

# Infant Deaths From Medical Causes After a Maltreatment Report

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abstract

**OBJECTIVES:** To examine whether postneonatal infants reported for maltreatment face a heightened risk of deaths attributable to medical causes.

**METHODS:** Birth and death records for all children born in California between 2010 and 2016 ( $N = 3\,455\,985$ ) were linked to administrative child protection system records. Infants were prospectively followed from birth through death or age 1 year. Reports of maltreatment and foster care placement episodes were modeled as time-varying covariates; sociodemographic characteristics at birth were modeled as baseline covariates. Stratified, multivariable competing risk models were used to estimate the adjusted relative hazard of postneonatal infant death attributed to a medical cause ( $n = 1051$ ).

**RESULTS:** After adjusting for baseline risk factors, and compared with infants never reported for maltreatment, the medical-related mortality risk was almost twice as great among infants reported once for maltreatment (hazard ratio: 1.77; 95% confidence interval: 1.36–2.30) and 3 times greater if there was >1 maltreatment report (hazard ratio: 3.27; 95% confidence interval: 2.48, 4.30). Among infants reported for maltreatment, periods of foster care placement reduced the risk of death by roughly half.

**CONCLUSION:** Infants reported for alleged maltreatment had a higher risk of death from medical causes, with foster care emerging as protective. Targeted support services for parents and improved communication between the child protection system and the pediatric health care community is needed, especially when infants who may be medically fragile remain at home after an allegation of abuse or neglect.

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**WHAT'S KNOWN ON THIS SUBJECT:** A previous maltreatment report is a predictor of injury deaths, sudden unexplained infant deaths, and poor physical health in infants. Families with child maltreatment reports have multiple stressors, which may also increase risk of deaths due to medical causes.

**WHAT THIS STUDY ADDS:** Infants reported for abuse or neglect had a risk of medical-related death almost twice as high as infants never reported. Periods of foster care placement were protective, raising questions regarding the adequacy of supports for infants remaining at home.

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In 2018, the child protection system (CPS) received 4.3 million abuse and neglect reports involving 7.8 million children in the United States.<sup>1</sup> Lifetime estimates suggest that upward of one-quarter to one-third of American children experience an investigation for alleged maltreatment between birth and age 18 years,<sup>2,3</sup> and 43% of those children experience additional reports.<sup>4</sup> Given the sheer number of children involved with CPS, significant attention has been devoted to documenting sociodemographic and other risk factors that uniquely characterize children who are reported for alleged maltreatment. Not surprisingly, when the profile of children reported to CPS is compared to that of the general population, it becomes clear that these children often face complex individual,<sup>5-7</sup> family,<sup>8-10</sup> and community<sup>11-13</sup> risk factors operating in both an additive and interacting fashion.

Far less is known, however, about how the nature and degree of the intervention response to a report of maltreatment affects children's outcomes.<sup>14</sup> For example, research indicates that children placed in foster care have higher rates of chronic medical disorders<sup>15</sup> and that children in foster care have a poorer health status than low-income children generally.<sup>16</sup> Studies have also shown that health and other medical risk factors are especially prominent among young children placed in foster care compared with their older counterparts.<sup>17</sup> Current evidence further suggests that many children investigated for maltreatment have serious medical problems<sup>18</sup> and that young children who are investigated for maltreatment and remain at home have similar physical health issues as children in foster care.<sup>19,20</sup> But

we have only a limited understanding of the extent to which CPS decisions to place children in foster care versus leaving them at home may affect their near-term health and safety or their longer-term outcomes.<sup>21,22</sup>

Children with a history of reported maltreatment have been documented to have an elevated risk of injury and noninjury deaths<sup>23-25</sup> and sudden unexplained infant deaths.<sup>26</sup> Although researchers have long proposed that parental neglect contributes to childhood morbidity and mortality from disease and illness,<sup>12,27,28</sup> less is known about the risk of medically explained deaths (noninjury deaths with a disease or medical condition) after CPS involvement. An investigation of childhood deaths in Arizona found that deaths from medical conditions were the second most common cause of preventable deaths, with some of these deaths arising from medical neglect (eg, delays in seeking medical care).<sup>29</sup> A child death review in England and Wales found that almost half of deaths attributed to medical conditions and causes among young infants were preventable and that parenting and environmental factors were prevalent in these preventable deaths.<sup>30</sup> Barth and Blackwell<sup>31</sup> studied child death rates in California's foster care population and documented that compared with the general population, foster children had higher mortality rates from diseases but not congenital abnormalities. Yet because there are limited data for studying what amounts to two low base-rate events, researchers have been unable to examine the relationship between CPS involvement and risk of medical-cause death prospectively.

Families with children reported to CPS often have risk factors<sup>8-10</sup> that may make providing adequate care

to their children and meeting children's health care needs more difficult, especially during infancy. In the current study, we investigated whether reports to CPS and system decisions to place a child in foster care after a report were associated with risk of death from medical causes during infancy. Specifically, using historical birth records, we constructed a population-based cohort of children born in California between 2010 and 2016. Through linkages to both CPS data and vital death records, we prospectively followed these children until age 1 year to estimate the extent to which reports of abuse or neglect and foster care placement episodes were associated with risk of a postneonatal death from a medical cause.

## METHODS

### Data

#### *Record Sources*

Birth, CPS, and death records from California were linked to create the data set used for analysis. Vital birth and death records were obtained from the California Department of Public Health. Administrative CPS and foster care placement records were available through a data-sharing agreement with the California Department of Social Services. Birth records were used to identify the population and to control for risk factors present at birth and associated with both CPS involvement and fatality risk; CPS records were used to examine the timing and response to alleged maltreatment during infancy; and information concerning deaths classified as due to medical causes was provided in death records. Linkages and analysis were approved by both state and university committees for the protection of human subjects.

## Record Linkages

Records were linked by using open-source probabilistic linkage software (ChoiceMaker, LLC, Princeton, NJ). Match pairs with a probability score in excess of 0.80 were coded as a true match, or a pair of records containing data for the same person in different data sets. The overall record linkage from which data were drawn for this analysis involved all births occurring between 1999 and 2017. These births were linked to CPS records reflecting all children reported for maltreatment between 1999 and 2017 and death records capturing all recorded deaths between 1999 and 2017. To construct our study cohort, we identified in the birth record data all children born between 2010 and 2016 ( $n = 3\,464\,535$ ). Using encrypted linkage keys generated during the linkage process, we then connected births in our study cohort to CPS records for the 1-year period after a child's birth ( $n = 183\,436$ ). Finally, we used linkage keys to incorporate death information for our study cohort. Death records were limited to deaths in which the date of death indicated a fatality within 365 days of a child's birth ( $n = 4027$ ). We excluded neonatal deaths ( $n = 9601$ ). Previous studies involving these data sources and data linkage procedures provide additional details on these data sources.<sup>32–34</sup>

## Variables

### Dependent Variable

Our dependent variable was defined as time to death from a medical cause, modeled as days from birth to death. Deaths from medical causes were identified from the death record on the basis of the medical cause-of-death codes ( $n = 1051$ ) (Table 1) designated in the *International Classification of Diseases, 10th Revision* (ICD-10). All mechanisms of deaths from a medical cause were included;

children with deaths due to nonmedical causes were censored on the date of death. Children who died during the neonatal period ( $\leq 28$  days after birth) were excluded from analyses ( $n = 9601$ ) given the typically congenital and perinatal nature of those deaths and the limited window for prevention (93% of deaths during that period were coded as due to congenital abnormalities).

### Independent Variable

Specific allegations of maltreatment and placement episodes in foster care were coded as time-varying covariates on the basis of event dates recorded in the administrative CPS records. This allowed us to dynamically model children's movement between risk groups or risk sets. Children in the overall study cohort (ie, children born between 2010 and 2016) entered the reported risk set beginning on the date of a first nonfatal allegation of abuse or neglect received by CPS. If additional maltreatment reports were received during infancy, they were coded on the basis of report dates. We also modeled changes in a child's risk of fatality during periods in which the child was placed in foster care. Specifically, on entry to foster care (ie, episode start date), the child transitioned from the reported risk set into a foster care placement risk set. If a child's foster care placement episode ended, they returned to their last report risk profile based on the number of previous reports and their earlier categorization. The child would move back into the foster care risk set if another out-of-home placement episode began. Through this coding, we dynamically modeled medical fatality risk associated with the time infants were at home (after a report of maltreatment) versus in foster care (also after a report of maltreatment). Observations were censored if there was no death by

the child's first birthday. All reports of alleged maltreatment were included, regardless of CPS decisions to investigate or substantiate.

### Covariates

To control for differences in child and family risk factors associated with CPS involvement and medical deaths, we adjusted for sociodemographic fields universally measured at the time of birth: child sex (male or female), maternal race and ethnicity (white, Black, US-born Hispanic, foreign-born Hispanic, and Asian/Pacific Islander), maternal age in years ( $<20$ , 20–24, 25–29, and 30+), prenatal care (first trimester and late or no care or missing), birth payment method (public insurance and private insurance), paternity (missing or established), and a combined indicator of birth vulnerability based on a low birth weight ( $<2500$  g) or preterm birth ( $<37$  weeks) (yes or no). In California, mothers not covered by any health insurance at the time of birth are retroactively enrolled in the state's Medicaid (ie, public health insurance) program, although this would not affect a mother's access to health care prenatally.

### Analysis

We computed descriptive statistics for the full population of children born between 2010 and 2016 who died of a medical-cause death during the postneonatal period of infancy. For our indicators of CPS involvement (ie, reported and placed in foster care) and for each birth record covariate, we ran a  $\chi^2$  test to assess whether the population of children who had died differed significantly from those who did not die. We then fit multivariable competing risk models.<sup>35</sup> We started by fitting a crude model with only our measures of CPS involvement and then incorporated birth record covariates into an adjusted model to address

**TABLE 1** Count of Deaths Classified as Medical Causes by ICD-10 Codes

Chapter	Code Range	Description	Death Count
1	A00-B99	Certain infectious and parasitic diseases	203
2	C00-D48	Neoplasms	61
3	D50-D90	Diseases of the blood	33
4	E00-E89	Endocrine, nutritional and metabolic diseases	67
5	F00-F99	Mental, behavioral and neurodevelopmental disorders	–
6	G00-G99	Diseases of the nervous system	144
7	H60-H59	Diseases of the eye and adnexa	–
8	H60-H95	Diseases of the ear and mastoid process	–
9	I00-I99	Diseases of the circulatory system	188
10	J00-J99	Diseases of the respiratory system	271
11	K00-K93	Diseases of the digestive system	59
12	L00-L99	Diseases of the skin and subcutaneous tissue	–
13	M00-M99	Diseases of the musculoskeletal system and connective tissue	–
14	N00-N99	Diseases of the genitourinary system	17

ICD-10 chapters with death counts of <11 are denoted as “–” to meet deidentification reporting requirements specified by California’s Health and Human Services Agency.

differences in risk. Estimates are reported as hazard ratios (HRs) with corresponding 95% confidence intervals (CIs). The proportional hazard assumption was evaluated both graphically and on the basis of Schoenfeld residuals. A significant relationship between birth vulnerability and hazard of death was found ( $\chi^2 = 52.7$ ;  $P < .05$ ). The adjusted model was then re-estimated with stratification by birth vulnerability status. The proportional hazard assumption held for the stratified adjusted model. All analyses were conducted by using the Stata statistical package version 16.1 (Stata Corp, College Station, TX).

## RESULTS

As shown in Table 2, among children born in California between 2010 and 2016, the postneonatal infant death rate due to medical causes was roughly 3.0 per 10 000. Among infants with a report of maltreatment, the rate of medical death was 13.1 per 10 000, or roughly 4 times the rate in the population overall. Infants who spent any time in foster care had a cumulative infant death rate from medical causes of 3.1 per 10 000. The average age (in months) of a first report was 4.2 (SD: 3.91) overall but 3.1 (SD: 2.94) among

children who died of a medical cause ( $t = 4.32$ ;  $P < .05$ ). Among infants with a medical-cause fatality, the average time from first report to death was 2.1 months (SD: 2.66).

Approximately 5% (0.053) of children in our study cohort were reported to CPS for maltreatment concerns during infancy (Table 2). Among those who died postneonatally from a death due to a medical cause, nearly one-quarter (0.229) had been reported to CPS for maltreatment, a notably larger proportion than children who did not die of a medical cause during infancy ( $P < .05$ ). Among children who died of medical fatalities, there was a higher proportion of male patients; Black children died of medical causes at a rate more than twice their proportion of the population. Younger maternal age, late prenatal care, public insurance, presence of a birth vulnerability, and missing paternity were all associated with heightened risk of a medical-cause fatality. There were no statistically significant differences in the proportion of children placed in foster care among children who died of a medical cause versus those who did not die.

In Table 3, we model a child’s crude risk of a medical fatality on the basis

of their reporting and foster care placement status, with additional estimates produced inclusive of adjustments for sociodemographic covariates observed at birth. Because minor differences in magnitude were observed between the crude and adjusted models, we focused our discussion on the final adjusted estimates. Infants with a history of reported maltreatment had a significantly heightened risk of death compared with children never reported (HR: 1.77; 95% CI: 1.36–2.30). The hazard of medical death increased among infants with  $\geq 2$  reports during the first year (HR: 3.27; 95% CI: 2.48–4.30). Among infants reported for maltreatment, periods of foster care placements emerged as protective. When in foster care, the rate of death was roughly 50% lower (HR: 0.43; 95% CI: 0.24–0.76). See Figure 1 for illustration of the cumulative hazard rates of postneonatal medical-cause deaths during infancy stratified by no maltreatment report, 1 or more maltreatment reports, and foster care placement.

## DISCUSSION

In this population-based prospective study, we documented that infants with a history of reported maltreatment had significantly greater rates of death due to

**TABLE 2** Descriptive Characteristics of Children Born in California Between 2010 and 2016 and Dying Postneonatally During Infancy Due to Medical Causes

	No Medical Fatality (N = 3 454 934)		Medical Fatalities (N = 1051)		$\chi^2$ Test P value
	N	Proportion	N	Proportion	
Reported for maltreatment	183 195	0.053	241	0.229	<.05
Placed in foster care	47 922	0.014	15	0.014	.911
Child sex					
Male	1 769 305	0.512	603	0.574	<.05
Female	1 685 629	0.488	448	0.426	<.05
Maternal race and/or ethnicity					
White	991 611	0.287	268	0.255	<.05
Black	195 829	0.057	112	0.107	<.05
US-born Hispanic	952 601	0.276	301	0.286	<.05
Foreign-born Hispanic	806 592	0.234	223	0.212	<.05
Asian/Pacific Islander	508 301	0.147	147	0.140	<.05
Maternal age, y					
<20	218 088	0.063	88	0.084	<.05
20–24	829 094	0.240	300	0.285	<.05
25–29	1 873 013	0.542	496	0.472	<.05
30+	532 943	0.154	167	0.159	<.05
Prenatal care					
First trimester	2 836 552	0.821	835	0.795	<.05
Late and/or missing care	618 382	0.179	216	0.206	<.05
Birth payment method					
Private	1 778 867	0.515	444	0.423	<.05
Public	1 676 067	0.485	607	0.578	<.05
Birth vulnerability					
None	3 095 241	0.896	504	0.480	<.05
Present	359 693	0.104	547	0.520	<.05
Paternity					
Established	3 212 430	0.930	924	0.879	<.05
Missing	242 504	0.070	127	0.121	<.05

$\chi^2$  tests were used to compare the characteristics and child protection involvement of infants who experienced a death because of medical causes versus those children in the study cohort who did not. The cohort included 2976 infants with censored data due to nonmedical death. Birth vulnerabilities includes low birth weight (<2500 g) or preterm birth (<37 wk).

medical causes than those who had never been reported. Our findings also reinforce that as more reports were received, the associated risk increased. Importantly, periods during which infants were placed in foster care were associated with significantly reduced rates of deaths due to medical causes, highlighting the preventable nature of many medical-cause deaths and raising questions regarding missed opportunities to ensure health and other preventive services for infants who remain at home. We discuss these findings in greater detail in the following sections.

First, data from the current study document a heightened risk of medical-cause fatalities among

infants reported to CPS. We also found that each additional report of maltreatment during infancy was associated with a heightened risk of death due to medical causes. These findings align with previous fatality studies in which researchers have concluded that maltreatment reports serve as an important signal of child risk,<sup>23</sup> including risk of death,<sup>23,26</sup> an established and largely objective indicator. Yet most previous studies examining CPS reports and death have focused on injury fatalities, a more direct and apparent manifestation of abuse or neglect.<sup>36</sup> No published research to date has used population-based data and a prospective analytic design to study the risk of medical fatalities after allegations of abuse or neglect.

Likewise, our findings of a higher risk of death with >1 maltreatment report also align with the established relationship between multiple maltreatment reports and more health problems.<sup>21,37</sup>

Several family and contextual dynamics may help explain the elevated rates of medical death observed in the current study. Families who have maltreatment reports may experience acute or chronic challenges with substance abuse, mental health conditions, or extreme poverty (all of which could lead to inadequate caregiver supervision and inadequate adherence to health care recommendations).<sup>38,39</sup> The lack of social support in CPS-involved

**TABLE 3** Crude Competing Risk and Adjusted Competing Risk Regression Model Estimates of Postneonatal Medically Explained Fatalities During Infancy, Stratified by Birth Vulnerabilities

	Crude Estimates		Adjusted Estimates	
	HR	95% CI	HR	95% CI
Referred	2.59***	(1.98–3.38)	1.77***	1.36–2.30
Placed in foster care	0.55*	(0.31–0.98)	0.43**	0.24–0.76
≥2 referrals	3.91***	(2.95–5.19)	3.27***	2.48–4.30
Child sex				
Female	—	—	Reference group	—
Male	—	—	1.28***	1.13–1.44
Maternal race and/or ethnicity				
White	—	—	Reference group	—
Black	—	—	1.30*	1.03–1.63
US-born Hispanic	—	—	0.98	0.83–1.17
Foreign-born Hispanic	—	—	0.96	0.80–1.16
Asian/Pacific Islander	—	—	1.13	0.92–1.38
Maternal age, y				
<20	—	—	Reference group	—
20–24	—	—	1.02	0.80–1.29
25–29	—	—	0.82	0.64–1.03
30+	—	—	0.88	0.67–1.16
Prenatal care				
First trimester	—	—	Reference group	—
Late and/or missing care	—	—	0.93	0.80–1.09
Birth payment method				
Private	—	—	Reference group	—
Public	—	—	1.21**	1.05–1.39
Paternity				
Established	—	—	Reference group	—
Missing	—	—	1.17	0.96–1.43

Birth vulnerabilities include low birth weight (<2500 g) or preterm birth (<37 wk). Changed reference group to female July 22, 2020. HR is more easily interpretable. —, not applicable.

\*  $P < .05$ .

\*\*  $P < .01$ .

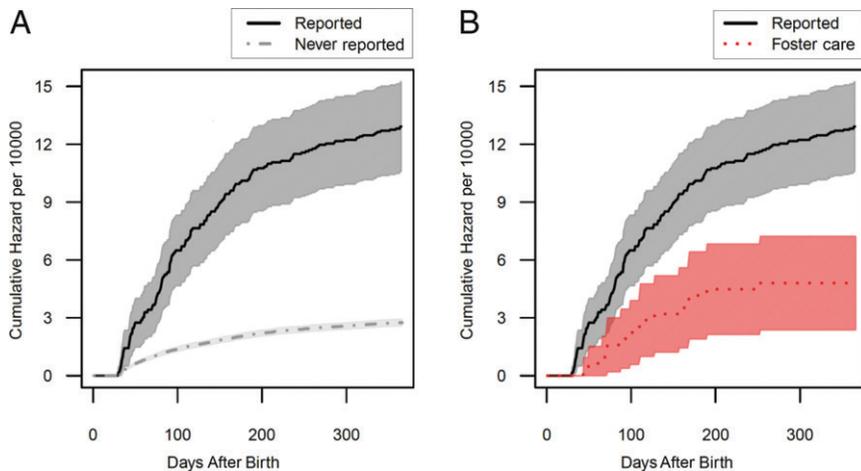
\*\*\* $P < .001$ .

families can also make it more difficult for families to care for infants with chronic or acute health problems.<sup>40</sup> Relatedly, medical neglect may be related to the increased risk of infant deaths from medical causes.<sup>41</sup> Pediatric providers may need to monitor adherence to home health care more closely and follow up on infants with health problems in families with a history of CPS involvement. Pediatric providers are already encouraged to provide anticipatory guidance to all families of children with medical complexities to prevent risks associated with medical fragility and unfavorable health-related outcomes.<sup>42</sup> This anticipatory guidance may be even more important for families in which challenges have already resulted in ≥1 maltreatment report.

Perhaps most notably, we found that periods of foster care placement were associated with significantly decreased rates of death from medical causes. To be clear, ~1 in 4 infants (26.1%) reported for maltreatment spent any time in foster care during the first year of life, and only a small fraction of infants who were reported for maltreatment died of medical causes during infancy, regardless of any time in foster care. However, the statistically significant finding that foster care protected against relatively rare medical-cause fatalities during infancy reinforces that foster care as a service intervention likely protects against other newborn health and developmental adversities. Infants in foster care may find themselves with caregivers who are better equipped to care for substance-exposed or

medically fragile newborns. As much as this is true, the implication is not that more infants necessarily need to be placed in foster care to obtain this level of care. It does suggest, however, that more intensive case management and health care supports may be needed generally for infants remaining at home after ≥1 CPS report.

Notwithstanding the strength of the prospective design and population-based data used for this study, the interpretation of findings and conclusions are limited in several ways. We did not have information about the frequency of health visits during infancy, including preventive care and treatment of health problems, nor did we have information about any other services that may have been offered.



**FIGURE 1** Cumulative hazard rates of postneonatal medical-cause deaths during infancy by maltreatment reporting and foster care placement status. A, The cumulative hazard distribution for infants born in California with at least 1 report during the first year of life versus those who were never reported. B, The cumulative hazard distribution for all reported infants and the subset of infants with placement in foster care during the first year of life. These curves identify the stratified hazards for 3 groups: infants without a report, infants who were reported, and infants who were reported and had a placement in foster care.

Likewise, we were unable to classify preexisting health risks associated with risk of medical-cause deaths (and our covariates for other social and economic risks were limited to information recorded in vital birth records). That said, previous literature suggested that infants placed in foster care would be, on average, more medically fragile, yet we found that foster care was associated with lower death rates. Sensitivity analyses indicate our findings held, regardless of whether we included or excluded deaths during the neonatal period. We also confirmed that our findings did not change if we narrowed our focus to reports of maltreatment that were screened in for investigation. Finally, although almost 1 in 8 children in the United States is born in California,<sup>43</sup> the use of any single state’s data restricts the generalizability of findings because maltreatment reporting rates vary widely across jurisdictions and reflect different definitions of abuse and neglect and varying community thresholds for reporting an infant to CPS.<sup>1</sup>

### CONCLUSIONS

The increased risk of infant death from a medical cause associated with a previous report of abuse or neglect underscores the importance of ongoing care coordination between CPS and pediatric providers. Newborns in families involved with the CPS system reflect a highly vulnerable group, so it is not surprising that their rates of death are elevated relative to infants never reported. But our findings also suggest that during periods of foster care placement, infants may receive a level of case management and care coordination that protects against death and other health and developmental adversities. Differences in death rates signal potential unmet service needs among infants who remain at home after reports.

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### ABBREVIATIONS

- CI: confidence interval
- CPS: child protection system
- HR: hazard ratio
- ICD-10: *International Classification of Diseases, 10th Revision*

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