



Research Paper

Infant mortality in coroner/medical examiner investigations

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ABSTRACT

Infant mortality rate is generally regarded as a fundamental indicator of population health and is often used to validate public health interventions. Hamilton County, Ohio, has one of the highest rates in the nation. Most deaths that do not occur in the hospital fall under the jurisdiction of a coroner/medical examiner. We reviewed all infant deaths evaluated by the Hamilton County Coroner from 2006 to 2013 in order to identify opportunities for public health interventions. We predicted that the majority of these infant deaths were unintentional, but preventable. The eligible population included live born infants, who died less than one year of age. There were 217 cases of infant deaths during this time frame and 14 primary causes of death identified in this cohort. Sleep related deaths made up the majority of deaths ($n = 141, 65\%$), a mean of 17.6 per year. This analysis identifies unsafe sleep patterns, particularly co-bedding and inappropriate sleep surface, as the most frequent contributing factors. Therefore, the coroner/medical examiner, working with public health and healthcare providers can generate information to drive targeted improvements in the outcome for infants.

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1. Introduction

For the past 25 years, the United States has experienced infant mortality rates (IMR) well in excess of other developed countries.¹ In 2014, the Centers for Disease Control (CDC) reported US IMR in 2010 as 6.1, Japan and Finland's as 2.3.² In Hamilton County, Ohio IMR was 8.9 per 1000 live births in 2013, which is amongst the highest in the nation.³ Premature birth, in particular, extreme prematurity drives much of this increase.⁴ Deaths due to congenital malformations also contribute significantly to the US IMR.⁵ Most infant deaths occur during the neonatal period, defined as the first 28 days following delivery. Infant deaths beyond this age are typically associated with unsafe sleep practices, infectious etiologies, and trauma.⁶

Beyond the neonatal period, there are few studies offering a comprehensive analysis of cause of death during infancy. In 2003,

Turlington and colleagues published a study in the Journal of Perinatology reviewing the postneonatal mortality in their institution. They found the cause of death included complications of prematurity and congenital defects.⁷ Most of these deaths fall under the jurisdiction of a coroner/medical examiner, and therefore include a careful review of the history and associated medical records, death scene investigation and a postmortem examination. In general, each state sets its own standards for types of deaths that require investigation.⁸ In Ohio, any death associated with criminal or other violent means, casualty, suicide, any suspicious or unusual manner, sudden death, or death of a developmentally disabled individual, or of a child under two years of age dying suddenly when in apparent good health is required to be reported to office of the coroner in the county where the death occurred.⁹ The coroner will take jurisdiction of the case when there is no identifiable medical explanation based on decedent's history for the death and perform an autopsy.⁹

We reviewed of all infant deaths evaluated by the Hamilton County Coroner from 2006 to 2013 in order to identify opportunities for public health interventions. We predicted that the majority of these infant deaths were unintentional, but preventable. Our findings demonstrate how public health providers could partner with the coroner to reduce infant death.

Abbreviations: IMR, infant mortality rate; IUFD, intrauterine fetal demise; SUID, sudden unexpected infant death; SIDS, sudden infant death syndrome; NAT, non-accidental trauma; MVC, motor vehicle collision; CDC, Centers for Disease Control.

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2. Methods

We conducted a retrospective record review from January 1, 2006 through December 31, 2013. The eligible population included live born infants, who died before one year of age and had an autopsy completed by the Office of the Hamilton County Coroner. All cases included a review of associated medical records, a death scene investigation, and review of relevant medical literature. The Hamilton County Coroner's office provided information of all deaths from birth until 364 days of age for the time of the study, which included the neonatal period, from birth to 28 days of life. The deputy coroner (WCR) and one of the authors (LMS) reviewed each case's cause of death information documented in the coroner report. For each case, the infant's age, race, gender, and cause of death were collected. For the unsafe sleep deaths, the contributing factors: position, co-bedding, excessive bedding, and sleep location were collected. If the infant was reported to be co-bedding with the mother, the method of feeding documented was also collected. The purpose of obtaining gender and race demographics was to determine if racial and/or gender disparities are seen in the coroner investigations.

The CDC divides Sudden Unexpected Infant Death (SUID) into three categories: Sudden Infant Death Syndrome (SIDS), unknown, and accidental suffocation and strangulation in bed.¹⁰ SIDS is defined as the sudden death of an infant less than one year of age that cannot be explained after a thorough investigation is conducted, including a complete autopsy, examination of the death scene, and a review of the clinical history. In 2004, Krous et al. introduced redefined criteria for sleep related deaths, referred to as the San Diego classification.¹¹ The general definition is a sudden, unexpected death under one year of age, lethal episode during sleep, or death unexplained by clinical history. This is further divided into categories. Category IA defining deaths occurring at over 21 days, but under nine months in safe sleep environment with no evidence of accident and all screening studies were negative. Category IB is for the cases where a scene investigation was not undertaken or one of the screening labs was not performed. Category II is defined as cases between 0–21 days and 270–365 days, neonatal/perinatal conditions that have resolved by time of death, abnormal growth and development and/or marked inflammatory changes not sufficient to cause death. Infants who died of unnatural causes such as suffocation by soft covering are excluded from the COD SIDS. In the Hamilton County, Ohio jurisdiction, SIDS is classified as a natural manner of death.

The CDC defines accidental suffocation and strangulation in bed as suffocation by soft bedding (pillow), overlay (another person rolls on top of infant), wedging (wedged between two objects), and strangulation (caught between crib rails).¹⁰ For our study, a sleep related death was a death that occurred due to one or more of the following contributing factors noted in the coroner's report: sleeping prone or side-lying, not in a crib, co-bedding, and/or having excessive bedding. Medical history, autopsy and laboratory results were negative for anatomic, toxicological, and/or metabolic explanations of death in these cases. We identified contributing factors based on the information provided from the involved parties obtained during investigator interviews and from the scene investigation conducted by the coroner, which included doll re-enactments to identify sleep position and unsafe sleep items.

The CDC defines unknown type of SUID death as sudden death of an infant less than one year of age that is unexplained and not consistent or does not meet criteria for the diagnosis of SIDS. In Hamilton County, Ohio, undetermined cause of death was assigned by the coroner if there were unexplained findings which were insufficient to cause death such as a single, remote rib fracture or if a thorough investigation could not be conducted.⁹

All information accessed through the Hamilton County Coroner's office is of public record.

3. Results

We identified 217 infant deaths from 2006 to 2013 that were evaluated by the Hamilton County Coroner. There were 14 primary causes of death identified in this cohort, which we defined based on the immediate cause of death documented in the coroner's report as assigned by the medical examiner or coroner (Table 1). We found 25 (11.5%) deaths due to non-accidental trauma. This was greatly exceeded by the number of unsafe sleep related deaths ($n = 141$, 65%), a mean of 17.6 deaths per year. There was no significant gender difference among total infant deaths evaluated by the coroner. In all 217 deaths evaluated 99 were female and 118 were male. Specifically, for unsafe sleep related deaths, there also was no significant difference in gender as there were 74 male and 67 female deaths. African Americans comprised 105 cases (48%) and Caucasians comprised 103 cases (47%) of the 217 total infant deaths evaluated by the coroner in this time frame. Of the 141 unsafe sleep deaths, 76 cases (54%) were African American and 60 cases (43%) were Caucasian. In Hamilton County, per report from the Ohio Department of Health, 35% of all live births during the eight year time frame were self-reported African American. By comparison, 22% of all infant deaths and 17% of all live births in the State of Ohio during the eight year time frame were self-reported African American (Table 2).

The infant's age at death for all deaths reviewed in the eight year study time frame ranged from 4 days of age to 11 months of age. Unsafe sleep related deaths had the same age range, 4 days to 11 months of age. 13 cases of the 217 total deaths were deaths that occurred at less than 28 days of life. Of the 13, there were 9 cases of unsafe sleep related deaths. Co-bedding was the most frequent contributing factor for unsafe sleep in the neonatal period documented in 7 of the 9 cases.

The investigation identified important contributing factors to unsafe sleep deaths including co-bedding, inappropriate sleep surface, excessive bedding (e.g. blankets, pillows, stuffed animals), and inappropriate positioning, such as prone or side lying, which were documented in the coroner's report.

We found 9 cases of SIDS, 8 of which met criteria for Category IA of the San Diego definition and 1 met criteria for Category II based on age at death. The investigation identified important contributing factors to unsafe sleep deaths including co-bedding, inappropriate sleep surface, excessive bedding (e.g. blankets, pillows, stuffed animals), and inappropriate positioning, such as prone or side lying, which were documented in the coroner's report. Several deaths had more than one contributing factor to the unsafe sleep death. For example, one death scene evaluation identified co-bedding (infant with sibling) and inappropriate sleep surface (adult mattress) as contributing factors. In another death investigation, an infant was reported to be in an inappropriate sleep position (prone) with excessive bedding (pillow). Among the 141 deaths associated with unsafe sleep, 112 (79.4%) had documented not sleeping in a crib, 77 (54.6%) had documented co-bedding, 43 (30.5%) had documented unsafe positioning, and 19 (13.5%) had documented excessive bedding (Fig. 1). Fig. 1 highlights that over the eight years analyzed the most frequent contributing factors every year were co-bedding and not sleeping in a crib. The difference in the totals of the two categories implies that several infants who were not sleeping in a crib may not have been co-bedding, which emphasizes that these are separate areas to target for public health interventions. Overall, when comparing the contributing factors to unsafe sleep deaths the totals are similar across gender and race groups, however, African American males had the highest number of co-bedding and not

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