

The Interface Among Poverty, Air Mattress Industry Trends, Policy, and Infant Safety

Infants can suffocate on air mattresses, even when the mattress is fully inflated. The interfacing issues of poverty, the bedbug epidemic, and changes in the design and marketing of air mattresses may be increasing consumer use of air mattresses as primary sleep environments and thus increasing the potential for infant death.

Despite recent changes to improve air mattress safety labeling, the National Child Death Review Case Reporting System found that between 2004 and 2015 across 24 states, an air mattress was the incident sleep place for 108 infants whose deaths were either during sleep or in a sleep environment. At the same time, design components such as inflatable headboards and memory foam pillow tops potentially increase the hazard to infants, and marketing changes represent air mattresses as a preferred low-cost primary sleep environment.

Analysis of current data surveillance systems, published position statements, and consumer materials from national organizations and federal agencies reveal opportunities for changing policy to better protect infants from this hazard. (*Am J Public Health*. Published online ahead of print April 20, 2017: e1–e5. doi:10.2105/AJPH.2017.303709)

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The Consumer Product Safety Commission (CPSC) received reports of 16 deaths between 2002 and 2008 of infants placed to sleep on air mattresses.^{1,2} The report notes,

Eleven suffocated in a facedown position on air mattresses, and five died as a result of suffocation after falling into gaps between the mattress and bed frame or mattress and adjacent furniture or walls.^{2(p1)}

This report led to improved safety labeling of air mattresses.² Although an air mattress does not meet the American Academy of Pediatrics (AAP) criteria for a safe infant sleep environment, our local Fetal and Infant Mortality Review committee has reviewed several infant deaths in which an air mattress was the incident sleep space.³ This prompted an exploration of the issue to examine direct and indirect evidence of trends in the industry and in public health. Our analysis reveals that surveillance systems and public policy on air mattress use for infants is lagging behind the potential widespread use of these products in US homes.

AIR MATTRESSES, POVERTY, AND BEDBUGS

The interfacing problems of poverty and bedbugs may be contributing to increased air mattress use in the United States. Fundamentally, air mattresses are air encased by an

air-impermeable material, usually vinyl.⁴ Besides providing a more comfortable sleeping surface than hardwood, concrete, or carpeted floors, air mattresses can also provide insulation against cold. Inadequate heating or drafty environments may increase the risk of infant placement on an air mattress despite safety warnings.^{5,6} Air mattresses are also appealing for their low cost and multiple size options. In one recent case in Milwaukee, Wisconsin, the air mattress held not only the mother and infant, but also 4 siblings.⁷ An Internet search on Amazon and Walmart retail sites revealed that a queen-size air mattress costs as little as \$15.97 compared with the lowest-cost queen box spring mattress being \$95.50. Air mattresses may be perceived as more desirable than a couch or recliner when multiple people need a sleep surface. In addition, our clinical experience suggests that in marginally or transitionally housed populations, deflation for easy transport and space-saving storage may also be desirable.

Bedbug infestations are a known problem in the United States that has become more widespread in the past 10 years, moving primarily from private

homes to now also include public spaces including hotels, schools, hospitals, nursing homes, day care centers, and homeless shelters.^{8,9} The problem is so widespread that, in February 2015, the Environmental Protection Agency published a report detailing a federal interagency strategy to address what the report calls a bedbug epidemic.¹⁰ Americans living in poverty may be disproportionately affected by bedbug infestations as remediation is financially burdensome and results in loss of property.⁸ For example, a recent media report noted that “professional extermination of bedbugs typically costs between \$200 to \$1,500 per room and often fails,” and often it is recommended that families discard infested mattresses and bedding.¹¹ Research suggests that bedbugs are becoming increasingly resistant to insecticides commonly used for extermination.^{12,13}

Although mattress encasement (a covering that fully encloses the mattress) can be a mattress-preserving strategy, encasements come at a cost that is similar to the cost of an air mattress, especially when separate encasements may be required for

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a mattress (around \$38 for a queen encasement) and box spring (around \$25). People who discard box spring mattresses as a bedbug-fighting strategy still need a place to sleep and may turn to air mattresses for replacement. Air mattresses may also be desirable because the materials used in their construction are less favorable for bedbugs by having fewer layers of fabric and crevices where bedbugs can nest.⁸ Concurrently, in response to the bedbug epidemic, some nonprofit agencies have stopped accepting mattress donations and have suspended programs to donate mattresses to people in need.¹⁴ The lack of supply to meet the demand for secondhand mattresses may increase air mattress use.

AIR MATTRESS DESIGN AND MARKETING TRENDS

Apart from factors such as cost, convenience, and necessity, several changes within the air mattress industry itself suggest a need to update health policy to be responsive to emerging trends. The consumer market for air mattresses has expanded from that of a camping accessory to home use as a cost-effective and technologically advanced sleeping environment.¹⁵ Manufacturers have significantly improved the quality of air mattresses recently through increased size, thickness, and ability to hold air through the night. New designs incorporate inflatable headboards, pillow rests,¹⁶ and memory foam.¹⁷ Memory foam and pillow tops have been factors in Milwaukee infant deaths on box spring mattresses, and the

integration of these elements into air mattresses may present additional hazards as potential carbon dioxide reservoirs.¹⁸

An online product search of Amazon.com using the keyword “inflatable mattress” reveals that technology is also now commonly integrated into “smart” air mattresses. Phone charging stations, USB ports, night-lights, and sensors to monitor inflation parameters aim to improve the comfort and desirability of air mattresses. Marketing has also shifted from camping accessories to primary sleep surfaces in the home. For example, one air mattress made by Seating Systems Inc is termed an “Air Sleep System” that mimics a traditional bed on a sleeper sofa.¹⁹ New product categories such as “Air bed,” “Airbed,” or “Inflatable Bed” for air mattresses are further evidence of this shift. Marketing air mattresses as “beds” suggests a market trend toward promoting these products as alternatives to traditional box spring mattresses. Among families who use air mattresses as primary sleep environments, a systematic, integrated, cross-sector approach is needed to address this threat to infant safety.

INFANT DEATH AND INJURY INVOLVING AIR MATTRESSES

The AAP recommends infants be placed supine for every sleep on a flat, firm, dedicated, and separate sleep space that is free of toys, blankets, and other objects.²⁰ The CPSC indicates that even a properly inflated mattress may not be firm enough for an infant to maintain a clear airway.¹ Even when fully inflated, air mattresses can mold to the

infant’s face and obstruct the airway by forming an occlusive seal. The risk increases when air mattresses leak during use. Underinflation was a factor in some of the infant deaths reviewed in Milwaukee.³

A query of the National Child Death Review Case Reporting System (NCDR-CRS) found that, between 2004 and 2015, there were 108 infant deaths in which an air mattress was the incident sleep place for infants whose deaths were either during sleep or while they were in a sleep environment (L. Potter, e-mail communication, April 29, 2016). These cases were reported by 24 states. Child Death Review teams in 45 states use the NCDR-CRS to enter information from child death review meetings; however, known limitations of the NCDR-CRS include that not every state reports into the database, not every state’s Child Death Review program reviews every infant death, and the 24 states began reporting in different years, which suggests that these deaths may be underreported. Moreover, “air mattress” is not an explicit choice on the case reporting form.²¹ From an injury standpoint, a query of the National Electronic Injury Surveillance System—a national probability sample of 100 US hospitals with detailed information from emergency department patient records on injury and death involving consumer products—found 6 infant injuries in 2015 related to inflatable furniture (product category 4011).²² All involved falling off an air mattress resulting in injuries to the head ranging from minor head injury and facial contusions to subdural hemorrhage.

PRODUCT STANDARDS FOR AIR MATTRESSES

Product standards are an important mechanism for reducing risk of injury and death from consumer products. In response to the report of the 16 deaths, the CPSC requested a standard be created by ASTM International for the labeling of air mattresses.² ASTM International is the global organization that develops and publishes standards for a wide variety of products, services, and systems, including air mattresses. In response to the CPSC request, ASTM International published F2755 Standard Safety Specification for Cautionary Labeling of Inflatable Air Mattresses in 2008 and reapproved it in 2014.² This standard provides manufacturers with detailed guidance on product safety labels and packaging. Labeling specifics suggest recommended symbols, colors, font, and size and location to promote visibility and consumer recognition through standardization. The standard details parameters for product packaging and inserts for the safe use of the product. Example language states,

Never place infant aged birth to 15 months to sleep on this inflatable air mattress/air bed. Infants can suffocate on an underinflated or deflated mattress, on bedding, by co-sleeping with another person.^{2(p2)}

Although adopted by the CPSC, standard F2755 is a voluntary standard, meaning it is not mandatory for manufacturers or retailers in the United States. Voluntary standards are considered best safety practices, and industry compliance with voluntary standards is common practice as it reduces risk of

liability to manufacturers. The creation of ASTM standards brings together industry (i.e., manufacturers), government agencies, and consumer groups to examine the industry practice and research to achieve consensus.²³ Mandatory standards require federal legislative action to change the Code of Federal Regulations. For example, adherence to a flammability standard is currently the only mandatory standard for mattresses.

ANALYSIS OF POLICY STATEMENTS

Health-related education materials are another means for promoting product safety. There

is an opportunity to communicate a unified message about infant sleep safety when infant sleep brochures also reflect industry safety standards. We examined materials such as position statements and health education brochures from several government (federal) agencies, health professional organizations, and consumer organizations to identify whether air mattresses or related terms (e.g., air bed, inflatable mattress) were mentioned (Table 1).

The Centers for Disease Control and Prevention, which houses information about the Sudden Unexpected Infant Death Case Registry, links directly to the Safe to Sleep initiative hosted by the National Institute of Child Health and

Human Development for all health care professional and consumer materials.²⁴ Materials on the Safe to Sleep site note that infants should not be placed on soft surfaces and give examples such as

Sleep surface matters. Babies who sleep on a soft surface, such as an adult bed, or under a soft covering, such as a soft blanket or quilt, are more likely to die of SIDS [sudden infant death syndrome] or suffocation.^{25(p3)}

The pamphlet notes the need for a firm sleep surface and recommends against use of specific products, such as car seats, carriers, or swings for daily sleep and to “Never place baby to sleep on soft surfaces, such as on a couch or sofa, pillows, quilts, sheepskins, or blankets.”^{25(p5)} However, the pamphlet does not mention air mattresses. The AAP policy does recommend use of a separate firm sleep surface, noting:

A firm surface maintains its shape and will not indent or conform to the shape of the infant’s head when the infant is placed on the surface. Soft mattresses, including those made from memory foam, could create a pocket (or indentation) and increase the chance of rebreathing or suffocation. . . .^{22(p3)}

The AAP also recommends avoiding bed-sharing “on a soft surface, such as a waterbed, old mattress, sofa, couch, or armchair.”^{22(p5)} Air mattresses are not directly mentioned. A consumer brochure on the AAP Web site states, “Don’t place babies to sleep on adult beds, chairs, sofas, waterbeds, pillows, or cushions,” but does not mention air mattresses.²⁶

The Academy of Breastfeeding Medicine is a worldwide organization of physicians committed to promoting breastfeeding and human lactation. The Academy of

Breastfeeding Medicine’s most recent clinical protocol detailing guidelines on cosleeping and breastfeeding references a “firm mattress,” but does not specifically mention air mattresses.^{27(p42)}

The breastfeeding organization La Leche League International’s “The Safe Sleep Seven” consumer pamphlet states: “No super-soft mattress,” but does not further specify air mattresses.²⁸

Attachment Parenting International is a nonprofit organization that describes itself as a group of “dedicated professionals” providing parenting advice. Attachment Parenting International’s published position paper on infant sleep safety states, “Don’t fall asleep with baby on a couch, bean bag chair or waterbed,” but does not specifically mention air mattresses.^{29(p4)} A consumer pamphlet does recommend against air mattresses, stating,

Never place your baby—or fall asleep with your baby—on a couch, recliner, beanbag chair, fold-out or pull-out couch, inflatable bed, or waterbed.³⁰

Finally, the National Sleep Foundation and its consumer education branch (<https://sleep.org>) provide recommendations on sleep and health for health professionals and consumers. A topic search for “inflatable mattress,” “air mattress,” and “air bed” on the Web site revealed 2 articles. One article discussed factors to consider when one is purchasing guest accommodations—specifically, a pullout sofa or an air bed.³¹ The second article reported on the factors to consider when one is purchasing an air mattress.⁴ Each article used a different term for air mattress and neither article warned against placing infants on these products.

In summary, although some local, city, and state efforts may

TABLE 1—Summary of Findings of Select Policy Documents Exploring Whether the Hazard Presented by Air Mattresses to Infant Safety Is Addressed

Organizations Researched	Air Mattress Addressed
US federal agencies	
Centers for Disease Control and Prevention	
SUID Case Registry and related sites	No
Bed bugs topic site	No
Environmental Protection Agency Bed Bugs Strategy	No
National Institutes of Health, National Institute of Child and Human Development (NICHD)	No
Professional provider organization	
American Academy of Pediatrics (AAP)	No
American Academy of Family Physicians (refers to AAP/NICHD)	No
Academy of Breastfeeding Medicine	No
Health professional and consumer information	
National Sleep Foundation (NSF)	No
Consumer arm of NSF (https://sleep.org)	No
La Leche League International	No
Parent organization	
Attachment Parenting International	
Position statement	No
Consumer materials	Yes

Note. SUID = sudden unexplained infant death.

specifically mention air mattresses in consumer pamphlets, the evidence strongly suggests that there is a need for integration of industry product safety standards related to air mattresses with health education materials provided to parents. Furthermore, these results suggest a larger need to increase awareness in parents about the types of materials and design features that may be integrated into air mattresses and box spring mattresses that may increase the risk of suffocation (e.g., memory foam and air elements within box spring mattresses).^{18,22}

RECOMMENDATIONS FOR INFANT SLEEP SAFETY POLICY

This analysis reveals that all the reviewed materials send a consistent message that a firm and flat sleep surface should be used for infant sleep; however, air mattresses were rarely mentioned. This omission could potentially introduce confusion or misinterpretation if families mistakenly think that a fully inflated air mattress is “firm enough.” The report of 108 deaths by the NCDR-CRS suggests an urgent need for a connected and integrated approach to policy and consumer messaging that maximizes dissemination to all consumers who purchase or use air mattresses. The first opportunity is that these organizations can explicitly caution against the use of air mattresses, air beds, and inflatable mattresses in position statements and consumer materials. Explicit warnings are needed to communicate that even a well-inflated air mattress is not a “firm” sleep surface. The ASTM standard F2755-14 offers language that may be

familiar and accessible to consumers.

An unexpected finding of our analysis of the industry is how frequently air components are being incorporated into box spring mattresses.¹⁵ Settings on both air beds and in some traditional box spring mattresses have adjustable firmness elements. We also noted that both air mattresses and traditional mattresses may include pillow tops or other products such as mattress toppers made of foam or polyester filling. Although such products may increase comfort for adult sleepers, they may also increase the risk of suffocation for infants and go unrecognized by parents as hazards.¹⁸ We argue that these changes suggest that there may be a fundamental shift in the definition of a “traditional” box spring mattress. Organizations need to attend to this development within messaging to parents and infant caregivers. There is a need in all organizations to better describe what type of mattress structure constitutes a firm and flat surface for infants and to use carefully constructed, simple, clear language to minimize the risk of misinterpretation.¹

Policy improvements may be further realized by encouraging government and other organizations that provide sleep-related or bedbug-related information to include warnings about infant sleep safety in materials wherever air mattresses are mentioned. Another recommendation includes identifying alternative, inexpensive bedding options for infant sleep surfaces that families can use in the event of a bedbug infestation. Public health programs can be created to offer low-risk strategies (e.g., mattress encasements) for combatting bedbugs so that traditional infant mattresses can still be used. Programs that

ensure families have access to a designated infant sleep surface upon discharge from the hospital have demonstrated promise in reducing risky infant sleep practices.^{32,33}

Clinicians might consider directly asking families with infants about the use of air mattresses and mattresses having air components and providing education about these hazards. Furthermore, public health and health care professionals must appreciate that families’ choices about infant sleep surface are influenced by competing risks and economic costs, including the potential effects of bedbugs, function in small spaces, and cost. Thus, it is important for professionals to develop sleep strategies with their families that respond to the factors that are most influential for each family.

IMPROVING SURVEILLANCE AND RISK DATA

A major limitation of our current analysis is reliance on non-scientific data sources to support our observations of increasing trends of air mattress use. This is because of limited systematic data being collected by public health surveillance systems. However, given the anecdotal evidence we do have of some infant deaths and injuries on air mattresses and the data from the CPSC and NCDR-CRS, we suggest that trends in air mattress use are worth monitoring. More detailed surveillance and risk data are needed to better understand the possible trend toward using air mattresses as primary sleep surfaces. More detailed consumer data on air mattress use along with data reporting infant deaths are needed. For example, to facilitate more accurate data

collection, the Sudden Unexpected Infant Death Case Registry Investigation Reporting form²⁰ could be revised to include additional responses for air mattresses, pillow tops, memory foam, and box spring mattresses with air components.

The CPSC can play a more active role in investigating mattress type in infant deaths, and there is a need for funding of quality case-control studies of risk from mattresses having air components. Furthermore, apart from the ASTM standard that states, “Infants have suffocated on inflatable mattresses,”^{2(p2)} there is limited published research on the mechanics of airway obstruction and suffocation on air mattresses. We recommend that researchers and product safety testing labs publish findings that led to the conclusion that air mattresses are hazardous so that future research can begin to estimate the relative risk that air mattresses and mattress components (e.g., memory foam) pose to infants. Given that the CPSC and NCDR-CRS are both collecting infant death data, we recommend continued collaboration to ensure that all deaths are reported to both organizations as erroneous data impede long-term efforts to improve product safety and policy in both public health and industry.

Given the market trends of labeling air and inflatable mattresses as “beds,” it is possible that parents completing surveys on infant sleep practices may incorrectly categorize an air mattress as an “adult bed” if the word “air” or “inflatable” is not specifically used. We recommend that researchers specifically ask about use of air mattresses and air components when assessing infant sleep location. For example, national surveys of infant sleep practices such as the Pregnancy Risk Assessment Monitoring System³⁴ and the Study of

Attitudes and Factors Effecting Infant Care Practices³⁵ could include the terms “air mattress” to improve monitoring of trends in product use. Not including air mattresses could result in incomplete data about infant sleep practices. Furthermore, health policy should consider how to record data on the prevalence of use of specific consumer products that surveillance systems (e.g., CPSC) find particularly hazardous. Although recall notices from the CPSC include an estimated number of products sold, actual sales data on trends of air mattress use are proprietary and are typically only available through prohibitively costly industry reports.

Finally, in clinical practice, health care professionals can stay current with trends in injuries and deaths on air mattresses by querying their local and state Fetal and Infant Mortality and Child Death Review committees and Sudden Unexpected Infant Death Registries.³⁶ Health professionals can also monitor CPSC product reports and recalls, query the National Electronic Injury Surveillance System database, and encourage parents to file product safety incidents at <https://www.saferproducts.gov>.

CONCLUSIONS

The continued evolution of the air mattress market in the United States, which constructs air mattresses as desirable, low-cost, and technologically advanced adult sleeping environments, places infants at great risk for sleep-related death. Sustained advocacy is needed to monitor trends in the air mattress industry to ensure that health policy and education is current, sends a consistent message to consumers, and is fully integrated across all relevant sectors of consumers, health

care professionals, government agencies, and industry. *AJPH*

CONTRIBUTORS

J. J. Doering conceptualized and drafted the initial article. T. C. Salm Ward assisted in analyzing sources of data and substantially revising subsequent article drafts.

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Institutional review board approval was not needed for this article because it did not involve human participants.

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