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Underascertainment of Child Maltreatment Fatalities by Death Certificates, 1990–1998

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ABSTRACT. *Objective.* Child fatality review teams have emerged across the United States in the past decade to address the concern that systems of child protection, law enforcement, criminal justice, and medicine do not adequately assess the circumstances surrounding child fatality as a result of maltreatment.

Methods. We compared data collected by a multidisciplinary child fatality review team with vital records for all children who were aged birth to 16 years and died in Colorado between January 1, 1990, and December 1, 1998. Odds ratios and 95% confidence intervals for ascertainment by the death certificate were estimated using logistic regression.

Results. Only half of the children who died as a result of maltreatment had death certificates that were coded consistently with maltreatment. Black race and female gender were associated with higher ascertainment, whereas death in a rural county was associated with lower ascertainment. Deaths resulting from violent causes (eg, shaking, blunt force trauma, striking) were more likely to be ascertained than those that involved acts of omission (eg, neglect and abandonment, drowning, fire). The most common perpetrators of maltreatment were parents. However, maltreatment by an unrelated perpetrator was 8.71 times (95% confidence interval: 3.52–21.55) more likely to be ascertained than maltreatment by a parent.

Conclusions. The degree of underascertainment found in this study is of concern because most national estimates of child maltreatment fatality in the United States are derived from coding on death certificates. In addition, the patterns recognized in this study raise concern about systematic underascertainment that may affect children of specific sociodemographic groups. *Pediatrics* 2002;110(2). URL: <http://www.pediatrics.org/cgi/content/full/110/2/e18>; *child abuse, death certificates, vital statistics, mortality, infant mortality, data collection, public health, records, logistic models, statistical models, cause of death, child welfare, battered child syndrome, child advocacy, infanticide.*

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ABBREVIATIONS. CFRC, child fatality review committee; ICD, *International Classification of Diseases*; SES, socioeconomic status.

There has long been concern regarding the adequacy of death certificates in determining the magnitude of fatalities from child abuse and neglect. Previous studies have estimated that between 52% and 85% of maltreatment fatalities are misidentified as attributable to accidents, natural causes, or other unknown causes.^{1–4} In 1993, the Centers for Disease Control and Prevention concluded that death certificates were an uncertain source of data on child maltreatment fatalities and recommended modifying the system to make identification easier.³ However, these changes have not occurred. The inability of any one system of child protection, law enforcement, health, or criminal justice to recognize, track, and assess the circumstances of child maltreatment deaths has led to the development of interagency multidisciplinary child fatality review teams across the United States. The goal of this study was to use data collected by a statewide child fatality review committee (CFRC) as the “gold standard” in determining child maltreatment fatality and to compare its findings with data from vital records to determine the extent to which death certificates underestimated child maltreatment mortality and to examine whether sociodemographic characteristics of the child are associated with the ascertainment of maltreatment.

METHODS

Cases included all children who were aged birth to 16 years and died in Colorado between January 1, 1990, and December 1, 1998, and were determined by the CFRC to have died of maltreatment. The CFRC's definition of maltreatment includes any death of a child, perpetrated by a parent or caregiver, as a result of physical abuse, violence, shaking, battering, neglect, and negligence. This definition is consistent with that developed by the 1989 National Institute of Child Health and Human Development Conference of Standard Definitions for Childhood Injury Research⁵ and that used by other studies of maltreatment.^{1,3} It is inherently more difficult to identify maltreatment deaths that are attributable to neglect or negligence than those that are attributable to violence. CFRC includes these cases in their definition of maltreatment when it is determined that the caregiver placed the child in a situation of substantial risk of physical or emotional harm. The behavior can be intentional or unintentional and may consist of actions (eg, physical violence, forced submersion, smothering) or omissions (eg, starvation, failure to seek medical care, failure to use a car seat).

Since 1989, the CFRC has reviewed every death of any child under the age of 18 that occurs in Colorado. The CFRC consists of professionals from medicine, social services, coroner's offices, law

enforcement, criminal justice, mental health, and public health. The CFRC's mission is to investigate, recognize, and assess the circumstances surrounding all child fatalities in Colorado. A record is created in the CFRC database for every child who dies in Colorado. There are between 600 and 700 deaths per year in Colorado among children under the age of 18, and approximately 70% of these are coded as having a "natural" manner of death. Each of the natural manner cases is screened by 1 of 3 expert physicians (focusing on neonatal deaths, sudden infant death syndrome, and other natural deaths, respectively). If the expert physician suspects that the case may not be attributable entirely to natural causes, then the case is sent to the CFRC Clinical Subcommittee for further review. All deaths of accidental, undetermined, or homicidal manner are sent to the CFRC Clinical Subcommittee for review. The Clinical Subcommittee requests the following records for their review process: autopsy report, medical records, law enforcement report, district attorney report, motor vehicle accident report, and social services history. All deaths determined by the Clinical Subcommittee to have resulted from maltreatment, regardless of manner, are sent, along with the records requested and received, to the full CFRC for review. Approximately 5% of the total cases reviewed each year by CFRC are determined to be from maltreatment.

Each death is linked to the Colorado Child Welfare Services system and the Central Registry of Child Protection system to identify any social services contacts with the family. Variables from the review process entered into the database include cause of death as determined by CFRC, perpetrator, and history of social services involvement.

The CFRC evaluates the cause of death for each case reviewed and, in some cases, reclassifies them or places them into more specific categories. These categories include drowning, fall, fire, burns, hanging, choking, suffocation, medical neglect, suicide, motor vehicle crash, handgun, rifle, blunt weapon, hot liquid, starvation, shaking, dropping, striking, poisoning, choking, or exposure. For the purposes of this analysis, we grouped these categories loosely based the *International Classification of Diseases Version 10 (ICD-10)*, External Causes of Morbidity and Mortality, Assault Categories (X85-Y09) as a template.⁶

Perpetrator was classified according to the caregiver/parent who was most directly responsible for the action or omission that resulted in the child's death. Data on the perpetrator were obtained from law enforcement records, state and local social services abuse database, district attorney's report, and media coverage.

The Colorado Department of Public Health and Environment's

Vital Statistics Section provides the CFRC with an electronic death certificate file for every child and a linked electronic birth certificate file for those children born in Colorado.

We considered the following *International Classification of Diseases, Ninth Revision (ICD-9)*⁷ codes on the death certificate to be consistent with maltreatment: 1) "child maltreatment syndrome" (N995.5) and 2) "homicide and/or injury purposely inflicted by other persons" (E960-969), which includes "child battering" (E967).

The Colorado State Demographer's Office provided Colorado child population estimates for 1990 through 1998 based on interpolations between the 1990 and 2000 census estimates. In addition, they provided estimates from the 1990 census on percentage of children living under the federal poverty level by zip code.

We calculated the average yearly mortality rates per 100 000 Colorado population of residents and nonresidents, ages 0 to 16 years from 1990 to 1998. Confidence intervals were calculated using the Poisson distribution. The univariate analysis was performed on each demographic variable using a χ^2 distribution. We estimated odds ratios and 95% confidence intervals for ascertainment of child maltreatment by the death certificate using multiple logistic regression. To assess whether socioeconomic status (SES) of the child influenced ascertainment of maltreatment by the death certificate, we created a proxy measure for SES by determining the proportion of children living under the federal poverty level in the child's zip code of residence and grouped cases into tertiles on the basis of the distribution of the percentage of children living under the federal poverty level in all zip codes. All analyses were performed using SAS, version 8 (SAS Institute Inc, Cary, NC). The identity of study cases was protected by conducting the analyses on a data set that was stripped of all identifiers, and the study was approved by the Colorado Multiple Institutional Review Board.

RESULTS

There were 295 child deaths attributable to maltreatment, as determined by the CFRC during the study period. The demographic characteristics of the child maltreatment deaths reported by death certificates and by the CFRC are shown in Table 1. The highest maltreatment mortality rates occurred among children younger than 1 year and among children of black, non-Hispanic ethnicity. The percentage of maltreatment cases ascertained by the

TABLE 1. Demographic Characteristics of the 295 Child Maltreatment Fatality Study Cases, Ages 0 to 16, Colorado, 1990 to 1998

Demographic Characteristic of Child	Maltreatment Deaths (N [%])		Average Yearly Maltreatment Death Rate per 100 000* (95% CI)		Average Yearly Colorado Population	% Ascertained by the Death Certificate
	By Death Certificates	By CFRC	By Death Certificates	By CFRC		
Gender						
Male	74 (50)	168 (57)	1.76 (1.38, 2.21)	4.00 (3.42, 4.65)	4 198 597	44
Female	73 (50)	127 (43)	1.83 (1.44, 2.30)	3.18 (2.66, 3.79)	3 985 926	57
Age (y)						
<1	59 (40)	120 (40)	11.72 (8.92, 15.1)	23.83 (19.75, 28.49)	503 614	49
1-4	60 (41)	109 (36)	3.06 (2.33, 3.93)	5.55 (4.56, 6.70)	1 963 742	55
5-9	13 (9)	31 (10)	0.52 (0.28, 0.90)	1.25 (0.85, 1.78)	2 478 981	42
10-14	11 (7)	25 (8)	0.47 (0.23, 0.84)	1.07 (0.69, 1.57)	2 344 801	44
15-16	4 (3)	10 (3)	0.45 (0.12, 1.15)	1.12 (0.54, 2.06)	893 386	40
Race/ethnicity						
White non-Hispanic	72 (49)	155 (53)	1.23 (0.97, 1.56)	2.66 (2.26, 3.12)	5 817 948	46
All Hispanic	38 (26)	76 (26)	2.38 (1.69, 3.28)	4.78 (3.77, 5.98)	1 590 360	50
Black non-Hispanic	35 (24)	55 (18)	8.19 (5.70, 11.39)	12.87 (9.69, 16.75)	427 441	64
Other†	2 (1)	8 (3)	0.94 (0.11, 3.40)	3.76 (1.62, 7.41)	212 647	25
Place of death						
Denver metro	97 (66)	185 (62)	2.15 (1.75, 2.63)	4.11 (3.54, 4.74)	4 505 428	52
Other metro	43 (29)	80 (27)	1.80 (1.30, 2.43)	3.35 (2.66, 4.17)	2 388 062	54
Rural	7 (5)	30 (10)	0.54 (0.21, 1.12)	2.33 (1.57, 3.33)	1 286 810	23
Total	147 (100)	295 (100)	1.79 (1.52, 2.11)	3.60 (3.20, 4.04)	8 184 524	50

CI indicates confidence interval.

* The denominator for rate is the Colorado population, ages 0-16, 1990-1998.

† Other ethnicity includes Native American, Chinese, Japanese, Hawaiian, Filipino, other Asian, or Pacific Islanders.

death certificate was higher for girls than for boys, for younger-aged children than for those aged 15 to 16, and for black non-Hispanic children than for other races/ethnicities. Ascertainment was lowest for children who died in a rural county.

The causes of death are shown in Table 2. The most common causes of maltreatment deaths were bodily force; hanging, strangulation, and suffocation; drowning and submersion; and neglect or abandonment. Cause of death was highly associated with ascertainment. More than 70% of the maltreatment deaths attributable to traumatic causes (blunt objects, sharp objects, bodily force, and firearms) were identified by the death certificate. However, <20% of the children who died of less obviously violent causes (motor vehicle crashes; other maltreatment, neglect, or abandonment; negligence; drowning or submersion; and smoke, fire, flames, or hot objects) were identified by the death certificate as maltreatment contributing to the death.

Thirty (10%) of 295 deaths occurred in rural areas (Table 3). A social services history was identified for 102 cases (35%). Parents were most commonly the perpetrators, accounting for 152 (52%) of all child maltreatment deaths. The remaining perpetrators included other relatives (12%), care providers (6%), and other unrelated individuals (17%). The CFRC was unable to determine the perpetrator in 37 cases (13%).

Table 3 shows the results of the univariate and multivariate analysis. In the univariate analysis, ascertainment was more likely for child maltreatment victims of female gender, black race, and unrelated perpetrator and less likely for rural place of death. The multivariate model included gender, age, race/ethnicity, place of death, social services history with the family, perpetrator, and SES of the child. After other covariates were controlled for, female gender and unrelated perpetrator remained significant predictors of ascertainment. The association with black

race and the inverse association with rural place of death persisted, but effect estimates were imprecise. Social services involvement with the family had no effect on the likelihood of ascertainment. These analyses showed no significant association between SES and ascertainment.

DISCUSSION

Our study found that half of all child maltreatment fatalities in Colorado from 1990 to 1998 were not ascertained by the death certificate. This proportion is consistent with that found in other studies of underreporting.¹⁻⁴ Our study found that ascertainment of maltreatment by the death certificate varied by gender of the child and by perpetrator of the maltreatment. Our results were also suggestive of variations in ascertainment by the race/ethnicity of the child and whether the child died in a rural or an urban county. These discrepancies in ascertainment raise concerns that professionals who investigate child deaths may be more likely to conclude that maltreatment was a contributing factor in the cause of death for children with certain sociodemographic characteristics.

The more violent types of deaths, such as death by blunt or sharp object, bodily force, or firearms, were most likely to be ascertained. Deaths involving methods that may be easier to conceal or to claim to have been accidental had very low ascertainment, if any. This result reflects biases in the death certificate coding system, as there is only limited coding available for deaths by omission (eg, failing to protect a young child from a pedestrian death) compared with deaths by commission (eg, homicide by blunt object).

The maltreatment was more likely to be ascertained when the perpetrator was unrelated to the child than when the perpetrator was a parent. This result may be attributable to differences in the likelihood of any witnesses to the death or to a bias in the system whereby law enforcement personnel are hes-

TABLE 2. Cause of Death of the 295 Total Child Maltreatment Fatalities as Determined by the Colorado CFRC and on Death Records, 1990 to 1998

Cause of Death	Cause of Death by CFRC		Ascertained as Maltreatment by Death Certificate			
	N	(%)	Yes		No	
			N	(%)	N	(%)
Bodily force (includes shaking, striking)	93	(31)	77	(83)	16	(17)
Hanging, strangulation, or suffocation (includes smothering, overlying, mechanical and inhalation suffocation)	42	(14)	15	(36)	27	(64)
Drowning or submersion	42	(14)	4	(10)	38	(90)
Neglect or abandonment (includes starvation, exposure, and medical neglect)	31	(11)	2	(7)	29	(93)
Firearm (includes all assaults or injuries by firearms)	19	(7)	15	(80)	4	(20)
Blunt object	16	(6)	16	(100)	0	(0)
Smoke, fire, flames, or hot objects (includes burns, fire, or smoke inhalation)	15	(5)	3	(20)	12	(80)
Drugs (poisoning)	13	(4)	8	(62)	5	(38)
Motor vehicle	10	(4)	0	(0)	10	(100)
Other maltreatment (includes mental cruelty, sexual abuse, and torture; excludes neglect and abandonment)	5	(2)	0	(0)	5	(100)
Sharp object	4	(1)	4	(100)	0	(0)
Dropping from high place	4	(1)	3	(75)	1	(25)
Total	295	(100)	147	(49)	152	(51)

TABLE 3. Likelihood of a Child Maltreatment Fatality Being Ascertained by the Death Certificate in Colorado, 1990 to 1998

Demographic Characteristic	Ascertainment by Death Certificate				Odds Ratio for Likelihood of Ascertainment of Maltreatment by Death Certificate (95% CI)			
	Yes		No		Univariate		Multivariate*	
	N	(%)	N	(%)				
Gender								
Male	74	(44)	94	(56)	1.00	Reference	1.00	Reference
Female	73	(57)	54	(43)	1.72	(1.08, 2.73)	1.90	(1.13, 3.18)
Age								
Birth to 1 y	59	(49)	61	(51)	1.00	Reference	1.00	Reference
1-4	60	(55)	49	(45)	1.27	(0.75, 2.13)	1.02	(0.57, 1.84)
5-9	13	(42)	18	(58)	0.75	(0.34, 1.66)	0.77	(0.32, 1.87)
10-14	11	(44)	14	(56)	0.81	(0.34, 1.93)	0.62	(0.22, 1.72)
15-16	4	(40)	6	(60)	0.69	(0.19, 2.57)	0.54	(0.12, 2.41)
Race/ethnicity								
White	72	(46)	83	(54)	1.00	Reference	1.00	Reference
Hispanic	38	(50)	38	(50)	1.17	(0.67, 2.02)	1.17	(0.64, 2.14)
Black	35	(64)	20	(36)	2.04	(1.08, 3.85)	1.86	(0.93, 3.72)
Other	2	(25)	6	(75)	0.39	(0.08, 2.00)	0.59	(0.11, 3.19)
Place of death								
Denver metro	97	(52)	88	(48)	1.00	Reference	1.00	Reference
Other metro	43	(54)	37	(46)	1.05	(0.62, 1.79)	0.94	(0.52, 1.70)
Rural	7	(23)	23	(77)	0.28	(0.11, 0.68)	0.41	(0.16, 1.05)
Social services history								
Yes	50	(49)	52	(51)	1.00	Reference	1.00	Reference
No	97	(50)	96	(50)	1.05	(0.65, 1.70)	0.91	(0.53, 1.56)
Perpetrator								
Parents	65	(43)	87	(57)	1.00	Reference	1.00	Reference
Other relatives (including step-parents)	17	(47)	19	(53)	1.20	(0.58, 2.48)	1.37	(0.62, 3.07)
Other unrelated (including boyfriend)	44	(86)	7	(14)	8.41	(3.56, 19.88)	8.71	(3.52, 21.55)
Care provider†	8	(42)	11	(58)	0.97	(0.37, 2.56)	0.94	(0.34, 2.64)
Unspecified	13	(35)	24	(65)	0.73	(0.34, 1.53)	0.75	(0.34, 1.65)
SES								
Low	45	(48)	48	(52)	1.00	Reference	1.00	Reference
Medium	46	(50)	45	(50)	1.11	(0.63, 1.98)	1.19	(0.61, 2.31)
High	54	(51)	52	(49)	1.11	(0.64, 1.93)	1.52	(0.77, 3.00)
Total	147	(50)	148	(50)				

CI indicates confidence interval.

* Place of death indicates the county in which the child died. Social services history refers to any previous history on the family. SES is based on the % of children living under the federal poverty level in the child's zip code of residence at the time of death, divided into tertiles based on the distribution of the cases.

† Includes licensed and unlicensed care providers as well as care providers in a medical or institutional setting.

itant to consider parents as potential abusers or may reflect differences in the method causing death.

In the multivariate analysis, children who died of maltreatment in rural counties (population <50 000) in Colorado were 60% less likely to be ascertained by the death certificate compared with children who died in the Denver metropolitan counties (population >1 million). Although small numbers (30 rural cases) limited our power to detect a statistical significance, the result is highly suggestive of a discrepancy in the way a child maltreatment death is investigated and recognized in rural counties as opposed to urban counties in Colorado. Professionals in rural counties may need additional support, eg, training, resources. Colorado uses a coroner system to investigate and determine cause of death for any death that occurs in a sudden or an unexpected manner (which would include any death in which maltreatment was involved). The physician who cares for the child at the time of death is responsible for reporting the death to the coroner when maltreatment is suspected. A discrepancy in the ascertainment of child maltreatment deaths in rural counties may reflect a failure of physicians to recognize signs of child mal-

treatment and refer the case to the coroner. Another possible explanation is that a higher proportion of maltreatment deaths that occur in rural counties are attributable to causes that have lower ascertainment by nature (eg, neglect, negligence, acts of omission).

We expected that children with a documented history of abuse or neglect would be more likely to be ascertained, but no association was observed with previous social services records pertaining to the family. An area of future investigation would be to determine whether social services records are being made available and used by those who investigate the cause of death.

Other studies of underascertainment have used a single source of data,⁸ did not review all child deaths for the possibility of maltreatment,^{1-4,8-10} or used a definition of maltreatment that considered only physical abuse.⁴ Our study makes use of comprehensive data collected by a formal child fatality review process to assess underascertainment by death certificates. The Colorado CFRC uses numerous sources of data and professional expertise from various fields that serve and protect children. The data collected by the CFRC supplements vital statistics data in Colo-

rado and allows for evaluation of the impact of maltreatment fatality in our state. Estimates that rely on data from vital statistics,^{11,12} child protection services agencies,¹³ or law enforcement alone would seriously underestimate the number of child maltreatment fatalities.

Other ascertainment studies that used a definition of maltreatment similar to ours found rates of underascertainment on death certificates consistent with those found in our study. Ewigman et al³ reviewed 384 children deaths in Missouri and found that fewer than half (48%) were coded consistently with maltreatment on the death certificate. Herman-Giddens et al⁴ compared medical examiner data with death certificates in North Carolina and found that 59% of the battering or abuse deaths were not coded as such.

There is not a reliable source of national data on child abuse and neglect fatalities. The National Child Abuse and Neglect Reporting System¹³ remains one of the only sources of national child maltreatment data. However, the National Child Abuse and Neglect Reporting System may be incomplete because most states include only child deaths from families known to child protection agencies. State child protection agencies vary widely in their definitions of maltreatment, making aggregate estimates unreliable, and it is estimated that more than half of the children who die from maltreatment are from families that were never investigated by such agencies.² The Centers for Disease Control and Prevention produce a national estimate for child maltreatment based on death certificate data.^{11,12} The results of this study demonstrate the extent to which death certificate data underascertain maltreatment fatality. Problems with using death certificate data to estimate child maltreatment deaths stem in part from limitations in the *ICD-9* and *ICD-10* coding system. Only 2 codes in the *ICD-9* coding system are specific for child maltreatment, and they are not applied consistently: 1) "nature of injury: child maltreatment syndrome" (N995.5), which includes abuse, emotional/psychological abuse, nutritional neglect, sexual abuse, physical abuse, shaken infant syndrome, and other child abuse and neglect, and 2) "external cause of death: child battering" (E967). In our study, of the 295 maltreatment deaths, only 16 (5%) were coded with N995.5 and 42 (14%) were coded with E967. The new *ICD* coding version, *ICD-10*, which has been in use since January 1999, does not have any specific changes in the requirements for applying the code E967 (Y07 in *ICD-10*). The other death certificate codes that are used to assess child maltreatment fatality are *ICD-9* "external cause of death: homicide" (E960–969) and *ICD-10* "assault" (X85–Y09). The concern with using these codes is that they are not specific for child maltreatment and include homicides that would not be considered maltreatment, eg, gang violence between teens.

The reasons for underascertainment of maltreatment deaths have been described in detail in other studies.^{1–4,14} Many child maltreatment deaths are easy to conceal: there are few if any witnesses, parents can give false or misleading histories, and investigators often do not want to believe that a griev-

ing parent killed a child. The type of evidence that needs to be collected in a child death investigation differs from that of an adult death investigation, but law enforcement officials may not be adequately trained, resulting in loss of key evidence. For example, homicide investigation officers often investigate child abuse deaths; however, they do not have the expertise to evaluate properly the circumstances of a child abuse death. Data collection and reporting among social services, law enforcement, and health agencies is not standardized, uniform, or coordinated, and cooperation between agencies is often poor as a result of jurisdictional or other issues, resulting in failure to communicate findings and lack of access to other professionals' records. Finally, there is no universally accepted definition of neglect.

The issue of what constitutes neglect and negligence generates considerable disagreement among professionals. Because of the varying definitions and debate about what constitutes neglect, other studies have chosen a definition of maltreatment that includes only death as a result of physical abuse or violence.⁴ Our study and several others^{1,3} have used the National Institute of Child Health and Human Development definition⁵ of maltreatment, which includes deaths as a result of neglect and negligence. We believed that it was important for our results to represent the spectrum of maltreatment, because although the act of neglect may not be as overtly malicious as an act of physical abuse, the result may be just as deadly. There is no doubt that excluding neglect and negligence makes for a clearer maltreatment definition. However, by consistently applying an operationalized definition of maltreatment during case review, neglect and negligence deaths need not be ignored. The importance of child fatality review teams to assess adequately maltreatment as a result of neglect and negligence cannot be understated, especially given that the current primary source of data on child maltreatment fatality (vital statistics) captures only homicide and physical abuse. By identifying and examining such cases, these multidisciplinary teams have a unique opportunity to suggest effective prevention strategies and approaches to community-level interventions. Such interventions are likely to be different for neglect than for physical abuse.

The major limitation of our study is that the quality of data collected through the Colorado CFRC's state-level review process is contingent on cooperation and support from the local levels. Since the committee's inception in 1989, it has been neither mandated nor funded to conduct child death review and has relied on local professionals to provide their records and knowledge of the cases voluntarily. The committee's capacity to assess the circumstances surrounding the death is dependent on this voluntary cooperation and support. Usually, the circumstances surrounding a child's death can be obtained from several sources, eg, law enforcement report, post-death social services investigation, coroner's report, newspaper articles, so if one agency refuses to release information, maltreatment often can be ascertained from another source. However, there are is-

sues that the Colorado CFRC cannot consistently assess, eg, charges raised against the perpetrator, because they rely solely on the coroner's report or law enforcement report. In addition, when the committee suspects maltreatment but is unable to verify it from records, they indicate that maltreatment is unknown. We did not include the unknown maltreatment cases in this study, but they do represent a population of potential maltreatment deaths.

A second limitation is the difficulty of designating a perpetrator. We classified perpetrator according to the caregiver or parent who was primarily responsible for the action or omission that resulted in the child's death. However, there are likely to be cases in which both parents are perpetrators, especially when applying the criteria of the National Institute of Child Health and Human Development definition of maltreatment, which includes neglect and negligence. For example, the father physically abuses the child and the mother is a passive participant. Perpetrator data are useful for prevention strategies, but it is rarely clear-cut, and for this reason we chose to combine mother and father in our univariate and multivariate analysis.

Another limitation in this study is the lack of precision of some of our estimates because of small numbers. For example, there were only 55 children of black race/ethnicity and only 30 children who died in a rural county. Our univariate results indicated significant discrepancies in ascertainment by race and rural/urban county of death; however, we did not have the power to detect a significant difference in our multivariate analysis. The CFRC database does not collect specific measures of SES; hence, we created a proxy using death certificates and census data. The proxy generalized about an individual child on the basis of a geographic area of residence may therefore have misclassified the SES of some children.

CFRCs have developed in many states during the past decade to address the inadequacies of child death data and the systems issues that allow child maltreatment deaths to go unrecognized. Communication between different state CFRCs has prompted a desire to standardize and evaluate the process and to determine how best to use the data. For the purposes of the this study, we considered the data collected by the Colorado CFRC to be the gold standard in our state for assessing child maltreatment fatality. However, counties in Colorado vary widely in the training and education provided to professionals who investigate and assess child fatalities. Some states, including Colorado, have conducted child death investigation training in an attempt to educate professionals about the indicators of a potential child maltreatment death and how to conduct an effective child death scene investigation, increase awareness about child maltreatment, and create a more standardized child death investigation process.

Half of child maltreatment fatalities are not ascertained by vital statistics. This analysis suggests variations in ascertainment by gender, perpetrator of the maltreatment and possibly population of the county

of death, and race/ethnicity of the child. Each state child death review is structured differently. Some are mandated and funded, whereas others are neither. A national data registry would allow for national analysis and monitoring of patterns of child maltreatment death. For this to be possible, standardized definitions and data elements to be collected in each state must be developed. Such a system could help to disclose better to social services, law enforcement, and the general public the true causes of child deaths and lead to better approaches to prevention of deaths of children as a result of maltreatment and neglect.

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