve neglect and at least one other form of maltreatment. In a 25 year retrospective review of fatal neglect in South Carolina, 16 cases of definite neglect were identified. Six (24 %) of these involved nutritional neglect, with malnutrition, starvation, or dehydration, and four (16 %) involved drowning. There were also several cases of toxic ingestions, hyperthermia, hypothermia, electrocution, and lack of medical care (Knight and Collins 2005). Because this review excluded "gray zone" cases, it underestimates the proportion of fatal neglect cases from lack of supervision, unsafe sleep environments, and motor vehicle crashes in which children were not properly restrained.

Neglect Deaths from Drowning – Drowning deaths may involve neglect in both infants and older children. One example is a parent who is bathing an infant or toddler and leaves briefly to answer the telephone, leaving the child unattended. In addition, mobile toddlers and young children have drowned from falling into buckets filled with water or cleaning solution. Toddlers or preschoolers may drown in home swimming pools when safety gates are absent or unsecured. Lapses in supervision, including supervision while intoxicated may contribute to drowning in swimming pools as well as natural bodies of water. A 2011 review of 5 years of pediatric drowning deaths in Washington State indicated that 68 % (21 of 31) of the drowning fatalities in children under 5 years of age involved some degree of neglect. While the authors noted that most of the 21 were due to isolated acts of inadequate supervision, they also indicated that ten of these families had prior CPS referrals (Quan et al. 2011).

Neglect Deaths from Household Fires – There are a number of different ways in which neglect may contribute to child deaths in household fires. Parents may leave children unattended in a home where a fire starts, leaving the child unable to escape because he is sleeping, is overcome by smoke inhalation, and/or does not know how to escape. An intoxicated adult may be present and unable to help the children escape. The fire may be started by a child with inadequate supervision who has easy access to matches or a lighter. In one study of residential fires in North Carolina, 48 children <18 years died in the course of a year – 14 of these died in nine fires without adult supervision, and seven died in four fires in which one or more surviving adults was impaired by alcohol or other drugs (Marshall et al. 1998). An epidemiologic study of house fires in Scotland had similar findings; parental intoxication was present in 30 % of 168 fires with child deaths, and 30 % involved some lapse in supervision (Squires and Busuttil 1995).

Heat Related Deaths – Death from hyperthermia may occur when children are left unattended in cars, or when unattended children climb into unlocked cars. There are few studies in the literature examining these deaths, in part because there is no specific ICD codes to identify these cases (Guard and Gallagher 2005). One study used news reports to identify 171 deaths over 8 years in children ≤5 years. The majority of these deaths (125, or 73 %) occurred when parents left children unattended in the car, while the remaining cases were instances in which an unsupervised child climbed into an unlocked car. Among the 125 cases where children were left in cars, caregivers in about half forgot or were unaware of the child in the car. In another 27 % the caregiver deliberately left a child in the car, either because he did not want to wake a sleeping child, or because he wanted to restrain a child while participating in another activity (Guard and Gallagher 2005).

Fatal Medical Neglect – Fatal medical neglect may occur when parents deny their children access to needed medical care because of religious or cultural beliefs. They may instead opt for prayer,

laying on of hands, faith healing, or other techniques. Asser and Swan (1997) published a review of religion-motivated medical neglect in which they retrospectively identified 172 child and perinatal fatalities over a 20 year period. Child deaths were primarily from infections, diabetes, malignancies, congenital heart disease, abdominal surgical disorders, and dehydration. The authors determined that 140 of the 172 children had at least a 90 % chance of survival, and all but three of the children could have benefitted from medical treatment.

The American Academy of Pediatrics has strongly objected to religious treatment in lieu of standard medical care, stating that children, "have the right to appropriate medical evaluation when it is likely that a serious illness, injury, or other medical condition endangers their lives or threatens substantial harm or suffering. Under such circumstances, parents and other guardians have a responsibility to seek medical treatment, regardless of their religious beliefs" (AAP 1997). Federal laws in the United States regarding religious exemptions for medical care have changed several times over the past four decades. In 1974, the U.S. Department of Health, Education and Welfare required religious exemption laws for states receiving federal child abuse prevention and treatment (CAPTA) funding. While this requirement was removed in 1983, many states have opted to maintain their religious exemption laws (Sinal et al. 2008).

Fatal Malnutrition/Starvation – Failure to thrive and malnutrition may occur for a number of reasons, including lack of knowledge of nutritional needs or formula preparation, parental mental health or substance abuse, breastfeeding difficulties, medical problems causing difficulty feeding, increased caloric needs, and/or vomiting and diarrhea. Purposeful withholding of food is uncommon, but may occur as a form of punishment or parental rejection (Kellogg and Lukefar 2005). Given the nutritional and health care resources in developed countries, neglect is likely a contributor to all fatalities with malnutrition as the sole cause of death.

Children who die from starvation are most often infants and toddlers (Kellogg and Lukefar 2005; Knight and Collins 2005; Berkowitz 2001). Published cases provide caretaker histories of minor complaints, sudden onset of symptoms, and lack of recognition or acknowledgement of child's severe symptoms (Kellogg and Lukefar 2005; Knight and Collins 2005). Yet these children all had a lack of subcutaneous fat and signs of dehydration at presentation. Autopsy findings included skin tenting, prominent ribs, loss of adipose tissue and poor muscle tone (Knight and Collins 2005). Parents in several cases reported that the child had just recently eaten, though the children's stomachs were empty on autopsy. Lack of medical care beyond the newborn period was common (Kellogg and Lukefar 2005).

Determination of the cause of death will naturally rely on autopsy findings, but growth data may be helpful in supporting placement decisions for siblings and criminal court proceedings. Growth charts will typically show a cessation of weight gain before linear growth and head circumference growth stops (Berkowitz 2001). If prior growth parameters are available, it may be possible to estimate the length of time without adequate nutrition (Berkowitz 2001).

Prevention

Child abuse fatality prevention uses two general strategies: parent education and home visitation. Approaches to parent education (e.g. Parents As Teachers (PAT) and Healthy Families America) provide new parents with knowledge about parenting and child development with the intention that it will reduce the likelihood that a child will be abused in that family (for a review of parent education programs see the Packard Foundation *Future of Children* report, 1999). These programs are not specific for child fatality prevention and have mixed success in preventing non-fatal child abuse (Duggan et al. 2007; Donelan-McCall et al. 2009).

Thirty five years ago, Gray and colleagues (1979) identified children at risk of physical abuse and neglect by observing the parents' interaction with their infants prenatally and perinatally. The provision

of a lay home visitor to these families reduced the level and severity of physical abuse and neglect. These were not controlled studies, but indicated that providing stressed, at-risk parents someone to contact could potentially prevent abusive and neglectful situations. While not specifically shown to reduce childhood mortality, Olds' home visiting studies using public health nurses intervening with high-risk mothers pre- and post-natally have demonstrated significant reductions in rates of child abuse reports, subsequent alcohol abuse, criminal behavior and other childhood negative well-being outcomes in a variety of settings (Olds et al. 1997; Donelan-McCall et al. 2009).

More recent primary preventive strategies that show promise provide education to parents of newborns about AHT. Dias in 2005 published an effective strategy that includes providing all parents of newborns a pamphlet about AHT and crying, showing parents a video, and having them sign a "commitment statement" to warn any caregiver about the dangers of shaking babies (Dias et al. 2005). This relatively simple nursery intervention reduced the incidence of AHT in Western NY 61 % compared to historical and geographical controls. More recent studies have questioned the effectiveness of the video as an intervention (Keenan and Leventhal 2010).

The CFR process itself may lead to a reduction in child deaths, though these results are not specific for maltreatment-related fatalities. Work from Georgia (Luallen et al. 1998) and Arizona (Rimsza et al. 2002) have shown a reduction in unintentional deaths. While a decrease in fatal abuse has not been demonstrated, the same process of identifying and modifying risk factors may help. Alternatively, proper review and well functioning death investigation systems may initially increase the measured incidence due to improved classification.

Unfortunately, there is no single effective strategy to prevent fatal child abuse deaths. The low overall incidence of childhood abuse fatalities coupled with the high prevalence of risk factors for fatal child abuse leads to a low predictive value for any individual or combination of risk factors. Any intervention needs to reach a large number of individuals in order to prevent one death. It is likely that a variety of approaches are needed to prevent child fatalities. Increased provision of effective strategies such as education in the newborn period, new parent support via home visitation, and community involvement in assuring healthy families will be the only way to significantly reduce the rates of fatal child abuse.

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