Sudden Infant Death Syndrome and Safe Infant Sleep

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No Conflicts of Interest to Disclose
“And this woman's son died in the night ...”

1 Kings 3: 19
(950 B.C.)

LAPSE OF TIME FROM MOMENT WHEN LAST SEEN ALIVE TO THE
DISCOVERY OF DEATH (96 Cases)

Figure Courtesy of Doctor Maria Valdes-Dapena
Sudden Death of an Infant

Emergency Responders

Coroner's Investigation

Autopsy

Determination of the Cause of Death
The sudden unexpected death of an infant, under one-year of age, with onset of the fatal episode apparently occurring during sleep, that remains unexplained after a thorough investigation, including performance of a complete autopsy, and review of the circumstances of death and the clinical history.

In this presentation, the following terms are considered synonymous:

- SIDS
- SUID
- SUDI
- Undetermined

They all mean the same thing; that the infant’s death is *unexpected* and *unexplained*.

Combined SUID
SIDS
Unknown Cause
ASSB

Infant Mortality (Deaths per 1000 Live Births)

Year


0 0.5 1.0 1.5 2.0

Infant Deaths by Gestational Age

SIDS Autopsy Findings

• No identifiable cause of death.

• No signs of severe illness.

• No signs of significant stress.

• Diagnosis of exclusion
With the perseverance of Trojans ...

- Faithful.
- Scholarly.
- Skillful.
- Courageous.
- Ambitious.

“Here are provided seats of meditative joy,
Where shall arise again the destined reign of Troy.”

Virgil, Aeneid
Imagine a car driving up a steep mountain road. The car has stopped. Why can’t the car continue up the hill?

Modified after Professor Jacopo P. Mortola. McGill University.
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**Medical Model.**

- There is a flat tire.
- Identify the problem.
- Find a solution to the problem.
- Fix the problem.

Modified after Professor Jacopo P. Mortola. McGill University.
Medical Model of SIDS

- Cardiac causes.
- Respiratory causes.
- Arousal disorders.
- Metabolic disorders.
- Infections.
- Vitamin deficiency.
- Environmental toxins.
Imagine a car driving up a steep mountain road. The car has stopped.
Why can’t the car continue up the hill?

A New Way of Thinking.

• There are too many passengers.
• The engine is not powerful enough.
• The road is too rocky.
• The road is too steep.

Modified after Professor Jacopo P. Mortola, McGill University.
### Step 1
- Life-threatening event
- Asphyxia and brain hypoperfusion

### Step 2
- Failure of arousal
- Progressive asphyxia

### Step 3
- Hypoxic coma

### Step 4
- Bradycardia and gasping

### Step 5
- Failure of autoresuscitation resulting in death

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Infant Vulnerability

Development

Environment

SIDS

Autonomic Dysfunction Disrupting Cardiorespiratory Control

If normal infants do not precisely control breathing, heart rate, and oxygenation …

Then SIDS may not have to be a catastrophic physiological crisis.

Maybe it just needs to be a small problem which nudges or pushes a vulnerable infant over the edge.
Infant Vulnerability

Development

Environment

SIDS

Step 1
Life-threatening event → Asphyxia and brain hypoperfusion → Head lifting or turning

Step 2
Progressive asphyxia → Failure of arousal → Head lifting or turning

Step 3
Failure of arousal → Hypoxic coma

Step 4
Hypoxic coma → Bradycardia and gasping

Step 5
Bradycardia and gasping → Failure of autoresuscitation resulting in death

Brainstem Neurotransmitters in SIDS

- Brainstem is the *life support* portion of the brain.
- Autopsy studies found decreased serotonin (5-HT) and serotonergic neurotransmitter receptor binding activity in brainstems of SIDS vs controls infants.

Brainstem Serotonin Concentration (pmol/mg)

- SIDS (n=35)
- Controls (n=5)
- Hospitalized (n=5)

SIDS vs Hospitalized:
- P < 0.05

Controls vs Hospitalized:
- P < 0.04

5-HT$_{1A}$ Receptor Binding Density in the SIDS Mid-Medulla

Sudden death without Asphyxia

Sudden death with Asphyxia

Known Cause of Death

Solitary Tract Nucleus

Gigantocellularis

5-HT$_{1A}$ Binding (Fmol/mg)

Percent Standard Value

Accidental Asphyxia or Suffocation

Sudden Death with Asphyxia

Sudden Death without Asphyxia

Brain Abnormality

Small

Intermediate

Severe

Asphyxial Insult

Severe

Intermediate

Small


Infant Vulnerability may have Many Causes

- Infant Vulnerability
- Development
- Environment

Imagine a car driving up a steep mountain road. The car has stopped. Why can’t the car continue up the hill?

**A New Way of Thinking:**

- Some cars are Ferrari’s.
- Some cars are Jeep’s.

Modified after Professor Jacopo P. Mortola. McGill University.

Diagram: A Venn diagram illustrating the overlap between Infant Vulnerability, Environment, Development, and SIDS.
The majority of SIDS victims have ≥1 Risk Factor

244 SIDS victims from New Jersey, 1996-2000.

The majority of SIDS victims have ≥1 Risk Factor

![Bar chart showing SIDS victims (%) and number of modifiable risk factors per case between Pre-BTS 1991-1993 (n=169) and BTS 1996-2008 (n=307).]

- **SIDS Victims (%):**
  - Pre-BTS: 91.7% (1 or More), 64.5% (2 or More)
  - BTS: 89.3% (1 or More), 68.7% (2 or More)

- **Number of Modifiable Risk Factors per Case:**
  - Pre-BTS: 2.1
  - BTS: 2.1

How can we, as a population, reduce the risks of SIDS?
• Most infants with risk factors will not die from SIDS.

• Some infants without risk factors will die from SIDS.

• However, infants with risk factors are at increased risk of dying from SIDS.
Babies Should Sleep on their Backs for Every Sleep

Prone Sleeping and SIDS (Odds Ratios vs Non-Prone Sleeping)

U.S. Prone Sleeping and SIDS Rate

Supine  Prone

California Infants Placed on the Back to Sleep: 76.1%
Use a Firm Sleep Surface. Firm Crib Mattress and Fitted Sheet

Sitting Devices are Not Recommended for Routine Sleep

Roomsharing, Without Bedsharing, is Recommended.

Early Study of Maternal Overlaying

• In 1892, a Scottish police surgeon, Templeman, first drew attention to the potential role of excessive alcohol consumption and overlaying.

• 258 cases of suffocation in infants.

• More than half of deaths occurred Saturday night.

• Postulated that intoxication impaired arousal responses of parents sleeping with infants, thus increasing the risk of accidental suffocation.

California Infants Who Always or Often Bedshare: 39.3%

Data Source: Maternal and Infant Health Assessment Survey Prepared by: Maternal, Child and Adolescent Health Program, Center for Family Health, California Department of Public Health
Bedsharing, Breathing, and Infant Sleep

• Increased breastfeeding, but not when compared to room-sharing.
• No decrease in apnea.
• No stimulation of breathing.
• Increased arousals (baby wakes mother).
• Decrease in deep sleep.
• No apparent physiological protection.

Bedsharing and SIDS in Ireland, 1994-1998


123 SIDS. 263 controls.
Bedsharing and SIDS Risk: CESDI Study (Odds Ratios vs did not sleep with an adult)

- Bedshare, but return to cot
- Bedshare, whole night
- Bedshare on sofa
- Separate room

SIDS = 325
Controls = 1300

Bedsharing and SIDS in the U.K.

• Infant’s crib or bassinet should be placed in the parents’ bedroom close to the parents’ bed.

• Infant can be brought to bed for breastfeeding, but then returned to the crib.

• Devices promoted to make bedsharing “safe” are not recommended.

Bedsharing is *Especially* Unsafe with:

- Infant <3-months of age.
- Parent cigarette smoking.
- Parent is excessively tired; such as sleep deprivation (<4-hours sleep the previous night).
- Parent depressant medication or alcohol use.
- With non-parent or multiple persons.
- Soft or unsafe bed.
- Duvets, pillows, or soft covers.
- Sleeping on a sofa, armchair, or couch.

AAP Recommendations

• Roomsharing, with the infant in a crib in the parents’ room next to the adult bed, is safest, and is safer than bedsharing.

• Infants brought to bed for breastfeeding should return to a separate crib.

• Do not bedshare if parents smoke cigarettes.

• Do not bedshare if the parents’ arousal is depressed (alcohol, drugs, sleep deprived <4-hours sleep the night before).

• Do not sleep with an infant on a sofa or chair.

Keep Soft Objects and Loose Bedding Out of the Crib

Consider Offering a Pacifier at Nap Time and Bedtime

Avoid Cigarette Smoke Exposure During Pregnancy and After Birth

BREATHING AREA
NO SMOKING
NO VAPING
Avoid Overheating and Head Covering; Infants should not feel hot to touch.

Infants Should be Immunized according to AAP and CDCP Advice.

http://healthlevelup.com/vaccinations-and-children/
Avoid Alcohol and Illicit Drug Use During Pregnancy and After Birth.

Avoid Use of Commercial Devices Inconsistent with Safe Infant Sleep

Encourage *Tummy Time* when the Infant is Awake and Observed.

No Evidence to Recommend Swaddling to Reduce the Risk of SIDS

Infant Swaddling
Infant Swaddling
Swaddling and SIDS

SIDS Odds Ratio compared to Unswaddled Supine

- Not Swaddled
- Swaddled

**Infant Sleep Position**

- **Supine**
  - SIDS: 1
  - Controls: 1.86

- **Side**
  - SIDS: 3.61
  - Controls: 4.33

- **Prone**
  - SIDS: 12.47
  - Controls: 49.86

Avoid Swaddling if …

- Prone sleeping position.
- Thick blankets.
- Face covered.
- For infants older than 3-months.

There is a danger when infants begin to roll from supine to prone, the swaddled infant can not regain the supine position.

Parents Ignore Safe Infant Sleep Recommendations

http://www.parents.com/baby/safety/nursery/how-safe-is-your-babys-sleep/?page=3
Many Parents Do Not Follow Safe Infant Sleep Recommendations

- Prone or Side Sleep: 22%
- Do Bedshare: 20%
- Do Not Breastfeed: 18%
- Smoke Cigarettes: 3%
- Do Not Immunize: 9%
- Put Soft Items in Crib: 22%

n = 121 parents

Primary Care Physicians Do Not Discuss SIDS Risk Reduction

![Graph showing the percentages of primary care physicians discussing SIDS risk]

- Behavior Can Reduce SIDS
- Knows Back Sleep Safest
- Should Discuss SIDS Risk
- Do Discuss SIDS Risk
- Give Written Material

N = 214

Mothers commonly receive no advice on infant care practices.

Advice from Physicians

- Immunizations
- Breastfeeding
- Sleep Position
- Sleep Location
- Pacifier Use

- AAP Advice
- Against AAP Advice
- No Advice

Mothers Commonly Receive No Advice on Infant Care Practices

Advice from Nurses

- Immunizations
- Breastfeeding
- Sleep Position
- Sleep Location
- Pacifier Use

- AAP Advice
- Against AAP Advice
- No Advice

Supine
Alone
Firm mattress
Empty crib
Safe infant sleep recommendations create a safer infant sleep environment. Should reduce accidental infant deaths during sleep. Triple Risk Hypothesis suggests SIDS is an interaction between age, intrinsic vulnerability, and environment. The only thing we can affect is the environmental stress.
WARNING

The cause of SIDS is not yet known.

This information has not been proved to be the cause of SIDS.

However, I have attempted to give you some idea about some current directions of SIDS research.
Infant Vulnerability

Development

Environment

SIDS

• Most common cause of sudden infant death between the ages of 1-month and 1-year.

• Cause remains unknown.

• Can not be predicted in infants prior to death.

• Reduction in SIDS in populations through public health intervention.

• SIDS has not been eliminated.
SAFE TO SLEEP