

What Do Home Monitors Contribute to the SIDS Problem?

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SUDDEN INFANT DEATH SYNDROME (SIDS) IS ONE OF THE most tragic events in medicine. The major hypotheses for the causes of SIDS are variants of the presumption that the SIDS event results from abnormal cardiopulmonary regulation, perhaps aggravated by environmental factors. Although multiple "immaturities" or "abnormalities" of cardiorespiratory control in preterm, term, and young infants have been demonstrated,¹ the links between those physiological responses and SIDS are tenuous. Nevertheless, a home monitoring industry with the noble goal of preventing SIDS has now operated for many years without either a sound scientific foundation for monitoring or a clear demonstration that monitoring decreases SIDS.

Based on epidemiologic information that demonstrated lower rates of SIDS in Asian vs American populations, the practice of placing infants prone for sleep was identified as a risk factor for SIDS.² The US custom of a prone sleeping position for infants was thought to prevent aspiration, whereas the Asian custom of supine positioning of infants for sleep was thought to prevent suffocation. Asian custom and logic proved to be correct, and following the Back to Sleep Campaign initiated in 1992 by the American Academy of Pediatrics and the US Department of Health and Human Services, SIDS deaths in the United States decreased from 1.2 per 1000 births in 1991 to 0.8 per 1000 in 1995.³ Although this decrease in SIDS is a major public health victory, about 3000 infants still die of SIDS each year in the United States. SIDS is more frequent in preterm infants and perhaps occurs more frequently in infants who have had apparent life-threatening events (ALTEs) and in siblings of infants who died of SIDS. Therefore, home monitoring has focused on these groups of infants as well as parents with high anxiety about the risks of SIDS.

The costs of home monitoring are substantial. In 1999, 44% of 26 000 infants with birth weights of 501 to 1500 g cared for in 325 neonatal units in the Vermont Oxford Network were sent home with monitors.⁴ The 14 neonatal units of the National Institute for Child Health and Human Development (NICHD)-Neonatal Research Network used home monitors for 26% of discharges for infants with birth weights

of 501 to 1500 g with a disconcerting range of monitor use of 7% to 70% among units.⁵ Given that there are approximately 4 million births in the United States annually, that approximately 1.3% of newborns weigh less than 1500 g, and that the survival is about 86%, about 20 000 preterm infants are sent home with monitors each year. According to estimates from neonatology colleagues, the average period of monitor use is about 4 months for preterm infants, and the monthly cost is about \$300. Therefore, a rough estimate for the costs of monitoring alone is about \$24 million per year for preterm infants. This amount does not include physician fees and other ancillary medical costs. Certainly, some preterm infants are monitored for reasons other than concerns about SIDS, including infants who require home oxygen therapy. On the other hand, this estimate also does not include monitors for term infants thought to be at increased risk of SIDS.

This issue of THE JOURNAL contains a study by Ramanathan et al⁶ in which the NICHD sought to insert some facts into the fractious discussion of the causes of SIDS and the benefits of monitors. This was done by creating a multicenter consortium, the Collaborative Home Infant Monitoring (CHIME) Study Group, to quantify the kinds of cardiorespiratory events that can be captured on smart monitors. The goal was to define normal patterns and to capture events before, during, and after "conventional" or "extreme" apnea/bradycardic events that might be physiologically or clinically relevant. The authors analyzed 29 000 days of monitoring data on 306 healthy term infants, 152 infants who had an ALTE, 178 siblings of infants who died of SIDS, and 443 preterm infants less than 34 weeks' gestation. Among term infants, 43% had apnea/bradycardic events that exceeded the conventional alarm threshold and 2.3% were extreme events.⁶

The risks for conventional or extreme events were not increased for term infants in the siblings or the ALTE groups. The preterm infants had increased incidences of both types of events, but those events disappeared once the infants were 43 weeks' postconceptional age. However, the peak incidence of SIDS in preterm and term infants is well beyond

See also p 2199.

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43 weeks' postconceptional age. A further finding was that many of the apnea events were associated with more than 3 obstructed breaths, events that would be missed by the transthoracic impedance monitors used for most home monitoring. In a previous report from the same group, longitudinal assessments of hemoglobin oxygen saturation were less than 90% at least once in 5% of healthy infants.⁷ Therefore, cardiorespiratory events are common in all infants, but their occurrence relative to postconceptional age does not support a cause and effect relationship to SIDS.

This report disproves the assumption that infants thought to be at increased risk of SIDS have more cardiorespiratory events than healthy infants and is consistent with the conclusion that such events are not precursors to SIDS. The study was not designed to test the utility of monitors to prevent SIDS, but as a result of this study, the physiological basis for such a practice is more in doubt than ever. As death scene investigations and autopsies have become more thorough, multiple causes of sudden and unexpected death in infants have been identified. Although the Back to Sleep Campaign has been successful, recent surveys indicate that many infants continue to be put to sleep in the prone position. In an analysis of 88 SIDS deaths, 61% of infants were found prone, 76% were on sleep surfaces not designed for infants, and 29% had their heads covered by bedding, with only 8% of deaths in nonprone (supine or side positions) with head uncovered.⁸ In a recent autopsy series, 48% of infants who died while sleeping supine were found to have explanations for the cause of death, while identifiable causes were found in less than 20% of infants that were sharing a bed or sleeping prone.⁹ When prone sleeping decreased by 98% in a region of Norway, SIDS decreased by 91%.¹⁰ If these results are generalizable, most SIDS can be prevented by education about the sleep position and location.

Knowing that the majority of SIDS can be prevented by proper positioning for sleep, what causes the remaining proportion of SIDS? Environmental and medical factors associated with SIDS include gastric-esophageal reflux, high environmental temperature, occult infection, congenital anomalies, and maternal smoking. SIDS also has been associated with the following: metabolic diseases such as fatty acid disorders,¹¹ abnormal mast cell function,¹² a unique interleukin 10 genotype,¹³ a prolonged QT interval,¹⁴ and *Helicobacter pylori* infection.¹⁵ The most disturbing cause of SIDS in perhaps 2% to 5% of cases is infanticide.¹⁶ A number of these causes of sudden and unanticipated death are well documented, suggesting that the residual SIDS cases have multiple diverse causes. A thorough autopsy by pathologists with expertise in SIDS will yield more definitive diagnoses than the standard coroner's investigation or medical-legal autopsy.¹⁷

If sleep position and infant bedding are appropriate, there should not be much SIDS left to try to prevent with home

monitors. Furthermore, the residual causes of SIDS are unlikely to be prevented by home monitoring. The elegant NICHD study in this issue of THE JOURNAL has provided sound information about the types of events experienced by healthy and at-risk infants. Certainly, there are rare occasions when term infants with abnormalities of respiratory control will benefit from home monitors. Similarly, some preterm infants requiring oxygen or having frequent apnea and bradycardia may benefit from short-term monitoring until they mature to 43 weeks' postconceptional age. Nevertheless, this study justifies a severe curtailing of home monitoring to prevent SIDS. The epidemiology of SIDS supports a redoubled effort to promote the Back to Sleep Campaign and safe sleeping surfaces for infants.

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