



What we know about the 'Other' deaths

**January 23, 2008
Secretary's Advisory Committee
On Infant Mortality**

Mary D. Overpeck, DrPH

- Manager, Maternal and Child Health Epidemiology Program
- Family Health Bureau
- New Mexico Department of Health

Acknowledgements

- **Teri Covington, MPH, Director**
*National Center for Child Death Review
Policy and Practice*
- **Pat Tackitt, Michigan Public Health Institute**
Death Scene Reenactment Expert
 - **Monique Sheppard, PhD**
Children's Safety Network
- **Captain Stephanie Bryn, MPH**
*Health Resources and Services Administration,
Maternal and Child Health Bureau*

What are the 'Other' Deaths?

- **Traditional leading causes:**



- *Conditions related to birth defects, prematurity, problems of labor and delivery, SIDS, and respiratory distress*

- *Primarily 'natural' deaths under International Classification of Diseases (ICD) category system*

- **'Unintentional' injury**



- *Only traumatic death cause ranked in top ten*

Ten Leading Causes of Infant Death

2004: 27,936 US Deaths

- Congenital Anomalies 20.1%
- Short Gestation 16.6%
- **SIDS 8.0%**
- Maternal Pregnancy Comp. 6.1%
- **Unintentional Injury 3.8%**
- **Unknown Cause 3.7%**
- Placenta, Cord, Membranes 3.7%
- Respiratory Distress 3.1%
- Bacterial Sepsis 3.0%
- Neonatal Hemorrhage 2.2%

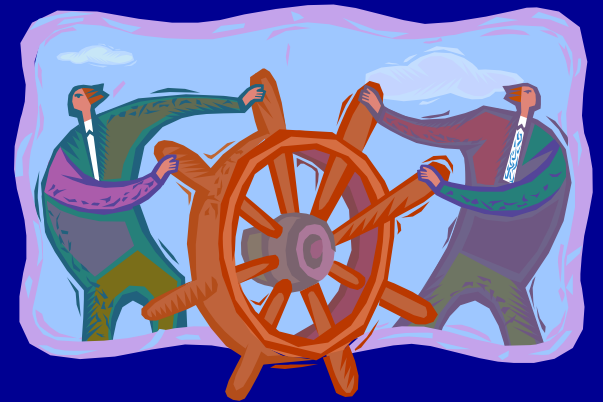


Recent approaches to assess 'Other' causes

- Reassessment within ICD categories
- Death scene reenactments
- Death scene investigations
- Child Death Review Process

Reassessment within ICD

- Diagnostic shift across 'natural' and 'traumatic ICD categorizations



- Development of new terminology

Ambiguity in ICD Cause of Death

- **Sudden Infant Death Syndrome (SIDS)**
 - *Unexplained cause after thorough autopsy and death scene investigation (excluding suffocation-related)*
- **Sudden Unexpected Infant Death (SUID/SUDI)**
 - *Suggested as option to SIDS since 1999*
 - *Recognizes diagnostic shift away from SIDS*
- **SIDS & SUID/SUDI – Manner of death classified as 'Natural' events**
- **Asphyxiation & Suffocations – Manner of death classified as 'Traumatic' (Injury) events**

ICD Infant Death Classifications considered for SUID*

- Unknown/unspecified causes
- Accidental suffocation and strangulation in bed
- Other accidental suffocation and strangulation
- Neglect, abandonment and other maltreatment syndromes (CAN)

**CDC SUID Investigation Initiative: Terry Davis, Oct. 2006*

SUID

Research Focus Defines Definition

- **SIDS + Unknown Cause + Asphyxia, suffocation, strangulation in bed (ASSB)**
- **SIDS + Unknown Cause + ASSB + suffocations of undetermined intent**
- **SIDS + Unknown Cause + ASSB + non-specific injury causes**
 - Usually excludes ‘known’ causes

“Known Causes”

Other than SIDS, SUID

- **Transportation-related**
- **Drowning**
- **Bites/stings by animals**
- **Fire and burns**
- **Poisoning**
- **Environmental exposures**
- **Inhalation of gastric contents**
- **Inhalation of food and obstructive objects**
- **Other obstructions of respiratory tract**
- **Caught, crushed, jammed or pinched**

What's Missing?

- **Shaken Baby or abusive head trauma**
 - Included in multiple other causes due to lack of a specific ICD category
 - May be found in:
 - Assault
 - Child abuse
 - Injury of undetermined intent
 - Other
- **Other causes**
 - Lack of specificity of ICD categories leads to missing or mis-categorized information on death certificates

Data Sources for 'Other' Causes

- **National: 1999-2004 mortality files**



- Total numbers and rates based on ICD-10 from CDC Wonder: Compressed Mortality

Age at death: NCHS Multiple Cause of Death

- **State: Multi-state Child Death Review web-based data system**

- Pennsylvania and Ohio



Sudden Unexpected Infant Deaths

Percent of total in US: 2004

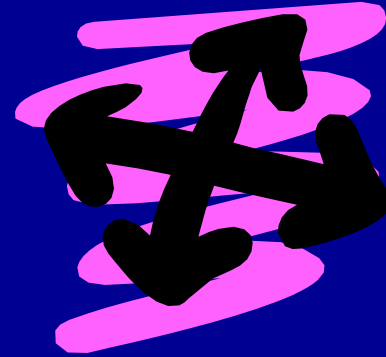
■ SIDS	8%	
■ Unknown Cause	<u>4%</u>	
'Natural' Causes		12%
■ ASSB	2%	
■ Other non-specific injury	<u>1%</u>	
ASSB & non-specific injury		<u>3%</u>
<i>Estimated SUID</i>		15%

Intersection and Interaction Natural and Traumatic Deaths

- **Background Sources**

- **Willinger, 2001 and later**

- **Hunt and Hauck (2000, 2006)**



Research on Causes

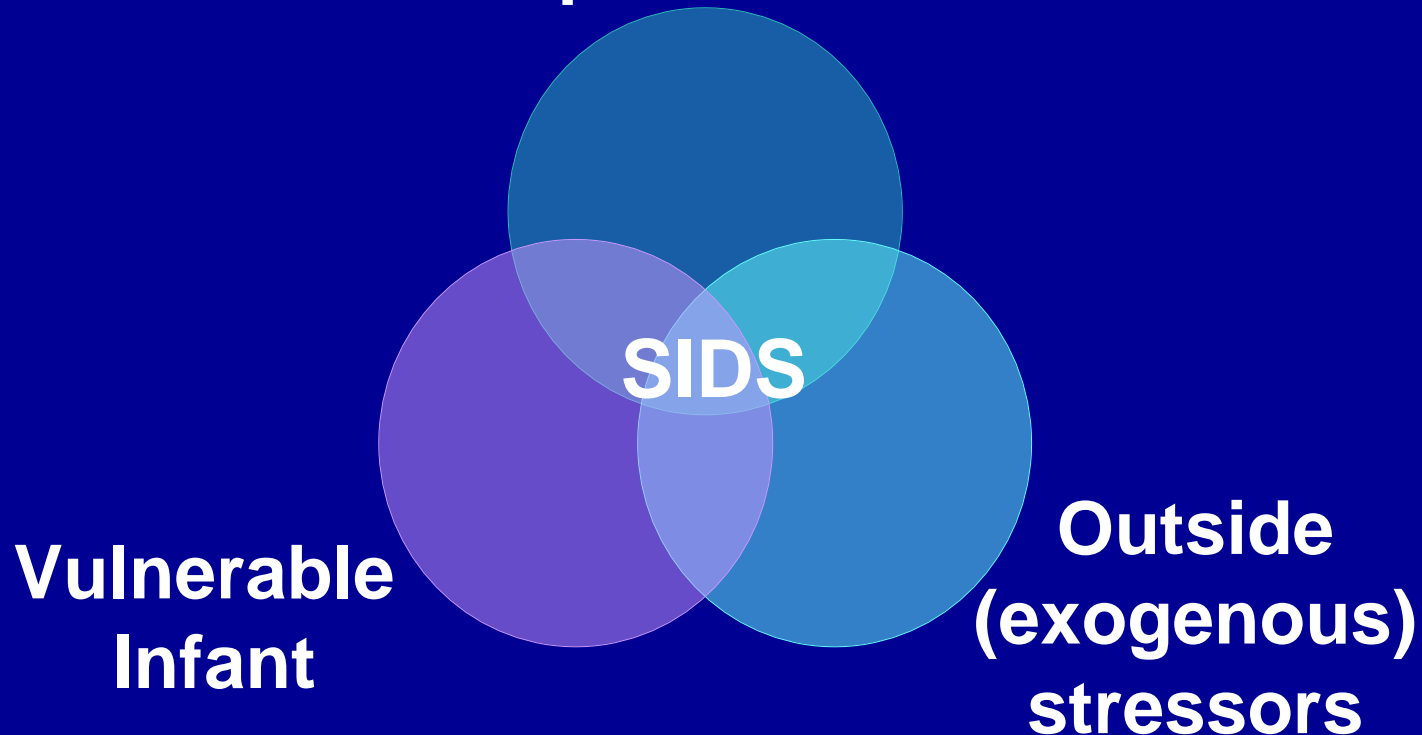
- **Basic Biological Research**
- **Case/control studies and common findings**
- **Death scene Investigations**
- **Child Death Review**

Basic Biologic Research

- **Autopsies of small samples of infant deaths diagnosed as SIDS**
- **Simulated causes in laboratory conditions**
- **Triple risk model postulated by Filliano and Kinney in 1994**

Triple Risk Model - 1994

**Critical
Developmental Period**



Triple Risk Model - 1994

The triple risk model proposed by Filliano & Kinney in 1994 proposed that some infants are born vulnerable, with certain brain stem abnormalities that make them susceptible to sudden death during a critical developmental period once an exogenous stressor or environmental or environmental challenge is presented.

Triple Risk Model - 1994

- Critical Developmental Period
 - Maturity of arousal response
- Vulnerable Infant
 - Brain stem abnormalities
- Outside (exogenous) stressors
 - Overheated
 - Second-hand smoke
 - Entrapment in soft materials
 - Environmental challenge

Summary of SIDS Research: Intensive biological and case studies

2000: review of >200 peer-reviewed studies & >1000 case post-mortems

2006: updated with almost 100 studies including genetic risk factors

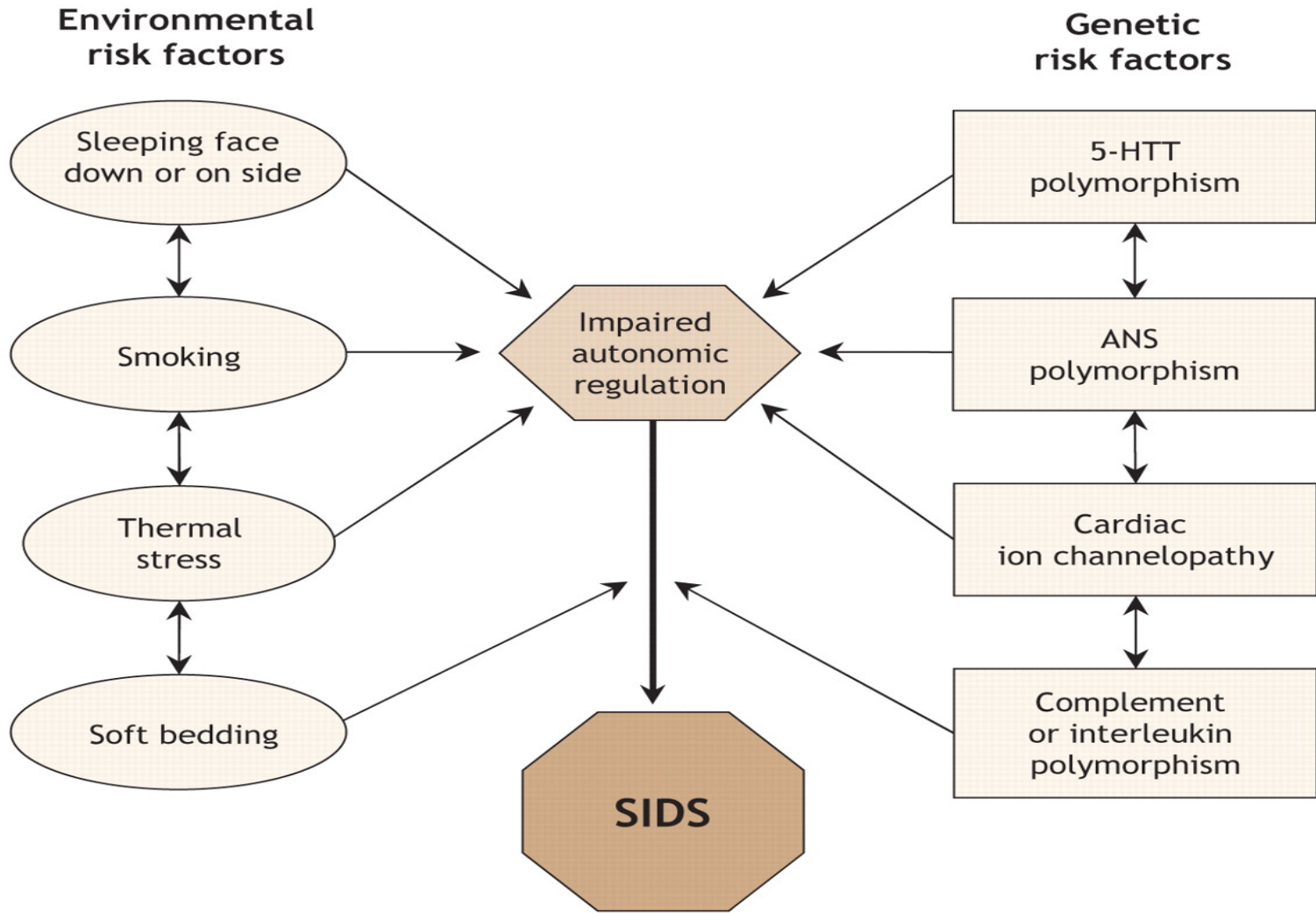
Dr. Fern Hauck, University of Virginia

Dr. Carl Hunt, National Heart, Lung and Blood Institute

2000 Review of All SIDS

- Postmortems explained about 20% of cases as:
 - Infection (sepsis, meningitis)
 - Unintentional injury (suffocation/strangulation)
 - Congenital anomalies (cardiac or CNS)
 - Metabolic disease (medium chain fatty acid)

Potential Interactions of Environmental and Genetic Risk Factors



Diagnostic Shifts on Death Certificates



More jurisdictions requiring mandatory autopsies of unexpected infant deaths

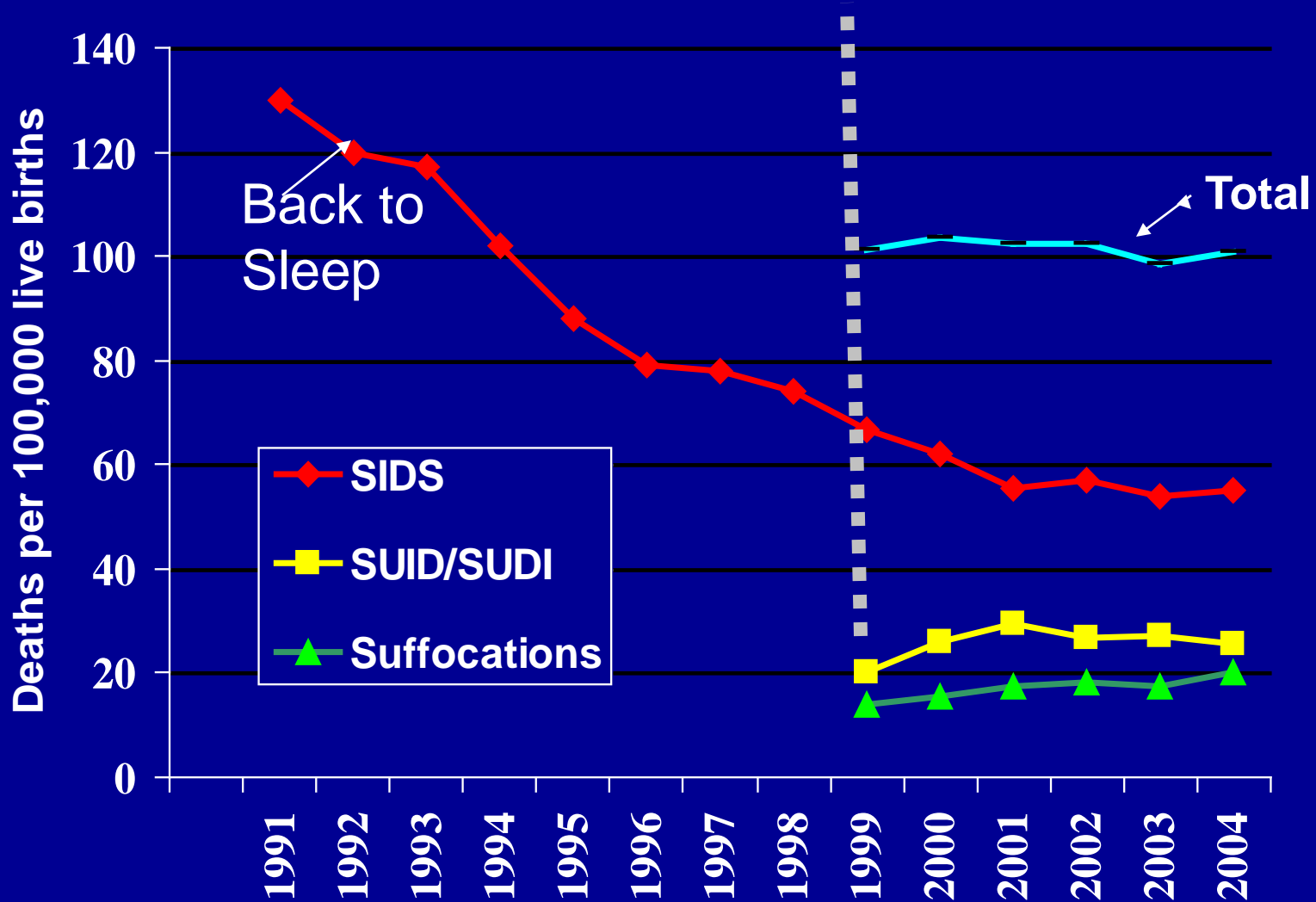
Medical certifiers shifting designations to categories other than SIDS

Recognition of multiple mechanisms involving vulnerable infants and environment

Most mechanisms involve asphyxia of some form

SIDS, SUID & Suffocation Rates

US Death Certificates, 1991-2004

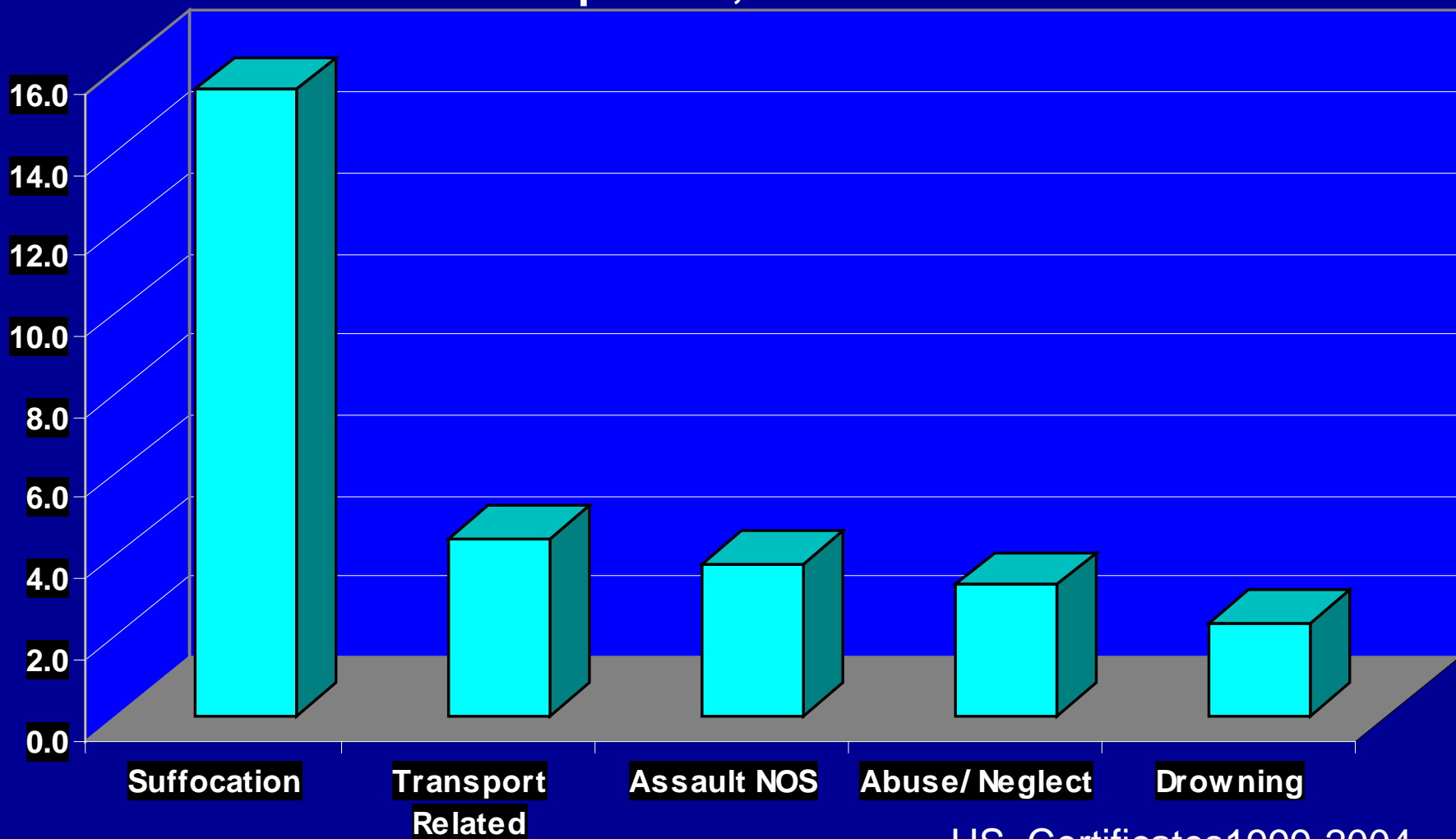


SIDS, SUID & Suffocation Rates US Death Certificates, 1991-2004

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SIDS	130	120	117	102	88	79	78	74	66.88	62.16	55.49	57.07	54	55.1
SUID/SUDI									20.34	25.84	29.43	26.95	27.2	25.5
Suffocations									14.15	15.45	17.41	18.17	17.26	20.16
Total Unexpected									101.4	103.5	102.3	102.3	98.5	100.8

Nature of Infant Injury Deaths as Classified by Cause/Mechanism

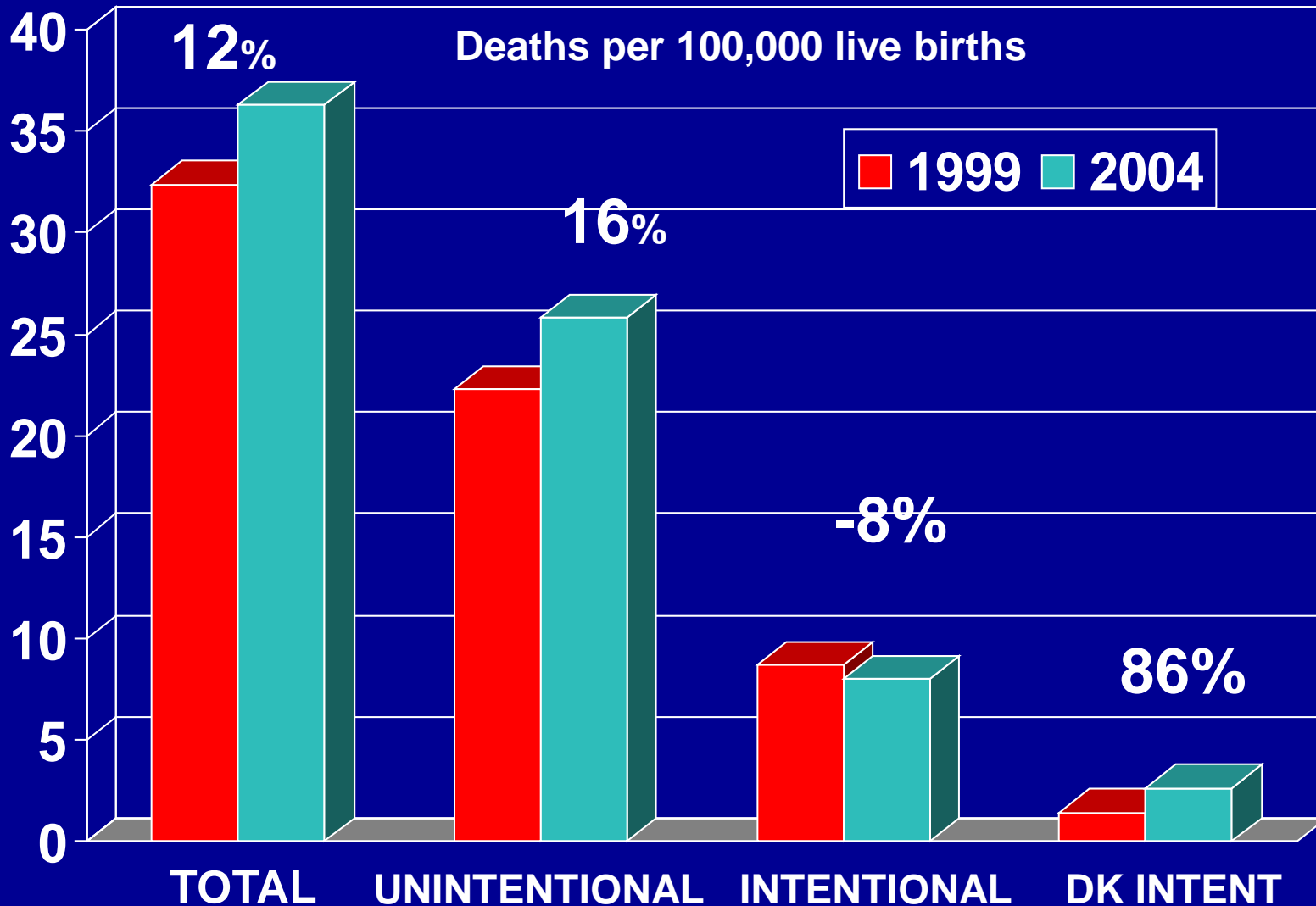
Deaths per 100,000 live births



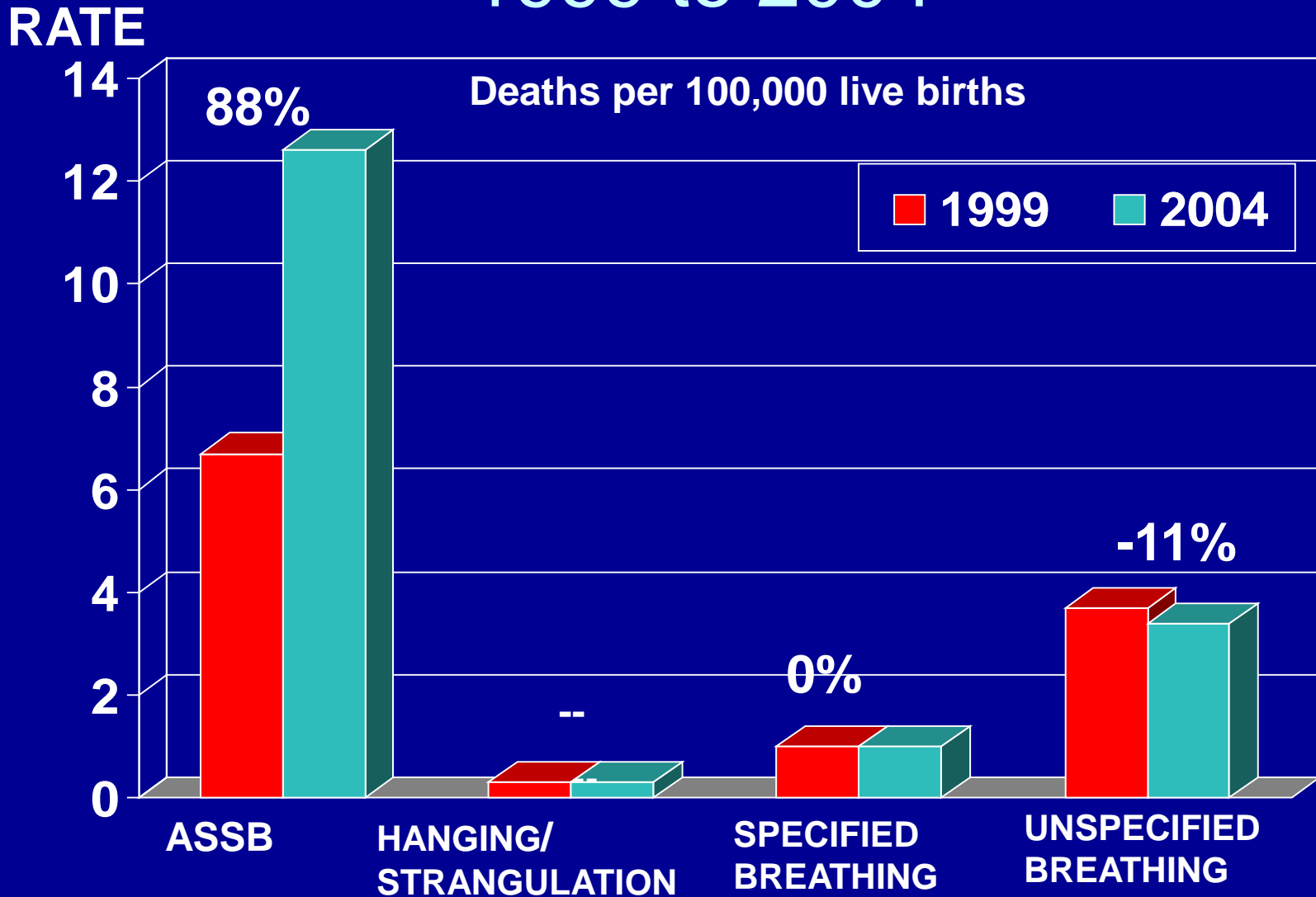
US, Certificates 1999-2004

Injury Rate Changes: 1999 to 2004

RATE

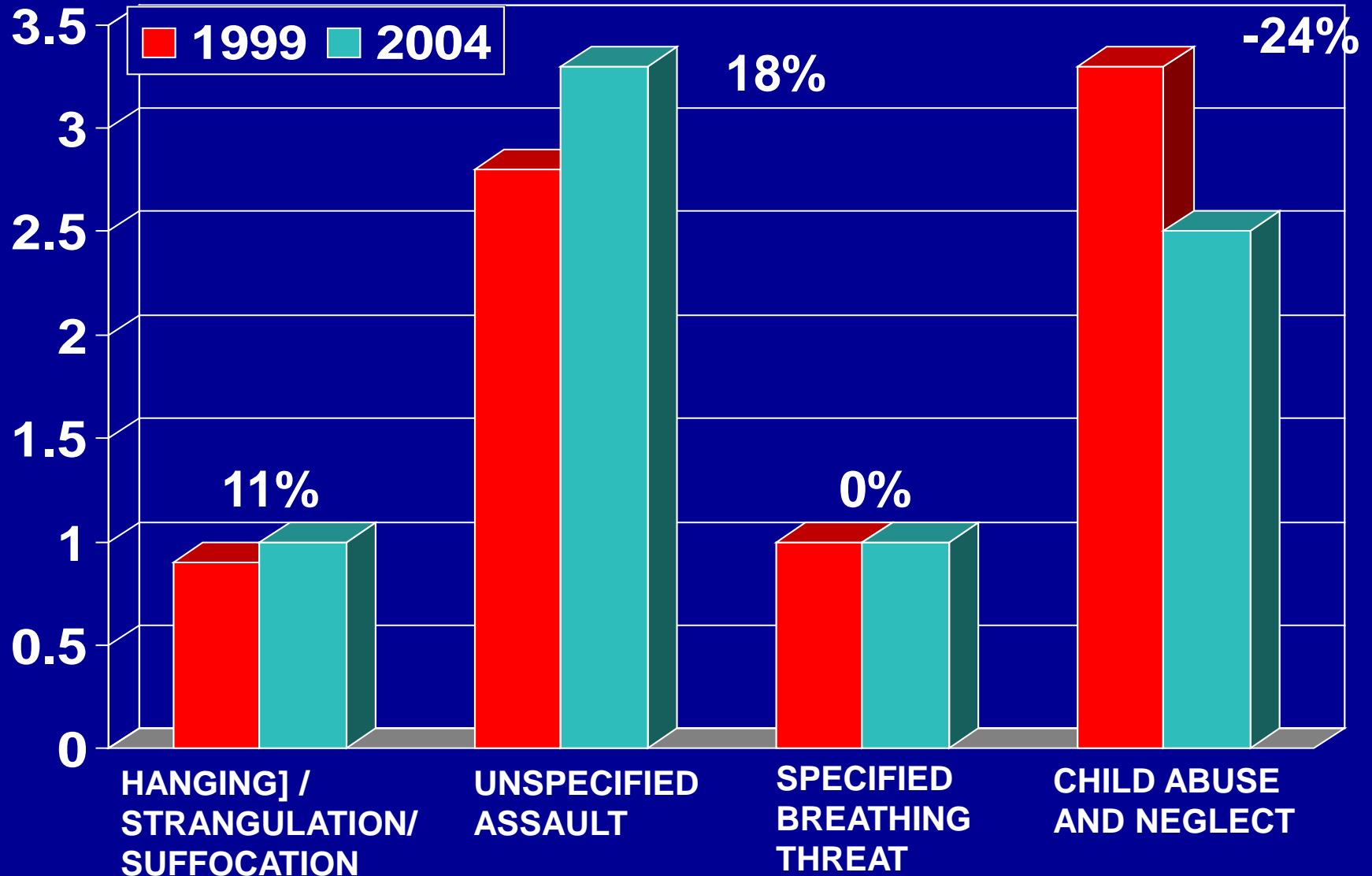


Unintentional Injury Rate Changes: 1999 to 2004



Intentional Injury Rate Changes: 1999 to 2004

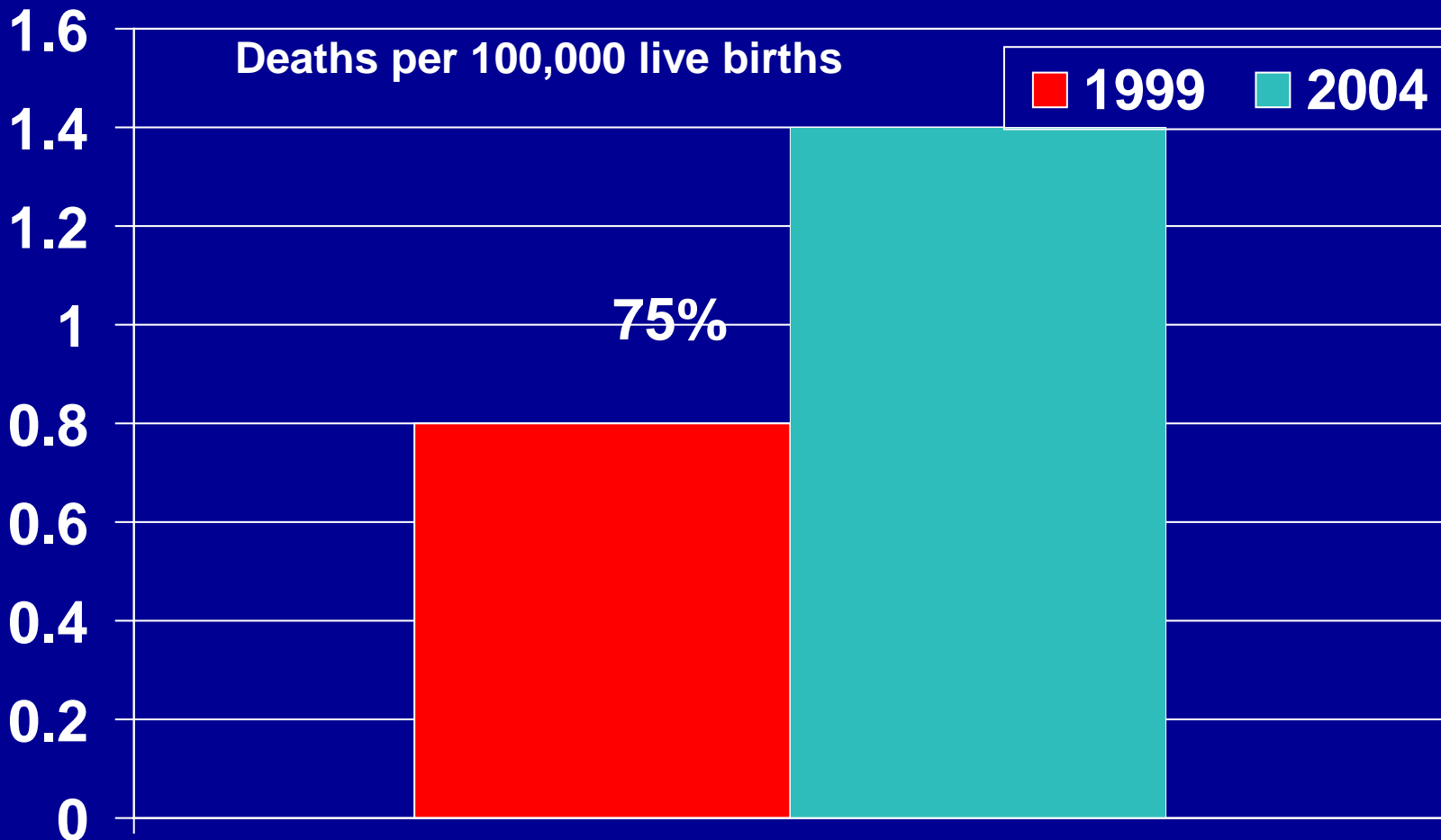
RATE



Undetermined Intent Hanging/Strangulation/Suffocation

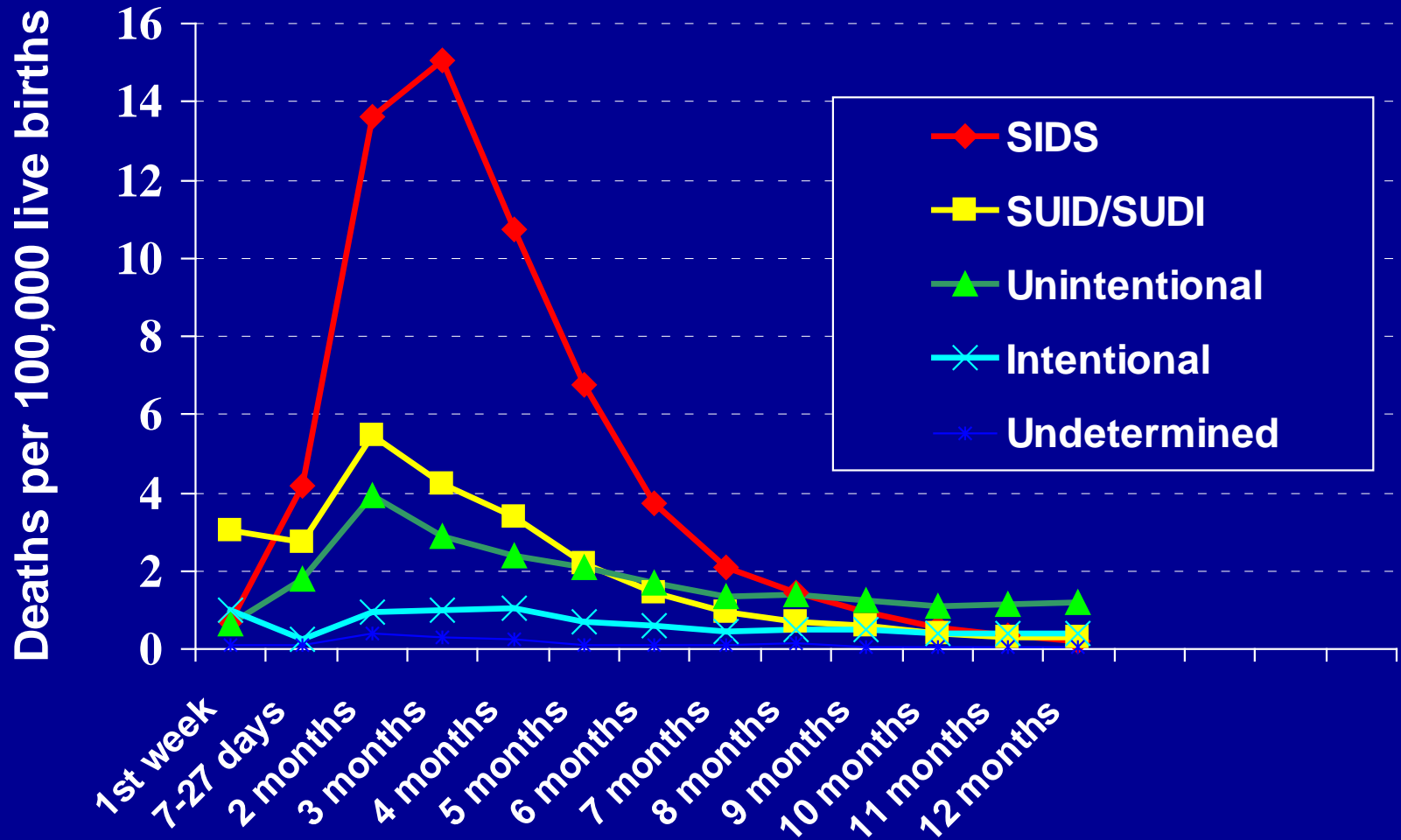
Rate Changes 1999 to 2004

RATE



HANGING/STRANGULATION/SUFFOCATION

SIDS, SUID/SUDI, and Injury Rates: Cause by Age at Death, 1999-2004



RESEARCH AND INTERVENTION

SIDS, SUID, Suffocations

- For purposes of counting, demonstrating trends, and targeting prevention efforts, ***overlap needs clarification***
- For purposes of prevention, ***interventions are similar for exposures and environment***
- ***Research on causes relies on supportive investigations***

Supportive Investigations



- Manner and mechanisms of sleep-related deaths, including injuries:
 - Infant Death Scene Investigation
 - Scene re-enactments for infant deaths occurring in sleeping environment
 - Child Death Review

CDC SUID Investigation Initiative

- Centers for Disease Control & Prevention Training Academies
 - *Medical Investigators and Coroners*
 - *Criminal Justice*
 - *Law Enforcement*
 - *Medico/legal Investigators*
 - *Child Protection Experts*



Scene Reenactment

- Doll taken to death scene for reenactment of how infant was found
- Used in a few jurisdictions within week of death
 - Michigan, Missouri, others
- Michigan pictures show sleep-related deaths



SIMULATED RECONSTRUCTION



SIMULATED RECONSTRUCTION



SIMULATED RECONSTRUCTION



SIMULATED RECONSTRUCTION





Child Death Review Investigative Processes

- Review performed at both state and local level in most states ($n=34$)
- All but one state reviews deaths to age 18.
- Majority focus on *Public Health Prevention Model* rather than only on child abuse ($n=42$)
- All but 3 states review all injury causes
- Half review 'natural' causes of death

National Center for Child Death Review Policy and Practice

- **Cooperative agreement funded by HRSA/MCHB**
- **Resource center for state and local programs**
- **Promotes, supports and enhances review methodology and activities at the state and local levels**
- **Coordinates prevention efforts with Children's Safety Network, NFIMR, EMSC, Suicide Prevention Resource Center and other National organizations**

Child Death Review Multi-state Data Tool



Expert development of needed data

- *Prevention*
- *Systems improvement*
- **Beta-testing completed November 2007**
- **State enrolling incrementally**
 - *Today: 25 states and over 36,000 cases*



Sleep-related Infant Deaths

- **Pennsylvania**
 - Deaths reviewed in 2004-2006
- **Ohio**
 - 2007 Annual Report
- **Michigan**
 - Deaths reviewed 1997-2007

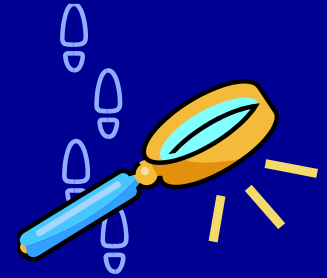


Scripps Howard SUID Series

- “Quality of investigation into sudden infant death improves dramatically in states that aggressively review the deaths of all children”
- Jan. 4, 2008: “Experts, lawmakers call for standardized infant death investigations”

<http://scrippsnews.s10113.gridserver.com/node/569>

‘Other’ Infant Deaths CONCLUSION



- **Focus on deaths in first 4 months of life due to high prevalence**
- **‘Other’ deaths are primarily associated with interactions in the larger environment**
- **Little information on injuries, including poisoning, that don’t result in death**
- **Interventions for deaths or morbidity may – or may not - be similar**

Summary

- **We can't rely on death certificates and standard classifications**
- **Death scene investigations require improvement**
- **Prevention models of child death review improve understanding of death circumstances and systems involvement**
- **Increasing work by Child Death Review teams improves our ability to save infant lives**